29. Mattole River Population

Southern Coastal Stratum

Non-Core 1, Functionally Independent Population

High Extinction Risk

1,000 Spawners Required for ESU Viability

Population likely below depensation threshold

296 mi² (21 % Federal ownership)

250 IP-km (155 IP-mi) (24% High)

Dominant Land Uses are Timber Harvest and Rural Residential

Key Limiting Stresses are 'Lack of Floodplain and Channel Structure' and 'Altered Hydrologic Function'

Key Limiting Threats are 'Dams/Diversions' and 'Urban/Residential/Industrial Development'

Highest Priority Recovery Actions

• Implement an enhancement program (e.g. captive broodstock, rescue rearing, or conservation hatchery) • Construct off-channel habitats, alcoves, backwater habitat, and old oxbows • Secure and maintain sufficient instream flows	• Determine effects of marijuana cultivation and reduce if necessary • Increase water retention (i.e. storage and recharge) • Increase large woody debris (LWD), boulders, or other instream structure

29.1 History of Habitat and Land Use

Euro-American settlers arrived in the Mattole River basin in the early 1850s, and with their arrival came land use practices that altered instream conditions for coho salmon. Initial land use consisted primarily of agriculture and sheep grazing. High intensity timber harvest and associated road building peaked throughout the basin during the 1950s and 1960s. Two significant storm events and wide-spread flooding occurred in 1955 and 1964, resulting in large scale mass-wasting that choked channels with sediment and filled deep pools (MRC 2008). The Mattole River basin is especially susceptible to landsliding and erosion due to widespread unstable bedrock and soils combined with relatively high levels of seismic activity.

As an example of the level of disturbance from the peak in timber harvest activity, 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 timber harvest (Figure 29-3) [Mattole Restoration Council (MRC) 2008]. The aerial photos show a significant amount of deforestation and road construction in this basin by 1965. This rate of activity was typical throughout much of the Mattole River population area.

Failure of timber harvest operations to replant Douglas-fir seedlings after harvesting allowed for the establishment of more aggressive hardwood species, primarily tanoak. Tractor and haul roads cut into logged hillsides, along with high amounts of rainfall, increased erosion and sediment delivery to Mattole River streams. The lack of reforestation 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). Figure 29-4 shows how the Upper North Fork Mattole River, at the confluence with the mainstem Mattole River, accumulated large amounts of sediment and lost riparian forests as a result of post-WWII disturbances (PALCO 2006b). These dramatic changes in stream conditions suggest there were likely significant reductions to the coho salmon population by the late 1960s. Currently, timber harvest continues on private and industrial timberlands throughout the Mattole River basin at a much reduced rate and under much stricter regulations. The largest industrial timberland owner in the population area, Humboldt Redwood Company (HRC), operates under a state and federal Habitat Conservation Plan (HCP) on 18,350 acres in the western and northern basin (PALCO 1999a). The HRC 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 managing several late-seral stands as "high conservation value forest," which will be protected as long as the company remains the landowner.

The effects of timber harvest on wood recruitment were exacerbated by the "stream cleaning" that occurred during the 1980s. During this time large woody debris (LWD) was removed from many of the productive coho salmon streams in the southern sub-basin (MRRP 2010). In some streams, more wood was removed than exists in the stream channel today (MRRP 2010).

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 are severe (Downie *et al.* 2003). Overall, the current landscape is comprised of either small-diameter conifer forest, or hardwood-dominated forests that provide less shade and reduced large wood recruitment than the former old-growth forests. Remaining late-seral conifer

stands are fragmented and occur primarily on the public lands in the western and eastern sub-basins.

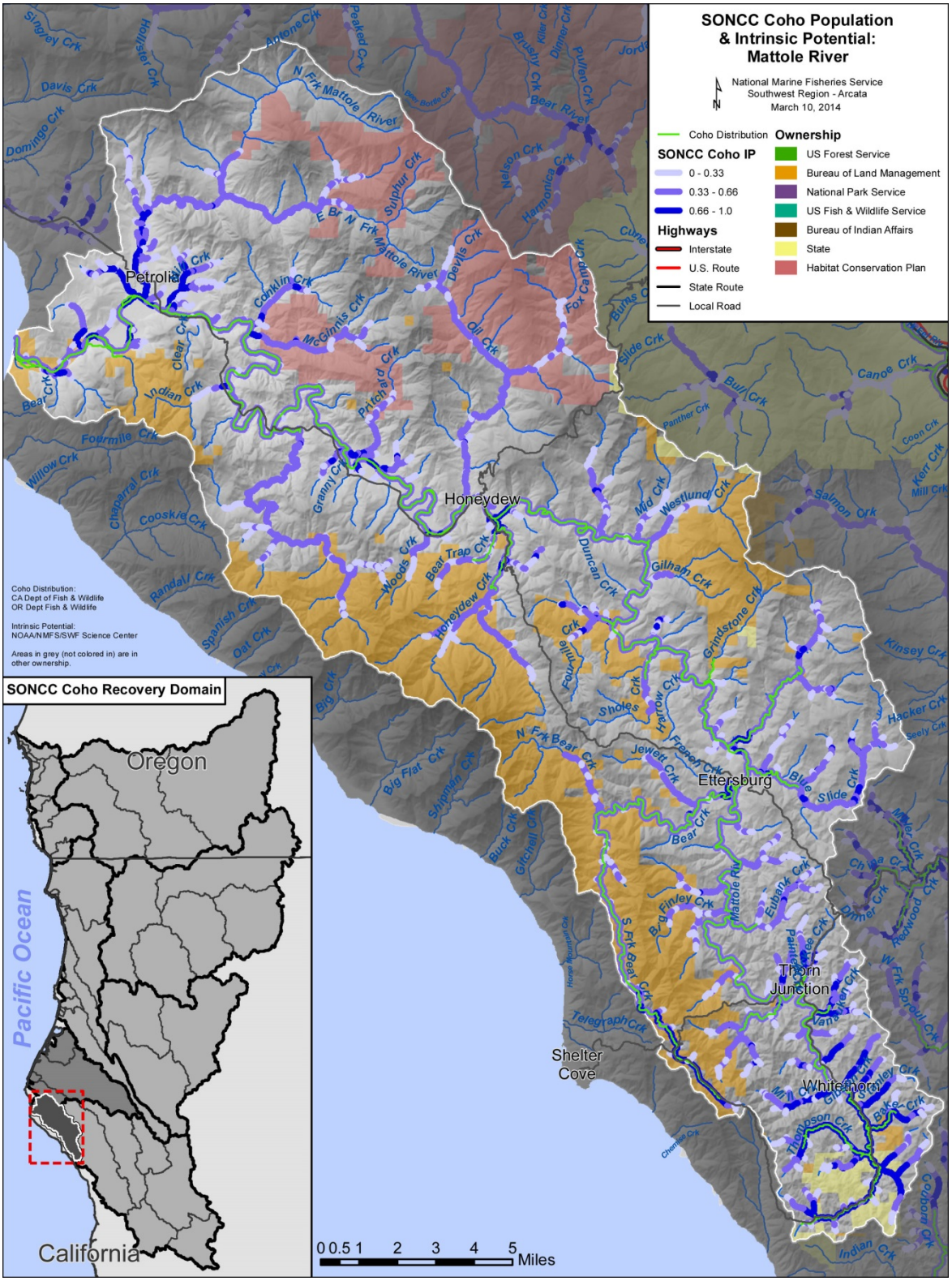

Figure 29-1. The geographic boundaries of the Mattole River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Southern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

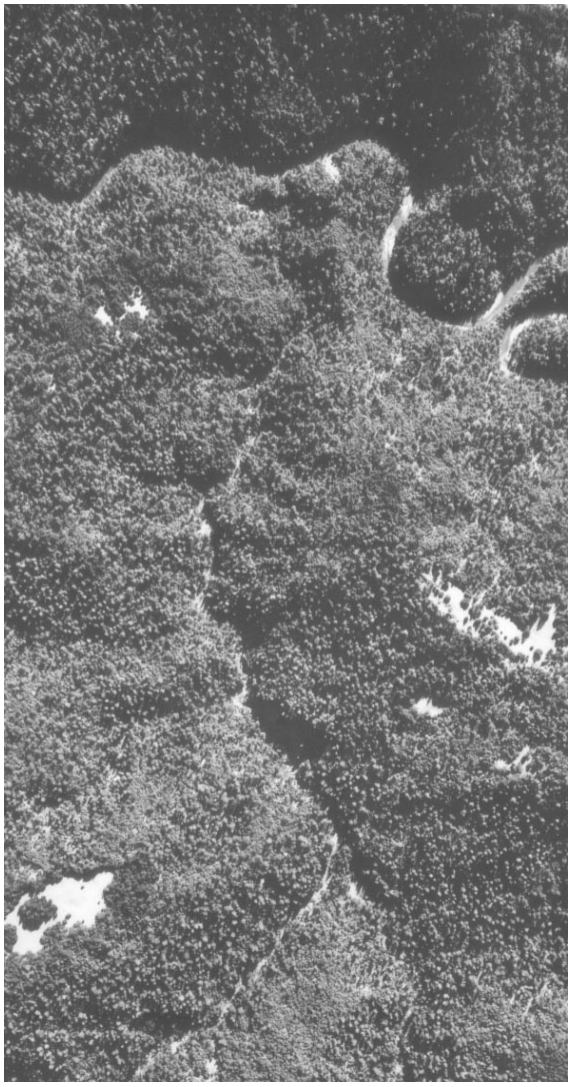

Figure 29-2 Aerial photo of Dry Creek, February 1942. Late-seral and mixed-aged stands of timber with good riparian and hill slope forest cover. Little evidence of increased sediment delivery to water courses (MRC 2008).

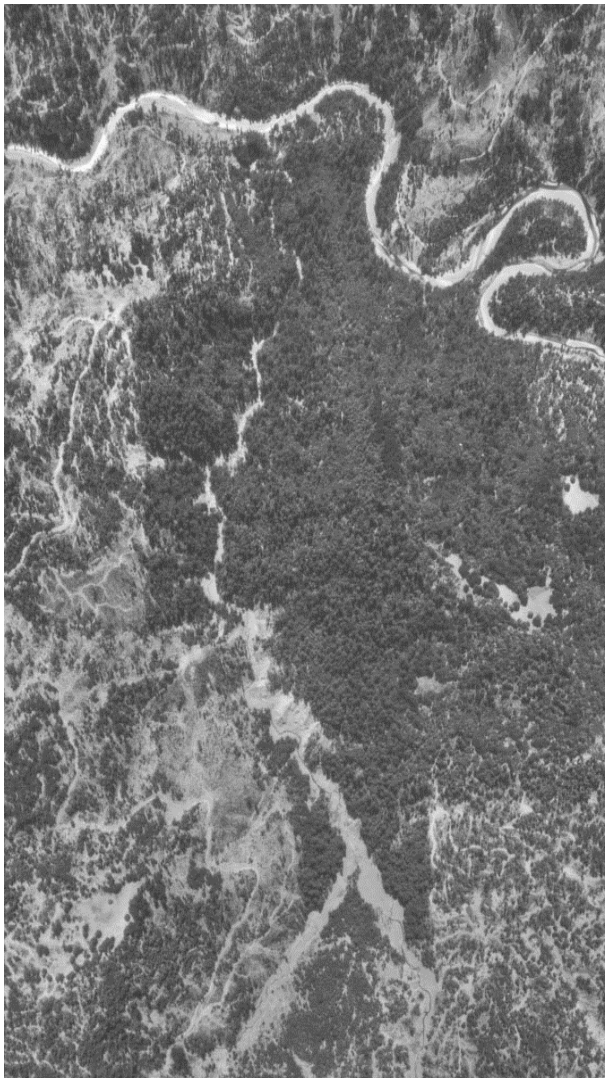

Figure 29-3. Aerial photo of Dry Creek, August 1965. High-grade and clear-cut timber harvest exposed bare ground to rains. Tributary channel widening and aggradation is evident (MRC 2008*)*

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). Although not widespread, livestock grazing within some geologically sensitive areas of the basin has likely led to erosion, suppressed vegetative growth, and streambank instability.

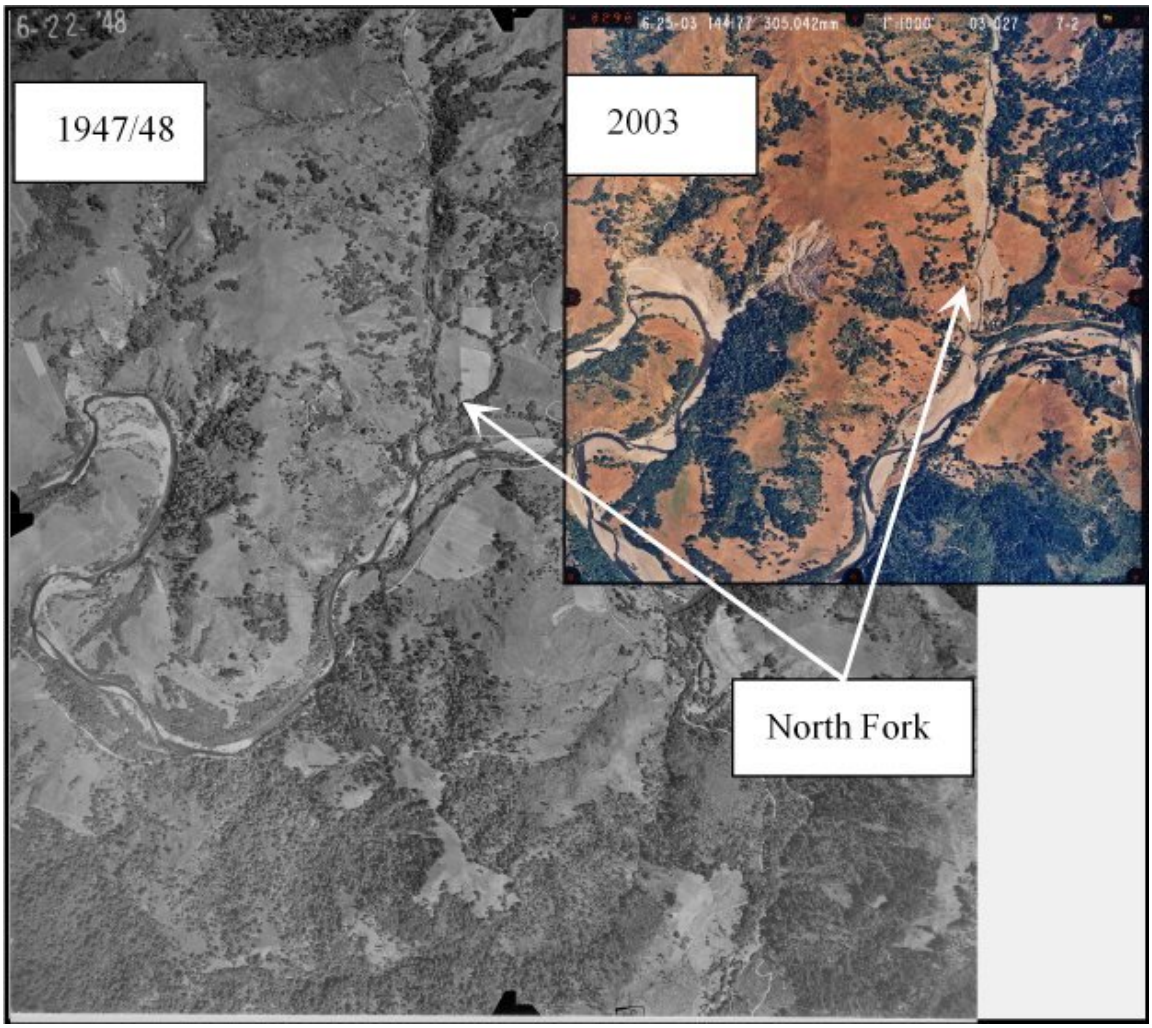

Figure 29-4. Aerial photos from 1948 and 2003 showing wider, aggraded channel in 2003 of the Upper North Fork near its confluence with the mainstem.

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 use is accommodated through in-stream diversions or shallow wells which diminish streamflows during summer low-flow periods. Much of the demand occurs in the southern sub-basin where the last known stronghold on coho salmon spawning occurs. Additionally, the southern sub-basin has experienced increasing levels of marijuana cultivation. 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 salmon. Unscreened water diversions using motorized 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 rural, the commitment from the local community to protecting and maintaining their natural environment is significant. Conservation-oriented non-profit groups such as the Mattole Salmon

Group, Mattole Restoration Council, and Sanctuary Forest have taken actions to protect and restore the river's salmonid populations. Completed projects include barrier removal, road upgrade and decommissioning, instream habitat restoration, fisheries monitoring, water quality monitoring, and stream bank stabilization.

29.2 Historic Fish Distribution and Abundance

Little data exists regarding run size or characteristics of coho salmon in the Mattole River prior to the 1950s. CDFG estimated an average run size of 8,000 coho salmon in the mid-to late 1950s, and in 1960 the United States Fish and Wildlife Service (USFWS) estimated an average run size of 2,000 coho salmon and a potential population abundance of 20,000 coho salmon based on habitat characteristics at the time.

High intrinsic-potential (IP) habitat is scattered throughout the basin's numerous tributaries; however, the southern basin headwater tributaries have the highest concentration of high IP values. The Mattole River is somewhat unique in the SONCC coho salmon ESU because 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. Concentrations of high IP habitat also exist in the western portion of the northern basin such as the lower North Fork Mattole and East Mill Creek. However, surveys have not documented consistent coho salmon presence in these reaches.

Table 29-1 lists Mattole River tributaries with high IP values.

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

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

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 coho salmon. The Mattole River population is considered 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). The Mattole River population is unique in that it is relatively isolated from other functionally independent populations in the ESU, and due to its location at the southern extent of the ESU, sources of straying spawners are likely limited to populations from the north.

Coho salmon currently utilize a small fraction of their historic habitat in the basin. Recently, the only known occurrences of coho salmon in the lower 27 miles of the Mattole have been in Lower Mill Creek (MRC 2008) and Squaw Creek (Queener, N., pers. comm. 2013).

Snorkel surveys conducted in the summer of 2013 documented successful spawning in four tributaries (Baker, Thompson, Ancestor, and Squaw creeks) (MSG 2013). As the current distribution of spawning adults is limited to just a few tributaries with suitable habitat, the Mattole River coho salmon population's spatial structure and diversity are very limited compared to estimated historical conditions.

Population Size and Productivity

Williams et al. (2008) determined at least 250 coho salmon must spawn in the Mattole River population area each year to avoid effects of extremely low population sizes. As recently as 1987-88 the Mattole River was believed to support as many as 1,000 coho salmon spawners (MRRP 2011). However, no more than 11 live fish or 10 redds have been documented in the five most recent spawning seasons (2008-09 to 2012-13), with an all-time low of three live adults and one redd in the basin in 2009-10 (MSG 2010). Although the spawner and redd counts do not represent a population abundance estimate, the population's rapid decline is evident (Figure 29-5). Due to extremely low catches of coho salmon juveniles during outmigrant trapping efforts, outmigrant population estimates have not been calculated.

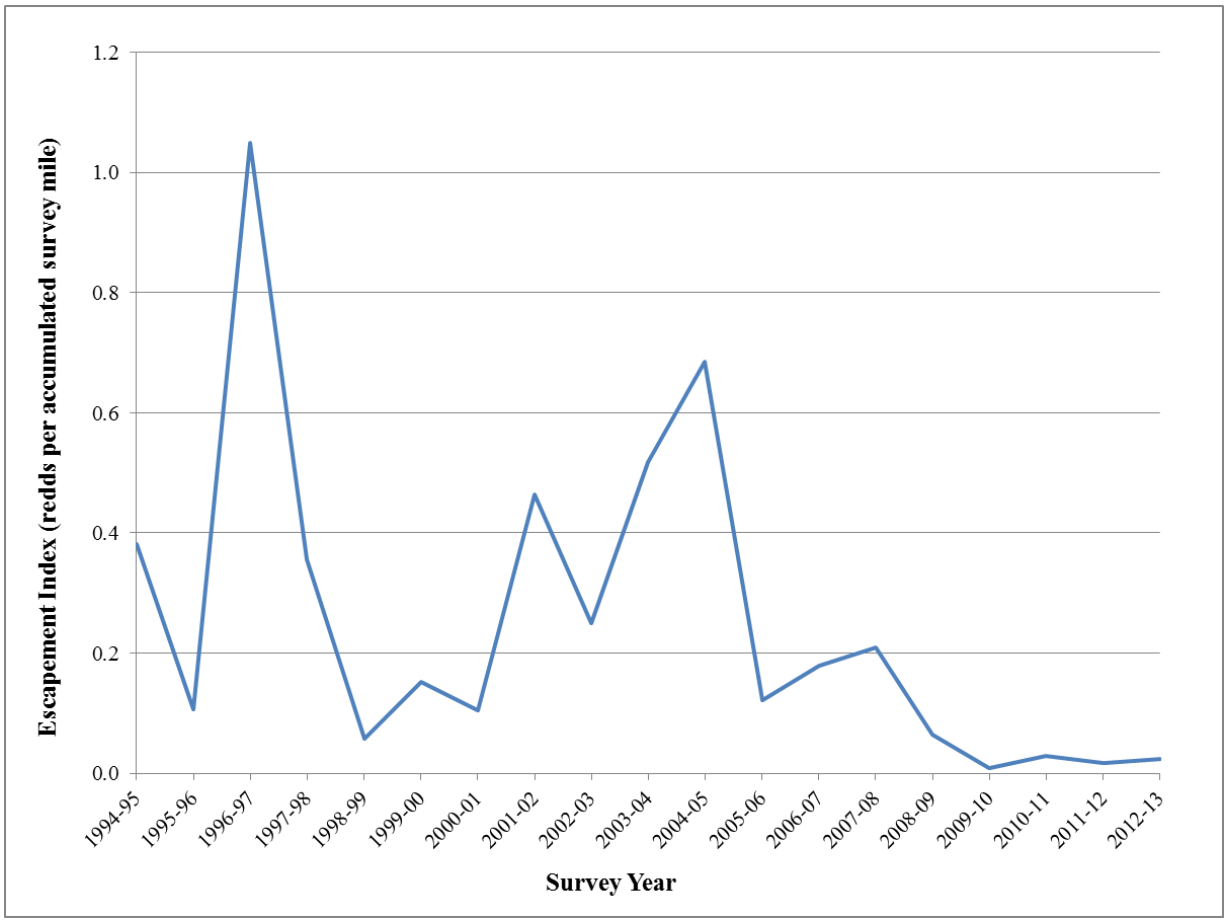

Figure 29-5. Escapement index (redds per survey mile) for the Mattole River coho salmon population. Data from Mattole Salmon Group (2013).

Extinction Risk

The Mattole River population is at high risk of extinction because NMFS estimates the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is less than one, the criterion described by Williams et al. (2008). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, pg. 17). These viability criteria reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role in SONCC Coho Salmon ESU Viability

The Mattole River population is a non-core 1, Functionally Independent population within the Southern Coastal diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, and with population dynamics or extinction risk over a 100-year time period that are not substantially altered by exchanges of individuals with other populations (Williams et al. 2006). To contribute to stratum and ESU viability, the Mattole River core population needs to have at least 1,000 spawners. Sufficient spawner densities are

needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. The Mattole River population will also contribute toward stratum and ESU viability by providing rearing, migratory, and refugia habitat to nearby populations.

29.4 Plans and Assessments

Mattole River and Range Partnership (MRRP)

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 strategy contains numerous recovery actions designed to improve coho salmon habitat in the Mattole River.

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 assessments and plans describe current conditions and needed actions in these watersheds.

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

Mill Creek Watershed Analysis (BLM 2001a)

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, assessment methods, and data used to assess stresses are described in Appendix B.

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

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

Key Limiting Stresses, Life Stages, and Habitat

The key limiting stresses for the Mattole River population are altered hydrologic function and lack of floodplain and channel structure, as they have the greatest impact on the population's ability to produce sufficient spawners to support recovery. The juvenile life stage is most limited, primarily due to reductions in quality and quantity of summer and winter rearing habitat. Juvenile summer rearing habitat is impaired by low flow conditions exacerbated by water withdrawals and a reduced water table. The lack of flow results in dried stream reaches during the summer season, thereby reducing the extent of available habitat and nutrient transport through drift. High flow refugia habitat is severely lacking for winter rearing juveniles due to disconnected floodplains and a lack of instream complexity.

Altered Hydrologic Function

Altered hydrologic functions are most stressful for summer rearing juveniles. Low stream flows are problematic for coho salmon throughout the population area. These conditions are most severe when little or no rainfall occurs during summer months and where agricultural and residential water use is the highest. Low flows can result in stranding of individuals in disconnected pools, where high water temperature and low dissolved oxygen may become lethal, and juveniles are at increased risk of exposure to terrestrial predators.

Reaches in the southern sub-basin are prone to seasonal drying, and in many years it has become necessary to rescue and relocate juvenile coho salmon from drying pools. Some southern sub-basin streams with very little human water use (e.g., Baker Creek) have lower per-unit area flows in the summer when compared to other southern sub-basin streams with relatively high human water use. Therefore, other factors, such as young forest stands and degraded stream channels may be contributing to diminished flows.

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 the 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.

Lack of Floodplain and Channel Structure

Lack of floodplain and channel structure is most stressful for winter rearing juveniles. 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 sub-basin. Data on instream large wood is limited, but lack of large wood does not appear to be a significant limiting factor in headwater tributaries. However, many headwater tributaries are incised and therefore potential for large wood recruitment is low. Increasing levels of instream wood would improve rearing conditions and result in higher 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 harvest 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. The lack of complex overwintering habitat throughout much of the system may be a significant factor in the historical population decline and current low population abundance.

Impaired Water Quality

High water temperatures are problematic in many areas of the Mattole River population area, including the estuary. Water quality is most stressful for the juvenile life history stage because they are present during the summer and early fall when temperatures are highest. The coolest water temperatures are found in the southern sub-basin, near the community of Whitethorn, where headwater tributaries (e.g., Thompson, Mill, Bridge, and Buck creeks) consistently provide cold water to the mainstem Mattole.

Lethal dissolved oxygen (DO) levels add to the stresses of low flow and stranding in dry years. A DO level of 0.2 mg/L was recorded in an extremely dry year in 2002, which is well below the 6.0 mg/L threshold considered adverse to salmonids (MRRP 2009).

Altered Sediment Supply

Altered sediment supply presents a high stress across all life stages, except adults. 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 shift and result 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 stress affecting the population.

Riparian Forest Conditions

Degraded riparian forest conditions exist across the basin and are a high stress for many life stages. Streamside canopy cover in the southern tributaries is primarily very good, but elsewhere in the population area canopy cover 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, riparian cover, and fully functioning slough habitat.

Water temperatures in the estuary during late summer have been found to be poor for juvenile salmonids and may be impairing their survival at ocean entry (MRRP 2009). The lack of habitat complexity in the estuary may also be a stress for the population as juveniles and smolts may be more susceptible to predation due to inadequate cover.

Although formation of a sand bar across the mouth of the Mattole River is a natural phenomenon, the timing and duration of bar closure is also affected by legacy and current anthropogenic factors which influence the hydrology and stream flow into the estuary. 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.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium stress to adults and a low stress to juveniles and smolts.

Barriers

Barriers are a low stress to the Mattole River population. Over the last two decades substantial funding has been provided to remove the barriers of most concern; however, there are five remaining barriers that are potentially limiting coho salmon distribution. The barriers (in order of priority for remediation) occur on the following creeks: Baker Creek, Painter Creek, Harris Creek, High Prairie Creek, and Granny Creek.

Adverse Hatchery-Related Effects

Small-scale hatch box and captive rearing programs were conducted in the past, but were discontinued in the 1980s. Hatchery-origin coho salmon may stray into Mattole River; however, the proportion of adults that are of hatchery origin is likely less than five percent and there are no hatcheries in the basin. Therefore, adverse hatchery-related effects pose a low risk to all life stages (Appendix B).

29.6 Threats

Table 29-3. Severity of threats affecting each life stage of coho salmon in the Mattole River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

Threats[2]		Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Dams/Diversions[1]	Low	Medium	Very High[1]	High	High	Very High
2	Urban/Residential/Industrial Dev.[1]	High	High	High[1]	High	Medium	High
3	Roads	High	High	High	High	Medium	High
4	Timber Harvest	High	High	High	High	Medium	High
5	High Severity Fire	High	High	High	High	Medium	High
6	Agricultural Practices	Medium	Medium	High	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	-	-	Low	Low	Medium	Low
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]Key limiting threats and limited life stage
[2]Invasive Non-Native/Alien Species is not considered a threat to this population.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are dams/diversions and urban/residential/industrial development.

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 concern is the southern sub-basin where many of the highest IP reaches occur coincident with numerous rural residences. Bear Creek and the North Fork Mattole River may also be influenced by agricultural and residential withdrawals. An ongoing forbearance program led by Sanctuary Forest, where water is stored in tanks during the wet season for summer use, will continue to reduce the number of dry season water diversions. However, the program alone is likely not sufficient to eliminate this threat.

Marijuana cultivation has continued to expand in many areas of the Mattole River population area. Although the number of plants grown each year is unknown, the water diversion required to support these plants is placing a high demand on a limited supply of water (Bauer 2013a). Most diversions for marijuana cultivation occur at headwater springs and streams, thereby removing the coldest, cleanest water at the most stressful time of the year for coho salmon (Bauer 2013b). Based on an estimate from the medical marijuana industry, each marijuana plant may consume 900 gallons of water per growing season (HGA 2010).

Urban/Residential/Industrial Development

Rural population growth will continue to present a high threat to coho salmon in the Mattole River as there is no water development agency in the basin and landowners are left to find their own sources of water. The lack of a structured water right permitting program is a significant deficiency in this basin for the protection of summer rearing coho salmon juveniles. Additionally, development 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.

Roads

Roads are a 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.

Road building for access to marijuana cultivation sites is common in many areas of the Mattole River population area. It is likely that many of these roads are unpermitted and contribute excessive amounts of fine sediment to coho salmon streams.

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 is most concentrated in the North Fork Mattole River, Oil Creek, and the southern sub-basin. Numerous small non-industrial timber harvesting activities occur throughout the population area. 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 sub-basin and other tributaries known to support coho salmon. A program-level environmental impact report for timber harvesting practices is available for landowners in the Mattole River population area when preparing timber harvest plans.

High Severity Fire

Young, dense forests throughout the population area present a high threat for high severity fires. High severity 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

Marijuana cultivation has become common in many areas of the Mattole River population area. Although the number of plants grown each year is unknown, the herbicides, pesticides, and fertilizers used to support these plants are likely impairing water quality in coho salmon streams.

Livestock grazing occurs throughout the basin and can result in 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 (e.g. Lower Bear Creek) 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). Average air temperature could increase by up to 1° 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

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium threat to adults and a low stress to juveniles and smolts.

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 River. Currently, upslope mining is minimal to non-existent 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.

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, five barriers exist but block a small amount of coho salmon habitat.

29.7 Recovery Strategy

Coho salmon abundance in the Mattole River is severely depressed with 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 the high-potential tributaries 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 enhance riparian functions to provide cover and moderate stressful water temperatures, and increase instream complexity for flow refugia and protection against predation. If suitable habitat exists but population recovery is limited by small population size, an enhancement program may be necessary. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 29-4 on the following page lists the recovery actions for the Mattole River population.

Table 29-4. Recovery action implementation schedule for the Mattole River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MatR.3.1.6	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Population wide	1
SONCC-MatR.3.1.6.1	*Identify and cease unauthorized water diversions*					
SONCC-MatR.3.1.3	Hydrology	Yes	Improve flow timing or volume	Provide adequate instream flow for coho salmon	Population wide	1
SONCC-MatR.3.1.3.1	*Conduct study to determine instream flow needs of coho salmon at all life stages.*					
SONCC-MatR.3.1.3.2	*If coho salmon instream flow needs are not being met, develop plan to provide adequate flows. Plan may include water conservation incentives for landowners and re-assessment of water allocation.*					
SONCC-MatR.3.1.3.3	*Implement coho salmon instream flow needs plan.*					
SONCC-MatR.26.1.1	Low Population Dynamics	No	Increase population abundance	Implement an enhancement program	Population wide	1
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	*If enhancement is determined to be beneficial, acquire necessary permits for enhancement program*					
SONCC-MatR.26.1.1.3	*If enhancement is determined to be beneficial, develop a facility to rear fish*					
SONCC-MatR.26.1.1.4	*Operate enhancement program as a temporary strategy to prevent extirpation*					
SONCC-MatR.26.1.1.5	*Monitor fish populations at all life stages including juvenile snorkel counts, downstream migrant counts, spawning surveys, and Passive Integrated Transponder (PIT) tagging*					
SONCC-MatR.26.1.47	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	1
SONCC-MatR.26.1.47.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-MatR.3.1.7	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2a
SONCC-MatR.3.1.7.1	*Work with partners to streamline the process needed for the dedication of water to fish and wildlife resources under CA Water Code section 1707*					
SONCC-MatR.3.1.7.2	*Implement water dedications to increase instream flows using the streamlined process*					
SONCC-MatR.3.1.8	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2a
SONCC-MatR.3.1.8.1	*Establish a categorical exemption under CEQA for water leasing to increase instream flows*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MatR.3.1.5	Hydrology	Yes	Improve flow timing or volume	Secure and maintain sufficient instream flows	All streams where coho salmon would benefit immediately	2a
SONCC-MatR.3.1.5.1	*Increase participation in forbearance program through education and incentives*					
SONCC-MatR.3.1.5.2	*Monitor forbearance compliance*					
SONCC-MatR.3.1.61	Hydrology	Yes	Improve flow timing or volume	Secure and maintain sufficient instream flows	Population wide	2b
SONCC-MatR.3.1.61.1	*Increase participation in forbearance program through education and incentives*					
SONCC-MatR.3.1.61.2	*Monitor forbearance compliance*					
SONCC-MatR.2.1.12	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately	2a
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.2.1.58	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2b
SONCC-MatR.2.1.58.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-MatR.2.1.58.2	*Place instream structures, guided by assessment results*					
SONCC-MatR.2.1.68	Floodplain and Channel Structure	Yes	Increase channel complexity	Re-connect channel to mainstem	Lower Bear Creek (lower mainstem)	2a
SONCC-MatR.2.1.68.1	*Assess feasibility of long-term solutions to re-connect Lower Bear Creek to the mainstem Mattole River*					
SONCC-MatR.2.1.68.2	*If feasible, develop plan to re-connect Lower Bear Creek to mainstem Mattole River*					
SONCC-MatR.2.1.68.3	*Re-connect Lower Bear Creek to the mainstem Mattole River*					
SONCC-MatR.3.2.10	Hydrology	Yes	Increase water storage	Increase water retention	All streams where coho salmon would benefit immediately	2a
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.3.2.62	Hydrology	Yes	Increase water storage	Increase water retention	Population wide	2b
SONCC-MatR.3.2.62.1	*Develop water storage and recharge plan*					
SONCC-MatR.3.2.62.2	*Implement projects identified in water storage and recharge plan*					
SONCC-MatR.3.2.62.3	*Maintain water storage structures*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MatR.2.2.13	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately	2a
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 to create refugia habitat, as guided by assessment results*					
SONCC-MatR.2.2.59	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2b
SONCC-MatR.2.2.59.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-MatR.2.2.59.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-MatR.3.1.48	Hydrology	Yes	Improve flow timing or volume	Determine effects of marijuana cultivation	Population wide	2b
SONCC-MatR.3.1.48.1	*Assess cumulative effects (e.g., flow, water quality) of marijuana cultivation*					
SONCC-MatR.3.1.48.2	*If needed, develop plan to reduce effects of marijuana cultivation*					
SONCC-MatR.3.1.48.3	*Implement plan*					
SONCC-MatR.22.2.49	Urban, Residential, Industrial Development	Yes	Improve flow timing or volume	Ensure adequate summer base flow	All areas where coho salmon would benefit immediately	2b
SONCC-MatR.22.2.49.1	*Ensure sub-division of existing parcels does not result in increased water demand during low-flow season*					
SONCC-MatR.22.2.60	Urban, Residential, Industrial Development	Yes	Improve flow timing or volume	Ensure adequate summer base flow	Population wide	2c
SONCC-MatR.22.2.60.1	*Ensure sub-division of existing parcels does not result in increased water demand during low-flow season*					
SONCC-MatR.22.3.45	Urban, Residential, Industrial Development	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve regulatory mechanisms	Population wide	2b
SONCC-MatR.22.3.45.1	*Develop ordinance, permit requirements, and guidance to maintain open space*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MatR.5.2.43	Passage	No	Decrease mortality	Screen all diversions	All areas where coho salmon would benefit immediately	2b
SONCC-MatR.5.2.43.1	*Assess diversions and develop a screening program*					
SONCC-MatR.5.2.43.2	*Screen all diversions*					
SONCC-MatR.5.2.64	Passage	No	Decrease mortality	Screen all diversions	Population wide	2d
SONCC-MatR.5.2.64.1	*Assess diversions and develop a screening program*					
SONCC-MatR.5.2.64.2	*Screen all diversions*					
SONCC-MatR.1.2.35	Estuary	No	Improve estuarine habitat	Assess estuary and tidal wetland habitat	Estuary	2b
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.1.2.35.3	*Restore estuary and tidal wetland habitat guided by the plan*					
SONCC-MatR.1.2.56	Estuary	No	Improve estuarine habitat	Restore estuarine habitat	Population wide	2d
SONCC-MatR.1.2.56.1	*Assess factors limiting coho rearing in the estuary including temperature, excess sediment, complexity, and size of estuary*					
SONCC-MatR.1.2.56.2	*Develop a plan to restore the estuary including restoration of the north and south sloughs, and potentially removing excess sediment*					
SONCC-MatR.1.2.56.3	*Implement the estuary restoration plan*					
SONCC-MatR.10.7.55	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All areas where coho salmon would benefit immediately	2b
SONCC-MatR.10.7.55.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-MatR.10.7.55.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-MatR.10.7.57	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	2d
SONCC-MatR.10.7.57.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-MatR.10.7.57.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-MatR.3.1.9	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3a
SONCC-MatR.3.1.9.1	*Establish a comprehensive groundwater permit process*					
SONCC-MatR.3.1.4	Hydrology	Yes	Improve flow timing or volume	Educate stakeholders	Population wide	3b
SONCC-MatR.3.1.4.1	*Develop an educational program about water conservation programs and instream leasing programs*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MatR.5.1.19	Passage	No	Improve access	Remove barriers	All streams where coho salmon would benefit immediately	3b
SONCC-MatR.5.1.19.1	*Inventory and prioritize barriers*					
SONCC-MatR.5.1.19.2	*Remove barriers, based on assessment*					
SONCC-MatR.5.1.63	Passage	No	Improve access	Remove barriers	Population wide	3d
SONCC-MatR.5.1.63.1	*Inventory and prioritize barriers*					
SONCC-MatR.5.1.63.2	*Remove barriers, based on assessment*					
SONCC-MatR.7.1.14	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Private lands where coho salmon would benefit immediately	3b
SONCC-MatR.7.1.14.1	*Assess grazing contribution to sediment delivery, pollutants, and riparian condition*					
SONCC-MatR.7.1.14.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-MatR.7.1.14.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					
SONCC-MatR.7.1.65	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Population wide	3d
SONCC-MatR.7.1.65.1	*Assess grazing contribution to sediment delivery, pollutants, and riparian condition*					
SONCC-MatR.7.1.65.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-MatR.7.1.65.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					
SONCC-MatR.8.1.18	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	All areas where coho salmon would benefit immediately	3b
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*					
SONCC-MatR.8.1.18.2	*Implement plan to stabilize slopes and revegetate areas based on assessment*					
SONCC-MatR.8.1.67	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	Population wide	3d
SONCC-MatR.8.1.67.1	*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*					
SONCC-MatR.8.1.67.2	*Implement plan to stabilize slopes and revegetate areas based on assessment*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MatR.8.1.17	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All areas where coho salmon would benefit immediately	3b
SONCC-MatR.8.1.17.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
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.8.1.66	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	3d
SONCC-MatR.8.1.66.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-MatR.8.1.66.2	*Decommission roads, guided by assessment*					
SONCC-MatR.8.1.66.3	*Upgrade roads, guided by assessment*					
SONCC-MatR.8.1.66.4	*Maintain roads, guided by assessment*					
SONCC-MatR.3.1.2	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3d
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.3.1.46	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3d
SONCC-MatR.3.1.46.1	*Provide tax and permit incentives for protection of coho salmon and their habitat*					
SONCC-MatR.7.1.16	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Population wide	3d
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.7.1.15	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Population wide	3d
SONCC-MatR.7.1.15.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-MatR.7.1.15.2	*Thin, or release conifers, guided by the plan*					
SONCC-MatR.7.1.15.3	*Plant conifers, guided by the plan*					
SONCC-MatR.7.1.40	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Re-establish natural fire regime	Population wide	3d
SONCC-MatR.7.1.40.1	*Identify areas prone to high severity fire and develop a plan to reestablish a natural fire regime*					
SONCC-MatR.7.1.40.2	*Carry out fuel reduction or modification projects such as thinning, prescribed burning, and piling, guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
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	3d
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 level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-MatR.16.1.22	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MatR.16.1.22.1	*Determine actual fishing impacts*					
SONCC-MatR.16.1.22.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
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	3d
SONCC-MatR.16.2.23.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-MatR.16.2.23.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-MatR.16.2.24	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MatR.16.2.24.1	*Determine actual impacts of scientific collection*					
SONCC-MatR.16.2.24.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					
SONCC-MatR.8.1.42	Sediment	No	Reduce delivery of sediment to streams	Reduce erosion	Population wide	3d
SONCC-MatR.8.1.42.1	*Identify and cease unauthorized road building or grading*					
SONCC-MatR.10.2.41	Water Quality	No	Reduce pollutants	Reduce point- and non-point source pollution	Population wide	3d
SONCC-MatR.10.2.41.1	*Identify pollution sources, and develop a strategy to minimize runoff to streams*					
SONCC-MatR.10.2.41.2	*Implement strategy to minimize pollution runoff to streams*					