29. Mattole River Population

- Southern Coastal Stratum
- Non-Core, Functionally Independent Population
- High Extinction Risk
- 1,000 Spawners Required for ESU Viability
- 296 mi^2
- 250 IP km (155 mi) (24% High)
- Dominant Land Uses are Timber Harvest and Rural Residential
- Principal Stresses are 'Impaired Water Quality' and 'Altered Hydrologic Function'
- Principal Threats are 'Dams/Diversions' and 'Roads'

29.1 History of Habitat and Land Use

Historic Impacts to the Basin

Given the underlying tectonics of the region coupled with post WWII human activity and disturbance within the basin, coho salmon habitat have been extensively impacted. One of the activities which may have dramatically impacted coho salmon habitat post WWII is timber harvest. Timber harvest had a pronounced effect on the physical nature of the Mattole River. Rapid population growth in California occurred after the end of WW II, and by 1965 more than 60 percent of the basin's large Douglas-fir had been high-grade or clear-cut logged. As an example of this level of disturbance, Figure 29-2 shows Dry Creek in 1942, when it had forest cover that was typical of the Mattole basin prior to extensive Douglas-fir logging as depicted in a comparative photo (Figure 29-3) of the same area taken in 1965 [Mattole Restoration Council (MRC) 200]8. The aerial photos show a significant amount of deforestation and road construction in this basin by the mid 1960's. This rate of activity was typical throughout much of the population area.

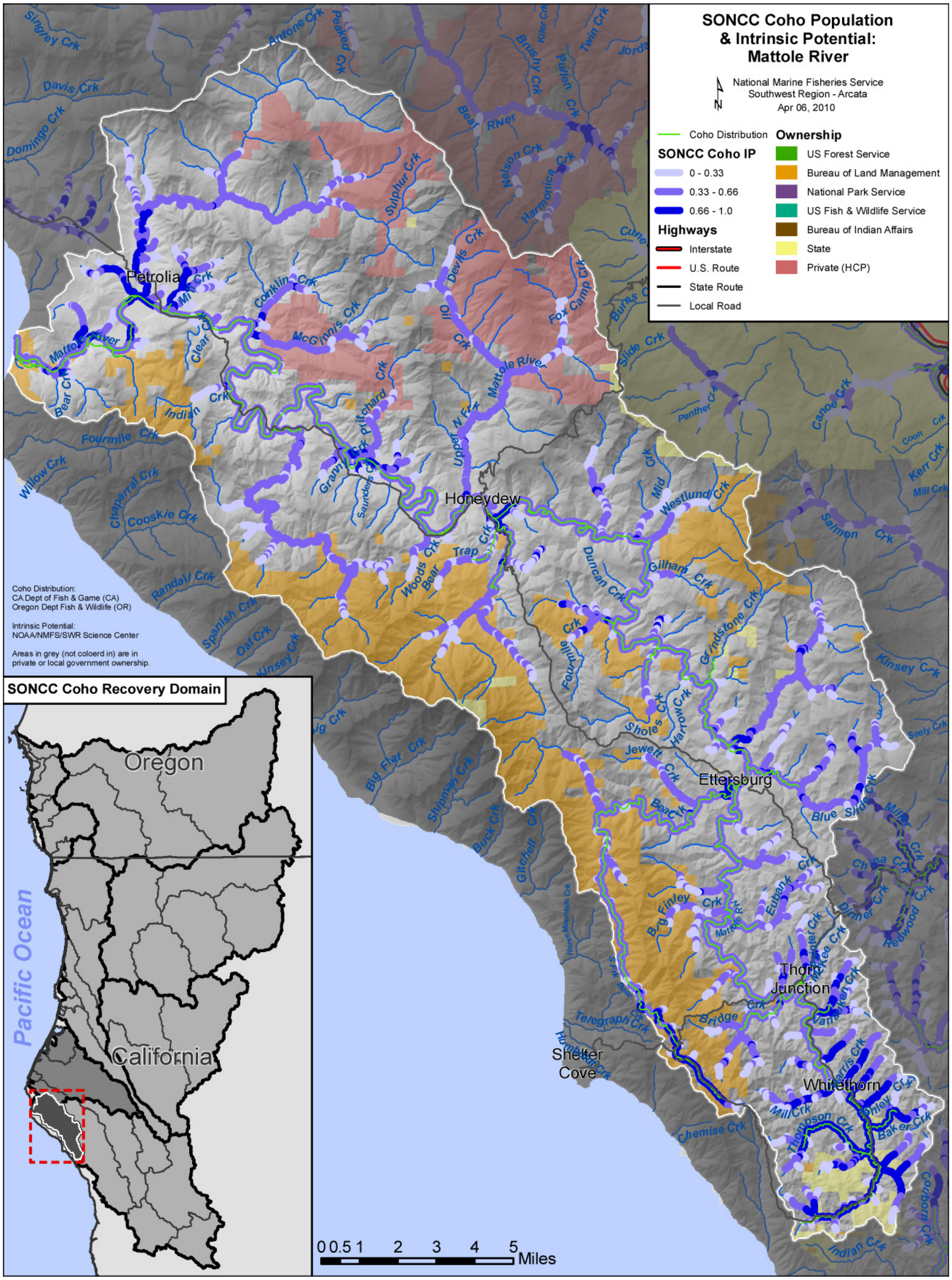

Figure 29-1. The geographic boundaries of the Mattole River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2009a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

A study in 1968 demonstrated that hardwoods, mainly tanoak, had increased significantly as a result of timber harvest practices. Unlike coastal redwood, Douglas-fir does not resprout, resulting in self-regeneration (Oswald 1978). Failure of logging operations to replant Douglas-fir seedlings after harvesting allowed for the establishment of more aggressive hardwood species. Once firmly established, hardwood stands are difficult and costly to restore back into conifer. Tractor and haul roads cut into recently logged hillsides, along with high amounts of rainfall, increased erosion and sediment delivery to Mattole River streams. The lack of reforestation also likely contributed to increased sediment loads, which in combination with other disturbances, left streams shallower, warmer, and more prone to flooding (Bodin et al. 1982; Raphael 1974). The 1955 and 1964 floods choked channels with sediment, filling deep pools (MRC 2008). Figure 29-4 shows how the North Fork of the Mattole, at the confluence with the mainstem, responded to basin disturbances post WWII (PALCO 2006b). The photographic evidence shows large accumulations of sediment within stream channels resulting in significant channel widening and loss of riparian forests. Such dramatic changes in stream conditions suggest there could have been significant reductions to coho salmon populations in this region by the late 1960's. Currently, timber harvest continues on private and industrial timberlands in the forested uplands throughout the Mattole River basin at a much reduced rate and under much stricter regulations. One large industrial timberland owner, the Pacific Lumber Company (PALCO), now HRC, in the Mattole basin operates under a state and federal Habitat Conservation Plan (HCP) on 18,350 acres in the western and northern basin (PALCO 1999a).

As a result of historical disturbances, as well as some ongoing disturbances, a river and estuary that likely once ran cold and deep now runs warm and shallow and the impacts to coho salmon and their habitat is severe (Downie et al. 2003). Overall, the current landscape is comprised of either small-diameter conifer forest, or hardwood-dominated forests that provide different ecological functions. Remaining late-seral conifer stands are fragmented and found largely on the public lands in the western and eastern basin. The PALCO HCP has a requirement to maintain a minimum of 10 percent late-seral stands on covered lands until 2049 (PALCO 1999b) and HRC is also designating several late seral stands as "high conservation value forest," which will be protected as long as the company remains the landowner.

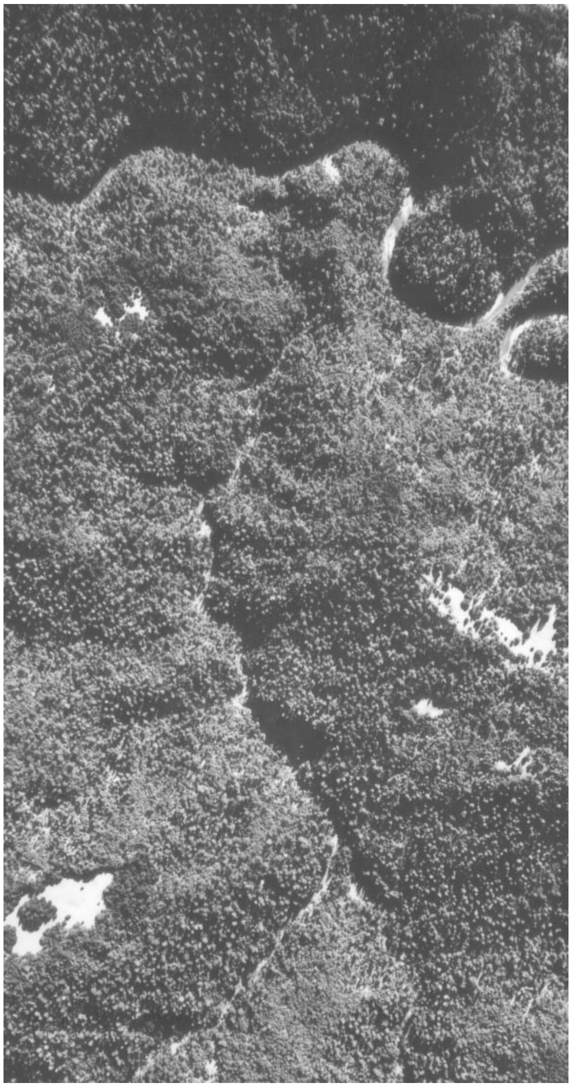

Figure 29-2 Aerial photo of Dry Creek, February 1942. Late-seral and mixed-aged stands of timber with good riparian and hill slope forest cover. Little evidence of increased sediment delivery to water courses (MRC 2008).

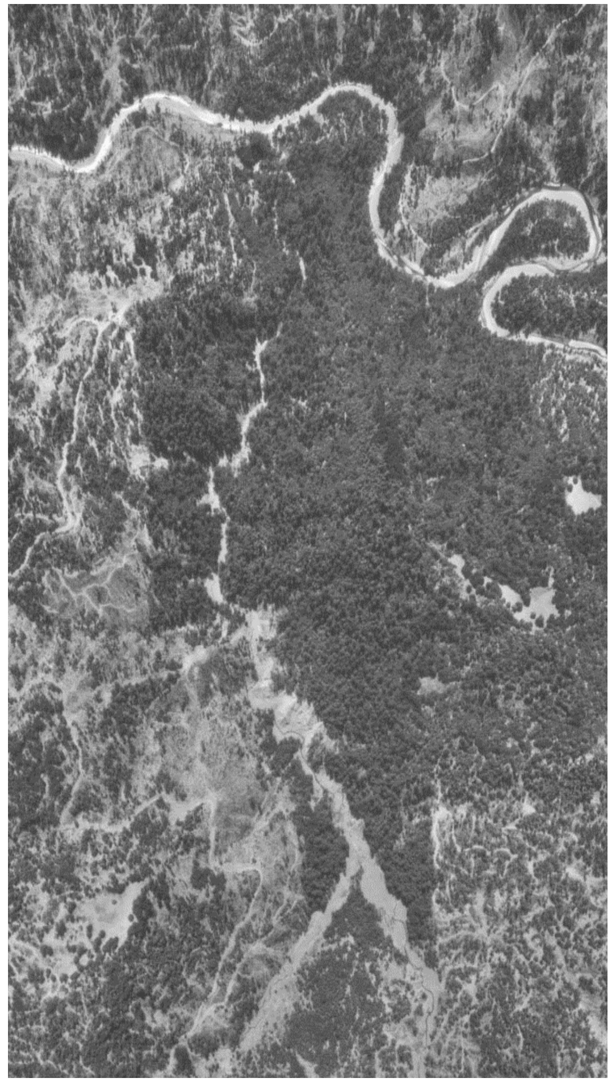

Figure 29-3. Aerial photo of Dry Creek, August 1965. High-grade and clear-cut logging exposed bare ground to rains. Tributary channel widening and filling is evident (MRC 2008*)*

Livestock grazing continues at various locations throughout the basin including lands managed by the Bureau of Land Management (BLM) King Range National Conservation Area (BLM 2004d). Livestock grazing within the geologically sensitive areas of the basin has also likely led to erosion as many riparian zones are not fenced allowing livestock to suppress vegetative growth and cause streambank instability.

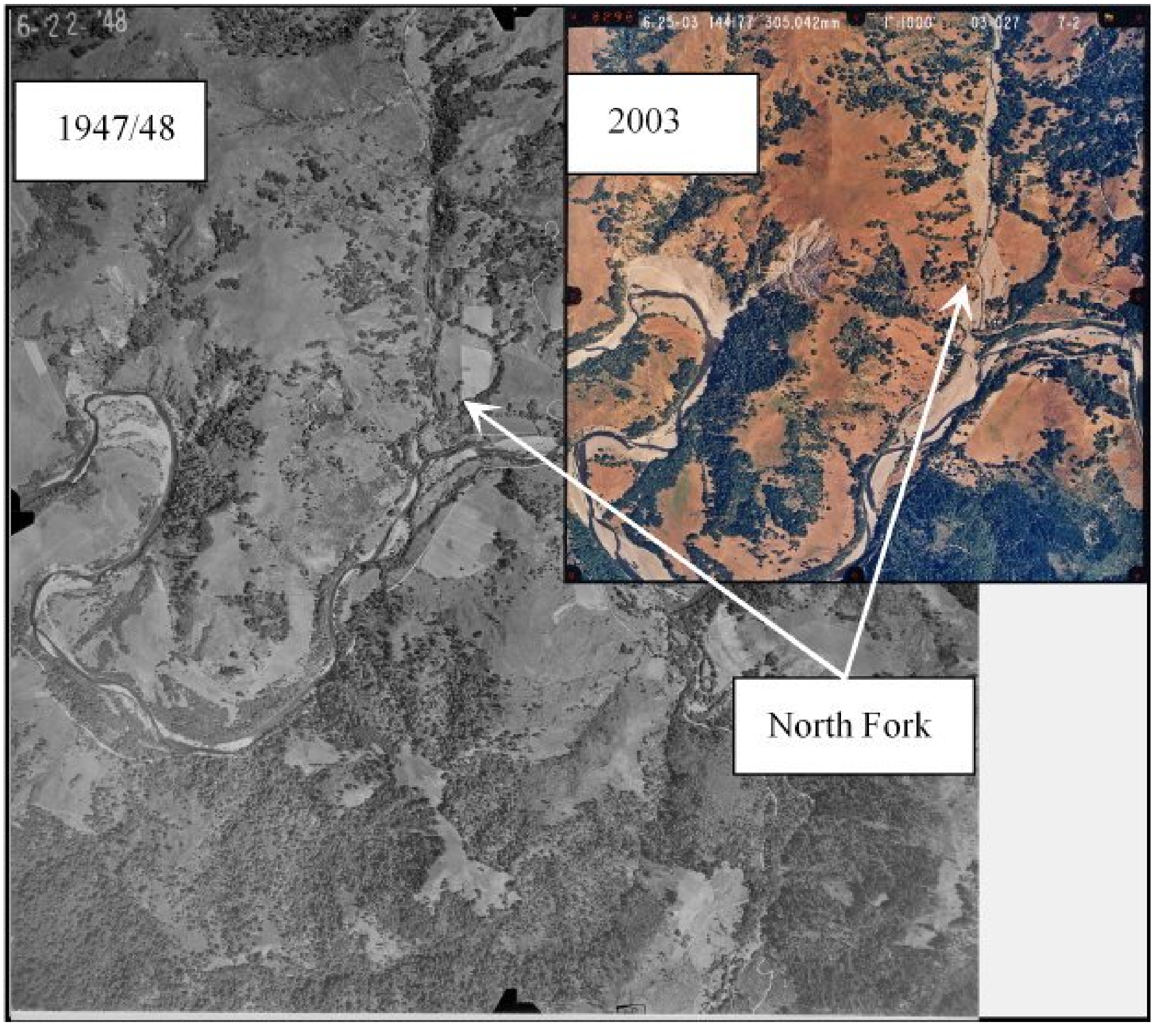

Figure 29-4. Comparative aerial photos between 1948 and 2003. Photos show wider (and aggraded) channel of the Upper North Fork Mattole near its confluence with the mainstem Mattole River.

With the establishment of rural residences and smaller ranches, water use has increased over the last 50 years. Currently, much of the demand for residential and agricultural uses is accommodated through in-stream diversions or shallow wells which may be affecting streamflows during summer low-flow periods. Much of the demand occurs in the southern basin where the last known stronghold on coho salmon spawning occurs. Additionally, the southern basin has experienced increasing levels of remote cultivation operations. Many of these operations require water sources during the summer, which coincides with juvenile coho salmon rearing. Water withdrawals in the mid- to late-summer may play a factor in late summer drying of stream reaches and stranding of juvenile coho. Unscreened water diversions (pumps) may entrain or impinge juvenile coho salmon.

The Mattole River basin is unique in the level of attention to natural resource conservation it has received for many decades. Although the human population size in the basin is relatively small and considered quite rural, the commitment from the local community to protecting and maintaining their natural environment is considerable. Conservation-oriented groups in the basin have taken actions to protect and restore the river's salmonid populations. Completed restoration projects include barrier removal, road upgrade and removal, fisheries science, water quality monitoring, and stream bank stabilization. .

29.2 Historic Fish Distribution and Abundance

Aside from the data described in the assessment of population viability detailed further in this section and the IP data shown in Figure 29-1, no data exist on run characteristics of coho salmon in the Mattole River prior to the 1950s. The IP data show the highest values (IP > 0.66) scattered throughout the basin's numerous tributaries. However, the southern basin headwaters have the highest concentration of high IP values. Somewhat unique to the SONCC ESU is that in the Mattole River basin the low gradient stream reaches suitable for coho spawning and rearing occur in headwater reaches (e.g., near the town of Whitethorn) where water temperature is consistently favorable to coho salmon growth and survival. Of interest to note are high IP values in the western portion of the northern basin such as the lower North Fork Mattole and East Mill Creek. However, historical data does not document extensive coho salmon distribution in these reaches, which raises concern as to whether coho salmon ever occupied these reaches. Table 29-1 lists those tributaries with high IP values. In the mid-to late 1950's, CDFG estimated an average run size of 8,000 coho salmon, 5,000 Chinook salmon, and 12,000 steelhead in the Mattole River (CDFG 1965). In 1960, the United States Fish and Wildlife Service (USFWS) estimated an average run size of 2,000 coho salmon, 5,000 Chinook salmon, and 12,000 steelhead; while the estimated potential population abundances were 20,000 coho salmon, 15,800 Chinook salmon, and 20,000 steelhead trout (Figure 29-5). The California Department of Water Resources (1965) reported that Chinook salmon were able to access 45 miles of the Mattole River, while coho salmon and steelhead trout used several more miles of the river. High intensity timber management in the basin (wide-scale road building and tractor logging) occurred during the 1950's and 1960's. Two significant storm seasons and wide-spread flooding occurred in 1955 and 1964, resulting in large scale mass-wasting and delivery of sediment to watercourses in areas where intensive timber harvest occurred. Some of the coho salmon population estimates provided above had been collected after these stochastic habitat altering events which may explain the reduction in coho salmon production throughout much of the population area.

Table 29-1. Tributaries with instances of high IP reaches (IP > 0.66) (Williams et al. 2006).

Stream Name	Stream Name	Stream Name
Mainstem Mattole upstream of Whitethorn	McNasty Creek	Indian Creek
Thompson Creek	Lost River	Bear Creek (near Estuary) Stansberry Creek
Baker Creek	McKee Creek	Unnamed tributary approx. 1 mile upstream of Pritchard Creek on right bank (Thornton Creek)
Stanley Creek	Unnamed tributary on right bank approx. 1 mile downstream of McKee Creek (Buck/Sinkyone Creek)	Pritchard Creek
Gibson Creek	Eubank Creek	McGinnis Creek
Harris Creek	Blue Slide Creek	Conklin Creek
Mill Creek	Mattole Canyon	East Mill Creek
Unnamed tributary on right bank approx. 1.5 miles downstream of Whitethorn (Ravasoni Creek)	Dry Creek	Lower North Fork Mattole River
Anderson Creek	Fourmile Creek	Jeffry Gulch
Vanauken Creek	Bear Creek (near Ettersburg)	Unnamed tributaries near estuary (Jim Goff Gulch)
Bridge Creek	Honeydew Creek	
Ancestor Creek	Granny Creek	

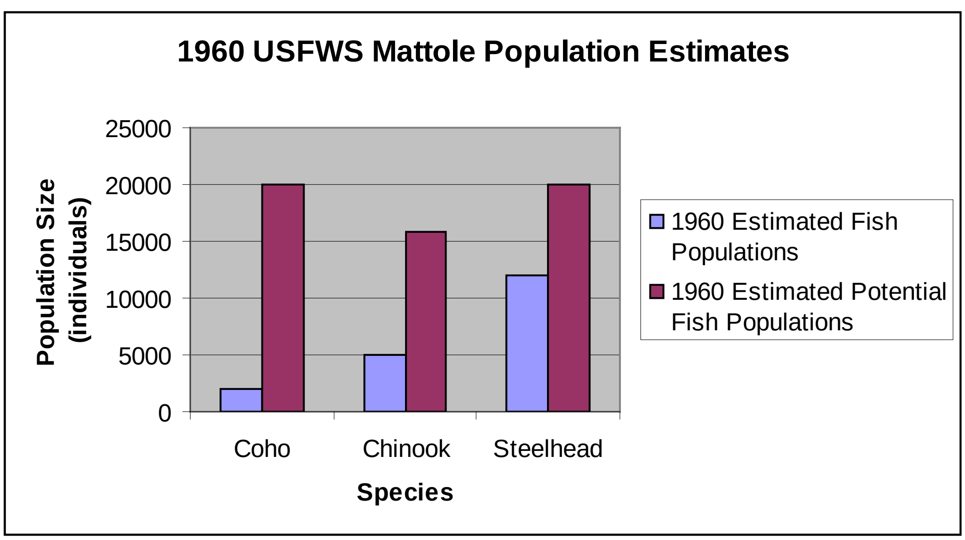

Figure 29-5. Population estimates from 1960. U.S. Fish and Wildlife Service-estimated actual and potential population abundance of adult Chinook salmon, coho salmon, and steelhead in the Mattole River basin (USFWS 1960).

29.3 Status of Mattole River Coho Salmon

Spatial Structure and Diversity

The diversity and complexity of the environmental conditions within the Mattole River basin have contributed to the evolutionary legacy of the coho salmon. The Mattole River population is functionally independent within the ESU (Williams et al., 2008). As a functionally independent population, the Mattole River population 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).

Hatchery influences have been minimal in the Mattole River basin. Small-scale hatch box and captive rearing programs were implemented, but were discontinued in the 1980's. Coho salmon are found in only a small fraction of their historic habitat in the basin, possibly due to habitat degradation such as high water temperatures. Recently, the only known occurrences of coho salmon in the lower 27 miles of the Mattole have been in Lower Mill Creek (MRC 2008). Survey efforts in the upper Mattole basin have been limited. As the current distribution of spawning adults is limited to just a few tributaries with suitable habitat (such as Lower Mill Creek), the Mattole River coho salmon population is at a high risk of extinction because its spatial structure and diversity are very limited compared to estimated historical conditions.

Population Size and Productivity

There were an estimated 500 spawners in 1981 to 1982, a peak of more than 1,000 spawners in 1987 to 1988, and less than 200 spawners in 1994 to 1995. In 2009, it was estimated that the coho salmon population was in the low hundreds at best (Mattole River and Range Partnership (MRRP) 2009). However spawning surveys in the winter of 2009/2010 found only three live adults and one redd in the basin (Mattole Salmon Group (MSG) 2010). Due to extremely low catches of coho salmon juveniles during outmigrant trapping efforts, population estimates cannot be calculated.

Extinction Risk

Williams et al. (2008) determined at least 250 coho salmon must spawn in the Mattole River each year to avoid the effects of extremely low population sizes. The number of adults believed to currently occur in this basin is believed to be well below this level. Based on the criteria set forth by Williams et al. (2008) the Mattole population is at a high risk of extinction. This conclusion is based on the limited distribution, diversity, and small size of the population. An important priority for recovery of the Mattole River coho salmon population is to increase its distribution across the basin from the headwaters through the estuary. A diversity of well distributed and connected habitats, from the headwaters to the ocean, will enhance species diversity, abundance and productivity, and minimize the effects of climate change or the risk of extinction associated with stochastic events.

Role in SONCC Coho Salmon ESU Viability

The Mattole River population is a non-core1 population and its recovery target is to recover the population to at least a moderate risk of extinction; meeting the moderate risk spawner threshold (see Chapter 4). The moderate risk spawner threshold addresses the need for adequate spatial structure and diversity within the population (see Williams et al. 2008).

29.4 Plans and Assessments

Mattole River and Range Partnership:

Mattole Coho Recovery Strategy

The MRRP was formed between three watershed groups active in the basin. The partnership developed a coho salmon recovery strategy for coho salmon in the Mattole River basin. The strategy discusses population status, recovery targets, limiting factors, strategies for recovery, and a prioritized list of recovery actions.

State of California

CDFG 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 and Game Commission in February 2004.

The North Coast Watershed Assessment Program (NCWAP)
http://www.coastalwatersheds.ca.gov

The NCWAP Mattole River basin Assessment identifies limiting factors for anadromous salmonids including, estuarine conditions, lack of habitat complexity, increased sediment levels, high water temperatures, and inadequate flows during the summer.

Bureau of Land Management (BLM)

Mattole River Watershed Assessments

The BLM has conducted several watershed assessments and developed Resource Management Plans for BLM managed lands within the Mattole River basin. These include:

The King Range National Conservation Area Resource Management Plan (BLM 2004d)

Mill Creek Watershed Analysis (BLM 2001)

Honeydew Creek Watershed Analysis (BLM 1996c)

Bear Creek Watershed Analysis (BLM 1995a)

29.5 Stresses

Table 29-2. Severity of stresses affecting each life stage of coho salmon in the Mattole 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)[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Impaired Water Quality[1]	Medium	Very High	Very High[1]	Very High	Medium	Very High
2	Altered Hydrologic Function[1]	Low	Medium	Very High[1]	Very High	High	Very High
3	Altered Sediment Supply	High	High	High	High	High	High
4	Lack of Floodplain and Channel Structure	Medium	High	High	High	High	High
5	Degraded Riparian Forest Conditions	-	High	High	High	Medium	High
6	Impaired Estuary /Mainstem Function	-	Low	High	High	Low	High
7	Adverse Fishery-Related Effects	-	-	-	-	Medium	Medium
8	Barriers	-	Low	Low	Low	Low	Low
9	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low

[1] Key limiting factor(s) and limited life stage(s).
[2] Increased Disease/Predation/Competition is not considered a stress for this population.

Limiting Stresses, Life Stages, and Habitat

Based on the type and extent of stresses and threats affecting the population as well as the limiting factors influencing productivity, it is likely that the juvenile life stage is most limited and that quality summer rearing habitat is lacking for the population. Low flow conditions increase water temperatures and even leave some tributaries dry during the summer season, creating an inhospitable environment for rearing and reducing the overall summer rearing habitat availability.

There are four primary and consistent sources of cold water in the lower seven miles of the Mattole River: Lower Mill Creek, which enters the Mattole at River Mile 2.8; Stansberry Creek at River Mile 1.3; Lower Bear Creek at River Mile 1.0, and the tidal prism. Additional sources of cold water in the lower river include Collins Gulch, Jeffrey Gulch, Jim Goff Gulch, Titus Creek, and Tom Scott Creek, although most of these tributaries likely do not flow year-round. Nevertheless, these drainages may still be sources of subsurface cold water to the mainstem providing some isolated pockets of cool water. They are also likely areas for placing habitat improvement structures to enhance already present coldwater refugia for juvenile salmonids.

Significant headwater tributaries that consistently provide cold water discharge to the mainstem Mattole include Thompson, Mill, Bridge, and Buck creeks. Three of these creeks are known to provide rearing habitat for coho. Finally, Klein (2009) concluded that greater participation in programs to cease pumping when mainstem flows reach 0.7 cfs are likely to result in measurable increases in low summer streamflows. Such an effect would likely increase the availability of cool water refugia to constrained coho salmon juveniles in this area of the basin.

In the western basin, Lower Bear Creek is part of a complex of cold seeps, springs and small streams that flow from the east side of the King Range. These cold water sources maintain temperatures in the 58 to 64° F degree range and flow into a well covered channel along the south bank. In August of 2004, there were pools of 58° F standing water in these channels (MSG 2004). As part of their assessment, Downie et al. (2003) identified several tributaries that provide high refugia value based on current habitat conditions. These are listed in Table 29-3.

Table 29-3. Potential refugia areas in the Mattole River basin.

Watershed	***Stream Name***	***Watershed***	***Stream Name***
Southern	Mainstem Mattole upstream of Whitethorn	Eastern	McKee Creek
	Thompson Creek	Western	Eubank Creek
	Baker Creek		Bear Creek (near Ettersburg)
	Mill Creek		
	Vanauken Creek		
	Bridge Creek		

Impaired Water Quality

High water temperature is problematic in many areas of the Mattole River population area, including the estuary. Water quality is most stressful for the fry and juvenile life history stages because they are present during the summer and early fall when temperatures are highest. The coolest temperatures were measured in the southern basin. Low dissolved oxygen (DO) levels in the headwaters during the late summer months are a water quality concern for juvenile survival.

Adding to the stresses of low flow and stranding of juvenile coho, in years with extremely low flow in the headwaters of the Mattole River, DO levels dropped to a point where they may be fatal to coho salmon juveniles. An extremely dry year in 2002 recorded a DO of 0.2 mg/L, while a guideline of greater than 6.0 mg/L is considered the level at which adverse effects to salmonids is not an issue (MRRP 2009). Low DO is common during the summer and may have contributed to the death of thousands of juveniles in 2002.

Altered Hydrologic Function

Altered hydrologic functions are most stressful for juveniles and smolts. Low stream flows are problematic for coho salmon throughout the basin. These conditions are most acute when little or no rainfall occurs during summer months and where rural and residential water use is the highest. Reaches in the southern basin are particularly prone to seasonal drying.

Klein (2009) conducted a study of low flow conditions in the headwater reaches of the Mattole River and found that small amounts of rainfall (0.25”) and multiple days of fog in the driest part of summer can provide relief to low or no flow conditions in the Mattole River headwaters. This study found that one inch of rainfall in July, 2007 elevated subsequent mainstem flows for almost two weeks. Another finding of this study was that mainstem discharges in the Upper Mattole River were less than the sum of upstream tributary discharges and concluded that, among other things, water withdrawal in the mainstem may be a contributing factor to frequent low flow conditions downstream.

Altered Sediment Supply

Altered sediment supply presents a high stress across all life history stages. Increased sediment delivery has filled pools, widened channels, and simplified stream habitat throughout the basin including the estuary. The widening of channels in the mainstem and major tributaries has likely exacerbated the rates of streambank failures as thalwegs are not stable resulting in channel braiding.

In many reaches stream beds have aggraded, reducing surface flows and limiting access for migrating juveniles. Measurements suggest that pools in the southern basin may be mostly free of fine sediment accumulation. However, the preponderance of poor rankings throughout the population area suggests that sediment delivery to stream channels is a critical stress affecting the population.

Lack of Floodplain and Channel Structure

Lack of floodplain and channel structure present a high stress across multiple life stages. Habitat conditions within the channel and adjacent floodplain vary depending on which metric is used. Pool depths are generally poor to fair throughout most of the basin, with the exception of the headwaters region. Pool frequency varies widely, with most of the very good ratings occurring in the smaller tributaries of the southern basin. Data on instream large wood is limited, but does not appear to be a significant limiting factor in the headwaters region. However, increasing levels of instream wood may improve rearing conditions resulting in potential increases in egg to smolt survival rates. In many of the middle and lower mainstem tributaries a lack of large, pool forming wood does appear to be a problem (PALCO 2006b). Given the extensive timber harvesting that has occurred in the basin and the changes in riparian vegetation characteristics, lack of large wood is likely limiting the development of complex stream habitat throughout the lower two thirds of the basin. This lack of complex overwintering habitat throughout much of the system may be a significant factor in the historical population decline and current low population numbers.

Riparian Forest Conditions

Degraded riparian forest conditions exist across the basin and present high stress across many life stages. Streamside canopy cover is variable. Conditions in the southern tributaries are mostly very good, but elsewhere canopy cover exists in a range of conditions. Much of the streamside canopy is either hardwood dominated or of insufficient size to provide large wood. .

Impaired Estuary/Mainstem Functions

Prior to major land disturbances, the Mattole estuary/lagoon was notable for its depth and numerous functioning slough channels on both the north and south banks of the river (MRC

1995). Currently, the estuary is severely aggraded and lacks channel complexity and riparian cover. Stored sediment in the mainstem and slough channels of the lower river is a critical problem for the Mattole estuary as is the bar that forms across the mouth during low flows and blocks access to and from the ocean. The lack of access can be a major stressor for smolts and adults, depending on the timing and duration. At times in the recent past, efforts have been made to artificially breach the river mouth bar due to concerns of low survival rates for salmonids from an extended period of residence time in the estuary.

Water temperatures in the estuary during late summer periods have been found to be poor for developing salmonids and may be impairing their survival at ocean entry (MRRP 2009). The lack of habitat for juveniles and smolts to use for rearing and holding and poor water quality in the estuary may also be a stressor for the population as they may be more susceptible to predation without adequate cover 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).

Barriers

Barriers are a low stress to the Mattole River population. Currently, there are five barriers that are potentially limiting coho salmon distribution. They are listed in order of priority for remediation: South Fork Vanauken Creek, Eubank Creek, High Prairie Creek, Harris, and Painter creeks. Over the last two decades substantial funding has been provided to remove barriers, and the last remaining barriers do not occur in tributaries with substantial coho salmon habitat upstream of the barrier.

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 Mattole River population area. Hatchery-origin coho salmon may stray into the population area, but the proportion of spawning adults that are of hatchery origin is unknown. 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.

29.6 Threats

Table 29-4. Severity of threats affecting each life stage of coho salmon in the Mattole 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[1]	Egg	Fry	Juvenile	Smolt	Adult	Overall Threat Rank
1	Dams/Diversions	High	Very High	Very High	High	High	Very High
2	Roads	High	High	High	High	High	High
3	Timber Harvest	High	High	High	High	High	High
4	Urban/Residential/Industrial	High	High	High	High	High	High
5	High Intensity Fire	High	High	High	High	High	High
6	Agricultural Practices	Medium	Medium	Medium	Medium	Medium	Medium
7	Channelization/Diking	Medium	Medium	Medium	Medium	Medium	Medium
8	Climate Change	Low	Low	Medium	Low	Medium	Medium
9	Fishing and Collecting	-	-	-	-	Medium	Medium
10	Mining/Gravel Extraction	Low	Low	Low	Low	Low	Low
11	Hatcheries	Low	Low	Low	Low	Low	Low
12	Road-Stream Crossing Barriers	-	Low	Low	Low	Low	Low

[1]Invasive Non-Native/Alien Species is not considered a threat to this population.

Dams/Diversions

Numerous wells and diversions for agricultural and domestic uses occur throughout the basin and reduce streamflows during critical low-flow periods. Of particular importance is the southern basin where many of the highest IP reaches occur coincident with numerous rural residences. Bear Creek and the North Fork Mattole may also be influenced by agricultural and residential withdrawals, although due to their size, water withdrawals may not be as noticeable as in the smaller tributaries of the southern basin.

Roads

Roads are a significant threat across all life stages. Although significant efforts have been made in the basin to upgrade and decommission roads to reduce their sediment generating potential, road density remains high throughout the basin, with some areas having greater than 5 road miles/square mile of basin (PALCO 2006b). Given the extensive problem of sedimentation, roads throughout the basin should continue to be considered for removal or treatments to reduce sediment delivery.

Roads in the northern and western basin should continue to receive high priority as they occur in the region most susceptible to mass-wasting and significant landslide events. The continuation of such occurrences impedes the ability of important tributaries to route sediment, and return to more balanced states of channel and riparian stability.

Timber Harvest

Timber harvest has been most concentrated in the North Fork Mattole, Oil Creek and southern basin. Numerous smaller non-industrial timber harvesting activities occur throughout the basin. Many of the changes in stream and riparian conditions are the result of more intensive historic harvest. However, given the percentage of the basin that is in private ownership, future timber harvest is still considered a high threat and should be carefully considered with regards to its effects on coho salmon, particularly in the southern basin and other tributaries with high IP values. There is a program-level environmental impact report for timber harvesting practices available for landowners in the Mattole River population area to use when preparing timber harvest plans. .

Urban/Residential/Industrial Development

Rural population growth will continue to present a high threat to coho salmon in the Mattole as there is no water development agency in the basin and landowners are left to finding their own sources of water. Lack of a structured water right permitting program is a significant deficiency in this basin for the protection of vestigial coho salmon populations. Additionally, such growth results in removal of vegetation, increased sediment generation and delivery, increased road density, and introduction of exotic species. Subdivision of existing parcels is likely to exacerbate this threat.

High Intensity Fire

The altered vegetation characteristics throughout the basin present a high threat for high intensity fires. High intensity fires can significantly contribute to large-scale mass-wasting events if not properly treated with high levels of erosion control devices after the fire has ended. Even with the best efforts made at controlling post-fire erosion, the first rains typically produce much higher rates of sediment delivery than pre-fire conditions and can contribute to high sediment loading in affected watercourses.

Agricultural Practices

Livestock grazing occurs throughout the basin and is known to cause increased erosion and sediment delivery if not properly managed. However, specific information on the magnitude of grazing impacts is limited. Water withdrawals for agricultural uses were considered in the "Dams/Diversions" threat.

Channelization/Diking

Although channelization and diking is not widespread, localized restrictions may occur where roads that run parallel to streams reduce floodplain connectivity and function. Other instances of channelization near tributary confluences should be identified and considered for alteration to improve floodplain function and potentially provide off-channel habitat.

Climate Change

Climate change modeling indicates climate change poses a medium threat to this population. As mentioned previously, air temperatures in this basin depend on proximity to the coastline. Along the coastal areas of the basin (essentially west of Petrolia), summertime temperatures are strongly influenced by the coastal marine layer (fog) and remain relatively cool throughout the summer. East of Petrolia, with the King Range blocking marine influence, daytime summer temperatures often remain above 80° F. Generally, as inland temperatures rise the marine layer becomes thicker and moves farther inland (the fog "belt"). If climate modeling proves correct, the impacts of climate change in this region will have the greatest impact on juveniles and adults. Modeled regional average temperature shows an increase over the next 50 years (see Appendix B for modeling methods). Juvenile and smolt life stages area most at risk to climate change. Average temperature could increase by up to 1^{o} C in the summer and by the same amount in the winter.

Annual precipitation in this area is predicted to trend downward over the next century; however, a critical factor is how precipitation is distributed over critical seasons. For example, if rains end sooner and begin later in the fall, the threat to coho salmon in this region is significant as the expectation would be that cool, rearing pools would be more susceptible to drying resulting in increasing mortality events as previously described. If, on the other hand, climate change results in slightly higher air temperatures, but more frequent instances of cool summer storms that generate overland flow, the opposite effect may be experienced (reduced rates of low or no flow events) potentially expanding the rearing habitat for juveniles.

Changes in precipitation patterns may not be beneficial in the estuary if changes to natural cycles of river mouth breaching and closing are a result. Early breaching events could negatively affect ocean survival of smolts to adults if smolts have not had enough time in the estuary to achieve optimal growth in preparation for ocean entry. In addition, these alterations in the freshwater input cycle to the marine environment could alter near-shore ecology and salmonid prey species. Overall, the range and degree of variability in temperature and precipitation is likely to increase in all populations. Also, as with all populations in the ESU adults will be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (see Independent Science Advisory Board 2007, Feely et al. 2008, Portner and Knust 2007).

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 Mattole River. NMFS has determined these collections are not likely to jeopardize the continued existence of the SONCC coho salmon ESU.

Mining/Gravel Extraction

Gravel extraction and mining was ranked as a low threat as very little in-stream gravel mining occurs in the Mattole. The County of Humboldt infrequently removes gravel from a single bar on the lower North Fork Mattole. Currently, upslope mining does not occur in the basin. Due to the remote location of the basin and the high cost of trucking gravel out of the basin, increased rates of gravel extraction are not anticipated. This threat ranking reflects sensitivity of the channel to additional disturbances due to the lack of floodplain and channel structure.

Hatcheries

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

Road-Stream Crossing Barriers

Much work has been done to remove barriers in the basin and as such, barriers are a low threat. As mentioned previously there are five barriers that remain to be treated which will allow access to a relatively limited amount of coho salmon habitat.

Table 29-5. List of prioritized road-stream crossing barriers.

Barrier Treatment Ranking*	Stream Name	Watershed	County	Miles of habitat**
1	South Fork Vanauken Creek	Southern	Humboldt	<0.5
2	Eubank Creek	Eastern	Humboldt	<0.5
3	High Prairie Creek		Humboldt	<1
4	Harris Creek	Southern	Humboldt	<1
5	Painter Creek	Eastern	Humboldt	<0.5

* MSG (2010)
** MSG (2010) and GIS estimate

29.7 Recovery Strategy

Coho salmon abundance in the Mattole River is severely depressed with a constricted distribution. Recovery activities in the basin should promote increased spatial distribution as well as increased productivity and abundance. Activities should occur basin-wide, with a focus on those tributaries with high IP values listed in Table 29-1. Activities that reduce the instances of low or no flow conditions, decrease sediment delivery, improve stream temperatures, improve long term prospects for large wood recruitment, and promote increased floodplain and channel structure should be a priority in the basin. Recovery actions for the estuary should include enhancing riparian functions to provide cover and moderate stressful water temperatures as well as actions to increase available cover habitat for protection against predation. Table 29-6 on the following page lists the recovery actions for the Mattole River population.

Table 29-6. Recovery action implementation schedule for the Mattole River population.

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MatR.3.1.2	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2
SONCC-MatR.3.1.2.1	*Review General Plan or City Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*					
SONCC-MatR.3.1.3	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2
SONCC-MatR.3.1.3.1	*Create water budgets that avoid over allocating water diversions*					
SONCC-MatR.3.1.4	Hydrology	Yes	Improve flow timing or volume	Educate stakeholders	Population wide	2
SONCC-MatR.3.1.4.1	*Develop an educational program about water conservation programs and instream leasing programs*					
SONCC-MatR.3.1.5	Hydrology	Yes	Improve flow timing or volume	Educate stakeholders	Headwaters	2
SONCC-MatR.3.1.5.1	*Increase participation in forbearance program*					
SONCC-MatR.3.1.5.2	*Monitor forbearance compliance*					
SONCC-MatR.3.1.6	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Headwaters	2
SONCC-MatR.3.1.6.1	*Reduce diversions*					
SONCC-MatR.3.1.7	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3
SONCC-MatR.3.1.7.1	*Prioritize and provide incentives for use of CA Water Code Section 1707*					
SONCC-MatR.3.1.8	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3
SONCC-MatR.3.1.8.1	*Establish a categorical exemption under CEQA for water leasing*					
SONCC-MatR.3.1.9	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3
SONCC-MatR.3.1.9.1	*Establish a comprehensive statewide groundwater permit process*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MatR.3.2.10	Hydrology	Yes	Increase water storage	Increase water retention	Headwaters	2
SONCC-MatR.3.2.10.1	*Develop water storage and recharge plan*					
SONCC-MatR.3.2.10.2	*Implement projects identified in water storage and recharge plan*					
SONCC-MatR.3.2.10.3	*Maintain water storage structures*					
SONCC-MatR.1.2.11	Estuary	No	Improve estuarine habitat	Restore estuarine habitat	Estuary	2
SONCC-MatR.1.2.11.1	*Assess factors limiting coho rearing in the estuary including temperature, excess sediment, and size of estuary*					
SONCC-MatR.1.2.11.2	*Develop a plan to restore the estuary including restoration of the south slough and potentially removing excess sediment*					
SONCC-MatR.1.2.11.3	*Implement the estuary restoration plan*					
SONCC-MatR.1.2.35	Estuary	No	Improve estuarine habitat	Assess estuary and tidal wetland habitat	Estuary	3
SONCC-MatR.1.2.35.1	*Identify parameters to assess condition of estuary and tidal wetland habitat*					
SONCC-MatR.1.2.35.2	*Determine amount of estuary and tidal wetland habitat needed for population recovery*					
SONCC-MatR.16.1.21	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-MatR.16.1.21.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-MatR.16.1.21.2	*Identify fishing impacts expected to be consistent with recovery*					
SONCC-MatR.16.1.22	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-MatR.16.1.22.1	*Determine actual fishing impacts*					
SONCC-MatR.16.1.22.2	*If actual fishing impacts exceed levels consistent with recovery, modify management so that levels are consistent with recovery*					
SONCC-MatR.16.2.23	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-MatR.16.2.23.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MatR.16.2.23.2	*Identify scientific collection impacts expected to be consistent with recovery*					
SONCC-MatR.16.2.24	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-MatR.16.2.24.1	*Determine actual impacts of scientific collection*					
SONCC-MatR.16.2.24.2	*If actual scientific collection impacts exceed levels consistent with recovery, modify collection so that impacts are consistent with recovery*					
SONCC-MatR.2.1.12	Floodplain and Channel Structure	No	Increase channel complexity	Increase LWD, boulders, or other instream structure	High IP subwatersheds in the Upper Mattole	3
SONCC-MatR.2.1.12.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-MatR.2.1.12.2	*Place instream structures, guided by assessment results*					
SONCC-MatR.2.2.13	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Construct off channel ponds, alcoves, backwater habitat, and old stream oxbows	High IP subwatersheds in the Upper Mattole	2
SONCC-MatR.2.2.13.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-MatR.2.2.13.2	*Implement restoration projects that improve off channel habitats as guided by assessment results*					
SONCC-MatR.26.1.1	Low Population Dynamics	No	Increase population abundance	Implement an enhancement program	Population wide	2
SONCC-MatR.26.1.1.1	*Assess impacts and benefits associated with different enhancement programs such as captive broodstock, rescue rearing, and conservation hatcheries*					
SONCC-MatR.26.1.1.2	*Develop a facility to rear fish*					
SONCC-MatR.26.1.1.3	*Operate enhancement program as a temporary strategy to 26.1*					
SONCC-MatR.26.1.1.4	*Monitor fish populations at all life stages including juvenile snorkel counts, downstream migrant counts, spawning surveys, and PIT tagging*					
SONCC-MatR.27.1.25	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3
SONCC-MatR.27.1.25.1	*Perform annual spawning surveys*					
SONCC-MatR.27.1.26	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life history diversity	Population wide	3

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MatR.27.1.26.1		*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*				
SONCC-MatR.27.1.27	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	2
SONCC-MatR.27.1.27.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-MatR.27.2.28	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3
SONCC-MatR.27.2.28.1		*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*				
SONCC-MatR.27.2.28.2		*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling 10% of the original habitat surveyed*				
SONCC-MatR.27.2.29	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3
SONCC-MatR.27.2.29.1		*Measure the indicators, pool depth, pool frequency, D50, and LWD*				
SONCC-MatR.27.2.30	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3
SONCC-MatR.27.2.30.1		*Measure the indicators, canopy cover, canopy type, and riparian condition*				
SONCC-MatR.27.2.31	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3
SONCC-MatR.27.2.31.1		*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*				
SONCC-MatR.27.2.32	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3
SONCC-MatR.27.2.32.1		*Measure the indicators, pH, D.O., temperature, and aquatic insects*				
SONCC-MatR.27.2.33	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3
SONCC-MatR.27.2.33.1		*Annually measure the hydrograph and identify instream flow needs*				

Action ID	**Strategy**	**Key LF**	**Objective**	**Action Description**	**Area**	**Priority**
Step ID	***Step Description***					
SONCC-MatR.27.2.34	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	All IP habitat	3
SONCC-MatR.27.2.34.1	*Identify habitat condition of the estuary*					
SONCC-MatR.27.1.36	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3
SONCC-MatR.27.1.36.1	*Conduct presence/absence surveys for juveniles (3 years on; 3 years off)*					
SONCC-MatR.27.1.37	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3
SONCC-MatR.27.1.37.1	*Develop supplemental or alternate means to set population types and targets*					
SONCC-MatR.27.1.37.2	*If appropriate, modify population types and targets using revised methodology*					
SONCC-MatR.27.2.38	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3
SONCC-MatR.27.2.38.1	*Determine best indicators of estuarine condition*					
SONCC-MatR.5.1.19	Passage	No	Improve access	Remove barriers	South Fork Vanauken, Eubank, High Prairie, Harris, Painter, South Fork Bear, Buck, and Baker creeks	3
SONCC-MatR.5.1.19.1	*Inventory and prioritize barriers*					
SONCC-MatR.5.1.19.2	*Remove barriers*					
SONCC-MatR.7.1.14	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	High IP subwatersheds	3
SONCC-MatR.7.1.14.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-MatR.7.1.14.2	*Develop grazing management plan to meet objective*					
SONCC-MatR.7.1.14.3	*Plant vegetation to stabilize stream bank*					
SONCC-MatR.7.1.14.4	*Fence livestock out of riparian zones*					
SONCC-MatR.7.1.14.5	*Remove instream livestock watering sources*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MatR.7.1.15	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	High IP subwatersheds	3
SONCC-MatR.7.1.15.1		*Determine appropriate silvicultural prescription for benefits to coho salmon habitat*				
SONCC-MatR.7.1.15.2		*Thin, or release conifers, guided by prescription*				
SONCC-MatR.7.1.15.3		*Plant conifers, guided by prescription*				
SONCC-MatR.7.1.16	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Population wide	2
SONCC-MatR.7.1.16.1		*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-MatR.8.1.17	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	3
SONCC-MatR.8.1.17.1		*Assess and prioritize road-stream connection, and identify appropriate treatment to meet objective*				
SONCC-MatR.8.1.17.2		*Decommission roads, guided by assessment*				
SONCC-MatR.8.1.17.3		*Upgrade roads, guided by assessment*				
SONCC-MatR.8.1.17.4		*Maintain roads, guided by assessment*				
SONCC-MatR.8.1.18	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	Population wide	3
SONCC-MatR.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*				