41. South Fork Eel River Population

- Interior Eel River Diversity Stratum
- Core, Functionally Independent Population
- Moderate Extinction Risk
- 9,600 Spawners Required for ESU Viability
- 689 mi^2
- 482 IP km (299 IP mi) (29% High)
- Dominant Land Uses are Timber Production and Agriculture
- Principal Stresses are 'Lack of Floodplain and Channel Structure' and 'Altered Sediment Supply'
- Principal Threats are 'Roads' and 'Timber Harvest'

41.1 History of Habitat and Land Use

Starting in the late 1850s, the South Fork Eel River became populated by homesteaders and ranchers. Because of the remoteness of the area, the South Fork Eel River watershed did not experience rapid growth until the 1900s. The tanbark industry between 1900 and 1920 provided an economic stimulus to the region. However, harvesting tanbark killed many tanoak trees, and resulted in significant environmental impacts in the harvested areas. When synthetic tannin was developed, the industry collapsed around 1920.

After World War II, timber harvesting significantly increased in the watershed. Logging has had a large impact on the physical nature of the South Fork Eel River, as has development and clearing of land for ranches and urbanization. Many riparian areas have been cleared for roads or timber production. Erosion from poorly constructed roads in the highly erosive Franciscan geology has contributed to increased sediment loads in the region's rivers, leaving streams shallower, warmer, and more prone to flooding (Raphael 1974; Bodin et al. 1982). Sediment mobilized from the 1955 and 1964 floods choked the channels with sediment. As a result, many streams have become wider and shallower (U.S. Environmental Protection Agency (EPA) 1999).

With the establishment of rural residences and smaller ranches, the need for water supplies has increased. Currently most of this demand is accommodated through in-stream diversions or shallow wells which have influenced stream flows during summer low-flow periods.

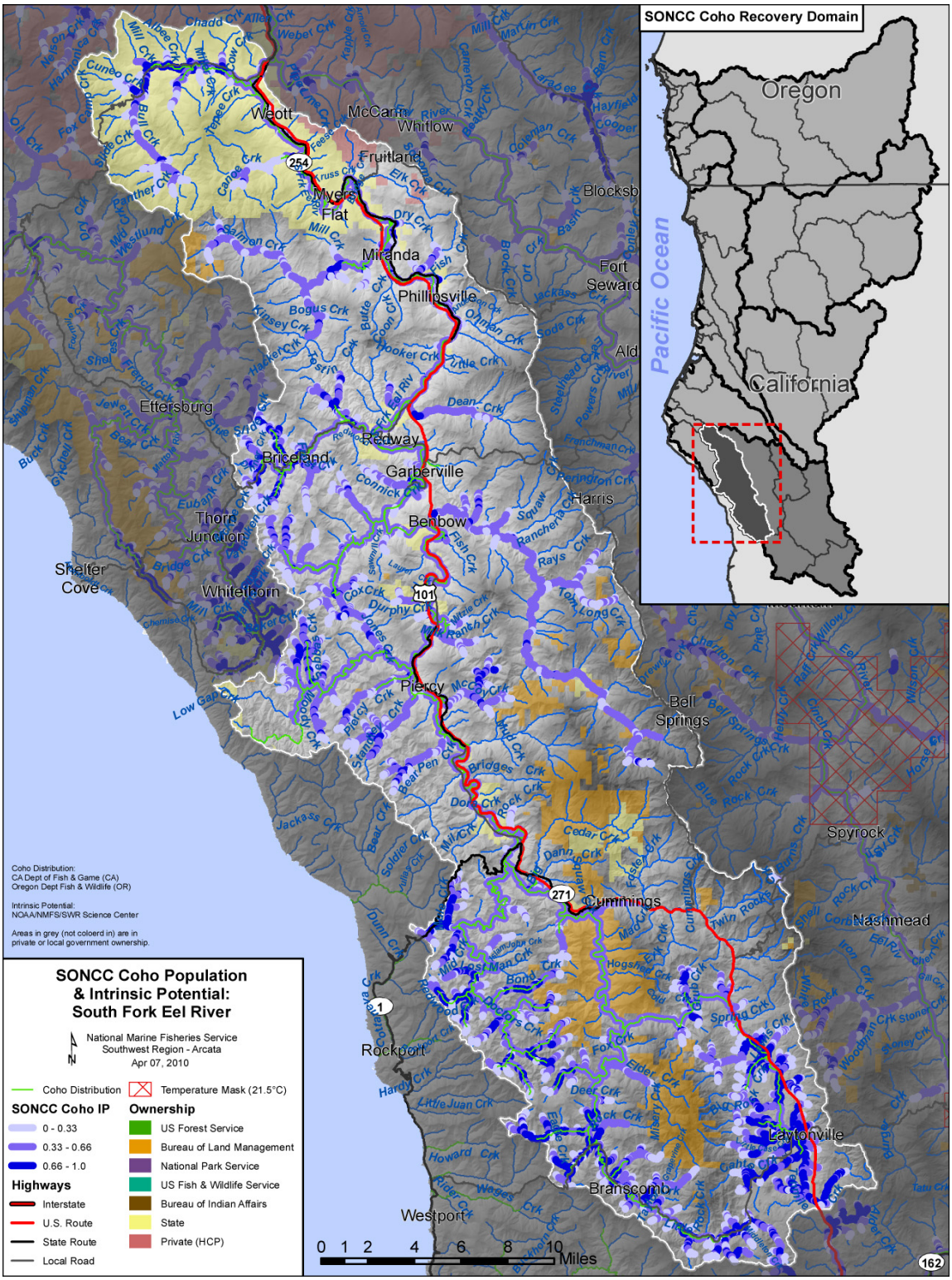

Figure 41-1. The geographic boundaries of the South Fork Eel River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2009a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

41.2 Historic Fish Distribution and Abundance

The South Fork Eel River watershed has been the largest producer of coho salmon in the Eel River basin, and perhaps one of the largest producers in all of California. An estimated 15,000 to 17,000 coho salmon spawners annually passed Benbow Dam in the 1930s (U.S. Bureau of Land Management (BLM) et al. 1996). By 1975, the last year fish were counted at the Benbow fish station; only 509 adult coho salmon were counted (Figure 41-2). Since then, coho salmon abundance has remained low, with an estimate of 1,320 in 1991 for the entire South Fork Eel River (Brown and Moyle 1991). Since 1975, coho salmon abundance has only been surveyed sparingly in the South Fork Eel River watershed. Presence-absence surveys have been conducted more frequently, and show that coho salmon are fairly well distributed in the western tributaries of the watershed. A majority of the eastern tributaries are not found to be used by coho salmon.

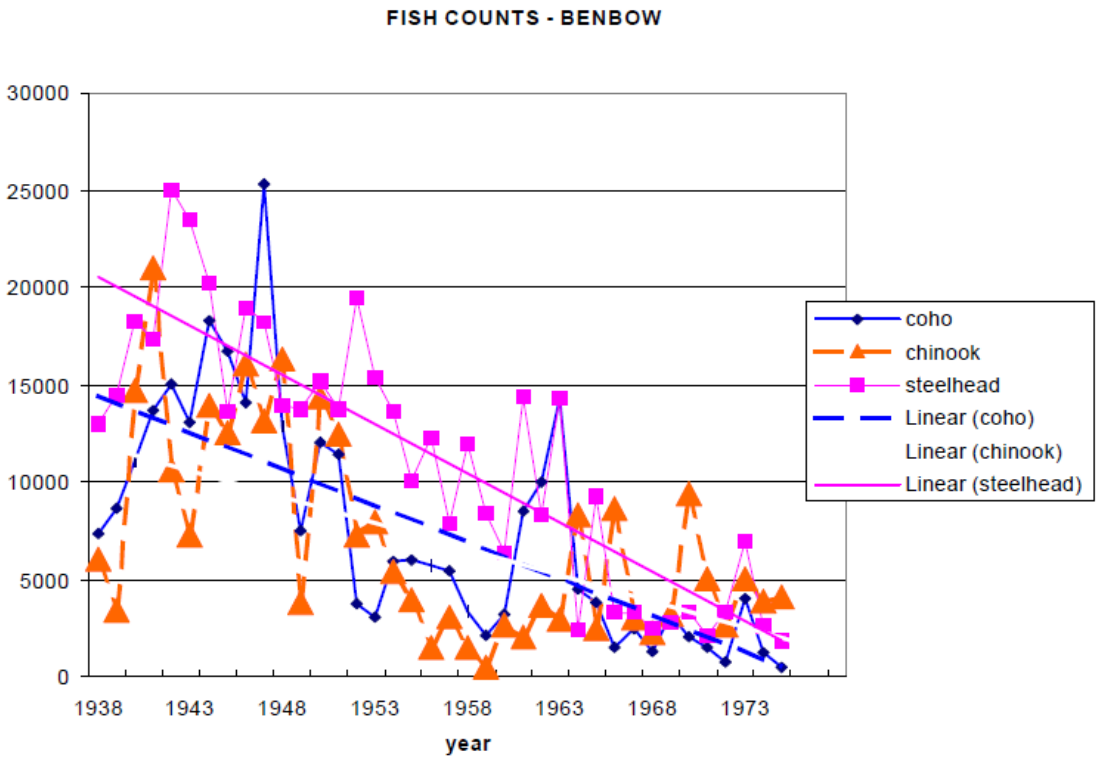

Figure 41-2. Fish counts at Benbow Fish Station from 1938 to 1975. Graph from EPA 1999.

Table 41-1. Tributaries with instances of high IP reaches (IP > 0.66). (Williams et al. 2006).

Watershed	Stream Name	Watershed	Stream Name
Benbow	Anderson Creek[1]	**Benbow**	Seely Creek[1]
	Bear Creek[1]		Sommerville Creek
	Bear Pen Creek[1]		Sproul Creek[1] (all forks and tribs included)
	Bear Wallow Creek[1]		Waldron Creek[1]
	Bond Creek[1]	**Laytonville**	Big Rock Creek
	Buck Mountain Creek		Cahto Creek
	Butler Creek[1]		Deer Creek
	China Creek[1]		Dutch Charlie Creek[1]
	Connick Creek		Eagle Creek
	Couborn Creek		Grub Creek[1]
	Cox Creek		Jack of Hearts Creek
	Dean Creek		Kenny Creek[1]
	Durphy Creek		Lewis Creek
	E. Br. South Fork Eel River		Little Charlie Creek
	Fish Creek		Middleton Creek
	Hartsook Creek		Mill Creek
	Hollow Tree Creek[1]		Mud Creek
	Huckleberry[1]		Muddy Gulch Creek
	Indian Creek[1]		Mud Springs Creek
	Jones Creek		Redwood Creek[1]
	Low Gap Creek[1]		Rock Creek[1]
	McCoy Creek[1]		Section Four Creek
	Michaels Creek		Streeter Creek
	Middle Creek		Taylor Creek
	Miller Creek[1]		Tenmile Creek[1]
	Moody Creek[1]		Wilson Creek
	Mule Creek[1]	**Weott**	Bull Creek[1]
	Parker Creek		Canoe Creek[1]
	Piercy Creek[1]		Salmon Creek[1]
	Redwood Creek[1]		
	Sebbas Creek[1]		

[1] Denotes a "Key Stream" as identified in the State of California's Coho Recovery Strategy

41.3 Status of South Fork Eel River Coho Salmon

Spatial Structure and Diversity

.Williams et al. (2008) determined that at least 20 coho salmon per-IP km of habitat are needed (9,600 spawners total) to approximate the historical distribution of South Fork Eel River coho salmon and habitat. The current distribution of spawners is mostly in western tributaries of the South Fork Eel River. The South Fork Eel population represents a unique life history adaptation which utilizes a 'long run' strategy. Both adults and smolts must migrate great distances from the ocean to their natal spawning grounds, or vice versa.

Population Size and Productivity

Williams et al. (2008) determined at least 481 coho salmon must spawn in the South Fork Eel River each year to avoid depensation.

The South Fork Eel River coho salmon population size is unknown, but is likely extremely reduced compared to historic levels. Surveys in the South Fork Eel River are limited, but indicate that coho salmon spawner abundance may be able to reach at least the 481 depensation threshold. In 2009, 357 adult coho salmon were counted at Hollow Tree Creek (Downie 2010). Because numerous other tributaries in the South Fork Eel River provide suitable spawning and rearing habitat for coho salmon, the potential is high for the entire South Fork Eel River population to produce at least 481 spawners. Some cohorts have been lost or severely depressed in some South Fork Eel River streams and the population growth rate is unknown, but expected to be negative in most years. Therefore, the South Fork Eel River coho salmon population is at moderate risk of extinction given the moderate population size and probable negative population growth rate.

Nine years (1999 to 2007) of juvenile capture data from the west and south forks of Sproul Creek (Trees Foundation 2007) indicate that both forks have the potential to produce thousands of juvenile coho salmon, and the highest combined population estimate of 5,218 occurred in the last year of the study. In addition, a three-year (2000 to 2002) out-migrant population monitoring study in Hollow Tree Creek (Mendocino Redwood Company 2002) reported an estimated smolt population size of 35,178, 35,976, and 9,785, respectively.

Extinction Risk

The South Fork Eel River coho salmon population is not viable and at moderate risk of extinction. The estimated number of spawners exceeds the depensation threshold, but does not meet the low-risk threshold (Table ES-1 in Williams et al. 2008).

Role in SONCC Coho Salmon ESU Viability

The South Fork Eel population is a "Functionally Independent" population in the Interior Eel River diversity stratum, meaning that it is sufficiently large to be historically viable-in-isolation and its demographics and extinction risk are minimally influenced by immigrants from adjacent populations (Williams et al. 2006). As a core population, the recovery target for the South Fork Eel population is for the population to be viable, meaning that it must have a low risk of

extinction according to population viability criteria (see Chapter 4). The South Fork Eel population is the largest and most stable in the stratum, and will therefore play a major role in the re-colonization of other populations in the stratum by providing strays.

41.4 Plans and Assessments

State of California

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

In December 1999, the EPA published the final Total Maximum Daily Loads (TMDL) for temperature and sediment for the South Fork Eel River. The North Coast Regional Water Quality Control Board (NCRWQCB) is required to develop measures that will result in the implementation of the TMDLs in accordance with the requirements of 40CFR 130.6. Water quality standards are identified in the Action Plan for the North Coast Region, which the NCRWQCB uses to regulate various sources of pollution.

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

The Recovery Strategy for California Coho Salmon was adopted by the California Fish & Game Commission in February 2004.

Eel River Salmon and Steelhead Restoration Action Plan

In 1997, the California Department of Fish and Game completed their assessment of the Eel River watershed and provided recommendations for restoration of salmonid stocks. Primary recommendations include removing barriers, reducing sediment inputs, improving riparian forest conditions, reducing water withdrawals, enhancing habitat, and controlling Sacramento pikeminnow.

Mendocino Redwood Company

Habitat Conservation Plan/Natural Communities Conservation Plan
http://www.mrc.com/Key-Policies-HCP.aspx

The Mendocino Redwood Company Habitat Conservation Plan (HCP) and Natural Communities Conservation Plan (NCCP) have been in the developmental stages since 1999 and are approaching completion. The goals of the HCP/NCCP are to maintain viable populations of covered salmonids and improve and enhance aquatic habitat conditions throughout MRC's forestlands.

Watershed Analysis for Hollow Tree Creek

MRC completed a Watershed Analysis in 2004 for their ownership in the South Fork Eel River which occurs primarily in Hollow Tree Creek, a tributary to the South Fork Eel River. It presents results of fish habitat assessments, fish distribution surveys, out-migrant population

estimates, stream channel conditions, road inventory, and mass wasting inventories. Bureau of Land Management, U.S. Forest Service, U.S. Fish and Wildlife Service

Watershed Analysis for the South Fork Eel River

In 1996, the Bureau of Land Management, Six Rivers National Forest, and the U.S. Fish and Wildlife Service finalized a watershed analysis for the South Fork Eel River. This watershed analysis focused on areas where information was available, such as lands managed by BLM and State Parks, and actions that federal agencies could implement to improve habitat.

Pacific Coast Federation of Fishermen's Associations

Eel River Salmon Restoration Project

As an affiliate organization of the Pacific Coast Federation of Fishermen's Associations, the Eel River Salmon Restoration Project was established in 1983 to enhance salmonid runs in the South Fork Eel River to benefit the sport and commercial fishery. The Eel River Salmon Restoration Project has operated a cooperative rearing facility on Redwood Creek, installed habitat improvement structures, improved fish passage, controlled erosion, monitored salmonids populations with surveys and downstream migrant traps, and educated students about salmonids.

41.5 Stresses

Table 41-2. Severity of stresses affecting each life stage of coho salmon in the South Fork Eel 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	Overall Stress Rank
1	Lack of Floodplain and Channel Structure[1]	High	Very High	Very High[1]	Very High	Very High	Very High
2	Altered Sediment Supply[1]	Very High	Very High	Very High[1]	High	Very High	Very HIgh
3	Degraded Riparian Forest Conditions	-	High	High	High	Medium	High
4	Impaired Water Quality	Medium	High	High	High	Medium	High
4	Altered Hydrologic Function	Medium	High	High	High	Medium	High
6	Barriers	-	High	High	Medium	High	High
7	Increased Disease/Predation/Competition	Low	High	High	High	Low	High
8	Impaired Estuary/Mainstem Function	-	Low	High	High	Medium	Medium
9	Adverse Fishery-Related Effects	-	-	-	-	Medium	Medium
10	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low

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

Limiting Stresses, Life Stages, and Habitat

The South Fork Eel River is a diverse watershed, where limiting stressors cannot be broadly applied to the entire watershed. Although the South Fork Eel River has been listed as water quality impaired because of elevated water temperature, the upper part of the watershed generally has water temperatures suitable for coho salmon. Elevated water temperature is a concern in the lower half of the South Fork Eel River, from approximately Benbow to the mouth (Downie 2010). Other limiting factors include water quantity where agricultural and domestic use reduces the availability and quality of habitat. This is especially the case in more urbanized areas, such as in the Salmon Creek watershed. Predation by Sacramento pikeminnow is a significant concern in the South Fork Eel River population area, as well as throughout the Eel River watershed. All of these limiting stressors affect fry, juveniles, and smolts the most, so reducing these stressors would increase successful emigration of juveniles and smolts to the ocean.

Because the juvenile life stages are the most limiting in this watershed, protecting quality rearing habitat is essential for the viability of this population. Tributaries that have cold water, instream cover, and deep pools are vital for juvenile survival. Tributaries, such as Indian, Hollow Tree, Jack of Hearts, Redwood, and Sproul Creeks still provide excellent rearing habitat for coho salmon.

Floodplain and Channel Structure

This stress was rated as very high for nearly all life stages. Lack of floodplain and channel structure in the South Fork Eel River is primarily due to excessive sediment loads occurring in the watershed, coupled with paucity of large woody and riparian vegetation. Roads constrict the channel where they occur parallel to the stream.

Sediment Supply

Sediment was rated as a high to very high stress to coho salmon in this population. The EPA recognized this by listing the South Fork Eel River as impaired by sediment. The Eel River has the highest natural sediment load in the United States due to the highly erodible soils in the area, and anthropogenic impacts in the South Fork Eel River have exacerbated these high loads such that pools have filled and substrate quality is poor. . High sediment loads result in shallower and less diverse habitat, reduce growth, and reduce reproductive success.

Riparian Forest Conditions

Degraded riparian forest conditions were rated as a high threat for the juvenile life stages. Riparian stands are currently dominated by willow, alder, and hardwood. Riparian habitat has somewhat rebounded from past large flood events. Riparian forests shade streams, provide terrestrial subsidies, increase habitat complexity, and influence sediment storage and transport.

Sudden oak death (SOD) is an exotic pathogen affecting almost all native species of plants, shrubs, and trees. SOD is in epidemic stages in the population area and in adjacent population areas. Because the SOD pathogen is water borne and can travel downstream in watercourses, the likelihood of SOD outbreaks in the population area and those mainstems in which coho salmon

must migrate through are high. One of the largest areas infected by SOD occurs near Redway and is growing at a very fast rate.

Water Quality

Although water quality was rated as an overall high stress to the population, the extent of the temperature problem warranted that the South Fork Eel River is 303(d) listed for temperature. Water temperature in the South Fork Eel River approaches lethal levels in a number of stream reaches, is stressful in most others, and severely limits the amount of habitat available to coho salmon. High temperatures also favor Sacramento pikeminnow productivity. High temperatures are caused by reduced stream flow, lack of riparian canopy, and broader, shallower streams.

Hydrologic Function

This stressor was rated as a medium threat overall. Summer base flows in tributaries to the South Fork Eel River are also affected by rural and urban water withdrawals. Low summer flows reduce habitat and contribute to higher water temperatures. Altered hydrology from roads results in higher peak flows and lower base flows.

Barriers

Barriers to fish passage present a significant impediment to restoration and recovery of the South Fork Eel River coho salmon population, resulting in a high stress ranking. Numerous stream-road crossings exist throughout the population area, and at least 58 crossings partially impede fish migration. The list of road crossing barriers is provided later in the threats section. The Benbow Dam is a seasonal barrier to juveniles, and is currently being evaluated for removal. There are currently no dams in the South Fork Eel River watershed other than unpermitted temporary summer dams on tributaries (Downie 2010).

Disease, Competition and Predation

The non-native Sacramento pikeminnow poses a high threat to coho salmon fry, juveniles, and smolts. Pikeminnow prey on all coho salmon life stages except adults, and also compete with juveniles for limited food and habitat. The pikeminnow is successful in the South Fork Eel River because it thrives in severely impacted habitat that is less favorable for salmonids.

Impaired Estuary/Mainstem Function

All salmon and steelhead that originate from the South Fork Eel River migrate to and from the ocean through the mainstem Eel River and the Eel River estuary. The Eel River estuary was once a highly complex and extensive habitat area that played a vital role in the health and productivity of all Eel River coho salmon. The degraded function of the Eel River estuary and mainstem migratory corridor is a high stress for this population. The Eel River estuary is severely impaired because of diking and filling of wetlands for agriculture and flood protection. Approximately 60 percent of the estuary has been lost through the construction of levees and dikes (CDFG 2010b). There is evidence that the estuary once supported a high degree of estuarine habitat and rearing potential, but very little of that function still exists due to the loss of tidal wetlands and simplification of habitats. Mainstem conditions contribute to this stress

because of the issues with reduced flow from diversions, such as the Potter Valley Project, water quality, predation, and degraded habitat in mainstem reaches. Juveniles, smolts, and adults transitioning through estuarine and mainstem habitat are stressed by the degraded conditions in these migratory habitats and suffer from lost opportunity for increased growth and survival. Loss and degradation of the formally-extensive and complex estuarine and mainstem habitat is considered a high stress for the population, with the most affected life stages being juveniles, smolts, and adults due to degradation of rearing and migratory habitat.

Adverse Fishery-Related Effects

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

Adverse Hatchery-Related Effects

The effects of hatchery fish on all life stages of coho salmon are described in Chapter 3. There are no operating hatcheries in the South Fork Eel River population area. Adverse hatchery-related effects pose a low risk to all life stages, because less than five percent of adults are presumed to be of hatchery origin (Appendix B) and there are no hatcheries in the basin.

41.6 Threats

Table 41-3. Severity of threats affecting each life stage of coho salmon in the South Fork Eel 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	Roads	Very High	Very High	Very High	Very High	Very High	Very High
2	Timber Harvest	High	High	High	High	High	High
3	Dams/Diversion	High	High	High	Medium	High	High
4	High Intensity Fire	High	High	High	Medium	High	High
5	Road-Stream Crossing Barriers	-	High	High	High	High	High
6	Urban/Residential/Industrial	Medium	High	High	High	Medium	High
7	Invasive Non-Native/Alien Species	Low	Medium	High	High	Low	High
8	Agricultural Practices	Medium	Medium	Medium	Medium	Medium	Medium
9	Channelization/Diking	Medium	Medium	Medium	Medium	Medium	Medium
10	Climate Change	Medium	Medium	Medium	Medium	Medium	Medium
11	Mining/Gravel Extraction	Medium	Medium	Medium	Medium	Medium	Medium
12	Fishing and Collecting	-	-	-	-	Medium	Medium
13	Hatcheries	Low	Low	Low	Low	Low	Low

Roads

Dirt and gravel roads are the primary threat to coho salmon and habitat restoration. Roads constitute a very high threat across all life stages. Road density is very high in most of the population area. Given the sedimentation problems throughout the watershed, roads should be considered for removal or upgrade treatments to reduce sediment delivery.

Timber Harvest

Timber harvest was ranked as a high threat because, given the percentage of the watershed that is privately owned, future timber harvest activities will continue to exacerbate the stresses caused by legacy logging activities. Only a fraction of the land base which is zoned as Timber Production Zones in this watershed is covered by a draft HCP.

Dams/Diversions

Benbow Dam is a seasonal barrier to juveniles, and is currently being studied for removal. Localized water diversion for rural residential and agricultural use reduces stream flow during critical juvenile rearing periods and in the early periods of adult migration.

Fire

Fire constitutes a high threat to most life stages of coho salmon. The altered vegetation characteristics throughout the watershed increase the risk of high intensity fires which alter sedimentation processes, as well as riparian vegetation characteristics. Historically, Native American vegetation management and natural fire cycles created a mosaic of fire resistant vegetation that lessened catastrophic fires.

Road-stream Crossing Barriers

Numerous road-stream crossings continue to block fish passage within the South Fork Eel River watershed, and contribute to a high threat to almost all life stages of coho salmon. The California Fish Passage Assessment Database (CalFish 2009) shows that there are 76 total road crossings that may block fish passage, of which 29 are total barriers, 29 are partial or temporal, and 18 are unknown.

Urban/Residential/Industrial Development

Although Urban/Residential/Industrial Development poses a moderate threat, much of the watershed with high IP value is located in and around the city of Laytonville. Future growth of this area is likely as transportation infrastructure improves and there is further northerly migration from southern metropolitan areas due to declining water supplies and other mandatory amenities in more southerly locations. In addition, further rural residential development is likely as large agricultural holdings are subdivided into smaller ranches. Higher population densities will combine to further increase road building, land clearing, well drilling, septic system construction, and other development with the consequent increase in stressors.

Invasive Non-Native/Alien Species

Agricultural and residential water withdrawals significantly influence the hydrology of the South Fork Eel River. In addition, high water temperatures severely limit the available habitat for summer rearing of juvenile coho salmon. These degraded habitat conditions favor production of the non-native Sacramento pikeminnow, resulting in significant levels of competition and predation on coho salmon. The non-native Sacramento pikeminnow is a high threat to fry, juveniles, and smolts because they compete with and prey on the young coho salmon. Sacramento pikeminnow was introduced in Lake Pillsbury in 1979 (Brown and Moyle 1997), and has spread throughout the entire Eel River watershed. The warm water temperatures in the Eel River and Lake Pillsbury make this voracious predator thrive in this system. The presence of the Sacramento pikeminnow in Lake Pillsbury makes eradication of this species extremely difficult. Any effort to remove this species in the Eel River without treating the lake will only be temporary because the lake will continue to be the source population for the rest of the Eel River watershed.

Agricultural Practices

Grazing occurs throughout the watershed and may contribute to increased sediment generation and delivery. However, specific information on the magnitude of the threat is limited. In addition, remote outdoor agricultural cultivation likely results in riparian vegetation impacts, water withdrawals, diesel spills, and pesticide leaching into streams and groundwater. Water withdrawals for agricultural uses were considered in the "Dams/Diversions" threat.

Channelization/Diking

Channelization and diking poses a moderate threat to coho salmon in the population area, and is primarily associated with road building.

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 2° C in the summer and by up to 1° C the winter. Annual precipitation is predicted to trend downward over the next century (Feely et al. 2008). The vulnerability of the Eel River estuary to sea level rise is very high. Juvenile and smolt rearing and migratory habitat in the South Fork Eel River and mainstem Eel 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. Rising sea level may also impact the quality and extent of wetland rearing habitat). Overall, the range and degree of variability in temperature and precipitation is likely to increase in all populations. Adults 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).

Mining/Gravel Extraction

Gravel extraction occurs in the South Fork Eel River, but is relatively isolated and conducted with state and federal oversight. The medium ranking for this threat reflects to sensitivity of the channel to additional disturbances (i.e., lack of floodplain and channel structure).

Fishing and Collecting

California-managed fisheries for species other than coho salmon occur in estuaries, freshwater, and nearshore marine areas. The effects of these fisheries on the continued existence of the SONCC coho salmon ESU have not been formally evaluated by NMFS. NMFS has authorized future collection of coho salmon for research purposes in the South Fork Eel River. NMFS has determined these collections are not likely to jeopardize the continued existence of the SONCC coho salmon ESU.

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the South Fork Eel River population area. The rationale for these ratings is described under the "Adverse Hatchery-Related Effects" stress.

41.7 Recovery Strategy

The severely degraded condition of the South Fork Eel River habitat, combined with the depressed coho salmon population size and distribution, significantly increases the risk of extinction of this important, inland coho salmon population. This combined with the facts that most of the watershed is in private ownership, much of the high IP areas are in developed areas, and predation and competition from non-native Sacramento pikeminnow severely limit juvenile survival, indicates that immediate measures may be necessary to sustain the South Fork Eel River population.

By addressing the major threats to the population – sediment from roads, timber harvest, and restoring the natural hydrograph, many of the major stresses affecting coho salmon will be addressed. Restoration activities that reduce sediment inputs, increase connectivity to floodplains, enhance estuarine habitats, increase riparian vegetation, increase summer instream flows, and reduce the abundance of Sacramento pikeminnow should be immediately implemented.

Coho salmon are found in relatively high numbers in several tributaries in the western region of the population area. Tributaries such as Hollow Tree Creek should be top priority to ensure that areas with extant sub-populations of coho salmon receive priority over those areas with little or no coho salmon. Focusing on areas where coho salmon are currently present ensures that recovery actions implemented will have maximum benefit over shorter periods of time. However, the most limiting life stages are juveniles and smolts predominantly because of poor migratory habitats in the mainstem and estuary of the Eel River. Addressing Sacramento pikeminnow and the quality of the Eel River estuary as well as other actions to improve the migratory corridors for the South Fork Eel population are top priority.

Table 41-4 on the following page lists the recovery actions for the South Fork Eel River population.

Table 41-4. Recovery action implementation schedule for the South Fork Eel River population.

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	***Step Description***					
SONCC-SFER.2.1.1	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide, prioritize Redwood, Sproul, Cedar, and Hollow Tree creeks	3
SONCC-SFER.2.1.1.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-SFER.2.1.1.2	*Place instream structures, guided by assessment results*					
SONCC-SFER.2.2.2	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Restore natural channel form and function	Population wide	3
SONCC-SFER.2.2.2.1	*Conduct assessment to identify and prioritize reaches which are confined and/or channelized by man-made structures such as roads, dikes, and levees*					
SONCC-SFER.2.2.2.2	*Implement priority actions to address confinement and channelization, guided by the assessment*					
SONCC-SFER.2.2.3	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel ponds, alcoves, backwater habitat, and old stream oxbows	Population wide, prioritize key tributaries such as Redowood, Sproul, Cedar, and Hollow Tree creeks	2
SONCC-SFER.2.2.3.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-SFER.2.2.3.2	*Implement restoration projects that improve off channel habitats as guided by assessment results*					
SONCC-SFER.8.1.15	Sediment	Yes	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide, priortize Red Mountain Management Area, Redwood, Sproul, and Cedar Creeks	3
SONCC-SFER.8.1.15.1	*Assess and prioritize road-stream connection, and identify appropriate treatment to meet objective*					
SONCC-SFER.8.1.15.2	*Decommission roads, guided by assessment*					
SONCC-SFER.8.1.15.3	*Upgrade roads, guided by assessment*					
SONCC-SFER.8.1.15.4	*Maintain roads, guided by assessment*					
SONCC-SFER.8.1.16	Sediment	Yes	Reduce delivery of sediment to streams	Reduce erosion	Hermitage Road	3
SONCC-SFER.8.1.16.1	*Install gates to control vehicle access*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	***Step Description***					
SONCC-SFER.8.1.17	Sediment	Yes	Reduce delivery of sediment to streams	Improve regulatory mechanisms	Population wide	3
SONCC-SFER.8.1.17.1	*Develop grading ordinance for maintenance and building of private roads that minimizes the effects to coho*					
SONCC-SFER.8.1.18	Sediment	Yes	Reduce delivery of sediment to streams	Minimize mass wasting	Population wide	3
SONCC-SFER.8.1.18.1	*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*					
SONCC-SFER.8.1.18.2	*Implement plan to stabilize slopes and revegetate areas*					
SONCC-SFER.14.2.14	Disease/Predation/ Competition	No	Reduce predation and competition	Reduce abundance of Sacramento pikeminnow	Population wide	2
SONCC-SFER.14.2.14.1	*Determine the effectiveness of various pikeminnow suppression techniques and develop experimental control methods. Develop a plan that identifies watersheds suitable for experimental pikeminnow control*					
SONCC-SFER.14.2.14.2	*Control Sacramento pikeminnow, guided by the control plan*					
SONCC-SFER.1.2.43	Estuary	No	Improve estuarine habitat	Improve estuary condition	Eel River Estuary	3
SONCC-SFER.1.2.43.1	*Implement recovery actions to address strategy "Estuary" for Lower Eel/Van Duzen River population*					
SONCC-SFER.16.1.28	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-SFER.16.1.28.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-SFER.16.1.28.2	*Identify fishing impacts expected to be consistent with recovery*					
SONCC-SFER.16.1.29	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-SFER.16.1.29.1	*Determine actual fishing impacts*					
SONCC-SFER.16.1.29.2	*If actual fishing impacts exceed levels consistent with recovery, modify management so that levels are consistent with recovery*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	***Step Description***					
SONCC-SFER.16.2.30	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-SFER.16.2.30.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-SFER.16.2.30.2	*Identify scientific collection impacts expected to be consistent with recovery*					
SONCC-SFER.16.2.31	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-SFER.16.2.31.1	*Determine actual impacts of scientific collection*					
SONCC-SFER.16.2.31.2	*If actual scientific collection impacts exceed levels consistent with recovery, modify collection so that impacts are consistent with recovery*					
SONCC-SFER.3.1.4	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3
SONCC-SFER.3.1.4.1	*Review General Plan or City Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*					
SONCC-SFER.3.1.5	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3
SONCC-SFER.3.1.5.1	*Create water budgets that avoid over allocating water diversions*					
SONCC-SFER.3.1.6	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide, especially Redwood, Sproul, and Cedar creeks	2
SONCC-SFER.3.1.6.1	*Provide incentives to reduce water use*					
SONCC-SFER.3.1.7	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide, especially Redwood, Sproul, and Cedar creeks	2
SONCC-SFER.3.1.7.1	*Establish a forbearance program modeled after the Mattole watershed*					
SONCC-SFER.3.1.7.2	*Monitor forbearance compliance and flow*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID		***Step Description***				
SONCC-SFER.3.1.8	Hydrology	No	Improve flow timing or volume	Educate stakeholders	Population wide, especially Redwood, Sproul, and Cedar creeks	BR
SONCC-SFER.3.1.8.1		*Provide educational materials describing how to most efficiently use water*				
SONCC-SFER.3.1.9	Hydrology	No	Improve flow timing or volume	Remove dam	South Fork Eel River at Benbow	3
SONCC-SFER.3.1.9.1		*Identify a plan to remove Benbow Dam*				
SONCC-SFER.3.1.9.2		*Remove Benbow Dam*				
SONCC-SFER.3.1.10	Hydrology	No	Improve flow timing or volume	Educate stakeholders	Population wide	BR
SONCC-SFER.3.1.10.1		*Develop an educational program about water conservation programs and instream leasing programs*				
SONCC-SFER.3.1.11	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3
SONCC-SFER.3.1.11.1		*Prioritize and provide incentives for use of CA Water Code Section 1707*				
SONCC-SFER.3.1.12	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3
SONCC-SFER.3.1.12.1		*Establish a categorical exemption under CEQA for water leasing*				
SONCC-SFER.3.1.13	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3
SONCC-SFER.3.1.13.1		*Establish a comprehensive statewide groundwater permit process*				
SONCC-SFER.27.1.32	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3
SONCC-SFER.27.1.32.1		*Perform annual spawning surveys*				
SONCC-SFER.27.1.33	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Develop survival estimates	Site to be determined	3
SONCC-SFER.27.1.33.1		*Install and annually operate a life cycle monitoring (LCM) station*				

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SONCC-SFER.27.1.34	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life history diversity	Population wide	3
SONCC-SFER.27.1.34.1		*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*				
SONCC-SFER.27.1.35	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	2
SONCC-SFER.27.1.35.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-SFER.27.1.36	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the threat 'Invasive Species'	Population wide	3
SONCC-SFER.27.1.36.1		*Annually estimate the density of non-native predators, such as the Sacramento pikeminnow in the Eel River basin*				
SONCC-SFER.27.1.36.2		*Identify the status and trend of invasive species*				
SONCC-SFER.27.2.37	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3
SONCC-SFER.27.2.37.1		*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*				
SONCC-SFER.27.2.37.2		*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling 10% of the original habitat surveyed*				
SONCC-SFER.27.2.38	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3
SONCC-SFER.27.2.38.1		*Measure the indicators, pool depth, pool frequency, D50, and LWD*				
SONCC-SFER.27.2.39	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3
SONCC-SFER.27.2.39.1		*Measure the indicators, canopy cover, canopy type, and riparian condition*				
SONCC-SFER.27.2.40	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3
SONCC-SFER.27.2.40.1		*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*				

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SONCC-SFER.27.2.41	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3
SONCC-SFER.27.2.41.1		*Measure the indicators, pH, D.O., temperature, and aquatic insects*				
SONCC-SFER.27.2.42	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3
SONCC-SFER.27.2.42.1		*Annually measure the hydrograph and identify instream flow needs*				
SONCC-SFER.27.1.44	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3
SONCC-SFER.27.1.44.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-SFER.27.1.44.2		*If appropriate, modify population types and targets using revised methodology*				
SONCC-SFER.5.1.25	Passage	No	Improve access	Remove barriers	Population wide	3
SONCC-SFER.5.1.25.1		*Evaluate and prioritize barriers for removal*				
SONCC-SFER.5.1.25.2		*Remove barriers*				
SONCC-SFER.7.1.21	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Population wide	3
SONCC-SFER.7.1.21.1		*Determine appropriate silvicultural prescription for benefits to coho salmon habitat*				
SONCC-SFER.7.1.21.2		*Thin, or release conifers, guided by prescription*				
SONCC-SFER.7.1.21.3		*Plant conifers, guided by prescription*				
SONCC-SFER.7.1.22	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Reduce fire hazard	Tributaries	3
SONCC-SFER.7.1.22.1		*Identify forested stands for fire hazard reduction*				
SONCC-SFER.7.1.22.2		*Apply appropriate management techniques (e.g. thinning, burning) to reduce risks of high intensity fire*				

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SONCC-SFER.7.1.23	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve regulatory mechanisms	Population wide	3
SONCC-SFER.7.1.23.1	*Develop planning guidelines or ordinances that protect riparian stands*					
SONCC-SFER.7.1.24	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Population wide	2
SONCC-SFER.7.1.24.1	*Amend California Forest Practice Rules to include regulations which describe the specific analysis, protective measures, and procedure required by timber owners and CalFire to demonstrate timber operations described in timber harvest plans meet the requirements specified in 14 CCR 898.2(d) prior to approval by the Director (similar to a Spotted Owl Resource Plan).*					
SONCC-SFER.10.2.19	Water Quality	No	Reduce pollutants	Remove pollutants	Population wide	3
SONCC-SFER.10.2.19.1	*Remove hazardous materials from streams*					