26. Lower Eel and Van Duzen River Population

Southern Coastal Stratum

Core, Functionally Independent Population

High Extinction Risk

Population likely below depensation threshold

7,900 Spawners Required for ESU Viability

726 mi² (11% Federal ownership)

394 IP-km (244 IP-mi) (50% High)

Dominant Land Uses are Timber Harvest and Agriculture

Key Limiting Stresses are 'Impaired Estuary/Mainstem Function' and 'Lack of Floodplain and Channel Structure'

Key Limiting Threats are 'Dams/Diversions' and 'Channelization and Diking'

Highest Priority Recovery Actions

• Reduce abundance of Sacramento pikeminnow • Setback or remove dikes and levees • Increase large woody debris (LWD), boulders, or other instream structure	• Restore salt marsh and tidal sloughs • Reconnect tidal channels and wetlands • Increase instream flows

26.1 History of Habitat and Land Use

Historically, the Lower Eel/Van Duzen River sub-basin consisted primarily of late-seral redwood/Douglas-fir (coniferous) forests with limited open oak woodland/prairies farther inland at higher elevations. Beginning near the turn-of-the twentieth century, timber harvest along stream corridors and easily accessible areas led to development of hardwood-dominated forests and reduced large wood recruitment potential to streams. In addition, floodplain and estuarine wetland areas were cleared, diked, and drained to provide land for agriculture and urban development. Technological developments after World War II enabled timber harvest and road building in steeper, more landslide prone areas. This caused excessive sediment delivery to streams, especially following large floods in 1955 and 1964, which resulted in shallow pools and wide streams. Levees were constructed along portions of the lower Van Duzen and Eel rivers to protect agricultural land and urban areas from flooding.

Since 1922, Eel River flows have been regulated and water has been diverted to the Russian River for hydroelectric power, municipal water supply, and agriculture via the Potter Valley Project. There are two major dams on the Upper Eel River associated with the Potter Valley Project: the Cape Horn Dam which impounds the 700 acre-foot Van Arsdale Reservoir and the Scott Dam which impounds the 75,000 acre-foot storage reservoir, Lake Pillsbury. Sacramento pikeminnow were introduced to Lake Pillsbury in 1979 (California Department of Fish and Game (CDFG) 1997b), and have since colonized all accessible reaches of the Eel River watershed. This predator thrives in the warmer waters in the Eel River.

Pools that were refuges and reaches that had large wood are lacking because of sedimentation, dams, historic wood removal from stream channels, and degraded riparian forests. These pools and large woody debris would have provided juvenile coho salmon some protection from native predators and the pikeminnow.

Establishment of rural residences, smaller ranches, and agriculture increased the need for water. Currently, much of this demand is accommodated through in-stream diversions or shallow wells, which have lowered stream flows during summer low-flow periods. The Potter Valley Project also diverted 160,000 acre feet of water from the Eel River to the Russian River prior to 2002 (FERC 2000).

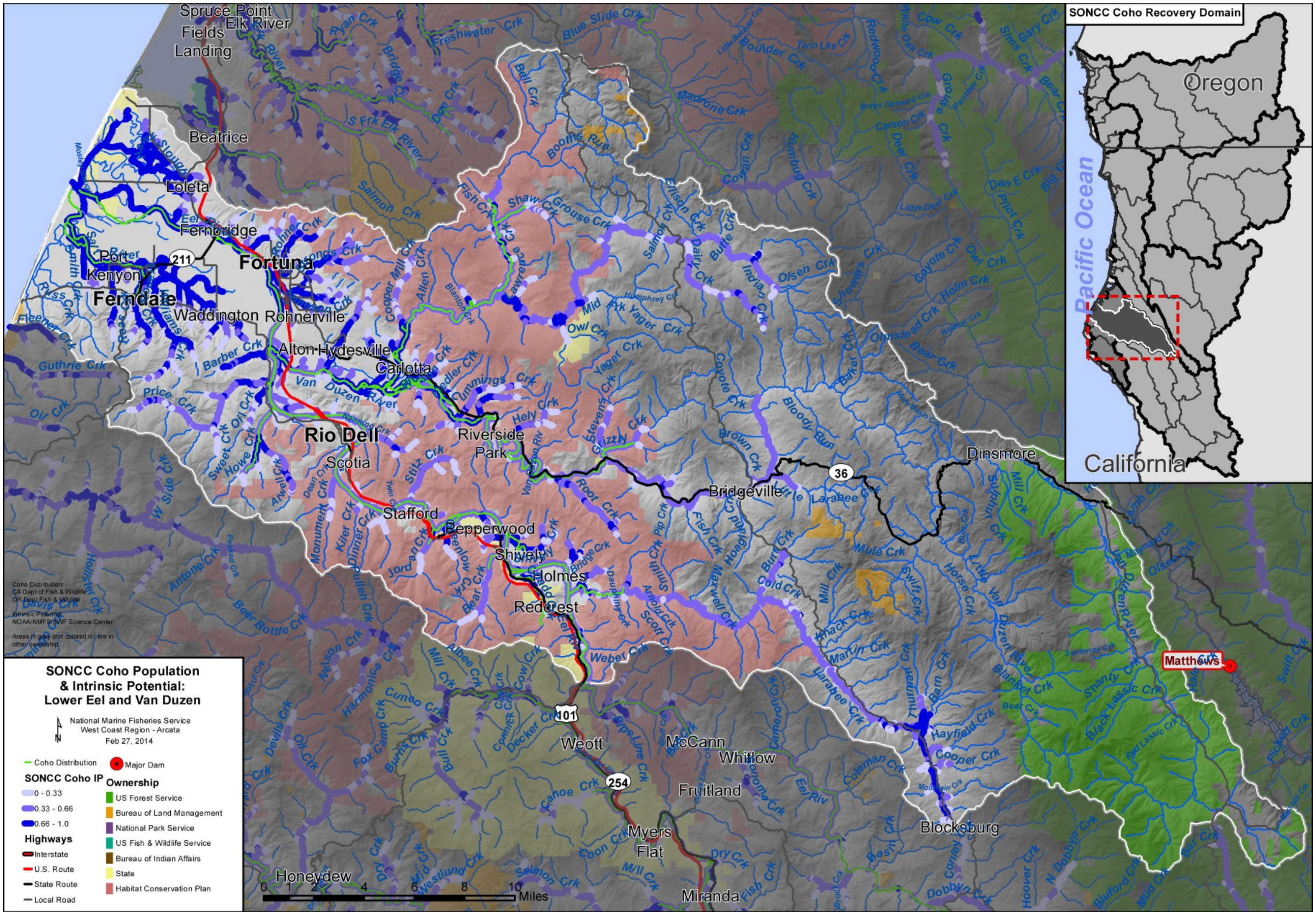

Figure 26-1. The geographic boundaries of the Lower Eel and Van Duzen rivers coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Southern Coastal diversity stratum (Williams et al. 2006. Grey areas indicate private ownership.

In the estuary, salt marsh was drained and riparian vegetation cleared to convert tidelands to pasture (Figure 26-2). The estuary appears to be mixing during the dry months and is stratified, or creates a "salt wedge" during wetter months (Gossard 1986). Tideland reclamation and the construction of dikes and levees have changed the function of the estuary considerably. Slough and creek channels that once meandered throughout the delta are now confined by levees, sufficiently slowing flow to a point that many have become filled with sediment. Remnant slough channels are visible throughout the delta. The estuary and tidal prism have been reduced by over half of their original size (CDFG 2010b).

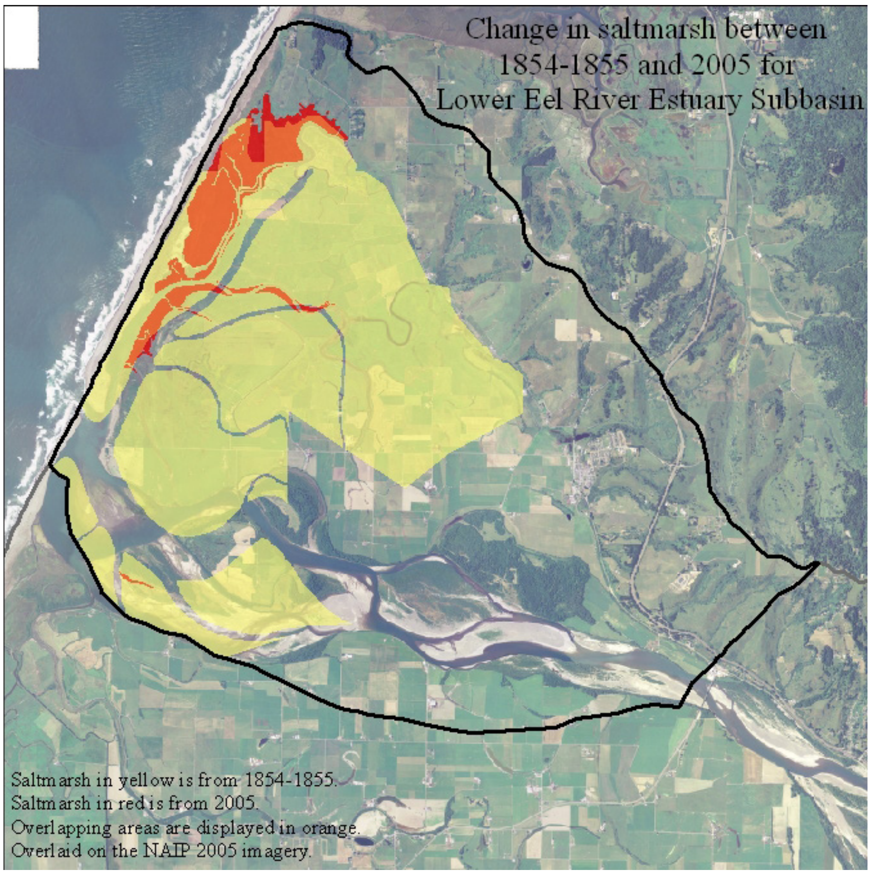

Figure 26-2. Change in salt marsh in the Eel River estuary between 1854 and 2005.

26.2 Historic Fish Distribution and Abundance

Historically, coho salmon occupied much of the Lower Eel and Van Duzen River sub-basin (CDFG 2010b). However, information on historic coho salmon distribution and abundance is limited. Coho salmon have been observed intermittently over the past few decades, but coho salmon are absent in many historically occupied tributaries. In 1965, CDFG estimated the escapement to be 500 each for the mainstem Eel River and the Van Duzen River (CDFG 1965). Two decades later, the escapement estimate for 1984 to 1985 declined to 200 for each (Wahle and Pearson 1987).

Survey records indicate coho salmon spawned in Carson, Bear, Chadd, and Shaw creeks (CDFG 1994, Brown et al. 2007). In a recent 2011 spawning survey conducted by CDFW in Fish Creek, a tributary to Lawrence Creek (and Van Duzen River), a total of eight adult coho salmon were observed spawning in a 1-km reach of IP habitat. If multiple surveys had been conducted in a more systematic fashion, it is likely that several more adult coho salmon spawners may have been detected in Fish Creek. This recent observation provides some optimism that the status of coho salmon in the population may be more stable than previously believed. The small number of fish observed in this population may be more a result of limited survey efforts rather than the actual number of fish in the population.

In addition, juveniles have been observed in the Van Duzen River, Grizzly, Cummings, Cuddeback, Fiedler, Howe, Wolverine Gulch, Oil, Atwell, Newman, Poison Oak, Strongs, Reas, Francis, Palmer, Rohner, and Jordan creeks (CDFG 1972, Brown and Moyle 1991, PALCO 2006a, Crowser 2005, Downie and Gleason 2007) as well as the Eel River estuary (Puckett 1977), the slough portion of Salt River (CDFG 1977), Centerville Slough (CDFG 1984) and North Slough channels (Puckett 1977). Estuary use by juveniles has been observed in multiple seasons from winter to summer (Puckett 1977, CDFG 2010b).

High IP reaches are found in the Salt River watershed, the lower Van Duzen River, lower Eel River and estuary sloughs, and upper Larabee Creek (see Table 26-1 for all tributaries with instances of high IP habitat).

Table 26-1. Tributaries with high IP reaches (IP > 0.66). (Williams et al. 2006).

Stream Name	Stream Name	Stream Name
Reas Creek	Rohner Creek	Burr Creek
Francis Creek	Strongs Creek	Boulder Flat Creek
Williams Creek	North Fork Strongs Creek	Cooper Creek
Salt River	Jameson Creek	Van Duzen River
Sweet Creek	Rogers Creek	Yager Creek
Howe Creek	Stevens Creek	Cummings Creek
Atwell Creek	Root Creek	Hely Creek
Manning Creek	N. Fk. Yager Creek	Fox Creek
Price Creek	Dairy Creek	Wilson Creek
Nanning Creek	Lawrence Creek	Cuddeback Creek
Hawks Slough	Blanton Creek	Fiedler Creek
Van Duzen River	Yager Creek	Chadd Creek
Penny Slough	Cooper Mill Creek	Bridge Creek
Coffee Creek	Larabee Creek	Greenlow Creek
Oil Creek	Carson Creek	Jordan Creek
Barber Creek	Thurman Creek	Stitz Creek
Eel River	Chris Creek	Burr Creek

26.3 Status of Lower Eel and Van Duzen River Coho Salmon

Spatial Structure and Diversity

The more restricted and fragmented the distribution of individuals within a population, and the more spatial distribution and habitat access diverge from historical conditions, the greater the extinction risk. Williams et al. (2008) determined that at least 20 coho salmon per-IP-km of habitat are needed (7,900 spawners total) to approximate the historical distribution of Lower Eel/Van Duzen River coho salmon. The current distribution of spawners is unknown, but it is expected to be extremely limited because the habitat has been severely degraded in most of the high to moderate IP reaches.

Population Size and Productivity

The Lower Eel/Van Duzen River coho salmon population size is unknown, but it is likely extremely reduced compared to historic levels. Breeding groups have been lost or severely depressed in some Lower Eel/Van Duzen River streams (CDFG 2002). Population growth rate is unknown, but it is expected to be negative in most years given the likely extremely low abundance of spawners. Therefore, the Lower Eel/Van Duzen River coho salmon population is at an elevated risk of extinction given the extremely low population size and negative population growth rate.

If a spawning population is too small, the survival and production of eggs or offspring may suffer because it may be difficult for spawners to find mates, or predation pressure may be too great. This situation accelerates a decline toward extinction. Williams et al. (2008) determined at least 394 coho salmon must spawn in the Lower Eel/Van Duzen River each year to avoid such effects of extremely low population sizes.

Extinction Risk

The Lower Eel/Van Duzen River coho 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 Lower Eel/Van Duzen River population is a core, 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 Lower Eel/Van Duzen River core population should have at least 7,900 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. Besides its role in achieving demographic goals and objectives for recovery, as a core population the Lower Eel/Van Duzen population may serve as a source of spawner strays for nearby coastal populations, as well as other populations in the Eel River basin. At present, the capacity of the Lower Eel/Van Duzen River coho salmon population to provide recruits to adjacent independent populations is limited due to its low spawner abundance. Conversely, recruits straying from nearby rivers may enhance recovery of the Lower Eel/Van Duzen River population. The tributaries and estuary located within this population may serve as essential non-natal rearing habitats for all populations in the Eel River watershed. Large-scale movements into non-natal streams have been documented in the Klamath River, tributaries to Humboldt Bay, and a variety of other locations where the 'nomad' life history pattern has been documented (Koski 2009). It is likely that Lower Eel and Van Duzen tributaries and estuarine habitats are key non-natal habitat for the populations within the entire Eel River watershed.

26.4 Plans and Assessments

State of California

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

The Recovery Strategy for California Coho Salmon was adopted by the California Fish & Game Commission in February 2004. The strategy contains recovery actions to improve coho salmon habitat in the Lower Eel and Van Duzen Rivers.

> *California Department of Fish and Game Eel River Salmon and Steelhead Restoration Action Plan*

In 1997, the California Department of Fish and Game completed their assessment of the Eel River watershed and provided recommendations for restoration of salmonid stocks. The issues and recommended action plans for the Eel River watershed are incorporated into this plan. Primary recommendations include removing barriers, reducing sediment inputs, improving riparian forest conditions, reducing water withdrawals, habitat enhancement, and suppressing Sacramento pikeminnow.

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

> *Lower Eel River Basin Assessment Report and Van Duzen River Basin Assessment Report*

The NCWAP Lower Eel River Basin (CDFG 2010b) and Van Duzen River (CDFG 2012b) Assessment Reports identify limiting factors for anadromous salmonids including estuarine conditions, lack of habitat complexity, increased sediment levels, and high water temperatures.

Environmental Protection Agency (USEPA)

In 1999 and 2007, the USEPA published the final Total Maximum Daily Loads (TMDL) for the Van Duzen and the Lower Eel River watersheds, respectively. The North Coast Regional Water

Quality Control Board is required to develop measures which will result in implementation of these TMDLs in accordance with the requirements of 40 CFR 130.6.

Humboldt Redwood Company (HRC)

Habitat Conservation Plan

Pacific Lumber Company (PALCO) finalized a Habitat Conservation Plan (HCP) covering SONCC coho salmon and their habitats in 1999. Since then, in 2008 the Humboldt Redwood Company (HRC) acquired the bankrupt PALCO and formally adopted the PALCO HCP. The HCP requires that forest roads are treated to minimize erosion at the rate of 75 miles of road treatments per year, resulting in 1,500 miles of road treatments in the first two decades of the HCP permit term. The HCP also identifies measures which will help trend aquatic habitat conditions towards ‘properly functioning conditions’.

Green Diamond Resources Company (GDRC)

Green Diamond Habitat Conservation Plan (HCP)

The GDRC HCP (GDRC 2006) contains measures that will aid in conservation of aquatic species in the Lower Eel and Van Duzen watersheds. The plan has a number of provisions designed to protect coho salmon and salmon habitat on GDRC land in the Mad River basin. The plan was developed in accordance with section 10(a)(1)(B) of the ESA and contains a conservation strategy to minimize and mitigate the potential adverse effects of any authorized take of aquatic species that may occur incidental to GDRC’s activities. The authorized take and its probable impacts will not appreciably reduce the likelihood of survival and recovery in the wild of aquatic species. Elements of the HCP are expected to contribute to efforts to reduce the need to list currently unlisted species in the future under the ESA by providing early conservation benefits to those species. GDRC covered lands in the Lower Eel/Van Duzen River population are located in Rohner Creek, Cummings Creek, Stevens Creek, Slater Creek, and Wilson Creek. More information about the GDRC HCP can be found in Section 3.2.5.

26.5 Stresses

Table 26-2. Severity of stresses affecting each life stage of coho salmon in the Lower Eel and Van Duzen rivers. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

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

[1] Key limiting stresses and limited life stage.

Key Limiting Stresses, Life Stages, and Habitat

The key limiting stresses include an impaired estuary/mainstem function and a lack of floodplain and channel structure. Dikes and levees have disconnected the mainstem channel from its floodplain and also significantly reduced the size and extent of the estuary. Sedimentation and poor land management practices resulted in a loss of channel complexity throughout most of the population area. Based on the type and extent of stresses and threats affecting the population as well as the key limiting stresses influencing productivity, it is likely that the juvenile life stage is the most limited. Juvenile coho salmon summer and winter rearing success is most limited by a lack of off channel and estuarine rearing habitat, elevated water temperatures, decreased flows from diversions, and an increased sediment supply that deteriorates the habitat quality in the tributaries. All of these factors contribute to preferable conditions for pikeminnow. Complexity of freshwater channels and a diverse estuary with suitable cover and deep channels and sloughs is important to juvenile coho salmon, increasing their size and fitness prior to ocean entry, and overall marine survival.

Complex stream channels with deep pools and woody structure as well as tidally influenced wetlands with off channel ponds are important refuge areas for juvenile coho salmon. Properly functional rearing habitat buffers other stresses affecting the population. Juvenile coho salmon would be more protected against predation, competition, and warm mainstem water temperatures if there were additional refugia areas. Currently, refugia areas for coho salmon are limited in the Lower Eel/Van Duzen River population area.

Altered Sediment Supply

Excessive sediment poses a medium stress to smolts and a very high stress to all other life stages of coho salmon in this population. Except for two sampling sites with moderate percentages of fines (<1mm), all sampling sites throughout the lower Eel and Van Duzen rivers have excessive levels of fines and sand (>6.4 mm). High sediment loads result in excessive embeddedness and reduce pool depths. High sediment levels impair feeding, simplify habitat, reduce reproductive success, and result in adverse physiological stress responses. The USEPA listed the Lower Eel and the Van Duzen rivers as impaired by sediment. The Eel River is one of the most erodible watersheds in the United States (Brown and Ritter 1971) because of the highly active tectonic setting, highly erodible soils in the area, and high precipitation. The Eel River carries fifteen times as much sediment as the Mississippi River and more than four times as the Colorado River (Brown and Ritter 1971). Anthropogenic activities in the Lower Eel/Van Duzen River population have exacerbated these naturally high sediment loads. A study of the continental shelf deposits offshore from the mouth of the Eel River indicates that there has been a sudden, three-fold increase in the rate of sedimentation since 1954 (USEPA 2007b). Most of the deep pools that existed in the estuary were filled by sediment brought by the flood waters of 1964. Excessive amounts of sediments generated by land use are still delivered to the estuary from upstream sources (USEPA 2007b).

Aggradation has interrupted the connectivity of surface flow in several areas. The Van Duzen River is often isolated from the Eel River by subsurface flows in late summer and early fall. An abundance of gravels and sediment are deposited at the confluence of the Van Duzen and Eel River which results in sub-surface flows and dry channels (Downie and Gleason 2007). Sedimentation has also restricted access to the Salt River downstream of Williams Creek and has severely restricted fish access to Salt River tributaries. Salmon Forever has been monitoring Francis Creek since January 2007, and preliminary results show maximum turbidity levels have reached 2200 Nephelometric Turbidity Unit (NTU) during a single storm. Combined with flow data, 2200 NTU is equivalent to 8.5 tons of sediment moving downstream every 10 minutes (Downie and Gleason 2007).

Impaired Estuary/Mainstem Function

This stress refers to the estuary and mainstem conditions in the Eel River, since this population is a part of a larger basin containing multiple populations (see chapter 3 for further description of this stress). Conditions in the Eel River mainstem and estuary are important to this population since all coho salmon that originate from the Eel River migrate to and from the ocean through the mainstem Eel River and Eel River estuary.

The Eel River estuary was once a highly complex and extensive habitat area that played a vital role in the health and productivity of all Eel River coho salmon populations. The degraded function of the Eel River estuary and mainstem migratory corridor today constitutes a very high stress for juveniles, a high stress for smolts, medium stress for adults, and a medium stress for fry. The Eel River estuary is severely impaired because of past diking, and filling of tidal wetlands for agriculture and flood protection. Approximately 60 percent of the estuary has been lost through the construction of levees and dikes and CDFG (2010b) estimates that only 10% of salt marsh habitats remain today. The estuary once supported a high degree of estuarine habitat and rearing potential, but very little of that historic function still exists. The function of the estuary (e.g., rearing, refugia, ocean transition) for coho salmon that originate in the Lower Eel/Van Duzen River is very important given the degraded habitat conditions and predation and competition from non-native Sacramento pikeminnow occurring upstream of the estuary in the mainstem river. Juveniles, smolts, and adults transitioning through mainstem and estuarine habitat are stressed by the degraded conditions in these migratory habitats. Juveniles and smolts suffer from the lost opportunity for increased growth, which would improve their survival at ocean entry. The loss and degradation of the formally-extensive and complex estuarine and mainstem habitat is a high stress for the population, with the most affected life stages being juveniles, smolts, and adults due to the degradation of rearing and migratory habitat.

Degraded Riparian Forest Conditions

Degraded riparian forest conditions exist across the population area, and present a high stress to fry, juvenile, smolt, and adult coho salmon. Where data exist, streamside canopy cover shows a range of conditions, with some good cover in the headwater areas of some tributaries, primarily in the Lawrence Creek watershed, and poor cover and shade conditions in the mainstem channel of all of the major tributaries in the Lower Eel/Van Duzen River watershed, and in the mainstem of the Lower Eel downstream of about Alton, California. Riparian habitat has somewhat rebounded from past large flood events (e.g., 1964). However, even where streamside canopy cover is good, it consists of open and hardwood dominated riparian forest conditions. Mature coniferous riparian forests provide the size and amount of large wood necessary for coho salmon rearing habitat, shade streams, reduce sediment delivery, and provide terrestrial subsidies. Hardwood and small conifer-dominated riparian forests provide limited large wood recruitment into the Lower Eel/Van Duzen River.

Riparian corridors in the Salt River watershed are, in places, lacking riparian vegetation; particularly the tributaries in the wildcat geological formation. The trans-delta reaches of the Salt River tributaries, such as in Reas Creek, tend to have little to no riparian vegetation.

Sudden oak death (SOD) is an exotic pathogen affecting almost all native species of plants, shrubs, and trees. SOD is in epidemic stages in the population area and upstream of the population area. Because the SOD pathogen is water borne and can travel downstream in watercourses, the likelihood of SOD outbreaks in the population area are high. One of the largest areas infected by SOD occurs near Redway and is growing at a very fast rate. SOD was recently (2011) detected in tributaries to the Van Duzen River.

Impaired Water Quality

Impaired water quality, specifically high water temperature, poses a high stress to all rearing life stages and a medium stress to eggs. The Lower Eel River and the Larabee Creek watershed are listed as impaired for elevated temperature under section 303(d) of the Clean Water Act. Water temperature in the Lower Eel/Van Duzen River and its tributaries approach lethal levels in a number of stream reaches and is stressful in most others, and severely limits the amount of habitat available to rearing coho salmon. An airborne thermal infrared remote sensing study of the main channel, as well as in-water monitoring, indicate water temperature is near lethal levels for rearing coho salmon in most of the mainstem of the Lower Eel River (USEPA 2007b).

However, modeling efforts show these water temperatures are only marginally higher than they would be with full riparian cover; because the mainstem of the Lower Eel is naturally very wide, much of it was likely not shaded even before the 1800s (USEPA 2007b). Tributaries in the coastal zone such as Salt River are important because of their cold water contribution to the mainstem. Temperature problems in the tributaries were attributed to inadequate shading due to removal of riparian vegetation, and to excess sediment which widens streams, fills pools, and makes the river shallower. The loss of deep pools removes cooler-water refugia, which coho salmon could use to persist in areas with otherwise uninhabitable water temperatures. Many tributaries in the population have suitable water temperature as evidenced by the monitoring being conducted by both HRC and GDRC related to their HCP's.

Additionally, water quality problems from agricultural runoff have been identified in the Salt River watershed and conductivity, turbidity, and dissolved oxygen may be limiting factors in the middle sub-basin. Therefore, water quality is likely a limiting factor, specifically nutrient enrichment, excess sediment, elevated water temperatures, and low dissolved oxygen.

Increased Disease/Competition/Predation

Competition and predation from non-native California roach and Sacramento pikeminnow poses a high stress to fry and juveniles and a very high stress to smolts. These invasive species have the greatest impact in watersheds such as the Lower Eel/Van Duzen, with the most impaired habitat conditions, because the altered conditions favor production of these non-native species over indigenous salmonids.

Lack of Floodplain and Channel Structure

The lack of floodplain and channel structure is a high stress for juveniles, smolts, adults, and fry; and a medium stress for eggs. The floodplains and channels have been degraded due to excessive sediment loads, coupled with the paucity of large wood and riparian vegetation. Except for one reach with fair levels of embeddedness, all surveyed reaches of Yager Creek and smaller tributaries to the Eel River have excessive embeddedness. These same surveyed reaches have mostly fair (2.01 to 3 ft.) or poor (<2 ft.) pool depths and mostly poor pool frequencies (<35 percent by length). Levees in the Lower Eel River from Fortuna to the Pacific Ocean significantly alter floodplain and channel structure (through altered connectivity) and significantly reduce the size of the estuary. Habitat complexity, via pools, large wood cover, and floodplains, is essential for juvenile rearing to optimize forage, avoid predation, and access thermal and velocity refuges.

Altered Hydrologic Function

Altered hydrologic function (the timing and availability of water) poses an overall medium stress to coho salmon. Base flows in tributaries to the Lower Eel/Van Duzen River are affected by rural and urban water withdrawals. Due to all the land changes that have occurred since the

1800s, the way that water runs off the land is altered compared to historic conditions; overall, peak flows are higher and base flows are lower. The Potter Valley Project diverted as much as 160,000 acre feet of water from the Eel River and into the Russian River prior to 2002 (FERC 2000). After 2002, the diversion has decreased depending on the water year type.

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 to fish passage do not present a major impediment to restoration and recovery of the Lower Eel/Van Duzen River coho salmon population, as reflected by their low stress ranking. Tidegates that separate the estuary from the river can be problematic because they can block juvenile access and therefore make it more difficult for them to utilize the estuary. In addition, tide gates reduce the tidal prism of the estuary which is important for maintaining water quality, channel maintenance, and overall estuarine function. Many tributaries to the mainstem Eel River become disconnected and inaccessible in the summer months due to sediment deposition and the resulting sub-surface flows. If the tributaries were accessible, they may provide refuge which is very limited in the Eel River mainstem reaches.

Adverse Hatchery-Related Effects

There are no operating hatcheries in the Lower Eel/Van Duzen River population area. Hatchery-origin coho salmon may stray into the Lower Eel/Van Duzen 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).

26.6 Threats

Table 26-3. Severity of threats affecting each life stage of coho salmon in the Lower Eel and Van Duzen rivers. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

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

[1]Key limiting threats and limited life stages

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are channelization/diking and dams/diversions.

Roads

Roads constitute a very high threat across all life stages. Road density is very high (>3 miles per square mile) in the Lower Eel/Van Duzen River sub-basin. Unpaved roads deliver large volumes of sediment to stream channels. Roads also alter the hydrology of stream systems resulting in higher peak flows and lower summer base flows. Unregulated road construction associated with marijuana cultivation contributes to the very high threat rankings of roads in this population.

Channelization/Diking

Channelization and diking is identified as high threat in the population area. The existence of extensive channelization and diking in the Lower Eel River, tributaries to the Eel River, especially in the Salt River watershed, and the estuary severely limits the function of the floodplain and estuary for production of coho salmon. For example, Reas Creek is contained in levees the entire length across the delta, and realigned with two 90 degree turns. The channelization and lengthening of the trans-delta reach of Reas Creek is suspected of causing problems related to sediment deposition and discharge within Reas Creek as well as in the Salt River. Williams Creek was leveed in 1999 from the mouth to 2,500 feet upstream. In addition, Williams Creek was diverted from the Salt River and now drains to the Eel River through the Old River, resulting in altered hydrology and sediment transport in the Salt River. Rohner Creek has been realigned and channelized through the City of Fortuna.

In 2006, the CDFG received permits to expand, raise, and widen the levee network in the vicinity of the Eel River Wildlife Area to address breaches of the levees which occurred in 1994 and 1998. The levees were enhanced to ensure that tidal action would not compromise the integrity of the levees and also to assist in keeping freshwater impoundments from being exposed to saltwater. Levees in the Eel River estuary are known to reduce the extent and intensity of tidal flushing which causes sedimentation and the resulting widening and reductions in depth. The Eel River estuary appears to be shrinking due to continued sedimentation and the number of species it harbors has apparently diminished from historic numbers (Puckett 1977). The exchange of tide water scours sediment and transports it to the ocean which helps maintain the depths of estuarine channels. In the late 1890s a court agreed that the construction of levees and the ensuing reduction of the tidal prism were responsible for the filling of the channels near the Salt River area (CDFG 2010b).

The Humboldt County Resource Conservation District is the lead agency on the Salt River Ecosystem Restoration Project. In the late 1800s the Salt River was a functioning river and large enough to accommodate small ocean vessels and steamers. At Port Kenyon, the Salt River was approximately 200 feet wide and 15 feet deep. Now the Salt River is so small that a person could jump over it. Over time fine sediments have eroded from the surrounding Wildcat Hills into the tributaries and deposited in the Salt River channel. Vegetation has sprouted up in the channel which traps more sediment, impedes fish passage and increases flooding on the surrounding agricultural lands, roads, and residences.

Reducing the amount of sediment that reaches the tributaries and the Salt River is one step in creating an open and functioning channel. This ecosystem-scale project includes a large tidal wetland restoration component that will create a succession of biologically rich and diverse tidal wetland habitats, including transitional wetlands and adjacent uplands as part of a sustainable estuary system. To offer some insight on the level of sedimentation involved, consider the following: in hydrologic year 2010 the annual suspended sediment yield from the Francis Creek watershed was 38 million pounds. This equates to an annual suspended sediment yield of 6,091 tons/sq. mile. By comparison, the sediment impaired Freshwater Creek and Elk River watersheds in Humboldt County have yields of 300-600 tons/sq. mile/year, and the Eel River carries 4,330 tons of sediment/sq. mile/year (Buffleben 2009).

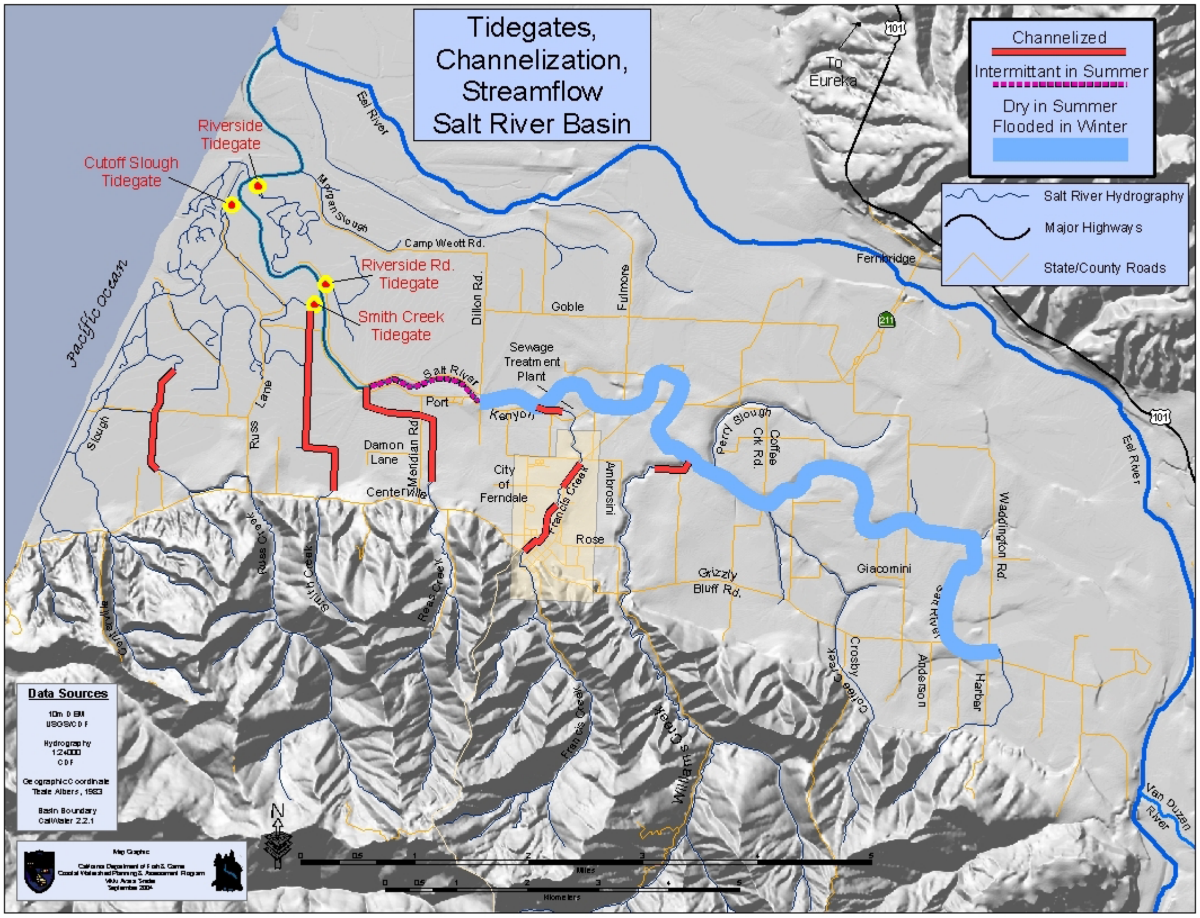

Figure 26-3. A map of tide gates and channelization in the Salt River watershed.

Figure 26-4. Photo of a tidegate on Cutoff Slough in the Lower Eel River estuary.

Dams/Diversions

Dams and diversions pose a medium threat to smolts and a high threat to all other life stages of coho salmon. Scott Dam and the Potter Valley Project altered the mainstem hydrologic regime under which the Lower Eel/Van Duzen River coho salmon evolved. In addition, localized water diversions for rural residential and agricultural operations reduce streamflow during juvenile rearing periods. Tide gates restrict juvenile coho salmon use of the estuary and levees reduce the tidal prism necessary for flushing the high sediment load to the ocean (Figure 26-3 and Figure 26-4).

Marijuana cultivation has become abundant in many areas of the SONCC coho salmon recovery domain. Although the extent of marijuana production is unknown, the water diversion required to support these plants appears to be 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).

Timber Harvest

Timber harvest is a high threat to most life stages. Many of the changes that have occurred to instream and riparian conditions in the Lower Eel/Van Duzen River reflect legacy effects of more intensive harvest from previous decades. However, given the percentage of the watershed that is privately owned by timber companies and actively managed as such, future timber harvest activities will continue to exacerbate the stresses caused by legacy timber harvest activities. Nearly half of the sub-basin has been logged on over 35 percent of its area, and continuing harvest on these areas has the potential to affect high IP-areas downstream by contributing to sediment deposition and reducing sources of large wood. HCP holders in the population area (HRC and GDRC) are expected to help reduce the threat of timber harvest through those conservation measures and mitigations developed for each plan.

Forest lands in the Van Duzen watershed are being cleared and graded to create new marijuana cultivation sites. In many cases the land disturbance and clearing of trees is not regulated, and likely contributes fine sediment to channels already burdened by sediment problems. Land clearing for marijuana operations also may result in a loss of shade and wood recruitment.

High Severity Fire

Fires pose a medium threat to all life stages. The dense understory vegetation throughout the population area increases the probability for high severity fires to alter sedimentation processes as well as riparian vegetation characteristics. Most of the population area is within the coastal influence and dominated by redwoods. Because only a fraction of the population area is subject to high severity fire, it was not considered a significant threat.

Invasive/Non-native Species

Sacramento pikeminnow thrive in the degraded habitat conditions in the Lower Eel/Van Duzen River, resulting in significant levels of competition and predation on coho salmon. The non-native Sacramento pikeminnow is a threat to fry, juveniles, and smolts because they compete with and prey on the young coho salmon. Sacramento pikeminnow were introduced to Lake Pillsbury in 1979 (Brown and Moyle 1997), and has spread throughout all accessible reaches of the Eel River watershed. The warm water temperatures in the Eel River and Lake Pillsbury allow this predator to thrive in this system. The widespread distribution and success of the Sacramento pikeminnow makes eradication extremely difficult.

Cordgrass (*Spartina densiflora*) is an introduced and invasive salt marsh plant that has spread across the estuarine wetlands. *S. densiflora* tends to displace native marsh species, can exacerbate sediment accumulations in wetlands, and may cause other undesirable changes to the estuarine ecosystem. Eradication projects have cleared areas of invasive cordgrass around Humboldt Bay. No efforts have been planned to control *S. densiflora* in the Eel River estuary. There are also a number of other invasives including non-native eel grass and reed-canary grass that may affect the success of restoration actions.

Agricultural Practices

Grazing occurs throughout the population area and increases sediment generation and delivery. In addition, much of the estuary is directly influenced by agriculture in historical tidelands. Agricultural land makes up 28 percent of the Lower Eel River sub-basin, and increases in area closer to the mouth (Downie and Gleason 2007). Livestock have unrestricted access to many of the Lower Eel River tributaries and estuary sloughs, resulting in stream bank erosion. Much of the Lower Eel River sub-basin has been cleared of riparian vegetation to create pastureland for cattle, and waste from the dairy industry has affected water quality. In the past, waste from dairies would flow into low lying areas, which are often former slough channels. During times of heavy precipitation, these often became active sloughs that would transport waste into the estuary.

Grazing cattle is common in many of the tributaries and grassy openings throughout the population area, including the valley bottoms and ridges of the mainstem Eel and Van Duzen rivers. Grazing beef or dairy cattle is the most common land use in the lower sub-basin and estuary (CDFG 2010b), where rich grasslands thrive in the delta of the Eel and Van Duzen rivers. Although this area has rich grasslands which can support a significant cattle industry, the effects of cattle grazing are very apparent. There are only a few areas with riparian exclusion fencing and livestock are commonly allowed unrestricted access to the creek.

Marijuana may be the primary crop cultivated in the area, and it has been implicated as a source of excessive nutrient inputs to streams. An excess of nutrients can degrade water quality by fueling toxic algal blooms that increase biological demand either through respiration or decomposition. Algae blooms are naturally occurring, however, excess nitrogen can increase the extent and severity of effects (i.e., decreased dissolved oxygen). The Van Duzen River has chronic issues with toxic blooms of blue-green algae. Blue green algal blooms are related to excess nitrogen and poor water quality conditions.

Urban/Residential/Industrial Development

Urban/residential/industrial development is a high threat because much of the watershed with high IP value is located in and around the cities of Ferndale and Fortuna. Future growth of this area is likely, with northerly migration from southern metropolitan areas due to declining water supplies. In addition, further rural residential development is likely as large agricultural holdings are subdivided into smaller ranches. All of this will combine to further increase road building, land clearing, and other development. Marijuana production is also common in many urban and residential areas.

When flows are sufficiently high, the Eel River floods the treatment ponds of the Fortuna Wastewater Treatment Plant (Downie and Gleason 2007). The Fortuna Wastewater Treatment Plant is working on raising the elevation of the surrounding levees to prevent flooding into the treatment ponds. In the winter months, the effluent from the Ferndale wastewater treatment plant is directed into Francis Creek, which historically had sufficient flow to meet dilution requirements year round. Sediment deposition has reduced the cross sectional area of the creek and now the wastewater treatment plant effluent exceeds one percent of receiving flows during winter months, which is a violation of Waste Discharge Requirements. The wastewater treatment facility has accumulated 241 water quality violations since 1996 (Spencer Engineering 2004). Improvements to the existing facility have been made in recent years and the number of water quality violations has declined. In addition, the City of Ferndale and the NCRWQCB have agreed on a design for tertiary treatment of effluent which will result in an improvement to water quality conditions in Francis Creek and the Salt River.

Treatment and percolation ponds are also constructed at the Town of Scotia to ensure that effluents from the mill and town site are allowed to settle and percolate into the sub-surface zones of the gravel bar to comport with NCRWQCB requirements, which does not allow treated or untreated effluents to be discharged into the Eel River. As high winter flow regimes approach in the fall, the percolation ponds are dismantled and allowed to be discharged into the Eel River when flows become high enough to capture the ponds.

Mining/Gravel Extraction

Past gravel mining in the Lower Eel sub-basin likely contributed to braiding and flattening of the Eel River between the confluence with the Van Duzen River to one mile downstream of Fernbridge (Humboldt County 1992). A shallow, wide channel provides less cover from predation, less food, and higher water temperatures for juvenile fish as the channel is often decoupled from riparian vegetation. Braiding reduces water depth and can become a migration barrier for adult fish, sometimes leading to stranding on shallows and mortality. A significant level of gravel extraction occurs in the Lower Eel/Van Duzen River, but is conducted with State and Federal oversight. The medium threat ranking reflects sensitivity of the channel to additional disturbances (i.e., lack of floodplain and channel structure). However, gravel extraction has been used successfully to address some of the problems associated with the high sediment load in the Lower Eel/Van Duzen River including an adult migration barrier that occasionally develops at the Van Duzen/Eel River confluence. Gravel mining methodologies have evolved over time to accommodate the narrowing and deepening of channels by using wet trenching techniques.

Climate Change

Climate change poses a medium threat to this population. The impacts of climate change in this region will have the greatest impact on juveniles, smolts, and adults. Although the current climate is generally cool, modeled regional average temperature shows a moderate increase over the next 50 years (see Appendix B for modeling methods). Average temperature could increase by up to 1.6 °C in the summer and by 1 °C in the winter. Annual precipitation in this area is predicted to trend downward over the next century. Snowpack in upper elevations of the Eel River basin, upstream of the Lower Eel and Van Duzen river sub-basin, will decrease with changes in temperature and precipitation (California Natural Resources Agency 2009). Increasing temperatures and changes in the amount and timing of precipitation and snowmelt will impact water quality and hydrologic function in the summer and winter. Rising sea level may also impact the quality and extent of wetland rearing habitat in the estuary. Wetlands could migrate inland with rising sea level but there are few places that are not armored and would allow for this migration and sea level may rise too quickly for adaptation of wetlands. Overall, the range and degree of variability in temperature and precipitation is likely to increase in all populations. Also, with all populations in the ESU adults will be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (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.

Hatcheries

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

Road-stream Crossing Barriers

Barriers pose a low threat. However, there are five known barriers to fish habitat, including one on Francis Creek at Port Kenyon road, two on Barber Creek, and two more on an unnamed tributary extending north from the mainstem west of Carlotta, CA.

A culvert on Mill Creek does not meet CDFW and NMFS fish passage guidelines. Other creeks with possible fish passage restrictions include Palmer, Dean, Price, and Adams.

26.7 Recovery Strategy

The degraded condition of the Lower Eel/Van Duzen River population area, combined with the depressed coho salmon population size and restricted distribution increases the risk of extinction of this important, coastal coho salmon population. Most of the population area is in private ownership, much of the high IP areas are in developed areas, and predation and competition from non-native Sacramento pikeminnow severely limits juvenile survival. Restoration activities that improve estuarine habitat, increase floodplain connectivity, reduce sediment input, increase riparian vegetation, increase summer instream flows, and reduce the influence of Sacramento pikeminnow should be immediately implemented. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 26-4 on the following page lists the recovery actions for the Lower Eel/Van Duzen River population.

Table 26-4. Recovery action implementation schedule for the Lower Eel/Van Duzen River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID / *Step ID*	Target	KLS/T	Strategy / *Step Description*	Action Description	Area	Priority
SONCC-LEVR.1.1.13	Estuary	Yes	Improve connectivity of tidally-influenced habitat	Remove or replace tidegates	Areas of estuary where coho salmon would benefit immediately	2a
SONCC-LEVR.1.1.13.1			*Inventory tidegates and develop a plan that prioritizes removal or replacement. Research possible incentive opportunities and work with landowners to replace tidegates with fish friendly versions*			
SONCC-LEVR.1.1.13.2			*Remove or replace tidegates as described in the plan*			
SONCC-LEVR.1.1.66	Estuary	Yes	Improve connectivity of tidally-influenced habitat	Remove or replace tidegates	Population wide	2b
SONCC-LEVR.1.1.66.1			*Inventory tidegates and develop a plan that prioritizes removal or replacement. Research possible incentive opportunities and work with landowners to replace tidegates with fish friendly versions*			
SONCC-LEVR.1.1.66.2			*Remove or replace tidegates as described in the plan*			
SONCC-LEVR.1.1.12	Estuary	Yes	Improve connectivity of tidally-influenced habitat	Set back or remove dikes or levees	Mid-channel islands such as Cock Robin Island, Salt River Slough, Mosley Slough, and McNulty Slough	2a
SONCC-LEVR.1.1.12.1			*Assess and prioritize levees for setback or removal*			
SONCC-LEVR.1.1.12.2			*Remove or setback levees, guided by assessment results*			
SONCC-LEVR.1.1.65	Estuary	Yes	Improve connectivity of tidally-influenced habitat	Set back or remove dikes or levees	Population wide	2b
SONCC-LEVR.1.1.65.1			*Assess and prioritize levees for setback or removal*			
SONCC-LEVR.1.1.65.2			*Remove or setback levees, guided by assessment results*			
SONCC-LEVR.1.2.38	Estuary	Yes	Improve estuarine habitat	Assess and improve estuary and tidal wetland habitat	Estuary	2a
SONCC-LEVR.1.2.38.1			*Identify parameters to assess condition of estuary and tidal wetland habitat*			
SONCC-LEVR.1.2.38.2			*Determine amount of estuary and tidal wetland habitat needed for population recovery and develop a plan for restoration*			
SONCC-LEVR.1.2.38.3			*Restore estuary and tidal wetland habitat guided by the plan*			

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LEVR.1.2.15	Estuary	Yes	Improve estuarine habitat	Re-connect tidal channels and wetlands	State lands including, Morgan Slough, Smith Creek, and Sevenmile Slough	2a
SONCC-LEVR.1.2.15.1	*Develop a plan to re-connect historic tidal channels and tidal wetlands as well as restore channelized tidal channels to a more natural channel form*					
SONCC-LEVR.1.2.15.2	*Re-connect tidal channels and wetlands, guided by the plan*					
SONCC-LEVR.1.2.15.3	*Restore channelized tidal channels to a more natural channel form, guided by the plan*					
SONCC-LEVR.1.2.16	Estuary	Yes	Improve estuarine habitat	Restore brackish wetlands	McNulty Slough and Salt River, and areas of estuary where coho salmon would benefit immediately	2a
SONCC-LEVR.1.2.16.1	*Develop a plan for the conversion of freshwater wetlands to functioning tidal habitat*					
SONCC-LEVR.1.2.16.2	*Convert formally brackish wetlands from freshwater wetlands back to functioning tidal habitat, guided by the plan*					
SONCC-LEVR.1.2.14	Estuary	Yes	Improve estuarine habitat	Restore salt marsh and tidal sloughs	State lands including, Hawk Slough, Hogpen Slough, Smith Creek Cutoff Slough, and Sevenmile Slough, and areas of estuary where coho salmon would benefit immediately	2a
SONCC-LEVR.1.2.14.1	*Develop a management plan in the Eel River estuary to restore salt marsh and tidal slough habitat*					
SONCC-LEVR.1.2.14.2	*Restore salt marsh and tidal slough habitat, guided by the plan*					
SONCC-LEVR.2.1.36	Floodplain and Channel Structure	Yes	Increase channel complexity	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately, particularly Yager and Lawrence creeks	2a
SONCC-LEVR.2.1.36.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-LEVR.2.1.36.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-LEVR.2.1.72	Floodplain and Channel Structure	Yes	Increase channel complexity	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2b
SONCC-LEVR.2.1.72.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-LEVR.2.1.72.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LEVR.2.2.45	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Re-connect channel to existing off-channel ponds, wetlands, oxbows, and side channels and restore features if needed	Yager Creek (upstream of Lawrence Creek)	2a
SONCC-LEVR.2.2.45.1	*Develop a plan to reconnect channel to old oxbows on Yager Creek (upstream of Lawrence Creek)*					
SONCC-LEVR.2.2.45.2	*Reconnect channel to old oxbows on Yager Creek, guided by the plan*					
SONCC-LEVR.2.2.47	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Reconnect floodplains, wetlands, oxbows, and off channel habitat	Lawrence Creek	2a
SONCC-LEVR.2.2.47.1	*Develop a plan to reconnect old oxbows, side channels, and off channel habitats to Lawrence Creek*					
SONCC-LEVR.2.2.47.2	*Reconnect old oxbows, side channels, and off channel habitats to Lawrence Creek, guided by the plan*					
SONCC-LEVR.3.1.20	Hydrology	No	Improve flow timing or volume	Educate stakeholders	Population wide	2a
SONCC-LEVR.3.1.20.1	*Provide education and training on conserving water while diverting*					
SONCC-LEVR.3.1.20.2	*Provide incentives to landowners to reduce water consumption*					
SONCC-LEVR.3.1.48	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	2a
SONCC-LEVR.3.1.48.1	*Identify and cease unauthorized water diversions*					
SONCC-LEVR.3.1.74	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2b
SONCC-LEVR.3.1.74.1	*Identify and cease unauthorized water diversions*					
SONCC-LEVR.14.2.4	Invasive, Non-native Species	No	Reduce predation and competition	Reduce abundance of Sacramento pikeminnow	Population wide	2a
SONCC-LEVR.14.2.4.1	*Determine the effectiveness of various pikeminnow suppression techniques and develop experimental control methods. Develop a plan that identifies watersheds suitable for experimental pikeminnow suppression*					
SONCC-LEVR.14.2.4.2	*Suppress Sacramento pikeminnow, guided by the suppression plan*					
SONCC-LEVR.2.1.17	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately	2b
SONCC-LEVR.2.1.17.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-LEVR.2.1.17.2	*Place instream structures, guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LEVR.2.1.71	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2c
SONCC-LEVR.2.1.71.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-LEVR.2.1.71.2	*Place instream structures, guided by assessment results*					
SONCC-LEVR.3.1.52	Hydrology	No	Improve flow timing or volume	Determine effects of marijuana cultivation	Population wide	2b
SONCC-LEVR.3.1.52.1	*Assess cumulative effects (e.g., flow, water quality) of marijuana cultivation*					
SONCC-LEVR.3.1.52.2	*If needed, develop plan to reduce effects of marijuana cultivation*					
SONCC-LEVR.3.1.52.3	*Implement plan*					
SONCC-LEVR.26.1.64	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2b
SONCC-LEVR.26.1.64.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-LEVR.8.1.77	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	2d
SONCC-LEVR.8.1.77.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-LEVR.8.1.77.2	*Decommission roads, guided by assessment*					
SONCC-LEVR.8.1.77.3	*Upgrade roads, guided by assessment*					
SONCC-LEVR.8.1.77.4	*Maintain roads, guided by assessment*					
SONCC-LEVR.10.1.51	Water Quality	No	Reduce water temperature, increase dissolved oxygen	Increase cool water and thermal refugia	All areas where coho salmon would benefit immediately	2b
SONCC-LEVR.10.1.51.1	*Assess sources of cool water and develop techniques to protect and/or improve cool water habitat*					
SONCC-LEVR.10.1.51.2	*Add LWD, boulders, or sources of structure as guided by assessment to augment habitat at cool water sources*					
SONCC-LEVR.10.1.51.3	*Increase riparian vegetation and shading at sources of cool water*					
SONCC-LEVR.10.1.67	Water Quality	No	Reduce water temperature, increase dissolved oxygen	Increase cool water and thermal refugia	Population wide	2d
SONCC-LEVR.10.1.67.1	*Assess sources of cool water and develop techniques to protect and/or improve cool water habitat*					
SONCC-LEVR.10.1.67.2	*Add LWD, boulders, or sources of structure as guided by assessment to augment habitat at cool water sources*					
SONCC-LEVR.10.1.67.3	*Increase riparian vegetation and shading at sources of cool water*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-LEVR.8.1.49	Sediment	No	Reduce delivery of sediment to streams	Reduce erosion	All streams where coho salmon would benefit immediately	2c
SONCC-LEVR.8.1.49.1		*Identify and cease unauthorized road building or grading*				
SONCC-LEVR.8.1.76	Sediment	No	Reduce delivery of sediment to streams	Reduce erosion	Population wide	2d
SONCC-LEVR.8.1.76.1		*Identify and cease unauthorized road building or grading*				
SONCC-LEVR.8.1.5	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All areas where coho salmon would benefit immediately	2c
SONCC-LEVR.8.1.5.1		*Assess and prioritize road-stream connection, and identify appropriate treatments*				
SONCC-LEVR.8.1.5.2		*Decommission roads, guided by assessment*				
SONCC-LEVR.8.1.5.3		*Upgrade roads, guided by assessment*				
SONCC-LEVR.8.1.5.4		*Maintain roads, guided by assessment*				
SONCC-LEVR.5.1.46	Passage	No	Improve access	Remove barrier	Port Kenyon	3a
SONCC-LEVR.5.1.46.1		*Remove barrier on Port Kenyon Creek*				
SONCC-LEVR.5.1.37	Passage	No	Improve access	Reduce sediment barriers	Tributary confluences with mainstem Eel and Van Duzen rivers where coho salmon would benefit immediately	3b
SONCC-LEVR.5.1.37.1		*Inventory and prioritize barriers formed by alluvial deposits*				
SONCC-LEVR.5.1.37.2		*Remove alluvial deposits, construct low flow channels, or reduce stream gradient to provide fish passage at all life stages*				
SONCC-LEVR.5.1.75	Passage	No	Improve access	Reduce sediment barriers	Population wide	3d
SONCC-LEVR.5.1.75.1		*Inventory and prioritize barriers formed by alluvial deposits*				
SONCC-LEVR.5.1.75.2		*Remove alluvial deposits, construct low flow channels, or reduce stream gradient to provide fish passage at all life stages*				
SONCC-LEVR.7.1.3	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Population wide	3b
SONCC-LEVR.7.1.3.1		*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)*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LEVR.7.1.2	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	High IP sub watersheds	3b
SONCC-LEVR.7.1.2.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-LEVR.7.1.2.2	*Thin, or release conifers, guided by the plan*					
SONCC-LEVR.7.1.2.3	*Plant conifers, guided by the plan*					
SONCC-LEVR.7.1.1	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve long-range planning	Population wide	3c
SONCC-LEVR.7.1.1.1	*Review General Plan or City Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*					
SONCC-LEVR.7.1.1.2	*Develop watershed-specific guidance for managing riparian vegetation*					
SONCC-LEVR.10.2.42	Water Quality	No	Reduce pollutants	Reduce point- and non-point source pollution	All streams where coho salmon would benefit immediately	3c
SONCC-LEVR.10.2.42.1	*Identify point and nonpoint pollution sources throughout the watershed*					
SONCC-LEVR.10.2.42.2	*Implement strategy to minimize pollution, guided by the assessment*					
SONCC-LEVR.10.2.68	Water Quality	No	Reduce pollutants	Reduce point- and non-point source pollution	Population wide	3d
SONCC-LEVR.10.2.68.1	*Identify point and nonpoint pollution sources throughout the watershed*					
SONCC-LEVR.10.2.68.2	*Implement strategy to minimize pollution, guided by the assessment*					
SONCC-LEVR.10.7.63	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All areas where coho salmon would benefit immediately	3c
SONCC-LEVR.10.7.63.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-LEVR.10.7.63.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-LEVR.10.7.70	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-LEVR.10.7.70.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-LEVR.10.7.70.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-LEVR.7.1.43	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase regulatory oversight	Van Duzen River	3d
SONCC-LEVR.7.1.43.1	*Ensure channel modifications are permitted and reviewed*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LEVR.16.1.22	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-LEVR.16.1.22.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-LEVR.16.1.22.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-LEVR.16.1.23	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-LEVR.16.1.23.1	*Determine actual fishing impacts*					
SONCC-LEVR.16.1.23.2	*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-LEVR.16.2.24	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-LEVR.16.2.24.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-LEVR.16.2.24.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-LEVR.16.2.25	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-LEVR.16.2.25.1	*Determine actual impacts of scientific collection*					
SONCC-LEVR.16.2.25.2	*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-LEVR.8.1.9	Sediment	No	Reduce delivery of sediment to streams	Improve grazing practices	Ferndale and Bridgeville HSAs	3d
SONCC-LEVR.8.1.9.1	*Develop educational materials for landowners that encourage retention of riparian vegetation*					
SONCC-LEVR.8.1.9.2	*Develop riparian buffer ordinance for grazing and agriculture*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-LEVR.8.1.44	Sediment	No	Reduce delivery of sediment to streams	Improve land management practices	Van Duzen River	3d
SONCC-LEVR.8.1.44.1		*Identify and cease all unauthorized land clearing and grading associated with marijuana cultivation*				
SONCC-LEVR.8.1.6	Sediment	No	Reduce delivery of sediment to streams	Improve regulatory mechanisms	Population wide	3d
SONCC-LEVR.8.1.6.1		*Develop grading ordinance for maintenance and building of private roads that minimizes the effects to coho*				
SONCC-LEVR.8.1.7	Sediment	No	Reduce delivery of sediment to streams	Improve regulatory mechanisms	Population wide	3d
SONCC-LEVR.8.1.7.1		*Develop regulatory mechanisms to limit off-road use of the floodplain and stream channel*				
SONCC-LEVR.8.1.11	Sediment	No	Reduce delivery of sediment to streams	Reduce risk of catastrophic fire	Population wide	3d
SONCC-LEVR.8.1.11.1		*Assess fire hazard and risk*				
SONCC-LEVR.8.1.11.2		*Promote appropriate treatment to reduce high severity fire hazard*				

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