United States Department of Agriculture

Forest Service

Pacific Southwest Region

Upper South Fork Trinity River – Happy Camp Creek Watershed Analysis

Hayfork Ranger District
Shasta-Trinity National Forest

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Section 1 - Characterization

The Watershed Analysis (WA) area encompasses the Upper South Fork Trinity and Happy Camp fifth-field watersheds, including the South Fork Trinity River, and drains 51,330 acres of land located along the southeast portion of South Fork Mountain from Forest Glen to the headwaters of the South Fork Trinity River. The analysis area is composed largely of South Fork Mountain Schist and Franciscan Formation bedrock geologies, and is characterized by steep, unstable, topographies, late-seral and old growth vegetation, and frequent high gradient and low-order streams. Approximately, 157 miles of mapped streams are located within the analysis area, of which 34 stream miles are considered to be accessible to ocean-run fish species. Within the analysis area there are 156 miles of roads and 38 miles of trail.

The Shasta-Trinity National Forests Land and Resource Management Plan has divided the watersheds into specific land allocations which are taken from the Northwest Forest Plan, and used to direct management activities and identify Standards and Guidelines for land management activities. Land allocation acreage and distribution are identified in Table 1-1 and Figures 1 and 2. The entire Watershed Analysis area is within the South Fork Trinity River Tier 1 Key Watershed.

Table 1-1. Land Allocation.

Land Allocation	Upper South Fork	Happy Camp
Late Successional Reserve	6,421	16,854
Matrix	11,954	352
Administratively Withdrawn Area	1,640	4,682
Congressionally Withdrawn Area	6,466	----
Private Parcels	644	2,317
Total Acreage	27,125	24,205

The 1964 flood and the 1988 Hermit fire are the two most recent large scale disturbances that have affected the distribution and abundance of plant and animal species within the analysis area. The Hermit fire burned approximately 7,600 arces of National Forest and private lands. In 1996 lightning ignited the Rock fire which burned an estimated 2,500 acres, much of which was previously burned during the Hermit fire.

Suitable habitat for sensitive and endemic plant species exists within the watersheds, but little field survey work has been done to verify the existence of known populations. Several other Survey and Manage species, particularly non-vascular lichens and bryophytes, and fungi occupy sites within the watersheds. There are no federally listed Threatened or Endangered plant species known to occur on the Shasta-Trinity National Forests. Water howellii (*Howellia aquatilis*), a listed species known to occur in seasonal ponds or vernal pools on the Mendocino National forest, may occur. Only one sensitive species is known to occur within the Upper South Fork and Happy Camp Watersheds. *Frasera umpquaensis* is found in meadow edges and openings along the highest elevations on the South Fork Mountain ridgeline, including a portion of the population to the north of the Happy Camp watershed. Forest Service sensitive and “Survey and Manage” plants are listed in Table 1-2.

Table 1-2. List of Forest Service Region 5 Sensitive and Northwest ROD "Survey & Manage" plant species known or suspected to occur in the Happy Camp and Upper South Fork fifth-field watersheds.

Taxa	Common Name	Scientific Name	[1]Status
Vascular Plants	fascicled lady's slipper	*Cypripedium fasciculatum*	R5S-SM
	mountain lady's slipper	*Cypripedium montanum*	R5S-SM
	Umpqua green gentian	*Frasera umpquaensis*	R5S
	Canyon Creek stonecrop	*Sedum paradisum*	R5S
	Oregon willow herb	*Epilobium oreganum*	R5S
	Stebbins' madia	*Madia stebbinsii*	R5S
	English Peak greenbriar	*Smilax jamesii*	R5S
	sugar stick	*Allotropa virgata*	SM
Non-vascular Plants	Pacific fuzzwort	*Ptilidium californicu* (liverwort)	SM
	bent-kneed four tooth	*Tetraphis geniculata* (moss)	SM
	green bug moss	*Buxbaumia viridis* (moss)	SM
	giant-spored tree moss	*Ulota megalospora* (moss)	SM
	blue chantrelle	*Polyozellus multiplex* (fungi)	SM
	scaly chantrelle	*Gomphus floccosus* (fungi)	SM
	ledgehog mushroom	*Hydnum repandum* (fungi)	SM
		Lobaria linita (lichen)	SM
		Lobaria hallii (lichen)	SM
		Leptogium saturninum (lichen)	SM
		Peltigera collina (lichen)	SM
		Collema nigrescens (lichen)	SM
		Lobaria pulmonaria (lichen)	SM
		Nephroma helviticum (lichen)	SM
		Nephroma resupinatum (lichen)	SM
		Pannaria saubinetii (lichen)	SM
		Pseudocyphellaria anomala (lichen)	SM
		Pseudocyphellaria anthraspis	SM

[1] *R5S = Region 5 Sensitive, SM = Survey & Manage.*

The analysis area has an abundance of animal life, with numerous species of concern. Based on the Wildlife Habitat Relationships database system version 5.0 (1993) with modifications adapted to the Shasta-Trinity National Forests in 1994, recorded sightings, and vegetation attributes, there are 157 birds, 59 mammals, and 32 herpetafauna species that are likely to utilize these two watersheds as residents and/or migratory species. A total of 29 special emphasis wildlife species not including fish are known or suspected to occur in the watersheds. These include two Federally Threatened and one Federally Endangered species, 11 Forest Service Sensitive species, four Protection Buffer species and 12 Survey and Manage species. Federally Threatened & Endangered; Forest Service Region 5 Sensitive; Northwest ROD (USDA and USDI 1994) "Protection Buffer" and "Survey & Manage" wildlife species have been identified in Table 1-3.

Table 1-3. List of Federally Threatened & Endangered; Forest Service Region 5 Sensitive; Northwest ROD "Protection Buffer" and "Survey & Manage" wildlife species known or suspected to occur in the Happy Camp and Upper South Fork fifth-field watersheds.

Taxa	Common Name	Scientific Name	Status[1]
Birds	bald eagle	*Haliaeetus leucocephalus*	FT
	northern goshawk	*Accipiter gentilis*	R5S
	American peregrine falcon	*Falco peregrinus anatum*	FE
	northern spotted owl	*Strix occidentalis caurina*	FT
	flammulated owl	*Otus flammeolus*	PB
	white-headed woodpecker	*Picoides albolarvatus*	PB
	willow flycatcher	*Empidonax traillii*	R5S
	pygmy nuthatch	*Sitta pygmaea*	PB
Mammals	fringed myotis	*Myotis thysanodes*	SM
	long-eared myotis	*Myotis evotis*	SM
	long-legged myotis	*Myotis volans*	SM
	silver-haired bat	*Lasionycteris noctivagans*	SM
	hoary bat	*Lasiurus cinereus*	SM
	Townsend's big-eared bat	*Corynorhinus townsendii*	SM,R5S
	pallid bat	*Antrozous pallidus*	R5S
	western red bat	*Lasiurus blossevilli*	R5S
	American marten	*Martes americana*	R5S
	Pacific fisher	*Martes pennanti pacifica*	R5S
	California wolverine	*Gulo gulo lutens*	R5S
Amphibians	southern torrent salamander	*Rhyacotriton variegatus*	R5S
Reptile	northwestern pond turtle	*Clemmys marmorata marmorata*	R5S
	foothill yellow-legged frog	*Rana boylii*	R5S
Mollusks	Klamath shoulderband snail	*Helminthoglypta talmadgei*	SM
	Oregon shoulderband snail	*Helminthoglypta hertleini*	SM
	Church's sideband snail	*Monadenia churchi*	SM
	Shasta chaparral snail	*Trilobopsis roperi*	SM
	Tehama chaparral snail	*Trilobopsis tehamana*	SM
	papilose tail-dropper slug	*Prophysaon dubium*	SM
	voyager snail	*Ancotrema voyanum*	PB

[1] *FT = Federally Threatened, FE = Federally Endangered, R5S = Region 5 Sensitive. SM = Survey & Manage, PB = Protection Buffer*

Summer and winter-run steelhead (*Oncorhynchus mykiss*), spring-run chinook salmon (*Oncorhynchus tshawytscha*), and Pacific lamprey (*Lampetra tridentata*) are found below migration barriers within the analysis area. Fish barriers are present within the lower 1/4 mile of Bierce, Cable, Happy Camp, and Rough Gulch Creeks (USFS 1992; 1995). Small tributaries entering from South Fork Mountain generally lack the flows and quantity of habitat needed to maintain seasonal populations of anadromous fish. Fall-run chinook salmon are present in the South Fork Trinity system, however, utilization is thought to be sporadic, with few sightings above Hyampom Valley. Resident rainbow trout (*Oncorhynchus mykiss*) are commonly found above migration barriers in this area. Federally listed and Forest Service sensitive fish species are listed in Table 1-4.

Table 1-4. List of Federally Threatened, Candidate for Federal listing and Forest Service Region 5 Sensitive fish species known or suspected to occur in the Happy Camp and Upper South Fork fifth-field watersheds.

Taxa	Common Name	Scientific Name	[1]Status
Fish	coho salmon	*Oncorhynchus kisutch*	FT
	chinook salmon	*Oncorhynchus tshawytscha*	R5S
	steelhead trout	*Oncorhynchus mykiss*	FC

[1] FT = Federally Threatened, FC = Candidate for Federal listing, R5S = Region 5 Sensitive

This watershed is dominated by two geographical features that have shaped the patterns of human use in this area for over 8,000 years. These features are South Fork Mountain (Mountain) and South Fork of the Trinity River. The former has been used as a prehistoric and early historic travel route from the Upper Sacramento River Valley and Northern California Coast into the landscape covered by this watershed analysis. Over 120 prehistoric sites have been recorded on the Mountain giving evidence to this long use. These sites have been grouped together into a National Register Eligible Historic District. The South Fork of the Trinity River, over this same period, provided anadromous and resident fish runs utilized in prehistoric and historic times. However, the prehistoric site density in the river canyon is much lower than along South Fork Mountain.

Section 2 - Key Questions

Issue 1: Late Successional Reserve (LSR) Protection and Enhancement

1.1 What is the condition of the LSR including vegetation, fuels, and unique characteristics?

The primary focus of this question is to determine if the current vegetation conditions within the LSR are able to support adequate numbers of late-successional dependent and associated species in order to maintain species viability and serve as source populations. In addition, identification of any unique characteristics that are ecologically important as well as any serious risks to the maintenance or development of desirable conditions can be an important part of the assessment.

1.2 How do lands surrounding the LSR influence the integrity and functioning of the LSR, including dispersal to and from the LSR?

The quantity and quality of adjacent habitat can influence the ability of the LSR to provide for interior forest species and the distribution of dispersal habitat in nearby watersheds will determine if species produced in the LSR are able to populate other areas and vice versa.

1.3 Are there management and/or restoration activities that will enhance or protect the LSR?

Late successional habitat is abundant, however LSRs contain some quantity of earlier seral stages that can benefit from specific management activities. Also the risk of catastrophic fire events occurring can sometimes be reduced.

Issue 2: Fish Habitat and Hydrologic Restoration

2.1 What is the distribution and abundance of fish species within the analysis area? Where does the high quality fish habitat occur?

The analysis area lies within Tier 1 Key Watershed, and provides important habitat for several life-history stages of fish species, including Threatened, Endangered, and Sensitive (TE&S) fish species. This question is intended to identify important spawning, rearing and holding areas for fish species, and to assess the condition of fish habitat within the analysis area.

2.2 What are the dominant ecological processes that shape fish habitat conditions within the watersheds?

Key ecological processes such as erosion processes, sediment and course woody debris routing will be identified and linked to key fish habitat parameters that are needed to maintain viable fish populations in the South Fork Trinity River.

2.3 Do natural or management related conditions exist which pose a risk to existing habitat conditions?

Recognizing existing conditions that may have the potential to alter or degrade existing fish habitat are essential in identifying steps needed to reverse or improve such trends.

2.4 What opportunities are available to minimize or reduce the effects of potential risks to fish habitat?

This question should identify actions that may be needed to reverse altered or degraded fish habitat.

Issue 3: Threatened, Endangered, Sensitive, (TES) and Survey and Manage (S&M) Species

3.1 What is the distribution and abundance of TES and S&M species within the analysis area?

This question involves identification of known populations, habitat availability, and risks to populations. This is the first step to establishing if and what types of enhancement/management opportunities are needed or desirable.

3.2 What is the importance of the watersheds to TES and S&M species locally and within a larger geographic area?

The importance of these watersheds to these species and their role in maintaining viability on the Shasta-Trinity National Forest and larger geographic areas will assist in prioritizing species, management objectives and limited human and natural resources.

3.3 Are there opportunities to enhance habitat conditions?

Given the current habitat conditions and management direction what actions are needed to maintain viable populations of TES and S&M species. This may include thinning of young stands to promote growth toward late-successional forest, or surveying for plant or animal species with little distribution information.

Issue 4: Fire and Fuels

4.1 What is the fire history within the watersheds and what are the contributing factors?

Historical fire regime(s) for the watersheds how and why they have changed. How fire management strategies have effected historical fire occurrences and intensities.

4.2 What and where are the critical resources at risk?

Human improvements and environmental resources at risk of being negatively impacted by future wildfires within the watersheds.

4.3 What management activities can reduce the risk of fire?

What types of fuel treatments and/or fire management strategies would have the most effect on reducing the impacts of future wildfires.

Issue 5: Commercial Wood Products

5.1 What harvest levels are ecologically and environmentally sustainable from Matrix land in the watersheds?

Section 3 - Current Conditions

Geology

The Upper South Fork and the Happy Camp watersheds are underlain by a single geologic formation whose rocks have been dated as forming between the Lower Cretaceous and Upper Jurassic period (120 to 150 million years old) The formation is composed of two members commonly referred to as the Franciscan Formation and the South Fork Mountain Schist. The South Fork Mountain Schist is referred to as the Pickett Peak Terrane by Irwin and others (1974). Virtually all of the watershed analysis area is within the Coast Range geologic province. The analysis area is bounded on the east by a major inactive fault called the Coast Range Thrust Fault (a.k.a. South Fork Fault). The main stem of the East Fork South Fork and the main stem of the South Fork Trinity River have eroded canyons that now flow along this fault from the headwaters to near Hyampom, California.

South Fork Mountain schist is typically a fine-grained mica and quartz rich metamorphic rock which is widely reported as being very unstable and prone to mass movement and deep gully erosion (Haskins 1981, Haskins and others 1980, CDWR 1979). South Fork Mountain schist underlies virtually all of the Happy Camp watershed, and most of the Upper South Fork watershed lands located to the north and northeast of the main stem of the South Fork Trinity River. South Fork Mountain Schist is metamorphosed Franciscan Formation sedimentary rocks.

The Upper South Fork Compartment lands located roughly south and southwest of the main stem South Fork Trinity River are underlain by Franciscan Formation lithologies, some of which are slightly metamorphosed. Rocks of the Franciscan Formation consist primarily of inter-bedded sandstones, mudstones and conglomerates, and at least locally containing lenses of thin-bedded red radiolarian chert and sparse mafic volcanic rocks (Irwin and others 1974). Franciscan rock types present in the Upper South Fork compartment are generally very competent and relatively stable compared to the same rock types present elsewhere throughout the Coast Range Province.

Geologic Hazard

Both deep-seated and shallow-landslide slope stability hazards exist within the analysis area. Many of these hazards can be expected to be located along inner gorge hillslopes, associated with ancient landslide deposits or landslide source areas, within steep headwall swale areas and below major breaks-in-slope anywhere on the landscape. Slope stability hazard, as defined by the U.S. Forest Service (Haskins and Chatoian, 1993) involves dividing landforms into areas and ranking each landform as to its risk of actual or potential failure via landslide processes. The analysis is referred to as an Ecological Unit Inventory and is used as an important planning tool in laying out proposed timber sales. No hazard analysis has been performed for the watershed analysis area.

Past timber harvesting and road construction has occurred across a variety of hillslopes each possessing a complex mix of geologic, topographic, geomorphic and sub-surface hydrologic characteristics. Each particular past and future harvest unit would have a relative slope stability hazard rating or risk of failure with or without harvesting. Depending on the level and extent of geologic review for each past and future harvest unit, the likelihood of not recognizing and delineating unstable or marginally stable land is potentially high.

The current lack of qualified geologic expertise to conduct timber harvest slope stability hazard evaluations within the STNF poses a risk of accelerating hillslope landslides and affecting existing in-stream habitat conditions.

The 1995 color aerial photos display few, recent streamside or inner gorge debris slide throughout the analysis area. Streamside hillslopes both along the main stem of the South Fork, and along most tributary streams appear stable. With the exception of discontinuous opening to the main stem riparian canopy, most tributary streams display essentially closed canopies. This, coupled with the lack of major channel and riparian damaging storm effects in the past, is interpreted to indicate most tributary streams have relatively stable and self functioning riparian zone to active channel linkages.

Vegetation

Current vegetative conditions were analyzed with the use of timber inventory data collected for the 1990 Land and Resource Management Plan (LRMP). Delineated stands were classified according to the LRMP timber stratification, wildlife habitat stage (Mayer and Laudenslayer 1988) and seral stage (USDA Forest Service 1994) (Table 3-1).

Landscape Ecology

The Upper South Fork watershed is characterized by medium density mixed conifer communities. Ponderosa pine and Douglas-fir comprise the predominant species at mid-elevation sites, with lesser stocking of sugar pine, incense cedar, and white fir. Higher-elevation mixed conifer sites are comprised of predominately white fir, with lesser degrees of stocking of associated conifer species. Lower-elevation mixed conifer sites have reduced stocking levels of white fir, with increased stocking levels of ponderosa pine. The highest elevation sites within the unit are comprised of stands of mostly pure red fir. California black oak comprises a significant stand element at mid to lower elevation mixed conifer sites, especially on better sites. Mixed conifer plantations account for approximately 13 percent of the analysis area.

The Happy Camp watershed is generally characterized by medium density mixed conifer communities. Douglas-fir comprises the predominant species at mid-elevation sites, with lesser stocking of ponderosa pine, sugar pine, incense cedar, and white fir. Higher-elevation mixed conifer sites are comprised of predominately white fir, with lesser degrees of stocking of associated conifer species. Lower-elevation mixed conifer sites have reduced stocking levels of white fir, with increased stocking levels of ponderosa pine. The highest elevation sites within the unit are comprised of stands of mostly pure red fir or red/white fir mixes. California black oak comprises a significant stand element at mid to lower elevation mixed conifer sites, especially on better sites. Mixed conifer plantations account for approximately 9 percent of the analysis area.

Grasslands

This plant community is predominantly found in the Upper South Fork watershed, where scattered grasslands comprise 680 acres of the watershed. The largest of these grasslands are found in the Yolla Bolla Wilderness between Brooks and Fischer Ridges and within the Penny Glades area. The presence of these grasslands is probably a result of the soils (Yollabolly and Goulding families-Rock outcrop complexes) which characteristically are composed of grassland and shrub species. Other small scattered grasslands are found around West Low Gap, below Hermit Rock, Jensett Cabin, and Shell Mountain Creek.

A site visit to Penny Glades was made on September 30, 1998 to make a qualitative assessment of the plant species found on these glades. In surveying the area, it was found that both native and non-native grasses were growing on the site. The dominant presence of non-native grasses and forbs suggests that disturbance, particularly from cattle grazing, has altered the composition of species within the glades.

Montane Shrub

This 1660 acre plant community is found predominately in the Upper South Fork watershed, where extensive stands are found from Rainbow Ridge in the western part of the watershed down to the 27N23 road at the southern end of the watershed. Other shrub communities are distributed between the Mule and Powell ridges in the center of the watershed. The majority of these shrub communities are composed of a mosaic of buckbrush, whitethorn (*Ceanothus cordulatus*), mountain mahogany (*Cercocarpus betuloides*), and green and whiteleaf manzanita.

Table 3-1. Vegetation type, size classes and densities excluding private land.

Vegetation Type	Size[1]	Density[2]	Happy Camp (acres)	Upper S. Fork (acres)
Douglas-fir	2	P	0	18
		N	85	43
		G	226	98
	3	S&P	1180	3477
		N	560	2054
		G	1415	1196
	4	P	55	118
		N	244	288
		G	13169	8053
	6	G	78	151
white fir	2	S&P	124	0
		N	74	0
		G	244	0
	3	S&P	310	535
		N	142	371
		G	805	167
	4	N	58	0
		G	578	224
red fir	2	P	0	3
	3	S&P	0	87
		N	0	6
		G	0	10
ponderosa pine	3	S&P	11	255
		N	7	0
mixed conifer	2	P	7	0
	3	S&P	0	68
		N	0	106
		G	0	27
	4	N	0	28
		G	0	164
plantations			1879	3082
hardwoods			41	737
riparian			200	17
misc.shrubs			99	23839
herbaceous			171	1250
barren and other			0	31
Total			21810	26503

*[1] Size classes refer to crown diameters in feet as follows: **1**= 0-5, **2**= 6-12, **3**= 13-24, **4**= 25-40, **5**= 40+, **6**= 40+ with a second understory canopy.*
[2] Density classes refer to crown cover percentages: S= <20, P= 20-39, N= 40-69, G= 70+

Montane Hardwood

Two types of montane hardwood communities are found within the watersheds. The largest community, comprising 654 acres in the Upper South Fork watershed, consists of canyon live oak (*Quercus*

chrysolepis). The largest stands of canyon live oak are found in the Yolla Bolla wilderness, below Brooks Ridge, with other stands distributed between Mule and Powell ridges. The second hardwood community is Oregon white oak (*Quercus garryana*), which comprises a single 40 acre stand around and below Cedar Gap in the Happy Camp watershed, and 164 acres in the Upper South Fork watershed, mainly around South Kelsey Peak.

Riparian Vegetation Communities

Forest vegetation GIS layers, stream inventories, and field reconnaissance were used to assess current riparian conditions within the analysis area. The majority of riparian stands within the analysis area are composed of vegetation size class 4 and above, (Table 3-1) composed largely of Douglas and White fir, with canopy closures ranging between 70-80%. Future course woody debris (CWD) recruitment in these stands is excellent, with some of the highest recorded volume measurements in the Trinity Basin (James unpublished).

Riparian vegetation composition within the watersheds is influenced by channel aspect, gradient, geomorphology, and hydrologic regime, as reflected by stream order. Upland plant communities located on the valley bottom floor or toeslope positions contribute shade and large wood to the system. Many riparian areas host relatively high numbers of large trees as compared with the adjacent uplands, presumably due to a favorable topographic position (protected from intense stand replacing fires) and environment. Communities well-adapted to the moist conditions of the riparian zone are present and often consist of species that are tolerant of saturated soils associated with frequent flooding or a high water table. Additionally, opportunistic “pioneer” species may colonize in these areas characterized by repeated disturbance.

Hydrologic regime and stream geomorphology appear to be the most significant factors determining species composition within the riparian area. Riparian vegetation ranges from absent in the driest ephemeral and intermittent streams, to bigleaf maple/white alder/Pacific yew in first order channels that are moist enough to support perennial riparian species. Where the channel contains an intermittent, sclerophyllous species, including prince’s pine and dwarf Oregon grape frequently co-occur with more hydrophytic species. Big leaf maple is ubiquitous, occurring in both perennial and intermittent channels, but white alder, mountain dogwood and Pacific yew appear to be limited to higher-order channels where water availability is greater year-round. Alder occurs most frequently on active channel shelves and floodplains where frequent flooding and high light levels permit establishment. Pacific yew occurs on floodplains, terraces and stream banks at moist sites, and is frequently associated with old-growth Douglas-fir and a well established shrub component of dogwood and/or California hazel.

Riparian areas where disturbance has affected the conditions of stands, include areas burned during the Hermit and Rock fires (Upper South Fork and tributaries between Hermit Rock and Penny Ridge), and areas in the headwaters of Cable, Rough Gulch, and Bierce Creek watersheds, where historic fires and past land management activities have produced stands that are currently in plantations, and vegetation size classes 2 and 3. These areas are generally dominated by dense overstocked stands and represent areas where conditions are less than optimal for healthy aquatic ecosystems.

Isolation appears to influence the distribution of riparian plant communities. The degree to which a channel is incised determines to some extent the amount of solar radiation received by, and the relative humidity of, that channel environment. Due to microclimatic factors at channel confluences, riparian vegetation may persist for several hundred feet up a tributary that would otherwise not support hydrophytic species.

Rough Gulch Research Natural Area (RNA)

The 4,682 acre Rough Gulch RNA is located in the Happy Camp Watershed between Chinquapin Butte and the summit of South Fork Mountain. This area was designated as an RNA in order to protect the unique biological components of the watershed for the purpose of preservation and ecological study, and to protect genetic diversity and habitat of sensitive plants and wildlife. Within the RNA there are exceptional stands of virgin old-growth forest, and populations of two sensitive plant species: pale yellow sedum and clustered green-gentian.

In proposing this area as an RNA, several studies were conducted within the research area. These consisted of a detailed ecological evaluation by Dr. Keeler-Wolf (1984), and two plant and wildlife species lists (Keeler-Wolf 1991, Downer 1993). From such studies it was found that the Rough Gulch RNA has a varied mosaic of plant communities, with mixed Douglas-fir forest the most extensive. As reported by Keeler-Wolf, the Douglas-fir forest of the RNA is highly variable with a unique species composition, most notably the Douglas-fir/Giant Chinquapin (*Castanopsis chrysophylla*) association. Other species that are commonly found in mixed Douglas-fir stands include ponderosa pine (particularly on southwest faces and ridgetops), white fir at higher elevations, incense cedar (*Calocedrus decurrens*), big-leaf maple (*Acer macrophyllum*), yew (*Taxus brevifolia*), and hardwoods such as madrone (*Arbutus menziesii*), canyon live oak, black oak (*Quercus kelloggii*).

Other plant communities within the Rough Gulch RNA include mountain chaparral, which is found at the upper elevations of the RNA above 5,500 ft, mostly around Chinquapin Butte and Horse Ridge Lookout. The mountain chaparral occurs mostly as a successional community after intense fires or timber harvesting, and much of the shrub community is being invaded by white fir from lack of fire. There are twelve shrub species that are mostly commonly found in this community, which include huckleberry oak (*Quercus vaccinifolia*), manzanita species, chinquapin species (*Castanopsis* sp.), mountain whitethorn, and silktassel (*Garrya fremontii*).

Wildlife Habitat

Late Successional Reserves

The objective of the LSR land allocation is to provide habitat for plant and animal species that are associated with late successional and old growth habitats. In combination with the standards and guidelines for other land allocations they are designed to maintain a functional, interactive, late-successional and old growth forest ecosystem (USDA and USDI 1994). There are two designated LSRs (RC-330 & RC-228) within these watersheds. LSRs are a significant influence to land management within these watersheds as approximately two thirds of Happy Camp and just under one fourth of Upper South Fork is in this land allocation. Additional areas managed as LSR within the Upper South Fork watershed are the 100-acre core areas for the four pairs of northern spotted owls that are in the Matrix land allocation and two pairs that are in Administratively Withdrawn land allocations. All of the known pairs of northern spotted owls within the Happy Camp watershed reside within the LSR. Approximately 2,110 acres of private lands within the LSR boundaries are not part of the LSR nor are they managed for late successional habitat. There are approximately 1,848 acres of Forest Service plantations in the LSR portion of Happy Camp and 1,183 acres in the LSR portion of Upper South Fork.

Late Successional and Old Growth Habitat

Many of the wildlife species of concern that are known or suspected to occur in these watersheds are associated and/or dependent on late successional and old growth habitat. Some associated species depend on a wider range of stand characteristics while others depend on only the oldest and largest trees. The

majority of old-growth dependant species find suitable habitat within stands in size classes 4-6, with 25 foot or greater crown diameters and crown closure densities exceeding 40%. Stands within size class 6 provide the highest quality habitat but are rare and found within the least accessable portions of the watersheds. The size class 6 stands represent some of the oldest and rarest stands.

Table 3-2. Acres of late successional and old growth habitat on LSR lands and all Forest Service lands in the Happy Camp and Upper South Fork watersheds.

	Happy Camp		Upper South Fork	
veg stratum	LSR	Total	LSR	Total
4N	55	302	8	316
4G	10,758	13,747	2,815	8,441
6G	78	78	49	151
Total	**10,891**	**14,127**	**2,872**	**8,908**

In the Happy Camp watershed 58% of Forest Service lands are late successional/old growth habitat, among the highest watershed percentage on the Shasta-Trinity National Forest (Figure 3). Because of the excellent quantity and quality of late successional habitat, it is likely that this watershed acts as a "source" for other less productive watersheds. Habitat in the Happy Camp watershed is fragmented by harvest activity on four parcels of private land and Forest Service plantations. Additionally there are scattered areas of size class 2 and smaller stands along the top of South Fork Mountain as well as along the roads surrounding Wilcox Ridge and the Chinquapin Butte area.

For the Upper South Fork Watershed, late successional/old growth habitat comprises 33% of all Forest Service lands (Figure 4). Late successional habitat is found in smaller more fragmented patches than in the Happy Camp watershed but is still well distributed. Seven thousand six hundred acres in the central and northeastern portions of the watershed burned in severe fires in 1988 and 1996, leaving a large parcel of early-seral habitat unsuitable for species adapted to late-seral conditions. Road densities are higher in this watershed and reflect a higher level of green and salvage timber harvesting than in the Happy Camp watershed.

Dispersal Habitat

Dispersal habitat for forest interior species includes all of the late successional habitat mentioned above plus mid-sized stands (size class 3 and some older and larger size class 2 stands) that have at least 40% crown closure. Within the Happy Camp watershed 65% of the watershed is in late successional habitat and an additional 14% is suitable for dispersal leaving less than 21% as unsuitable for dispersal (Figure 5). In the northwest and southeast portions of the watershed, large Forest Service plantations and adjacent private lands form the largest gaps in dispersal habitat. In the Upper South Fork watershed, an estimated 33% of the Forest Service lands are in late successional habitat and an additional 15% is suitable for dispersal leaving an estimated 52% of the watershed as unsuitable for dispersal (Figure 6). Large fires in 1988 and 1996 define the largest dispersal habitat gaps in the Upper South Fork with much of the area salvage logged and currently in plantations. The areas that burned within the Yolla Bolla Wilderness area were not replanted and are currently dominated by brush.

Dispersal opportunities into adjacent watersheds are good in most directions. Suitable dispersal corridors to the northeast lie along the South Fork Trinity River through the middle of the Smoky Creek watershed and the southern portion of the East Fork watershed. To the southwest, in the Upper Mad River watershed, early successional habitat dominates and dispersal habitat is highly fractured with many gaps. Dispersal habitat north of Chinquapin Butte is much better. The South Fork Cottonwood Creek watershed, to the east of the Upper South Fork, and the Middle Eel watershed to the south, are within the Yolla Bolla Wilderness. Habitat conditions will remain natural and should promote good dispersal opportunities.

Snags and Down Logs

Densities of snags 15 inches in DBH or greater typically range from 4+ per acre in natural late successional stands to few or no snags in plantations that were established 10 or more years ago. Between these two ends are areas that have had selective harvesting where the majority of the stand remains. In the Happy Camp watershed seven visual snags plots were conducted in roadside stands along South Fork Mountain Ridge. Average snag densities of 2.5 per acre were calculated for these 3G and 4N stands that have had some selective harvest in the past. More intensively managed areas typically have one or fewer snags per acre. Even where more snags and recruitment trees were retained post harvest, the loss of the majority of the stand leaves them susceptible to windthrow. Thoroughly charred snags in fire areas are not much use to wildlife because they harbor fewer insects and other prey species, do not have suitable cavities, and fall down much earlier when compared to snags that died and decayed over a longer period of time. Also snags that are a great distance from green forest cover have less utility. The ideal arrangement for many wildlife species is abundant snags in a dense green forest or solitary and groupings of snags in open areas with nearby forest stands. Down logs levels and diameters logically parallel those of snags with natural unharvested stands having abundant large logs and plantations with site preparation having the least. Log densities are typically higher than snag densities since snags eventually become down logs.

Since the Happy Camp watershed has a lot of late successional habitat that has never been harvested one can expect to find an great abundance of large diameter snags and logs in this habitat. However snags and logs would be lacking in the almost 2,000 acres of plantations within this watershed. Upper South Fork has less late successional habitat and therefore less green stands with abundant large snags and logs and about 3,082 acres of plantations with few or no snags. Within the large scale forest fire areas of the Upper South Fork watershed many snags are left on the acres that had little or no salvage logging. Snags and logs that are charred and or isolated from other forest vegetation have limited wildlife use. Uncharred snags and logs do provide wildlife habitat however, especially where they occur near green forest stands at the edges of the fire areas.

Fish Habitat

Stream Channel Morphology

Stream channels in the headwaters of the analysis area are characterized as high energy, low order streams with steep stream gradients and sideslopes which often exceed 70%. These channels function largely as transport channels, readily delivering CWD, bedload, and finer sediment and organic material to downstream channels. Debris torrents and inner gorge slides can occur frequently in these channels and are the primary disturbances associated with CWD and sediment recruitment and delivery. Available fish habitat is limited in these lower order channels due to steep gradients, poor rearing habitat, and absence of suitable spawning gravels.

As stream channels progress downstream into higher order channels, utilization by resident and anadromous salmonids increase. Streams containing fish are comprised largely of A and B Rosgen type stream channels (Rosgen 1996). These channels are high to moderately entrenched, with low to moderate sinuosity, and have channel slopes between 2 and 10%. Bedload and CWD are routed fairly easily through these reaches during periods of higher stream flows. While bedrock and other structural features are largely responsible for shaping channel features such as residual pool depth and width to depth ratio, CWD plays an important role in providing cover, additional channel complexity, as well as nutrients in these systems, which are generally considered to be nutrient poor. Stream inventories completed on the Upper South Fork indicate that CWD densities are comparable with those of unmanaged stream in the Trinity River Basin (James unpublished).

A trend toward increasing pool depths appears to be occurring within the South Fork Trinity River. Johnston (East Fork/Smoky WA 1998) reported that 28 pools greater than 6 feet in depth were recorded from the East Fork confluence to Forest Glen during a 1989 stream inventory. Since then this number has increased to 48 pools (USFS 1998), indicating that the South Fork may be in a state of recovery from the effects of the 1964 flood. Recent stream inventories on the Upper South Fork indicate similar trends in pool quality improvement (USFS 1997).

Elevated levels of fine sediment have been recorded for most of the South Fork (USFS 1989; Jong and Borok 1997). Literature on the effects of fine sediment on juvenile coho fry emergence indicates that egg to fry survival can decrease when percentages of fines less than 0.85 mm exceed 20% (Tagart 1976, Koski 1966). An assessment of spawning gravels on the South Fork revealed that sediment finer than 0.85mm ranged from 14 to 20% of the total (Jong and Borok 1997). During spring chinook spawning season, visual inspection of riffle crests revealed that most fine material was located in the first few inches, with suitable spawning substrate below. Additionally, inspection of redds seemed to indicate that most fines were removed from redds during construction. However, egg to fry survival may be most impacted by spring flows which may deposit a fresh layer of fines on redds, thus reducing egg to fry survival. Fine sediment levels in the Upper South Fork appear to be similar to conditions in the South Fork except where stream channels are steep and confined (Rosgen A-type characteristics).

Water Temperatures

Elevated water temperatures have been considered a limiting factor in the production of salmon and steelhead populations on the South Fork (PWA 1994, USFS 1989). However, a recent assessment of historic and current water temperature regimes may indicate that current water temperatures in the South Fork are within the historic range of variability, and are likely controlled by topographic (elevation) and geomorphic (channel width) variables (Farber et al. unpublished). Reiser and Bjorn (1979) found that 68.4ºF to be the upper limit considered to be optimal, and 75ºF the upper limit considered to be lethal for salmonids. Based on stream temperatures collected between 1989 and 1997, the majority of the watersheds which drain into the South Fork, as well as approximately half of the reaches sampled for 7-day maximum temperatures on the South Fork currently are at or below 68.4ºF (Farber et al. unpublished).

Dominant Ecological Processes Shaping Fish Habitat

Salmonid habitats are the products of geology, soils, topography, vegetation, climate, and hydrology of a watershed (Meehan 1991). Natural disturbances such as fires, floods, and mass wasting have played integral part in the development, maintenance, and variation in the quantity and quality of habitat on the South Fork. In some areas, land management activities such as timber harvest, road construction, and fire suppression have aggravated the effects of natural disturbances on fish populations by altering flow, sediment delivery, and fire regimes. Mass wasting areas, increased levels of fine sediment and degraded riparian areas have been observed in many tributaries of the Upper South Fork as a result of recent stand replacing fires, and may have been intensified by localized land management activities.

Mining and grazing activities have had little effect on fish habitat within the analysis area. The South Fork has never been considered a productive mining area (Baker 1982), with only one large scale placer mining operation located above the river at the Klondyke Road. Grazing activities have had even less an effect. Although cows have been observed along the South Fork and Upper South Fork during the late summer and early fall, they do not alter or degrade channel morphology or riparian areas to the extent that fish habitat is affected (James pers. obs.). Timing of allotment closure and onset of chinook spawning overlap very little, making the likelihood of salmon redd destruction minimal.

It should also be noted that habitat conditions and land management practices outside of the South Fork may have adverse effects on anadromous fish populations. Since the construction of the dams on the Trinity and Klamath Rivers, historic flow and temperature regimes have been greatly altered, which may have habitat and behavioral effects on adult and juvenile salmonids migrating and emigrating to and from the South Fork. Additional impacts associated with variations in climatic and ocean conditions, reductions in ocean food sources, and commercial mixed-stock harvest can also negatively impact salmonid returns (The Forest Foundation 1998, PWA 1994, Nehlsen et al. 1991). Kaczynski (1998) reported that ocean survival for coho salmon has gone from an average of 6.5 percent between 1965-75, to 3.2 percent from 1976-90, to 1.2 percent between 1991-97, based on the returns of all hatchery coho from Washington, Oregon, and California.

Threatened, Endangered, Sensitive, and Survey and Manage Species

Plant Species

Suitable habitat for sensitive and endemic plant species exists, but little field survey work has been done to verify the existence of known populations. Several other Survey and Manage species, particularly non-vascular lichens and bryophytes, and fungi occupy known sites within the watersheds.

There are no federally listed Threatened or Endangered plant species known to occur on the Shasta-Trinity National Forests. Water howellii, a listed species known to occur in seasonal ponds or vernal pools on the Mendocino National forest, may occur. GIS records indicate no lakes or ponds within the watersheds aside from a small body of water near South Fork Mountain, possibly a stock pond for livestock or wildlife. No field surveys have been done to verify presence or absence of this species.

Only one sensitive species is known to occur within the Upper South Fork and Happy Camp Watersheds. *Frasera umpquaensis* is found in meadow edges and openings along the highest elevations on the South Fork Mountain ridgeline, including a portion of the population to the north of the Happy Camp watershed. The California range of this species is restricted to 12 populations (possibly including subpopulations) on South Fork Mountain, with all other populations in Oregon.

The amount of quality habitat for this species has decreased with successional conifer encroachment, recreational camping, and livestock grazing. Threats from timber harvest activities are greatest because habitat usually lies within commercial timberland. Loss of individuals or populations from management activities in the watersheds may not impact the species as a whole, but would be important to the localized distribution in California.

Standards and Guidelines within the Shasta-Trinity National Forest give direction to protect and manage for endemic plant species as for sensitive plant species. One of these species has potential to exist within the watersheds, *Arnica venosa*. Habitat includes ridgetops and old road cuts in mixed conifer/oak forest, which is fairly stable within the watersheds. Despite being a narrow endemic with a restricted distribution, this species has shown a positive response to ground disturbance and is not likely in danger of losing a significant number of individuals from management activities. As with the sensitive species, little field survey work has been done to determine presence or absence of this species.

Sensitive Plant Species

Seven plant species on the Regional Forester's Sensitive Plant List have potential or are known to exist within the Upper South Fork and Happy Camp Watersheds (Table 3-3).

Table 3-3. Sensitive Plants known or suspected to occur within Watershed Analysis area.

Sensitive Plant Species	Habitat	Acres of Suitable Habitat	Known Populations
Fascicled lady's-slipper *Cypripedium fasciculatum*	Moist, cool sites found primarily in riparian zones, also in canopy gaps in older Douglas-fir or mixed conifer forests. Wide ranging in elevation	39153 (including 5362 acres in riparian)	no
Mountain lady's-slipper *Cypripedium montanum*	Similar to fascicled lady's-slipper	39153 (including 5362 in riparian)	no
Umpqua green gentian *Frasera umpquaensis*	Cool, moist Douglas-fir/white fir forest margins or openings between 5000 and 6000 feet	7142	yes
Canyon Creek stonecrop *Sedum paradisum*	Shaded rock outcrops in forest or woodland openings. Wide ranging in elevation	17441	no
Oregon willow herb *Epilobium oreganum*	wet, gently sloping stream banks, meadows and bogs on ultramafic soil. Wide ranging in elevation	58	no
Stebbin's madia *Madia stebbinsii*	Rocky, ultramafic semi-barrens in pine forest types	104	no
English Peak greenbriar *Smilax jamesii*	Shaded riparian habitat above 4000 feet	212	no

Mountain and fascicled lady's-slippers

A large percentage of both watersheds provides habitat for the two lady's-slippers, although the highest quality habitat is found within riparian zones which occupy a much smaller area. The amount of suitable habitat in riparian areas has increased since reference periods as overstory shade has increased, but has decreased in upland sites where management activities have caused ground disturbance and loss of overstory. Many populations of fascicled lady's-slipper can be found in openings in mixed conifer and white fir stands on the Six Rivers National Forest, however known sites are restricted to shady streamside zones on the Shasta-Trinity. Informal studies throughout western United States have shown mixed results from treatments within riparian reserves and further study is needed on disturbance and canopy cover needs.

No populations of either species were found within the analysis area during surveys in a small number of riparian areas within red fir, Douglas-fir, and white fir zones in 1998 and there are no records of field surveys in the rest of the watersheds. While populations tend to be limited to low numbers of individuals, both species occupy a wide range of habitats and are widespread outside of California, so loss of individuals within the watersheds would have little effect on the species as a whole or on the Shasta-Trinity National Forest.

Canyon Creek stonecrop

GIS records indicate a large portion of the analysis area includes soils with rock outcrops, habitat for this species. Informal field surveys on parts of the watersheds in 1998 found no *Sedum* species growing on the schist and metasedimentary soils which dominate the area, but many other sites are unsurveyed. There are two known populations of *Sedum laxum* var. *flavidum* within the Rough Gulch Research Natural Area, indicating suitable habitat for Sedum species in general.

This species is a narrow endemic found only in Shasta and Trinity counties in California. Only five populations are known to exist, primarily in the Trinity Alps, and loss of individuals or populations could impact the species as a whole. It is possible that lack of fire suppression and increasing conifer density could play a part in increasing habitat for Canyon Creek stonecrop by providing additional shade on

outcrops, but this trend could be reversed in the event of stand-replacement fire resulting from overstocked stands. Placement on rock outcrops is keeping threats to individuals low, and commonly used mitigations of directional falling will keep physical impacts to a minimum.

Oregon willow herb and Stebbin's madia

Serpentine soils in the project area are limited to less than 1% of total area, as are springs and rocky openings. It is unlikely either of these species exists within the watersheds, but without formal surveys, this cannot be stated for sure. Spring areas recieve only light use by livestock and wildlife and have not been degraded extensively to date. Rocky openings over serpentine soils are almost nonexistent, but also have not been surveyed to confirm presence or absence. Oregon willow herb is a candidate for state listing in Oregon, but has been verified in several counties in northern California. Stebbins madia is localized to the intersection of Shasta, Trinity, and Tehama counties with only 10 known populations or subpopulations. Oregon willow herb is not threatened by management or recreation acitivities, but Stebbins' madia may be threatened by road maintenance.

Survey and Manage Plant Species

Table 3-4. Survey and Manage Plant species within the Watershed Analysis area.

Survey and Manage Vascular Plant Species	Strategy	Habitat	Acres of suitable habitat	Known Populations
Sugar stick *Allotropa virgata*	1,2	a wide variety of forested habitats, most often in red fir; or tanoak on coastal sites.	1892	Possibly near Forest Glen
Fascicled lady's-slipper *Cypripedium fasciculatum*	1,2	mesic conifer and/or hardwood forest, especially riparian zones; also canopy gaps in conifer forest	39153	no
Mountain lady's-slipper *Cypripedium montanum*	1,2	mesic conifer and/or hardwood forest, especially riparian zones; also canopy gaps in conifer forest.	39153	no

Sugar stick

This species is found most often in highly porous soils, such as pumice, in the southern and central Cascade mountains. It is found widely on the Six Rivers National Forest in tanoak or tanoak/Douglas-fir stands at low to mid-elevations. It is found in a wide variety of other forest types, most often in association with red fir on the Shasta-Trinity National Forest. It could exist anywhere in the watershed where older conifers and abundant rotted woody material is found on the ground. Specific critical habitat requirements have not been defined, other than the need for higher soil porosity, so it is difficult to determine whether the amount of habitat has increased or decreased since reference times. This species occurs in wide distribution from British Columbia and Idaho south to northern California, and has proven to be more common than originally thought in Oregon and Washington. Loss of individuals within the watersheds would have little importance to the viability of this species on the Shasta-Trinity National Forests or the range of the species as a whole.

Non-vascular Plant Species

Species within Group 1 (Table 3-5) can be found in conifer forest or conifer/hardwood forest with a high component of conifer species. Habitat requires the shade, decayed logs, and thicker duff/organic matter layers provided by mature, late-seral stands. This is provided in the higher elevations of the two

watersheds, generally above 3000 feet where white fir integrates into stands. While the range of suitable habitat has probably increased slightly in response to the expansion of the true fir range, the increase has probably been balanced by past timber harvest activities which have set sites back to early-seral conditions. *Gomphus floccusus* and *Hydnum repandum* occur near Cold Spring within the Happy Camp watershed.

Species within Group 2 occupy lower elevation sites dominated by hardwood species, primarily canyon live oak, black oak (upland), or bigleaf maple (riparian/upland), less than 150 years of age. *Ulota megalospora* is restricted to riparian areas. Most live oak stands in the watersheds have remained relatively undisturbed through time aside from road construction due to low commercial value. *Lobaria hallii* occurs near Cold Spring within the Happy Camp watershed. Only two lichen species, *Lobaria linita* and *Lobaria hallii*, require management of known sites or surveys prior to planned activities.

Little information is available on habitat requirements of non-vascular plant species and fungi as compared to that available for vascular plant species. In addition, rarity of these species can be at least partially attributed to their small, non-descript nature which causes them to be overlooked in the field. Field surveys are in their infancy for these species and some may prove to be more common than thought over time, but caution and a conservative attitude are the appropriate course of action until more is known.

Table 3-5. Known or suspected Survey and Manage non-vascular plant species within the Watershed Analysis area.

Survey and Manage Non-Vascular Species	Strategy	Habitat	Known Populations
Group 1			
Ptilidium californicu (liverwort)	PB,1,2	large diameter white fir between 3000 and 5000 feet.	no
Tetraphis geniculata (moss)	PB	decay class 4 and 5 stumps and logs	no
Buxbaumia viridis (moss)	PB	heavily decayed logs in dense shady conifer forest	no
Polyozellus multiplex (fungi)	PB	occurs in association with roots of true fir species in mid-elevation conifer forests	no
Gomphus floccosus (fungi)	3	occupies the duff layer of Douglas-fir and white fir stands	yes
Hydnum repandum (fungi)	3	occupies the base of white fir trees in mid-mature and older stands	yes
Group 2			
Lobaria linita (lichen)	1,2,3	boles of hardwood species	no
Ulota megalospora (moss)	PB	riparian hardwoods below 5000 feet	no
Lobaria hallii (lichen)	1,3	bigleaf maple and black oak in Douglas-rir/black oak and Douglas-fir/maple associations	yes
Leptogium saturninum (lichen)	4	moss covered rocks or soil	yes
Peltigera collina (lichen)	4	live oak, black oak and bigleaf maple in various conifer/hardwood associations	yes
Collema nigrescens (lichen)	4	live oak, black oak, white oak and bigleaf maple in various conifer/hardwood associations	no
Lobaria pulmonaria (lichen)	4	live oak and maple, in Douglas-fir/live oak and Douglas-fir/maple associations	no
Nephroma helviticum (lichen)	4	live oak, black oak and bigleaf maple in various conifer/hardwood associations	yes
Nephroma resupinatum (lichen)	4	live oak, black oak, white oak and bigleaf maple in various conifer/hardwood associations	no
Pannaria saubinetii (lichen)	4	live oak in Douglas-fir/live oak association	no
Pseudocyphellaria anomala (lichen)	4	live oak and black oak in various conifer/hardwood associations	no
Pseudocyphellaria anthraspis (lichen)	4	live oak, black oak, white oak, and bigleaf maple in various conifer/hardwood associations.	no

Wildlife Species

The following information was obtained from wildlife surveys that have been conducted in these two watersheds, incidental observations, 1995 aerial photographs, and the most current and available GIS vegetation data.

Bald Eagle

The bald eagle is a federally threatened species that is a year-round resident and winter migrant in northern California. They require lakes or rivers with abundant fish to feed themselves and raise their young. Large riparian trees and snags are needed for hunting perches and nesting platforms (Zeiner et al. 1990). The South Fork of the Trinity River which forms the northeast boundary of the Happy Camp watershed and runs through the middle of the Upper South Fork watershed forms the primary foraging and nesting areas available in the analysis area. Some of the major tributaries to the South Fork including Happy Camp Creek and Bierce Creek are also potential foraging areas. Fish populations are far below historic levels and constitute a significant limiting factor to bald eagle populations. Within the Upper South Fork watershed late successional habitat within one-quarter mile of the South Fork Trinity River is quite fragmented due to large scale forest fires and timber harvesting. This has reduced the availability of large trees for bald eagle hunting perches and nesting sites. In the Happy Camp watershed along the southwest side of the river habitat is much more contiguous with primarily size class 3 and 4 stands that typically contain many large trees.

No bald eagle surveys have occurred in the analysis area. There are no known bald eagle nesting sites and only a handful of recorded sightings. The lack of known nesting areas may be a reflection of survey effort rather than population. Given the limited fish resource, bald eagle populations are not expected to be high but it is reasonable to expect that there may be one or two nesting sites in the watersheds.

Within the Shasta-Trinity National Forests and the state of California, Shasta and Trinity Lakes are more important to maintaining viable populations of bald eagles (Woodbridge 1998) because they support many nesting pairs compared to no known pairs within the Happy Camp and Upper South Fork watersheds. Despite this there is good potential for the analysis area to currently support nesting and that potential would increase if fish populations increase.

Northern Goshawk

This Forest Service Sensitive species is a year-round resident in northwestern California (Zeiner et al. 1990). Northern goshawks have a large species range but low population densities. They use mid to high elevation dense mature mixed conifer and deciduous forest stands near riparian areas for nesting (Zeiner et al. 1990). Their territories range from 0.6 to 15 square miles (384-9,600 acres) (Zeiner e. al. 1990). A rough estimate of available goshawk habitat within the two watersheds was calculated by assuming that half of the 3G and 4N and all of the 4G and 6G conifer stands were suitable (Table 3-1). Based on these assumptions there currently is an estimated 15,086 acres of potential goshawk habitat in the Happy Camp watershed and 9,450 acres in the Upper South Fork watershed.

A few goshawk surveys have occurred in very small portions of these watersheds, primarily in association with proposed management activities. Most of the analysis area has never been surveyed for this species. Within the Upper South Fork watershed, surveys and incidental sightings revealed two established territories, one within LSR land allocation and the other within Matrix/Wildlife Habitat Management land allocation. There are at least five additional goshawk observations not associated with the two territories in this watershed. In the Happy Camp watershed there are two known territories within LSR land allocation and at least 10 additional observations of goshawks not associated with these two territories. Additional goshawk territories and incidental observations are found within two miles of the analysis area

in adjacent watersheds. Based on the amount of available habitat, quantity of incidental sightings and lack of survey effort, it is probable that there are more than the four known goshawk territories within these watersheds.

These watersheds are important to this species locally and within their species range. Of the dozen or so historic and/or currently known goshawk territories on the Hayfork and Yolla Bolla Ranger Districts, four of them are found in these watersheds. The quality and quantity of available suitable habitat and known goshawk territories is among the best on the Shasta-Trinity National Forests.

American Peregrine Falcon

This federally endangered species is a year-round resident and migrant in northern California. Its dramatic increase in numbers over the last 20 years has lead to the current proposal (USFWS 1998) to delist this species. Delisting may occur very soon but it is likely that the species will remain a Forest Service Sensitive species if and when federal delisting occurs.

On the Shasta-Trinity National Forests peregrines use high cliffs with ledges to raise their young. The cliffs are usually near a lake, stream, river or wetland (Zeiner et al. 1990). It preys primarily on birds but occasionally takes mammals and fish (Zeiner et al. 1990). A peregrine habitat survey using aerial photographs and helicopter searches was completed for the Shasta-Trinity National Forests and found no suitable nest cliffs in the analysis area nor within two miles of it (Wilderness Research Institute 1979). There have been two recorded sightings of peregrines in the Happy Camp watershed and four in the Upper South Fork watershed. These watersheds likely provide foraging and dispersal habitat for peregrines but due to the lack of suitable nesting cliffs are not as important as other areas.

Northern Spotted Owl

The northern spotted owl (NSO) is a federally threatened subspecies with a restricted year-round range from just north of Washington state south to northern California. They require large areas of mature forest stands with large trees and snags and high crown closure. They are sensitive to habitat loss and fragmentation (Zeiner et al. 1990). They have high site fidelity and both pairs and territorial singles will establish what we refer to as activity centers (ACs) that may be used for 10 years or longer.

An estimate of available nesting and roosting habitat was calculated using size class 4-6 and crown closure N & G stands as suitable. Additional foraging and dispersal habitat (nesting/roosting habitat is also foraging/dispersal habitat) can be found in adjacent areas that may have smaller trees and less crown closure. An estimate of the quantity of this habitat was made based on 3 N and G, and 4N stands being suitable for foraging. (Table 3-1). These calculations resulted in an estimated 14,127 acres of nesting/roosting habitat and 3,053 acres of additional foraging habitat in the Happy Camp watershed and 8,908 acres of nesting/roosting habitat and 3,975 acres of additional foraging habitat in the Upper South Fork watershed. There are ten known NSO ACs in the Happy Camp watershed and an additional three activity centers have a portion of their home range (1.3 mile radius) within the watershed. Likewise, there are ten known NSO ACs in the Upper South Fork watershed and an additional three activity centers have a portion of their home range within this watershed. The quantity and quality of habitat in the Happy Camp and Upper South Fork watersheds is as good or better than other watersheds and densities of known NSO are among the highest on the Forest.

The U.S. Fish and Wildlife Service designated critical habitat for the northern spotted owl in 1992. This designation is intended to provide habitat that will maintain species viability. Critical habitat area CA-38 encompasses a large proportion of both of these watersheds. Most of it is concurrent with the LSR designation such that there are only slightly fewer acres of Critical Habitat than LSR in each watershed.

Flammulated Owl

The flamulated owl is a “protection buffer” species identified in the Standards and Guidelines for management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl, 1994. These owls are secondary cavity nesters, that is they use holes in both dead and live trees that have been excavated by other wildlife such as woodpeckers (USDA and USDI 1994). No surveys have been conducted for this species within these watershed nor elsewhere on the Hayfork and Yolla Bolla Ranger Districts. There are no identified nesting territories and only a few recorded sightings of this species exist for the Hayfork Ranger District but none are close to these watersheds. Abundant high quality habitat exists in both watersheds and likely there are many flammulated owls present.

White-headed Woodpecker

This is another “protection buffer” species that is a primary cavity nester and requires abundant soft snags 15” DBH or greater for nesting (USFS 1994) and large mature live conifers and snags for foraging (Zeiner et al. 1990). These watersheds have not had any surveys conducted for this species nor are there any known nesting territories. There are recorded sightings of white-headed woodpeckers within 2 miles of the north and east boundaries of the Upper South Fork watershed. Abundant suitable habitat exists in both watersheds so there are likely to be white-headed woodpeckers present, but due to the lack of surveys their population levels are unknown. These watersheds are likely to be quite important to this species due to the abundance of suitable high elevation habitat along South Fork Mountain and other ridges.

Willow Flycatcher

This is a Forest Service Sensitive species and a neotropical migrant which uses shrubby riparian areas and wet meadows for nesting in California (Zeiner et al. 1990). No surveys have been conducted in the Happy Camp and Upper South Fork watersheds. The closest surveys were mist netting stations on the Trinity River (Big Bar Ranger District) plus along Indian Valley Creek and some wet meadows near the town of Hyampom (Hayfork Ranger District). The mist netting stations did pick up juvenile willow flycatchers in late summer and fall. These were assumed to be dispersing birds and no confirmation of nesting at or near these locations has been made. There are no large areas of suitable willow flycatcher nesting habitat in the analysis area but there may be some scattered small pockets of habitat. Given the above mentioned detections on the Shasta-Trinity National Forests it is likely that willow flycatchers disperse or migrate through the analysis area but due to the scarcity of shrubby riparian areas and wet meadows little if any nesting occurs. This would make these watersheds low in importance for this species.

Pygmy Nuthatch

This is a “protection buffer” species that estivates nesting cavities in snags and inhabits mature conifer forests (Zeiner et al. 1990). No surveys have been conducted for this species nor is there any record of sightings for the analysis area. However there is abundant high quality habitat in both watersheds. Given the quality of habitat available these watersheds may be important to this species.

Pacific Fisher

This Forest Service Sensitive species is most often found in mature to late successional conifer forests and deciduous riparian habitats with large snags and greater than 50% canopy closure. They use large hollow trees, snags, logs and windthrown trees for cover and denning (Zeiner et al. 1990). There have not been any surveys in the analysis area specific to fishers however there have been three recorded sightings in

each watershed and many more sightings which were not documented. Suitable habitat is abundant in both watersheds with more acres of it being found in the Happy Camp watershed. These watersheds contain high quantity, quality and relatively unfragmented suitable habitat, and may be important to maintaining healthy populations of this species on the Shasta-Trinity National Forests.

American Marten

The American marten is another Forest Service Sensitive species that, like the fisher, depends on late successional habitat with large trees, snags, and down logs for cover and denning. They are sensitive to human disturbance and even-aged forest management (Zeiner et al. 1990). No surveys have been conducted in the Happy Camp and Upper South Fork watersheds. There has been only one recorded sighting in the Happy Camp watershed and none in the Upper South Fork. Even this one sighting may have been a mistakenly identified fisher rather than a marten. In any case martens are rarely seen on the Hayfork and Yolla Bolla Ranger Districts possibly due to competition and even predation by fishers (Zeiner et al. 1990). Abundant suitable habitat does exist for this species but the lack of sightings indicate they are rare if even present in the watersheds.

California Wolverine

This Forest Service Sensitive species uses a variety of habitats from open areas for hunting to dense forests for cover and reproduction. They frequently travel long distances and occur at low population densities (Zeiner et al. 1990). There have been no known surveys conducted on the Hayfork or Yolla Bolla Ranger Districts. A few wolverine sightings have been recorded on these districts but none within the analysis area. Habitat does exist in the analysis area but high elevation areas in the Trinity Alps may currently be more important for this species on the Forest level than the watersheds in the analysis area and within California.

Bats

There are eight bat species that are Forest Service Sensitive and/or “survey and manage” species which have the potential to occur in the Happy Camp and Upper South Fork watersheds. There are no known roosting sites of any of these species within the watersheds but suitable habitat does occur in both watersheds. Some species such as the hoary bat are migratory and likely to leave the watersheds during the winter months. Others such as Townsend’s big-eared bat, pallid bat and western red bat hibernate as an adaptation to cold temperatures and do not move very far from summer to winter range. Some species such as the fringed myotis and long legged myotis form large colonies which would make one roosting or maternity site very important to the species. All of these bats are sensitive to disturbance of roosting sites and some such as the Townsend’s big-eared bat may abandon a roost site after only a single human visit (Zeiner et al. 1990).

Table 3-6. Survey and Manage bat species and general habitats (Zeiner et al. 1990).

Species	Habitat
fringed myotis	Mixed conifer and hardwood forests; roosts and hibernates in crevices, caves, mines, wooden bridges and buildings.
long-eared myotis	Mixed conifer and hardwood forests; roosts in buildings, rock crevices, snags, under tree bark and caves.
long-legged myotis	Prefers mixed conifer and hardwood forests above 4,000 feet; roosts in rock crevices, buildings, under tree bark, in snags, mines, and caves. Trees are most important for day and maternity roosts.
silver-haired bat	Mixed conifer and hardwood forests; roosts in hollow trees, snags, buildings, rock crevices, caves and under tree bark.
hoary bat	Forests; generally roosts and raises young in dense foliage of medium to large trees.
Townsend's big-eared bat	Uses many different habitats but requires caves, mines, tunnels, buildings or other human-made structures for roosting.
pallid bat	Uses many different habitats but requires caves, rock crevices, mines, and occasionally hollow trees and buildings for roosting.
western red bat	Mixed conifer and hardwood forests; Roosts primarily in trees.

Northwestern Pond Turtle

This is a Forest Service Sensitive species associated with permanent and nearly permanent ponds, lakes, streams and ditches. Riparian and upland areas up to 500 meters from aquatic habitats are used for nesting and overwintering. They may also travel several miles between suitable aquatic habitats (Reese 1996). Suitable habitat exists in both watersheds along the South Fork of the Trinity River, its tributaries, and possibly in some small wetlands. Pond turtles have been found during stream and riparian area surveys and from incidental sightings in both watersheds. Surveys specific to turtles and/or identification of their nesting areas has not occured in these watersheds. Pond turtle population densities within these watersheds is still unknown. On the Shasta-Trinity National Forests the watersheds associated with Hayfork Creek have been better studied and are known to contain some of the highest densities of turtles in the state. On a statewide scale, given the quality of habitat along the South Fork Trinity River and its tributaries, the Happy Camp and Upper South Fork watersheds are probably quite important to this species.

Foothill Yellow-legged Frog

The foothill yellow-legged frog is a Forest Service Sensitive species associated with shallow, partly shaded streams with riffles and cobble sized or larger substrates (Hayes and Jennings 1988). In the Upper South Fork watershed foothill yellow-legged frog adults and tadpoles were found during a 1993 riparian inventory of approximately a five mile stretch of South Fork Trinity River headwaters. Frogs were absent however in areas that had lost shading due to the Hermit Fire (Bashaw 1993). Foothill yellow-legged frogs have also been found in other surveys of the mainstem and tributaries to the South Fork within the Happy Camp and Upper South Fork watersheds (James 1998). Their presence here indicates the watersheds are important for this species in decline.

Southern Torrent Salamander

This salamander is a newly designated Forest Service Sensitive species that is associated with cold, clear headwater to low order streams in humid forests with abundant moss, large conifers and greater than 80% crown closure (Welsh and Lind 1996). There are no known records of these salamanders in either watershed but there have also been no known surveys specifically for this species. The closest documented sighting is several specimens found by Bury in 1967 less than 5 miles away from the Happy Camp watershed (Welsh 1998). Suitable habitat does occur in the watersheds because there are many

acres of relatively unfragmented late successional habitat. The relative quantity and quality of the habitat is unknown given the very specific microhabitat requirements of this species. If they are present, the watersheds could be quite important to the species because of the abundant unfragmented late-successional habitat.

Mollusks

There are seven identified “survey and manage” or “protection buffer” species that may occur in the Happy Camp and Upper South Fork watersheds. No surveys have been conducted nor are there any known sites within these watersheds. Limestone outcrops have limited and patchy distribution in the watersheds. Surveys and incidental sightings on the Hayfork and Yolla Bolla Ranger districts indicate that Church’s sideband snail may be relatively common on these districts. There is too little information on any of the other mollusk species to determine the abundance of the species.

Table 3-7. Survey and Manage mollusk species and general habitats (Crumpton, 1998).

Species	Habitat
Klamath shoulderband snail	Limestone rockland with partial shading by conifers or hardwoods.
Oregon shoulderband snail	Areas with rock and/or woody debris cover.
Church’s sideband snail	Areas with rock and/or woody debris cover and heavy brush or tree shading.
Shasta chaparral snail	Talus, caves, fissures, limestone rockslides and outcrops with oak or shrub cover.
Tehama chaparral snail	Within 100 meters of limestone outcrops in rocks, caves, leaf litter or woody debris.
papilose tail-dropper slug	Conifer forests with hardwood component.
voyager snail	Terrestrial and along permanent streams and small headwaters.

Fish Species

Summer and winter-run steelhead, spring-run chinook salmon, and Pacific lamprey are found below barriers within the analysis area (Figures 7 and 8). Fish barriers are present within the lower 1/4 mile of Bierce, Cable, Happy Camp, and Rough Gulch Creeks (USFS 1992, 1995). Small tributaries entering from South Fork Mountain generally lack the flows and quantity of habitat needed to maintain seasonal populations of anadromous fish. Fall-run chinook salmon are present in the South Fork Trinity system, however, utilization is thought to be sporadic, with few sightings above Hyampom Valley. Coho salmon are presently not found within the analysis area.

National Marine Fisheries Service (NMFS) has classified species of anadromous fish into Evolutionary Significant Units (ESU’s). Table 3-8 has identified each species and race of anadromous fish, their designated ESU, and Endangered Species Act (ESA) status. Additionally, NMFS has proposed all stream courses which are accessible by anadromous fish to be critical habitat for coho salmon.

Table 3-8. Species, ESU classifications and respective ESA status for fish species within the Watershed Analysis area.

Species	Evolutionary Significant Unit	Endangered Species Act Status
Winter-run steelhead	Klamath Mountain Province	Candidate for Listing
Summer-run Steelhead	Klamath Mountain Province	Candidate for Listing
Spring Chinook Salmon	Upper Klamath-Trinity River	Not Warranted for Listing
Fall Chinook Salmon	Upper Klamath-Trinity River	Not Warranted for Listing
Coho Salmon	Southern Oregon/Northern California Coastal	Threatened

Other fish species occurring within the analysis area are Klamath small-nosed sucker (*Catostomus rimiculus*), resident rainbow trout and speckled dace (*Rhinichthys osculus*). Sucker populations are generally confined to the mainstem of the South Fork Trinity River, with the highest densities increasing

as the river moves downstream. Resident trout populations are well distributed throughout the analysis area (Figures 7 and 8), and can vary annually based on flows, migration barriers, and other habitat variables, and can overlap with anadromous fish reaches making quantification of juvenile steelhead densities difficult to determine. Speckled dace are common and found throughout the river.

Spring Chinook

Adult spring chinook enter the South Fork from May through July and hold in pools throughout the summer prior to fall spawning. Information on run size, timing, and distribution has been collected over the last 10 years, indicating that run sizes can vary greatly from year to year. However, the distribution of fish, and area of spawning activity are consistent annually. Based on available data, the analysis area accounts for 18% of the holding and 24% of the spawning habitat for spring-run chinook on the South Fork (CDF&G 1991-98). However, holding and rearing habitat appear to be limited to the mainstem of the South Fork Trinity. The availability of suitable spawning habitat and frequent low flow barriers appear to be a limiting factor for adult spring chinook in the headwaters of the South Fork (Upper South Fork) (Dean pers. comm.).

Juvenile spring chinook spend a year in fresh water, with outmigration from the South Fork occurring from April through mid June. The South Fork from the East Fork South Fork confluence downstream to Hitchcock Creek is thought to be an important rearing area for juvenile spring chinook (East Fork/Smoky WA 1998). However, Dean (CDF&G 1992) reported that summer rearing habitat in the South Fork may be a limiting factor for juvenile chinook due to warm summer water temperatures and competition for suitable habitat with juvenile steelhead. Farber et al. (unpublished) showed that 7-day maximum average water temperatures remain at or below 20º C above Forest Glen, indicating that the analysis area may be important rearing habitat for juvenile spring chinook on the South Fork.

Winter Steelhead

Winter steelhead are capable of using the majority of anadromous fish habitat that is available. They return to the South Fork in the fall and early winter, and generally spawn between March and May (PWA 1994). Since steelhead move through the system at higher flows, they are able to utilize reaches of stream and small tributaries that may be unaccessible or unsuitable to spring chinook. Recent spring chinook surveys in the Upper South Fork revealed nine steelhead redds that were constructed during the spring, despite the annual absence of spring chinook in that reach (James pers. obs.).

Though attempts have been made to quantify adult steelhead escapement in the past 10 years, most efforts have been ineffective. Since peak adult steelhead migrations coincide with periods of higher runoff, flooding, and snow; many monitoring techniques such as weirs and redd counts have been unable to accurately estimate steelhead populations in the South Fork. Despite data gaps, population estimates were generated for the 1988/89 through 1994/95 sampling years. During that six-year period winter steelhead populations on the South Fork have averaged 2,574 fish, ranging between 969 and 3,741 (CDF&G 1989-94). Redd counts have been successful at documenting steelhead spawning use in many key tributaries of the South Fork, including East Fork South Fork Trinity River (East Fork), Upper South Fork, and Smoky, Plummer, Butter, and Rattlesnake Creeks (CDF&G 1991-95). Utilization of smaller tributaries coming off South Fork Mountain are limited due to the stream size and gradient, and availability of suitable spawning gravels.

Juvenile steelhead emerge between March and late July depending on the timing of spawning activities and other physical variables such as water temperatures and flows. Juveniles in the South Fork generally spend 1-2 year in freshwater before emigrating to the ocean, although 3 + steelhead have been observed in the South Fork (James pers. obs.). Stream inventories conducted by the USFS indicate that juvenile steelhead use above Forest Glen is substantial when compared to other areas of the South Fork (USFS

1989), indicating that the analysis area may provide important rearing habitat for juvenile steelhead. Additionally, information may suggest that juvenile steelhead may migrate to key tributaries during summer months to avoid elevated water temperature conditions in the mainstem (PWA 1994).

Summer Steelhead

Information on summer steelhead populations in the South Fork is sparse, with most information being obtained through annual spring chinook counts. Summer steelhead life history pattern is similar to the spring chinook in that they enter the South Fork in the spring and early summer. Annual returns to the South Fork average approximately 50 fish (PWA 1994). Scientific and personal observations indicate that summer steelhead runs in the South Fork have never been substantial (PWA 1994). Dean (pers. comm.) reported that no summer steelhead spawning has ever been observed in the mainstem during spring chinook surveys.

Commercial Timber Opportunities

Commercial timber opportunities exist primarily on Matrix lands within the Upper South Fork and Happy Camp watersheds. Suitable timber lands occur in four major commercial forest types: mixed conifer, Douglas-fir, ponderosa pine, and red fir. The mixed conifer forest type provides most of the opportunity within the analysis area. The LRMP direction on timber harvest is outlined below.

Forest Goals

- Provide a sustained yield of timber and other wood products to help support the economic structure of local communities and to supply regional and national needs (Timber #35, page 4-5).

Forest-Wide Standards & Guidelines

- Emphasize the regeneration harvest of understocked and poorly-growing stands, whether using even or uneven-aged systems (Timber e., page 4-27).

Matrix Lands (Description)

- Substantial portions of the management direction for the Forest were directed by the NW ROD (Introduction, page 4-1).
- Regulated harvest from Matrix (and AMA) lands (NW ROD, table on page A-4).
- Production of timber and other commodities is an important objective for the Matrix (NW ROD, page B-1).
- Most timber harvest and other silvicultural activities would be conducted in that portion of the Matrix with suitable forest lands, according to standards and guidelines. Most scheduled timber harvest (that contributing to the probable sale quantity [PSQ] not taking place in Adaptive Management Areas) takes place in the Matrix (NW ROD, page C-39).

Management Prescriptions

- Timber yields from Prescriptions III, VI and VIII are regulated harvests and are chargeable to the Allowable Sale Quantity (Appendix L, page L-7).
- Prescription VIII - Intensive (Timber) Management is identified as an Emphasized Management Practice. “This timber management regime assumes a wide range of...silvicultural treatments including...appropriate final harvest methods...including regeneration cutting systems such as clearcutting, green tree retention, and shelterwood cutting” (Appendix L, page L-7).

Tentative Ten-Year Timber Sale Program

- Reasons for Harvest - Stands to be managed intensively-Harvests will be carried out for the following purposes...to regenerate stands to meet regeneration acreage allocations to provide planned future yields (Appendix C, page C-1).
- Harvest Priority - Regeneration is the means by which productivity can be increased and regulation approached. The understocked and poorly-growing strata should receive first consideration (Appendix C, page C-1).
- Timber Management Controls - The Forests' goal is to approach regulation through scheduled regeneration harvests over a period of time called the "conversion period". Regeneration harvests to achieve regulation include 2,000 acres of green tree retention and 1,500 acres of selection cutting per year (Appendix C, page C-3).

Estimated Capable, Available, and Suitable

The following tables (Tables 3-9 and 3-10) itemize the estimated number of Capable, Available, and Suitable (CAS) acres available with the Upper South Fork and Happy Camp watershed analysis areas displayed by subwatershed. Information presented is as per the LRMP 93 database. The following components and assumptions were used in constructing this table: 1). Prescription III, VI, and VIII lands only by subwatershed, minus buffered Riparian Reserve acres; 2). Productivity class High and Low for density S and P; productivity class High, Low, and Null (un-attributed) for density N and G; 3). Plantations are located upon suitable lands only; 4). that an additional 15% of indicated available lands are unmapped Riparian Reserves; and 5). Regenerability must be determined at the site-specific level to ensure adequate regeneration within five years of final harvest. Using these assumptions, an estimated 450 acres would be regeneration harvested per decade on CAS lands within the combined watersheds to move the regulated component lands toward a fully-regulated condition.

Table 3-9. Estimated Capable Available and Suitable Landbase and Timber Volume within the Upper South Fork and Happy Camp Watersheds.

Watershed	Stratum[1]	Gross CAS Acres	Net CAS Acres	Volume/Acre (MBF)	Total Volume/STR (MBF)
Upper South Fork	XX1	1,802	1,532	0.0	0.0
	XX2	5	4	0.0	0.0
	XX3	159	135	0.0	0.0
	M3G	1,202	1,022	28.9	29,535.8
	M4G	3,465	2,945	28.9	85,110.5
	M6G	43	37	16.8	621.6
Sub-Total: Upper South Fork	---	6,676	5,675		115,267.9
Happy Camp					
	XX3	35	30	0.0	0.0
	M2G	5	4	22.4	89.6
	M3G	25	21	28.9	606.9
	M4G	192	163	28.9	4,710.7
Sub-Total: Happy Camp	---	257	218	---	5,407.2
Total: Upper South Fork/Happy Camp	---	6,933	5,893	----	120,675.1

[1]Timber stratum - M = mixed conifer, X = all, 2 = pole-size timber, 3 = small sawtimber, 4 = medium/large sawtimber, G = good stocking

Table 3-10. Age class and size for plantations within the Watershed Analysis area.

Watershed	Plantation Age Group	Acres in LSR	Acres in Matrix	Total Acres
Happy Camp	1-10 yrs	111	0	111
	11-20 yrs	895	31	926
	21-30 yrs	842	0	842
Upper South Fork	1-10 yrs	322	1545	1867
	11-20 yrs	686	81	767
	21-30 yrs	175	273	448
Total	1-10 yrs	433	1545	1978
	11-20 yrs	1581	112	1693
	21-30 yrs	1017	273	1290

Non-Timber Forest Products

Bear-grass

The predominate non-timber resource in the watersheds is bear-grass (*Xerophyllum tenax*), which traditionally has been harvested by the No'rel'muk, Wintu and Wi'laki people for use in basket weaving. In utilizing this plant, these Native American people traditionally burned bear-grass to remove dead material and to stimulate the growth of young, pliable shoots that are desired for weaving.

Traditional use of bear-grass by Native Americans has been relatively limited, with an estimated 20 area weavers that currently harvest bear-grass on South Fork mountain (Ray Patton pers. comm.). However, there currently is a tremendous demand for bear-grass by non-Native American commercial harvesters from California, Oregon, and Washington for use as floral greens in flower arrangements. The Hayfork and Yolla Bolla Ranger Districts received numerous permit requests for bear-grass collection in 1997 (Jack Ratledge pers. comm.). Because of this demand and the subsequent harvesting of large quantities of bear-grass, the Forest Service imposed a temporary moratorium on bear-grass permits in 1997, until the impact of collecting could be assessed. The Forest Service does have concerns that bear-grass in the South Fork mountain area is not being harvested sustainably, with commercial harvesters cutting entire plants and harvesting truck loads of bear-grass (Jack Ratledge pers. comm.). At this time there is no monitoring system established to ascertain the effects of either commercial or traditional harvesting of bear-grass on South Fork mountain. It is expected that harvesting permits will be issued in the future, based on qualitative assessments as to the health of the bear-grass populations.

Other Products

Other non-timber products harvested from the watersheds include manzanita, burls, mullein and medicinal herbs such as dock (*Rumex* sp.), plantain (*Plantago* sp.), grape (*Vitis californica*), raspberry (*Rubus leucodermis*), and horsetail (Flo Rabalais pers. comm.). During the Christmas season there are usually a few requests for commercial collection of tree boughs and mistletoe. Most of these requests are for personal use permits, so the quantity of material collected is relatively small. The number of permit request for such products varies from year to year; in 1997 the Hayfork District issued eight permits for such products (Flo Rabalais pers. comm.).

Range

Two grazing allotments are found within the analysis area. The first one, known as the South Fork Mountain allotment, is located along the southwestern boundary of the Shasta-Trinity National Forests, from Norse Butte south to the Pickett Peak area, all on the southwestern side of the South Fork of the

Trinity River. Most of this allotment is located outside the Happy Camp watershed, with only a small portion of the allotment within the northwestern section of the watershed, below Pickett Peak.

The second allotment is the Upper South Fork allotment, which encompasses a total of 64,000 acres, of which 18,000 is considered suitable for grazing. Approximately one-third of this allotment are found within the Upper South Fork watershed, from Wilcox Ridge to the wilderness boundary. The allotment is permitted for 117 cattle/horses, with grazing allowed for a five month period, from May 5th to October 15th each year (USFS 1998a). Four water developments have been constructed for this allotment, two of which (Trough Ridge and West Low Gap trailhead), are within the analysis area.

Transportation System

Until the early 1950's the only access into the analysis area was by foot or horse, except for a jeep trail across the top of South Fork Mountain from Hwy 36 to the Horse Ridge lookout area. When the timber market started to grow there was a need for roads, and in the late 1950's and early 1960's the first roads were built. The 29N30 (Wild-Mad) road was built up to and just north of South Kelsey Peak, plus a few short spurs along the way. Between 1960 and 1970 the main roads to Buck Ridge, West Low Gap, Bierce Ridge, and Wilcox Ridge were built. During this time the Wild-Mad Road was extended across South Fork Mountain to the headwaters of the Mad River. Road building continued in the 1980's, however, the majority of road construction was occurring on private timber lands (Figures 7 and 8).

Table 3-11. Classification of roads and road densities for the watershed analysis area.

	Upper South Fork	Happy Camp
FS System road	74.3	56.4
Jeep trail	4.8	0.0
FS Non-System road	3.1	3.4
FS Road Density (mi/sq mi)	1.94	1.58
Private road	5.6	13.1
Private Road Density (mi/sq mi)	5.39	3.57
Foot/Horse Trail	26.1	12.4

Currently the road system in the analysis area is being used primarily for recreational purposes such as wilderness access and hunting. The Wild-Mad Road is still used to access the town of Ruth, located on the Six Rivers side of South Fork Mountain.

Widespread road construction and timber harvesting in the analysis area since 1966 has significantly increased the rate and volume of sediment being delivered to nearby stream channels by both surface and fluvial erosion processes. Roads and other management activities have altered natural hillslope drainage patterns in a variety of ways to accelerate erosion and increase sediment yield.

Roads are constructed across the natural watercourses on the landscape, and each road crossing functions as an earthen dam with a risk of failure (wash-out) or diversion of stream flow if the culvert capacity is exceeded, for any reason. While USFS roads are generally constructed to high design standards, most road stream crossings within the analysis area were only designed to accommodate the 50-year storm discharge. The primary risk for stream crossing failure is sediment and woody debris in transport during infrequent large storms. At the time most of the roads in the analysis area were constructed, the stream crossing culvert sizes were not designed to accommodate high sediment and debris loads. This poses a major risk to in-stream habitat condition since the ROD (USFS 1994) says all stream crossings in Key Watersheds will be designed to accommodate the 100 storm flow and debris in transport.

Second, road and skid trail shapes and inboard ditches concentrate rainfall and surface runoff, and have been documented to deliver high volumes of sediment and discharge to natural stream channels (PWA,

1994a; Wemple, 1994; PWA, 1994c; and USFS, 1998). As a result, roads are serving to expand and extent the natural drainage network on the landscape, and serve as a chronic source of man-caused, accelerated sediment production and delivery.

The same land use activities have also increased the occurrence of landsliding within the analysis area, but to a lesser degree than for surface and fluvial erosion processes. Past road, skid trail and landing construction has resulted in the redistribution of large volumes of earthen material throughout the watershed. Some of these road cuts and fills have triggered various sized cutbank and hillslope failures, as well as fill slope failures, many of which pose risks of delivering sediment to stream channels in the analysis area.

The Trinity County Resource Conservation District conducted road inventories throughout the analysis area during 1998. Field crews inventoried a total of 201 miles of roads within the Upper South Fork, Happy Camp and Hidden Valley watersheds, of which 177 miles were USFS built and maintained roads (TCRCD 1998). Surveys indicate 44% of the stream crossings in these three watersheds have diversion potential, which poses a risk of triggering extensive hillslope gully erosion. Of the 316 stream crossing sites on USFS lands in the analysis area, nearly 66% currently serve as active sediment sources. The crossing sites exhibit either poor design or lack of maintenance which permit the sites to contribute to cumulative watershed impacts associated with past and current land management activities.

Fire and Fuels

In the Happy Camp watershed there have been 71 recorded fires since 1911, eleven of these fire starts are of human origin, the remainder being lightning caused. In the Upper South Fork Watershed during the same time period there have been 115 fire starts, nine being of human origin. The two largest recorded fires in the area have both been in the Upper South Fork Watershed. The 1988 Hermit Fire was human caused and burned an estimated 7,600 arces of National Forest and private lands. In 1996 lightning ignited the Rock Fire which burned an estimated 2,500 acres. These fires burned at high intensity levels, causing the complete mortality of most vegetation. Since 1911, excluding the above two fires, lightning fires have consumed 68 acres in the Happy Camp Watershed and 179 acres in the Upper South Fork Watershed. During the same time period human fire start have burned 44 acres in Happy Camp and 66 acres in Upper South Fork. These records show fire sizes overall are of smaller extent than those of reference conditions, and have higher, stand replacement, intensity levels.

Wildfire occurrence within forested areas of the watersheds, during 90th percentile weather conditions are expected to result in the development and sustainability of crown fires. Response times to the area by the nearest ground based initial attack fire suppression forces are approximately 1-1/2 hours. Response times of approximately 30 minutes are estimated before a lead plane arrives from Redding Air Attack base, followed 10 minutes later by the first retardant plane, if one is available.

Fire Hazards and Risks

In the field of fire and fuels management “Risk” is a wildfire causative agent, such as lightning, chainsaws or campfires. Risk management would eliminate or reduce sources of firebrands (intense heat sources). “Hazard” is a rating assigned to a fuel complex that reflects its susceptibility to ignition, the wildfire behavior and severity it would support, and/or the suppression difficulty it represents. A fuel complex is defined by kind, arrangement, volume, conditions, and location. Hazard ratings are generally subjective, ranging from very low (green grasses and conifer litter) to extreme (cured grass and heavy slash) (Deeming 1990). A fuels reduction program can pursue one or both of two strategies: risk management, or hazard management.

Values at risk to wildfire impacts include LSR, wildlife habitat, riparian reserves, fisheries habitat, water quality, soils, commercial timber values, plantations, private lands, recreational residences, the quality of

recreational use, visual quality and air quality. In Class I areas only a small amount of increment of air quality deterioration is permissible. The Yolla Bolla Middle Eel Wilderness is classified as having a Class I Airshed, the remainder of the watersheds are classified as Class II Airsheds.

Rural interface areas are present throughout and adjacent to the watersheds. All recorded human caused fires have been either in these urban interface areas or along roads and trails. Lightning fire starts are well distributed throughout the watersheds (Figures 9 and 10).

Effects of Fire Exclusion

Historically, the frequent, low-severity surface fires typical of this watershed killed only a small percentage of living trees while consuming much of the coarse woody debris, therefore input rates of coarse woody debris were slow and relatively constant. Fire exclusion and past timber harvest has resulted in the formation of a dense “midstory” of shade-tolerant conifers and shrubs. The overall increase in surface fuels and the laddering effect of existing vegetation has increased the threat and occurrence of crown fires where historically they were rare. Though fire regimes have been altered by land use, fires still greatly influence the watershed. Fire exclusion is a powerful form of vegetation manipulation, not likely to result in ecosystem preservation where the historic plant and animal communities were fire-dependent (Heinselman 1971). Through fire exclusion and past management practices we are essentially trying to produce climax communities over the entire landscape, where such situations never occurred historically.

Fire suppression activities have led to retarding rates of fire disturbance which has allowed the ingrowth of fire intolerant species, specifically incense cedar and white fir. Many of the larger pines have either died or were harvested. Natural regeneration of all species has occurred in greater numbers, further increasing stand densities. Smaller size classes now account for a higher percentage of the total stand. The increasing competition for available light, water, and nutrients creates stress on vegetation, facilitating suppressed growth, lack of vigor and susceptibility to damaging attacks by insects and pathogens. Fire exclusion has created forest patterns of even-age vegetation which has greater opportunity to develop larger, more severe fires.

Plantations

There are currently over 5,000 acres of plantations within the analysis area that are at high risk to fire. Plantations are important investments in future land management, potentially providing future opportunities for timber harvest, late-successional and dispersal habitat, and ecological susceptibility. There are multiple fuel treatment alternatives which would serve to help protect plantations from fire damage, most involve modification of fuel loadings, arrangement, and continuity.

Human Use/Heritage

The prehistoric sites on South Fork Mountain have been impacted over the years by a series of factors. On going timber and salvage activities have posed management work to avoid or mitigate adverse effects to these sites. However, of worse consequence is the effects of dispersed camping, illicit surface collecting, and looting excavation of these sites by the public. This activity is made easy by the road system running the entire length of the Mountain and the closeness of the various sites to the roads. The effects of Forest Service land management on these sites has been mitigated well and if anything has enhanced our knowledge of South Fork Mountain’s prehistory. The latter effects of illegal artifact collecting and uncontrolled dispersed camping are areas needing attention, but are limited by budget and resources.

Along the South Fork of the Trinity River archaeological sites found there have not been impacted to the same degree. Past activities such as grazing, logging, and settlement have affected these sites. However,

most of this activity has decreased over the last 50 years. Because access to these sites is from the South Fork Trail impacts from the public is much less. This may change if the South Fork Trail becomes more popular.

As an additional note, two National Register eligible historic properties lie within the WA area. At the Northwest end of the analysis area is the old Forest Glen Guard Station. This facility has been restored. Current plans have this station being used as a Forest Service rental under the Granger-Thye Act provisions. At the far Southeast end of the analysis area in the Yolla Bolla/Middle Eel Wilderness is the historic Black Rock Lookout. This structure is in poor condition and is considered a non-conforming use in the Wilderness. Under the Shasta-Trinity Land Management Plan the Black Rock Lookout is slated for removal.

Section 4 - Reference Conditions

Geology

Dominant Natural Processes

Prior to the mid 1960's, with the advent of widespread timber harvesting and road construction throughout the analysis area, the dominant natural erosional processes operating in the upper South Fork watershed were mass wasting, followed by a variety of streambank erosion and surface erosion processes. Natural mass wasting events would have been associated with or triggered by infrequent, large rainfall events, rain-on-snow events, seismic shaking or following stand replacing wildfires. Because the bedrock geologies are fairly homogenous throughout the analysis area, mass wasting or landsliding processes would have primarily occurred as either 1) generally shallow and rapid moving debris slides and debris avalanches, or 2) generally deep-seated and slow moving translational-rotational landslides.

Geomorphologically, both types of landslides would have a higher likelihood of occurring in several recognized, high risk hillslope locations. These include 1) steep, inner gorge hillslopes adjacent stream channels, 2) in steep, headwall amphitheater basins, and/or 3) associated with zones of weak, low strength materials such as along fault and shear zones, in ancient landslide deposits, in deeply weathered soils or in zones exhibiting abundant seepage and emergent groundwater. Depending on the regional extent of sediment production from mass wasting events, significant and sustained damage and alteration to in-stream habitat form and function could occur.

Natural streambank erosional processes would have occurred largely as isolated features caused by a combination of 1) normal sediment and woody debris transport processes, 2) interaction between stream bed, bank and hillslope processes and 3) possibly wind storms triggering tree throw. This type of disturbance would create instantaneous but relatively small and short-lived changes to the physical structure and biological function of in-stream habitat.

Background surface erosional processes would locally have contributed generally low volumes of sediment to nearby stream channels at the decade to century scale. This is because most pre-European fires were not large, stand replacing fires. Consequently, it was probably rare at these time scales to have large acreages of bare hillslopes within riparian areas where surface erosional products would/could have access to stream channels in high volumes.

However, at the century to half millennium scale, fire ecologists are indicating large and very large acreage stand replacing wildfires were occurring, and these could have resulted in locally significant imputs of fine and coarse sediment to stream channels in the analysis area. If the imputs were largely surface erosional processes, and to a lesser degree concentrated fluvial erosion processes, then the effects of natural, large fires on channel and biological processes are theorized to be short-lived, and not resulting in significant persistent alteration of channel morphology. This conclusion is based on observations taken to date following the Hermit and Penny Ridge Fires, which burned in the Upper South Fork Compartment. Immediately following the fire, surface and fluvial erosion was greatly accelerated for several years until vegetation (natural and planted) slowly began to cover the denuted hillslopes. A decade later, sediment yield to nearby stream channels appears fairly low from surface and fluvial erosional processes within the burned areas. While stream channels within the burned area routed high volumes of sediment over the last decade, the channels display no widespread and persistent changes in morphology or in the natural channel forming and maintenance processes.

Had stand replacing fires triggered increases in mass wasting and large landslide processes, in addition to the expected increases in surface and fluvial erosional processes, then the potential effects on channel

processes and geometry could be long-lived and much more persistent. In the later case, these disturbed natural channels would require considerably longer time frames for recovery. Stream channels and riparian zones in the analysis area show no obvious indications of pre-historic, fire caused disturbance.

Forest and wildland land management activities can altered the frequency, type and volume of sediment production occurring on the landscape. As discussed above, mass wasting (landslides), and to a lesser degree, stream bank erosion are the dominant erosional processes operating in undisturbed watersheds in the analysis area. Surface and fluvial erosion processes in an undisturbed watershed would frequently be a minor component in the long term sediment production budget.

As of 1944:

Analysis of available 1944 aerial photographs covering the Upper South Fork and Happy Camp watersheds indicates no significant land use had occurred. Faint tracts of known recreational and hunting jeep routes are discernible. In essence, the 1944 photos indicate the vast majority of the upper South Fork Trinity River above the town of Forest Glen functioned as undisturbed wilderness. The photos exhibit only a few streamside debris slides or active inner gorge failures along the main stem of the South Fork above Forest Glen, as well as in the Happy Camp, Bierce and Shell Mountain Creek watersheds.

Throughout the analysis area, most of the lower order tributary stream channels, as well as along most of the main stem (named) higher order stream channels generally display steep channel gradients, are largely bounded by competent bedrock side slopes, have closed riparian canopy conditions and appear relatively stable. The few obvious short opening in the riparian canopy are most frequently located on the inside of prominent bends in the channel (point bars), or in the lowest gradient reaches where the channel is naturally wider and alternating longitudinal bar forms would be expected to be present.

Along the main stem of the South Fork Trinity River within the WA area, the photos reveal fairly widespread but discontinuous opening in the riparian canopy. It is estimated approximately 60-70% of the main stem length exhibited a narrow open canopy, while another 10% of the stream length is obvious gravel bars. Active debris slides are very infrequent, and those present are generally small in size. The main stem is bounded by steep, inner gorge side slopes for the most part, although discontinuous, elevated stream terraces are present along the channel especially downstream from the mouth of Bierce Creek.

As of 1965:

In December, 1964, the flood of record occurred in the upper South Fork Trinity River as well as throughout much of northern California. Within the WA area, several months of arctic storms produced thick snowpacks, which were followed by huge tropical rainstorms. Numerous reports and studies documented widespread road and hillslope erosion, as well as significant stream channel changes throughout the South Fork watershed (PWA 1994, Haskins and Irizarry 1988, Irizarry et al. 1985, CDWR 1979, LaFaunce 1975, McCleery 1974). However, few reports are available which document what were the actual storm affects within the Upper South Fork/Happy Camp watersheds. The following discussion serves to describe discernible channel changes and watershed response in the upper South Fork triggered by the 1964 storm.

Within the Upper South Fork watershed, the only roads apparent on the available 1965 aerial photos appear to be accessing the few isolated private parcels in the compartment. By 1965, aerial photograph analysis indicates that the 30 (Wild Mad) Road had been recently constructed all the way through the East Fork drainage and across the South Fork itself, and extended upslope for approximately 1 mile to the private parcel located within section 32 on Bierce Ridge. The private parcel appears to be the only logged parcel in the Bierce to Shell Mtn. Creek watersheds. The 30 (Wild Mad) Road has been constructed from the Six Rivers (i.e. Mad River) side of South Fork Mountain to near the headwaters of Raspberry Gulch (junction with 27N02 Road), but no timber harvesting is apparent in the photos.

Finally, the only other apparent land use in the compartment is road construction on Buck Ridge to gain access to harvest timber from the private parcels at Martin Cabin and Hermit Rock. By 1965, it is not obvious any commercial timber harvesting (other than right-of-way salvage) had occurred on federal lands in the Upper South Fork Compartment. The remaining areas in the compartment were essentially functioning as undisturbed ecosystem.

Within the Happy Camp watershed, aerial photograph was available from Cable Creek upstream to the current location of the 30 Road. With the exception of jeep roads on the crest of South Fork Mountain, no significant and obvious land use activities had occurred by 1965 upstream of Cable Creek. This whole area (roughly two-thirds) of the compartment was essentially undisturbed and self functioning ecosystem.

Given the high percentage of private land downstream of Cable Creek, and the apparent tendency in this region of the forest to road federal lands to gain access to private lands, it is safe to assume some level of land use (roading and harvesting) had probably occurred by 1965.

Hickey and CWR (1969;1992) provides the only physical data to document channel changes in the upper South Fork above Forest Glen as a result of the 1964 storm. They report at the USGS gaging station at Forest Glen, stream bed elevations increased by 2.2 feet between 1964 and 1965. This is a modest amount of change when compared to the documented 12.9 feet of channel filling which occurred at another gaging station located near the mouth of the South Fork, approximately 60 river miles downstream.

After the 1964 storm, aerial photograph analysis indicates the main stem of the South Fork both within the WA area and upstream to approximately Shell Mountain Creek is a continuously open channel with the stream bed showing good evidence for aggradation or additions of channel stored sediment. The whole length of the stream channel appears recently re-worked, major pools are few and far between and many sections of the summer low flow channel display multiple (braided) channels. Within the same reach of the main stem, approximately 35 discrete streamside debris slides and/or incidences of channel widening (bank erosion) are visible. All of these erosional features have occurred on steep, inner gorge hillslopes with only one slide (where the 30 Road crosses the South Fork) having obvious past land management linkages. The main stem erosional features alone do not account for the amount of channel filling suggested by the aerial photos.

Most tributary stream channels within the analysis area display minor response to the 1964 storm, and virtually all the streamside debris slides observed have no apparent land management association. In the Upper South Fork Compartment, only Shell Mountain Creek, which is largely underlain by slightly metamorphosed sandstones and shales of the Franciscan Formation, displays isolated and generally discontinuous opening in the riparian canopy, as well as scattered streamside and inner gorge debris slides. Given the high elevation of the watershed and the relatively steep nature of the topography, it is somewhat surprising to see no evidence for debris torrents or channelized landsliding modifying the stream channels in the Compartment.

Within the Happy Camp Compartment, which is nearly completely underlain by the South Fork Mountain Schist, most of the larger, named tributaries (Cable, Frisbie, Rough Gulch and Bierce Creeks) also display evidence of isolated streamside and inner gorge debris slides, but significant opening in or damage to the riparian canopy are lacking. All of the landslides appear to be natural features, triggered presumably by the extremely high stream flows associated with a rain-on-snow storm event, and routine sediment and organic debris transport processes. The most severe sediment production occurred in lower Frisbie and Happy Camp Creeks, but again, the erosion appears to be natural. Likewise, excluding the lower portions of the two tributary stream channels, all the remaining stream channels throughout the watershed analysis area display little to no storm damage to the riparian canopy or significant evidence of aggradation or channel filling by recently introduced or routed sediment.

Within the Upper South Fork and Happy Camp watersheds, it appears the watershed response to the 1964 flood, the flood of record for the SFTR, was minor compared to channels changes which were

documented to have occurred in the nearby East Fork and Smoky Creek watersheds during the same storm (STNF 1998). The primary difference in the two watershed analysis areas is the significantly higher percent of land which had been extensively managed (roaded and harvested) in the East Fork/Smoky Creek watersheds by 1964.

In summary, the watershed response associated with the 1964 storm in the upper South Fork and Happy Camp watersheds above Forest Glen are within a predictable range. Bedrock geology and topographic position largely controlled the distribution of debris slides and mass movement features. Virtually all slides occurred on hillslopes underlain by the Franciscan Formation and the South Fork Mountain Schist, both of which have long been recognized as generally unstable bedrock geologies in the South Fork watershed (Haskins et al. 1980, CDWR 1979). In addition, virtually all slides occurred on inner gorge side slopes to streams, many at the outside of bends in the channel, both of which are geomorphic locations where one would expect a higher incidence of landsliding (LaHusen 1984, Furbish and Rice 1983, Haskins 1981). Finally, since few roads, clearcuts and large openings in the forest canopy were present in the analysis area as of the 1964 storm, it is safe to surmise that surface and fluvial erosion processes were not greatly accelerated, and that sediment production associated with these processes approximated background sediment production rates and yields.

Vegetation

Information regarding reference conditions for these watersheds is limited. A point of reference used for this analysis were 1944 aerial photos. The vegetative characteristics considered for the Upper South Fork and Happy Camp watersheds include plant community and canopy density.

To adequately describe broad vegetative patterns and disturbance regimes, the watersheds were stratified into two analysis areas. These were based upon fifth field watershed boundaries.

The Upper South Fork watershed was characterized in 1944 by medium to high density mixed conifer communities. In 1944 ponderosa pine and sugar pine comprised a higher component of the mixed conifer type, with white fir a much lesser component, particularly in the lower canopy levels. Stand density was higher in the over-story component of the mixed conifer stands, and lower in the understory component. This difference is most likely related to harvest practices within the type between 1944 and today and aggressive fire suppression efforts. A large contiguous matrix of late seral stands of mixed conifer was predominant across the analysis unit.

The Happy Camp watershed was characterized in 1944 by high-density almost pure red fir stands on higher elevation sites, much as it is today. Mid-elevation sites were comprised of red fir/white fir communities, with lesser stocking of Douglas-fir. Lower elevation sites were composed of mixed conifer communities, with stocking predominately comprised of ponderosa pine and Douglas-fir. Stand density was high in the over-story component of the mixed conifer stands, and lower in the understory component. This difference is most likely related to harvest practices within the type between 1944 and today and aggressive fire suppression efforts. A large contiguous matrix of late seral stands of true fir and mixed conifer was predominant across the analysis unit.

Wildlife Habitat

Perhaps the most significant habitat change, from pre-european conditions, which affects many of the TES and Survey and Manage species is a decrease in late successional habitat. Road building, timber harvesting, and large-scale fires have dramatically reduced late successional habitat in the last 50 years on the Shasta-Trinity National Forest. With 65% of this habitat remaining, the Happy Camp watershed is one of the least affected areas. This was first due to issues of accessibility and then later the majority of the watershed was placed in Administratively Withdrawn and Late Successional Reserve land allocations that

promote maintenance of late successional habitat. The Upper South Fork Watershed has had more road building, timber harvesting, and large fires and therefore has less late successional habitat but still at 33% it has more than many other watersheds on the forest. Fire is a complicated and dynamic process that can affect the quantity and quality of late successional habitat in both positive and negative ways. In this area the most common fire starts are either lightning or human caused. Fire has been used by Native Americans and Europeans both on purpose and accidentally. In positive ways many small fires can open understory areas and reduce fuel ladders that lead to large crown fires. We have come to understand now that suppression of these small fires in the last 80-100 years can lead to fuel buildup and more closed understories. Since it is evident that there was more late successional habitat in both watersheds but especially in the Upper South Fork watershed, we can expect that there were higher populations of northern spotted owl, northern goshawks, Pacific fisher, California wolverine, some mollusk species and perhaps the southern torrent salamander. Since flammulated owls prefer dense understories in late successional stands they are likely to have been negatively impacted by loss of late successional habitat and positively impacted by increased understory growth due to fire suppression in the remaining late successional stands. The decrease in snags and down logs due to timber harvesting and large fires has negatively impacted and likely decrease the populations of white-headed woodpeckers, pygmy nuthatches, fishers, martens and many bat species with the impacts being greater in Upper South Fork than in Happy Camp.

Prior to the 1964 flood, stream conditions would have been better for many aquatic species with less fine sediment and more larger sized substrates and deeper pools. We know there were higher populations of anadromous fish and the better stream conditions also suggest that there were likely more foothill yellow-legged frogs and northwestern pond turtles as well. With historically much higher populations of anadromous fish in the South Fork of the Trinity River and its tributaries there probably would have been more breeding pairs of bald eagles using the area.

The introduction of DDT as a pesticide immediately following World War II lead to decreasing populations of peregrine falcons and bald eagles from toxic buildup in their bodies and subsequent eggshell thinning. Due to the migratory nature of these raptors and many of their avian prey, the effects of DDT application can be felt hundreds or even thousands of miles away. Since the banning of this chemical at least in the United States, significant species recovery has been made, however populations are likely still below their historic levels. This may have impacted bald eagles in these watersheds to some degree but probably not as much as the decreased fish populations. Higher populations of peregrine falcons prior to the introduction of DDT would likely have meant more foraging peregrines but the lack of suitable nesting cliffs would have already limited reproduction in these watersheds.

Fish Habitat

Historically, it is noted that large numbers of anadromous fish populations occurred within the Klamath Basin (PWA 1994). Salmon returns have been linked to archaeological reports indicating that runs were substantial enough to support commercial fishing enterprises and seasonal subsistence fishing villages by Native Americans during the mid 1800’s and early 1900’s (Upper Hayfork WA 1998, Hildebrandt and Hayes 1983). Hildebrandt and Hayes (1983) noted that Native Americans reported returns of salmon to the South Fork as early as February and again in the early fall annually. Reports of declining fish returns have been noted on the Trinity River as early as 1850, and were linked predominantly to mining sedimentation (Carr 1891). From 1860-1900, “hidehunters” were able to establish a lucrative business by selling fish and game from the South Fork to miners on the Trinity River (East Fork/Smoky WA 1998). These supplies were necessary since miners and mining communities had exhausted fish and game resources either through habitat degradation or overexploitation. Due to the absence of large-scale mining operations and other land management practices it can be theorized that the South Fork may have supported large populations of anadromous salmonids, and may have played an important role in the recovery and recolonization of these species on the Trinity River during the early 1900’s.

Recent history indicates that the 1964 flood has been the most significant event which has effected fish populations and habitat conditions on the South Fork. Prior to 1963, spring chinook salmon runs had been estimated between 10,000-12,000 fish (LaFuance 1964; Healy, unpublished), and steelhead populations were thought to be large and well distributed throughout the South Fork Basin (J. Rourke pers comm, R. Maroviov pers comm). Dramatic declines in spring chinook population were observed in the years following the 1964 flood, with fewer than 50 spring chinook observed in the South Fork during some years in the 1970's and 1980's. A trend of increasing returns has been observed in the 1990's, however, these number are far below the pre-1964 population estimates.

Anecdotal information suggests that habitat conditions changed drastically following the 1964 floods. Numerous discussions with local residents indicate that pools were much deeper prior to 1964 (G. Maker pers. comm., J. Rourke pers. comm.), possibly providing greater carrying capacity for adult and juvenile salmonids, and better thermal refuge from warm summer water temperatures. Following the 1964 flood, substantial pool filling was noted throughout the South Fork (Healy unpublished, J. Rourke pers. comm.). However, Healy (unpublished) noted signs of recovery beginning in 1969 as pools begin the deepen and fines begin to diminish in gravel bars. Rogers (unpublished) stated that only five pools exceeded six feet in depth between the East Fork confluence and Forest Glen during a 1970 survey. LaFuance (unpublished), indicated that recovery seemed to be progressing in a downstream direction with the best pool habitat observed above Silver Creek. Stream surveys in 1989 seem to substantiate this observation, revealing that the number of pools exceeding six feet in depth between the East Fork confluence and Forest Glen had increased to 28 (USFS 1989); and following a 1997 survey had increased again to 48 (USFS 1997).

Range

Settlers came into this area in the mid 1800's bringing with them various types of livestock; predominantly cattle, horses, sheep, goats and some swine and fowl. Lands of Public Domain were established in the late 1800's and were under the purview of the U.S. Government. Grazing during this era (1860-1905) was not closely administered and settlers took their stock onto these lands pretty much at will with very little control over numbers, types of animals or season of use.

During this time livestock owners utilized various management practices on their own lands as well as on Public Domain Lands including the use of prescribed fire to burn over/off areas that were grazed by their animals each year. While results of this are not entirely known, this type of treatment, which was also being used by the Native Americans when the settlers arrived on the scene, played a role in the ecological succession and condition of various vegetation types/species. One of the primary results was the loss or reduction of new conifer and/or chaparral type growth or regeneration on sites capable of producing such species. This type of treatment would tend to help maintain open vegetative areas which helped provide for suitable grazing by livestock and other animals.

Another management practice (1854-1865) was that of bringing in, accidentally or deliberately, seeds of non-indigenous plant species. This coupled with grazing eventually contributed to a decline in native annuals and perennials and an increase in exotic annuals and perennials in the Mad River and Eel River areas some 5-10 miles to the south (Keter 1995). It is quite likely that such events also occurred in portions of the Upper South Fork watershed as well.

The Trinity National Forest was established as a National Reserve in 1905 and in 1906 was established as a National Forest. Between 1906 and 1910 the Trinity National Forest began active management of their range program (Contrary to Keter, 1995 page 8). The 1910 Trinity Range Report supports this supposition and outlines actions taken by the USFS on resource concerns in both the Yolla Bolla and Hayfork District sections of the report. Primary actions included 1) completing the first assessments of estimated carrying capacity and comparing that to existing use at the time these Public Domain Lands came into the National Forest Service System (this type of analysis led to significant reductions in authorized grazing between

1906 and 1910 including the exclusion of most grazing by sheep on the Yolla Bolla and Hayfork units. (Although some sheep grazing did occur intermittently within the South Fork of the Trinity up until the second World War) and 2) the Forest Service stopped or attempted to stop the practice of permittees burning over portions of their grazing areas as they went out onto or came off of the allotments. The primary reason listed for this, was to allow for the establishment and growth of new coniferous forest areas (Trinity Forest Range Report 1910). This latter effort, of course, affected what we see vegetatively on the ground today.

Grazing levels in this general area averaged between 300 and 1300 cow/calf pairs from 1911 through 1943 after which numbers of cow/calf pairs dropped down to a hundred or so pair up until now. In addition to the cattle grazing there a few horses and mules that utilized the area also. Numbers of sheep that were grazed within this area, during this time frame, in any one year from 1911 to the end of World War 1 varied from 300 to 1300 head and they were not grazed every year. In 1921 (peak of World War ll) there were some 2500 head listed as being in the area.

During World War 1, there was a national demand for increased red meat production and grazing on the Trinity National Forest reached and sustained its highest levels of grazing (since 1906) from 1917 through 1923, after that grazing use for all classes of animals again declined. Sheep grazing was basically non existent by the mid 40's with cattle and horse use increasing slightly for World War II and then leveling off at pretty close to present day levels by the 1950s.

The Upper South Fork of the Trinity watershed was occupied by several (10-15) grazing allotments from 1910 through 1942 since that time only one allotment (Upper South Fork) has been on line. It has went through various boundary changes during this latter time period.

Fire and Fuels

Prior to organized fire suppression around the turn of the century, fires burned frequently and unrestricted throughout both watersheds and across the landscape in general. This fire regime would have prevented significant fuel buildup from occurring that would facilitate high intensity fires, and suggests that low and mid-elevation forests within these watersheds were shaped and formed through frequent low-intensity fires. Many of the fires occurring during the pre-suppression era were of large extent and of low-intensity that would burn for months. There was a good deal of site-by-site variation in terms of fire behavior and the effects. In some areas where fuel levels were higher and fire conditions favorable the areas would be impacted by high intensity, stand replacement type fires. Within openings or gaps, fire tolerant, shade intolerant vegetation would regenerate, given proper seedbed conditions. Fires thinned stands and helped maintain an "open and park-like" forest with an understory consisting primarily of herbs and shrubs. Stands contained a diversity of species and age classes but relative densities were lower and stands were characterized by generally large trees. (per discussion with Carl Skinner, PSW). At the low and mid-elevations pre-suppression era forests were primarily composed of mixed conifer trees, with ponderosa pine, sugar pine, and Douglas-fir being the dominant trees species.

At higher elevation levels along the top of South Fork Mountain the forest composition changes from mix-conifer to pure stands of white fire and red fir. These "true fir" forests indicate that these areas were historically impacted by less frequent fires of higher intensity. These forest types are classified as shade tolerant, fire intolerant and are a common forest type where the historic fire regime was one of infrequent high-severity stand replacement type fires. High-severity fire regimes are characterized by infrequent, high intensity, stand repalcement type fires with fire return intervals of 100 years or more being common.

Organized fire suppression has effectively excluded the low-intensity fires of pre-suppression years allowing fuel accumulations (dead/down materials and biomass) to increase to the level of supporting large high intensity fires. In absence of periodic low-intensity surface fires stands undergo relatively rapid changes in species composition and structure, apparent by the thick understories of white fir, (contributing

"fuel ladders") which often facilitates insect and disease attacks, setting the stage for catastrophic stand replacement wildfires. Fire suppression has increased from reference conditions and is expected to continue increasing as biomass levels and human use increase.

Human Use/Heritage

Prehistory

Use of the analysis area prehistorically centered around the Upper South Fork of the Trinity River and the ridgeline of South Fork Mountain. For over 8,000 years the South Fork of the Trinity River provided a rich anadromous and resident fishery. This food source helped to sustain the local American Indian population throughout the year.

Along South Fork Mountain you had an ideal area for late spring through early fall habitation. Plants used for food or material culture items would come into season later after these same plants had passed their prime at lower elevations. Hunting would have been important in this area especially in the late fall deer rut. Also, South Fork Mountain would have been a very pleasant place to reside during the hot summer months of July and August.

One of the management methods used by Indians in this area to enhance game habitat for hunting was through the use of fire. Openings were maintained by fire creating better feed for deer and easier hunting. Burning would also benefit various plant species by enhancing growth and controlling pests and diseases. By doing this Indians provided themselves a more abundant, better quality, and healthier food and material crop.

Over the long history of South Fork Mountain its use as a travel route may have been one of its most important attractions for humans. The mountain ranges separating the interior Sacramento Valley from the coast were a severe barrier. South Fork by its unique geographic position and length allowed people to traverse most of the distance across these mountains along a relatively straight and level course. The many sites on South Fork Mountain may reflect regular campsite locations used by parties traveling to and from the coast or valley. South Fork Mountain may have been a very busy place during the summer months with various groups utilizing the area for hunting and gathering, trading, and travel.

The conditions described above occurred over a period of 8,000 years. During this period human use of South Fork Mountain and the surrounding area increased as population numbers grew. At certain times in this length of prehistory there were climatic changes in temperature which resulted in fluctuating vegetation and wildlife patterns. Consequently, there were periods of lesser use of South Fork Mountain. However, human use on South Fork Mountain was constant throughout this period.

Historic

The first Euro-Americans in this area were fur trappers and explorers. This period lasted between the 1820's to the early 1840's. These individuals may have been British, French-Canadian, Russian, or American. Their primary goal was fur. However, related to this was the other goal of territorial expansion by one of these competing countries.

It is during this period that the Indians of Northern California were first impacted adversely by Euro-American culture. But, this impact was not an overt violent act. The impact was through disease brought into the Upper Sacramento Valley area by Hudson Bay Company fur brigades. The disease was a form of malaria brought to Fort Vancouver from Hawaii. Those individuals infected with the disease, including Native Hawaiians working for the Hudson Bay brigades, spread this disease southward into Northern California. Mosquitoes were the vector.

By the early 1840's whole villages were killed off up and down the Sacramento Valley. From this area the disease spread into the foothills, mountains, and river canyons to the east and west. Because the Native populations were so reduced, along with the consequent weakening of their cultural and political systems, the next wave of white settlement met little resistance.

This next wave was the Gold Rush of 1849 and 1850. During this period violence towards the Natives was rampant. Violent acts were common either through murder or literal forced enslavement. Mining activity kept Indians from traditional fishing locals or destroyed them. This took away one of their primary food sources. Village sites along the major streams were taken over and claimed by miners or settlers. This forced these people into more marginal areas. These actions affected the analysis area later on in reducing the numbers of Natives using the South Fork. Consequently, settlers in this area had little opposition. Within ten years of the first gold rush many tribes had ceased to exist or were represented by only a few individuals.

It was from the 1860's on that Euro-American movement into the Trinity area took on a more settled direction. Farms and ranches were laid out and claimed by individuals wanting long term stability rather than the hit or miss existence of the gold seeker. In the analysis area ranching and grazing became the primary economies of these early settlers. To this day, range cattle are run on South Fork Mountain. Stock animals driven through or grazed on the Mountain and along the River included cattle, pigs, goats, and sheep.

It is also during this period that one of the original uses of South Fork Mountain was put to use by the early settlers. The trail system used by the Indians along the Mountain became the Humboldt Trail. This system was one of the primary access routes into the South Fork drainage and Hyampom Valley. One of its most important uses was as a stock driveway. Cattle and other stock animals were driven along the trail from the Red Bluff area to summer ranges in the Trinity County area. In the fall, the process was reversed. Until the main roads were put through in the 1920's and 1930's this trail and others were the primary transportation routes.

The next major land use was the onset of controlled timber management on both Forest Service and private land. Starting in the 1940's, once roads capable of handling trucks were built, logging became the primary economic activity in this area. Sawmills were built in Hyampom Valley, Wildwood area, and in Hayfork. From this time up to the late 1980's logging was the main human activity modifying the analysis area landscape. However, the spotted owl management directions of the 1980's began to limit the harvesting on Forest Service land. To this day, timber management continues, but not to the levels of the past. Private timber lands also continue to be harvested, but current levels compared to past activity is much less.

Finally, during the 20th-Century recreation has been an important human use of this area. Fishing along the South Fork of the Trinity River and hunting on South Fork Mountain have drawn people from all parts of California. Increasing in this area is backpacking, especially along the South Fork Trail, and auto touring the various Forest Service system roads on South Fork Mountain. Into the foreseeable future, recreation will continue to be an important activity within these watersheds.

Section 5 - Synthesis and Interpretation

This step of the analysis is designed to synthesize and interpret information collected in previous chapters. Emphasis was placed on identifying human disturbance processes and how they have changed from historic conditions. Predictions in the future trends of human disturbance processes were based primarily on Land Allocation objectives and how they would affect future land management practices (Table 5-1). Future trends were then integrated with natural processes and species needs to develop opportunities for management objectives and ecosystem function within the WA area.

Table 5-1. Human disturbance processes, their change from reference conditions, and predicted future trends for selected Land Allocations within the Watershed Analysis area.

Land Allocation	Disturbance Process Human uses	Change from Reference	Future Trend	Comments
All Land Allocations	Fire Frequency Natural	ð	ð	No change.
	Fire Frequency Human	ò	ö	Decrease compared to Native American. Increase in trend due to increased use of public land.
	Fire Intensity	ñ	ñ	Due to accumulated fuels.
	Fire Size	ò	ö	Due to accumulated fuels.
	Fire Suppression	ñ	ñ	More suppression due to more fires from biomass accumulation and increased human use.
	Grazing	ò	ø	Gradual due to loss of transitional range.
	Recreation	ñ	ñ	Increased emphasis on recreational use (hunting, camping, Discovery trail, Wilderness)
	Exotic Plants	ñ	ö	1. Main disturbance vectors decrease (roads, grazing) 2. Little or no eradication funding.
Matrix	Harvest	ñ	ø	Moving existing landbase toward regulated harvest.
	Roads	ñ	ð	1. No net increase in road miles due to Key Watershed. 2. Close to meeting future harvest needs.
LSR	Harvest	ñ	ò	1. Need LSRA to enhance LSR. 2. Not in CAS landbase for regulated forest.
	Roads	ñ	ø	1. Fewer new miles of road - trend toward road reduction. 2. Needs for LSR enhancement 3. Benefit to terrestrial species.
Wilderness/ Administratively	Harvest	ñ	ò	Not in CAS landbase for regulated forest.
Withdrawn	Roads	ö	ð	1. No roads in wilderness. 2. Low density in administratively withdrawn areas.
Riparian Reserves	Harvest	ñ	ø	Harvest permitted only to meet ACS. Reduced rate.
	Roads	ñ	ø	ACS and Key Watershed objectives suggest risk reduction and reduction in road density.

Late Successional Reserve Protection and Enhancement

Late Successional Reserves (LSR) were established to provide late successional habitat for dependent plant and animal species. Since late successional habitat is abundant, and removal from the commercial

timber production landbase is the primary protection tool. However, late-successional habitat is now a very small fraction of what it was prior to European influences in northern California, therefore it is desirable to attempt to protect LSRs from catastrophic events that would destroy many acres of late successional habitat.

There are 1,848 and 1,183 acres of LSR plantations within the Happy Camp and Upper South Fork watersheds, respectively. Most of these plantations are densely stocked with ponderosa pine saplings and pole trees under 20 feet in height. While these plantations have the potential to develop into late successional habitat in the future, they are currently a liability due to high fire risk. Plantations are extremely flammable because of the high crown to trunk ratio and because the crowns are very close to the ground. Once a plantation starts to burn it can burn hot and fast and then ignite adjacent late successional habitat. As these plantation trees grow they compete more and more for available sunlight and ground moisture which causes their growth rate to slow down. Thinning and removal of thinned biomass from these plantations would benefit the LSR from both a protection and enhancement standpoint. Increasing the distance between these young trees and removing some of the biomass reduces the fire risk and promotes faster growth toward late successional stages. Thinning of overstocked plantations is a logical first choice enhancement opportunity because it treats stands that are farthest from late successional habitat and have the highest capability of responding to treatment.

An undetermined quantity of acres within the LSR land allocation of both watersheds naturally regenerated into dense even-aged forests following a stand replacing event such as a fire. Carefully controlled thinning in these stands can promote late successional characteristics by reducing the competition for sun and water and promoting growth in the remaining trees. It can also reduce fire risk by removing biomass and increasing tree spacing. In the absence of mechanical thinning these stands will naturally thin themselves but it will take longer and the higher fire risk will remain longer as well. The larger and older the trees are, the less dramatically they respond to mechanical thinning and the lower their inherent fire risk. Likewise, they are more advanced on the continuum into late successional characteristics. The standards and guidelines for LSRs (USFS 1994) directs us to primarily thin stands up to 80 years of age to promote late successional characteristics. After the young plantations, thinning natural even-aged stands up to 80 years old is the next best enhancement opportunity. Select opportunities for thinning stands over 80 years of age exist within the analysis area, and would be the last priority for LSR enhancement. The implementation schedule of any project within the LSR, however, must consider multiple factors, risks and the overall management objectives. For example if thinning needs to precede a road closure, it may be important to thin plantations and natural stands on that road system before thinning other areas in a given watershed.

Prescribed fire is a land management tool which may be used to enhance or protect LSR conditions by reducing fuel levels and catastrophic fire risk. While prescribed fire is not logistically feasible in young plantations, it can be very effective within natural stands, either by itself, or in conjunction with natural stand thinning. High priority areas for prescribed fire are LSR and Private land boundaries where risks to late-successional habitat and private inholdings can be greatest.

One proposal discussed by the team was the construction of a shaded fuelbreak along South Fork Mountain to give protection to LSR land from fires coming from the west. However, this proposal was dismissed from consideration since it was unknown if such as project would be logistically feasible and consistent with LSR direction.

In general, roads detract from desirable characteristics of LSRs because they reduce the acres of forest, cause habitat fragmentation, and increase the opportunities for disturbance and human caused fire ignitions. Roads also provide mandated access to private property that is surrounded by LSR and permit access of fire suppression personnel and equipment. Balancing the needs for access and the opportunity to enhance late successional characteristics within the LSRs of these lands will most likely translate to some road decommissioning opportunities.

Fish Habitat and Hydrologic Restoration

Natural disturbances have played a major part in the alteration of fish habitat within South Fork Trinity River. Impacts from the 1964 flood and Hermit Fire are clearly visible, and have been responsible for changes in the fluvial erosion process and sediment regime, creating fish habitat that may be limiting for egg-to-fry survival, and adult salmonid holding and spawning habitat. Land management practices in some areas, have exasperated impacts to fish habitat conditions caused by natural disturbances. Surface erosion from roads, particularly in the Hermit Fire, and watersheds to the east of the analysis area have increased surface erosion and fine sediment input to streams. Salvage from intermittent streams have reduced the effectiveness of streams to buffer downstream fish habitat from increased surface erosion caused by fires, logging, and roads. Additionally, many upland riparian areas remain at risk from catastrophic fire due to past fire suppression activities, resulting in overstocked, dense stands.

Presently, the SFTR appears to be recovering from these disturbances in a “top down” fashion. The primary restoration opportunity is to reduce the cumulative impacts of roads on downstream fish habitat. This can be accomplished by reducing the risk of accelerated, human-caused erosion and sediment delivery to streams throughout the WA area. This includes not only reducing the risk of catastrophic storms causing widespread culvert failure at the numerous stream crossing, but also addressing annual contributions of fine sediment being delivered to stream channels by actively reducing the length of road, cutbank and inboard ditch draining to streams along all USFS roads.

According to the ROD (1994), the control and prevention of road-related runoff and sediment production should be accomplished by decommissioning, hydrologic closure or road upgrading. Technically sound techniques to either close or upgrade a road are well tested and documented in a variety of reports (TCRCD 1997, Pacific Rivers Council (Chapter 4) 1996, PWA 1994, Harr and Nichols 1993, National Park Service 1992, PWA 1990, Weaver et al. 1987, and Weaver and Sonnevil 1984).

As stated earlier, both management related and natural mass movement risks are highest on hillslopes underlain by the South Fork Mountain Schist. The rock type underlies all the LSR areas within the Happy Camp watershed and most of the lands east of the main stem in the Upper South Fork watershed. Numerous clear cut patches and fire salvaged areas are located within the LSR areas. Many of the roads accessing the patch cuts and plantations, and the fire salvage areas in the LSR should be high priority roads for hydrologic closure based on the high risk of rain-on-snow storms triggering debris slides and torrents which could directly impact anadromous reaches of the upper South Fork watershed. Priority subwatersheds include Collins, Farley, Marie, Happy Camp, and Bierce Creeks.

The majority of private property inholdings are located within the LSR lands within the analysis area. The Forest Service is required to provide road access across their lands to private parcels surrounded by federal lands. However, many parcels currently have more than one access route across federal land to access private property. The multiple routes should be evaluated to determine which access roads are of secondary importance, and which might serve as good candidates for decommissioning.

Additional opportunities for restoration should focus on reducing the risk of catastrophic fire. Plantation and natural stand thinnings, and prescribed fire are the best tools to move “at risk” riparian areas towards their desired condition. These areas include Bierce, Wilcox, Penny, and Mule Ridge areas and throughout the Hermit Fire area.

Threatened, Endangered, Sensitive and Survey & Manage Species

Loss of late successional habitat and forest fragmentation is the greatest threat to many of the TES and S&M species within these watersheds. With an estimated 65% of the late successional habitat remaining

on Forest Service lands within the Happy Camp watershed, it still ranks among one of the most intact watersheds on the Forest. The Upper South Fork watershed has had more habitat fragmentation and an estimated 33% of late successional habitat remains. Both watersheds are above the 15% minimum retention standard. With only 229 acres of the largest, size class 6, trees remaining in both watersheds combined, these stands represent a unique habitat feature. Over half (102 acres) of this habitat type is outside of LSR land allocation and within Matrix land of the Upper South Fork watershed. Most of these size class 6 stands are adjacent to large young plantations and add much needed biodiversity and old growth components to the landscape. Since these stands are unique and many watersheds on the Forest do not contain this size class, these stands would be valuable to old growth retention standards or within wildlife dispersal corridors.

Within the Happy Camp watershed there is no need to designate dispersal corridors because the majority of the watershed is in the LSR or Administratively Withdrawn land allocations and therefore largely not available for timber harvesting. An estimated 79% of the watershed is already suitable for dispersal. The greatest impediments to dispersal are the large young plantations concentrated in the northwest and southeast portions of the watershed. Thinning these plantations would facilitate a more rapid return to dispersal habitat conditions. Within the Upper South Fork watershed there is a need to identify dispersal corridors because more habitat fragmentation has already occurred and approximately 45% of the watershed is within matrix lands and available for timber harvesting. Several dispersal options do exist in the watershed to go between LSRs and other watersheds. The largest impediment to dispersal is the nearly 8,000 acres that burned in 1989 Hermit fire. Dispersal corridors were not specified during the watershed analysis process to permit more time to review habitat conditions and address them during the NEPA process.

There are approximately 3,497 acres of wildlife habitat management matrix land within the Upper South Fork watershed. Minimal, modified and uneven-aged timber management practices are permitted on these lands. This area would provide an ideal opportunity to test experimental or controversial silvicultural and controlled fire prescriptions designed to protect and enhance late successional habitat characteristics prior to implementing them within LSR lands.

S&M and more recently listed sensitive species lack important information on species distribution and habitat utilization. Much information can be gained by conducting habitat and species surveys. The highest priority areas for gathering this information is within matrix lands where management activities are being proposed.

Fire and Fuels

Fire frequency - natural: Lightning has been a primary source of wildfire ignitions in both watersheds, historically and presently. Since 1911, a total of 166 lightning fire starts have occurred within the analysis area, of which 106 occurred in the Upper South Fork watershed. Studies in the Jud-Rusch Creek area (having similar vegetation types as these watersheds), approximately 20 air miles to the north, indicates that historically fires may have been as frequent as 5 years apart (Skinner 1996). Natural fire frequency is not intended to change from historical reference conditions.

Fire frequency - human: Prior to the beginning of organized fire suppression efforts around the turn of the century Native Americans used fire as a tool, preserving and enhancing oaklands, meadows, and bear grass populations among other uses. Early in the 1900’s fire use by the Native Americans was curtailed by encroaching civilization and the creation of the Forest Service in 1905, with fire protection as a chief task. Recorded human fire starts from 1911 to the present show there have been eleven fires caused by human activities within the Happy Camp Watershed and nine human caused fires within the Upper South Fork Watershed. Although the initial trend shows a decrease in human fire starts it is predicted this trend will show an increase in the future, and can be attributed to increased public recreation.

Fire intensity: Fire Management has been effective in containing and controlling the majority of wildfire ignitions within both watersheds to rather small events, with two exceptions, both in the Upper South Fork Watershed. In 1988 the Hermit Fire, human caused, burned approximately 7,600 acres of National Forest lands and in 1996 the Rock Fire, lightning caused, burned an estimated 2,500 acres in the same vicinity as the Hermit Fire burned. The intensity levels of both of these wildfires are considered to be in excess of historic fire starts that burned under similar environmental conditions. By containing the vast majority of fire starts to very limited acreages we have allowed increases in biomass levels and natural fuels throughout both watersheds. Now when a fire start exceeds the capabilities of the initial attack forces these higher available fuel levels allow for increases in fire intensity, well above historic in most situations. Although pre-suppression era fires occasionally burned portions of the areas at high intensity levels these areas were usually scattered and of small acreages. Increase in biomass and fuel levels as well as changes in species composition show future trends of higher intensity fires, possibly resulting in catastrophic resource damages.

Fire size: Before the 1900's both watersheds were impacted by frequent fire starts, from both lightning and Native American sources. These fires occurred generally during the summer and fall months and under the right conditions could burn for months at a time, until available fuel sources or unfavorable weather conditions diminished further advancement. These fires would burn vast acreages of land, but fire intensity and spread was generally low with the fire burning more of a mosaic pattern on the landscape. Fire sizes have decreased from our reference conditions due to fire suppression, fire impacted areas presently are of a much more continuous area, with major portions of stand replacement. With biomass levels continuing to increase, and increases in public recreational, and diminishing fire management budget and resources, future trends will continue to increase.

Fire suppression: The Trinity Forest Fire Risk Potential Map, which indicates areas of the watershed most susceptible to wildfire, shows the Happy Camp Watershed area as a whole of been at medium risk to wildfires. The Upper South Fork area is shown as having a general mosaic of low and high fire risk areas. Due to the remoteness of the areas as well as the other previously described hazards, diminishing fire management programs and budgets, the risk of a catastrophic fire start in either watershed can be viewed as very high. Future fire starts that exceed initial attack capabilities can be expected to be of catastrophic proportions.

Horse Ridge Lookout and Pickett Peak Lookout are the closest detection points to either watershed, it has been proven that early detection is one of the major parameters to limiting fire size and spread. Due to budget cuts Pickett Peak has not been in service for the past few years, and the future of Horse Ridge Lookout is unknown. Maintaining at least one of these forest lookouts would be beneficial to fire prevention efforts.

In ecosystems having historic fire regimes of frequent fires, changing these regimes to infrequent high-intensity fire can result in catastrophic results. Absence of the low-intensity fires has allowed rapid changes in species composition and structure which often lead to epidemic insect and disease outbreaks cumulating in severe stand replacement type fires. Fire exclusion through fire suppression has already allowed the ingrowth of many fire intolerant vegetation species and increased biomass levels of all species. These increases in vegetation levels result in more competition for available moisture, light, and nutrients, and in weakened states they are more susceptible to damaging attacks by insects and pathogens. These overstocked forests, having heavy understory fuel ladders and high levels of natural fuels are prime candidates for catastrophic wildfire.

A strategy to improve overall stand conditions and lessen fire impacts could consist of the thinning of overstocked stands and concentrations of standing dead material, and the use of prescribed fire on a landscape scale. The planning, construction, and maintenance of a strategic ridgetop shaded fuelbreak system could assist in fire suppression efforts and the act as anchor lines for the use of prescribed fire.

Periodic salvage sales should also be considered as a tool to remove dead, dying, and diseased trees from these watersheds.

Treatment area priorities should be guided by the following criteria from the Shasta-Trinity Land and Resource Management Plan: 1.) Public safety, 2.) High investment situations (structural improvements, powerlines, plantations, etc.), 3.) Known high fire occurrence areas, 4.) Coordinated resources benefits, i.e. ecosystem maintenance for natural fire regimes.

Commercial Wood Products

Within the Matrix land allocation it is estimated that 450 acres per decade of regeneration harvest is needed to meet regulated forest objectives identified in the LRMP. As these lands progress towards a fully-regulated condition it is anticipated that a well distributed range of seral stages would occur. Increasing emphasis will be placed on intermediate harvest (thinning) treatments to meet regulated forest objectives.

Limited harvest opportunities are available within LSR and Riparian Reserve land allocations. Any harvest opportunities must be consistent with LSR and Aquatic Conservation Strategy objectives and aimed at enhancing late-successional and riparian stand conditions by increasing stand resiliency to catastrophic disturbances such as fire, insect outbreak, and disease. Opportunities for intermediate harvest and plantation thinning within LSR and Riparian Reserve land allocations are concentrated in areas of disturbance.

Transportation Needs

The transportation system within the Matrix portion of the analysis area is basically complete from past management activities, the outlook for the future is to extend some short segments of roads and use some temporary spurs to access the remainder of the tractor and/or cable ground, with the remaining isolated areas being accessed by helicopter. Since this area is in Key Watershed with no net increase in road density, some roads not needed for future management will have to decommissioned before any new roads can be constructed.

Section 6 - Recommendations

Late Successional Reserves Protection and Enhancement

1. Use thinning and prescribed fire to protect and enhance late successional stand characteristics in the LSR. Enhancement priorities are as follows:

1. plantations;
2. natural stands up to 80 years old;
3. and where appropriate, older stands that lack adequate late successional characteristic.

Proximity to private property, heavily used roads, popular recreation sites and road decommissioning opportunities are also important factors to consider in selecting and prioritizing stands to be treated. Priority treatment areas include Wilcox, Bierce, and Buck Ridge areas, and the Pickett Peak area.

2. New road construction is not recommended in LSR unless the negative impacts can be minimized and are clearly outweighed by the benefits to late successional habitat.

Fish Habitat, and Hydrologic Restoration

1. Reduce the impacts of open road densities within the WA area by upgrading and “storm proofing” roads within the Forest Service transportation system. This would include reducing diversion potential and risk of stream crossing failures, upgrading culverts to meet 100 year storm events, disconnecting inboard ditches, and annually inspecting and maintaining open roads. High priority areas include Shell Mountian Creek, Bierce Creek, and Raspberry Gulch subwatersheds and the Hermit Fire area.

2. Reduce the impacts of road densities within the Matrix lands by properly “closing, not gating or blocking” selected roads. This recommendation doesn’t mean actual decommissioning, but instead implies excavating all stream crossings and “storing” the road route as a temporary road until it is needed for future management activities. However, the decision as to which roads in the Matrix to close should be made at the same time as silviculture decisions and commodities opportunities are developed along each route. In particular, roads within extensively burned, fire salvage areas within Matrix lands should be strongly considered for proper closure.

3. Reduce the impacts of road density in the LSRs by decommissioning or hydrologic closure of roads that access plantations and fire salvage areas. Prior to the selection of each road, review the needs for future land management activities such as plantation and natural stand treatments, fuels reduction opportunities, fire suppression needs, and private property access. Priority subwatersheds include Collins, Farley, Marie, Happy Camp, and Bierce Creeks.

Threatened, Endangered, Sensitive and Survey & Manage Species

1. Prior to planning additional timber sales in the Upper South Fork watershed develop a wildlife corridor strategy that provides for dispersal between LSRs RC328, RC 330 and spotted owl activity centers as well as adjacent wilderness areas and watersheds. Because of their scarcity and value to overall biodiversity defer the 102 acres of size class 6 stands within Matrix lands from regeneration treatments, and include them as part of the wildlife dispersal corridor and/or old growth retention requirements.

2. Within Wildlife Habitat Management Matrix lands in the Upper South Fork, silviculturist and wildlife management techniques should emphasize Sensitive species habitat management. Due to the existence of a known territory and sightings in these lands, the northern goshawk and Pacific fisher should be given first priority. We also recommend using wildlife habitat management matrix lands within the Upper South Fork watershed to test experimental or controversial silvicultural and controlled fire prescriptions designed to protect and enhance late successional habitat characteristics prior to implementing them within LSR lands.

3. Maintain snags and down log levels at or above Forest LRMP minimums with an emphasis on the larger diameter sizes and full range of tree species diversity. We acknowledge that snag retention is difficult to achieve with many harvest systems and therefore careful attention is needed in selecting the locations of snags and recruitment trees such that more are retained in some areas to compensate for the lack of them in other areas and that the placement is close enough to ensure that large areas are not left with too few snags and down logs.

4. Conduct habitat and species surveys for TES and S&M species where little information exists in both watersheds with matrix lands being the highest priority.

5. Increase field surveys for Canyon Creek Stonecrop to better determine the range and differentiate this species from the several other species of Sedum in northwestern California that closely resemble one another.

Fire and Fuels

1. Use prescribed fire to re-introduce low-intensity fires back into the watersheds at low and mid-elevation levels (All Land Allocations). Fuelbreaks, roads, or natural openings can be used as anchor points to facilitate initial burning. Where feasible burning should be done contouring downslope from anchor points with various width strips (to fit site-specific conditions) being burned annually. Annual burning programs should be limited to 10% or less of overall watershed acres. Some pre-treatments, such as overstory and\or understory thinning, maybe used to facilitate burning operations where appropriate (Matrix Lands). Priority areas include blocks of LSR lands adjacent to private property, areas below Forest Service Road 1S26, and areas adjacent to Bierce, Wilcox, Penny, and Trough Ridges.

2. Within Matrix lands, when and if feasible, continue construction and maintenance of ridgetop fuelbreak system.

3. Maintain both Forest Service fire lookout towers along South Fork Mountain in the following order of priority:

1. Horse Ridge fire lookout tower.
2. Pickett Peak fire lookout tower.

4. Salvage sales should be allowed to assist in removing excess levels of windthrow, insect, or fire mortality timber that will otherwise become a fire hazard if left in place (Matrix Lands & LSRs as described within the Forest LSR Fire Plan). Treat all activity generated fuels.

5. Slash generated from plantation thinnings within the watersheds should be treated to eliminate fire hazard. Appropriate treatments should be identified at the NEPA documentation level (All Land Allocations).

Commercial Wood Products

1. **Plantation Thinning Opportunities**. Conduct site-specific analysis of plantations which may be suitable for stocking-control (thinning) through the development of silvicultural prescriptions. Indicators

of stand conditions which may be candidates include size/density stands of UX or XUX. Subwatersheds currently deficient in connectivity habitat may be priority for treatment. Priority areas include the Hermit Fire area and along Trough Ridge.

2. **Thinning Opportunities on Overstocked Young Growth Sites**. Conduct site-specific analysis of well-stocked stands which may be suitable for intermediate (thinning) harvest on suitable matrix lands, within late-successional reserves, and within select riparian reserves through the development of silvicultural prescriptions. Indicators of stand conditions which may be candidates include size/density stands of 2 or 3, N or G. Thin overstocked stands to restore vigor and prevent mortality. Many mature stands in the watershed are beyond the natural range of variability in carrying capacity due to fire suppression and the subsequent encroachment of a shade tolerant understory. This has led to conditions of low vigor, resiliency to stressors and excessive mortality.

3. **Ponderosa Pine/Jeffrey Pine Thinning Opportunities**. It is recommended that ponderosa and Jeffrey pine stands be thinned to reduce the probability of successful bark beetle group kill. Older stands should be thinned, while younger stands could be managed through a combination of thinning and underburning. These treatments may be integrated with fuels reduction activities to achieve mutual benefits. In areas where the sudden death of a group of pine has resulted in the accumulation of unacceptably high levels of fuel, the risk of mortality can be lowered by thinning. Thinning pine stands will reduce the probability of a successful *Dendroctonus* group kill by both increasing the amount of soil moisture available to each leave tree, as well as by increasing the spacing between leave trees to the outer limits of effectiveness of the aggregating pheromone. The only reliable and effective method to thin existing stands of thick-barked mature pines is to mechanically cut some trees. Prescribed fire can be used to open up some very young pine stands, or to maintain an open condition in an older pine stand after it has been thinned.

4. **Regeneration Opportunities on CMAI CAS Sites**. Conduct site-specific analysis of stands which may be suitable for regeneration harvest on suitable (CAS) lands which have culminated mean annual increment (CMAI) through the development of silvicultural prescriptions. Indicators of stand conditions which may be candidates include size/density stands of 3 N or G, or 4 N or G. Areas on and adjacent to Rainbow and Penny Ridges are the top priority.

5. **Regeneration Opportunities on Understocked CAS Sites**. Conduct site-specific analysis of understocked stands which may be suitable for regeneration harvest on suitable (CAS) lands through the development of silvicultural prescriptions. Indicators of stand conditions which may be candidates include size/density stands of 3 S or P, or 4 S or P. Subwatersheds currently deficient in connectivity habitat may be priority for treatment.

6. **Include Riparian Reserves in "Upland" Prescriptions**. When the logical placement of a regeneration or thinning unit abuts a Riparian Reserve, include that portion of the RR in the unit boundary. Then develop an appropriate prescription that integrates the Aquatic Conservation Strategy with the upland forested area.

7. **Sugar Pine Enhancement Opportunities**. Locating resistant parent trees and outplanting resistant stock are critical to maintenance of sugar pine at or near historical levels in the Upper South Fork-Happy Camp watersheds. Other management activities such as pruning and localized Ribes removal may be used in stands where only non-resistant sugar pine are available and it is desired to recruit sugar pine as a part of the future overstory. Although sugar pine will likely not become extirpated from the watershed, without some actions to protect it and promote regeneration of resistant trees, demographics will change as immature trees will not be available to move into mature and overmature age classes.

Human Use / Heritage

1. Recommend removal of the Black Rock fire lookout.

2. Evaluate the effects of dispersed camping on South Fork Mountain prehistoric sites.

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Appendix A. List of Preparers

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Bill Clark	Forest Service	Fire/Fuels
Ken Coop	Forest Service	Range
Susan Erwin	Forest Service	Botany
Danny Hagans	Pacific Watershed Associates	Geology/Hydrology
Jeff Paulo	Forest Service	Silviculture
Mark Stevens	Forest Service	Transportation
Christine Veverka	Natural Resource Conservation Service	Botany

Appendix B. Figures

Happy Camp Watershed

U.S.D.A Forest Service
Shasta-Trinity National Forests
Southfork Management Unit

Land Allocation
Figure 1

R.8 E. | R.12 W.

T.1 S.
T.2 S.

T.29 N.
T.28 N.

R.7 E. | R.8 E.

R.12 W. | R.11 W.

R.8 E. | R.12 W.

T.28 N.
T.27 N.

R.12 W. | R.11 W.

N

LEGEND

- Watershed Boundary
- Streams
- Adaptive Management Areas
- Administratively Withdrawn Areas
- Congressionally Withdraw Areas
- Late-Successional Reserves
- Matrix
- Private

Prepared by S.F.M.U.
Projection: UTM Zone 10
1927 North American Datum
February 22, 1999 Map File: /fsfiles/unit/gis/hf/special/hcamp_usft/hpcmp_bw/hpcmp_17alloc.gra

Humboldt and Mount Diablo Baselines and Meridians

Upper South Fork Watershed

U.S.D.A Forest Service
Shasta-Trinity National Forests
Southfork Management Unit

Land Allocation
Figure 2

T.28 N.
T.27 N.

T.28 N.
T.27 N.

R.11 W. | R.10 W.

T.27 N.
T.26 N.

T.27 N.
T.26 N.

LEGEND

- Adaptive Management Areas
- Administratively Withdrawn Areas
- Congressionally Withdrawn Areas
- Late-Successional Reserves
- Matrix
- Private
- Watershed Boundary
- Streams

Humboldt and Mount Diablo Baseline and Meridian

Prepared by S.F.M.U.
Projection: UTM Zone 10
1927 North American Datum
February 22, 1999 Map File: /fsfiles/unit/gis/hf/special/hcamp_usft/usft_bw/usft_17alloc.gra

Happy Camp Watershed

U.S.D.A Forest Service
Shasta-Trinity National Forests
Southfork Management Unit

Late Successional Habitat
Figure 3

R.8 E.| R.12 W.

T.1 S.
T.2 S.

T.29 N.
T.28 N.

R.7 E.| R.8 E.

R.12 W.| R.11 W.

R.8 E.| R.12 W.

T.28 N.
T.27 N.

R.12 W.| R.11 W.

LEGEND

- Watershed Boundary
- Late Successional Habitat
  Veg Stratum:
  Size 4-6, N&G
- Private

Prepared by S.F.M.U.
Projection: UTM Zone 10
1927 North American Datum
February 22, 1999 Map File: /fsfiles/unit/gis/hf/special/hcamp_usft/hpcmp_bw/hpcmp_17late.gra

Humboldt and Mount Diablo Baselines and Meridians

Upper South Fork Watershed

U.S.D.A Forest Service
Shasta-Trinity National Forests
Southfork Management Unit

Late Successional Habitat
Figure 4

T.28 N.
T.27 N.

T.28 N.
T.27 N.

R.11 W. | R.10 W.

T.27 N.
T.26 N.

T.27 N.
T.26 N.

LEGEND

- Watershed Boundary
- Late Successional Habitat
  Veg Stratum:
  Size 4-6, N&G
- Private

Humboldt and Mount Diablo Baseline and Meridian

Prepared by S.F.M.U.
Projection: UTM Zone 10
1927 North American Datum
February 22, 1999 Map File: /fsfiles/unit/gis/hf/special/hcamp_usft/usft_bw/usft_17late.gra

Happy Camp Watershed

U.S.D.A Forest Service
Shasta-Trinity National Forests
Southfork Management Unit

Dispersal Habitat
Figure 5

R.8 E. | R.12 W.

T.1 S.
T.2 S.

T.29 N.
T.28 N.

R.7 E. | R.8 E.

R.12 W. | R.11 W.

R.8 E. | R.12 W.

T.28 N.
T.27 N.

R.12 W. | R.11 W.

N

LEGEND

- Watershed Boundary
- Streams
- Dispersal Habitat
  Veg Stratum:
  Size 3-6, N&G
  Size 4, P
- Private

Prepared by S.F.M.U.
Projection: UTM Zone 10
1927 North American Datum
February 22, 1999 Map File: /fsfiles/unit/gis/hf/special/hcamp_usft/hpcmp_bw/hpcmp_17disp.gra

Humboldt and Mount Diablo Baselines and Meridians

Upper South Fork Watershed

U.S.D.A Forest Service
Shasta-Trinity National Forests
Southfork Management Unit

Dispersal Habitat
Figure 6

T.28 N.
T.27 N.

T.28 N.
T.27 N.

R.11 W. | R.10 W.

T.27 N.
T.26 N.

T.27 N.
T.26 N.

LEGEND

- Watershed Boundary
- Streams
- Dispersal Habitat
  Veg Stratum:
  Size 3-6, N&G
  Size 4, P
- Private

Humboldt and Mount Diablo Baseline and Meridian

Prepared by S.F.M.U.
Projection: UTM Zone 10
1927 North American Datum
February 22, 1999 Map File: /fsfiles/unit/gis/hf/special/hcamp_usft/usft_bw/usft_17disp.gra

Upper South Fork/Happy Camp EA
Happy Camp Watershed

U.S.D.A Forest Service
Shasta-Trinity National Forests
Southfork Management Unit

Fish Distribution and Roads Coverage
Figure 1

R.8 E. | R.12 W.
T.1 S.
T.2 S.
T.29 N.
T.28 N.
R.7 E. | R.8 E.
R.8 E. | R.12 W.
R.12 W. | R.11 W.
T.28 N.
T.27 N.
R.12 W. | R.11 W.

LEGEND

- Anadromous Fish-Bearing Streams
- Perennial Fish-Bearing Streams
- Perennial & Intermittent Fish-Bearing Streams
- Watershed Boundary
- Private

Prepared by S.F.M.U.
Projection: UTM Zone 10
1927 North American Datum
March 30, 1999 Map File: /fsfiles/unit/gis/hf/special/hcamp_usft/hpcmp_bw/hpcmp_17fish.gra

Humboldt and Mount Diablo Baselines and Meridians

Upper South Fork Watershed

U.S.D.A Forest Service
Shasta-Trinity National Forests
Southfork Management Unit

Fish Distribution and Roads Coverage
Figure 8

T.28 N.
T.27 N.

T.28 N.
T.27 N.

R.11 W. | R.10 W.

T.27 N.
T.26 N.

T.27 N.
T.26 N.

LEGEND

- Anadromous Fish-Bearing Streams
- Perennial Fish-Bearing Streams
- Perennial & Intermittent Fish-Bearing Streams
- Watershed Boundary
- Private

Humboldt and Mount Diablo Baseline and Meridian

Prepared by S.F.M.U.
Projection: UTM Zone 10
1927 North American Datum
April 29, 1999 Map File: /fsfiles/unit/gis/hf/special/hcamp_usft/usft_bw/usft_17fish.gra

Happy Camp Watershed

U.S.D.A Forest Service
Shasta-Trinity National Forests
Southfork Management Unit

Fire Starts
Figure 9

R.8 E. | R.12 W.
T.1 S.
T.2 S.
T.29 N.
T.28 N.
R.7 E. | R.8 E.
R.8 E. | R.12 W.
R.12 W. | R.11 W.
R.8 E. | R.12 W.
T.28 N.
T.27 N.
R.12 W. | R.11 W.

LEGEND

- Private
- Lightning Caused Fire Areas
- Unknown Cause Fire Areas
- Lightning Caused
- Human Caused
- Watershed Boundary
- Streams

Prepared by S.F.M.U.
Projection: UTM Zone 10
1927 North American Datum
February 22, 1999 Map File: /fsfiles/unit/gis/hf/special/hcamp_usft/hpcmp_bw/hpcmp_17fire.gra

Humboldt and Mount Diablo Baselines and Meridians

Upper South Fork Watershed

U.S.D.A Forest Service
Shasta-Trinity National Forests
Southfork Management Unit

Fire Starts
Figure 10

T.28 N.
T.27 N.

T.28 N.
T.27 N.

R.11 W. | R.10 W.

T.27 N.
T.26 N.

T.27 N.
T.26 N.

LEGEND

- Watershed Boundary
- Streams
- Private
- Lightning Caused Fire Areas
- Human Caused

N

Prepared by S.F.M.U.