40. South Fork Trinity River Population

- Interior-Trinity Diversity Stratum
- Non-Core -1, Functionally Independent Population
- High Extinction Risk
- 970 Spawners Required for ESU Viability
- 932 mi^2
- 242 IP km (150 mi) (26% High)
- Dominant Land Uses are Agriculture and Timber Harvest
- Principal Stresses are 'Altered Hydrologic Function' and 'Impaired Water Quality'
- Principal Threats are 'Water Diversions' and 'Roads'

40.1 History of Habitat and Land Use

The South Fork Trinity River is the largest undammed river in California. Past and present land use practices in the South Fork Trinity River basin have led to a decreased ability to support salmon and steelhead, as evidenced by significantly decreased runs of spawning salmonids (Pacific Watershed Associates (PWA) 1994). Activities such as mining, road construction, fire suppression, stream diversion, and timber harvest have modified streamflow and natural erosion processes and altered stream channels in the South Fork Trinity River basin (U.S. Forest Service (USFS) 2008). These disturbances have been widely distributed and have caused sustained alteration of ecosystem structure and function, particularly in riparian areas (USFS 2008).

Overgrazing in the late 1800s and early 1900s damaged riparian vegetation and led to significant erosion (Tetra Tech 2000). By 1977, 52 percent of forested areas within the basin had been logged. An additional 4 percent of the old growth had been lost to fire. At the time, total road length was 3,456 miles, 92 percent of which were associated with timber harvests (California Department of Water Resources (DWR) 1979, PWA 1994). Since that time, an undetermined, but substantial, amount of additional acreage has been affected by logging, road construction and wildfires. Industrial pollution from lumber mills, domestic pollution from poorly functioning septic systems, and pollution from agricultural non-point sources have also contributed to the declines of salmonids in the South Fork Trinity River (PWA 1994).

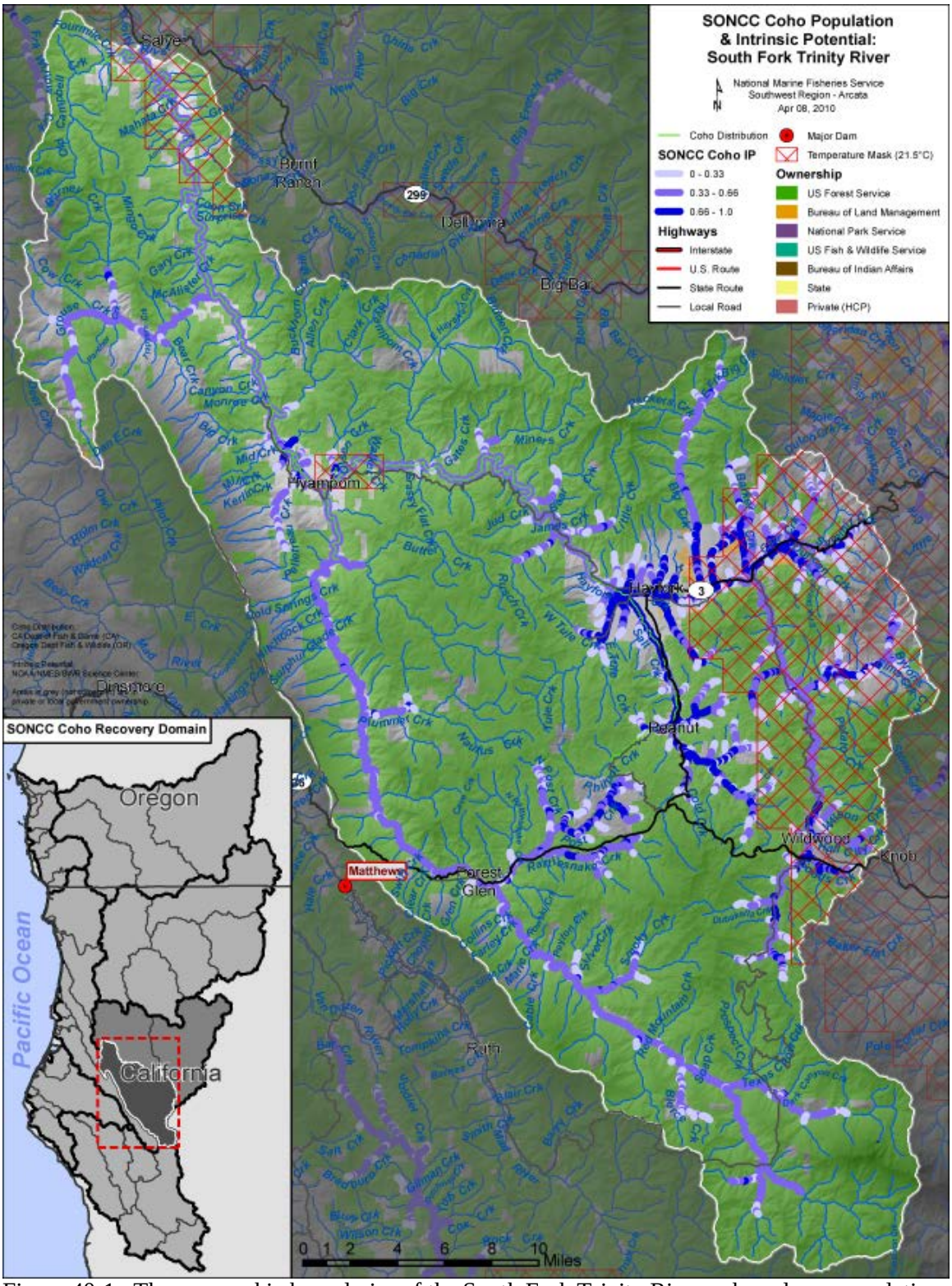

Figure 40-1. The geographic boundaries of the South Fork Trinity River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2009a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

The mid-1850s saw the beginning of placer mining on several tributaries of the South Fork Trinity, followed later by dragline mining and hardrock mining. The timber industry developed concurrently and became economically important in the area. The 1905 formation of the Trinity Forest Reserves (later the Trinity National Forest) led to changes in forest management practices, particularly in grazing and fire suppression (USFS 1999c). Changes in land use led to accelerated natural erosion processes in the South Fork Trinity River basin, resulting in increased sedimentation in the river channels. Smaller tributaries generally have been affected less severely than mainstem lower gradient reaches. Sedimentation is most notable in the Hyampom Valley, with most of the sediment being delivered from South Fork Mountain tributaries, particularly downstream of Hyampom Valley and the Pelletreau Creek subwatershed, both of which have been heavily logged since the 1940s (PWA 1994).

Fire is a significant disturbance factor within the South Fork Trinity River basin (USFS 2008). Prior to the initiation of organized fire suppression in the early 1900s, low intensity, surface fires of relatively short intervals of 5 to 30 years were typical in the basin (USFS 2008). The suppression of fire, along with unnatural fuel loading, has initiated a transition to a fire regime characterized by more frequent, high intensity fires and vegetative community changes such as greater abundance of white fir (USFS 2008). Several intense wildland fires have burned in the South Fork Trinity basin since fire suppression commenced. Continued accelerated sediment production is found in many of the areas where large-scale forest fires have burned (U.S. Environmental Protection Agency (EPA) 1998).

Salmon in the South Fork Trinity River have also been affected by a number of large floods over the past several decades, especially by the flood of December 1964 (EPA 1998). The 1964 flood caused tremendous soil loss in tributaries, especially those that had been logged (MacCleery 1974). Sedimentation from road failures and mass wasting associated with roads and clearcut logged areas choked the channels of many of these tributaries. As these tributary streams delivered sediment into the South Fork Trinity River, additional streamside landslides were triggered (PWA 1994). “Unstable geology, along with erosion-producing land use practices have been blamed for the many mass wasting events triggered by the 1964 flood, which resulted in dramatic instream changes, including channel widening, aggradation, and loss of pool depth, all of which adversely affected salmonids” (EPA 1998). The Salyer reach (river mile 1.5 to 6.2) showed about 20 feet of aggradation after the 1964 flood (Dresser et al. 2001). Hyampom Valley (as of 1982) still had 25 feet of aggradation and the channel has widened 66 feet due to the 1964 flood (PWA 1994). Since that time, further changes suggest improvements in some locations, while continued, chronic sediment inputs may be hindering a more complete or faster recovery (EPA 1998).

Recently, Van Kirk and Naman (2008) found that river discharge of the South Fork Trinity River was significantly lower in the period from 1977 to 2005 than the period from 1966 to 1976. This decrease in flow is likely due to a combination of increasing water utilization, land use changes, and climate change, which has resulted in a decrease in snowpack in the region (Van Kirk and Naman 2008). Water utilization and the resulting reduction in the water table also results in longer recharge times for aquifers. This means that the increase in streamflows associated with fall and winter rains is often delayed as groundwater resources recharge.

The Hayfork Creek sub-basin (the largest tributary to the South Fork) includes approximately 191,000 acres of public land and 52,000 acres of private land (South Fork Trinity River Coordinated Resource Management and Planning Group (SFCRMP) 2008). The Hayfork Creek sub-basin is a relatively geologically stable basin in comparison to the rest of the South Fork Trinity River basin. The majority of water diversions and water quality issues (high water temperatures, high nutrient loads, low dissolved oxygen) in the South Fork Trinity River basin occur in the Hayfork sub-basin, where depleted summer flows and lack of riparian shading have adversely affected salmonid production in Hayfork Creek (PWA 1994). The upper reaches of Hayfork Creek are covered by the temperature mask (Figure 40-1), making it uninhabitable to coho salmon without thermal refugia from coldwater springs or groundwater. The loss of riparian canopy (from grazing and timber harvest) contributes significantly to increased water temperatures, which can exceed 80°F in Hayfork Creek (PWA 1994). Flow depletion, lack of riparian cover, and water pollution all affect the ability of Hayfork Creek and its major tributaries to produce salmon and steelhead. Because of its high water temperature, Hayfork Creek increases temperature problems in the main stem South Fork Trinity River in some years, whereas it formerly provided a moderating influence (PWA 1994).

40.2 Historic Fish Distribution and Abundance

It was noted by USFWS and CDFG ((1956) that “Silver [coho] salmon enter most lower Trinity River tributaries to spawn.” Similarly, Moffet and Smith (1950) stated that “Silver [coho] salmon enter the lower Trinity River to spawn.” Although it is thought that anadromous fish, including coho salmon, were abundant in the middle 20th century but their populations have declined dramatically since the flood of 1964 (Borok and Jong 1997, Dresser et al. 2001). Beyond these few statements, little information is available on the historic distribution and abundance of coho salmon in the South Fork Trinity River basin.

CDFG operated a weir on the South Fork Trinity River at Sandy Bar—about two kilometers upstream of the confluence with the Trinity River—between 1984 to 1990 (Jong and Mills 1992). In 1985 and 1990, years when enough adult and jack coho salmon returned to the river to make escapement estimates possible, it was estimated that 127 [95 percent CI = 109 to 222] and 99 [95 percent CI = 68 to 256] adult and jack coho salmon returned to the river (Jong and Mills 1992). However, 35.8 percent of the adult coho salmon captured in 1985 were of hatchery origin (Jong and Mills 1992). Consistent marking of coho salmon at Trinity River Hatchery did not occur until 1996, but the hatchery fish in 1985 could be identified by marks made in the hatchery as part of a separate experiment (Marshall 2008).

Based on the Intrinsic Potential (IP) of the watershed, Williams et al. (2008) calculated that the low-risk spawner threshold for the South Fork Trinity River population is 6,400 coho salmon. The depensation (high risk) threshold is 242 coho salmon (Williams et al. 2008). Moderate IP reaches exist throughout the South Fork Trinity River basin, both in the mainstem, the East Fork of the South Fork Trinity River, and tributaries such as Butter Creek. There are several streams that contain high IP reaches (IP > 0.66) such as Hayfork Creek and Salt Creek, however, many of these high IP stream reaches are on private land in the low-gradient valley floors of the watershed and experience high temperatures during the summer (Table 40-1). There are no historical accounts of coho salmon presence in the Hayfork Valley, and their prevalence in Hayfork Valley remains in question. There is a section in Hayfork Creek thought to inhibit coho

salmon migration into Hayfork Valley because of its high gradient, particularly in dry water years.

Coho salmon in the upper reaches of the South Fork Trinity River were likely dissimilar to those of the coast range and lower Trinity River. In order to access spawning grounds in the Hayfork Valley, Salt Creek, and upper mainstem South Fork Trinity River, they would have begun their spawning migration in late September or October. These "long-run" coho salmon most likely had run timing that was similar to that of coho salmon in the Shasta River. This is unlike coho salmon in the coast range that enter rivers and streams to spawn in November and December following winter rains. The far distance that they travel, distinctive geology and ecology of the Yolla Bolly Mountains, and unregulated flow of the South Fork Trinity River, would have made this population of coho salmon unique among Trinity River coho salmon populations.

Table 40-1. Tributaries with high IP reaches in the South Fork Trinity (IP > 0.66) (Williams et al. 2006).

Subarea[1]	**Stream Name**
Hayfork Valley	Hayfork Creek
	Salt Creek
	Big Creek
	Barker Creek
Forest Glenn	Butter Creek
	Post Creek
	Rattlesnake Creek
Corral Creek	Corral Creek
Hyampom	Olsen Creek
Grouse Creek	Eltapom Creek

[1]Subarea refers to hydrologic subarea (HSA) in the CALWATER classification system.

40.3 Status of South Fork Trinity River Coho Salmon

Spatial Structure and Diversity

Coho salmon are limited in their distribution in the South Fork Trinity River basin and occur only in the mainstem South Fork Trinity River up to Butter Creek, Butter Creek, Hayfork Creek up to Corral Creek, Eltapom Creek, Olsen Creek, and Madden Creek (Everest 2008; Boberg 2008). There are no know barriers to migration for coho salmon in the South Fork Trinity River upstream of Butter Creek, and Rattlesnake Creek has moderate and high IP reaches. Yet no coho salmon are known to inhabit these stream reaches. Coho salmon have not been found in Hayfork Creek near or upstream of the town of Hayfork. This area has the greatest concentration of high IP values of any stream in the basin. It is not clear if coho salmon are currently able to migrate through Hayfork Creek upstream of Corral Creek, or if they were historically able to migrate past Corral Creek. However, it is likely that habitat conditions, such as high summer water temperatures and low dissolved oxygen, arising from land use, water utilization, climate change and channel aggradation are currently limiting the spatial structure of coho salmon in the South Fork Trinity River basin. The more restricted and fragmented the distribution of individuals within a population, and the more spatial distribution and habitat access diverge from historical conditions, the greater the extinction risk. For these reasons, coho salmon of the South Fork

Trinity River are spatially restricted in the basin and have an elevated risk of extinction because of their spatial structure.

Each year, Trinity River Hatchery releases approximately 500,000 coho salmon smolts, 800,000 steelhead, and 4.3 million Chinook salmon. Currently, coho salmon returns to the Trinity River are dominated by hatchery fish (US Fish and Wildlife Service (USFWS) and Hoopa Valley Tribe (HVT) 1999; Table 40-2). From 2003 to 2005, over 75 percent of coho salmon adults returning to the Trinity River, as estimated at Willow Creek, were of hatchery origin (Table 40-2). In 1985, Jong and Mills (1992) found that 35.8 percent of adult coho salmon returning to the South Fork Trinity River were of hatchery origin. Straying of hatchery fish into tributaries such as the South Fork Trinity River presents a particular threat to the diversity of the population because the hatchery fish may reduce the reproductive success of the overall population (Mclean et al. 2003) through outbreeding depression (Reisenbichler and Rubin 1999).

Table 40-2 Coho salmon run size estimates for the Trinity River. Based on counts at the Willow Creek counting weir. Data are from CDFG (2008c).

Year	Dates*	Location	Catch	Hatchery proportion of catch	Estimated Run Size
2003	17 Sep-18 Nov	Willow Creek	250	86	28,152
2004	10 Sep-25 Nov	Willow Creek	1,009	77	38,882
2005	3 Sept-4 Nov	Willow Creek	772	92	31,419
2005	24 Sep-2 Dec	Junction City	1,161	92	24,615

**Note that naturally produced coho salmon may return to the Trinity River later than their hatchery counterparts and/or after the weir at Willow Creek is removed from the river.*

Little is known about life history diversity in the South Fork Trinity River such as unique migration timing, redistribution of juveniles, or non-natal rearing. There does appear to be some diversity of life history strategies in the Trinity River based on data on run timing and outmigration. Coho salmon enter the Trinity River between September and November and spawning in the river continues into December (CDFG 2009b). Also, both young-of-the-year and yearling coho salmon are captured at downstream migrant traps located in the Trinity River near Willow Creek (Pinnix et al. 2007). Outmigration of age 0+ coho salmon occurs over a large time period between March and September as does outmigration of Age 1+ (Pinnix et al. 2007). Outmigration of subyearling coho salmon may be due to competition for rearing habitat or sub-optimal rearing conditions or it may be due to a unique life history type that may rear in natal or non-natal streams or both prior to emigrating to the ocean. It is unknown whether the South Fork Trinity population has any of these unique life history characteristics because no juvenile salmonid trapping currently occurs in the basin.

Because of the high numbers of adult hatchery coho salmon migrating past the South Fork Trinity River, and because they are known to stray into non-natal tributaries, the South Fork Trinity River population of coho salmon is, at least, at a moderate risk of extinction with regards to the Diversity viability parameter. Based on current spawning densities and locations, the South Fork Trinity River population is at an elevated risk of extinction because its spatial structure and diversity are very limited compared to modeled IP.

Population Size and Productivity

The only population estimates for the South Fork Trinity River are based on work by Jong and Mills (1992) who estimated that 127 adult and jack coho salmon returned to the South Fork Trinity River in 1985 and 99 returned in 1990. With 35.8 percent (46) of the adult coho salmon captured in 1985 being of hatchery origin, the total wild population was likely under 100 adults during these years (Jong and Mills 1992). In 1985, several hundred coho salmon juveniles were trapped in the South Fork Trinity River below the mouth of Madden Creek (CDFG 1993). More recent data on population sizes, other than that of Jong and Mills (1992) are unavailable. Overall, if a spawning population is too small, the survival and production of eggs or offspring may suffer because it may be difficult for spawners to find mates, or predation pressure may be too great. This situation accelerates a decline toward extinction. Williams et al. (2008) determined at least 242 spawners are needed each year in the South Fork Trinity River to avoid dispensatory effects of extremely low population sizes. If we assume abundances are similar to those found in 1985 and 1990, the South Fork Trinity River population does not meet this depensation threshold and is at high risk of extinction. The population growth rate in South Fork Trinity River basin has not been quantified but is likely negative based on loss of habitat, declining water quality, and detrimental hatchery influences. This downward trend further adds to the extinction risk of the population.

Extinction Risk

The South Fork Trinity River coho salmon population is not viable and at high risk of extinction, because the most recent estimated average spawner abundance was less than the depensation threshold (Table ES-1 in Williams et al. 2008).

Role in SONCC Coho Salmon ESU Viability

The South Fork Trinity River coho salmon population is considered to be a non-core "Functionally Independent" population within the Trinity diversity stratum. This population was likely once sufficiently large to be historically viable-in-isolation and had demographics and extinction risk that were minimally influenced by immigrants from adjacent populations (Bjorkstedt et al. 2005; Williams et al. 2006). As a non-core population, the recovery target for the South Fork Trinity population is for the population to meet the depensation threshold of 242 spawners (Williams et al. 2008).

40.4 Plans and Assessments

Trinity County Resource Conservation District

South Fork Trinity River Coordinated Resource Management Plan Committee

Action Plan for Restoration of the South Fork Trinity River Watershed and Its Fisheries
http://www.krisweb.com/biblio/sft_usbor_pwa_1994_sftplan/pwa1.htm

U.S. Forest Service Watershed Analyses
http://www.fs.fed.us/r5/shastatrinity/publications/watershed-analysis.shtml

State of California

Total Maximum Daily Load
http://www.swrcb.ca.gov/northcoast/

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

40.5 Stresses

Table 40-3. Severity of stresses affecting each life stage of coho salmon in the South Fork Trinity River. Stress rank categories and assessment methods are described in Appendix B, and the data used to assess stresses for the initial threats assessment (described in Appendix B) is presented in Appendix H.

Stresses (Limiting Factors)		Egg	Fry	Juvenile[1]	Smolt	Adult[1]	Overall Stress Rank
1	Adverse Hatchery-Related Effects	Very High	Very High	Very High[1]	Very High	Very High[1]	Very High
2	Altered Sediment Supply[1]	High	High	High[1]	Medium	High	High
3	Impaired Water Quality[1]	Low	Medium	High[1]	High	Medium	High
4	Altered Hydrologic Function[1]	Medium	High	High[1]	Medium	High	High
5	Degraded Riparian Forest Conditions	-	High	High	High	Medium	High
6	Lack of Floodplain and Channel Structure	Medium	High	High	High	Medium	High
7	Impaired Estuary/Mainstem Function	-	Low	Medium	Medium	Medium	Medium
8	Barriers	-	Low	High	Low	High	Medium
9	Adverse Fishery-Related Effects	-	-	-	-	Medium	Medium
10	Increased Disease/Predation/Competition	Low	Low	Low	Low	Low	Low

[1] Key limiting factor(s) and limited life stage(s).

Limiting Stresses, Life Stages, and Habitat

Several factors limit the viability of the South Fork Trinity River coho salmon population. The most dominant of these factors stem from the effects of agricultural practices on private land, legacy sediment-related impacts from past floods, fire, and land management. Altered sediment supply, impaired water quality, and altered hydrologic function are the most likely stresses limiting productivity of the South Fork Trinity population. Juveniles are the most likely limited life stage due to the poor summer rearing conditions.

The majority of high IP habitat exists on private land in the Hayfork Valley. This area is characterized by poor water quality, a lack of hydrologic function, sedimentation and high water temperatures. High water temperatures, while affected by high summer air temperatures, are exacerbated by reduction of riparian trees, stream widening due to aggradation, over-grazing of

riparian zones, flow depletion and agricultural runoff. The stream bed may remain unstable for a long duration, making recolonization of stream side trees difficult even by invasive species such as willows or alders (e.g., lower reaches of Pelletreau Creek and the South Fork Trinity River at Hyampom; Lisle 1981). Several studies and habitat typing reports have noted stream temperature as a major limiting factor for fisheries in the South Fork Trinity (USFS 1990; PWA 1994). Stream temperatures in the mainstem below Hyampom and in Hayfork Creek often reach lethal levels during the summer and tributaries with the potential for thermal refugia often lack adequate flows during the summer (PWA 1994). Poor water quality leads to reduced survival and growth of juveniles and can contribute to thermal barriers for migrating juveniles and smolts. A limited amount of habitat with adequate temperatures and habitat attributes for juvenile summer rearing exists in the South Fork Trinity. Riparian vegetation is reestablishing in some smaller tributaries and is expected to experience improved water quality in the future (e.g., Sulphur Glade Creek). However many of these streams lack the flow and/or habitat requirements of juveniles coho salmon.

High levels of fine sediment indicate that excessive sediment may also be a major limiting factor in some tributaries and mainstem reaches, for example, the South Fork Trinity River near Hyampom and Hayfork Creek (Gilroy et al. 1992, Dresser et al. 2001). Many streams exhibiting higher channel gradients have flushed substantial amounts of introduced coarse sediment, similar to a pattern of recovery described by Lisle (1981) and Hagans et al. (1986). The mainstem South Fork Trinity River downstream of Hyampom to the confluence with the Trinity River has flushed a substantial portion of the sediment deposited in the 1964 flood. Hyampom Valley transitions from a low gradient, wide alluvial valley to a narrow canyon downstream. The transition area functions as a pinch point that prevents the mobilization of the greater than 25 feet of sediment that filled the Hyampom valley during the 1964 flood. Channel recovery is exacerbated by continued delivery of more sediment than the channel can transport. Headwater streams have also, in some cases, experienced re-growth of riparian zones that has promoted lower stream temperatures. However, reaches of the mainstem South Fork Trinity River upstream of lower Hyampom Valley, and lower Hayfork Creek, seem to be lagging in recovery both in terms of flushing recently introduced sediment and lowering water temperatures (Dale 1990). Water quality and water yield appear to be the main limiting factors to fisheries recovery in the potentially productive Hayfork Creek watershed. In order to improve the viability of this population it will be imperative to improve habitat conditions for juveniles and adults, and address the issues related to straying hatchery adults.

Vital habitat for the South Fork Trinity coho salmon population exists in areas that provide thermal refugia for juveniles in the summer and in areas with relatively intact habitat features such as clean spawning gravel, functional floodplain and channel structure, and established riparian forest. Potential coho salmon refugia areas exist at many stream confluences with the South Fork Trinity River. Madden Creek provides excellent refugia for juvenile and adult coho salmon in the lower South Fork Trinity River (Boberg 2008). It has cool, clean water that originates in the mountains of the Six Rivers National Forest and moderates the high temperature of the South Fork Trinity River in the summer months near the confluence of the two waterways. At times, hundreds of juvenile salmonids congregate in this area. Table 40-4 lists other potential refugia areas.

Table 40-4. Potential coho salmon temperature refugia. Areas in the South Fork Trinity River watershed.

HSA	Stream Name	Ownership
Grouse Creek	Madden Creek	Private/Public
Grouse Creek	Grouse Creek	Private/public
Forest Glenn	Butter Creek	Private
Forest Glenn	Rattle Snake Creek	Private/Public
Hyampom	Olsen Creek	Private
Grouse Creek	Eltapom	Public

Areas with relatively intact spawning and rearing habitat exist is isolated patches of Hayfork Creek and in other, smaller tributaries to the South Fork Trinity. Madden Creek is in the late stages of recovery from the 1964 flood and represents one of the few tributaries flowing off South Fork mountain with good water quality and the potential to accommodate spawning and rearing. The lower part of Hayfork Creek has the greatest extent of high IP habitat and with increased water quality; this section of Hayfork Creek could serve as the major seat of recovery for coho salmon in the South Fork Trinity River basin. Other important tributaries where coho salmon have recently been found include Butter Creek, Eltapom Creek, Olsen Creek, and Madden Creek (Everest 2008; Boberg 2008).

Adverse Hatchery-Related Effects

The effects of hatchery fish on all life stages of coho salmon are described in Chapter 3. No hatcheries or artificial propagation occur in the South Fork Trinity River population area, but Trinity River Hatchery is upstream on the Trinity River. Trinity River Hatchery currently releases 4.3 million juvenile and yearling Chinook salmon, 500,000 yearling coho salmon, and 800,000 yearling steelhead. Jong and Mills (1992) found that 35.8 percent of returning adults to the South Fork Trinity River in 1985 were of hatchery origin. Because adult coho salmon returns to Trinity Hatchery have been in excess of 25,000 fish during some years, it is likely that the stray rate of hatchery coho salmon to the South Fork Trinity River has continued to be high (>35 percent). Because hatchery smolts are not likely to migrate from the Trinity River upstream into the South Fork Trinity River, ecological interactions, such as competition and predation, between juveniles are not likely to occur within the South Fork Trinity River. However, juvenile coho salmon from the South Fork Trinity River population may compete with hatchery fish for food and habitat while rearing in the Lower Trinity River and in the Lower Klamath River. Adverse hatchery-related effects pose a very high stress to all life stages in the South Fork Trinity River sub-basin, because more than 30 percent of the spawners are of hatchery origin (Appendix B) and there is significant potential for ecological interactions.

Altered Sediment Supply

Altered sediment supply presents a high stress for most life stages. The 1964 flood resulted in widespread erosion in the mainstem South Fork Trinity River and many tributaries. Adding to these effects was the extensive harvesting of steep inner gorge slopes and widespread land disturbance. Many basins still suffer from chronic erosion and sedimentation as well as thick deposits of stored sediment and resultant wide, shallow streambeds (PWA 1994). Although the 1964 flood delivered substantial sediment to the South Fork Trinity River, there is evidence that

some sites affected by the 1964 flood have since downcut to pre-flood levels (Dresser et al. 2001). In areas where sediment loading is still ongoing, sediment has filled pools, widened channels, and simplified stream habitat. In many reaches, aggradation reduced surface flows, potentially limiting access to migrating juveniles. Stream channels with the greatest fine sediment accumulations in pools and with associated low juvenile fish densities include lower Salt Creek, Hayfork Creek above 9-mile bridge, the entire main stem, East Fork South Fork and Grouse Creek (PWA 1994). High turbidity also has negative impacts on respiration and feeding as well as egg incubation. Sediment loading is greatest in the Hyampom Valley, with most of the sediment being delivered from South Fork Mountain tributaries. The Grouse Creek and Pelletreau Creek subwatersheds, both of which have been heavily logged since the 1940s, are both major sediment contributors (PWA 1994). "In the 1964 flood, many debris torrents caused significant aggradation (from 15 to 20 ft in some locations), which probably then triggered many inner gorge landslides" (EPA 1998), along with substantial channel widening, up to 60 feet in areas. Studies have identified landslides as the major source of sediment, followed by streambank erosion, road surface erosion, and hillslope surface erosion. Hillslope sediment inputs seem to have declined dramatically, indicating that upslope conditions are recovering (Raines 1999, Dresser et al. 2001). There has been some indication that fine sediment levels may be limiting for fish, and it is thought that pools are too shallow now for temperature stratification (Gilroy et al. 1992, PWA 1994). Federally managed watersheds in which cumulative erosion and sedimentation effects are likely to be problems include Butter Creek, Rattlesnake Creek, Plummer Creek, South Fork Mountain Tributaries, East Fork South Fork, Upper South Fork, Hidden Valley, Upper Hayfork Creek, Hyampom and Gulch watersheds.

Impaired Water Quality

The stressors from poor water quality are generally high and have the greatest impact on juveniles and smolts due to poor seasonal rearing and migratory conditions. Areas of poor water quality related to accelerated erosion rates, elevated temperature, and contaminant runoff are scattered throughout the basin (PWA 1994). Water quality primarily affects fish and fish habitat in the mainstem South Fork Trinity River and in Hayfork Creek. In Hayfork Creek, water diversion, agricultural practices, residential septic systems, and industrial pollution all contribute to impaired water quality. Water quality has been so bad some years in Hayfork Creek that seasonal fish kills have been documented in the past (PWA 1994). Water temperature in Hayfork Creek and the mainstem South Fork Trinity can reach levels stressful or even lethal (>17 °C) for rearing coho salmon in the summer months (PWA 1994; USFS 1990). Hayfork Creek contributes to poor water temperatures in the mainstem (PWA 1994). In addition to temperature, turbidity effects have been found in the more erodible portions of the basin in the Upper and Lower South Fork sub-basins, particularly west of the mainstem, and in areas where land management practices are most intense (PWA 1994). Other tributaries including, but not limited to Salt Creek, Rattlesnake Creek, Post Creek, Rusch Creek, Tule Creek also suffer from high stream temperatures and associated low dissolved oxygen in the summer months. Many of these streams are adversely affected by illegal water withdrawals, and nutrient and pesticide loading associated with outdoor marijuana cultivation and associated road building and land clearing. Localized areas of non-point source pollution exist and nutrients and toxins from agriculture, roads, and developed areas contribute to poor water quality in the South Fork Trinity basin.

Altered Hydrologic Function

Altered hydrologic function represents a high stress for the population and is especially significant for fry, juveniles, and adults. Flows are naturally low during the summer due to the low elevations in the basin, the bedrock geology and their low water holding capacity. The summers are hot and dry for several months and there is often little water flowing in most creeks during the summer (USFS 1996c). Exacerbating this issue is the substantial water utilization in the South Fork Trinity River, especially Hayfork Creek and its tributaries (PWA 1994), and Rattlesnake Creek (Wiseman 2011) which has caused reductions in the amount of habitat available to rearing juvenile salmon in the summer and restricted access to spawning grounds in the fall. Hayfork Creek below the East Fork has been designated as a critical water shortage area (PWA 1994). Water uses within the Hayfork watershed include numerous withdrawals from Hayfork Creek and East Fork Hayfork Creek for mostly domestic, agricultural and livestock watering purposes. Quantification of the amount diverted is difficult because only an estimated 13 percent of the water diverted from Hayfork Creek is under an appropriated water right (USFS 1996c). Groundwater is also utilized in several portions of the watershed, like Hayfork Valley, and remains undocumented and unregulated. Marijuana cultivation is a serious problem in many areas, such as the Rattlesnake Creek watershed and likely has a significant impact on the hydrologic function of tributary streams during critical low-flow periods in the summer and fall. The South Fork Trinity River basin is also susceptible to rain-on-snow events and intense flooding. Adding to this is the effects grazing and logging have had on the hydrologic function of several streams in the basin by removing trees and vegetation, compacting soils, and widening streams and decreasing pool depth. As a result, flows can be flashy and intense at time, leading to possible reduced survival of eggs and fry.

Degraded Riparian Forest Conditions

Degraded riparian forest conditions present a high to medium stress across all life history stages of the South Fork Trinity River population. Decades of intensive grazing, logging, and intense fire impacted the riparian plant and forest communities throughout the basin (Tetra Tech 2000), impacting stream cover and water temperatures during the summer months. Habitat impairments have been identified in Hayfork Creek and its tributaries related to the lack of riparian vegetation. Loss of riparian vegetation can cause a stream to erode its bed, leading to subsequent streambank erosion problems. In some cases, stream down cutting can cause a drop in the local water table, which leads to reduced floodplain connectivity (PWA 1994). In past surveys, the U.S. Forest Service assessed riparian areas and identified watersheds that have more than 15 percent of their riparian zone acreage with low LWD recruitment potential and low shade. From least (17 percent) to greatest (30 percent) were Butter, Corral, Upper S.F. Trinity, Plummer, Lower Hayfork, Eltapom, Rattlesnake, Hidden Valley, Upper Hayfork, and Salt. Grouse Creek and Eltapom Creek in the Crouse Creek HSA, Naufus, Indian Valley, Dobbins, Rattlesnake, and Salt Creeks also show signs of low LWD recruitment. The Upper South Fork, by comparison, has a riparian forest composed largely of Douglas fir and White fir, with canopy closures ranging between 70 percent and 80 percent. Future LWD recruitment in these stands is excellent, with some of the highest recorded volume measurements in the Trinity Basin (USFS 1999c).

Lack of Floodplain and Channel Structure

Floodplain and channel structure present a high to medium stress across life history stages. Lack of floodplain and channel structure is primarily the result of the 1964 flood, with many stream reaches still not recovered. Past and present activities such as mining, road construction, stream diversion, and timber harvest have also modified streamflow and natural erosion processes and altered the dynamic equilibrium of stream channels in areas of the South Fork watershed such as the Hayfork Valley (USFS 1996c). Piles of mine tailings still line the channels of streams such as Hayfork Creek, constricting flows in places, producing sediment sources, and reducing the proper functioning condition of the stream and associated riparian zone. Recent data on instream LWD is limited but an apparent lack of LWD is likely adding to a lack of channel complexity and floodplain connectivity. Juvenile coho salmon are especially affected by a lack of stream complexity because they rely on instream structure and off-channel habitat for freshwater rearing.

Impaired Estuary/Mainstem Function

All salmon and steelhead that originate from the South Fork Trinity River migrate to and from the ocean through the mainstem Lower Trinity, Lower Klamath River, and the Klamath River estuary. The Klamath River estuary likely plays an important role in providing holding habitat and foraging and refuge opportunities for some juvenile coho salmon from the South Fork Trinity River, given the results of recent research indicating the importance of non-natal rearing in the Lower Klamath River. The degraded conditions that exist throughout the Trinity basin may mean that the estuary plays a very important role by providing the opportunity for juvenile and smolt growth and refugia prior to entering the ocean. The estuary, although relatively intact, suffers from poor water quality, elevated sedimentation and accretion, loss of habitat, and disconnection from tributary streams and the floodplain. Mainstem conditions contribute to this stress because of the issues with water quality, sedimentation and accretion, and degraded habitat in mainstem reaches of both the Lower Trinity and the Lower Klamath rivers. Juveniles, smolts, and adults transitioning through mainstem habitat are exposed to the degraded conditions in these migratory habitats and suffer from the lost opportunity for increased growth and consequently a lower survival rate. The loss and degradation of estuarine and mainstem habitat is considered a medium stress for the population, with the most affected life stages being juveniles, smolts, and adults due to the degradation of rearing and migratory habitat.

Barriers

Barriers are a medium stress across all life stages except the egg life stage. There are no large dams in the South Fork Trinity River drainage; however, numerous small barriers are scattered throughout the sub-basin and could potentially block a significant amount of available habitat. Devastation slide is an adult migration barrier on Grouse Creek and Hyampom (mainstem) and Hayfork (Hayfork Creek) valleys may be temperature barriers to rearing juvenile coho salmon. According to CalFish (2009), there are potentially 4 small dams and 147 road-stream crossing barriers. Of these potential barriers for coho salmon, 11 have been identified as priorities for removal in this database. An assessment on county-owned roads identified 12 low priority stream crossings and four moderate to high priority stream crossings (Trinity County 2000). The number of diversions that act as fish passage barriers to juvenile coho salmon is unknown but

presumed to be potentially large given the amount of agriculture in the sub-basin. Unscreened diversions may act to trap juveniles and may prevent upstream or downstream movement.

Adverse Fishery-Related Effects

NMFS has determined that federally-managed fisheries in California are not likely to jeopardize the continued existence of the SONCC coho salmon ESU (Appendix B). The effects of fisheries managed by the state of California and tribal governments on the continued existence of the SONCC coho salmon ESU have not been formally evaluated by NMFS (Appendix B).

Increased Disease/Predation/Competition

Disease is a medium to low stress across life history stages in the South Fork Trinity River. By the time adult coho salmon enter the Lower Klamath River, columnaris (gill rot) is probably not a significant issue. Coho salmon smolts may be exposed to diseases like ceratomyxosis once they reach the Klamath River; however, the rates of infection are likely to be somewhat low given that the zones with the highest rates of infection are upstream of the Trinity-Klamath confluence (Bartholomew 2008). Competition and predation by non-native German Brown trout, which have been found in the South Fork Trinity River (Jong and Mills 1992), may cause stress to fry, juvenile, and smolt coho salmon. However brown trout numbers are not significant enough to cause high mortality rates.

40.6 Threats

Table 40-5. Severity of threats affecting each life stage of coho salmon in the South Fork Trinity River. Threat rank categories and assessment methods are described in Appendix B, and the data used to assess threats for the initial threats assessment (described in Appendix B) is presented in Appendix H.

Threats		Egg	Fry	Juvenile	Smolt	Adult	Overall Threat Rank
1	Hatcheries	Very High	Very High	Very High	Very High	Very High	Very High
2	Roads	High	Very High	Very High	Medium	High	Very High
3	Dams/Diversion	Medium	High	Very High	Medium	High	High
4	Climate Change	Low	Medium	High	Medium	High	High
5	Agricultural Practices	Low	High	Very High	Medium	Low	Medium
6	High Intensity Fire	Medium	Medium	Medium	Medium	Medium	Medium
7	Fishing and Collecting	-	-	-	-	Medium	Medium
8	Channelization/Diking	Low	Medium	Low	Low	Low	Low
9	Timber Harvest	Low	Medium	Low	Low	Low	Low
10	Urban/Residential/Industrial	Low	Medium	Low	Low	Low	Low
11	Road-Stream Crossing Barriers	-	Low	Medium	Low	Low	Low
12	Invasive Non-Native/Alien Species	Low	Low	Low	Low	Low	Low
13	Mining/Gravel Extraction	Low	Low	Low	Low	Low	Low

Hatcheries

Hatcheries pose a very high threat to all life stages in the South Fork Trinity River sub-basin. The rationale for these ratings is described under the “Adverse Hatchery-Related Effects” stress.

Roads

Roads are a high to very high threat across most life history stages. Data indicate road density is very high (>3 miles/square mile) throughout much of the watershed. There are 1,946 miles of roads within the South Fork Trinity River watershed not including skid trails (Tetra Tech 2000). Road density ranges from a high of 5.1 mi/mi2 in Rattlesnake Creek to a low of 1.7 mi/mi2 in Happy Camp and the Upper South Fork Trinity sub-basins (Tetra Tech 2000). The East Fork of Hayfork Creek also has a dense road network on private land in the upper subwatersheds (USFS 1996c). Impacts associated with roads and tractor skid trails include increased peak flows and

increased rates of fine sediment production and incidence of mass failures (Tetra Tech 2000). Sedimentation associated with roads continues to alter natural river processes and salmonid habitat by filling in pools and reducing the quality of spawning gravels. High rates of aggradation resulting in decreased channel complexity and decreased pool depth can be found throughout the South Fork Trinity (Dresser et al. 2001).

Dams/Diversions

Dams and diversions present a high threat to the population and affect multiple life stages. Although no major dams exist in this part of the South Fork Trinity River, numerous wells and diversions for domestic and agricultural uses occur throughout the watershed and reduce streamflows during critical low-flow periods. Ewing Reservoir is a small reservoir northeast of Hayfork, but Ewing Gulch, where the dam is located, does not provide habitat for salmon. Numerous vineyards, small farms, and marijuana plantations use water from the South Fork Trinity River and its tributaries including, but not limited to, Rattlesnake and Post creeks. It has been estimated that only 13 percent of water currently diverted from Hayfork Creek and its tributaries have recognized permits (Trinity County 1987, PWA 1994). The effects of diversion are particularly acute in the Hyampom and Hayfork Valleys as well as the Forest Glenn area where summer low flows lead to elevated water temperatures and a constriction of summer rearing habitat. Unscreened diversions can also act as fish passage barriers for juvenile coho salmon and it is likely that many if not all of the illegal diversions in the watershed are unscreened. Although there is a need for more recent assessments, the need for fish screens on diversions in Barker, Big, E. Fork Hayfork, Upper Hayfork, Little, Olsen, Salt, and Tule creeks was identified by PWA (1994). Because of the impacts on summer rearing, diversions pose a very high threat to the juvenile life stage.

Climate Change

Climate change poses a high threat to this population. The impacts of climate change in this region will have the greatest impact on juveniles, smolts, and adults. The current climate is generally warm and modeled regional average temperature shows a large increase over the next 50 years (see Appendix B for modeling methods). Average temperature could increase by up to 3 °C in the summer and by 1.2 °C in the winter. Bartholow (2005) showed that temperature has already been increasing at a rate of 0.5 °C per decade (1966 to 1979). Annual precipitation amount is predicted to change little over the next century. However, the proportion of precipitation falling as snow is expected to decrease. Snowpack in upper elevations of the basin will decrease with changes in temperature (California Natural Resources Agency 2009). Many of the peaks which now hold snow during the winter months are at elevations that are low enough to be on the cusp of the transition point of snow and rain (<1,800m; Knowles and Cayan 2004; Mote 2006; Regonda et al. 2005). This means that additional warming in the area will immediately impact accumulation of snow, regardless of trends in precipitation. Additionally, the southerly latitude of the basin (Mote 2006) within the SONCC coho salmon ESU puts this basin at a relatively high risk for snowpack loss, which will exacerbate low summer discharge. For the South Fork Trinity River, the trend towards less snowpack, earlier onset of spring snowmelt, and reductions in summertime surface flow are expected to continue into the future (Zhu et al. 2005, Vicuna et al. 2007). Juvenile and smolt rearing and migratory habitat in the South Fork Trinity River and mainstem Klamath River is most at risk to climate change.

Increasing temperatures and changes in the amount and timing of precipitation and snowmelt will impact water quality and hydrologic function in the summer and winter. McCarthy et al. (2009) ran three climate change scenarios in two representative streams in the South Fork Trinity River basin. Simulated temperature increases ranged from 1.4°C to 5.5°C during the summer and from 1.5°C to 2.9°C during the winter. These temperature increases amplified the weight loss in fish (McCarthy et al. 2009). They concluded that feeding rate and temperature during the summer currently limit the growth and productivity of salmonids (steelhead and rainbow trout) in low-order streams in the South Fork Trinity River basin and predicted that climate change will have detrimental effects on fish growth as well as on macroinvertebrate communities and stream ecosystems in general (McCarthy et al. 2009). Overall, the range and degree of variability in temperature and precipitation is likely to increase in all populations. Also, with all populations in the ESU adult coho salmon will be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (Independent Science Advisory Board 2007, Portner and Knust 2007, Feely et al. 2008).

Agricultural Practices

The effects of water utilization, agricultural runoff, non-point source pollution and sedimentation associated with small farms and wineries is a significant threat to most life stages. Agricultural practices often result in development within floodplain habitat, removal of riparian vegetation, simplification of stream habitat, and degradation of water quality. Substantial portion of low gradient valley reaches in the South Fork Trinity River watershed are used for farming (including marijuana) and ranching. These sub-basins include Hayfork Creek, Rattlesnake Creek, and streams near Hyampom Valley. A survey of parcels owners in the early 1990s who were using water indicated that they can be expected to increase their use of water in the future (PWA 1994). Many survey respondents envisioned expanded water systems, new fences to increase pasture lands, and expanded crops and gardens in the future (PWA 1994). The U.S. Soil Conservation Service reported that groundwater is limited in the Hayfork Valley, so drilling of wells will be of limited utility in meeting future water needs. Illegal marijuana cultivation on public and private land also adds to this threat due to the associated illegal diversion of water and the potential dewatering of tributaries during critical low-flow periods. The juvenile and fry life stages are most affected by agriculture due to the impacts on summer rearing habitat and water quality.

High Intensity Fire

High intensity, widespread fire has swept through regions of the South Fork Trinity River in the recent past, such as the complex of fires in 2008. Fires present a medium to high threat across life stages and particularly affect the fry life stage. Although low-intensity fire is a natural and healthy process in the watershed, fires are now greater in intensity and severity than they were historically (USFS 2008). High intensity, or stand-replacing, fire in the subbasin occurs due to excess fuel loads resulting from decades of fire suppression and timber harvest. Impacts to salmon include altered sedimentation processes as well as degraded riparian vegetation characteristics.

Fishing and Collecting

California-managed fisheries for species other than coho salmon occur in estuaries, freshwater, and nearshore marine areas. In addition, tribal salmonid fisheries have the potential to cause injury and death to coho salmon in the Klamath/Trinity basin. The effects of the fisheries managed by the State of California and the Yurok and Hoopa Tribes, on the continued existence of the SONCC coho salmon ESU have not been formally evaluated by NMFS. As of April 2011, NMS has not authorized future collection of coho salmon for research purposes in the South Fork Trinity River.

Channelization/Diking

Channelization and diking is a low threat to coho salmon in the South Fork Trinity given the large amount of public land in the watershed. Although channelization and diking are not widespread throughout the watershed, localized restrictions of the channel in areas where roads parallel streams reduce floodplain connectivity and function. Other localized instances of channelization near tributary confluences likely occur but the extent of this problem has not been documented. Because the Hayfork Valley does have a substantial amount of private land, this area has the greatest threat from future channelization and diking.

Timber Harvest

Timber harvest is a low to moderate overall threat in the South Fork Trinity River drainage, but certain local factors amplify the level of threat to moderate-high levels. Much of the watershed is in public ownership (U.S. Forest Service). Timber harvest on public land is highly regulated and current and future timber harvesting on Forest Service land is projected to be relatively small in scale and is conducted under strict guidelines designed to protect aquatic resources. However, several extensive vegetation management projects on Forest Service lands in the watershed are planned in the next decade (Rattlesnake, Smoky, East Fork) which will have some effects on hydrologic response despite strict application of BMPs.

Timber resources on private land are limited for the most part, but are concentrated in some highly unstable watersheds south and west of Hyampom. Intensive industrial crop forestry in these areas continues to contribute to cumulative watershed effects that have resulted from legacy timber harvest practices. While impacts from private forestry are largely localized to the upper reaches of these western tributaries, sediment routed from these streams, particularly Pelletreau Creek, enters the South Fork at a critical "pinch point" where the river traverses the Hyampom Valley and aggradation is extreme. Valley confinement downstream of Hyampom has resulted in gravel accumulation that has not recovered from historic sediment pulses associated with the 1955 and 1964 floods. In this regard, the latent effects of past logging practices and ongoing modification of hydrologic response on private industrial timberlands continue to impair the watershed.

Urban/Residential/Industrial Development

Rural population growth will continue to present a moderate to low threat to coho salmon in the South Fork Trinity River. In most areas human population is tempered by the large amount of publicly owned land as well as the steep surrounding terrain. However, some areas such as

Hayfork and Hyampom contain relatively large tracts of level ground. The South Fork Trinity River basin contains 167 mi2 of private land (18 percent of total watershed area). Population trends indicate that in 2050, the population of Trinity County could be upward of 26,479, roughly double current the current population. If this trend holds true for the South Fork Trinity River, demand for water and other resources could increase substantially as the area experiences an increase in the number of housing projects, vacation homes, ranches, vineyards, and small farms. Such growth will likely result in removal of vegetation, increased sediment generation, and the introduction and spread of exotic species. Subdivision of existing parcels will exacerbate this threat. Diversions and groundwater extraction associated with population growth are addressed above under Dams/Diversions.

Road-Stream Crossing Barriers

There are several road-stream crossing barriers in the South Fork Trinity River basin. The California Fish Passage Assessment Database (CalFish 2009) lists 147 road-stream crossing barriers in the South Fork Trinity River basin. Of these, 28 are partial barriers to fish migration, 64 are total barriers, and 42 are unknown. Because of their locations, some above the range of coho salmon, these barriers are considered only a low threat to the population. County surveys by (Trinity County 2000) indicate there are a few total barriers for anadromous fish on county roads (Table 40-6). The crossing on Barker Creek is a barrier to 1.5 miles of fair-to-good habitat. The crossings in Kingsbury Gulch also pose a threat to coho salmon due to the number of crossings (total of four crossings). The habitat upstream of these crossing, however, is of fair quality and of unknown value to coho salmon. On public land, this threat is likely to continue to decrease over time as roads are upgraded and culverts removed or upgraded.

Table 40-6. List of selected moderate to high priority road-stream crossing barriers.

Priority*	Stream Name	Road Name	County	Barrier Status*
High	Kingsbury Gulch #1, Hayfork Creek	Riverview Road	Trinity	Total
High	Kingsbury Gulch #2, Hayfork Creek	Morgan Hill Road	Trinity	Total
High	Little Barker Creek, Barker Creek	Barker Creek Rd	Trinity	Total
*From Trinity County 2000				

Invasive Non-Native/Alien Species

Competition and predation from German brown trout, a non-native species, poses at least a low threat to young coho salmon. Brown trout are a piscivorous species that are known to prey on juvenile coho salmon. Additionally, brown trout may compete with coho salmon at all life stages for food and rearing habitat. Green sunfish and other exotic species have also established breeding populations in drought years, however, the impacts from these populations on coho salmon are unknown (PWA 1994).

Mining/Gravel Extraction

There are few are few current threats to coho salmon from suction dredging in the South Fork Trinity River basin. Currently, mining is regulated by CDFG to ensure safe environmental practices and minimal impacts on salmon and salmon habitat. Regulations include special closed areas, closed seasons, and restrictions on methods and operations (Cal. Code Regs., tit. 14,

Sections 228 and 228.5; CDFG 2008c). Mining activities in the region have decreased significantly from historic levels, and suction dredging permits by the state of California were ceased in 2009. Permit issuance will likely resume in 2011 and regulations are expected to be adequate to protect habitat; however, careful monitoring of mining activity must occur to ensure that these regulations are followed and that this threat remains low to moderate. There are no known gravel mining operations in the South Fork Trinity River.

40.7 Recovery Strategy

The threats that pose the biggest risk to coho salmon are water diversions, agricultural practices (including marijuana cultivation) and roads. The stresses that are most acute in this population are altered hydrologic function, poor water quality, and altered sediment supply. Decommissioning of roads that are not utilized, or upgrading of roads, and stabilizing areas prone to mass wasting should be a priority for recovery efforts. This will help reduce sediment yield to the river, which will help make flushing of the current sediment load more likely. Decreasing the amount of water diverted during the summer months by promoting off-channel storage during high winter flows is imperative to recovery of this population. Bolstering water conservation initiatives should also be integral to recovery efforts and should help reduce the threats of water utilization to this population. Educating land owners and individuals about the effects of nutrient rich runoff from fertilizers and other agricultural activities is a necessary step in improving water quality. Minimizing the interactions that naturally-produced coho salmon experience after migrating into the Trinity and Klamath rivers where they encounter millions of hatchery fish could help promote recovery of coho salmon. Reducing adult hatchery coho salmon straying into the South Fork Trinity River will help reduce genetic interactions between hatchery and naturally produced fish.

Coho salmon are currently found in the South Fork Trinity River up to Butter Creek, Butter Creek, Hayfork Creek up to Corral Creek, Eltapom Creek, Olsen Creek, and Madden Creek (Everest 2008; Boberg 2008). These areas should be a priority for recovery. Also, high and moderate IP habitat exists in Pelletreau Creek in the Hyampom HSA and Rattlesnake and Post creeks in the Forest Glenn HSA. These streams should also be considered a high priority for recovery.

Several actions will be required to ensure the South Fork Trinity River population meets recovery the recovery target. In order to make water available for use during low summer flow periods, it will be important to increase water storage and increase and improve water delivery from Ewing Reservoir. Also to reduce water diversions during the summer and fall months, it will be necessary to provide water storage tanks, education programs, and incentives to land owners with a priority on Hayfork, E. F. Hayfork, Summit, Big, Baker, Salt, Carr, Duncan Tule, Olsen, Butter, Corral, Pelletreau, Rattlesnake and Post creeks. Because much of the South Fork Trinity River watershed is comprised of unstable soils, it will be important to decommission unneeded roads and upgrade other roads with a priority on Corral, Butter, and Hyampom subbasins and the Grouse Creek HSA excluding Surprise, Mingo, Hells Half Acre, and Middle Eltapom Creeks and the Forest Glenn HSA. Because the proportion of precipitation falling as snow is expected to decrease, it will be necessary to protect cold water tributary streams to ensure that the maximum amount of water is available as thermal refugia for hot summer periods.

Table 40-7 on the following page lists the recovery actions for the South Fork Trinity River population

Table 40-7. Recovery action implementation schedule for the South Fork Trinity River population.

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID		***Step Description***				
SONCC-SFTR.3.1.1	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Hayfork, E. F. Hayfork, Summit, Big, Baker, Salt, Carr, Duncan Tule, Olsen, Butter, Corral, Pelletreau, Rattlesnake and Post Creeks	2
SONCC-SFTR.3.1.1.1		*Determine instream flow needs for coho salmon*				
SONCC-SFTR.3.1.1.2		*Measure stream flow hourly by establishing a USGS gauging station. This station to be operated in addition to USGS station 11528700.*				
SONCC-SFTR.3.1.1.3		*Maintain USGS gauging station*				
SONCC-SFTR.3.1.1.4		*Perform a groundwater study to determine the volume of aquifer storage and the role of aquifers in stream flow*				
SONCC-SFTR.3.1.2	Hydrology	Yes	Improve flow timing or volume	Manage flow	Hayfork, E. F. Hayfork, Summit, Big, Baker, Salt, Carr, Duncan Tule, Olsen, Butter, Corral, Pelletreau, Rattlesnake and Post creeks	2
SONCC-SFTR.3.1.2.1		*Provide consistent (daily) water master service to monitor ground and surface water withdrawals*				
SONCC-SFTR.3.1.3	Hydrology	Yes	Improve flow timing or volume	Educate stakeholders	Population wide	BR
SONCC-SFTR.3.1.3.1		*Develop an educational program about water conservation programs and instream leasing programs*				
SONCC-SFTR.3.1.4	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3
SONCC-SFTR.3.1.4.1		*Prioritize and provide incentives for use of CA Water Code Section 1707*				
SONCC-SFTR.3.1.5	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3
SONCC-SFTR.3.1.5.1		*Establish a categorical exemption under CEQA for water leasing*				
SONCC-SFTR.3.1.6	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3
SONCC-SFTR.3.1.6.1		*Establish a comprehensive statewide groundwater permit process*				

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID		***Step Description***				
SONCC-SFTR.3.1.7	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Hayfork, E. F. Hayfork, Summit, Big, Baker, Salt, Carr, Duncan Tule, Olsen, Butter, Corral, Pelletreau, Rattlesnake and Post creeks	2
SONCC-SFTR.3.1.7.1		*Assess the utility of water storage tanks for private agricultural and domestic water uses during periods of low flow.*				
SONCC-SFTR.3.1.7.2		*Establish a forbearance program, using water storage tanks to decrease diversion during periods of low flow*				
SONCC-SFTR.3.1.7.3		*Monitor forbearance compliance and flow*				
SONCC-SFTR.3.1.8	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Hayfork, E. F. Hayfork, Summit, Big, Baker, Salt, Carr, Duncan Tule, Olsen, Butter, Corral, Pelletreau, Rattlesnake and Post creeks	2
SONCC-SFTR.3.1.8.1		*Reduce diversions*				
SONCC-SFTR.3.1.9	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2
SONCC-SFTR.3.1.9.1		*Re-adjudicate surface water rights and adjudicate groundwater rights based on instream flow needs and groundwater studies*				
SONCC-SFTR.3.1.10	Hydrology	Yes	Improve flow timing or volume	Improve irrigation practices	Agricultural private lands in South Fork Trinity Sub-Basin (likely Hyampom, Hayfork, and Lower South Fork)	2
SONCC-SFTR.3.1.10.1		*Assess agricultural lands and develop a plan for improving water delivery systems*				
SONCC-SFTR.3.1.10.2		*Improve water delivery systems, guided by the assessment*				
SONCC-SFTR.3.1.40	Hydrology	Yes	Improve flow timing or volume	Improve water management techniques	Population wide	3
SONCC-SFTR.3.1.40.1		*Develop plan to manage stream flows and water temperature during periods of drought*				
SONCC-SFTR.3.1.41	Hydrology	Yes	Improve flow timing or volume	Improve water management techniques	Population wide	3
SONCC-SFTR.3.1.41.1		*Develop plan to protect coho salmon from effects of climate change*				
SONCC-SFTR.3.1.41.2		*Implement plan based on findings*				

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID		***Step Description***				
SONCC-SFTR.3.1.42	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Hayfork Valley	3
SONCC-SFTR.3.1.42.1		*Increase storage capacity or delivery capability for Ewing Reservoir*				
SONCC-SFTR.8.1.16	Sediment	Yes	Reduce delivery of sediment to streams	Improve timber harvest management practices	Private lands, especially Hayfork and Hyampom	3
SONCC-SFTR.8.1.16.1		*Apply best management practices for timber harvest*				
SONCC-SFTR.8.1.17	Sediment	Yes	Reduce delivery of sediment to streams	Minimize mass wasting	Population wide	3
SONCC-SFTR.8.1.17.1		*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*				
SONCC-SFTR.8.1.17.2		*Implement plan to stabilize slopes and revegetate areas*				
SONCC-SFTR.8.1.18	Sediment	Yes	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide, (prioritize Corral, Butter, and Hyampom subbasins and the Grouse Creek HSA excluding Suprise, Mingo, Hells Half Acre, and Middle Eltapom Creeks)	3
SONCC-SFTR.8.1.18.1		*Assess and prioritize road-stream connection, and identify appropriate treatment to meet objective*				
SONCC-SFTR.8.1.18.2		*Decommission roads, guided by assessment*				
SONCC-SFTR.8.1.18.3		*Upgrade roads, guided by assessment*				
SONCC-SFTR.8.1.18.4		*Maintain roads, guided by assessment*				
SONCC-SFTR.8.1.19	Sediment	Yes	Reduce delivery of sediment to streams	Improve grazing practices	Hyampom and Hayfork	3
SONCC-SFTR.8.1.19.1		*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*				
SONCC-SFTR.8.1.19.2		*Develop grazing management plan to meet objective*				
SONCC-SFTR.8.1.19.3		*Plant vegetation to stabilize stream bank*				
SONCC-SFTR.8.1.19.4		*Fence livestock out of riparian zones*				
SONCC-SFTR.8.1.19.5		*Remove instream livestock watering sources*				
SONCC-SFTR.10.1.11	Water Quality	Yes	Reduce water temperature, increase disssolved oxygen	Increase conifer riparian vegetation	South Fork Trinity Sub-Basin	3

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	***Step Description***					
SONCC-SFTR.10.1.11.1	*Determine appropriate silvicultural prescription for benefits to coho salmon habitat*					
SONCC-SFTR.10.1.11.2	*Thin, or release conifers, guided by prescription*					
SONCC-SFTR.10.1.11.3	*Plant conifers, guided by prescription*					
SONCC-SFTR.10.1.12	Water Quality	Yes	Reduce water temperature, increase disssolved oxygen	Increase flow	Downstream of Hyampom (Butter Creek, Hayfork Creek, Eltapom Creek, Olsen Creek, and Madden Creek)	2
SONCC-SFTR.10.1.12.1	*Develop a plan to address water quality and quantity*					
SONCC-SFTR.10.1.12.2	*Implement plan to address water quality and quantity*					
SONCC-SFTR.10.3.13	Water Quality	Yes	Protect cold water	Improve regulatory mechanisms	Madden, Grouse, Butter, Olsen, Eltapom, Rattlesnake Creeks	3
SONCC-SFTR.10.3.13.1	*Identify and prioritize cold water refugia areas currently or potentially supporting coho salmon and develop a plan to improve regulatory oversight*					
SONCC-SFTR.10.3.13.2	*Increase regulatory oversight, guided by the plan*					
SONCC-SFTR.10.3.14	Water Quality	Yes	Protect cold water	Protect existing or potential cold water refugia	Madden, Grouse, Butter, Olsen, Eltapom, Rattlesnake Creeks	3
SONCC-SFTR.10.3.14.1	*Develop emergency plan that will protect thermal refugia during warm periods*					
SONCC-SFTR.1.2.44	Estuary	No	Improve estuarine habitat	Improve estuary condition	Klamath River Estuary	3
SONCC-SFTR.1.2.44.1	*Implement recovery actions to address strategy "Estuary" for Lower Klamath River population*					
SONCC-SFTR.16.1.27	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3
SONCC-SFTR.16.1.27.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-SFTR.16.1.27.2	*Identify fishing impacts expected to be consistent with recovery*					
SONCC-SFTR.16.1.28	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Limit fishing impacts to levels consistent with recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	2
SONCC-SFTR.16.1.28.1	*Determine actual fishing impacts*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	***Step Description***					
SONCC-SFTR.16.1.28.2	*If actual fishing impacts exceed levels consistent with recovery, modify management so that levels are consistent with recovery*					
SONCC-SFTR.16.2.29	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3
SONCC-SFTR.16.2.29.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-SFTR.16.2.29.2	*Identify scientific collection impacts expected to be consistent with recovery*					
SONCC-SFTR.16.2.30	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Limit impacts of scientific collection to levels consistent with recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3
SONCC-SFTR.16.2.30.1	*Determine actual impacts of scientific collection*					
SONCC-SFTR.16.2.30.2	*If actual scientific collection impacts exceed levels consistent with recovery, modify collection so that impacts are consistent with recovery*					
SONCC-SFTR.2.2.20	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Construct off channel ponds, alcoves, backwater habitat, and old stream oxbows	Mainstem to Butter Cr., Butter Cr., Hayfork Cr. up to Corral Creek, Eltapom Cr., Olsen Cr., and Madden Cr	3
SONCC-SFTR.2.2.20.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-SFTR.2.2.20.2	*Implement restoration projects that improve off channel habitats as guided by assessment results*					
SONCC-SFTR.2.2.21	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Increase beaver abundance	Mainstem to Butter Cr., Butter Cr., Hayfork Cr. up to Corral Creek, Eltapom Cr., Olsen Cr., and Madden Cr	BR
SONCC-SFTR.2.2.21.1	*Develop program to educate and provide incentives for landowners to keep beavers on their lands*					
SONCC-SFTR.2.2.21.2	*Implement beaver program (may include reintroduction)*					
SONCC-SFTR.2.2.22	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Improve regulatory mechanisms	Population wide	BR
SONCC-SFTR.2.2.22.1	*Limit hunting or removal of beaver*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	***Step Description***					
SONCC-SFTR.2.1.23	Floodplain and Channel Structure	No	Increase channel complexity	Increase LWD, boulders, or other instream structure	Mainstem to Butter Cr., Butter Cr., Hayfork Cr. up to Corral Creek, Eltapom Cr., Olsen Cr., and Madden Cr	3
SONCC-SFTR.2.1.23.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-SFTR.2.1.23.2	*Place instream structures, guided by assessment results*					
SONCC-SFTR.2.2.24	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Restore natural channel form and function	Mainstem to Butter Cr., Butter Cr., Hayfork Cr. up to Corral Creek, Eltapom Cr., Olsen Cr., and Madden Cr	3
SONCC-SFTR.2.2.24.1	*Assess habitat to where potential exists to restore channelized or disconnected reaches. Develop a plan to restore prioritized reaches*					
SONCC-SFTR.2.2.24.2	*Restore natural channel form and function to prioritized reaches, guided by the plan*					
SONCC-SFTR.27.1.31	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3
SONCC-SFTR.27.1.31.1	*Perform annual spawning surveys*					
SONCC-SFTR.27.1.32	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3
SONCC-SFTR.27.1.32.1	*Conduct presence/absence surveys for juveniles (3 years on; 3 years off)*					
SONCC-SFTR.27.1.33	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	2
SONCC-SFTR.27.1.33.1	*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*					
SONCC-SFTR.27.2.34	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3
SONCC-SFTR.27.2.34.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-SFTR.27.2.34.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling 10% of the original habitat surveyed*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID		***Step Description***				
SONCC-SFTR.27.2.35	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3
SONCC-SFTR.27.2.35.1		*Measure the indicators, pool depth, pool frequency, D50, and LWD*				
SONCC-SFTR.27.2.36	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3
SONCC-SFTR.27.2.36.1		*Measure the indicators, canopy cover, canopy type, and riparian condition*				
SONCC-SFTR.27.2.37	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3
SONCC-SFTR.27.2.37.1		*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*				
SONCC-SFTR.27.2.38	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3
SONCC-SFTR.27.2.38.1		*Measure the indicators, pH, D.O., temperature, and aquatic insects*				
SONCC-SFTR.27.2.39	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3
SONCC-SFTR.27.2.39.1		*Annually measure the hydrograph and identify instream flow needs*				
SONCC-SFTR.27.1.43	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life history diversity	Population wide	3
SONCC-SFTR.27.1.43.1		*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*				
SONCC-SFTR.27.1.45	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3
SONCC-SFTR.27.1.45.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-SFTR.27.1.45.2		*If appropriate, modify population types and targets using revised methodology*				

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID		***Step Description***				
SONCC-SFTR.7.1.25	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Educate landowners and develop community programs	Hyampom, Madden Creek, Grouse Creek, Lower S.F. Trinity, Corral Creek, Lower Hayfork, Hidden Valley SubBasins, E.F. S.F. Trinity, Upper South Forkand Happy Camp Creek	BR
SONCC-SFTR.7.1.25.1		*Develop fire hazard reduction educational materials for landowners*				
SONCC-SFTR.7.1.25.2		*Develop a plan for fire break stewardship and defensible space*				
SONCC-SFTR.7.1.25.3		*Implement fire-safe community action plans in identified areas*				
SONCC-SFTR.7.1.26	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Reduce fire hazard	Hyampom, Madden Creek, Grouse Creek, Lower S.F. Trinity, Corral Creek, Lower Hayfork, Hidden Valley SubBasins, E.F. S.F. Trinity, Upper South Forkand Happy Camp Creek	BR
SONCC-SFTR.7.1.26.1		*Identify forested stands for fire hazard reduction*				
SONCC-SFTR.7.1.26.2		*Apply appropriate management techniques (e.g., thinning, burning) to reduce risk of high intensity fire*				