SILVER CREEK
NATIONAL WATERSHED #9
APRIL 1995
Ver. 1.0

WATERSHED ANALYSIS

GALICE RANGER DISTRICT
SISKIYOU NATIONAL FOREST

LIST OF FIGURES

BASIN OVERVIEW

INTRODUCTION

The purpose of this analysis is to examine the past and current ecological condition of the watershed, explore the major processes at work in the drainage, determine if there are recognizable trends to these processes and suggest a desired condition for the future of the area. Opportunities to restore the watershed to a healthier condition are presented as well as opportunities to provide goods and services to the local community. The concepts and management direction presented in the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (ROD) have set the stage for a landscape level analysis as part of the Aquatic Conservation Strategy. The analysis of various components and interrelationships in the ecosystem will be the tool for development of future land management programs and projects. The ROD refers to this landscape level analysis as a "Watershed Analysis". Watershed Analysis is one of the principal analyses that will be used in making decisions on implementation of the Aquatic Conservation Strategy (ROD, p B-20)

The Silver Creek Drainage (National Forest System Watershed #9) was selected based on the criteria outlined by the Report of the Forest Ecosystem Management Assessment Team (FEMAT) and the Interagency Watershed Restoration Strategy for Fiscal Year 1995. The Silver Creek drainage has been classified as a Tier 1 Key Watershed. Although the Silver Creek drainage is primarily remote and undeveloped, there is a high level of existing information for the majority of this watershed. Most of this information was gathered during the Environmental Impact Statement for the Silver Fire Recovery Project (1988) and subsequent monitoring and evaluation.

The focus for the analysis is based on the current major issues for the drainage that have been developed by the interdisciplinary team on the Galice Ranger District.
The key issues for this area are based upon
1) Commodity Values: these are activities related to tourism, timber products, fishing, mining, special forest products, and outfitter guides.

2) Amenity and Recreation Values: these relate to scenery, solitude, and recreational uses of the area.

3) Environmental Quality and Ecology Values: these relate to water quality, land productivity, healthy and diverse forests.

From these issues, thirteen Key Questions were developed. These questions attempt to address the main issues in the watershed and focus the analysis on particular types and locations of cause and effect relationships.

Processes and existing conditions were addressed in our analysis based upon these issues. Future trends, opportunities and potential projects were also developed.

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Silver Creek Watershed Analysis

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Overall Watershed Description

The Silver Creek Watershed is approximately 51,600 acres in size. It has been broken into five sub-watersheds for the purpose of this analysis: North Fork (15230 acres), South Fork (3780 acres), Lower Fork (8880 acres), Middle Fork (17250 acres), and the Upper Fork (6460 acres). This watershed drains into the Illinois River and is primarily under federal ownership.

A. PHYSICAL SETTING

1. Soils

Soils within the watershed analysis area have been grouped into associations. Each soil association is unique to the natural landscape and can be used to compare the suitability of large areas for general land uses. These associations group soils that were formed from similar rock types or parent material on similar landscapes and, as a result, have similar characteristics. Soil depth and rock content vary between soil series that make up the associations. The general soil map units are Pollard-Abegg (4), Josephine-Speaker-Pollard (8), Beekman-Vermisa-Colestine (9), and Pearsoll-Dubakella-Eightdollar (11).

Most of the soils in the watershed are relatively shallow gravelly soils derived from granitic or metamorphic rocks.

2. Geology/Geomorphology

Structurally, the bedrock geology in the area occurs as a broad north-south band. This band is composed rimarily of metamorphosed igneous and sedimentary rocks. These bands were brought together by plate ectonic activity in the late Jurassic Period into the Eocene Epoch. This watershed has evidence of mass movement of soils, with many slide events occurring in 1964.

3. Climate and Precipitation

The current climate is characterized by moist and cool winters with warm and dry summers. Normal rainfall for the Silver Creek watershed is 60-110 inches of precipitation and generally increases with elevation.

4. Hydrology

The steep, rugged terrain of the Silver watershed is similar to that of the other areas of the Klamath Mountains of northern California and southwest Oregon. The area is typified by deeply incised streams in narrow rocky canyons, steep slopes, and numerous landslides. The confined nature and relatively steep channel gradients in Silver Creek provide stream power that is adequate to flush much of the sediment supply through its system to flatter or wider areas.

Riparian area vegetation currently provides on the average about 60% shading to streams. Most of this is from larger conifers, but some sections of riparian vegetation (North Fork) have been removed or altered throughout the watershed by flooding (1964 flood), road construction, logging, land clearing, or mining.

Estimated perennial stream miles in the Watershed are as follows:
Class I & II -43 miles (fish habitat)
lass III - 269 miles (permanently flowing streams)

Class IV - are estimated at 342 miles (intermittent streams)

5. Heritage Resources

a. Cultural Resources

Native American communities have occupied southwest Oregon for at least the last 8000 years (Aikens 1993). During that time aboriginal groups actively "managed" portions of their environment, often using fire as a management tool.

The importance of anadromous fish resources to aboriginal societies is documented in the ethnographic literature for northwestern California and southwestern Oregon (Hewes 1942,1947; Rostland 1952; Kroeber 1925; Kroeber and Barrett 1960; Suttles 1990). The abundant seasonal runs and ease of procurement of anadromous fish strongly influenced the distribution of aboriginal settlements and the spiritual life of native peoples. Current watershed productivity of anadromous fish is considered to be less than precontact times.

b. Mining History

Gold was discovered in Silver Creek in the 1860's. Additional and persistent mineral exploration and development has continued in the upper portion of the watershed since that time. Most of this mineral work has been restricted to the gold bearing placer gravels adjacent to the Silver Creek drainages.

c. Fire History

Southwestern Oregon and the Siskiyou National Forest have a long history of major wildfires (Payne 1983, Haefner 1975, Cooper 1939, Morris 1934). In the warm-temperate, dry-summer, "Mediterranean" climate of the Siskiyou Mountains, the forests are easily set afire; and fires of widely varying intensities have been frequent (Whittaker 1960).

Fire Frequency & Risk

Large fires within the Silver Watershed include the recent Silver and Galice Fires (23,031 and 1,256 acres burned within the watershed). Historically 56 (2 per year) fires were caused by lightning and 31 (1 per year) were human-caused. Most of the fires were kept small as a result of heavy suppression efforts through this period.

Atzet, Wheeler, and Gripp (1988) described the settlement period of 1820-1910 as a period when fire was forced on the land by trappers, miners, ranchers, and settlers to eliminate vegetation, drive game, enhance forage and clear land.

Fire suppression programs begun around 1910 have created a relatively fire-free condition except for the area that burned with the 1987 Silver Fire.

Fire frequency for prehistoric or pre-settlement times is a better reflection of the natural role of fire in the ecosystem than data from more recent times due to the large amount of burning during the settlement era. A 30 year average fire cycle for the Mixed Conifer forest type was determined by Agee (1991). Atzet and Wheeler (1982) determined fire cycles of 20 years for inland plant associations with cycle length increasing to 60 years or more for coastal areas. Natural fire cycle for Silver Creek watershed is between 30 and 50 years. A sampling of existing fuel loading was gathered from five vegetation categories and modeled for fire behavior predictions. These predictions indicate the potential for large size wildfire exists in this watershed as well as the majority of the watersheds to the north and west (Murphy, 1991).

The potential for large fire occurrence is high to extreme. This is a result of the vegetation, steep slopes, abundance of south aspects, and the scarcity of road access into large portions of the area. There are also portions of the Silver Fire that contain heavy fuel loadings and have a high risk of reburning.

B. BIOLOGICAL SETTING

1. Vegetation

The Watershed features diverse plant communities and successional stages. Most vegetation has evolved under the natural disturbance effects of fire.
Historically (prior to 1900) approximately 35% of this watershed was in early seral stages. Presently approximately 20% of the land base is occupied by pioneer seral stage, 22% is in early seral stages, 24% mid seral and 22% late seral stages. Approximately 12 % of the lands are not capable of developing continuous forest cover.
Large woody material, stand size and vertical structure have been altered in managed stands. Excess stocking levels in natural stands has occurred, primarily due to the absence of natural fire in the area outside of the Silver Fire. These stands contain an increased risk of intense wildfire and have had some effect on altering the cyclical variations in the hydrologic cycle.

2. Special Botanical Resources

There are no known Federally listed Endangered or Threatened plant species found in the watershed, but several sensitive botanical species are found or are likely to be present in the watershed.
Documented sightings of 6 plant species that are presently listed as "Review" or "Watch" list species do occur within these watersheds. The watersheds are quite diverse from the botanical standpoint. With the diversity of habitats, soils, and parent materials present within these watersheds, the probability of discovering additional sensitive plants species, or additional populations of known species, is high.

There are several botanical species that have been introduced into the area. Many of these species came from grass seeding that was done for erosion control purposes in the past.

3. Wildlife

There is a variety of wildlife species found within the watershed. Some species (e.g., black-tailed deer) associated with early to mid- successional forests are considered to be very abundant compared to historic levels. However, others (e.g., some South American migratory birds, and most native frog species) are probably declining. A few recently rare species (e.g., osprey and bald eagles) are increasing both locally and regionally. Some species susceptible to loss or fragmentation of Mature or Old Growth habitat (e.g., spotted owl and tailed frog) are probably declining.
Fire suppression, silvicultural practices and human developments in the riparian areas are factors that have probably caused the greatest changes in wildlife species composition and abundance.

There is a Late-Successional Reserve (LSR) in the Silver Creek drainage, that is approximately 15,000 acres. This area will be managed to protect or enhance old-growth forest conditions and is designed to serve as habitat for late successional and old-growth related species.

4. Fisheries

All of the sub-watersheds support some anadromous fish populations. Species present in the watershed include fall chinook salmon, steelhead trout, and sea- run cutthroat trout. Resident fish populations include rainbow and cutthroat trout. Non game fish species that are present in Silver Creek include sculpins and a few redside shiners near the mouth of stream.
Approximately 21 miles of anadromous fish habitat exist in the watershed. An additional 22 miles of streams are used by resident fish. Overall habitat condition is good to excellent.

C. SOCIAL SETTING

1. Social Overview

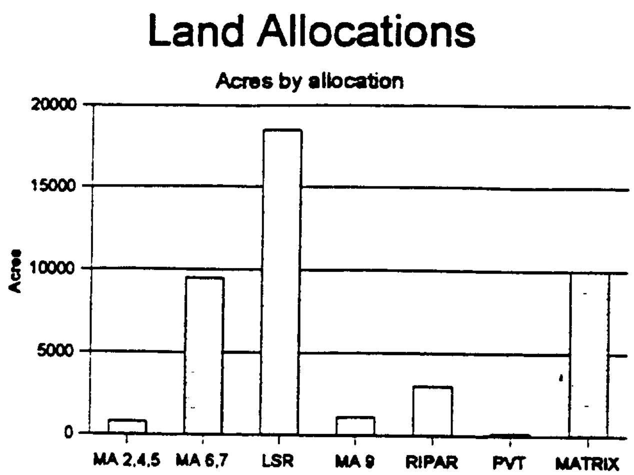
This area of Southern Oregon has had human occupation for at least the last 8000 years. European and Asian populations immigrated to the area starting in the mid-1800's(with the discovery of gold). This population developed around primarily agricultural economy in the late nineteenth to mid twentieth century.
Since 1950, the primary and most significant contributor to the economy has been the timber industry. The population has steadily increased and the demographics have gradually shifted to a greater percentage of senior citizens and younger ex-urbanites. There has been a significant shift in the last decade toward a more service oriented economy.

Outdoor or nature related activities are the primary recreation uses for visitors to the area.

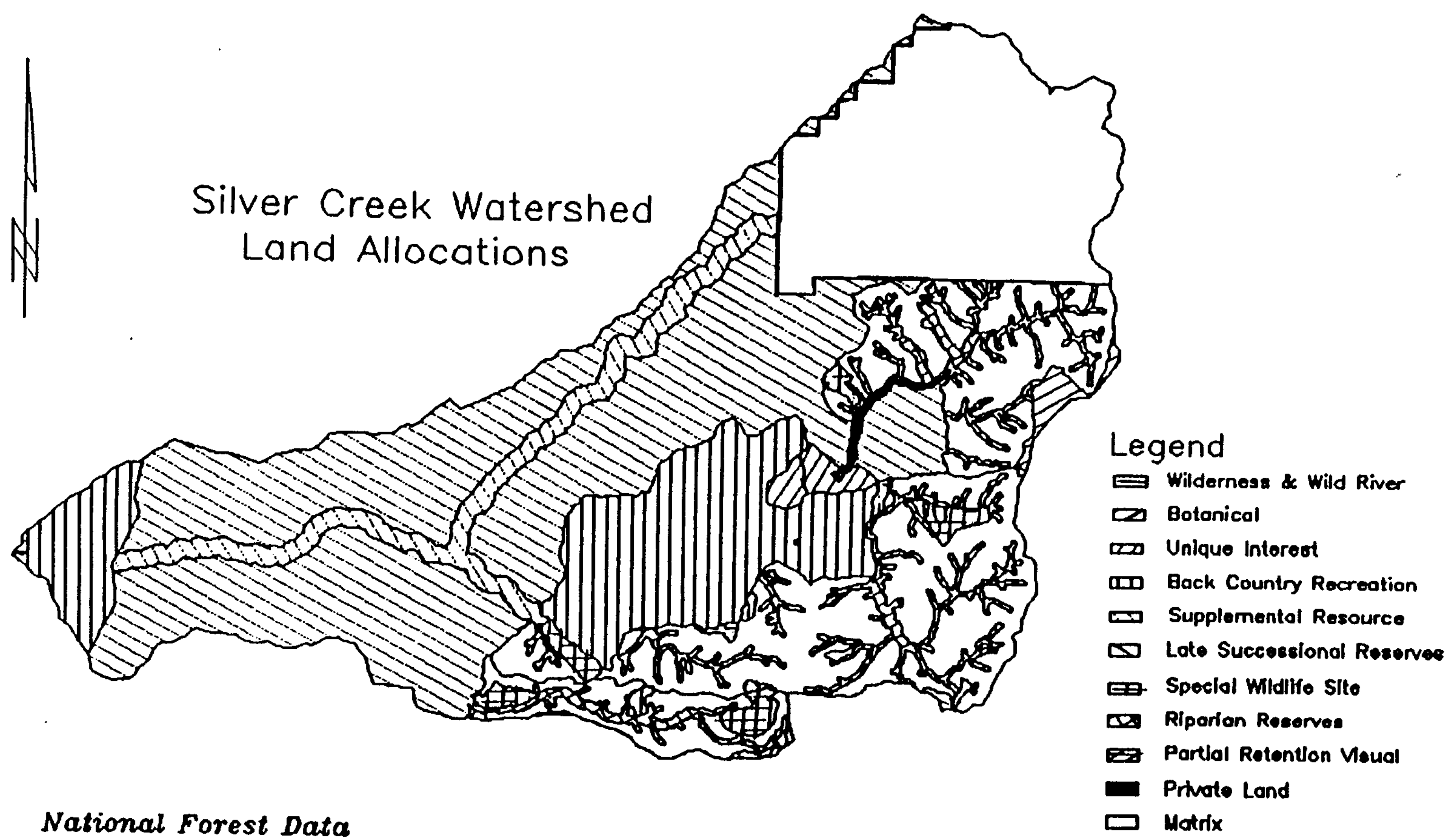
2. Land Status

The National Forest portion of this watershed has several designated Land Allocations Areas. These areas give direction on the kinds and amounts of activities that are permitted within them.
These land allocations can be Congressionally (Wilderness) or Administratively Designated (Forest Plans). The following table shows the acres within National Forest Boundaries. Other Federal Lands in the Watershed (BLM) has similar allocations from the ROD.

The watershed has approximately 51,600 acres of land area of which about 43,100 is managed by the Siskiyou National Forest.



MA 2, 4, & 5 = Wild River, Botanical, & Unique
MA 6 & 7 = Backcounty and Special Recreation
LSR = Late-Successional Reserve
MA 9 = Special Wildlife Site
Reserve = Riparian Reserve (acres outside LSR only)
Matrix = outside of other designated areas
Pvt = Private lands



Silver Creek Watershed
Land Allocations
Legend
Wilderness & Wild River
Botanical
Unique Interest
Back Country Recreation
Supplemental Resource
Late Successional Reserves
Special Wildlife Site
Riparian Reserves
Partial Retention Visual
Private Land
Matrix
National Forest Data

OPPORTUNITIES AND RECOMMENDATIONS

EXISTING CONDITON AND TRENDS	OBJECTIVE	PRIORITY LOCATIONS	TREATMENT OPTIONS
Competition from hardwoods and conifers is slowing down development of young and mid aged stands	Accelerate growth and development of young and mid seral stands toward late seral conditions	North Fork Silver Creek	Thinning and release of young stands; Fertilization
Dense stocking of stands is contributing to the risk of catastrophic events	Increase stand vigor and reduce susceptibility to large scale losses	Watershed wide	Thinning, with removal or treatment of small-medium diameter fuels
High proportion of stands are in mid size age class	Restore a balance of conditions that resembles presettlement conditions	Watershed wide	Thinning of mid age stands
Existence of fragmented patterns across landscape	Maintain historic range of patch sizes for older and younger forest habitats	Watershed wide	Restore natural patterns by increasing the size of some younger openings
Port-Orford-cedar is present and disease free except for N.Fork Silver	Lower the risk to non-infected drainages	In those drainages containing populations of POC	Close roads, remove roads, remove host, upgrade stream crossings, or isolate infection centers
Risk of high intensity fires with stand replacement potential exists throughout the watershed	Decrease risk of high fire rate of spread and intensity	In dense stands with ladder fuels and concentrations of down woody material	Thinning fuels, increase fire tolerance, create and maintain shaded fuel breaks, prescribed burning

In some riparian areas there is a decreased conifer component from historic levels	Enhance future supply of LWM and large conifers. Add complexity and large wood habitat to riparian areas (Aquatic Conservation Strategy objectives)	Managed stands along riparian areas Watershed wide	Plant conifers. Prune, culture, thin, and release existing vegetation
Noxious weed species populations are present within some sub-watersheds, or may have been introduced by recent activities	Eliminate or reduce noxious weed populations, survey recent restoration projects for noxious weed populations	Watershed wide	Remove noxious weed populations by cutting, pulling, covering with black plastic, or other methods; survey for introduced noxious weed populations
Later seral stage stands fragmented above natural range.	Prevent further fragmentation of relatively large patches.	Areas within the Late Successional Reserve.	Aggregate projects which will degrade habitat to avoid fragmenting relatively large, intact patches.
Later seral stage stands fragmented above natural range.	Improve or accelerate recovery of habitat.	Areas where potentially large patches of habitat exist.	Ground fire to produce thinning action, precommercial & commercial thinning.
Decline in aquatic wildlife species dependent on clear, cold streams.	Unfragmented stretches of clear, cold streams.(Aquatic Conservation Strategy objectives)	Any degraded riparian areas adjacent to reaches containing tailed frogs or other species in the same guild.	Riparian planting, thinning or pruning to increase conifer growth. Erosion control of sediment sources
Inadequate large woody material for wildlife species viability.	Genetically diverse & demographically healthy populations of species dependent on large wood.	Throughout watershed except in recently burned areas.	Reintroduce fire with a frequency & intensity that resembles prehistoric regime (thinning action).

Inadequate grass/forb habitat.	Recovery of meadows and reduction of forest encroachment on meadows.	encroached-upon meadows.	Prescribed burning.
Inadequate large woody material in clearcuts.	Genetically diverse & demographically healthy populations of species dependent on large wood.	Areas adjacent to managed units with inadequate large wood.	Avoid burning large wood in presc. burns, including large reserve trees and downed logs.

DATA GAPS AND MONITORING NEEDS

A PMR veg polygon layer for each quad (2.64"/mile). would allow for improved accuracy checks for seral stage, patch delineation and better interpretation of vegetation data. Accuracy checks should include a process to correct individual polygon data.

Additional field data to interpret historic disturbance regimes in older stands and range of vegetative conditions within riparian zones.

Field classification of plant series in locations not yet classified. further breakdown in the classification of PSME/LIDE3 could be done into PSME or LIDE3.

Better definition of BLM's pine/PSME3 and white oak series.

Need for improved data integration between agencies. Need common definitions for seral stage/condition class, plant series, etc., with ability for larger-scale (provincial) applications.

BLM's lands need ground verification of plant series determinations.

Data for non-federal ownerships is lacking. Need to integrate data with BLM & USFS.

Additional surveys of aquatic wildlife species are needed. This could be incorporated into stream survey work.

Additional breakdown in seral stages/condition classes to aid in analysis of species specific needs and habitat.

Additional survey work is needed to identify presence and condition of species of concern (C-3 ROD)

Monitoring sensitive, endemic or declining species populations would add to the knowledge of population trends, habitat needs, and effects of activities on known populations.

Lack of information on the natural distribution of coarse woody material across the watershed.

Additional road condition surveys on existing roads are needed to help determine which roads are not meeting the Riparian Reserve standards and guidelines). The priority for upgrading is also needed.

Development of a sediment hazard map and updated landslide inventory are needed to predict impacts from future projects.

Monitoring of past harvest units to determine hydrologic recovery. This would help predict cumulative effects of future projects.

KEY QUESTIONS

SILVER CREEK DRAINAGE
WA #9

KEY QUESTIONS are used as a guide to focus the Watershed Analysis. They are developed from issues raised for Silver Creek.

1) What type of local employment has the Silver Creek watershed contributed in the past, present, and is expected to do in the future? Related activities are tourism, timber products, fishing, mining, special forest products, and outfitter guides.

2) How does Silver Creek watershed provide for amenity values? Is there a difference between past, present, and future values? These are values related to scenery, wilderness, solitude, and related activities.

3) What is the past, present, and future recreation use of the watershed?

4) How has the watershed been accessed in the past, present and what are the future needs?

5) What are the measurable factors that affect Silver Creek's ability to sustain Threatened and Endangered species? Some of these factors are vegetation, seral stage, patch size, patch distribution, T&E species present, special sites used by these species (non-vegetative habitats), and the influence of adjacent watersheds and the connections between them (Provence level). How can habitat be maintained or improved?

6) What are the factors that sustain a genetically diverse and demographically healthy population of plant and animal species? Connections between adjacent watersheds will also be considered (Provence level needs).

7) What is the historic disturbance pattern for the Silver Creek watershed? How has management activities affected this pattern? These activities are Logging, fire suppression, and roads. What is the ability of the Watershed to sustain disturbances?

8) What are the historic cycles and amounts of large woody material in the watershed? What are the processes which deliver large wood and where do they occur?
Where have management activities changed the large wood supply below historic levels? Are there areas of concern for future wood supply and should and can the supply of large wood be restored?

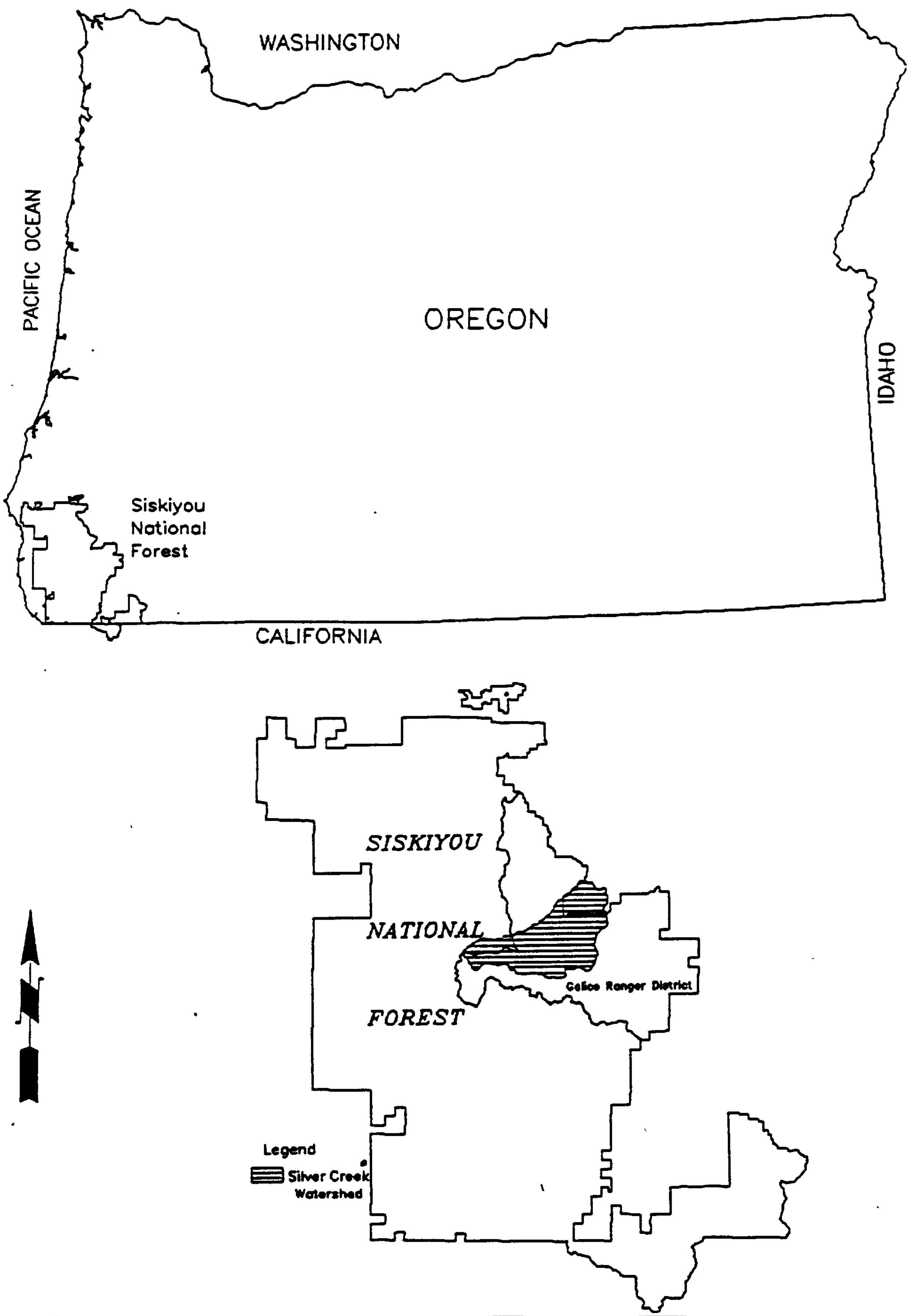
9) What are the processes which deliver sediment, and where do they occur?

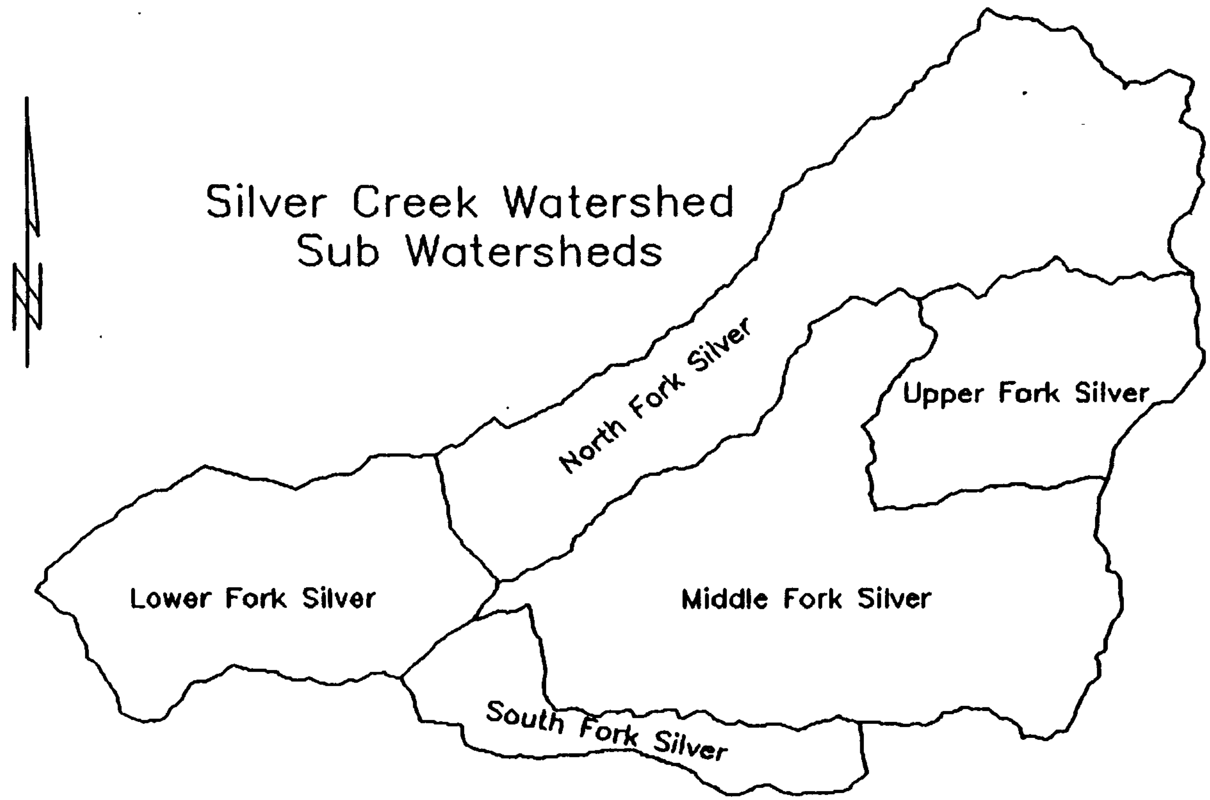
10) What processes reduce shade and increase stream water temperature and where do they occur? Where have management activities increased solar exposure and stream water temperature? Where are fish habitats sensitive to increased stream water temperatures? What are the future trends in stream temperature and can they be improved?

11) What processes have the potential to change the magnitude and frequency of stream flow?

12) Where are channels sensitive to increased sediment and decreased large wood? Is there evidence that channel morphology and sediment storage have changed form historic conditions? What are the expected channel morphology and storage condition trends? How can the channel conditions be improved?

13) What fish species inhabit the watershed? Are these different from the historic species? What are the current fish habitat conditions? This can be expressed basinwide and in susceptible reaches. Is there evidence that fish habitat conditions have changed form historic levels? What are the expected trends in fish habitat conditions? How can the fish habitat be improved?


WASHINGTON
PACIFIC OCEAN
OREGON
IDAHO
Siskiyou
National
Forest
CALIFORNIA
SISKIYOU
NATIONAL
FOREST
Galice Ranger District
Legend
Silver Creek
Watershed


Silver Creek Watershed
Sub Watersheds
North Fork Silver
Upper Fork Silver
Lower Fork Silver
Middle Fork Silver
South Fork Silver

Social Conditions
Silver Creek

Southern Oregon has a long history of human inhabitation. Native American communities have occupied southwest Oregon for at least the last 8,000 years (Aikens 1993). It wasn't until the mid-1800's (and the discovery of gold) that European and Asian populations began to grow in southern Oregon. With that increased settlement came increased fire, land clearing (for agriculture), timber harvest and road-building. The rich alluvial soils of the Rogue and Illinois Valleys have experienced a tremendous level of agricultural related development, particularly during the early part of the 20th century. The Silver Creek watershed has experienced very little of this development.

Agriculture, wood products, tourism, and sport and commercial fishing are the Province's three basic industries. Although there has been growth in the non-timber related manufacturing, there is still a strong reliance upon the wood products industry for this area's economic well-being. The decline in wood products activity through the 1980's, locally amplified the nation-wide recession. Josephine county has consistently rated among the least wealthy of Oregon counties. Curry and Coos counties have ranked significantly higher. Unemployment is currently 11% (Coos and Josephine) and 8.9% (Curry), per capita income is $14,004 (Josephine), $15,934 (Coos), and $16,873 (Curry). Typically, citizens in this region are older, retired individuals who rely heavily on income from Social Security, etirement, and public assistance programs.

This watershed is located primarily in Josephine county with a small portion in Curry county. 62,649 people live in Josephine county, 60,500 in Coos county, and 21,300 in Curry county. Curry and Coos counties population has traditionally shown more dependance upon the timber industry than Josephine. Consistent with throughout the province, communities are diversifying their economic base. The population of Coos/Curry counties fell 2% in the 1980's, the most recent data suggests a small increase in Coos/Curry population since 1990. This is possibly due to the entry of large chain-stores and re-opening of a small mill.

The population of Curry, Coos and Josephine county is focused in unincorporated areas. Much of this unincorporated area is identified as the "interface." Throughout the "interface" of forest and rural development there are a number of usually unnamed communities. These communities are defined by little more than a small store or tavern.

Over the past decade, a number of demographic shifts have been taking place. Young people who were raised in southern Oregon have been inclined to leave in search of employment while the region has been experiencing a steady increase in overall population. The increase is primarily due to an immigration of both young, professional ex-urbanites and senior citizens (USDI BLM, September 1994).

all three counties surrounding the Silver Creek Watershed, the proportion of citizens aged 65 years and older is on the increase. Between 1980 and 1990, the proportion of persons over 65 in Josephine county increased 42%. In Coos county, the proportion increased 35% and Curry county increased 64% to make persons aged 65 years and older account for nearly 25% of the total population of Curry county. The median age in Josephine is 39.9 years, Coos county is 37.6 and Curry county is 44 years, the second highest median age in Oregon.

Seniors are frequently not tied economically to southern Oregon, most receive an annuity of some type. They are commonly here for other reasons including a favorable social climate, proximity to family, and/or enjoyment of southern Oregon's many amenity values. The new, young immigrants generally possess a higher income, higher education level, they generally have strong environmental values but little experience in land management (USDI BLM, September 1994). Many of these folks also have few ties to the traditional industries of southern Oregon.

Demographics of the Basin and watershed seem to match the Province. A growing population dispersed throughout the "interface" of forest and urban growth. The Applegate Adaptive Management Area's Ecosystem Health Assessment lists a number of social and economic trends occurring in the "interface" these include;

- Strong population influx and residential development;
- Dispersed settlement patterns which have created widespread residential/forest interface;
- In-migration of younger, more educated ex-urbanites with strong environmental values and community interest;
- Dramatic shrinking of the local traditional economic base (specifically, ranching, farming and timber employment;
- Strong representation and economic contribution of "lone eagles," that is "global entrepreneurs" with few ties to the local economy;
- Declining ties to the land for economic contributions and reliance on commuting to urban employment sites;
- Newcomers are less integrated into the community and less knowledgeable about the local ecosystem than in previous decades;
- An increase in a wide-range of recreation activities on public lands, creating endemic conflict between users and management challenges of incorporating different interests.

Key Questions

1. What type of local employment has the Silver Creek Watershed contributed in the past, present, and is expected to provide in the future?

Agriculture, wood products, tourism, and sport and commercial fishing are the province's basic industries. Total sales from farms in Jackson and Josephine counties totaled $75 million in 1991 and Curry/Coos counties produced $70 million in 1992. (Oregon, 1993). Personal income from farms in Jackson and Josephine counties was $26.4 million in 1991, 3% of all farm income in Oregon (Oregon, 1993). Personal income from farms was not reported for

Coos/Curry counties. Agriculture including farms, ranches, nurseries, bulbs, grain, hay, vegetables, grapes, and timber-cutting from small woodlots is not as important to the basin as it is to the province. Agricultural related employment in Josephine county averages 400 jobs, with an additional 100 employed during harvest seasons. Coos county generated 450 jobs and Curry county 250 jobs. (Oregon, 1993). There is very little land suitable for agriculture within the watershed.

The province has a continual need for wood products. Since 1957, USDA Forest Service administered lands within the Silver Creek Watershed has provided 197.21 MMBF of timber to the surrounding communities. The first timber extraction appears to have been in 1957. Between 1957 and 1987, 114.63 MMBF were extracted. This accounts for 3,550 jobs (direct, indirect, and induced jobs, based on formula provided by the Siskiyou National Forest of 18 jobs/MMBF harvest). This averages 6.6 MMBF annually for an average of 119 jobs annually.

Reduced timber output from 1979-1982 had a devastating effect on the state and local economy. During that period, Oregon lost 95,000 jobs (50,000 in the timber industry). By 1986, 68,000 of these jobs had been regained, but nearly two-thirds were in these were in retail trade and service industries (SCORP, 1988) Locally, non-manufacturing jobs increased over 20% led by an increase in trade and services (Oregon, 1993).

Although timber production will continue to provide employment in southern Oregon, the continued survival of communities (especially rural communities) will depend on the region's ability to diversify their economic base. For many rural areas, the path to sustainable economic development will include innovative approaches to natural resource conservation, management, and utilization (USDA FS, 1993)

Tourism is the third largest industry in Oregon (SCORP, 1988). In 1988, visitors to Jackson and Josephine counties spent $126,235,000 creating 2,826 jobs, while visitors to Coos/Curry counties spent $77,591,000 and created 1,598 jobs (Runyan, 1991). Approximately 73% of all visitors to southern Oregon are from out-of-state. 84% of all visitors participate in some outdoor/nature related activity, 20% of these specifically listed hiking (SOVA, 1991). Regionally, "driving for pleasure" and "sight-seeing" is ranked as the number 1 and 2 (respectively) demanded outdoor recreation activities in 1987 and they are projected to remain 1 and 2 through the year 2040 (USDA FS, 1993). Although few roads exist in the Silver Creek Watershed, this area is viewed as background from Forest Road 23, a well used recreational route connecting Grants Pass and the Oregon Coast. These statistics indicate that in the region's quest for economic diversification, amenity values such as scenic quality and recreation settings management will play an increasingly important role in the management of the region's natural resources.

Commercial and sport fishing is economically important to the residents of Coos and Curry counties. They have historically reported major landings of salmon but due to environmental problems impacting fish habitat (including loss of stream-rearing habitat) they have reported that groundfish and shrimp account for 87% of the poundage. In 1992, 190 million pounds of groundfish (including rockfish, sole, and Hake) were grounded. Fishing industry of Coos/Curry counties produced $25,000,000 in 1992.

Mining has played a significant role in the early development of southern Oregon. It contributed to the early economy and substantially altered the scenic quality as well as the natural biotic systems. In the case of Silver Creek, mining is a permanent and undeniable part of the culture. Silver Creek itself is said to have gotten its name from "...a pretended discovery of silver... in 1879." (Walling, A.G., 1883). The Jacksonville "Democratic Times", mentioned Silver Creek in every issue in 1879. The entries were as follows;

Jan 31, 1879: The mines of Silver Creek are a topic of interest among those who contemplate engaging in mining in the spring and summer - at present, there is too much snow.

February 28: The trail is open and there is a stream of miners flowing into the region

March 7, 1879: The rush to Silver Creek is getting in, and before spring the most available claims will be taken up. about 30 men there now and more coming.

April 4, 1879: Trail open - about 75 men there now. Ab Giddings, Oregon and California Stage Company representative returned from Silver and Briggs Creeks - He does not give a flattering report - says there are too many boulders and not enough gold - Briggs Creek is best.

June 6, 1879: $54 nugget found on Silver Creek

June 20, 1879: Many claims not being worked - Instead they are being held for sale. Ground is spotted and some will be disappointed.

July 4, 1879: Many Silver Creek miners are making good wages.

July 18, 1879: Silver Creek correspondent says Simmons and Company and H. Todd are making $10 per day. Feldt and Ficke are doing good

September 26: Silver Creek excitement dying out.

October 3: Work suspended in nearly all Silver Creek mines. Some still working.

Mining in the Province began in 1852. The principle minerals were gold, copper and chromium. Today, the primary mining activities in the province are the quarrying of sand and gravel for construction (Oregon, 1993). It is estimated that "somewhere" around $50,000 in gold is extracted from the Silver Creek Watershed for the past few years. In 1992, total reported employment from mining was 57 jobs, and these were reported for non-metallic mining (Oregon, 1992). Some employment is known to exist from gold mining, but information on employment and production is difficult or impossible to collect and verify.

Non-timber forest resources (or "special forest products") is a commodity resource which is developing in support of economic diversification. Special forest products include; aromatics, berries, chips, shavings, excelsior, sawdust, bark, smokewood, fuelwood, decorative wood, forest botanicals, greenery and floral products, honey, mushrooms, and wildlife. Except for the collection fuelwood (which appears to be tied to timber harvest activities), conversations with land managers in the province confirm that sale of these products have been on the increase. Due to inaccessibility, most of the Silver Creek Watershed in unsuited for this form of development. The upper sub-basin may be the only suitable area for development of "special forest products" extraction. In the period of 1950 through 1989, an average of 1,315 cords of fuelwood collected annually from USDA Forest Service administered lands within the watershed.

2. How does the Silver Creek Watershed provide for amenity values? Is there a difference between past, present, and future values?

Amenity values relate to visitor satisfaction. These are subjective and personal values which vary from individual to individual. Generally, satisfaction can be predicted by examining such items as the scenic quality, wilderness values (or how well the watershed provides for an individuals need for solitude), and what settings are available within the watershed for recreational activities to take place.

Assessing Visual Quality

Visitors participating in recreational activities are generally more sensitive to highly modified landscapes. For that reason, The USDI Bureau of Land Management and USDA Forest Service manage for scenic quality in highly used recreational areas. The Siskiyou National Forest outlines management of the Siskiyou National Forest Visual Resources in their Land Resource and Management Plan (LRMP) by assigning Visual Quality Objectives (VQO's) to the landscape. Criteria used to define VQO's are: scenery quality ratings, public sensitivity ratings, and distance from the viewer. The Siskiyou National Forest LRMP described management objectives by VQO as follows;

MA 12: **Retention Visual**: This land is managed with the primary goal being "to provide a level of attractive scenery by maintaining the area in a natural or near natural condition." "Management activities will be conducted in such a way that they are completely subordinate to the character of the landscape and not evident to the casual Forest visitor."

MA 13: **Partial Retention Visual**: This land is managed with the primary goal being "to provide a level of attractive scenery by maintaining the area in a near natural condition." "Management activities will be conducted in such a way that they are subordinate to the character of the landscape."

MA 14: **General Forest (VQO: "Modification")**: Land managed with the primary goal being "to obtain a full yield of timber within the capabilities of the land..." The VQO for this management area is modification.

The USDI Bureau of Land Management uses a similar system classifying visually sensitive lands as Class I (Protected, no planned harvest), Class II (similar to USDA Forest Service VRM rating "Retention"), Class III (similar to USDA Forest Service VRM rating "Partial Retention"), and Class IV (similar to USDA Forest Service VRM rating "Modification").

The Medford District Resource Management Plan inventories all USDI BLM administered land within the Watershed.

Assessing visual quality is a two step process. Standardized, objective size and area criteria have been established as a general "rule of thumb." Site specific analysis is more subjective. Using objective criteria outlined in USDA Forest Service Manual 2380 Landscape Management, Agriculture Handbook #462, each sub-basin was assessed as generally meeting or generally not meeting the stated VQO.

Lower Fork Sub-basin:
Stated VQO:
USDA Forest Service: Retention (in Illinois River Corridor), Partial Retention and (primarily) Modification.
USDI Bureau of Land Management: N/A
Based on Pacific Meridian Research (PMR) data this sub-basin meets the stated VQO.

North Fork Sub-basin:
Stated VQO:
USDA Forest Service: Modification
USDI Bureau of Land Management: Class IV
Based on PMR data, this sub-basin generally meets the stated VQO. The perceived openings are primarily upon BLM land.

South Fork Sub-basin:
Stated VQO:
USDA Forest Service: Partial Retention, Modification.
USDI Bureau of Land Management: N/A
Based on Pacific Meridian Research (PMR) data this sub-basin generally meets the stated VQO.

Middle Fork Sub-basin:
Stated VQO:
USDA Forest Service: Partial Retention, Modification
USDI Bureau of Land Management: N/A
Based on Pacific Meridian Research (PMR) data this sub-basin generally meets the stated VQO.

Upper Sub-basin
Stated VQO:
USDA Forest Service: Partial Retention, Modification
USDI Bureau of Land Management: Class IV
Based on Pacific Meridian Research (PMR) data this sub-basin generally meets the stated VQO.

Assessing Recreation Settings:

In addition, the USDA Forest Service uses the "Recreation Opportunity Spectrum" (ROS) as a method to classify land as to its suitability as a setting for recreation activities.

Settings within the watershed are classified as "Roaded Natural" (RN) and "Semi-primitive Motorized" (SPM). In the North Fork Sub-basin, settings would be closer to "Roaded Modified," where there is significant evidence of management. Much of the interior regions of the Silver Creek Watershed area possesses values normally associated with wilderness. Most of this watershed has a complete "Roadless Area evaluation" contained in APPENDIX C of the Siskiyou National Forest Land and Resource Management Plan FEIS. It is identified as #6176, the North Kalmiopsis. A full discussion of this area's wilderness characteristics can be found in that document. In summary, this area was found to have HIGH natural integrity, MODERATE opportunities for solitude, HIGH opportunity for primitive experience, and HIGH public interest.

Most of this watershed has remained in what appears to be a state unaltered by man. The North Fork and Upper Sub-basins display evidence of extensive timber management. In the Upper Sub-basin, there is a long history of human inhabitation, evidence of mining (except buildings, equipment, and sounds) can be largely missed by the casual visitor or interpreted as a natural phenomenon. The area remains substantially unroaded, it exists much as it did a century ago. Users today, as in the past, need to be experienced, physically fit and very self-reliant. Trails (and river travel) provide the primary access to the lower sub-basin. The Upper Sub-basin is now within an LSR, and the BLM has proposed the North Fork Silver Creek RNA whose management direction will be to "...maintain, protect, or restore relevant and important value(s)...".

The Silver Creek Watershed provides some extraordinary scenic quality, clean water and unique recreation settings for most visitors to have a satisfying experience.

3. What is the past, present, and future recreation use of the watershed?

An overview of the recreation settings in the Silver Creek Watershed is provided under Question 1 above. In addition to that information, Siskiyou National Forest has the following trails and facilities;

Facilities:

No developed facilities, other than trailheads.

Trails: (total 22.5 miles)

Silver Creek Trail #1130 and Silver Falls Trail (#1130A):
Approx 2 trail miles. 2,160 visits (1994)

Little Silver Lake Trail #1184:
2.2 miles within WA #26, Taylor Creek Sub-basin. Approx. 1,000 visits (1994)

Dutchy Creek Trail #1146:
Approx. 2.5 miles within Silver Creek Watershed. Approx. 2,000 visits (1994)

Silver Peak - Hobson Horn Trail (#1166)
Approx. 13 miles in the Silver Creek Watershed. Trail has essentially been closed since 1992. Reopened in spring, 1995.

Illinois River Trail (#1161)
Approx 12 miles in the Silver Creek Watershed. 1,500 visits

There are 3 commercial river guides with permits to guide on the Illinois River. Their reported use has ranged from 8 to 57 customers per year. Non-commercial rafters have ranged from 68 to 273 rafters per year. Two commercial guides are permitted to guide in the Silver Creek Watershed, using the Silver Peak-Hobson Horn Trail (#1166) and the Illinois River Trail (#1161). 207 people are reported to have used the Illinois River Trail in 1993, The Silver Peak-Hobson Horn Trail has received little use since 1992 when storms dropped hundreds of trees across the trail in the vicinity of the Silver Fire burn. Prior to that time, use is estimated to be 75-150 users annually. The Southcoast edition of the US West yellow pages lists 18 fishing guide services who gain some benefit from Silver Creek Watershed (based upon rearing habitat provided).

Much of the Silver Creek Watershed has been designated a Backcountry Recreation Area (MA-6) in the Siskiyou National Forest Land and Resource Management Plan. Silver Falls is a locally popular site which (based upon observation) draws more than 1,500 visitors each year. Access to this site is from within private land owned by the Lloyd Corporation.

Traffic counts are not available for within the Silver Creek Watershed, however one access road in the Middle Fork Sub-basin shows a Average Daily Traffic (ADT) of 14 vehicles. 12 of these vehicles were using the road for recreational travel.

Trends and demand projections indicate that recreation use will continue to grow in the Silver Creek Watershed. It provides an experience similar to wilderness without the restrictions of wilderness, making it suitable for users of all types. The degree of isolation and solitude that this watershed provides makes it an extremely valuable recreation resource on the Siskiyou National Forest.

The USDI Bureau of Land Management has proposed 2 recreation facilities in the North Fork Sub-basin, Sourgrass and Shady Branch Recreation sites/Areas (USDI BLM, October, 1994).

The watershed is connected by trail to Briggs Valley and the Galice Ranger District's extensive trail system. Future connections could be made (by restoring some of the historical trails) to make non-wilderness trail connections east-west across the Galice District to the Gold Beach Ranger District's trail system. Opportunities to build connections between trails should be sought, especially where historic trails may still be usable.

4. Trails and historic trail access.

The 1937 forest map shows a number of trails which, at that time, provided the sole access to the Silver Creek Watershed. These trails generally followed the ridgelines and creeks connecting mines, cabins, and Ranger Stations in this wild, and undeveloped country. Accurate mileages and locations are not available.

Illinois River Trail: (Lower and South Fork sub-basin)
Connection to the Coast from the Silver Creek Watershed
Silver Creek Trail: (Lower, South Fork, Middle, and Upper sub-basins)
Bald Mountain to Galice via White Cabin, Old Glory Mine, Metz Mine and Howland Mine.
Silver Peak - Hobson Horn Trail: (North Fork sub-basin)
Sourgrass Camp to the Illinois River via Silver Peak.
Sourgrass Camp Trail: (Upper Fork Sub-basin)
Sourgrass Camp to Silver Creek Trail.
Flat Top Trail (Middle Fork Sub-basin)
White Cabin to Briggs Valley via Mud Springs Ranger Station
Todd Creek Trail (Middle Fork Sub-basin)
Old Glory to the Mud Springs Ranger Station.

Road Access

SILVER WATERSHED (09) ROAD SYSTEM

The road system in this watershed is served by three (3) major road systems. Oregon State High Highway #199 (Redwood HWY.) and Josephine County#2400 (Merlin-Galice Road). From these main access roads several secondary forest roads provide access to portion s of the watershed.

Oregon State Highway #199, FS road #2500 and FS road #2512 provide access to the South and Middle Silver Creek drainage. Josephine County Road # 2400 provides access to Upper Silver Creek drainage.

BLM has numerous roads in Watershed #09 within the following drainage:
North Fork Silver No.2 Approx. 62.0 Miles See BLM Silver Watershed Analyses

Lower Fork Silver Creek No 1 is unroaded.

The U.S. Forest Service roads within Watershed #09 and inside the Forest Boundary are listed by maintenance Level by drainage as follows:

	Miles	Acres
South Fork Silver Creek No.3		
Maintenance Level 2	16.78	40.27
Maintenance Level 1	1.98	4.75
Middle Fork Silver Creek No. 4		
Maintenance Level 2	26.03	62.47
Maintenance Level 3	3.64	8.74
Upper Fork Silver Creek No.5		
Maintenance Level 2	8.46	20.30
Maintenance Level 1	3.26	7.80

Transportation Network Analysis (TNA) Findings were used to determine what roads will not be needed in the future. They are identified in the individual roads listing that is part of the reference material. The maintenance levels were determined using the Maintenance Handbook 7709.58.

Forest Service Roads 23 and 25 are the main access roads into the watershed and will need to be upgraded for future needs for Recreation and Timber haul. There may be a need for future roads to be added to the existing road system for timber haul and/or recreation needs.

TERRESTRIAL

The Vegetation and Fire sections address Key Question #7- What is the historic disturbance pattern for the Silver Creek watershed? How have management activites affected this pattern? What is the ability of the Watershed to sustain disturbances? There is also background information for Key Question #5 -What are the factors that affect Silver Creek's ability to sustain Threatened and Endangered species?

Biologic Setting: Vegetation

Seral Stages

The vegetative cover of the Silver Watershed features considerable diversity in terms of plant communities and seral stages. Of the major seral stage groupings that occur within the watershed's National Forest and BLM-managed lands, approximately 22 percent are occupied by late-seral stage forest stands. This stage includes mature and old-growth conditions, ranging from the point where stand growth slows (typically after age 100) through development of increased structural diversity. During the latter phase, stands retain fewer large overstory trees per acre, develop intermediate shade-tolerant canopy layers, canopy gaps and increase the recruitment of snags and down wood.

Approximately 24 percent of these lands are occupied by mid-seral stage forest stands, which typically occur from ages 40 through 120 with stand diameters of 12 inches or greater. During this time, ›mpetition-related mortality accelerates while dominant trees continue to make significant growth.

Approximately 22 percent of lands are occupied by early seral stage vegetation. Plant communities change rapidly during this period, with forest development progressing from seedling-shrub through pole-sized trees.

Approximately 20 percent of lands are occupied by pioneer seral stage vegetation. This period begins after some type of disturbance and subsequent development of pioneer vegetation, through the time when stands are dominated by shrubs and small conifer seedlings. The recent large-scale fire disturbances within the watershed included approximately 18 percent of burn acres that burned at high intensity, where nearly all above-ground vegetation was consumed. This resulted in a comparatively high percentage of pioneer seral stage vegetation. Vegetation recovery has been rapid on most intensely burned sites, with aggressively sprouting brush accounting for most of the vegetative cover. Natural regeneration of conifers has been limited by a succession of poor cone crops, drought and rapidly developing brush cover. Knobcone pine has successfully invaded those sites where fire enabled serotinous cones to release seed. Post-burn reforestation and subsequent vegetation management has given early seral conifers an early competitive advantage on approximately 1,200 acres within the watershed.

Approximately 12 percent of lands within the watershed are not capable of developing continuous forest cover and consequently do not exhibit a great deal of vegetative change over time. Surface rock, extremely skeletal soils, low shrubs and very sparse tree cover are characteristic of non-forest lands.

Figure T1 displays the area in acres and percent acreage by sub-drainage for each of the major seral stage classes within the Silver Watershed.

Figure T1

Sub-Watershed	Seral Stage	% of subWA	Acres
Lower Fork	Pioneer	20	1768
	Early Seral	25	2192
	Mid-seral	23	2053
	Late Seral	22	1919
	Non-forest	10	847
North Fork	Pioneer	18	2761
	Early Seral	13	1956
	Mid-seral	20	3000
	Late Seral	38	5758
	Non-forest	11	1620
South Fork	Pioneer	36	1343
	Early Seral	16	584
	Mid-seral	16	593
	Late Seral	6	241
	Non-forest	26	974
Middle Fork	Pioneer	20	3497
	Early Seral	26	4380
	Mid-seral	27	4650
	Late Seral	13	2222
	Non-forest	14	2308
Upper Fork	Pioneer	12	730
	Early Seral	35	2188
	Mid-seral	29	1829
	Late Seral	15	963
	Non-forest	8	476
TOTAL	Pioneer	20	10099
	Early Seral	22	11300
	Mid-seral	24	12125
	Late Seral	22	11103
	Non-forest	12	6225

Periodic fluctuations in the magnitude of disturbance events have contributed to the variation in seral stage distribution between the watershed's sub-basins. Both human and natural disturbance agents (such as fire, insects and timber harvest) have played a role.
When seral stage distribution is examined along the lines of acres burned in 1987 versus unburned, the overall distribution is as follows:

Figure T2

AREA BURNED IN 1987				AREA NOT BURNED IN 1987		
Seral Stage	Acres	Percent of Area		Seral Stage	Acres	Percent of Area
Non-Forest	4449	19		Non-Forest	1776	6
Pioneer	6639	28		Pioneer	3460	13
Early	4635	20		Early	6665	25
Mid	4298	18		Mid	7827	28
Late	3347	14		Late	7756	28

Areas burned in 1987 have more than double the proportion of lands classified as pioneer seral stage, while early seral stage distribution does not appreciably differ between burned and unburned areas. Unburned areas have a greater proportion of forest lands in the mid- and late seral stages.

Plant Series

Forest stands have been grouped into "plant series", aggregations of plant communities that indicate site conditions such as soil type, site productivity, regeneration potential and fire frequency. Each series is identified by the potential climax species that would predominate after an extended disturbance-free period. Seven plant series and plant series groupings have been identified within the watershed: Douglas-fir, tanoak, Douglas-fir/tanoak, white fir, Jeffrey pine, western hemlock and white oak. Of these, the Douglas-fir, tanoak and Douglas-fir/tanoak series are the most common.

The Douglas-fir series occurs in areas that have experienced frequent fire disturbance, and tends toward warmer and drier sites. The tanoak series tends to occur on moister more productive sites with less-frequent fire intervals. Sometimes the Douglas-fir and tanoak series occur in a coarse mosaic as opposed to larger contiguous blocks, with subtle shifts in microsite and soil conditions affecting species mposition and regeneration potential. This blend of communities is referred to as the Douglas-fir/tanoak series. The white fir series is most often found within the Silver Creek watershed on higher elevation sites above 3,000 feet and some moist sites lower in elevation. The Jeffrey pine series is indicative of ultrabasic serpentines and peridotites and comprises less than two percent of the watershed area.

Two less-common plant series found within the Silver watershed are the white oak and western hemlock series, each of which occupies less than one percent of the watershed's area. The white oak series consists of low elevation oak/brush/grass woodland areas growing on shallow infertile soils that are very limiting to survival and growth. The western hemlock series is not common east of the coastal crest, but can occur in isolated pockets where deep moist soils, cool aspects and frequent fog occurs.

Figure T3

SERIES	SERAL STAGE	ACRES	PERCENT AREA
Tanoak	Pioneer	2037	18.3
	Early Stage	2436	21.9
	Mid seral	2633	23.7
	Late seral	4032	36.0
	Acres/% for series	11,111	25.6
Douglas-fir	Pioneer	3077	25.6
	Early Stage	3228	26.9
	Mid seral	3697	30.8
	Late seral	2053	16.7
	Acres/% for series	12,012	27.6
Douglas-fir/ Tanoak	Pioneer	3609	22.6
	Early Stage	5061	31.6
	Mid seral	4467	27.9
	Late seral	2866	17.1
	Acres/% for series	16,003	36.8
White fir	Pioneer	1083	32.9
	Early Stage	659	20.1
	Mid seral	912	27.8
	Late seral	630	19.2
	Acres/% for series	3284	7.6
Jeffrey pine	Pioneer	204	25.3
	Early Stage	264	32.7
	Mid seral	335	41.5
	Late seral	4	0.5
	Acres/% for series	807	1.9

Western hemlock	Pioneer	55	27.8
	Early Stage	61	30.8
	Mid seral	45	22.7
	Late seral	37	18.7
	Acres/% for series	198	0.5
White oak	Pioneer	0	0.0
	Early Stage	10	23.3
	Mid seral	0	0.0
	Late seral	33	76.7
	Acres/% for series	43	0.1

Comparison of seral stage distribution within the most common plant series in the Silver Creek watershed indicates that the tanoak series hosts a comparatively high percentage of late seral stand conditions. Topographic and atmospheric moisture conditions tend to favor less frequent fire events than typically occurs for the other series present. Tanoak is generally indicative of a productive site (Atzet and Wheeler, 1984). As such, more rapid development of large conifer characteristics would enable stands to reach late seral characteristics in a shorter period of time.

Lands within the Douglas-fir series include a high percentage of area within pioneer and early seral stages, attributable to the 1987 fire events. This series produces conditions that favor fire wherever it occurs, and commonly occupies shallow soils with low water-holding capacity.

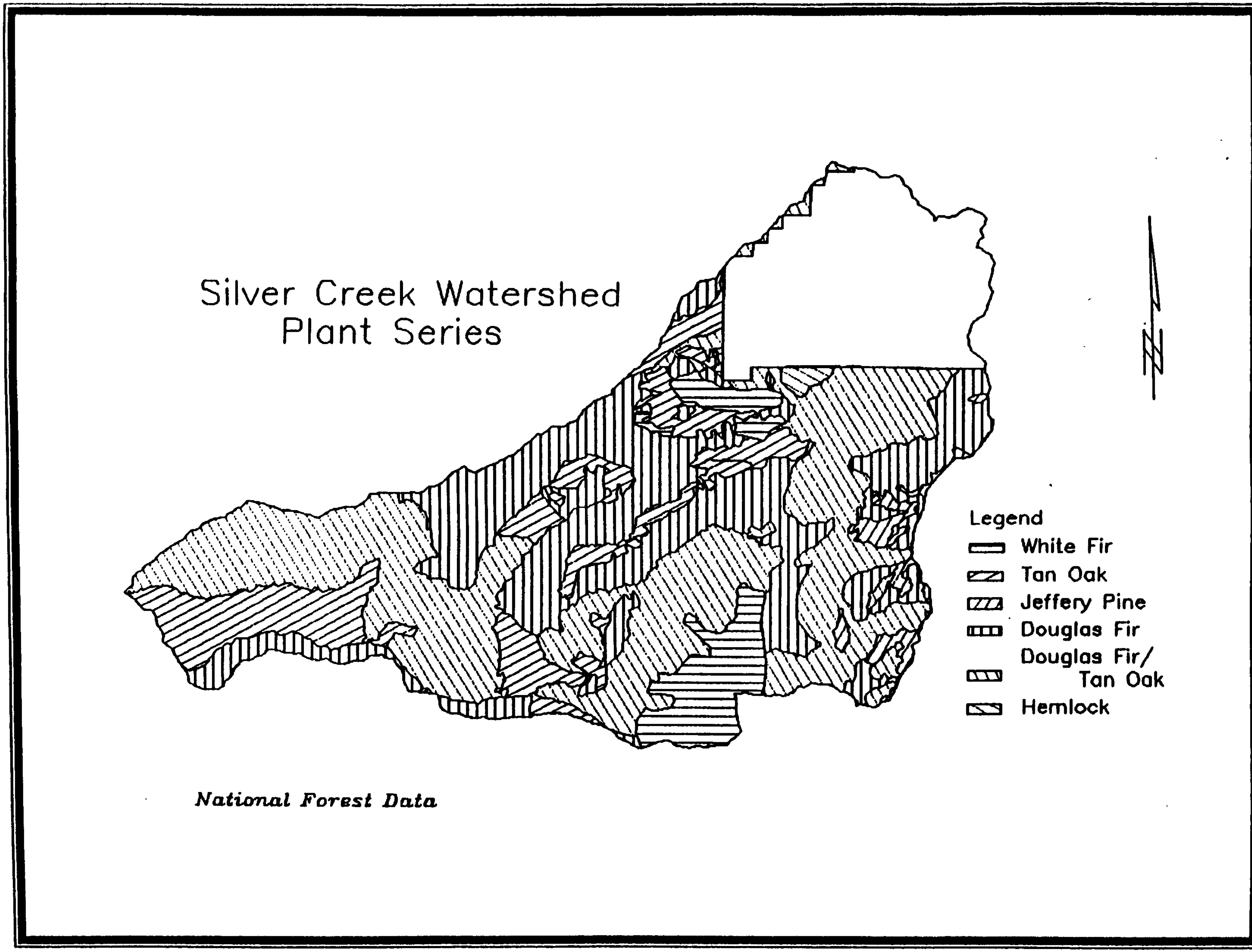
Fifty-six percent of the area occupied by the Jeffrey pine series is shown as pioneer or early seral stage. This designation is more attributable to low biomass productivity than disturbance, as effects of fire are generally low due to lack of fuel connectivity (Atzet and Wheeler, 1982).

Tree and Shrub Species

Douglas-fir is the most common overstory tree species found in the Silver Watershed and is frequently associated with other conifers, including ponderosa pine, sugar pine, Jeffrey pine, western white pine, knobcone pine, white fir, incense cedar, Port-Orford-cedar, Brewer spruce, western hemlock and Pacific yew. Associated hardwoods include Pacific madrone, tanoak, golden chinkapin, bigleaf maple, red alder, canyon live oak, Oregon white oak and California black oak.

Stand structure is quite variable and ranges from single-storied and even-aged to multi-aged and structurally complex. Two to four distinct age classes is typical of most stands, although one or two cohorts tend to predominate. This condition usually relates to past fires and other disturbances that have taken place over time. Less-productive sites that lack continuous crown cover are often more structurally diverse than productive sites that feature a strong dominant/codominant size class.

Common shrub species include tanoak, poison oak, Sadler oak and several species of manzanita and ceanothus. Species such as vine maple, Pacific rhododendron, salal and sword fern are found most often


Silver Creek Watershed
Plant Series
Legend
White Fir
Tan Oak
Jeffery Pine
Douglas Fir
Douglas Fir/
Tan Oak
Hemlock
National Forest Data

on cooler sites and within riparian zones. Ultrabasic soils feature shrubs such as huckleberry oak, California coffeeberry and several herbaceous species endemic to these soils.

Vegetation Conditions and Trends

The current vegetation pattern within the Silver watershed developed as a result of geologic conditions, climatic conditions, floristic migrations over time and periodic disturbance, both natural and human-caused. Fire is the most evident disturbance agent in the watershed. Past occurrence prior to about 1850 is attributed to a combination of lightning strikes and Native American burning. After 1850 the incidence of Native American burning declined, but frequent and extensive fires were set by miners, ranchers and other European settlers. The 1987 Silver Fire Complex resulted from lightning and burned the western most one-half of the watershed.

For an approximate 70-year period prior to 1987, active fire suppression had effectively excluded fire from much of the area (Atzet and Wheeler, 1982). Fire suppression efforts over the years increased the availability of fuels, which in turn affected the Silver fire's behavior and its effect on vegetation (Silver Fire Recovery Project FEIS, 1988).

Watershed stand data suggests that earlier frequent fire intervals contributed to the existing within-stand species and structural diversity, where several size and age classes are present. Similarly, the 1987 fire created a complex mosaic of light underburns, stand gaps and larger-patch burned over areas, providing onditions favorable for the establishment of younger vegetation, and also favoring residual vegetation in ,nany instances. When natural disturbances are allowed to occur, surviving trees expand into available growing space, which is also invaded by a new age class of trees that compete amongst themselves and with older individuals (Oliver and Larson, 1990).

Data was analyzed to estimate pre-suppression fire periodicity within the watershed, as evidenced by distinct age groupings that related to past disturbance. Using this method, the estimated average fire return interval was determined to be approximately 50 years. It is noted that this estimate is probably high, since the disturbance effects of low-intensity fire do not generally include significant changes in stand structure or composition (McCrimmon, 1995).

Atzet and Martin (1991) determined mean fire interval for the Douglas-fir, tanoak and white fir series in the Klamath Region to be 30, 25 and 90 years respectively. These intervals are likely to be more indicative of past events in the Silver Watershed than stand data would indicate. One possible exception would be the tanoak series, which tends to have shorter fire intervals on the east side of its range where coastal influence is less pronounced.

Most historic fire-related disturbances within Silver Watershed appear to have been of low to moderate intensity, with a sizeable proportion of trees in the larger size classes surviving the fires. High intensity or "stand replacement" fires where most vegetation is killed are less frequent. Stand data indicates that high intensity fires range at intervals from approximately 151 years (Standard Deviation = 30 years) on warmer drier sites where the Douglas-fir series predominates to approximately 287 years (SD = 62 years) on the ore productive sites where the tanoak and white fir series are found. Most of the late seral stands located north and east of Bald Mountain originated around the year 1700. These stands occur on some of the most productive sites within the watershed, with pre-burn basal areas averaging approximately 266 square feet per acre (SD = 74). Typically, late seral stands associated with less productive gabbro, olivine gabbro and metagabbro soils (such as found in the Freeland Mtn.. and Chinaman Hat areas) average approximately 170 (SD = 49) square feet of basal area per acre.

Within the eastern half of the watershed that was largely unburned in 1987, the effects of fire exclusion on the forested parts of the watershed can be weighed against the effects of past management practices to determine an approximate degree of departure from historic fire-related stand replacement intervals (Van Wagner, 1978). FigureT4 illustrates stand replacement events since 1920, the approximate time when historic levels of burning began to decline in the watershed. Combined effects of fire exclusion and timber harvest are displayed. Projection of earlier trends indicate that, in the 75-year period between 1920 and 1995 approximately 49 percent of the area occupied by Douglas fir series would have experienced a stand replacement fire if fires had not been suppressed. The percentage for the tanoak series is 25 percent. The actual basin-wide area affected by high-intensity fire since 1920 is closer to 9 percent, most of which occurred in 1987. Consequently, the net estimated effect of fire suppression probably ranges between 16 and 43 percent of watershed acres where fire-associated stand replacement intervals have been extended from historic levels.

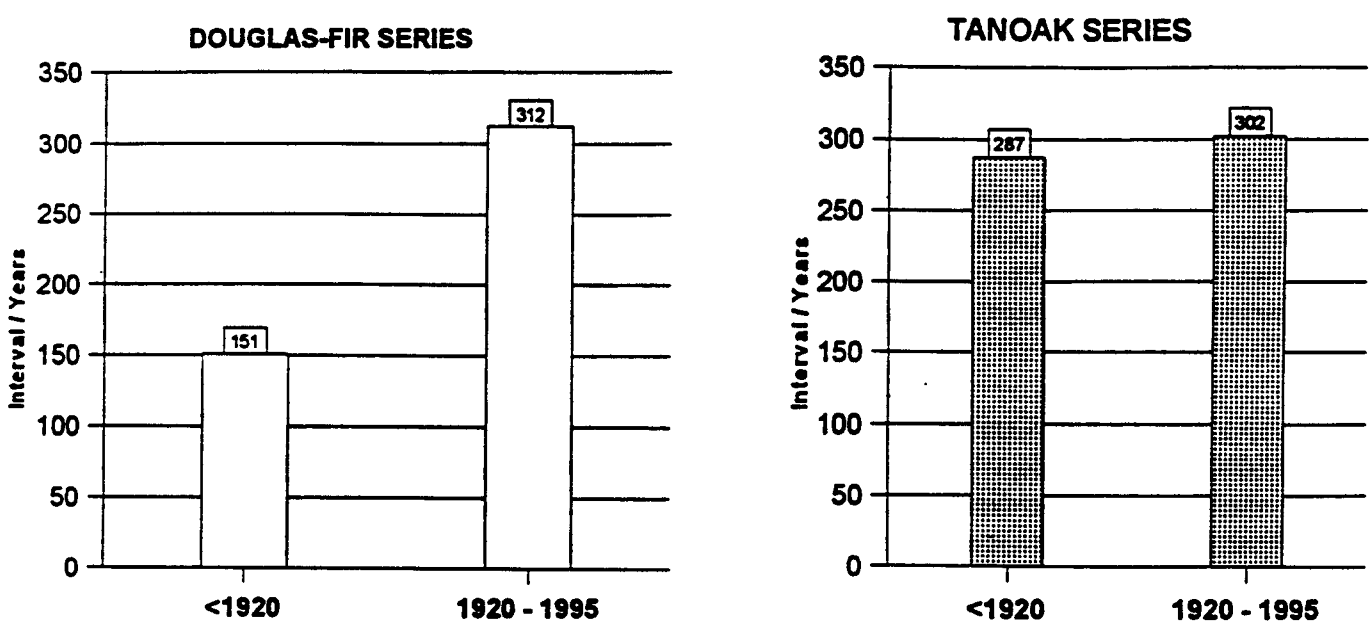


Figure T4

Timber harvest has affected the watershed in an opposite manner from fire suppression. Since 1920, 4,023 acres of late seral forested lands within the Silver watershed have been regeneration harvested. This is approximately 25 percent of the late seral lands that existed at the time that intensive timber management was initiated in the 1950's. Acres of salvage that occurred after the 1987 fires are not included.

Landscape Patterns

The existing proportion of major seral stage groupings within the eastern most half of the watershed suggests that the combination of fire suppression and timber harvest have altered the historic vegetative pattern. In contrast, the remaining (western half) area within the watershed has been less-affected by intensive timber management and fire suppression, as evidenced by the 1987 Silver Fire.

The SWEAT (Southwest Oregon Ecosystem Assessment Team, Atzet et al, 1993) Team Report described methods employed to estimated a reference point of average pre-1850 seral stage distribution within the Siskiyou National Forest. Assumptions pertaining to climate, fire regime and Native American activities were made, with the more recent timber harvest acres added to the late seral category. Using the team's baseline estimates for the Siskiyou National Forest, a current trend toward less late seral and increased mid-seral stages is evident, while the percentage of pioneer/early stage areas would closely approximate the baseline distribution. Differences between historic and existing seral stage distribution can be attributed to a number of natural and management-induced trends that have taken place over the past 70 years or so, and are described as follows:

Fire suppression, the effect of which has been a departure from frequent low-impact fires to less-frequent higher-impact fires. Lack of large-scale fire disturbance (prior to 1987) allowed stands to develop toward later seral stage characteristics.

2. Timber harvest, shifting affected areas from typically late to pioneer stage vegetation.

3. 1987 fires, the recent nature and extent of which departs somewhat from the historic picture, where fire was relatively frequent but occurred at average intervals of 20 to 50 years. Most areas within the Silver Complex had not experienced fire for 70 to 120 years.

Using existing seral stage data, it is possible to project back through time and estimate what conditions within the watershed might have occurred prior to fire suppression and timber harvest. A reference point of 100 years ago (1895) was selected, using the following assumptions:

1. Average age of existing pioneer is 10 years; early seral is 30 years; mid-seral is 75 years; late seral is 175 years.

2. Managed stands currently in pioneer through mid-seral stages were 60% late, 30% mid and 10% early seral stage 100 years ago.

3. Natural stands currently in pioneer and early seral stages were 45% late, 15% mid and 40% early seral stage 100 years ago. These estimates originate from the SWEAT team's reference point described previously.

4. Existing mid-seral vegetation was 67% early and 33% late-seral stage 100 years ago.

5. Existing late seral vegetation was 33% mid-seral and 67% late seral stage 100 years ago.

The results of this trend analysis are compared with existing conditions in Figure T4 .

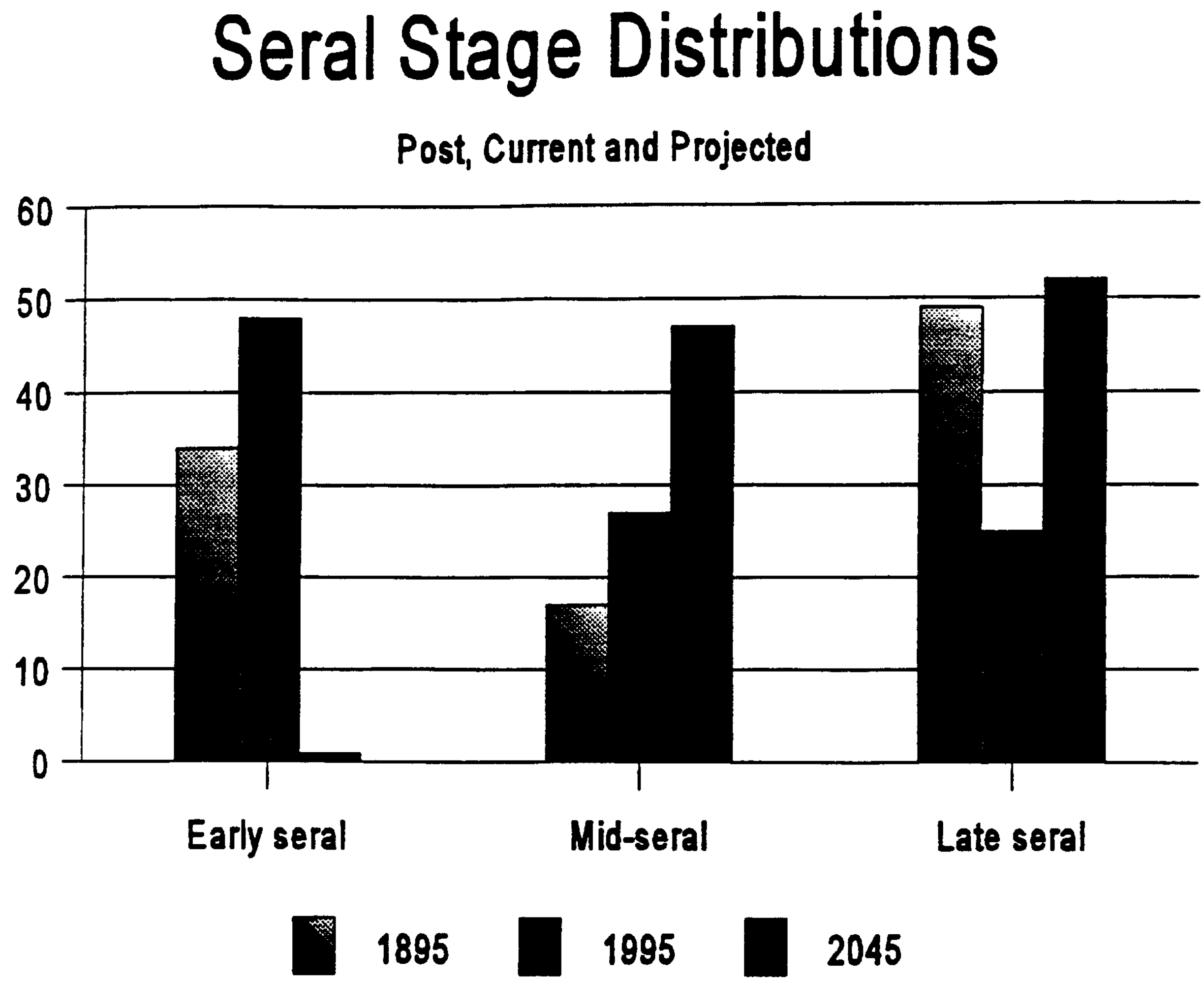
A notable difference between estimated 1895 and current conditions is the increase in the proportion of forest lands in pioneer/early and mid-seral stages and considerable decrease in proportion of late seral stage forest. A combination of management and natural disturbance events are responsible for this shift. Regeneration harvest in the eastern portion of the watershed has been the most common disturbance agent, while recent wildfire played a more prominent role in the western half of the watershed. A hypothetical explanation for the increase in mid-seral stage forest is long-term fire suppression, which enabled a high proportion of early seral stands to progress toward mid-seral, as opposed to the effect of frequent periodic fire that would have otherwise maintained a higher proportion of those areas in early seral stage. However, the 1987 fires moderated the effect of fire suppression and reduced the acres of mid-seral stage lands considerably (a reduction from 49 to 27 percent, based on photo interpretation).

It is also possible to project vegetative growth forward, as a basis for predicting what seral stage distribution might exist if no further high- intensity disturbance took place. The assumptions for this are that fire suppression efforts would be 100 percent effective, bark beetle and defoliant insect populations would remain within typical endemic levels and that stand regeneration timber harvest such as clearcutting would not occur. In projecting stand development forward 50 years, areas with pioneer or early seral stage become mid-seral, existing mid-seral vegetation becomes late seral, and late seral vegetation remains as such. Areas classified within the Jeffrey pine series are not changed from the current condition, as inherent low biomass production and low stand density for the series result in a comparatively slow rate of change over time, even with disturbance (Atzet and Martin, 1991).

It should be noted that this projection is largely hypothetical and does not consider associated risks such as insect attack related to overstocking, increased risk of catastrophic fire as a result of increased fuel loading, effects of periodic drought on overstocked stands and "fuel ladder" development.

If fire suppression proved successful for a long extended period, stand structural changes such as dense understory development, increased presence of shade-tolerant trees and shrubs, and increased development of fuel ladders would become the predominant condition in most stands. Average patch size would increase as existing age and size class distinctions between adjacent stands became less distinct. The increased fuel loading associated with extended fire suppression would tend to contribute to less frequent but more intense stand-replacing fires.

FigureT5 displays 1895, current and projected seral stage distribution in 50 years:



Density of Vegetation

For stands having little or no recent disturbance, density of mid and late-seral stands expressed in square feet of basal area per acre generally ranges from 100 to 300 per acre. Plot density in excess of 400 square feet of basal area per acre occurs in some stands, indicating local conditions of high productivity, long-term exclusion of high-intensity disturbance, or both. The more productive sites within the watershed such as the Bald Mountain area have potential to attain higher basal areas. The more common less-productive sites in the watershed typically carry 100-250 square feet of basal area per acre. Marginal forest lands associated with ultrabasic and metavolcanic soils are commonly low density, low canopy cover stands with less than 100 square feet of basal area per acre.

Frequent fires as an agent of stocking control tended to produce stands that were occupied by widely spaced, older, larger trees. Long-term fire exclusion resulted in stand size class distributions that tend toward dense stocking in the smaller size classes (seedlings and saplings), with stands at or in excess of natural carrying capacity. 1987 fire behavior was variable, with low to moderate intensity fires occurring over much of the landscape. Effects on vegetative structure and density characteristically included reduction or elimination of above ground shrubs and small trees (poles and smaller) with retention of most larger conifers and hardwoods. Within this low-to-moderate disturbance pattern, several "gaps" were created by small scale intense flareups. Gaps range in size from a few trees to several acres in size. Approximately 18 percent of the burned area within the watershed experienced a high-intensity or "stand replacement" burn, where virtually all above-ground biomass was killed.

Successful artificial regeneration of managed stands combined with varying quantities of naturally-regenerated hardwoods and conifers in these stands generally results in early crown closure, recession of live crowns and greatly reduced diameter growth. Current high basal area levels and reduced growth in those natural stands where fire has been excluded may reflect the results of recent fire management policy. Basal area would be reduced if fires were allowed to burn, favoring within-stand diversity and more rapid development of a large tree component.

Patch Size and Distribution

The forested portion of the watershed is a patchwork of different age and size classes, influenced by natural process and human activity. Most mature and old growth patches exist on cooler aspects and riparian areas where fire is less frequent and has typically burned at lower intensities. Size and distribution of forest patches within the watershed suggest both geologic influences as well as the randomness, variability, intensity and time interval between past disturbance events.

Average patch sizes within the watershed do not appear to increase with age. Typically, the reverse is true, as contrasting characteristics between adjacent stands become less distinct following a prolonged disturbance-free period. A by-product of the 1987 fires, resulting from variation in burn intensity, was to increase the contrast between adjacent patches and within previously- existing patches. As a result, many larger forest patches that existed prior to the fires were dissected into smaller patches. At the same time, vegetative diversity increased, as wide variations in stand density, vertical structure, presence of canopy gaps and species composition occurred as a result of fire.

When patch sizes for all seral stages are examined collectively, smaller patch sizes (less than 10 acres) predominate, accounting for frequency of nearly 98 percent. However, larger patch sizes account for a higher proportion of acres. For example, a size class of greater than 100 acres is represented by less than one percent of total patches but occupies 27 percent of the watershed area. Patches ranging between 11 and 100 acres occupy just over one percent of total patches but also occupy 27 of the watershed area.

High-intensity large-scale disturbances have tended to produce larger more homogeneous patches over time in locations where subsequent disturbance has been lacking or has been of a low intensity. Other influences on patch size and distribution are geologic, as in serpentine and peridotite soils which tend to produce a more steady-state vegetation pattern that is less-affected by periodic disturbance.

The cumulative effect of several thousand acres of dispersed managed stands has been to change vegetative patterns and to create additional "edge", or interface between adjacent stands of older and younger trees. In the process, patch size of some late seral stands have been reduced by the presence of staggered harvest blocks. In other instances, all of the previous mature patch has reverted to the pioneer stage. Most harvest blocks range from 10 to 60 acres in size, within the general range of historic disturbance events but considerably smaller than the larger patches typically created by infrequent stand replacement fires.

Summary of Management Recommendations, Opportunities and Findings (Vegetation):

Condition/Trend: Fire regime has been altered from frequent low-to-moderate intensity toward a predisposition for high-intensity fires. Continued fire suppression exacerbates this condition.

Objective: Reduce the risk of high-intensity fire that threatens high-value resources.

Locations Areas not affected by Silver and Galice fires, primarily in the eastern half of the watershed.

Options: Restore fire regime and/or fuel profile to presettlement range of variability.

Condition/Trend: A reduction in mature/late seral stands has occurred during the past 40 years, while proportion of younger-aged stands has increased.

Objective: Restore a balance of conditions that resembles presettlement conditions.

Locations: All sub-basins.

Options: Preference for treating stands in the early and mid age/size class. Use thinnings and other vegetation management techniques such as release and fertilization to promote development of healthy stands that are more resilient to catastrophic disturbance. Consider use of prescribed fire where appropriate.

Condition/Trend: Existence of unnatural patterns of landscape scale, such as seral/structural condition and fragmentation of mature forest patches.

Objective: Encourage development of historic range of patch sizes for older and younger forest habitats, particularly large interior older forest patches.

Locations: North Fork, Middle Silver and Upper Silver sub-basins.

Options: Minimize further fragmentation of remaining older forest patches from high intensity fire or harvest.

Condition/Trend: High density stands are susceptible to large-scale losses from insects and drought. Accumulation of dead material increases susceptibility to intense wildfire.

Objective: Increase stand vigor and reduce susceptibility to large-scale losses.

Location: All sub-basins.

Options: Thinning, with removal or treatment of small-medium diameter fuels. Consider appropriate fuels treatments, including prescribed burning where risk of damage to residual stand is low.

Condition/Trend: A high percentage of young stands have reached their "carrying capacity" as a result of dense stocking or effects of heavy brush and hardwood competition.

Objective: Accelerate growth and development of young stands toward late seral or old growth conditions.

Location: Primarily North Fork, Middle Silver and Upper Silver sub-basins. Also includes young stands within Silver Recovery Area reforested between 1990 and 1992.

Options: Thinning and release of young stands; fertilization where site and vegetation conditions are appropriate.

Condition/Trend: Port-Orford-cedar (POC) contributes to shade and structure in some riparian areas. Known Phytopthora infection is confined to the main stem of Silver Creek. Risk of infection is highest in roaded areas where POC populations occur within or adjacent to human activity centers.

Objective: Lower the risk of infection.

Locations: All forest roads within Silver watershed with adjacent POC populations. All sub-basins are included with the exception of Lower Silver sub-basin.

Options: (1) During the wet season, consider closing roads that are adjacent to at-risk POC populations. (2) Remove roads. (3) Remove host along roads that are kept open. (4) For protection of existing uninfected but at-risk populations, upgrade stream fords in order to prevent direct contact of vehicles with flowing water. (4) Isolate infection centers by removing adjacent host.

FIRE HISTORY

General Overview

Fire has always been an integral part of the forest ecosystem in southwestern Oregon, and the Siskiyou National Forest, which have had a long history of wildfire occurrence (Payne 1983, Haefner 1975, Cooper 1939, Morris 1934). In the warm-temperate, dry-summer, "Mediterranean" climate of the Siskiyou Mountains, the forests are easily set afire; and fires of widely varying intensities have been frequent (Whittaker 1960). Morris (1934), reporting on written accounts of major fire occurrence years in Oregon from the 1840's to the 1933 Tillamook Fire, notes fires in the southwestern Oregon area in the years 1853, 1857, 1864, 1867, 1868, and 1902. Soon after the establishment of the Siskiyou National Forest (1907), 179,000 acres burned in 1917 and 152,000 acres burned the following year. A total of 50,800 acres burned in 1938. Fires in 1987 were the third worst on record (Silver Fire-96,540 acres, Galice Fire-21,331 acres, & Longwood Fire-9,916 acres).

The distribution of fire in this Forest is extremely variable. There are places where 190-year-old trees show no evidence of fire. At the other extreme, a ponderosa pine had 11 scars (from fires in 1814, 1826, 1833, 1843, 1866, 1881, 1892, 1902, 1910, 1925, and 1980). A 30 year average fire cycle for the Mixed Conifer forest type was determined by Agee (1990) from forest survey work done in the 1940's by Andrews and Cowlin. Atzet and Wheeler (1982) determined fire cycles of 20 years for inland plant associations with cycle length increasing to 60 years or more for coastal areas. For this watershed, the natural fire cycle is between 20 and 30 years.

Atzet, Wheeler, and Gripp (1988) described the settlement period of 1820-1910 as a period when fire was forced on the land by trappers, miners, ranchers, and settlers to eliminate vegetation, drive game, enhance forage and clear land. Many of the 70 to 170 year-old age class stands on the Siskiyou are on sites burned by settlers and miners (Siskiyou Final EIS 1989). The intent was to burn off as much vegetation as possible. Burns were ignited during the driest, hottest weather possible, and were more intense than natural fires. This type of fire use by miners is believed to have occurred in this watershed (Murphy 1986).

Records from the Siskiyou National Forest give an indication of the extent of burning. Hundreds of thousands of acres burned in the early part of this century, as shown in Figure T6. After 1940, when the smokejumper base was installed at Cave Junction, significantly fewer acres burned until 1987.

Figure T6 . Number of acres burned on the Siskiyou National Forest, 1910-1989.

DECADE	ACRES BURNED
1910-1919	410369
1920-1929	60813
1930-1939	153812
1940-1949	4157
1950-1959	5805
1960-1969	4601
1970-1979	2942
1980-1989	112822
Totals	755321

Reports on the 1987 fires indicate that between 12 and 27 percent of the area within the fire perimeters burned at stand replacement intensity. Records of the Cedar Camp fire in 1937 indicate similar proportions of high intensity fire (12%) (Gripp, internal Forest Service Report).

Thus, fire frequency for prehistoric or pre-settlement times is a better reflection of the natural role of fire in the ecosystem than data from more recent times, due to the large amount of burning during the settlement era. Specific records for the previous century are not available, but U.S.G.S. reports indicate virtually all areas surveyed were burned (Leiberg, 1900). Because little is known about the severity of historic fires, reconstruction of historic proportions of seral stages is tentative. According to Native Americans, fire was used extensively for the last 10,000 years. Therefore, the recent reduction of fire is new to the ecosystem.

Indian Burning in Southwest Oregon

Restoring ecosystem function is one of the many goals of the Aquatic Conservation Strategy for Tier II Key Watersheds located in west-side owl forests. Fire is an important aspect of ecosystem function in southwest Oregon. Major plant communities are dependent on fire and other types of disturbance to successfully maintain ecosystem health (Atzet and Martin 1991). Native American communities have occupied southwest Oregon for at least the last 8000 years (Aikens 1993). During that time aboriginal groups actively "managed" portions of their environment, often using fire as a management tool. While it may be difficult to isolate Indian burning from the natural fire cycle, native Americans played an active role in maintaining fire dependent communities over time and in establishing themselves as the dominant "edge dependent species" (Bean and Lawton 1993; Lewis 1989, 1993).

There are numerous parallels between present day management objectives in fire ecology and Indian burning. Both seek to maintain an array of early to mid-seral plant communities across the landscape. Such communities provide small and big game habitat, natural fuel breaks, and for native populations various edible plant foods and materials for basketry and other technological uses. Other uses for Indian fires included hunting, crop management, insect collection, pest management, warfare, preparing foods, and clearing areas for travel (Williams 1993). Fire also recycles nutrients, provides vistas, and often destroys forest pathogens. See Williams (1993) for a recent bibliography of use of fire by native Americans.

Specific ethnographic information for the use of fire in southwest Oregon is limited (Lewis 1989). Detailed information is available for the Willamette Valley (Boyd 1986), however, and it is possible to extrapolate techniques to native populations in the Rogue Valley area based on similarities of plant communities. Plant communities that occur in northern California such as mixed brush also extend into southern Oregon and ethnographic data is available for burning by those tribes. Indian practices of burning in southwest Oregon must have functioned similar to those described for such tribes as the Miwok, Hupa, Tolowa and Wintun (Lewis 1989, 1993).

Indian burning occurred in three broadly defined plant communities in southwest Oregon: oak-grasslands, mixed brush, and forested areas. The following review is based on Lewis (1989). For a more detailed discussion see Lewis (1993).

<u>Oak-grasslands</u>: These plant communities were fired beginning as early as late July and continuing through September. This commonly occurred after spring rains. Burning initiated early growth of grasses and provided habitat for game. Burning also controlled acorn destroying insects (McCarthy 1993).

<u>Mixed brush</u>: Fires were usually initiated in the fall. The primary goal was to maintain a mosaic of early to mid-seral plant communities that functioned as small and big game habitat. Edible plant species were also produced. This mosaic created natural fuel breaks. Spring burning helped to maintain more permanent openings. Fire was also used to create seedbeds for planting of tobacco; tobacco was the only "cultivated" plant species.

<u>Forested Areas-Dry</u>: Fire was used to maintain open understories in stands dominated by Douglas fir and ponderosa pine. Fires eliminated the build up of ladder fuels that could contribute to stand replacement fires. In all cases fire provided forage for game.

<u>Forested Areas-Wet</u>: No information is reported for native burning in mesic coastal forest. However, fire was probably used to maintain "prairies" and grasslands as game habitat and to control tree encroachment.

In summary, Indian burning maintained a diversity of habitats across forested landscapes. Given the lack of specific ethnographic data for southwest Oregon it may be difficult to separate Indian burning from the natural fire regime. However, it is possible to extrapolate from areas with known data and similar plant communities to use patterns of Indian burning as a possible guide for management ignited fires. Indian ignited fires maintained the amount of "edge" or ecotones across the landscape. In this context, aboriginal peoples were the ultimate "edge loving species" (Lewis 1993). Edges are one of the most productive habitats for both plants, animals, and people. The long occupation of southwest Oregon by aboriginal peoples and their use of fire to maintain certain landscape features calls into question the idea that native peoples were passive in relation to manipulating their environments (Thomas and Anderson 1993). Given this context, the desired future condition of specific watersheds would be a mosaic of plant communities created by using both natural and human caused fire within specific management objectives.

Effective fire suppression programs have, therefore, created a relatively fire-free condition during the last half of this century. Atzet and Wheeler (1988) found few fire scars on trees in stands less than 70 years of age. Fire suppression has reduced the occurrence and the numbers of acres burned. Thomas and Agee (1986) found that fire suppression has effectively eliminated five fire-cycles in the mixed-conifer forests of southwestern Oregon. This has lengthened the fire-free period vegetation has previously experienced.

Charred snags, charcoal in the soil, even-aged stands, and fire-scarred trees are all evidence of past fires. In most cases, the year of the burn can be estimated. Fire scars are the most accurate evidence and often reveal fire frequencies and indicate intensity. Old fire boundaries can be estimated by species or age-class patterns.

Fire Frequency & Risk (Specific to Silver Creek Watershed)
An analysis of fire occurrence was made based on fire occurrence records for the Siskiyou National Forest. It included lightning and human-caused fires. Large fires within the Silver Creek Watershed include the recent Silver Fire of 1987 (97,573 acres with 23,031 of these acres burning in the watershed), and the Galice Fire, also in 1987 (21,331 acres, of which 1,256 acres burned in this watershed). During a 55-year period (1940-1994) 34 fires (.62 per year) were recorded as started in this area. Thirty-one of these fires (.56 per year) were caused by lightning and only three (.05 per year) were human-caused. 24,304 acres (47%) of the watershed has been burned by wildfire, since 1940.

Silver Creek Fire History
1940-1994

Size Class	Size Acres	Lightning fires	Human fires
A	0-.25	15	0
B	.25-9	13	3
C	10-99	2	0
D	100-299	0	0
E	300-999	0	0
F	1000-4999	0	0
G	5000+	1	0
Total Fires		31	3

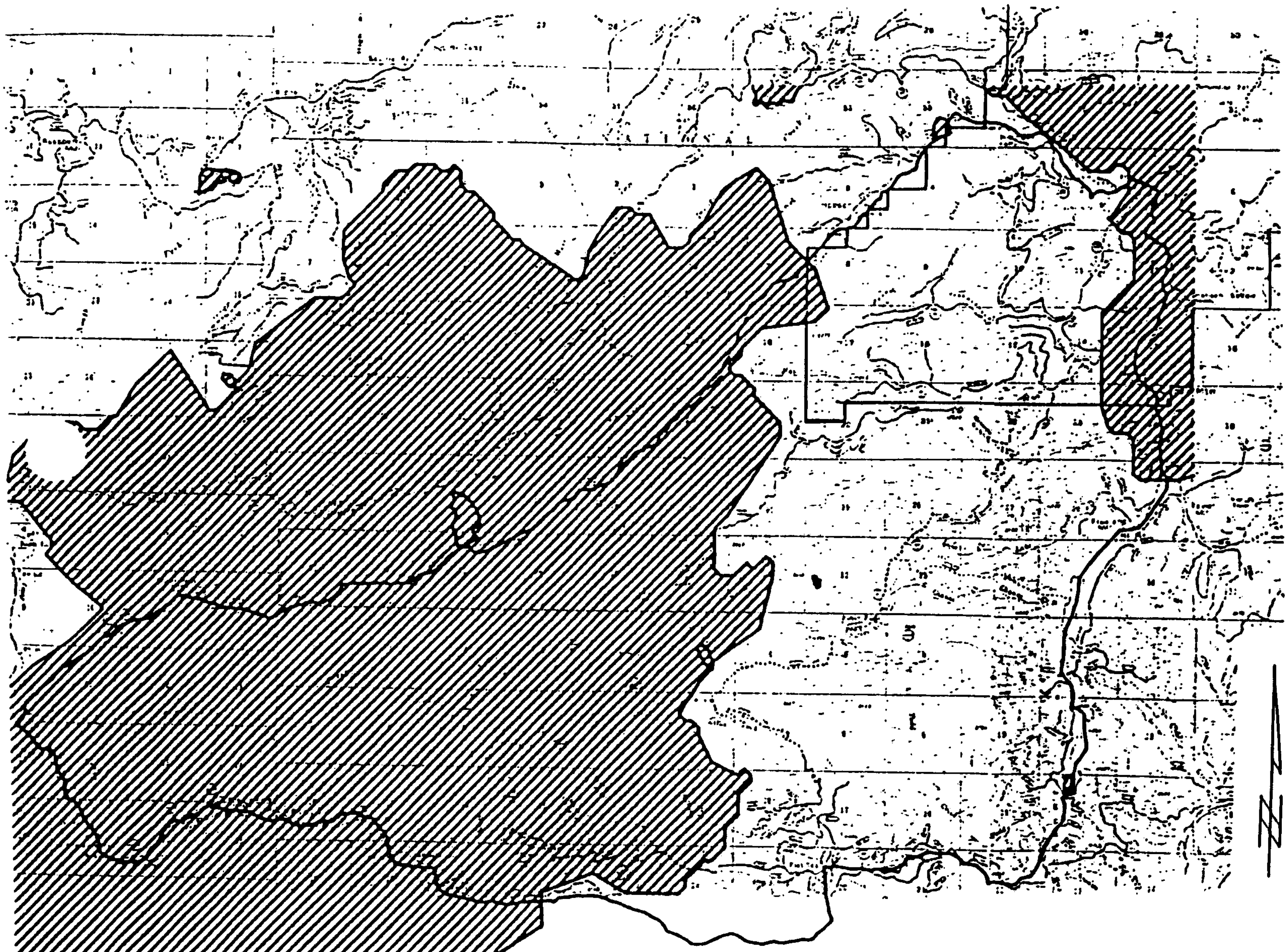
The Galice Fire, in 1987, did not start in the Silver Creek watershed, so it is not included in the above analysis.

The occurrence of a large-sized, high intensity, fire would have the greatest impact on the key issues identified. These include fish habitat, ecosystem function, and human use. An assessment of the wildfire hazard, and risk potential for large fire occurrence, was undertaken in 1990, on BLM watersheds adjacent to Silver Creek to the north and northeast. A sampling of existing fuel loading was gathered from five vegetation categories and modeled for fire behavior predictions. These predictions (Murphy, 1991) indicate the potential for large size wildfire exists in the majority of the watersheds to the north and east.

The potential for large fire occurrence in the Silver Creek watershed is moderate to high. This is a result of the vegetation, steep slopes, abundance of southerly oriented aspects, and the scarcity of road access into large portions of the area.

FIRE HIS?ORY

Silver Creek Watershed



Fire Regime, Role, and Hazard
Fire regimes are a function of environment, ignition patterns, and plant species characteristics (Agee 1990). Temperature and moisture make up the growing environment. Ignition patterns are caused by lightning and humans. Plant species characteristics are a result of adaption to fire and fuel accumulations.

Many natural stands in the watershed have two and three even-aged overstories as a result of frequent surface fires. The layered understory vegetation can contribute to high-intensity fires due to waxy-leaved shrubs and trees carrying flames into the overstory. Tanoak will sprout from the roots following intense fires, and a solid canopy of tanoak will form. If Douglas-fir is mixed in the stand it will take up to 30 or more years to outgrow and dominate the tanoak. In older stands, when Douglas-fir begins to break-up, tanoak established in the understory is released. This is occurring in many stands in the watershed and tanoak will also release following partial cutting of the overstory Douglas-fir. Very high intensity fires or successive intense fires may result in nearly pure hardwood stands.

Fire has a natural role in the vegetative community in the watershed. Vegetation adaption to fire has accounted for its persistence over time. The exclusion of fire for most of this century has created an unnatural ecosystem. Fuel has accumulated over longer periods than would occur naturally. Shrub and understory vegetation has not been "set back" as would have typically occurred and now presents an abnormal fuel ladder in many stands. The artificial exclusion of fire has altered the natural fire regime. The natural fire regime would normally create a mosaic of high, moderate, and low intensity burning. A mosaic of forest patches is created and maintained by moderate-severity regime fires. The size of these patches is largely determined by length of return interval, aspect, and slope.

Exclusion of fire can also reduce the natural mosaic pattern in vegetation heights and age classes, creating larger contiguous areas of vegetation of uniform heights and uniform fuel conditions. This creates an increase in areas experiencing similar wildfire behavior and can result in a more uniform fire intensity occurrence. Natural old growth forests typically have an uneven mosaic of size classes, which act as a buffer from catastrophic crown fires (Kauffman 1990). This buffer effect is lost as vegetation becomes more uniform.

Species diversity is reduced when disturbance is reduced. With infrequent disturbance, species composition and stand structure tends to stabilize. Climax species dominate and pioneer species are reduced or eliminated. Nature consistently introduces disturbance which maintains a diversity of both pioneer and climax species.

An additional habitat type found in the watershed are open meadows. They are important as forage areas for deer and elk. Some of the meadows, with deeper soils, will move toward open grown tree overstories, and are currently experiencing tree encroachment, due to fire exclusion.

Organic matter, in the form of large woody material and litter on the forest floor, are important to forest productivity. Fire plays an important role in the creation and loss of large woody material. Fire is the primary agent for the breakdown of large woody material in forests with fire frequencies of less than 50 years (Kauffman 1990). Fire also has a strong effect on the rate of input of woody debris into the system. Fires kill living trees creating new large woody material as they consume existing debris.

A fire in late summer or early fall can consume up to 85 percent of the debris (Kauffman and Martin 1985). Wildfires burning with much higher intensities than occurred naturally could drastically reduce the amounts of woody debris and affect the replacement cycle by also consuming sources of replacement material.

The total amount of downed woody debris in the watershed is believed to be above historic levels, while the level of large woody material is probably below historic levels. This is a result of fire suppression and exclusion. In natural (unmanaged) stands fire suppression and resulting fire exclusion has resulted in increases of total material above historic levels, as the smaller material has not been consumed by late summer/fall, naturally occurring, wildfire. Large wood in these unmanaged stands, on the other hand, has not been added to the system as rapidly as would have occurred under a natural fire regime. Managed stands in the watershed are areas which do not approximate historic levels, for both total woody debris and large wood. This is a result of clearcut harvesting, yarding of unmerchantable large woody material, and fall prescribed burning. Clearcuts within the last ten years often did not have large material yarded out, and had spring prescribed burning, which did not consume large material. These stands are closer to historic levels than older clearcuts. Consequently, large woody material is probably below historic levels in most of the watershed and total downed woody material (in the form of small diameter limbs and boles) is much above historic levels.

Organic matter, in the form of soil organic matter, litter and duff, and shrubs and trees, are important as nutrient reserves. Losses of these from fire may reduce productivity by lowering total moisture on the site and the nutrient holding capacity. A loss of 22 percent of total organic matter was reported for the Silver Fire (Silver Fire Final EIS 1988). Duff and litter levels on the study area are thin and most nutrients are held in the live vegetation (McNabb and Cromack 1990). Accumulations of litter increase with the exclusion of fire. This will increase nitrogen and organic matter on the forest floor. Frequent wildfires burn less intensely and may consume the forest floor without destroying most of the overstory or damaging the soil. Infrequent wildfire burns with higher intensities and volatilize a higher percentage of nutrients, above ground and in the soil. Because of this, frequent wildfires are considered less damaging to productivity than infrequent, more intense, conflagrations (Waring and Schlesinger 1985).

Vegetation changes from altering the fire regime include increases in the amount of tanoak, and of shade-tolerant conifer species in the understory. Species such as white fir, grand fir, and incense-cedar are fire-intolerant. They change both the horizontal and vertical structure of the forest, and can change the fire behavior and intensity level by providing an increase in flammable ladder fuels in the understory. Tanoak can successfully germinate and survive under a conifer understory and has probably increased in abundance as a result of fire exclusion. This can have a similar effect of providing an increase in fuel ladder in the understory.

Desired Condition

A reduction in the potential for large, high intensity, wildfire is desired in order to meet anadromous fish habitat and ecosystem function objectives. This potential can be reduced by vegetation manipulation to produce conditions limiting fire spread and high intensity burns, and measures to reduce human ignition sources.

Vegetation manipulation efforts would be designed to decrease fire rate of spread and reduce intensity to prevent stand replacement fire events. These efforts include stand density management, slash disposal, use of prescribed burning to reintroduce fire in natural stands, and utilization of green strips and other barriers to limit fire spread. Specific examples could be: thinning with removal or treatment of activity and accumulated natural downed woody fuels to reduce fuel ladders and fuel loadings, and increase fire tolerance; creation and maintenance of shaded fuelbreaks around key areas; understory removal or underburning to reduce ladder fuels; or, long-term maintenance of natural fire regimes through prescribed burning.

Reduction of human ignition sources primarily involves standard fire prevention efforts, as well as regulating use and limiting access, particularly during periods of high fire danger.

Botanical Resources

Existing Condition and Trends:

Much of Silver Creek watershed has never been survey for sensitive plant species. None of the FSEIS, Appendix J2 or ROD, Table C-3 species have ever been surveyed for within the watershed. The low density of roads and trails, the rough and rugged terrain, and the steep canyon walls of Silver Creek have been a deterrent to the accomplishment of botanical surveys in this watershed. These factors will continue to be a deterrent in the future. There are no Federally listed threaten or endangered plant species within the Silver Creek watershed. However, there are 6 sensitive species known to occur within the watershed: Allium bolanderi var. mirabile, Erigeron cervinus, Eriogonum lobbii, Frasera umpquaensis, Gentiana setigera, and Fritillaria glauca. Two of the species are Federal candidate species (see Figure T7) and all are category 1 or 2 listed species in the state of Oregon. Two of these species are category 1 listed species in the state of California. Several other species are category 3 or 4 listed species in the states of Oregon and/or California. Two FSEIS, Appendix J2 or ROD, Table C-3 species are known to occur from ecology plot or other data collection efforts in the watershed in the past.

Figure T7 - Rare or sensitive plant species found in Silver Creek watershed

Scientific Name	Common Name	Status		
		Fed	OR	CA
Allum bolanderi	Bolander's Onion		2	
Cypripedium californicum	Califorinia Lady Slipper		4	4
Darlingtonia californicum	Califorinia Pitcher Plant		4	4
Dicentra formosa ssp.	Oregon Bleeding Heart		4	4
Erigeron cervinus	Siskiyou Daisy		2	3
Eriogonum lobbii	Lobb's eriogonum		2	
Frasera umpquaensis	Umpqua Frasera	C2	1	1
Fritillaria glauca	Siskiyou Fritilllaria		2	
Gentiana setigera	Waldo Gentian	C2	1	1
Iris chrysophylla	Yellow-flowered Iris			4
Iris innominata	Golden Iris			4
Kalmiopsis leachiana	Kalmiopsis		4	

Lewisia cotyledon ssp.	Howell's Lewisia		4	3
Lilium bolanderi	Bolander's Lily			4
Lilium vollmeri	Vollmer's Lily			4
Montia diffusa	Branching Montia		4	
Trillium rivale	Brook Trillium			4

Status Codes: Fed - Federal list; OR - Oregon State list; CA - California State list

Record of Decision Species Found in the Silver Creek Watershed

Scientific Name	Common Name	Survey Strategy
Allotropa virgata	Candy Stick	1 and 2
Rhizopogon sp. nov. #Trappe 9432	None	1 and 3

Survey Strategies:
1. Manage known sites
2. Survey prior to activities and manage sites
3. Conduct extensive surveys and manage sites

The Silver Creek watershed is quite diverse from the botanical standpoint. With the diversity of habitats present within this watershed, the probability of discovering additional sensitive plants species or populations is high. Potential habitats for sensitive plant species would include: serpentine, non-serpentine, coniferous forest, open dry places, rock outcrops, talus, and riparian locations. The botanical diversity found in the Silver Creek watershed is, in part, related to the diverse geology in the watershed. The watershed contains a large block of gabbro (about 41 percent of watershed) that supports some rare or unique plant species populations. There is one large block of gabbro geology in Josephine County, the larger proportion of it is located in this watershed. Populations of Eriogonum lobbii, first discovered in Oregon in 1984, are only known to occur in the Silver Creek watershed and appears to be confined to soils that develop from gabbro. Serpentine geology (about 5 percent of watershed) provides dry, vernally wet, and wet habitats for serpentine endemic and non-endimic plant species. The largest populations of Darlingtonia californica found on the Galice Ranger District occur in this watershed in bog-like habitats. Bog habitats, where Darlingtonia californica often are found, are generally associated with other sensitive species as well.

A large portion of this watershed was burned during the 1987 wildfires (Silver Complex fire) and provided habitat for those sensitive plant species requiring early seral stage conditions.

The Silver Creek watershed contains many plant species, or combination of species, that are unique (not necessarily sensitive species) with respect to other Siskiyou National Forest watersheds, southwest Oregon, or the Klamath Mountain Provenance. Kalmiopsis leachiana, for which the Kalmiopsis

Wilderness Area was named, is a southwest Oregon endemic species. Good sized populations of this species can be found within the Silver Creek watershed. Leucothoe davisiae, occurring within this watershed, could be considered uncommon in southwest Oregon. It is a single-species genus found only in North America in the Klamath and high elevation Sierra Nevada Mountain Ranges. The Silver Creek watershed contains the largest stands of Picea brewerana found on the Galice Ranger District. In addition, some small-sized stands of mixed-species conifers within this watershed contain at least 10 different species. Stands within the watershed that contain more then 10 species of conifers are probable. These mixed-species conifer stands are unique to the Silver Creek watershed on the Siskiyou National Forest.

General comments:

Populations of Kalmiopsis leachiana, found in the 1987 Silver Complex Fire, are being monitored. The identification of population locations, with approximate size and associated vegetation data, is the extent of current knowledge of the sensitive plant populations within these watersheds. None of the known sensitive species populations have been monitored by any protocol approved for the species.

The populations of a species of Vaccinium (V. scoparium, also called V. myrtillus) are perhaps most plentiful within the Silver Creek Watershed, when compared with other Siskiyou National Forest watersheds. This species is associated (larva food plant) with a sensitive butterfly species, the Mariposa Copper. This Vaccinium species is considered rare in the California part of the Klamath Mountains; the majority of the populations of this species are found to the north of the Klamath Mountains. The large-sized populations found within the Silver Creek Watershed are perhaps the southern most populations that will effectively support Mariposa Copper butterfly populations.

Most of sensitive species known to occur within this watershed do not have management guidelines written for them (draft or final). With most of these sensitive species, little is known about their ecological processes, reproductive biology, long-term survival requirements, or long-term population trends. No trend data is available for any of the sensitive species found within the watershed, either within the species entire range or the populations occurring within the watershed.

One sensitive species has a final management plan written for it as part of a cooperative effort between the U.S. Forest Service and the Bureau of Land Management. This species is Frasera umpuaensis. A draft management plan is due in 1995 for Gentiana setigera. Found in these documents are management recommendations, based on current knowledge of the species, that is felt would increase the probability of their long-term survival.

One other species of concern found within the Silver Creek watershed would be Port-Orford-cedar (Chamaecyparis lawsoniana), which can be killed if infected by a root-rot fungi (Phytophthora lateralis).

Known botanical resources located on the Medford District of the Bureau of Land Management (BLM) lands within this watershed would be available to the U.S. Forest Service either directly through the BLM or the Oregon Natural Heritage Database (Biological Conservation Data or BCD). We have some knowledge of sensitive species locations on BLM managed lands through BCD. Little is known about the botanical resources on private lands found within this watershed.

Introduced Species and Noxious Weeds:

The probability is large that not all non-native grasses or other introduced species within these watersheds are known, however, there are several that have been identified.

Roadside erosion control measures in the past often used some grass species that were not native to the watershed. Introduced grass species used within the watershed were ones where seed was available for agricultural use. Seed from native grass species was not available. A mixture of grass species known as the "Siskiyou mix" was used to seed along road systems to reduce erosion and was likely applied within this watershed. This mix consisted of orchard grass (Dactylis glomerata), perennial rye (Lolium perenne), cereal rye (Lolium spp.), fawn fescue (Festuca spp.), timothy (Phleum pratense), and white Dutch clover (Trifolium repens). Large areas of the Silver Fire Complex (1987) were seeded with annual rye (Lolium multiflorum), a non-native grass seed species.

The introduction of other "weed" species has occurred in association with past activities. At least one population of yellow star thistle (Centaurea solstitialis) is known to occur along the Bald Mountain road (USFS road 2512-091). This population likely started from seed that was transported on soil remaining on heavy equipment used for road construction or timber harvest activities. This species has become a problem in dry, disturbed habitats where introduced.

Port-Orford-cedar

Port-Orford-cedar (Chamaecyparis lawsoniana) is found within the Silver Creek Watershed. Although not considered a Threatened and Endangered species, or a sensitive one, due to its susceptibility to a root-rot fungi (Phytophthora lateralis) it has recently become more of a concern. Port-Orford-cedar is known to occur, to some degree, in all the sub-watersheds. The species is highly susceptible to the root rot with little resistance known to occur.

The spores of the root-rot fungi are generally spread by water, especially flowing water. Spread of spores is more prevalent during periods of rainfall or the winter season. Port-Orford-cedar is a species associated with moist sites or riparian zones and is primarily adjacent to flowing water on the east side of the Siskiyou National Forest. The nature of Port-Orford-cedar habitat is locations where the root-rot spores can survive and are spread. Where many individual trees are adjacent to one another, below ground root grafts can spread infection from trees adjacent to flowing water to other trees some distance from them. Large number of individuals can be killed if the spores are introduced into a previously uninfested drainage.

Currently, the root-rot fungi is known only to be present in the headwaters of North Fork Silver Creek. Infection has killed Port-Orford-cedar trees in the drainage about one mile downslope from Soldier Camp Saddle on lands managed by the Medford District of the Bureau of Land Management. The location of this infection has the potential of infecting Port-Orford-cedar populations along the entire length of North Fork Silver Creek over time.

Roads that ford streams with Port-Orford-cedar found at or below the ford points with root systems within the water channel ,increse the risk of introducing or spreading root-rot infection. At at least one such ford occurs within the Silver Creek Watershed. It is located where US Forest Service Road 2512090 crosses Little Todd Creek. At this time, the Port-Orford-cedar found below this ford point are not known to be infected.

The largest concentrations of at-risk POC are located in the Chrome Ridge area, a broad north-south ridge system that forms the east boundary of the watershed. Road 2402000 is situated along this ridge and is a potential vector for infection, but risk is comparatively low due to lack of moisture during times of the year that the road is negotiable. Several intermittent streams and draws originate adjacent to the road and many have associated POC populations, as do other sites with cooler aspects. No infection sites are known to occur at this time. Prevention strategies to maintain the Chrome Ridge area in a disease-free condition should be undertaken.

A multi-organizational Port-Orford-cedar Action Plan (USDA 1988) has been written and approved in a coordinate effort to control the root-rot fungi throughout the range of Port-Orford-cedar. The Siskiyou National Forest is following this plan with respect to management of this disease.

Processes:

From a botanical standpoint, the affect of naturally occurring events or management activities on sensitive plant species would need to be evaluated at the species level for any population in, or near, an activity area. Some sensitive species benefit from early seral stage conditions created by ground disturbance or naturally occurring events (wildfire), however, many of the species known to occur within this watershed generally do not fall into this category. One species generally found in mixed conifer forests in the Klamath Mountains, Frasera umpquaensis, is found in habitats that are different than the Cascade Mountain populations. The populations are more tolerant of higher summer temperatures and are not associated with a mesic environment that the Cascade Mountain populations. One other species, Gentiana setigera, is associated with wet areas, particularly Darlingtonia californica bogs. Some species are serpentine endemics and are found only on ultramafic geology. Still others appear to be associated with gabbro geology.

The vegetative material used within this watershed in the future should be naturally occurring or native species. Care should be taken to use "local" vegetative sources of material that would be adapted to the watershed. The use of native species from non-local sources could create undesirable populations by genetically "contaminating" the local races. It may be more desirable to use short-lived, "neutral" introduced species, that could be readily identified at a site in the future, then a non-local race of a native species that could not be separated from local occurring individuals.

Reducing or eliminating introduced plant species populations would be desirable, however, other concerns should be evaluated before implementation of projects related to non-native species. With some species it could well be impossible to eliminate them altogether.

Roadways with bare soil are avenues for introduction of "weed" species and provide travel corridors for them as well. Open or bare-soil conditions along roadways should be minimized.

Another vector for introduction of noxious weeds is the use of heavy equipment previously used at locations where undesirable weed species occur. Noxious weed seed can adhere to the soil remaining on the equipment and then dislodged at forest sites if the equipment is not cleaned before entering the watershed.

Desired Condition:

The desired botanical condition would be to maintain the present botanical diversity of all native plant species within the watershed. In order to maintain or enhance populations of the many known sensitive species within the watershed, a wide range of habitat conditions would need to be maintained. The specific habitat requirements of each individual species would need to be determined and maintained within the watershed. With many species, additional habitats could not be created for them. A balance of habitats associated with different seral stage conditions would insure that a wide range of niches were available for native plant species within the watershed.

Another desired condition would be to reduce or remove completely non-native plant species from forest ecosystems. This may not be practical to achieve with all introduced species that may be present.

Restoration Activities:

The restoration activities that would benefit the botanical resources within these watersheds would be those that maintained the diversity of habitat conditions for native species now found there. With sensitive species that require early seral stage or disturbed habitats, the removal of dense canopy conditions or burning of habitats would benefit them. With those species requiring late seral stage habitat, some stands may need total protection and growth accelerated by silvicultural practices in some younger stands.

The final management guidelines for Frasera umpquaensis has identified selected populations that are critical to maintain the genetic viability of the species. All Siskiyou National Forest populations are "selected" populations. As such, the conservation strategy calls for no further human-caused impacts, such as logging and recreational structures (trails, campgrounds, etc). Further, the strategy calls for up to 600 foot buffers around populations to minimize edge effect and protect potential habitat; these populations may well be sensitive to temperature and relative humidity changes.

Some plant species within this watershed are dependent on habitats with frequent wildfire (Kalmiopsis leachiana, as an example). Fire prevention measures have allowed for habitat conditions much different from those of the past. The reintroduction of fire would be desirable and help to create habitat conditions somewhat equivalent to those of the past.

Restoring or maintaining populations of sensitive species with no management plans would have to be based on our best knowledge of the species. With these species, summarizing what is known about the biology of the species would be a beginning. The best activity for sensitive species with little or no biological data would be to monitor populations to learn more about them and to collect trend information.

Although it would appear to be desirable to eliminate all introduced species, this condition is not practical to obtain. Some introduced botanical species may be beneficial in some ways, or neutral, and could remain without serious long-term affects to native species.

It would be desirable to greatly reduce or attempted to eliminate some recently introduced problem species while their populations are still small, such as yellow star thistle (Centaurea solstitialis). With this species an insect biological control is known and approved for release into thistle populations. The insects have been released in yellow star thistle populations in other watersheds on the Galice Ranger District and could be considered for this watershed as well. Other treatment possibilities are pulling, cutting, or covering with black plastic, depending on the population size and location.

Other species, such as bull thistle (Cirsium vulgare) and Canada thistle (Cirsium arvense), probably occur throughout the watershed in small populations. It would be desirable to treat concentrated populations of these species where they occur, but it is unlikely they could be eradicated altogether due to unknown individuals or small populations. Concentrations of these species could be pulled or covered with black plastic to reduce their occurrence.

It is recommended that any heavy equipment to be used for restoration projects be cleaned of any loose soil and mud to greatly reduce the probability of transporting undesirable "weed" species to forest sites.

Native grass seed should be used for all restoration projects, however, it is unlikely that large amounts of native grass seed will become available for many years. An alternative to lack of native grass seed would be to identify collection locations where large populations of native species are located and could be collect. Collected ripe seed heads could be spread at the desired restoration locations.

Any native or non-native species seed lots used for restoration within the watershed should be those that are certified containing no or minute amounts of "weed" species to prevent further introduction of undesirable plant species.

In order to advance the use of native grass species for restoration projects, it is recommended that some allocations of restoration funds be used for native grass seed work that would include collecting and sowing of native grass seed.

Question Number 5

What are the measurable factors that affect Silver Creek Watershed's ability to sustain Threatened and Endangered species? Some of the factors are vegetation, seral stage, patch size, patch distribution, T&E species present, special sites used by these species (non-vegetative habitats), and the influences of adjacent watersheds and the connections between them (Provenance level). How can habitat be improved?

No declared Federal Threatened and Endangered plant species occur within the Silver Creek Watershed, however, two federal candidate species are found, along with many species listed as endangered and threatened by the Oregon Natural Heritage Program (Vroman 1995). These species are collectively known as "sensitive species." The occurrence of FSEIS, Appendix J2 or ROD, Table C-3 species have not been determined for this watershed; surveys have yet to be undertaken for them. However, two species, Allotropa virgata (saprophytic plant) and an unnamed Rhizopogon species (a false truffle recently discovered within the watershed) are known to occur. The presence of many ROD, Table C-3 species within Silver Creek Watershed is highly probable. Habitat requirements for those sensitive species known to occur differ widely, therefore, the measurable factors to sustain populations do as well. With many of these species little is known about their ecological processes, reproductive biology and the other requirements for long-term survival. Our best judgement should be used to determine what should be measured with these species. No single, dominate factor can be used to determine long-term survival of any one species; several must be considered. The maintainence of sensitive species habitat would be a method of sustaining existing populations.

An evaluation process should be undertaken and a scientifically-based monitoring plan developed for each species and population before implementation of management practices that might affect populations. The lack of knowledge about the sensitive species found within the watershed makes it difficult to impossible to determine what might be done to improve habitat conditions. Some species are closely associated with gabbro or serpentine habitats. The Silver Creek Watershed contains a large, continuous block of gabbro geology (over 41 percent), the largest geology type in the watershed. This large block of gabbro could support some sensitive species populations yet to be identified. Serpentine habitats are locations where large numbers of unique or endemic plant species are generally found (Kruckeberg 1984). Serpentine associated species are limited by the overall amount of ultramafic geology and favorable micro-habitats available. The serpentine geology within Silver Creek Watershed is somewhat isolated from other expanses of serpentine. This could isolate endemic plant populations found here from other populations and limit gene flow. Protection and conservation of gabbro and serpentine habitats in the watershed, with unique plant communities or suitable habitat features, are perhaps the best management strategies until we have better knowledge to manage individual species.

The recent wildfire (1987 Silver Complex) has probably improved habitat conditions for some early seral stage sensitive plant species found within the watershed. The practice of harvest with removal of material, then burning to reduce fuel loads, may not mimic or duplicate those habitat conditions created by wildfire that a sensitive species would require (Agee 1991). The majority of the wildfire area had never been surveyed for sensitive plant species prior to the wildfire, therefore, little opportunity was available to compare population data before and after the wildfire. Some sensitive plant species populations were located following the wildfire.

With some species, particularly Frasera umpquaensis, an increase of late-seral stage stand conditions would increase the quality and quantity of functional habitat for the species.

One species known to occur within the watershed, Gentiana setigera, is a bog or wet area related species. Not degrading bogs or wet area habitats suitable for this species would help to insure its long-term survival. This species is sometime associated with Darlingtonia californica in this area.

Question Number 6

What are the factors that sustain a genetically diverse and demographically healthy population of plant and animal species? Connections between adjacent watersheds will also be considered (Province level needs).

The subject of sustaining healthy plant populations is complex; numerous books have been written on plant and animal genetics and population biology. This brief document will only touch the surface of the subject. Species that occur in small populations with low numbers of individuals are of high concern. Such species and populations are found in the Silver Creek Watershed, particularly some of the sensitive plant species.

The Silver Creek Watershed is contained in the Klamath Mountains of southwest Oregon. Southwest Oregon is a region with complex geology, topography and climate where interactions over time have allowed the development of extremely diverse and complex plant communities (Franklin and Dyrness 1973). These complexities have created countless habitat conditions of various scale and large arrays of plants species in the Silver Creek Watershed. Many species found here are considered indigenous to the Klamath Mountains or this region of southwest Oregon. The Silver Creek Watershed typically contains the biological diversity of the Klamath Mountain Provenance in general.

The nature of this diverse landscape has allowed for the development of small, somewhat isolated populations of many plant species. These small populations of different species are part of the overall botanical diversity within the watershed. Small, isolated populations are significant when considering species genetics, breeding structure, evolutionary dynamics and conservation biology (Barrett and Kohn 1991). Therefore, most of our concern for sustaining sensitive plant populations tends to focus on small populations. Within small populations, the loss of genetic variation is thought to reduce the ability of a species to adapt to changing environments and increases their susceptibility to pest and disease pressures.

Four evolutionary forces interact with any population of individuals. These factors are: Mutation, migration, natural selection, and random genetic drift (Wilson and Bossert 1971, Wright 1976).

Mutation: The ultimate source of variation. A mutation is a heritable change in the genetic makeup of an organism, usually at the gene level. Most mutations are deleterious, but some are beneficial in a given environment and remain in a population. It is the ultimate source of genetic variation.

Migration: Another action within a population that increases variation. It is the migration of genetic material from one population to another. It can introduce genetic material into a different population or change the frequency of occurrence of genes in a population.

Natural selection: A strong force that usually reduces variation. Natural selection favors the fittest individuals that are best suited to an environment. It determines which individuals remain in a population to reproduce.

Random genetic drift: Another action within a population that reduces variation. It is a change in gene frequency and population characteristics due to chance lose of a gene rather then by natural selection.

With small, isolated populations the factor of random genetic drift is the dominant influence in the populations. These populations tend to lose variation more readily than larger, wide-spread populations and are more prone to local extinction. Species with small populations known to have suffered recent reductions in distribution and abundance are more likely to be threatened by the loss of genetic diversity than are those that have always been rare, but otherwise stable (Huenneke 1991). This indicates the importance of maintaining distribution and abundance levels with species with small populations. In addition, reductions in distribution and abundance subjects a species to a higher probability of lose by a eographically large catastrophic event (wildfire, volcanic eruption and others).

To manage small populations of a plant species a variety of life-history characteristics, such as: Geographical range, life form, mode of reproduction, breeding system, seed dispersal mechanism and successional status, need to be analyzed in relation to the distribution and abundance of genetic variation in the plant population (Hamrick and others 1991). With the majority of those sensitive plant species, with small distributions and populations, occurring in the Silver Creek Watershed there is a lack of life-history data.

Sustaining genetically diverse and demographically healthy populations of plants and animals are only possible when habitat and other life-history requirements are provided for at the species level. Another important factor in sustaining healthy populations of species (especially sensitive species or small-sized populations) is long-term monitoring that would establish population trends. Most all sensitive plant populations known to occur within the Silver Creek Watershed are not being monitoring either long-term or systematically.

Wildlife

Figure T8 Primary and Secondary Habitat of Species of Concern (FS or OR Sensitive; Federal Threatened, Endangered or Candidate; ROD "Survey and Manage").

	Vegetative Structure "seral stage")				Habitat Component						
Species (status)	Grass/Forb (pioneer)	Shrub/Pole/Sap (early)	Young Forest (mid)	Mature or Old Growth (late)	Cave or Burrow	Cliff or Rim	Large Woody Material	Large Snags	Talus	Riparian & Stream	Trend
Mariposa copper butterfly (endemic)+	1	2	2							1	?
Southern Torrent Salamander (Federal Candidate)+			1	1					1	1	-
Clouded Salamander (OR Sensitive)+	1*	1	1	2*			1F**	2	2		-
DelNorte Salamander (OR/FS Sensitive)			1	1			2		1F		?

*1= Primary habitat . 2= Secondary habitat. +[after the species status] The species has been observed in WA #26. **F=Fragmentation of this component decreases viability either directly through edge effects or indirectly because the species cannot disperse over non-habitat areas. From ODF&W (1993) and Brown (1985). Under "Trend," a minus [-] indicates a population decline, a plus [+] indicates increase and a question mark [?] indicates an unknown trend for the species.

FigureT8. Primary and Secondary Habitat of Species of Concern (FS or OR Sensitive, Federal Threatened or Endangered, ROD "Survey and Manage").

	Vegetative Structure ("seral stage")				Habitat Component						
Species (status)	Grass/Forb (pioneer)	Shrub/Pole/Sap (early)	Young Forest (mid)	Mature or Old Growth (late)	Cave or Burrow	Cliff or Rim	Large Woody Material	Large Snags	Talus	Riparian & Stream	Trend
Tailed Frog (OR Sensitive, Fed Candidate)	2	1	1	1			1		2	1F**	-
Red-legged Frog (OR/FS Sensitive, Fed Candidate)	2		2	2						1	-
Western Toad (OR Sensitive)	1	1	2	2			1		2		-
Sharptail Snake (OR Sensitive)	1	1	1	2			1		1		?
Common Kingsnake (OR/FS Sensitive)	1	2	2				2		2		-
CA Mtn. Kingsnake (OR/FS Sensitive)+		1	1	2			2			1	-
N. Pygmy Owl (OR Sensitive)+	2	2	2	1				1		2	?

Figure T8. Primary and Secondary Habitat of Species of Concern (FS or OR Sensitive, Federal Threatened or Endangered, ROD "Survey and Manage").

	Vegetative Structure ("seral stage")				Habitat Component						
Species (status)	Grass/Forb (pioneer)	Shrub/Pole/Sap (early)	Young Forest (mid)	Mature or Old Growth (late)	Cave or Burrow	Cliff or Rim	Large Woody Material	Large Snags	Talus	Riparian & Stream	Trend
Peregrine Falcon (Endangered)+	2	2	2	2		1		2	2	2	-
Spotted Owl (Threatened)+				1F				2			-
Acorn Woodpecker (OR Sensitive)+			2	2		2	1				?
Pileated Woodpecker (OR Sensitive)+			2	1			1	1		2	-
Pallid Bat (OR Sensitive)		1	2	2	1	1		2		1	?
Fringed Myotis (OR Sensitive)	1	1		2	1	1		2		1	?
Townsend's Big-Eared Bat (OR Sensitive)		2	2		1					2	-

Figure T8. Primary and Secondary Habitat of Species of Concern (FS or OR Sensitive, Federal Threatened or Endangered, ROD "Survey and Manage").

	Vegetative Structure ("seral stage")				Habitat Component						
Species (status)	Grass/Forb (pioneer)	Shrub/Pole/Sap (early)	Young Forest (mid)	Mature or Old Growth (late)	Cave or Burrow	Cliff or Rim	Large Woody Material	Large Snags	Talus	Riparian & Stream	Trend
Western Red-Backed Vole (ROD "Survey & Manage/OR Sensitive)+			1	1F			1		2		?
Wolverine (Federal Candidate, OR Sensitive)+					1		1		1		-
Total Number of Species Needing Each Characteristic	10	12	17	15	4	4	11	7	10	11	

Question 5. What are the measurable factors that affect Silver Creek's ability to sustain Threatened and Endangered ("T&E") species? Some of these factors are vegetation, seral stage, patch size, patch distribution, the presence of T&E species or their habitat, including special sites used by these species (non-vegetative habitats), and the influence of adjacent watersheds and the connections between them (a province-level effect). How can habitat be maintained or improved?

Question 6. What are the factors that sustain a genetically diverse and demographically healthy population of plant and animal species?

Treatment of Species Types.
As is apparent from FigureT8, some species of concern use only older vegetative stages; while others cannot survive in such conditions. The same is true of animal species not known to be in decline (Question #6). Because maintaining both rare and abundant species in this watershed requires maintaining the same wide array of habitats, the effects discussed below for species of concern holds true for more common species.

While vertebrates are usually what come to mind when one thinks of "animals," the ecosystem's ability to function also depends on invertebrate animals, including insects, spiders and other Arachnids, molluscs, and subterranean invertebrates. "...Many species play crucial and diverse ecological roles... including decomposers of organic material for replenishment of soils, pollinators of flowering plants, and prey for a wide variety of other invertebrates and vertebrates" (p. 267, SAT 1993). It is assumed that these lesser known species also need the array of habitat conditions with which the watershed evolved, in order to sustain genetically diverse and demographically healthy populations.

Neotropical Migrant Songbirds
Species not recognized as having special status by agencies, but which should be mentioned include songbirds found in this watershed and which have shown statistically significant declines over the last 2 decades in Oregon (PIF 1995). They are not represented by any one habitat type and the effects discussed below hold true for them, too. However, they do appear to be more dependent on grass/forb, mature/old growth and large, woody debris than on other habitat types (Brown et al. 1985).

Large Tree Guild.
As shown by Figure T8, habitat types produced by big trees (generally 22" in diameter as a minimum) are important to many species. These habitat types are large, woody material, large snags, and mature/old growth vegetative structure. They form the primary habitat for 13 out of the 20 species in Table N and they include secondary habitat for all the rest except 4 species. These species could be said to comprise a guild of species dependent on large trees. Forestry practices [on private and public lands] "top the list among the human-caused factors" for the decline of species in the state of Oregon (p. III-99, ODF&W 1993) and these are habitat types most affected by forestry practices.

LARGE WOOD

The amount, distribution and decay rates of large wood are important because large wood contributes to a variety of ecosystem functions and processes. It contributes to forest productivity by serving as moisture and nutrient reservoirs and as habitat for both macro and micro-organisms. Decomposing wood eventually breaks down to become surface litter and soil organic matter. Large wood pieces contribute to the bank stability of smaller streams and improve fish habitat in the larger channels. Although we have recently come to recognize its essential roles, little is known about how large wood is distributed over time and space. More knowledge of existing natural quantities is needed to form a basis for managing the resource and maintaining these essential functions and processes.

amounts and distribution of large wood and forest litter is a function of stand history, plant association and age. If left undisturbed, climax stands would reflect natural amounts of large wood. In the Silver Creek Watershed and throughout Southwest Oregon, however, stand history has been repeatedly interupted and truncated, leaving a variety of ages within a stand reflecting the results of multiple disturbance agents, such as wind, landslides, insects, disease, and underburns. The supply of large wood over time is largely governed by the timing and nature of these disturbance events. Work by McCrimmon and Atzet (1992), has shown the mean tons/acre for this plant series to be about 35 T/A. They also show a break down of 1.6 T/A in the 3-9" class material, 6.7 T/A in the 9-20" class, and 26.9 T/A in the 20" or greater size class.

Burned Area

The Silver fire complex of 1987 burned approximately 50% of this watershed. Large wood distribution now and into the future is directly controled by that fire's behavior and the salvage operations in its wake. Few large trees, the major source of large woody material, survive post-fire in areas of high intensity burn. Although dead and dying trees will fall and contribute to the organic reserve, the total volume available is still greatly reduced and it will take decades before total organic matter returns to pre-fire levels (Amaranthus, 1988, Environmental Consequences, Silver Fire Project). Approximately 15% of the fire area burned with high intensity.

As part of the Silver Fire Recovery Project, mitigation measures were developed to ensure that adequate numbers of snags and green trees remained after salvage logging. In-service monitoring in 1988 and 1989 found that the number of trees per acre left on each of the sampled units met or exceeded the amount prescribed (Silver Fire Recovery Monitoring Report , 1990). The number of down logs per acre was found to be highly variable [illegible]en units.

Although the long-term reserve is generally reduced in these areas of greater fire intensity, some units that were salvage logged without any subsequent fuels treatment have localized excessive fuel loadings at this point in time. This condition is especially pronounced on the east-facing slopes of Bald Mountain within the South Fork Subwatershed. In this area, soils derived from Dothan Sandstone are fairly productive, occupied by the Douglas fir/ Tanoak series, and stands were dominated by large diameter conifers prior to burning at moderate and high fire intensity.

In this area, permanent photo - sample points were established by the Galice RD to chronicle residue and vegetation changes over time. Although a wide natural variation is expected for sites in this series, these data illustrate that salvaged portions of the burned area have values on the high end of the range of expected, natural fuel loadings. A high potential exists for an eventual reburn of these areas.

Unburned

In contrast to 1988 post-fire harvested areas, many units resulting from earlier timber sales have substantially lower levels of large wood than would be found following stand replacement conditions. Clearcutting did not routinely leave standing wood, alive or dead. Broadcast burning for site prep often produced high intensities which consumed even the largest diameter down wood. The impacts of past timber harvest tend to be localized. BLM-managed lands in the North Fork Subwatershed have the highest concentration of conventional clearcuts, where the large wood supply is assumed to be substantially below historic levels. The South Fork Subwatershed also has that were harvested via regeneration cuts that did not retain large woody debris.

Trends

Harvest has reduced the quantity and distribution of large size conifer in certain localized areas. The North Fork and South Fork Subwatersheds have experienced the most alterations of the large wood component. A new understanding and acceptance of the critical role of large wood in maintaining populations and forest health has developed. Stricter guidelines on federal lands for leaving large wood on site after management activities has reversed earlier trends in removing or burning this material. The ROD directs the land management agencies "to provide coarse woody debris well distributed across the landscape in a manner which meets the needs of species and provides for ecological function." (ROD Standards and guidelines C-40).

These resources form the primary habitat for nearly half the species in Figure T8, and are primary or secondary habitat for all but 5 of these species. In addition, a significant fraction of the trees cut for the salvage sales following the Silver Fire were not yarded from the units. (The cost of yarding the material would have been greater than its value, since many trees were found to be "culls" only after being cut.) This action probably greatly increased the quantity of large wood available for large-wood-dependent species in the short term. Indeed, today casual observations of the avian community in the Silver Fire area are dominated by cavity nesters.

The Influence of Fire.

Where burning was intense, the flames consumed most of the large structures present; but in most cases, the consumption was not complete (Tanner and Atzet, pers. comm.) Some stands appear to have been burned repeatedly and currently support only decadent brushfields. Fires in pre-settlement times left relatively great quantities of large, woody material and snags; and depending on their severity, thinned some areas to produce trees and thus, eventually snags of larger diameter than those that commonly resulted when fires were suppressed. The size of large wood and snags has probably been reduced somewhat by successful fire suppression.

In addition to changing the amount of large, woody material, snags and the size of the trees present in naturally forested areas, fire suppression has also probably decreased the amount of area in earliest seral stages (grass/forb and small shrub).

Fragmentation, Edge Effect and Effective Polygon Size

Discussions of fragmentation are based in part on the concept of edge effect. For any mature and old growth stand, the microclimate can change a measurable amount up to 3 tree lengths from the edge (Chen 1991). E.g., on a hot day, air temperature in a mature stand can be increased in the area of the stand that is within 400' of a road or clearcut. Edge effect is believed to affect habitat viability because a species' inability to tolerate other habitat (e.g., pole/sap) may be due in part to the microclimate of that other habitat. Parasitic (e.g., brown cowbirds, a songbird "nest parasite") and predatory species (e.g., great horned owls, predators of spotted owls) often frequent edges, and reduce or negate the viability of otherwise useful habitat.

It is of interest to know how large stands are, but edge effects can overwhelm narrow polygons (polygons in which all the area is in "edge") and make them useless to species susceptible to edge effects.

Aerial photos of the Silver Creek Watershed show that there is a high degree of natural fragmentation for habitat

. depends on good levels of productivity, e.g., mature and old growth-dependents. Those species which are susceptible to fragmentation of such habitat are probably distributed much more sparsely in this watershed compared to other watersheds with more contiguous vegetation, where greater expanses of productive habitat are a natural phenomenon. Animals in less-than-optimum habitat are at greater risk of extirpation in such a situation.

Fragmentation and Unpredictable Effects

Fragmentation also may make a local population at greater risk of extinction for 3 other reasons: random events, inbreeding and genetic drift. Some species do not disperse across expanses of non-habitat (e.g., Western red-backed vole). If the habitat patch is reduced to a small number of individuals and immigration is not possible, the population is at greater risk of extinction due to random events (e.g., fire, windstorm, disease). Genetic drift results from the random sampling of parental genes. In large populations no change in gene frequency occurs. But in very small populations, tremendous changes in genetic variation can occur with each generation (Harris 1984). Changes caused by genetic drift or inbreeding may be lethal or reduce reproduction or survival to the level that other formerly minor causes of mortality cause extinction.

So fragmentation may cause not only a change in the micro-environment of a declining or endemic species, but also affects the species' ability to cope with these changes; its resiliency.

The Fragmentation Guild

While it is of some interest to know how much habitat exists for any species at risk, the degree of fragmentation he effective size of the patch (the area unaffected by edge) is of equal importance. While probably *all* .iing species are affected to some degree by fragmentation, some species are especially subject to these effects. Especially vulnerable are the clouded salamander, the Del Norte salamander, the tailed frog, the spotted owl and the western red-backed vole.

Province-Level Importance of the Silver Creek Watershed

The role of this watershed in providing habitat for these species and others that commonly disperse over elatively short distances has importance to the viability of those species in adjacent WAs. This is true, because of the potential for isolation caused by human development and the loss of habitat; and the potential adverse ffects of isolating subpopulations. (See the discussion above on Fragmentation and Unpredictable Effects.)

Inventory and Monitoring

While the above discussion used state, provincial or regional trends; very little is actually known about the distribution, habitat quality or survival of most species of concern in this watershed. The only species for which information on distribution is known to any great degree are the spotted owl and peregrine falcon. While information is gathered annually on falcon nesting success, survival of most spotted owl individuals in this watershed and inferences on habitat quality is largely a matter of educated guesswork.

Information on distribution, habitat quality and survival of nearly all other wildlife species of concern is strictly anecdotal (e.g., a handful of accidental observations acquired over the years.) It is difficult to intelligently manage for these species or even habitat guilds of species in the absence of watershed-wide information.

Riparian guild
"Riparian zones...provide some of the most important wildlife habitat in forestlands of western Oregon.... Wildlife use is generally greater than in other habitats...." (p. 63, Brown et al. 1985). The riparian zone and stream are primary habitat for 7 of the 20 wildlife species of concern in Figure T8 and are secondary habitat for an additional 4 species. In addition to being essential for several aquatic and semi-aquatic species, riparian areas form natural connections for many other habitat types.
Non-native bullfrogs can have a negative inpact other aquatic species in Oregon, but they are not known to be present in this.

Recommendation: Before the introduction of any species not native to the area, a thorough analysis of the potential effects to native species should be undertaken. If resources are inadequate to perform such an analysis, do not introduce non-native species. The objective is to avoid the irretrievable consequences of introducing a species which adversely affects native species.

Water Quality and Temperature
Tailed frogs are dependent on the existence of very cold, clear, fast-running streams. Tailed frogs have been observed to be extremely sensitive to temperature and sediment levels and have often been eliminated from streams adjacent to clearcuts. Management that improves habitat for anadromous fish will, in general, improve conditions for tailed frogs and several other aquatic species of wildlife. Tailed frog tadpoles have been located in this watershed.

AQUATIC

WATERSHED CHARACTERIZATION

Silver Creek watershed (51,600 acres) is a key watershed.

GEOLOGY AND GEOMORPHOLOGY

The following overview of landscape formation and character is largely excerpted from the Wild and Scenic Eligibility Study completed for Silver Creek. and its tributaries in 1993.

Bedrock Geology: The lowermost, western third of the watershed is underlain by sandstone and shale of the Dothan Formation of the Jurassic Era. This Formation is widespread throughout the central and western part of the Siskiyou National Forest and throughout the California Coast Ranges (where it is known as the Franciscan Complex). Sixty percent of the watershed contains igneous rocks of the Chetco complex, including gabbro, olivine gabbro, and quartz diorite. This rock unit occurs as a broad north-south trending band about four miles wide and 35 miles long. A one mile wide band of ultramafic rocks, serpentine and peridotite, underlies the eastern divide known as Chrome Ridge (10% of the area). These rocks were added to the edge of North America by plate tectonic sand have been crushed, broken, and mineralogically altered by deep burial and the movement of the great plates.

Origin of canyon landscape: The steep, rugged terrain of the Silver watershed is similar to that of the other areas of the Klamath Mountains of northern California and southwest Oregon. The area is characterized by deeply incised streams in narrow rocky canyons, steep slopes, rock cliffs, and numerous landslides. The rugged canyon topography is a product of Pleistocene (Ice Age) glaciation. The present canyons were eroded as the land rose relative to sea level and precipitation was sometimes greater. The pre-Pleistocene landscape had perhaps half the topographic relief of today. Remnants of the earlier topography occur at Flat Top and in the upper ends of all forks of Silver Creek, especially above Silver Falls.

Much Ice Age erosion took place as very large landslides. Landslide dams ponded streams, creating lakes probably miles long. When these dams burst, severe debris floods scoured down the channels. The largest ancient landslides were many times greater than those active today. Both landslide activity and dam burst floods may have been triggerred by the occassional large earthquake. Along the bottoms of the canyons, inner gorges are the steeper toeslopes that are several hundred feet high.. The dam burst debris floods scoured loose rock from the bedrock of the canyon bottoms, incising them deeper and deeper. Many slopes above the inner gorges were periodically de-stabilized as their toeslopes were affected by inner gorge landslides. Heavy precipitation, stream cutting of canyons, and landsliding continue, but at lesser rates.

Most of Silver Creek and its tributaries have channel configurations shaped and influenced by the narrow bedrock canyon and by the landslides of the inner gorge. Areas of large wood or sediment accumulation are largely controlled by the valley and sideslope form. The confined nature and relatively steep channel gradients in Silver Creek provide stream power that is adequate to flush much of the sediment supply through its system to flatter or wider areas. These lower gradient areas are known as "critical reaches" because of their sediment storage function and importance for aquatic organisms. Channel morphology is similar to other streams formed by these geologic proceeses in the Illinois River Basin.

LARGE WOOD

What are the historical cycles and amounts of large wood in the watershed? What are the processes that deliver large wood and where do they occur in the watershed? Where have management activities changed the large wood supply below historic levels? Are there areas of concern for future wood supply? Should and can the supply of large wood be restored?

Large wood is delivered to the channels primarily by landslides, by falling from riparian areas and toeslopes, and by transport from steep tributaries. Natural landslides are numerous along the oversteepened inner gorges and steep tributaries that characterize the watershed. This topography allows for recruitment from far upslope. This "riparian influence zone" is equivalent to the area delineated as high watershed sensitivity within the fire area, or to riparian reserves that include unstable and potentially unstable lands, as defined in the ROD.

Effects of the 1987 fires on the distribution and quantity of down wood are less pronounced along riparian corridors than in upslope positions. In general the streamside areas burn less frequently and with less intensity. As a result they often support more snags and down woody material in late seral stages.

SEDIMENT

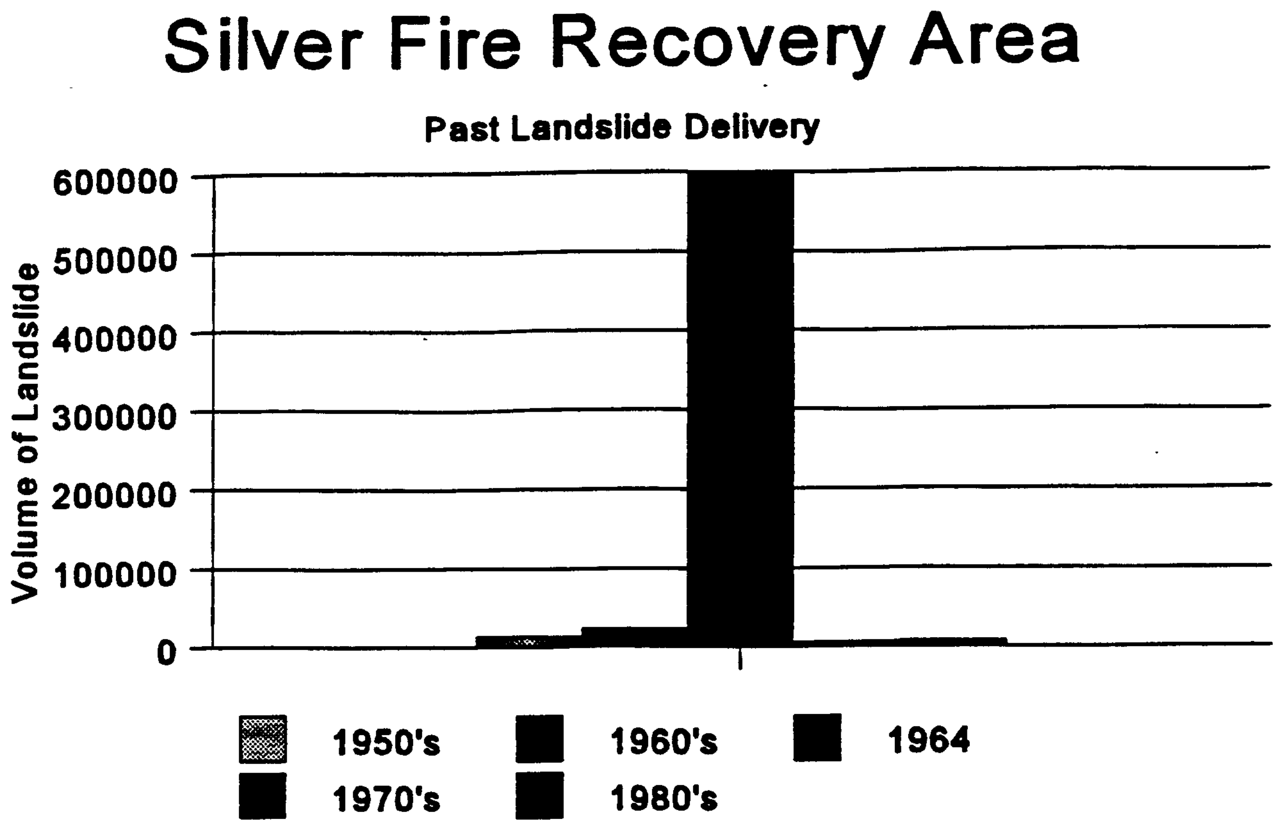
What are the processes that deliver sediment and where do they occur?

Mass failures are an important geomorphic agent of change affecting hillslope characteristics and channels in this watershed. They deliver sediment and large wood to streams. Recently active landslides are most common along gorges and steep tributaries where slopes are oversteepened, which means that the inclination of the slopes exceeds or nearly exceeds the angle of repose of soils on the slopes. In some areas, however, there has been comparatively recent landslide activity near the ridges. In the basins on the north slope of Bald Mountain, massive slumps up to half mile wide appear to have been active within the last few centuries.

Past

Estimated volumes of sediment delivered by historic landslides prior to the 1987 wildfire are shown in Figure T1 (Cornell, 1990). Although this inventory includes both Silver and Indigo Creek watersheds, historic trends for Silver Creek watershed alone would be similar. The graphed volumes also need to be corrected to reflect the discovery that photo-estimated slide depths average about 70% of field measurements. The annual landslide rate varies from virtually nothing to nearly three million cubic yards during rare events like 1964. This storm reactivated slides at the mouth of the North Fork of Silver Creek and the mile-long Philips Creek slide, each delivering about 1 million cubic yards of soil and rock. The inventoried pre-fire landslides were all naturally-occurring, except for two-three small cutbank slides along the Bald Mountain Road that did not deliver sediment.

Figure A1



Landslides outside the fire area were not inventoried, but subsequent investigation showed very few slides, all relatively small, upstream from the fire since 1940. The inventory found 63 major mass movements at 58 sites from 1940 to 1987. In 1940 there were only a few barren recent-appearing landslide scars along the inner gorges of Silver Creek. Most of these were on granitic parent materials that had retarded vegetation. Overall, pre-1940 landslide features appear to have been stable for a long time prior due to the good vegetative cover. The inner gorge slopes seem to have become more unstable since 1940, beginning in the 1950's. The cause is suspected to be recent weather patterns which included major storms in 1955 and 1964.

Nearly 80% of the landslides were classified as debris slides, fairly shallow slope failures of steep inner gorges or steep banks of draws. Most failed directly into stream bottoms. A few rockfalls occurred along rocky cliffs of the inner gorges. Most other landslides were debris torrents from the banks and upper ends (headwalls) of narrow drainages (debris chutes). Scars caused by debris torrents averageover 2,000 feet in length..

Post-Fire to Current

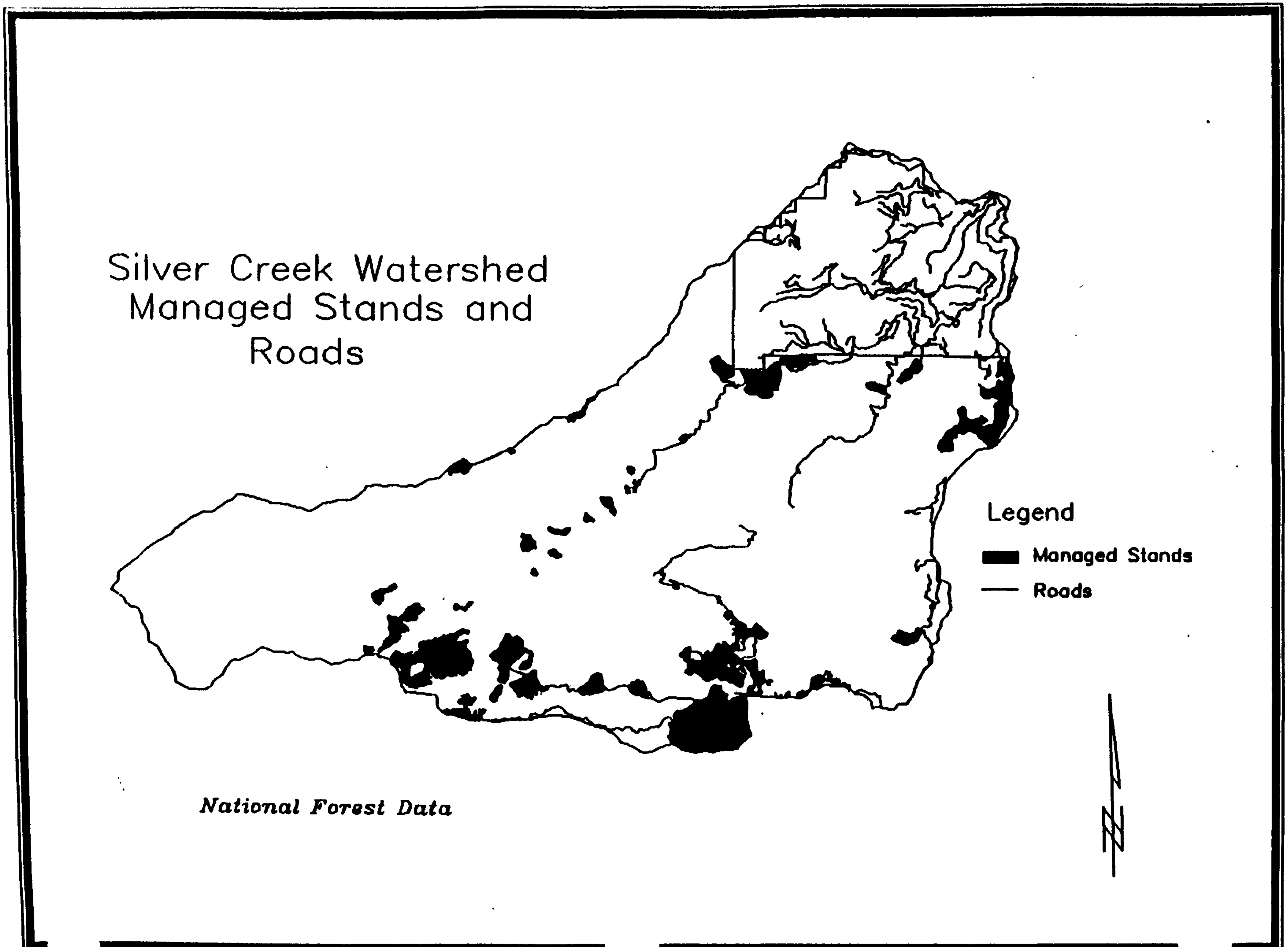
Ground traverses, helicopter flights, and aerial photos of 1987, 1988, and 1989 were used to monitor post-fire landslides. After the first heavy rains of 1987, a few streambank slides delivery volumes of 100-300 cubic yards were observed along steep tributaries (Cornell, 1990). Late in 1988 or early in 1989, a naturally occurring rock slide on Silver Creek formed a temporary lake that lasted one season (Cornell, 1989). This slide occurred upstream from the fire area, and inventory data show that such an event is not unusual. On average, two slides of comparable size occur per year in the inventoried area. The early January 1990 precipitation associated with failure of the rockslide dam, scoured banks of Silver Creek and triggered five relatively small landslides (Cornell, 1990). An overflight in April 1993, detected no new landslides within the fire area (Cornell, 1993). Landslide activity for the winter of 1994-1995 has not yet been evaluated. Channel erosion monitoring on small perennial and intermittent streams was initiated in 1988. Followup measurements on these cross-sections could help estimate the magnitude of this process following the fire.

Future

Future sediment yields from the 1987 fire area and from fire salvage activities were projected in the Silver Fire Recovery Project EIS. The landslide inventory showed that the projected delivery (based on a forest-wide landslide inventory by Amaranthus, et. Al., 1985) underestimated natural landslide volumes for the watershed. Future sediment yields were also based on assumptions about the sizes of storms that would be expected in the decade following the fire. The streamflow discussion below shows that larger storms have not yet tested these projections. Erosion rates following disturbance tend to decrease over a ten year period, as documented in Vanderheyden, et. al., 1988. The lack of large storms during this period of vegetative regrowth has likely resulted in much less erosion that was projected. Monitoring on the Longwood Fire showed that most of the surface erosion following intense wildfire occurred during the first storm, although volumes of delivered material were not measured (Amaranthus, 1988).

The interior portions of Silver basin are especially rough and remote. Consequently, alterations due to man's activities have been minimal. Natural processes have been the dominant influence, and the primary sediment sources. Management activities can aggravate these natural processes and significantly alter the timing and quantity of erosion. The potential loss of site productivity is based on increased surface erosion and mass wasting. Increased sediment yield is more likely where roads and harvest are located on high and and moderate sensitivity lands. A watershed sensitivity map was constructed for the fire area, but is not yet available for the area upstream. Because road and harvest disturbance has been concentrated in the North Fork and South Fork subwatersheds, these areas will present the most opportunities for restoration. The curent trend on public lands is toward restoring sites where past land use has adversely affected soil condition.

Roads may alter natural pathways of surface and sub-surface flows, and concentrate water. Erosion and slope failures that would not occur under natural conditions may result. The heaviest roading within National Forest lands exists off ridge systems in the headwaters of subwatersheds 3 and 4 (T36S, R9W, SEC.18, 19, W 1/2 17 & 20). Roads that were contructed after the 1964 storm, but prior to improved construction practices in the mid-1970's are of particular concern. Vegetation removal by harvest increases the potential for landslides through a decline in root strength from root decay, and a decrease in


Silver Creek Watershed
Managed Stands and
Roads
Legend
Managed Stands
Roads
National Forest Data

evapotranspiration which increases groundwater levels. Figure A2 displays the sum total of harvest history and roadconstruction to date for each of the sub-watersheds. The South Fork is the subwatershed with the highest proportion of harvest. Of this about half were treated as multiple entries during the 70's and 80's, primarily in the higher elevations of the Flattop area. The remaining units were salvage logged after the Silver fire in 1988-89 and replanted to mixed conifer in 1990 and 1991.

Figure A2

Acres of Mangaed Stands by SubWA			
Name	Acres managed	FS acres	% in managed stands
Lower Silver	162	8879	1.8
North Fork Silver	241	6932	3.5
South Fork Silver	1356	3779	35.9
Middle Fork Silver	1081	17244	6.3
Upper Silver	435	6253	7.0

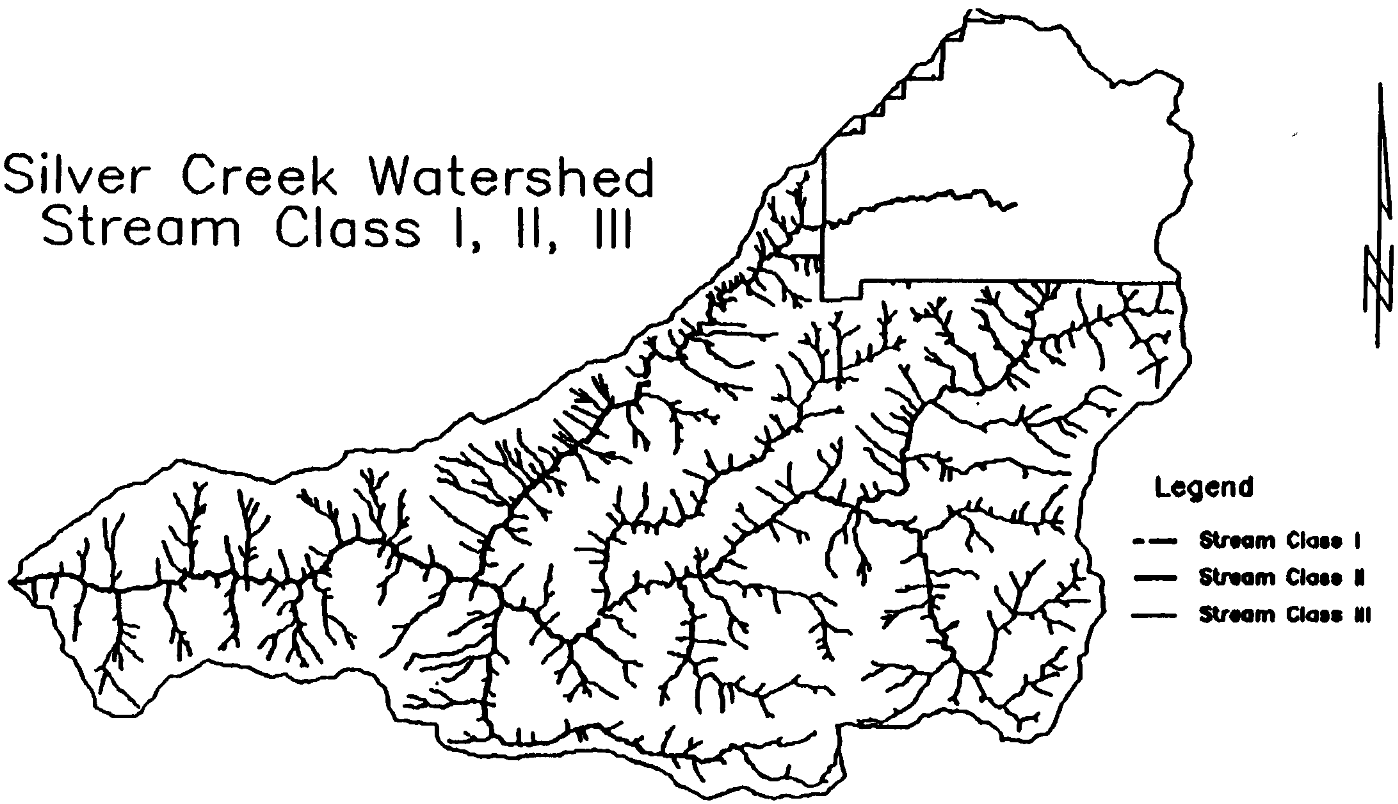
Roading by SubWA			
Name	Acres of roads	FS acres	% of NF lands roaded
Lower Silver	0	0	0
North Fork Silver	0	0	0
South Fork Silver	45	3779	1.2
Middle Fork Silver	71.2	17244	0.4
Upper Silver	28.1	6253	0.4

The potential for a high intensity reburn of the Silver Fire Area is still present, and would again increase the likelihood of landslides and erosion.

Question 10) A) What processes reduce shade and increase stream water temperature and where do they occur? B) Where have management activities increased solar exposure and stream water temperature? C) Where are fish habitats sensitive to increased stream water temperatures? D) What are the future trends in stream temperature and can they be improved?

Summer stream water temperatures are primarily influenced by streamflow, and vegetative and topographic

Silver Creek Watershed
Stream Class I, II, III



National Forest Data

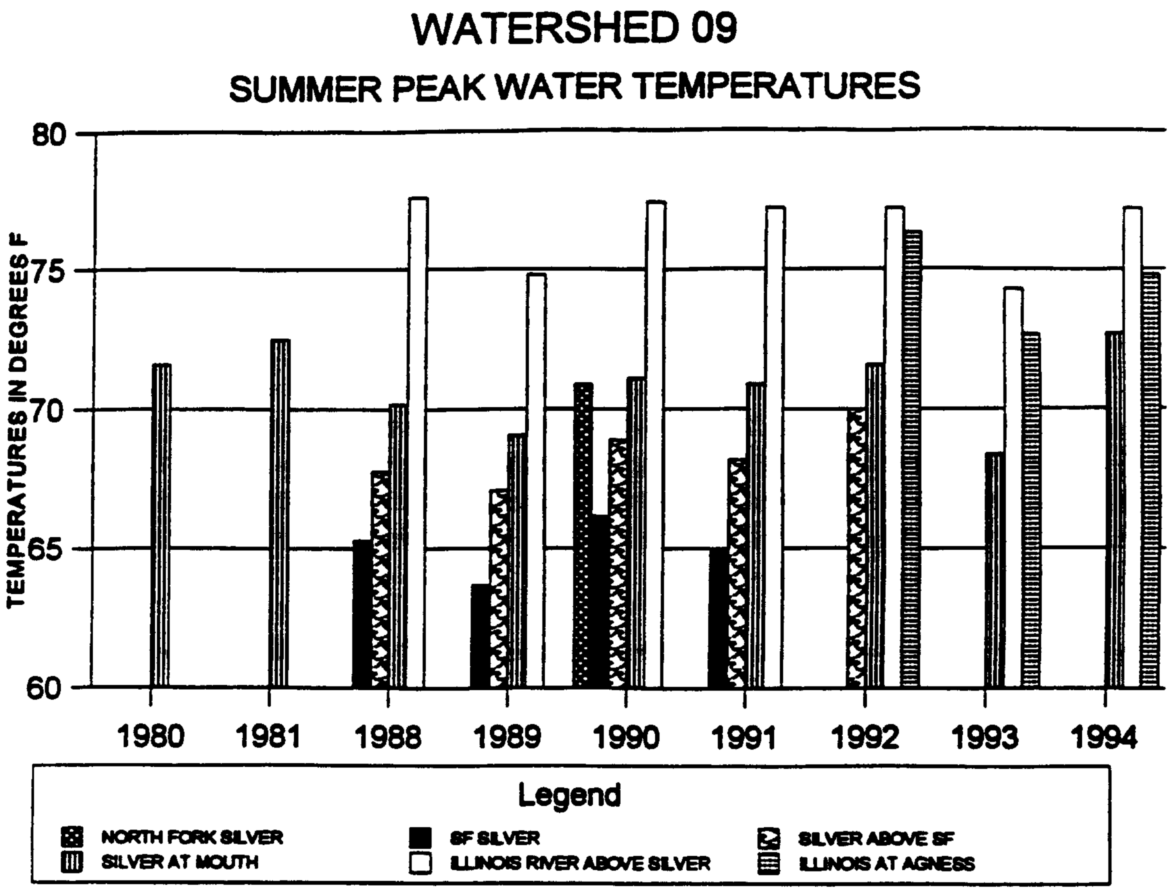
shade. Stream shading is the amount of solar radiation blocked from reaching the stream by vegetation or topographic features. Stream shade can be lost by natural processes (e.g. fire, floods) or may result from human activities (e.g.. harvest, roads, mining). The temperature of fish-bearing streams can be influenced by reducing forest canopy of riparian vegetation along headwater streams (Amaranthus, et. al., 1989). When under stress from water temperatures exceeding 70°F, salmonid fish populations may have reduced fitness, greater susceptibility to disease, decreased growth and changes in time of migration or reproduction. Growth begins to decline and eventually ceases as water temperature approaches the upper lethal limit of 75°F (Beschta et al. 1987).

Wildfire, disease, and insects are natural components of forest ecosystems which normally affect riparian condition. Disease and insect control by pesticide application, and wildfire control by suppression, may have altered processes which naturally helped shape watershed health. Upland silviculture techniques, which often include riparian areas of ephemeral, seasonal, and perennial low order streams, often culture even-aged stands which are more susceptible to high rates of loss due to wildfire and insect epidemics. Unmanaged stands which have been protected from wildfire and insect loss may exhibit high amounts of ladder or ground fuels and high levels of organic matter and biomass. Wildfire suppression may have increased the risk of disease and insect epidemic. Selected stands which burned at moderate or high intensity as a result of the 1987 Silver Fire had large connected pockets of vegetative mortality. A reburn through these areas is currently a high risk due to the high quantity of dead continuous fuels. Eight years after the fire, root strength of fire killed vegetation has weakened or failed. This has resulted in mass felling, and in some areas of the watershed, there are more fuels now than before the fire. Overall risk of catastrophic wildfire, disease, and insect epidemic, has increased in this watershed and continues to increase with time. Riparian values are at risk, especially higher in the watershed, in the smaller perennial, intermittent and ephemeral streams. A catastrophic fire, disease, or insect epidemic, in a subwatershed, could reduce riparian shade and indirectly cause temporary summer water temperature increases.

Solar radiation and convection are primary factors affecting summer stream water temperature (Levno and Rothacher, 1967). Stream discharge or flow is a factor that may modify the impacts of incident radiation thereby affecting stream temperature (Brown, 1980). Summer peak stream temperatures measured at the mouth of Silver Creek, range from 68.4° to 72.7°F. Long term temperature monitoring (1980-1994) indicates no trend of peak stream temperature increases over the last decade of drought. Seven day maximum temperatures were generally 1-3 degrees cooler than measured peaks. Natural processes have contributed to the current condition of summer stream temperatures.

There are approximately 325 miles of perennial streams (GIS, 1995) in the watershed; 56 miles are Class I and II (4068 acres of riparian reserve), 269 miles are class III (7166 acres of riparian reserve). There are also an estimated 342 miles of intermittent class IV streams (8290 acres of riparian reserve). There are a total of 19,525 acres of riparian reserve (38% of total watershed) in watershed 09.

Figure A3



The 1988-1991 macro-invertebrate studies in Silver Creek watershed indicate that the aquatic invertebrate community is in good to excellent condition. Although this suggesst that water quality is not a limiting factor for cold water fish, summer water temperatures are less than optimum for fish survival and success on the lower mainstem of Silver and North Fork Silver Creeks. Further increases in summer water temperatures could dramatically alter water quality and fish habitat in those areas. The Oregon Department of Environmental Quality has not identified any impacted beneficial uses on streams in Watershed 09.

Question 11) What management-related and natural processes have the potential to change the magnitude and frequency of stream flow?

The magnitude and frequency of stream flow varies seasonally and with climate. The floods of 1955, 1964, and 1974 had dramatic effects in watershed 09. Changes in the timing or increases in the magnitude of peak ›ws may be associated with management activity. Road surfaces and cutslopes intercept water, and road .itches act as intermittent streams, transporting water more rapidly than natural processes. These properties of roads combine to change the timing and increase the size of peak flows. The potential for effects from increased peak flows are the greatest in areas where roads route water directly into channels.

Megahan (1988) measured subsurface flow interception by roads constructed on steep, granitic slopes in Idaho and found that prior to logging, the total volume of water intercepted by the roads averaged about 35% of the total runoff for perennial study watersheds in the vicinity. This runoff is estimated to be 7 times the amount of accelerated, direct runoff from roads, which is caused by precipitation (rain and snowmelt) falling directly on the road. Post logging subsurface flow intercepted by the road was estimated to exceed direct road runoff by a factor of 18. 50% of the watershed is in the intermittent snow zone.

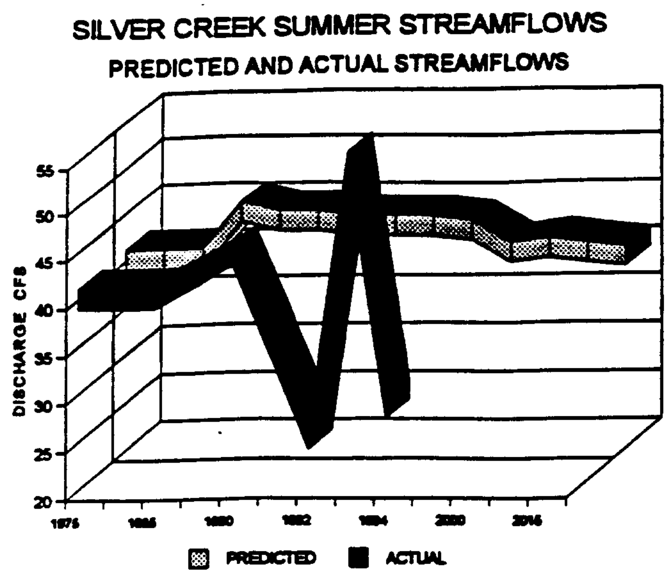
Winter flows range from 50 to 2000 cubic feet per second during events with less than a 5 year recurrence interval. Field observations indicate that bankfull stage for the geographical area occurs during the 1-3 year storm event. Seventeen foot high winter event water marks were recorded above the mouth (partially due to back flooding because of the merging of waters with the Illinois River). Portions of the watershed are in a state of recovery from public and private land management and from the effects of the 1955, 1964, and 1974 floods. Land management agencies have constructed 122 miles of road and harvested approximately 5000 acres (10% of total watershed) in the watershed during the past 40 years. It is unknown the extent that total harvest and road construction has had on the timing of peak flows during storms but it is probable that there has been some increase in peak flow. There are no flow records or documented accounts of amount of stream flow resulting from floods.

A debris flood in 1990 is attributed to a dam burst failure at "Silver Lake." The unusually high flow removed streamside vegetation and deposited small gravel bars for a distance greater than 1 mile downstream from the event.

Summer flows contribute approximately 20% of the total Illinois River flow, immediately downstream of the Silver Creek, Illinois River confluence. Silver Creek's water quality has considerable local influence on the Illinois River during summer months, due to the high proportion of flow contributed.

Southwest Oregon has been in a drought since 1985. Lower than average flows have been recorded in Siskiyou National Forest during these years. However, the effects of drought in this watershed were not as pronounced as in other watersheds monitored during the same time period. The Silver Fire of 1987 may have affected streamflow by eliminating large amounts of transpiring biomass.. Increases in water yield are associated with large wildfires (Amaranthus, et.al, 1989). Flows may have increased enough to offset some of the effects of the drought. Warmer summer weather during the same time period would allow for greater heat transfer by convection to lower flows.

Summer flows are well documented by measurements taken at the mouth of this watershed. Flows from the 1950's-1960's are similar to flows during the drought years. This supports other data indicating increases in summer flow due to vegetation loss in the fire area.



Future trends for Silver Creek regarding low flows were made in the Silver Fire EIS (1988). Predicted was a slight increase in summer flows after the fire and salvage harvest with a gradual tapering decrease until historic levels (around 40 cfs) were reached. The actual trend is one of natural and random variability, which ranges from 20-60 cfs. Increases were noted during wet years as were decreases during dry years. Summer streamflow in this watershed is highly dependent on weather, especially precipitation. Average precipitation for the watershed ranges from 80-110 inches/year (Soil Resource Inventory Isohyetal Map, 1979).

Figure A4

Question #12: A) Where are channels sensitive to increased sediment and decreased large wood? B) Is there evidence that channel morphology and sediment storage have changed from historic conditions? C) What are the expected channel morphology and storage condition trends? D) How can the channel conditions be improved?

The lowest gradient reaches in the watershed were identified as "critical reaches" in the Silver Fire EIS. Most of the main stem reaches are intermediate-sized streams with enough stream power to move and redistribute large wood. In intermediate sized streams, large in stream woody debris strongly influences the morphology of the stream channel and routing of sediment and water, and may be the principle factor in determining the characteristics of aquatic habitats (Franklin et.al, 1981).

Typically, a natural condition of health regarding large wood for an intermediate-sized stream in the Pacific Northwest, is approximately 11% of the stream area with 16% in wood-created habitat (primarily depositions of sediments behind woody material) with the remainder in nonwoody habitat (Swanson and Lienkaemper, 1976).

Sediment delivered to a stream channel may be transported or stored, depending on the amount, particle size, and timing of the input. The transportation of coarse materials by the stream changes channel equilibrium through aggradation or degradation processes. Increased sediment input may cause channel widening, abrading, storage of sediment on flood plains, in gravel bars, and within the channel causing decreased pool area (Sullivan, et.al, 1987). Massive additions of sediments from the 1964 flood have left minor long-term effects (scattered localized bars or high channel terraces,and rare aggraded reaches from debris floods and temporary lakes).

Cross sectional survey studies of 1988-1990 document no significant changes in pool or glide volume. The survey was conducted at a two critical reaches (identified by Silver Fire Recovery FEIS, 1988) where aggradation of sediments would be expected if sediment availability exceeded channel capacity. The short term data show that the stream is gradually down cutting. This indicates a good equilibrium regarding sediment transport. It was expected that the Silver Fire and Salvage activities would have some low effects regarding sediment contribution to the mainstem system.

Turbidity levels at the mouth of Silver Creek after the fire averaged a low level of 1-2 NTU (Nephelometric Turbidity Units) during non-storm periods. Soils in Silver Creek have a low percentage of fine colloidal material persisting in suspension (Silver Creek Eligibility Study, 1993). Turbidity is an indicator of sediment or dissolved solids moving through the system. These low levels of turbidity are indicators of low amounts of sediment and dissolved solids.

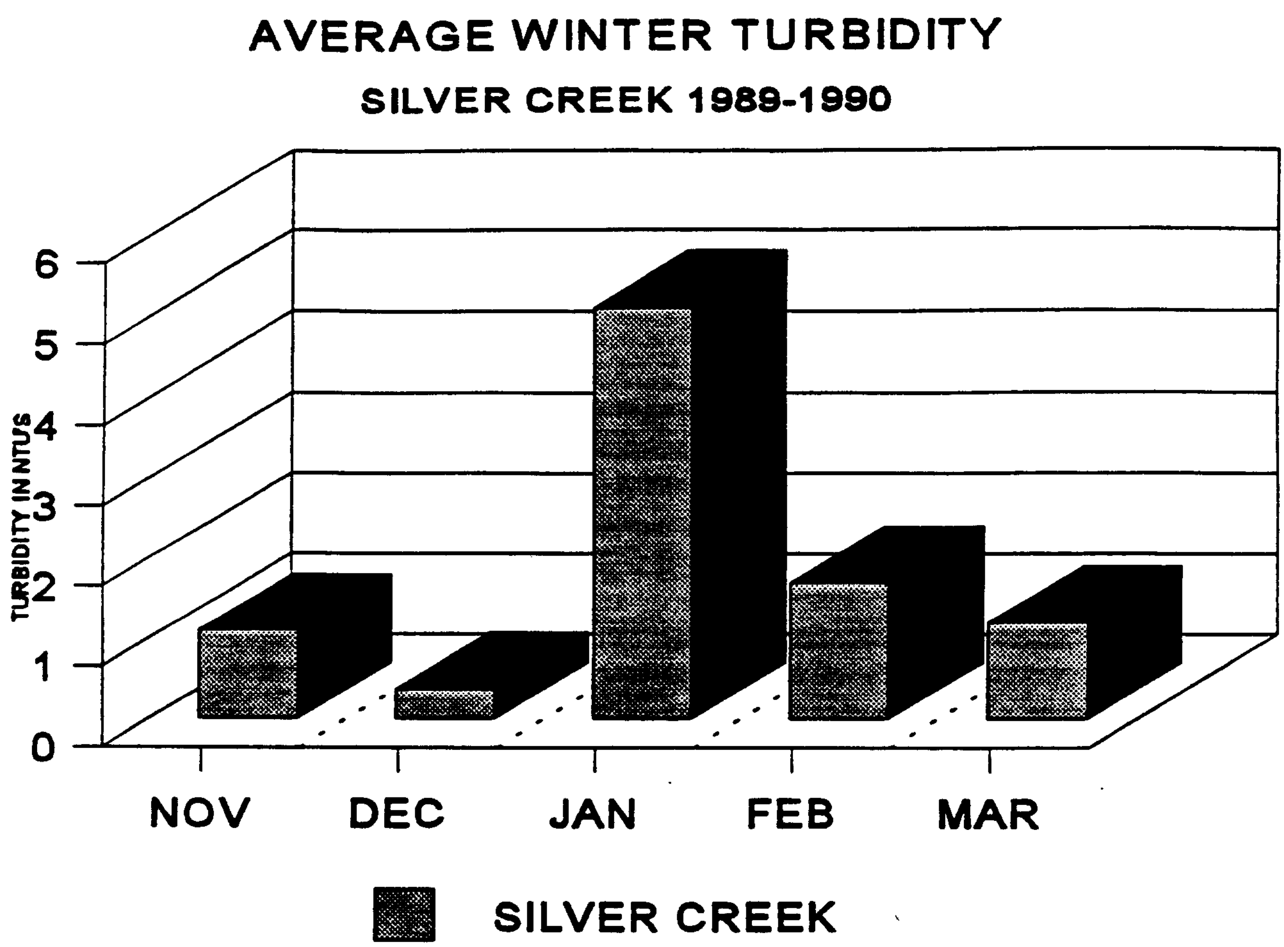


Figure A5

The cross sectional surveys and turbidity levels reflect low levels of overall sedimentation. Lower than expected levels of sedimentation can be attributed to lower than average precipitation (drought) during the period of study following the fire and salvage activity. Furthermore, it can take between one and two decades for the effects of sedimentation to be realized in critical reaches of the mainstem (Silver FEIS, 1988). Photographic observations and aerial reconnaissance flights of the remote fire area have not revealed any management or fire related sediment problems which would cause increases in turbidity or decreases in pool or glide volume with the exception of the Silver Lake dam burst debris flood, located more than 10 miles upstream in the Middle Silver subwatershed .

LOWER SILVER CREEK SUBWATERSHED

This subwatershed includes only 8879 acres, but Lower Silver Creek receives the cumulative effects of the entire watershed. Monitoring of the critical reach located in this subwatershed provided most of the watershed scale conclusions noted above. Silver Creek is a 6th order stream in this reach. The mainstem of Silver Creek flows from east to west. The tributaries are oriented mostly north or south. There are approximately 43 miles of perennial and 44 miles of intermittent streams in this subwatershed (3054 acres of riparian reserve).

The inner gorges of the canyon in the lower reaches confine and define the stream. Pools are deep (depths recorded over 30 feet) and are formed by cascades over bedrock drops and falls. Fish habitat is excellent. There is a 3/4 mile long, low gradient, "critical reach" located one mile above the mouth. Terraces exist along the canyon bottom here, but are rare. Some are elevated 20 to 100 feet above the stream. Much of this portion of the canyon is wall to wall stream during peak flows. Large wood is not the primary element for pool formation or cover. Large wood is restricted to scattered log jams between bedrock crevices or high terraces. High velocity flows and natural erosional processes are responsible for the quantity and quality of available vegetative shade. Topographic shade is the dominant value due to the steep canyon walls and narrow incised valley bottom.

This subwatershed has had no harvest or road construction. Part of the upland is in wilderness. There have been some low levels of mining (the entire mainstem above the wilderness boundary is open to mineral entry and is claimed) and trail construction (Illinois River Trail and low water foot bridge are located at the mouth in the wilderness portion of the subwatershed).. 100% of the subwatershed was involved in the Silver Fire. No harvest or salvage activities occurred. Burn intensities were: 2% High, 16% burned moderate, and 82% burned low. The Silver Fire had little effect on riparian areas along perennial streams. This subwatershed is in or near historic condition with respect to riparian shade, instream large wood, and for channel morphology factors that affect shade/stream temperature. Current shade values throughout the mainstem of this subwatershed are approximately 60% which is rated as fair (USDA, 1994).

NORTH FORK SILVER SUBWATERSHED

The North Fork Silver subwatershed is 15,232 acres, the largest tributary to the mainstem Silver Creek. The mainstem of the North Fork Silver Creek flows from northeast to southwest. The tributaries are oriented mostly east to west. There are approximately 132 miles of perennial and 137 miles of intermittent streams in this subwatershed (6025 acres of riparian reserve).

Lower North Fork Silver is naturally confined by a deep bedrock canyon. Stream velocities are very high in the lower mainstem due to confinement and high channel gradient (up to 12%). A 30 foot high waterfall five miles above the mouth ends all anadromous fish use. The lower five miles have excellent rearing conditions for anadromous fish regarding deep pool depth and cascades. Large wood averages 55 piece per mile. In 1964, one million cubic yards of soil and rock were reactivated from the landslide located at the mouth of this watershed (Silver Eligibility Study, 1994). This slide moved large boulders into the mainstem and is now unique cascade and pocket pool habitat. The slide is still active and is expected to be a long term natural contributor of sediment to the mouth of North Fork and the mainstem of Silver Creek.

This subwatershed contributes between 12 and 18 cfs of summer streamflow to the mainstem (1988-1990 Galice District hydrologic data). This is approximately 40% of total flow for Silver Creek, with a large effect on the water quality of the downstream mainstem. The lower North Fork receives the cumulative effects of all the managed lands from the upper portion. The lower end of the subwatershed is very remote and has had no direct local effects from roading or harvest. Vegetation has been affected by natural slide activity and flood. The Silver Fire burned 41% of the subwatershed mostly in the lower portion. 1% burned at a high intensity, 17% moderate, 23% low.

Current shade values through the mainstem here are approximately 50% which is rated as fair (USDA, 1994). A Forest Service study in 1990 documented North Fork Silver Creek as the warmest main tributary in the watershed (peak summer water temperature of 70.9, just .2 degrees cooler than the mouth of Silver Creek for the period of study). These are warmer than desired temperatures. The reasons for warmer temperatures are suspected to be related to management in the upper end of the watershed.

The upper portion (above the falls) has an average 4% gradient. The stream has cut a 10-25 foot wide channel with depths ranging from 2 feet (riffles) to over 15 feet (pools). Much of the streambed has been soured down to bedrock. Boulders and large woody material are abundant. Embeddedness is slight to moderate.

Four miles of BLM road #35-9-1 parallel the upper North Fork. The road restricts riparian width and shade, and alters channel morphology. Some segments of road occupy the stream channel, reducing width in some places to only 50 percent of historic width, and are subject to erosion during high stream flow (BLM, 1994). At least 8 culverts block fish movement. In addition, harvest in the 1950's removed mature and old growth conifers from over a mile of mainstem (BLM, 1994). Alder trees now occupy many of these streams and are dominant in heavily managed riparian areas. Many large conifers which survived early harvest and road construction within the floodplain were lost during the 1964 and 1974 floods, with disturbed areas primarily seeding in to red alder. The alder now constitutes a dense canopy that precludes successful establishment of native conifers. In some instances Douglas-fir stands have developed around the fringes of the alder-dominated zone, but are growing slowly as a result of competition for light. Alders use more water for evapotranspiration during hot summer months than conifers, and may be partially responsible for lower stream flows and indirectly responsible for a warming summer water trend. Summer water temperatures are 55-60 degrees F in the upper reach (BLM, 1994).

8300 acres of the subwatershed are managed by the BLM, 6932 are managed by Forest Service. The BLM has harvested approximately 1980 acres, and the Forest Service has harvested approximately 241 acres

(15% of total) over a period of 40 years. There are 62 miles of public roads (4.5 miles/square mile). Roads have been cited as the source of moderately high amounts of sedimentation. Sections 3 and 14 have the highest road densities and affect Sourgrass, Cedar Swamp, and Upper North Fork Silver Creeks. Moderate amounts of sediment embeddedness in these creeks are attributed to the roads and associated management (BLM, 1994). It is unknown the extent that harvest and road construction has had on peak flows, but it is suspected tha some increases may have occurred. Stream flows are unable to move management- related sediment in Cedar Swamp Creek and upper reaches of Sourgrass and North Fork near the headwaters (Shady Branch area).

Trends: Continued slightly lower than historic summer flows (due to riparian vegetation components demand for water consumption) and higher water volume and velocity during peak flows (due to narrowing and cutting of stream channel from road construction and increases in openings from roads and managed harvest units). Future sources of large wood are limited but current amounts are reported to be adequate (BLM, 1994). Large wood volumes are expected to decline until the conifer component returns to the riparian area. The reach that is constricted by a road will continue to have increased water velocities, transporting large wood out of the system and keeping the channel scoured to bedrock. Sediment generated from road construction, maintenance, and road water drainage will continue to be directly made available to the stream.

SOUTH FORK SILVER SUBWATERSHED

South Fork Silver Creek subwatershed includes 3779 acres. The lower reach of South Fork Silver Creek flows from south to north. The tributaries are oriented mostly east to west. The upper reach flows from east to west with tributaries oriented mostly north or south. There are a minimum of 19 miles of perennial and 21 miles of intermittent streams in this subwatershed (1413 acres of riparian reserve). Stream gradients average 5% in the lower half mile and 10% in the upper reaches.

This subwatershed was most affected by the Silver Fire (1987) and salvage activities. 68% burned with fire intensity levels of 2% high, 35% moderate, and 31% low. Most of the mainstem riparian vegetation survived the fire; salvage activities were not conducted in these areas. Several headwater streams burned at high and moderate intensities.

Summer water temperatures from a study at the mouth of South Fork Silver during a drought following the fire document low summer water temperatures.

Dramatic increases in direct solar radiation resulted in large but variable increases in summer stream temperature on headwater perennial streams affected by the Silver Fire in this subwatershed (Amaranthus, 1988). Solar radiation increases were related to a 66% shade reduction due to vegetation loss from fire in an intensely burned area. Increases in summer water temperature were not detected at the mouth of South Fork Silver Creek several miles downstream from the study site. This is possibly due to increases in groundwater resulting from widespread loss of vegetation over the fire area (groundwater was measured at 52 degrees F). The mixing of warmer low volume flows associated with the affected small perennial streams (average .055 cfs) with cooler increased flows of groundwater in the mainstem may be responsible for the lack of significant increases in summer temperature at the mouth of this subwatershed.

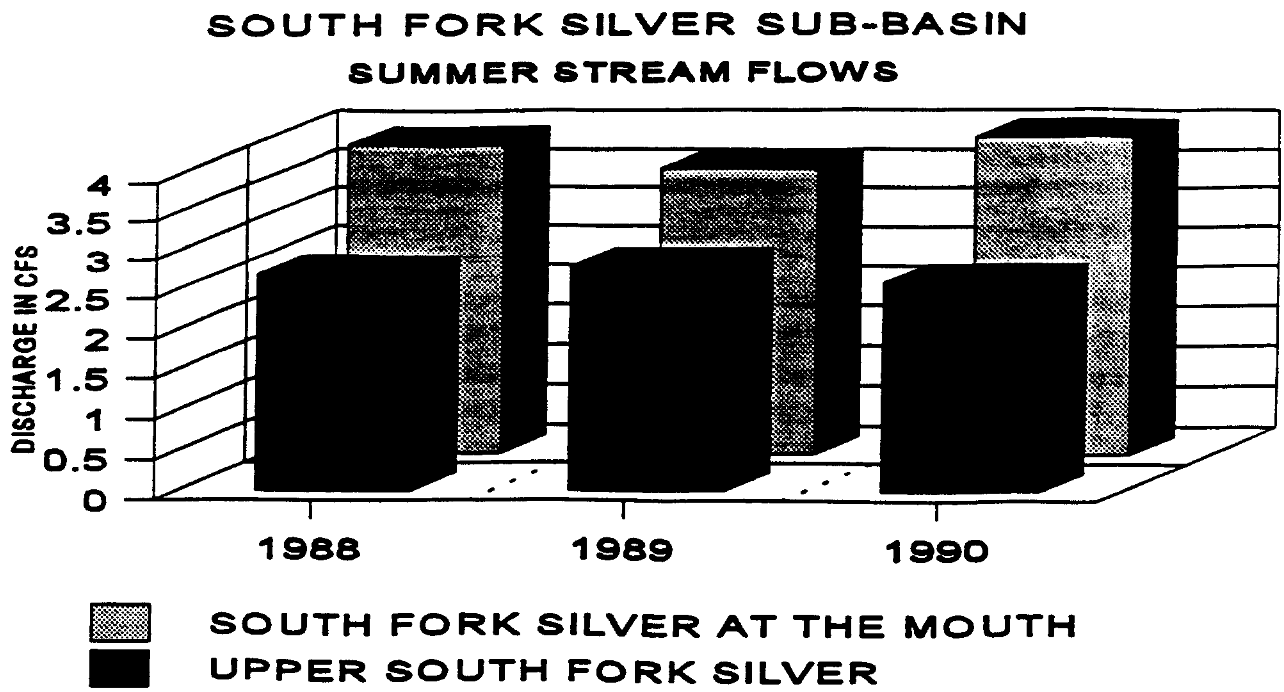


Figure A6

The expectations of increased summer flows after the fire were realized in the upper reaches during 1989. The lower portion (burned cooler) did not receive noticeable increases in summer flows until three years following the fire. Vegetation grew quickly (mostly hardwoods) during the years immediately following fire. The drought is partially responsible for masking increases in summer flow during the time period following the fire. Currently, vegetative biomass in the fire area has recovered sufficiently to restore the variable equilibrium regarding summer flows.

Large instream wood (greater than 20 pieces per mile) is at desired levels. Some upland drainages may have less than desired levels of large conifers. Large wood is an essential component of smaller order streams ability to moderate winter flow velocities. Large down wood deflects and slows stream velocities in the steeper gradient reaches found in this subwatershed. These smaller order headwater streams should be cultured with upland silviculture techniques which would encourage large conifers.

Past public management of this drainage may have affected winter stream flows. The Forest Service has harvested about 1356 acres (36% of total) over a period of 40 years.

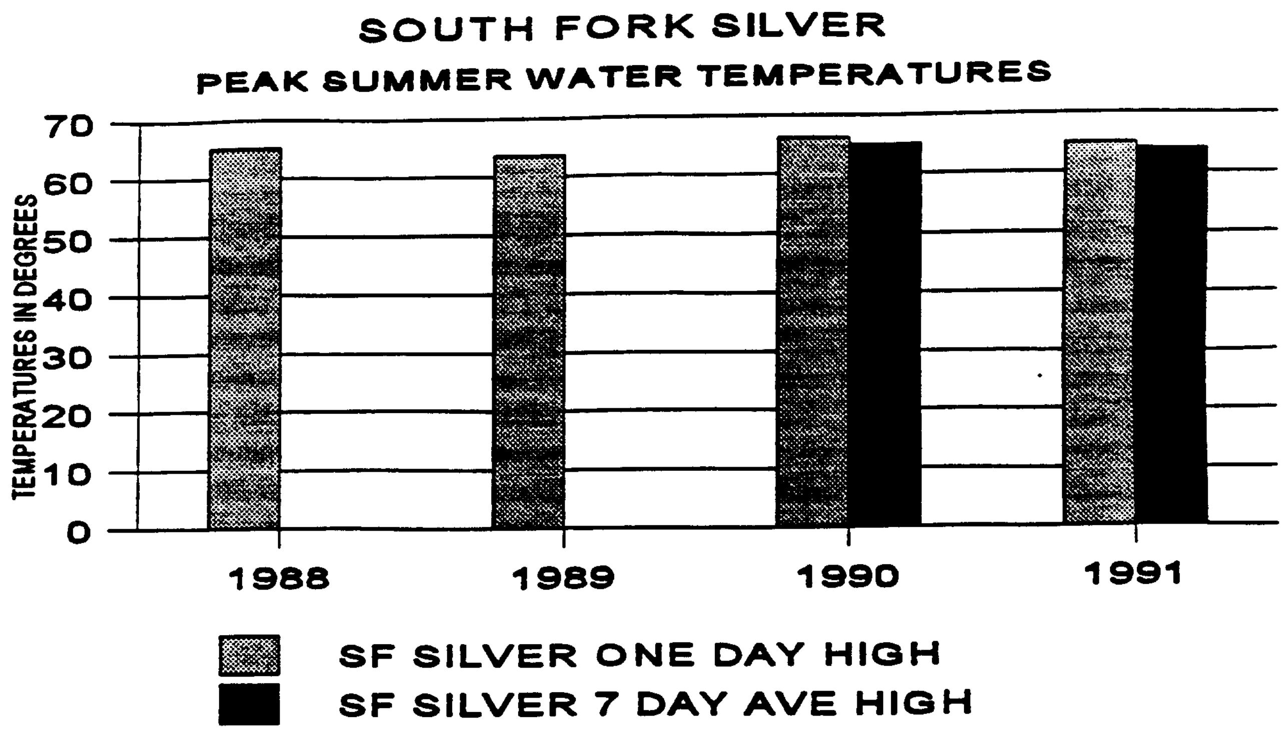


Figure A7

There are 19 miles of Forest Service roads (3.2 miles/square mile). The magnitude of increased peak flow from roads and harvest is unknown..

Cross-sectional studies in perennial headwater streams in this subwatershed from 1988-1989 documented no significant erosional or depositional changes from the combined fire and salvage activities. The study is not conclusive but is representative of the effects expected during the drought years which followed the fire. Now that vegetation has partially recovered and is established in the riparian areas throughout the fire area, it is expected that the worst case scenario of surface erosion of unprotected soils is not likely. The sites could be revisited and monitored. The information would be especially valuable after a storm with greater than a 5 year return interval.

Roads in this subwatershed contribute low amounts of sediment but do not confine the channel. Most roads are along the ridge tops and are in good condition. The Bald Mountain Road (#2512.091) is in the poorest condition. One section is a chronic maintenance problem (steep fill-slope fractures) and is slowly eroding into upper South Fork drainage. There are landings on the Chinaman Hat road (#2512.642) which puddle ıd cause rilling of side slopes and roads, or cutting of order 1 or 2 drainages.

Trends: In the headwater perennial stream study area, vegetation is recovering (predominantly hardwoods) and shade values are expected to be increasing. Perennial summer stream temperatures in the fire area are lowering as riparian vegetation continues to recover and mature. The short term large wood supply due to fire-caused mortality will increase in riparian areas. As root strength fails, large snags fall and become current sources of large wood. Harvest activities were buffered along headwater and mainstem streams. Long term supplies should replenish with natural regeneration in the fire areas although some areas have been replanted manually following salvage activities.

MIDDLE SILVER SUBWATERSHED

This subwatershed includes 17,250 acres. The mainstem of Middle Silver Creek flows from east to west. The tributaries are oriented mostly north or south. There are a minimum of 90 miles of perennial and 96 miles of intermittent streams (6225 acres of riparian reserve). This subwatershed includes the mainstem above North Fork to Silver Falls and Little Silver, Todd, and Phillips Creeks. Streamflow here is highly variable. The channels are confined and defined by steep walled canyons, bedrock, and debris from major slides (Phillips Creek and Silver Lake). Large wood in the mainstem is approximately 44 pieces per mile and is not a primary contributor to channel dynamics regarding pool formation. Large wood stockpiles in log jams and is found wedged between bedrock and large boulders or on terraces. Low flows are moderate, stream gradient is low (1-3%) and there is enough water for excellent fish habitat if water quality is maintained. Little Silver, Todd, and Little Todd Creeks are highly dependant on large wood for pool formation, sediment storage, and general stream health..

Natural processes are the primary factors affecting shade-producing riparian vegetation. Slide activity and flood, especially on Phillips Creek and the mainstem immediately below the falls, has been responsible for large or mass removal of riparian shade vegetation. It is likely that natural removal of vegetation has historically been responsible for higher than desired summer temperatures along this portion of the mainstem.

The recent dam burst flood is responsible for mass and sudden removal of mainstem riparian vegetation (especially native alders). The dam burst flood deposited boulders, cobbles, and fine sediment over one and three quarter miles of low gradient stretch. Habitat in this reach is not presently good habitat for anadromous or resident fisheries. One million cubic yards of soil and rock were reactivated during the 1964 flood from the mile long Phillips Creek slide. The low gradient stretch which has been peripherally affected on the mainstem is located downstream from Phillips Creek, and is a natural settling ground for sediments of all sizes. Due to the confinement of the channel by the steep bedrock canyons, stream velocities transport the materials through the system.

Minimal riparian management has included small amounts removed from past mining access and operations and some public harvest and road construction at the higher elevations. The Silver Fire burned 37% of the subwatershed with 2% at a high intensity, 16% moderate, 19% low. Road miles are low and most are located at or near ridge tops.

Drought during this period has resulted in slightly lower than average summer flows. The Silver Fire may have had an effect on localized streamflow when it eliminated low to moderate amounts of transpiring biomass. Flows may have increased enough to offset some of the effects of the drought. Warmer summer weather during the same time period would allow for greater heat transfer by convection to lower flows.

Peak temperatures consistently approach 70 degrees F in this area. Due to the small area involved in the Silver Fire and the low effects due to primarily low burn intensities, this subwatershed received less benefits of increased post-fire stream flow increases and more effects from drought than downstream reaches.

Past public management of this drainage may have affected winter stream flows. The Forest Service has harvested about 1081 acres (6% total), and constructed 30 miles of roads over a period of 40 years. The magnitude of increased peak flow from roads and harvest is unknown but it is expected that there has been no effect.

Placer mining is the dominant management-related short-term impactor to channel morphology. All sediment and material moved by mining, or by accelerated natural processes due to mining, during the past 100 years in this stream, was estimated as 350,000 cubic yards (approximately 2/3 of which are associated with the patented claims in the upper Silver subwatershed).

Figure A8

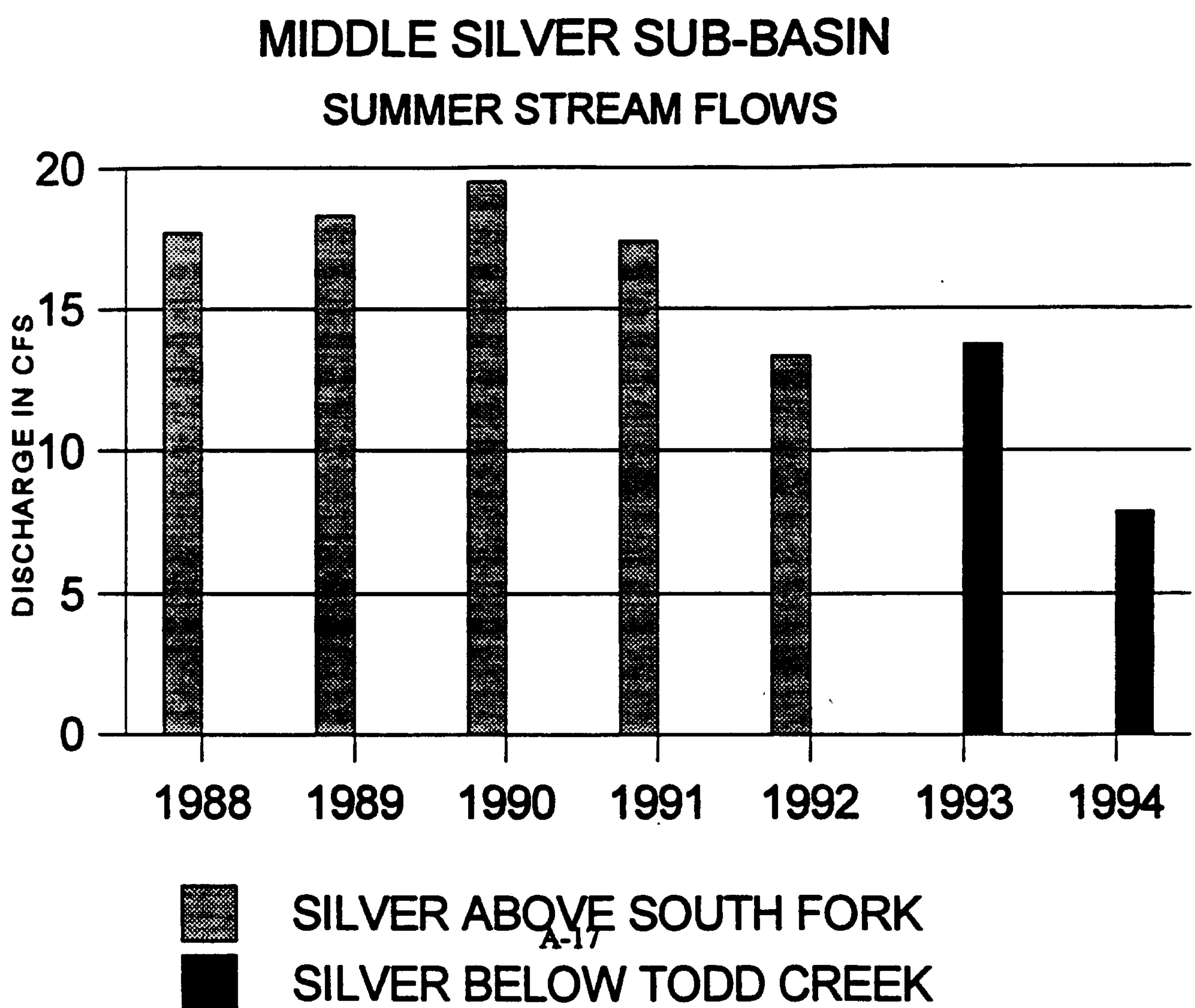
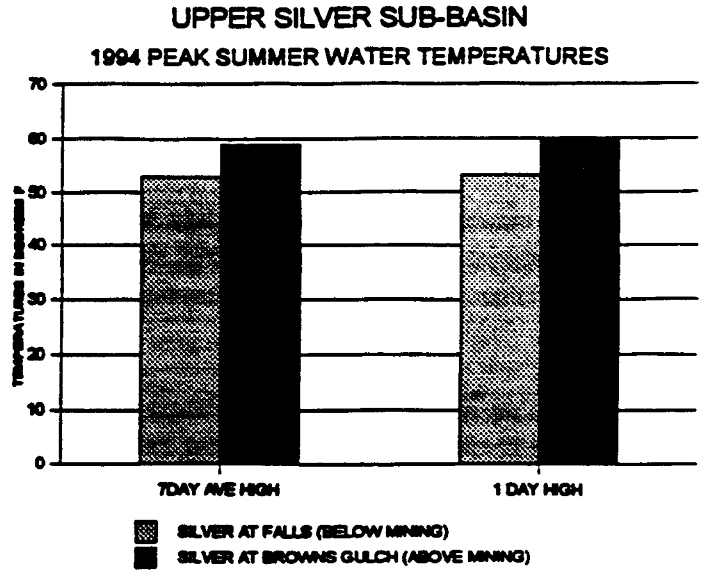


Figure A9



Several small placer operations currently dredge on the main stem Silver Creek. Most do not operate yearly, and generally operate for a few weeks during the years of operation. These are primarily recreational miners. Cumulative effects from their activities are not likely due to the small volumes of materials processed. The entire mainstem from Silver Falls to the Kalmiopsis Wilderness border (12 miles of stream) is claimed by several individuals. Claims are bought and sold; the area is open to mining and exploration under the mining law. Most of the currently active operations are in this subwatershed. Current mining activity has decreased considerably, processing approximately 1000 cubic yards of placer material per year. The material associated with dredging sediments or spoils is not imported to the stream by the mining operations. Existing instream sediment is temporarily displaced, processed for gold extraction, and immediately replaced in the general location of its origin. This volume is not substantial in comparison to the estimated 50,000-200,000 cubic yards per year added to the system due to natural erosional processes (.005%-2% of total sediment per year attributed to mining). All the data used in the determination study for Silver Creek and Tributaries Eligibility Study (1993) concluded that, "historical gold mining had no lasting effects on water quality or stream function." Field reviews have recorded observations which indicate that in any normal year, the effects from dredging would be confused and altered by the bankfull stage occurrence of the following year. G.R. Stern noted (1988) that 91% of the stream disturbance cause by mining was obliterated on his study area with a flow average reoccurrence interval of 1.9 years. These placer operations are the only current management activities directly affecting the Middle Silver reach morphology. There are a couple of older high terrace placer operations that have ceased to operate.. These sites are candidates for low levels of restoration activity as they and their access routes are responsible for low levels of sedimentation in their current condition. Any efforts for restoration of mining activity in Silver Creek watershed outside the wilderness, should be cautioned, with regards that the area is subject to mineral entry under the mining law.

Trends: Large wood will continue to be in plentiful supply from riparian areas in primarily in unmanaged conditions. Bankfull flows will slowly move wood through the system and fish habitat will naturally restore over time until the next large event reactivates the slide. This process is expected to be a continuing cycle of natural disturbance and restoration.

UPPER SILVER SUBWATERSHED

The mainstem of Upper Silver flows from northeast to southwest. The tributaries are oriented mostly east or west. There are a minimum of 41 miles of perennial and 44 miles of intermittent streams in this sub-watershed (2808 acres of riparian reserve).

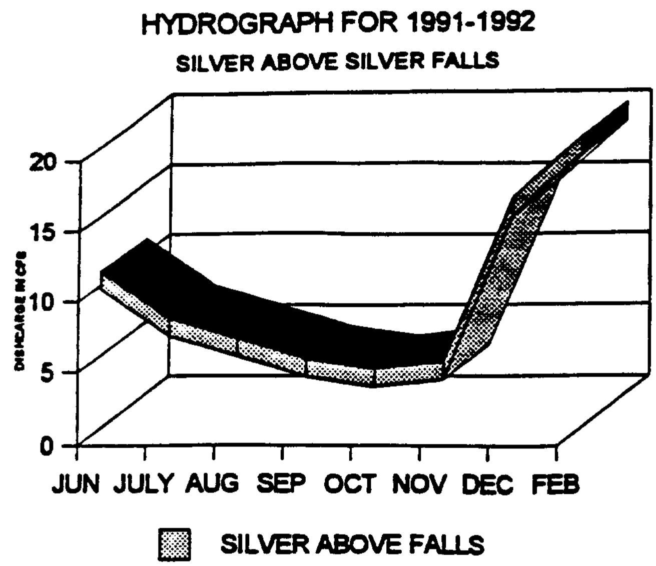


Figure A10

Clearing of lands for minerals access, exploration, development, and occupancy has left a wide aggraded riparian strip on the lower mainstem of this subwatershed which is composed mostly of hardwoods and young conifers on unstable banks. Water temperatures in this area have probably decreased since the 1950's due to mining activity. 1994 data document a 6.9 degree F drop in downstream peak water temperature between two sites separated by two miles. The stream goes sub-surface for 3/4 mile in this stretch. This is primarily due to an aggraded condition of the stream caused by mining activity and natural erosion by stream processes accelerated by mining activity. Sub-surface flow lowers peak summer water temperatures in this reach, and possibly affects summer water temperatures in the downstream portions of Silver Creek. This sub-surface reach has no summer fish habitat and is a major contributor of sediment to the downstream reaches. Any efforts to restore surface flow in the aggraded portion of stream prior to establishing long term riparian vegetation would result in increased summer water temperatures.

Many of the large conifers which survived early harvest and road construction on private and public lands within the floodplain were lost during the 1964 and 1974 floods, with disturbed areas primarily seeding in to red alder.

Above the falls, Silver Creek (6456 acres) has been affected by road construction and placer mining activity. A road built within the flood plain and 100 years of mining activity have had direct effects on low and winter flows. Current conditions and trends for flows are; lower than historic summer and fall flows (due to sub-surface portions of aggraded channel, and changes in riparian vegetation component) and lower velocity peak flows (due to widening and braiding of channel). Low summer flows will greatly affect native fisheries especially during periods of drought. Spring, summer, and fall fish habitat is non-existent on a 3/4 mile reach where zero summer flow occurs.

Approximately 220,000 cubic yards of in-stream material have been removed by a combination of mining and natural processes in the lower end of the subwatershed (based on measurements taken from aerial photographs, 1950-1987). The natural processes of stream cutting and erosion have been accelerated by localized mining activity since the 1950's. This amount of material is substantial. The effects are measurable and are most evident on the site where the material has been removed and below Silver Falls where a low gradient one mile stretch of stream has acted as an initial settling ground for this material.

Past public and private management of this drainage may have affected summer and winter stream flows. 6253 acres are managed by the Forest Service. The Forest Service has harvested about 435 acres (7% of total) and constructed 11.72 miles (1 mile/square mile) of road over a period of 40 years. It is unknown the extent that harvest and road construction has altered peak flows during storms.

The mainstem stream is in a state of recovery from management and flood effects. The unmanaged areas indicate that sediment dynamics and channel complexity (pool depth and frequency etc.) were partially controlled by large wood, and that wood is a major component of the drainages in this subwatershed. The evidence is that sediment is stored and pools are being formed where wood accumulations are present.

Trends: In the patented mined area, streambank erosion will continue, providing a chronic source of sedimentation and removal of riparian vegetation. Summer flows will continue to flow subsurface in the aggraded reach, and maintain the desired low summer water temperatures. The stream channel will continue to aggrade and large in-stream wood will be lacking. Above the mined area, stable stream banks will continue with desired quantities of large in-stream wood.

Desired Condition For Entire Watershed and Method For Attainment:
Restore healthy and resilient aquatic and riparian habitats.

Decrease summer water temperatures. Decrease roadside stream solar exposure and increase riparian shade where roads parallel the stream. Maximize the amount of in-stream summer flow by vegetation management (culturing conifer production in hardwood dominated streams) and discourage water consumption on private lands during peak periods of drought. Known priorities are North Fork and Upper Silver sub-basins.

Identify riparian areas which are at high risk of loss to wildfire and insect activity and consider restoration activities, including thinning, which would decrease risk. Known priorities are North Fork and South Fork Silver sub-basins.

Riparian improvement techniques include planting and culturing primary conifer and secondary hardwood vegetation to provide a long term balanced source of large wood and shade. Create microsites conducive for vegetation establishment. Future management should discourage the removal of shade producing vegetation. Known priorities are on North Fork, South Fork, and Upper sub-basins.

Work with BLM, to gather data regarding water temperature and percent riparian shade on public lands where information is lacking. Information priorities are on North Fork sub-basin.

Increase summer flows over existing conditions. Historic or premanaged conditions are unknown. Increased summer flows could help lower summer water temperatures and increase and improve fish habitat. There are no known water withdrawals in the watershed. Therefore, increases in summer flows should be achieved through riparian silviculture.

Riparian improvement techniques such as culturing conifer vegetation in hardwood dominated areas would help increase summer flows by reducing the type of vegetation associated with higher amounts of summer water use.

Reduce accelerated and direct runoff from roads and other managed lands, by removing unused roads by ripping and planting. Special attention regarding stabilization and restoration of vegetation should be given to slides, skid roads, landings, and other areas resistant to revegetation applications. This will restore the soil permeability and lessen management's effects regarding increases in water yield from direct runoff. Key priorities are South Fork, and North Fork.

Increased availability and long-term recruitment of large wood, and wood of varying sizes. This would improve channel complexity and stability, habitat complexity and productivity for fish, and improve sediment transport and storage dynamics. Large wood could be imported to the stream and/or adjacent side slopes, or cultured through silvicultural practices in North Fork, South Fork and Middle Fork sub-basins. Although it is not known what the overall historic quantity of large wood is in Watershed 09, it is know that current levels are often lower than levels documented as healthy by old growth standards (Swanson et. al, 1978).

Increase the large wood availability and in stream placement to 40-80 pieces/mile, on sub-basin North Fork Silver (upper part of sub-basin). Develop microsites on channel bars by placing wood or vegetation in a manner conducive for the channel to deposit fine sediments.

parian area vigor and function could be improved through increased riparian vegetation and large wood availability, particularly in reaches identified as lacking, in the fish habitat surveys. Culture riparian vegetation to maximize growth of existing vegetation, encourage conifer growth and occupancy, provide a short and long-term supply of large and other size wood. Future planning in this basin should recognize the need for protecting riparian conifer vegetation, by selectively releasing existing conifers and by stocking riparian areas with shade tolerant conifers which can produce a large woody debris component and compete with established hardwoods.

Sediment dynamics within the stream could be returned to a more natural balance by reducing erosion and sediment from roads and recreational trails in the basin. Although a lot of the road cut and fill slopes, landings, and slides, have been replanted with vegetation, there are opportunities to upgrade and provide additional drainage relief, armor and improve culvert (all replacements affecting or in riparian areas should meet 100 year event flow capacities) inlet, outlet, and ditch line function, as well as reduce the miles of road (Bald Mountain Road is priority). All culverts limiting fish movement should be assessed and replaced (priority is North Fork Silver sub-basin). To totally restore the channel condition to it's previous morphology, complexity, and sediment transport regime, roads occupying the valley bottom or historic stream channel flood plains (North Fork and Upper Silver sub-basins) would have to be removed and relocated. Future recreational trails should be constructed with crowns or outslopes.

FISHERIES

RELATIONSHIP OF SILVER CREEK AND THE ILLINOIS RIVER TO THE ROGUE RIVER BASIN

The Rogue River is located in the SW Oregon Province, an area that includes the Umpqua River, Rogue River watersheds and various sub-basins along the coast of Southwest Oregon - lumped as "south coast basins". The Rogue River is 5,161 square miles or 3,301,000 acres.

The major sub - basins of the Rogue River are:

Illinois River - 628,500 acres
Applegate River - 491,000 acres
Bear Creek - 218,000 acres
Little Butte Creek - 230,000 acres
Upper Rogue -800,000 acres (upstream of Little Butte Cr., plus Elk & Trail Crs.
Middle Rogue - 603,500 acres (Grave Creek to Little Butte Creek)
Lower Rogue - 322,000 acres (Gold Beach to Graves Creek)

The basin is approximately 110 miles from east to west, with the main river about 210 miles in length from Crater Lake National Park to Gold Beach. About 60% of the Rogue River is in public ownership. Much of the remaining private ownership is managed for timber production. Streamflow can vary from under 1000 CFS in the record drought years of 1931-1940 to greater than 500,000 CFS in the December 1964 flood event.

The Rogue River is cited by the Oregon Department of Fish and Wildlife as the most productive anadromous fish basin in the state outside of the Columbia River system. It produces a variety of species from diverse sub-basin environments with quite different geology, flow regime and habitats. The interior valleys were once wetlands and important for coho salmon. Coho spawn and rear in smaller tributaries and off-channel areas of low gradient streams. These riparian habitats have been considerably changed by agricultural activities and water diversions for irrigation. The upper sections of the river have cooler water temperatures and provide habitat suitable for spring chinook and summer steelhead to hold for the summer before spawning. The short facing drainages provide spawning habitat for for summer steelhead while winter steelhead tend to spawn and rear in larger tributaries. Chinook, both fall and spring races, tend to spawn and rear in the mainstem or lower segments of tributaries.

Silver Creek is 51,600 acres or about 8 percent of the Illinois River Basin. It is one of the most important tributaries to the Illinois system because of its relatively unmanaged condition. In addition most of the drainage is in public ownership and therefore has no water diverted for irrigation purposes, one of the major causes of poor water quality in the Illinois River System. Approximately 20 percent of the summer flow of the Illinois River comes from Silver Creek. During the summer months salmonid fish can be seen at the confluence of Silver Creek with the Illinois, and are considered to be attracted to the cooler water entering the system.

SILVER CREEK

Species/Stocks Presence and Distribution

Silver Creek is home to several anadromous and resident species of salmonids. Anadromous forms include fall-chinook salmon, steelhead trout and sea-run cutthroat trout. Resident forms include rainbow and cutthroat trout. Non-game fish species that are present in Silver are sculpins, and a few redside shiners near the mouth.

Silver Creek is a major tributary to the lower Illinois River. Rogue River chinook populations are the largest among Oregon's coastal chinook salmon populations (Nicholas and Hankin, 1988). Silver Creek basin contains approximately 21 miles of anadromous habitat and another 22 miles of resident fish only habitat. It has been designated a Key Watershed under the ROD, one of 3 key watersheds in the Illinois River Basin.

Population/Escapement Data

Stream surveys have been conducted on Silver creek in 1986, and following the Silver fire in 1988, 1989, 1990, 1991, 1993, and 1994. In all of these surveys it has been noted that overall fish populations have been high. Different portions of the mainstem were surveyed each year. The 1986 survey was conducted on the first mile of creek from the confluence up. In 1988, 11 miles were surveyed from the mouth upstream to Old Glory Mine. In 1989, 12.9 miles were surveyed from the mouth upstream to a natural slide that temporarily blocked fish passage. In 1990, 13.7 miles were surveyed from the mouth upstream to Silver Falls, a permanent fish blockage. In 1991 and 1994, 4.0 miles were surveyed from the confluence of Phillips Creek to Silver Falls. In 1993, approximately 4.4 miles from Silver Falls upstream to the end of resident fish were surveyed, (See attached relative fish abundance tables.)

Migratory fish are subject to a large number of direct and indirect mortality variables. Harvest and predation appear to be the most important direct variables affecting adult escapement back to Silver Creek. The ocean plays an important role in the development and abundance of anadromous stocks. Climatic events such as El Nino (a warming of the ocean water) cause a lack of nutrient rich cold water off the Pacific coasts, which in turns means less productivity in the sea, and less than optimum conditions for salmon and steelhead. Often in years of El Nino, returns of salmon and steelhead to their natal streams is down. Silver Creek produces robust smolts, leading to more chance of success in the ocean environment.

HABITAT CONDITION AND TRENDS

For the most part fish habitat in the first 2 reaches of Silver Creek remains in fairly pristine conditions and not much degradation, if any, has occurred to the habitat. In the third reach natural slides have added sediment to the creek, most of the fines have been flushed out and spawning size gravel remains. The mainstem of Silver Creek contains approximately 13.7 miles of anadromous fish habitat. At approximately river mile 13.7 Silver Falls occurs, this 100+ foot high waterfall is a barrier to all anadromous fish. Resident fish occur for another 4.0 miles beyond the falls.

Silver Creek can be broken into 4 distinct reaches. Reaches 1 through 3 are the same as found in the Silver Fire Recovery EIS.

REACH 1 (Lower Silver Sub-WA)
The first reach begins at the mouth and continues upstream for approximately 5 miles. This reach contains excellent fish habitat throughout. Fall chinook salmon use all of this reach as do winter steelhead and a few sea-run cutthroat trout. Redside shiners were found only in the first several hundred feet of this reach. Fish habitat in this reach is diverse and can be considered excellent. Large, deep pools and cascade habitat with many pocket pools provide excellent rearing conditions for salmonids. This reach is contained in a deep bedrock canyon. The stream power in this creek is high and keeps spawning gravels clean of fine sediments. Because of this stream power large woody material within the active stream channel is often scarce, however more wood is being recruited following the 1987 Silver Fire. The pool-riffle-glide ratio averaged 42-45-13, with good spawning gravel beyond the first mile of stream. Much of the riffle habitat is actually cascades that provide excellent fish habitat. Large woody material instream averaged 28 pieces per mile, sometimes occurring in logjams. The gradient averaged 3%.

REACH 2 (Lower Silver Sub-WA)
The second reach is similar to the first reach and is approximately 2 miles long ending just upstream of the confluence with South Fork Silver Creek. Fall chinook salmon, winter steelhead and a few searun cutthroat trout use all of this reach.

REACH 3 (Middle Silver Sub-WA)
The third reach becomes less diverse near the confluence of Phillips Creek. A 6 foot high chute may be a partial upstream migration barrier at certain flows. The gradient drops in this reach, and gravel size sediment from Phillips Creek Slide is still evident in the creek. Pools tend to be long, slow moving and deep, cascade habitat is not present for the most part. This is an area of good spawning grounds for winter steelhead because it is far enough upstream to avoid much of the force of water during winter freshets. About 1 mile below Silver falls, a natural landslide occurred in 1989 temporarily blocking the upstream movement of anadromous fish. Fish densities are less in this reach than in reaches 1 or 2. Large instream wood averaged 44 pieces per mile up to Phillips Creek and 20 pieces per mile from Phillips Creek to Silver Falls, however more wood was accumulated outside the bankfull, high up on gravel bars. This reach is poorly shaded and canopy cover is low. Fern covered seeps are common along both banks. The pool-riffle-glide ratio averaged 30-47-23. Cobble and gravel were dominant substrate types. Winter steelhead and possibly searun cutthroat trout use this reach.

REACH 4 (Upper Silver Sub-WA)
The fourth and last reach begins just above the 100+ foot high Silver Falls and continues for 4.0 miles until resident fish use ceases. Low numbers of rainbow trout were observed throughout the survey. A bedrock falls at stream mile 4.0 marks the apparent end of fish use in Silver Creek. There are unsubstantiated claims that fish populations used to extend above the falls, and that the stream has been "fished out" by miners and recreationists. The first 3 miles of Upper Silver Creek is private property (145 acres) and has a history of mining. Rearrangment of the substrate by hand or machine has had a profound effect on the streambed in many areas, causing portions of it to go subsurface during the summer months. A road closely parallels the creek for about 2.4 miles, in places so close that the roadbed is eroding into the stream. Valley width varied from 75 to over 400 feet just above the falls. Much of the wetted width is characterized by braided channels, partially or totally dry side channels that weave their way around the streambed. The

pool-riffle-glide ratio in this first section is 11-80-9. Woody material averages 14 pieces per mile and is primarily of the smallest size class. Canopy closure is poor. The next section of this reach, up to Rawhide Creek averages 6 pieces of wood per mile and canopy closure is fair. The road closely paralleles the stream in this reach. The pool-riffle-glide ratio is 13-79-8. Above Rawhide Creek, Silver Creek has had some riparian vegetation removed and non-vegetated flats remain.. The current trend is for very slow natural recovery for this reach. Periodic mining and harvest activity on private land (using previous methods) is expected to delay or prevent the fish habitat recovery. Fish habitat could be improved in this reach by replanting riparian zones, redesign of the existing road, and the addition of instream wood.

GENERAL DISCUSSION
Silver Creek contains a wild fish population. No records of hatchery fish being released into Silver Creek exist.

Access to lower Silver Creek is poor. The Illinois River Trail crosses just upstream from the mouth, and a 4-wheel drive road to Old Glory Mine occurs at river mile 11. Access to the upper portions of Silver Creek is better due to several roads in the vicinity, including one that parallels the creek. A few people may angle for trout where the trail crosses Silver Creek, and possibly in the Reach 3 also. The poor fishing access in the lower reach helps reduce fishing pressure on much of this stream..
Overall the trend in fish habitat is for it to remain excellent in the lower 2 reaches, and good in the third reach and poor to fair in the fourth reach.

Sensitive Species Classification: The Oregon Department of Fish and Wildlife has a list of Sensitive Species and Stocks of Concern. Three of the species on this list occur in mainstem Silver. They are: Fall Chinook Salmon (Oncorhynchus tshawytscha), Illinois River Winter Steelhead (Oncorhynchus mykiss), and Coastal Cutthroat (Oncorhynchus clarki clarki). The American Fisheries Society (AFS) also has a list of Sensitive Species and Stocks of Concern. These same species occur on the AFS list. On March 10, 1995 the National Marine Fisheries Service has proposed listing steelhead stocks in the Klamath Management Province.

NORTH FORK SILVER CREEK

Species/Stocks Presence and Distribution

North Fork Silver Creek contains populations of fall chinook salmon, winter steelhead and possibly searun cutthroat trout. Resident rainbow and cutthroat trout are present throughout. Sculpins are the only non-game species of fish known to exist in North Fork Silver. There are 5.0 miles of anadromous habitat and another 3.0 miles of resident habitat on National Forest land. The Bureau of Land Management manages the upper portions of North Fork Silver Creek which contains another 13 miles of Resident fish habitat. A separate document has been prepared on this section. Fall Chinook use the lower 1.1 miles of the North Fork and Steelhead use all 5.0 miles available to them.

Population/Escapement Data

Stream surveys have been conducted on lower North Fork Silver Creek in 1988, 1989 and 1990. The upper section was surveyed in 1993.

Habitat Condition and Trends
North Fork Silver Creek on National Forest Lands can be broken into 2 distinct reaches. Both reaches are contained in a deep bedrock canyon.

REACH 1 (North Fork Silver Sub-WA)
The first reach begins at the mouth of the North Fork and continues upstream for approximately 5.0 miles. At this point a 30 foot high waterfall occurs, ending all anadromous fish use. Fall chinook salmon use the first 1.1 miles of this reach. Winter steelhead and possibly a few sea-run cutthroat trout use the entire reach. The first 2 miles of the reach had a pool-riffle-glide ratio of 52-47-1, cobble and bedrock were dominant substrate types and many areas of good spawning gravel were found. Wetted width was 28 feet, with a gradient ranging from 3%-5% with a few steep areas at 12%. Log jams were common and provided good cover for fish where they occurred. Large woody material averaged 98 pieces per mile. Between stream miles two and 3 the gradient averaged 4%-8%. The valley broadened somewhat, and the wetted width averaged 42 feet. The pool-riffle-glide ratio was 26-16-58. There were less pieces of large wood to be found at 51 pieces per mile. Shade was mainly topographic and from large conifers. From stream mile 3-3.5 trench pools became commonplace and the pool-riffle-glide ratio was a good 85-12-3, however large wood dropped to only 12 pieces per mile. The gradient remained fairly steep at 5%, as the wetted width decreased to 27 feet. The last 1.5 miles of anadromous use was dominated by riffles which were 85% of the habitat. Large wood tapered down to only 5 pieces per mile. Overall for the reach there are many deep pools and cascades providing excellent rearing conditions for salmonids throughout. Fish habitat can be considered excellent in this reach.

REACH 2 (North Fork Sub-WA)
The second reach of North Fork Silver Creek begins just above the falls and ends at the National Forest property boundary. Resident rainbow and cutthroat trout use this reach. Portions of the riparian habitat in this reach was used as fireline during the Silver Fire. Large conifers were dropped into the creek in efforts to stop the fire, this has caused an unnatural increase in large wood that has tended to settle in mobile log jams. The log jams appear to be moving thru the stream in small events causing bank erosion as they mobilize. We have also lost the potential for future recruitment of wood because of these fire fighting activities. Gradients averaged 6 percent in this reach and dominant substrates consisted of cobble and bedrock. The pool-riffle ratio was 30-70, and there was more wood in this reach than the previous one because of the above mentioned activities. Canopy closure was estimated at 50%.

GENERAL DISCUSSION
North Fork Silver Creek is very remote and access is incredibly poor on National Forest Lands. No roads or trails cross the creek. This poor access provides excellent opportunity for steelhead to rear to smolt size without fishing pressure. No known angling occurs on National Forest portions of this creek. Fish habitat should remain excellent in lower reaches of North Fork Silver in the future.

REACH 3
The Bureau of Land Management manages a portion of North Fork Silver Creek beginning at the end of

Reach 2. There is a total of 13 miles of cutthroat trout habitat on BLM lands in this drainage, 7.4 of which are on the mainstem. They have found this reach unsuitable for Wild and Scenic River status in 1992. This reach is heavily impacted by roads, and past timber harvest. Recent and past gold mining has occurred in these headwaters degrading fish habitat. Additional information can be found in the Watershed Analysis for Upper North Fork Silver CreekWatershed, that was completed in 1994 by the BLM.

SOUTH FORK SILVER CREEK

Species/Stock Presence and Distribution

South Fork Silver Creek contains a small population of winter steelhead in the lower 0.25 miles of creek. There is another 5.0 miles of resident trout habitat upstream of this used by both rainbow and cutthroat trout.

Habitat Condition and Trends

Winter steelhead use the first several hundred yards, after this the stream becomes steep and mostly cascade like with hundreds of small plunge pools for the rest of the reach. A few resident rainbow, and mostly cutthroat trout use the creek upstream of anadromous fish. Pool-riffle ratios were 54-46 at the mouth going down to 30-70 in the middle sections and getting a little better at 40-60 near the top section of the reach. Overhead canopy is dense, and substrate consists primarily of cobble, large and small boulders, and bedrock. The creek is full of woody material, often occurring in small log jams. Some of the upper portions of the South Fork have been impacted by roads and past timber harvest activities.

GENERAL DISCUSSION

Fish habitat can be considered fair. Habitat in South Fork Silver should remain in fair condition in the future. As past harvest units revegetate, the quality of fish habitat should increase.

LITTLE SILVER CREEK

Species/Stocks Presence and Distribution

Little Silver Creek contains populations of winter steelhead and possibly searun cutthroat trout. Anadromous fish use the lower 0.95 miles of creek and resident rainbow and cutthroat trout use the upper 4.8 miles.

Habitat Condition and Trends

Little Silver Creek can be broken into two reaches

REACH 1

The first reach begins at the mouth and continues upstream for 0.95 miles until a 25 foot high waterfall is encountered. This falls is a barrier to all anadromous fish. Winter steelhead and possibly a few sea-run cutthroat trout use this reach. This is a relatively low gradient reach (2%-4%) containing a few areas with dry channels during summer months. There is good spawning gravel throughout. The stream is contained in a very narrow bedrock box-type canyon. The canyon walls are often unstable, and small slides are found in numerous locations. Canopy cover is low, but shading is fairly good due to topographic features. The pool-riffle-glide ratio was 26-69-5. Twenty five percent of the pools were over 5 feet deep. Large woody material was fairly plentiful, averaging 109 pieces per mile, often occurring in small log jams, most pieces were in the smallest size class. A log jam in the first 1/4 mile is a low water passage barrier. Fish habitat can be considered good in this reach. Fish habitat should remain stable in future years.

REACH 2
The second reach begins at the top of the impassable falls and continues upstream until fish use ceases. Resident rainbow and cutthroat trout inhabit this reach. A small landslide caused lake, "Little Silver Lake" occurs about mid reach. Resident fish inhabit this lake. The stream continued to flow through a narrow canyon with a higher gradient than REACH 1 (Lower Silver Sub-WA). Below the lake the pool-riffle glide ratio averaged 16-17-6. Gradient averaged 4%-15%, a few 8 foot waterfalls and a 30 foot waterfall are located in this section. Wood was more plentiful than in the previous reach, and fire charred logs were often encountered. Topographic shade was less plentiful than in the first reach. Two areas of subsurface flow were located just downstream from the lake. Above the lake for the next mile a large alluvial flat formed by the slide that created the lake was encountered, with a gradient of 1%. Large Port-Orford-cedar was growing in this flat, some of which had been killed by fire during 1987 and had fallen into the creek. Large woody material provided over 90% of instream fish cover. The pool-riffle-glide ratio was 17-67-16 with dominant substrate composed of gravel and cobble. Above this section of creek the pool-riffle-glide ratio dropped to 7-92-1. Salmonid fish habitat can be considered good throughout this reach.

GENERAL DISCUSSION
Fish habitat should remain stable in future years. Little Silver Lake will probably experience angling pressure increases, if the trail built in 1990 becomes more popular.

Access to the lower reach is poor, a trail makes the upper reach more accessible to anglers, who use the lake.

TODD CREEK

Species/Stocks Presence and Distribution

Todd Creek contains winter steelhead and possibly searun cutthroat trout in the lower 1.1 miles of creek. Resident rainbow and cutthroat trout use another 3 to 4 miles of creek upstream of this.

Habitat Condition and Trends

REACH 1
Reach one is 1.1 miles long, and begins at the mouth, ending at a 12 foot high waterfall just below the forks. It runs through a narrow "V" shaped canyon with large lateral scour pools and cascades providing good fish habitat. Some large woody material is encountered in the active stream channel, large woody material averages 70 pieces per mile, however 4 large log jams made up a good portion of this wood count, most pieces were in the smallest size category. There are areas of steep unstable side slopes contributing rock to the stream, cobbles and small boulders are dominant substrate types and rough edged rocks are often

found within the creek. The pool-riffle-glide ratio was 47-42-11. Canopy closure was good. Spawning gravel is infrequent, but plentiful enough to provide adequate areas for the amount of fish in this stream. Salmonid fish habitat can be considered good throughout this reach. Although unentered for harvest in most of the drainage at this time, much of Todd Creek is in matrix land and may be harvested in the future. Buffer widths in the presidents plan may or may not be adequate protection for streams in the long term.

REACH 2

The upper reaches of this creek have not been surveyed. A study of maps and aerial photographs concludes that resident trout probably use another 3 to 4 miles of Todd Creek above the falls, and in both forks. All of the landbase in the upper section is in matrix and subject to future harvest.

Access to Todd Creek is poor. No known angling occurs in either reach.

LAKE CREEK

Species/Stocks Presence and Distribution

Lake Creek is located above Silver Falls and contains 1.0 miles of resident rainbow trout habitat.

Population/Escapement Data

Lake Creek was surveyed in 1993. There are limited numbers of trout located in small numbers throughout the one mile reach.

Habitat Condition and Trends

Lake Creek is contained within a moderate "V" shaped channel with fairly unstable banks. Waterflow goes subsurface for 100 feet above the mouth during the hot summer months. Riffles with shallow pocket pools make up most of the instream habitat, the pool-riffle-glide ratio was 5-92-3. Gradients ranged between 7% and 13% in the lower mile. Canopy closure is fairly good and large woody material ranged between 28 and 47 pieces per mile, mostly in the smallest sizes class. Salmonid fish habitat is generally poor throughout this creek. It will slowy improve in the future as past impacts are ameliorated.

BROWNS GULCH

Species/Stocks Presence and Distribution

Browns Gulch is located above Silver Falls and contains 0.28 miles of resident rainbow trout habitat in the lower reach of the right fork.

Population/Escapement Data

Browns Gulch was surveyed in 1993. Small numbers of trout were observed.

Habitat condition and Trends

Browns Gulch is contained in a narrow "V" shaped canyon. Substrate consists mainly of cobble and gravel with a steep bouldery cascade type falls at stream mile 0.28 which is a barrier to upstream migration of trout. The pool-riffle-glide ratio averaged 7-88-5. Stream gradients averaged 3% to 7% and the upper portions contained 20% fall type habitat. Canopy closure was good, and large woody material ranged from

43 pieces per mile in the lower reach to 8 pieces per mile in the upper reach. Above the first falls an old clearcut ran along the edge of the stream, logging debris and small Alder blowdown was found within the stream adjacent to this area.

GENERAL DISCUSSION

Gold mining is an ongoing activity throughout this drainage, above the first falls large amounts of fine gravel are found within the stream, most likely due to a combination of mining and past harvest activities. Salmonid fish habitat is generally poor throughout this creek. Future trends are for habitat to improve as old clearcuts recover. There are roads in the headwaters and road obliteration could improve habitat in the long term.

LITTLE TOOD CREEK

Species/Stocks Presence and Distribution

Little Todd Creek contains a small population of winter steelhead and rainbow trout in the first 0.15 miles of stream.

Habitat Condition and Trends

Little Todd enters mainstem Silver Creek in 2 channels that combine about 150 feet upstream from the mouth. It is a small narrow stream that is accessible to anadromous fish for the first 800 feet. At this point a large waterfall occurs that ends all upstream migration. The stream survey ended at the falls because surveyors could not get around it.

GENERAL DISCUSSION

Fish habitat should remain the same in future years. Some mining has occurred near the mouth. There are many roads in the drainage, including one that parallels much of the creek and includes a fording of the creek. Turbidty and some sediment enter the section of stream below the road during storms. Road obliteration in this drainage would be beneficial for downstream fish habitat.

PHILLIPS CREEK

Species/Stock Presence and Distribution

Phillips Creek contains a very small population of winter steelhead in the first 0.18 miles of stream. Resident rainbow trout inhabit the same section.

Population/Escapement Data

Stream surveys were conducted in Phillips Creek in 1994. Very few fish were found.

Habitat Condition and Trends

In the first 0.18 stream miles the pool-riffle-glide ratio was 45-50-0. Average channel gradient was 2%. A small 5 foot falls created by a downed log caused a partial migration barrier just upstream of the mouth. Canopy closure was a low 20 to 30%. Large wood averaged 29 pieces per mile, with most pieces in the small size class. Above the range of fish, Phillips Creek dropped to a 1% gradient. Wood material averaged 50 pieces per mile all in the 2 smallest size classes.

GENERAL DISCUSSION

Fish habitat was fairly good throughout the survey although no few fish were found. Future trends expected would be for habitat to remain the same. The lower half of the drainage is in Backcountry Recreation and the upper half is in matrix lands. There are a number of roads in the headwaters that could benefit downstream fisheries if obliterated.

Figure A11. Numbers Of Pre-smolt Steelhead Estimated From Dive Counts in Silver and Indigo Creeks 1988, 1989, and 1990.

Creek	1988	1989	1990
Mainstem Silver	852	2,495	8,620
North Fork Silver	1,168	1,418	2,384
South Fork Silver	28	N/A	N/A
Total Silver Basin[1]	2,048	3,913	11,004

[1] Total Silver Basin estimates do not include Little Silver Creek, or Todd Creek.
The numbers in this table are for comparison only. Standing crop numbers are highly variable depending on the time of year surveyed, environmental conditions during survey, and experience of survey crew. Fry f the 0+ size were too abundant in either system to accurately count, so were not included in table.

Figure A12

FISH HABITAT, DISTRIBUTION, AND POPULATIONS				
Subwatershed	Stream Miles	Species	Habitat Miles	Pool/ Riffle/ Glide
Phillips	0.2	Wsteel Res Tr	0.2 0.2	Good
Little Todd	0.1	Wsteel Res Tr	0.1 0.1	Fair
Lake Cr	1.0	Res Tr	1.0	Poor
Browns Gulch	0.3	Res Tr	0.2	Poor

Main Silver	13.7	Chinook Wsteel Sea Run Res Tr	7.0 13.7 13.7 13.7	Good Upper/ poor
North Fork Silver	15.4	Chinook Wsteel Sea Run Res Tr	1.1 5.0 5.0 13.0	Good Upper/fair
South Fork Silver	5.2	Wsteel Res Tr	0.2 5.2	Fair
Little Silver	5.7	W.steel Res Tr	1.0 4.8	Good Upper/Fair
Todd	5.1	Wsteel Res Tr	1.1 4.0	Good

AQUATIC MACRO-INVERTEBRATE SAMPLING

Sampling results from the USDA Forest Service Intermountain Region Aquatic Ecosystem Analysis Laboratory in Provo, Utah have been published in a report entitled " Aquatic Ecosystem Analysis for Selected Streams on the Siskiyou National Forest ". Aquatic macroinvertebrate community structure changes dramatically in response to changes in habitat (such as temperature, sediment and water chemistry) and is an effective tool in detecting environmental change. Results from the macroinvertebrate lab in Utah have been assessed in using three basic indexes: 1) a biotic condition index (BCI) which indicates as a percentage how close an aquatic ecosystem is to its potential. 2) a species diversity index (DAT) which gives a measure of dominance and number of taxa, and 3) a standing crop index. No significant difference in the BCI (paired student T-test $P<0.05$) was observed between 1988, 1989, and 1990 for all streams monitored. Results indicate that the macroinvertebrate community in Silver Creek basin is in good to excellent shape. Based on these results it can then be said that water quality for rearing juvenile salmonids is good to excellent quality.

Findings

Silver Creek is one of two most important tributaries (Indigo creek is the other), in terms of wild fish production, in the Illinois River Basin. The large size of the basin provides an extensive amount of high quality habitat. These pristine conditions, large, deep pools, excellent water quality, and cascade habitat with pocket pools provide excellent rearing conditions for salmonids. In addition, inaccessibility to fishermen provide juvenile steelhead excellent conditions to rear to smolt size without fishing pressure. Water temperatures are cooler than most other tributaries in the basin. The anadromous reaches of Mainstem Silver Creek, North Fork

Silver Creek, Todd Creek and South Fork Silver Creek all provide excellent rearing conditions for juvenile salmonids. Little Silver Creek provides good pristine habitat for salmonids, but not as many large, deep pools exist within the system.

Resident Trout habitat above anadromous barriers on North Fork Silver, South Fork Silver, Todd, and Little Silver Creek is in good condition. Resident trout habitat on National Forest Land above private property in the second reach of Silver Creek, Lake Creek and Browns Gulch is generally in poor condition .

Silver Creek and its tributaries are home to wild populations of resident and anadromous salmonids. Three of these species are on the Oregon Department of Fish and Wildlife's Sensitive Species List. ODFW places a high priority on these wild stocks of salmonids, both anadromous and resident.

Desired Condition for the Entire Watershed and Methods For Attainment:

Healthy fisheries including a viable populations of anadromous and resident salmonids. Maintaining and improving fish habitat conditions are key to reaching this condition.

Increased quantity and quality of instream pools with diverse pool habitat for resident fish.

Pools should have overhead cover and refuge habitat with frequency approaching 40% of total surface in pool habitat.

Reduced sediment and road densities along riparian areas by putting roads back into production of trees. Reduce erosion from headwater areas. Stabilize and revegetate, cutbanks, fillslopes, landings, skid trails, and the large flat Upper Silver Creek.

No instream projects for fisheries are recommended anywhere in Silver Creek basin at this time with the exception of Upper Silver Creek on private lands, and possibly North Fork Silver on Bureau of Land Management lands. Adequate amounts of wood exist in the rest of the system due to the natural character of the stream. Fix fish passage problems where they are management related on headwater streams.

Increase riparian shade and future sources of large woody debris by restoring conifer component in areas that have been degraded by management activities in the past. Riparian vegetation with a mature or greater age class is desired to mimic "natural ecological conditions of the site."

The addition of the private land parcel to the National Forest System, would facilitate many of the restoration opportunities for this part of the Watershed .

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