46. Upper Mainstem Eel River Population

Interior Eel River Diversity Stratum

Non-Core 2, Potentially Independent Population

Recovery criteria: 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival

Habitat likely available to support all life stages

361 mi^2 watershed (82% Federal ownership)

54 IP-km (34 IP-mi.) (27% High)

Dominant Land Uses are Recreation and Agriculture

Key Limiting Stresses are 'Barriers' and 'Altered Hydrologic Function'

Key Limiting Threats are 'Dams/Diversions' and 'Roads'

Highest Priority Recovery Actions

• Screen all water diversions • Reduce abundance of Sacramento pikeminnow • Increase large woody debris (LWD), boulders, and other instream structure	• Identify and enhance non-natal rearing sites for juvenile coho salmon • Reduce road-stream hydrologic connection • Determine the effects of marijuana cultivation and minimize if necessary

46.1 History of Habitat and Land Use

Land use activities in the Upper Mainstem Eel River include timber harvest, hydropower production, agriculture, recreation, limited livestock operations, and residence construction.

The Potter Valley Project's 1908-built Cape Horn and 1922-erected Scott hydropower production dams represent the most significant Upper Mainstem Eel River coho salmon habitat alterations and precipitated the loss of most of this population's historic habitat.

Built without a fish ladder, Scott Dam blocks a significant amount of potential anadromous salmonid habitat. Estimates of the extent of habitat lost by construction of Scott Dam were made by both VTN (1982) and Lee and Baker (1975). VTN conducted detailed stream surveys that documented 35.7 miles of major channels in and above Lake Pillsbury that would have been historically suitable for Chinook salmon or steelhead spawning and rearing. An additional 22.7 miles of minor channels were considered suitable for steelhead, resulting in a total of 58.4 miles for that species. Lee and Baker (1975) reported "as much as 50 miles" for Chinook spawning, and "more than 75 miles" for steelhead spawning. Most likely, the extent of habitat lost for coho salmon is most similar to the extent of habitat lost for Chinook salmon. The 1922-built Cape Horn Dam fish ladder was ineffective until more recent renovations in 1987. With an approximate 75,000 acre-feet (AF) capacity, Lake Pillsbury is situated upon, and restricts access to, most of the high IP reaches present in the population area.

From 1992 to 2004, up to approximately 160,000 acre-feet of Eel River water was annually diverted into the East Fork of the Russian River for hydropower production and agricultural uses. From 2007-2012 the Potter Valley Project annually diverted approximately 22% of the estimated unimpaired flow at the point of diversion (i.e., Cape Horn Dam), with an average diversion of 77,000 acre-feet (Kubicek 2013). Until 2004, flows released downstream of Cape Horn Dam were approximately 3 cubic feet per second (cfs) during most of the summer. In 2004, the Federal Energy Regulatory Commission issued an order requiring Pacific Gas and Electric (PG&E) to implement an instream flow regime consistent with the Reasonable and Prudent Alternative in the NMFS 2002 Biological Opinion. The new flow requirement increased the minimum Cape Horn Dam release flows and incorporated within-year and between-year variability. Project releases generally approximate unimpaired flows during the summer and fall, but may deviate from the natural hydrograph during the winter and early spring as runoff is impounded to fill the Lake Pillsbury reservoir. Minimum flows are dependent on a number of factors and formulas, including cumulative inflow into Lake Pillsbury and classification (e.g., wet, dry) of the current and previous water year.

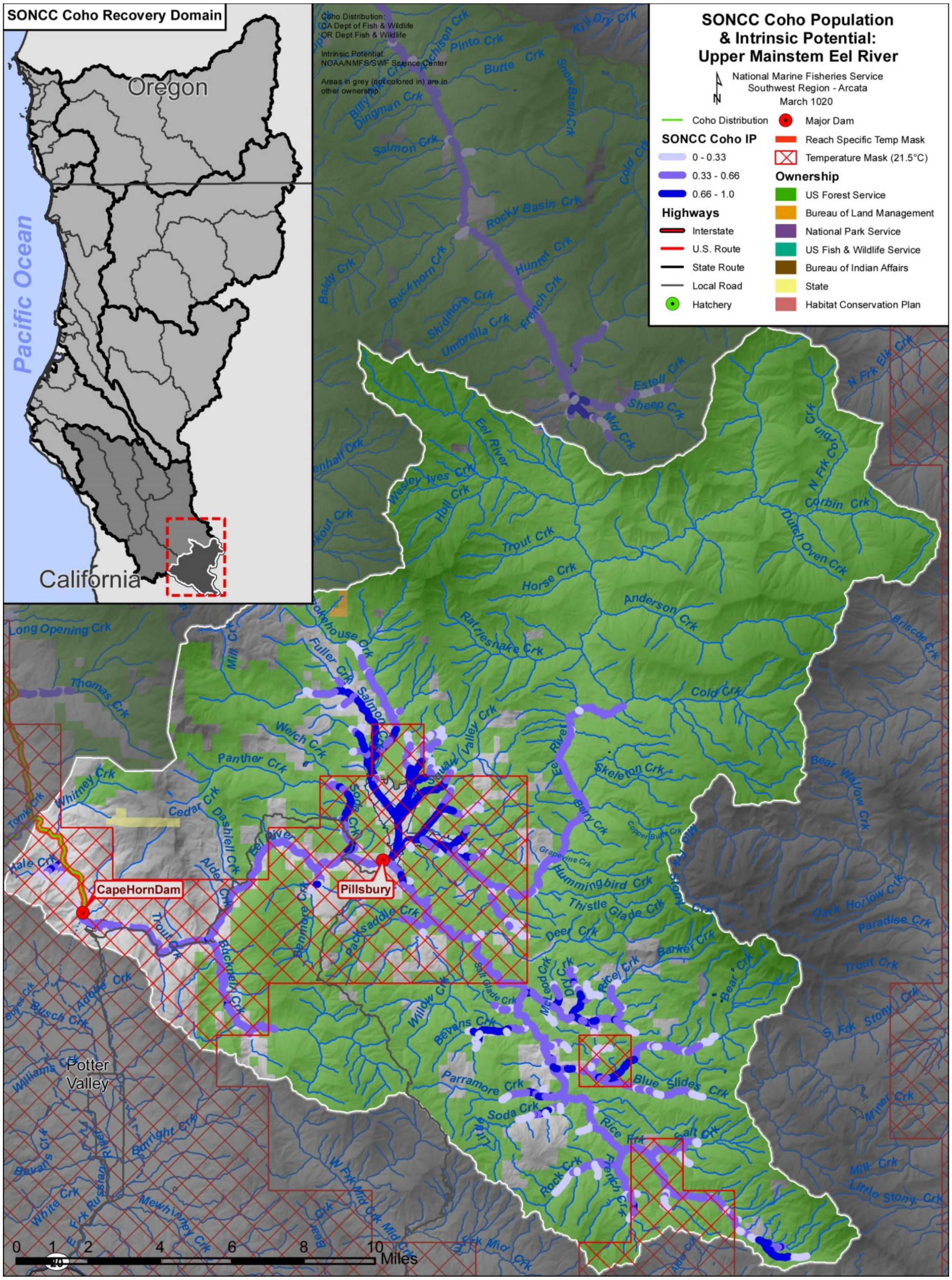

Figure 46-1. The geographic boundaries of the Upper Mainstem Eel River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), a temperature mask (indicating areas that are inherently too warm for rearing coho salmon), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Interior Eel River diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

The 1964 flood caused significant sedimentation within the Eel River and its tributaries, by filling in many pools, destroying riparian vegetation, and widening channels. Timber harvest activities were widespread and resulted in sediment transport into creeks. The preponderance of unstable landforms, high road densities, and past timber harvest have contributed to the poor habitat quality evident throughout the population area.

In 1979, predatory Sacramento pikeminnow were introduced into Lake Pillsbury (California Department of Fish and Game (CDFG) 1997b), and now occupy the entirety of the Eel River basin's accessible habitat. This predator thrives in the warmer waters created by degraded riparian forest conditions and low flow conditions. Pools which were formerly high quality refugia which had large woody debris have decreased because of increased sedimentation and degraded riparian forests. These pools and large woody structures would have provided juveniles some protection from predators.

More recently, marijuana production has become the dominant agricultural activity in the area. David Ferrell, the U.S. Forest Service's director of law enforcement offered these comments on environmental degradation brought about in Northern California by the marijuana industry. In December of 2011, Ferrell testified before the Senate Caucus on International Narcotics Control that "growers clear native vegetation, use harsh pesticides, herbicides and rodenticides and divert large amounts of water from streams and rivers", noting an average marijuana plot with 1,000 plants requires up to 5,000 gallons of water a day.

46.2 Historic Fish Distribution and Abundance

Information on historic coho salmon use of the population area is limited. Over the past half century, coho salmon have been intermittently observed, and surveys were rarely conducted. During the 1946/1947 spawning season, 47 adults were observed at the Cape Horn Dam's Van Arsdale Fisheries Station and since that time, adults have been observed on only four other occasions, including a 2010/2011 season observation (Jahn 2011). There have been no scientific or anecdotal coho salmon observations for the areas above Lake Pillsbury. Spawning habitat on the 12 mile reach between Scott and Cape Horn dams was and continues to be suitable because cool water flows out of Scott Dam. By 1964, less than 500 coho salmon were estimated to return to the Eel River above the South Fork (CDFG 1965). The current Eel River population above the South Fork is estimated to be less than 100 based upon 1989 to 1999 NMFS estimates.

Downstream of the dams, water temperature further restricts coho salmon distribution within the population area. The temperature mask data contained in Williams et al. (2006) suggests that portions of IP habitat may be too warm during the summer to support coho salmon.

Table 46-1. Tributaries with high IP reaches (IP > 0.66). (Williams et al. 2006).

Subarea	Stream Name	Subarea	Stream Name
Lake Pillsbury	Bear Creek[2]	Lake Pillsbury	North Fork Corbin Creek[2]
	Bevans Creek[2]		Packsaddle Creek[2]
	Bucknell Creek[1]		Perramore Creek[2]
	Dry Creek[2]		Rice Creek[2]

	French Creek[2]		Rice Fork[2]
	Hale Creek		Salmon Creek (and tribs.)[2]
	Little Soda Creek[2]		Salt Spring Creek[2]
	McLeod Creek[2]		Soda Creek[1]

[1] Denotes a "special tributary" as identified in the 1995 watershed analysis for this area given their relatively large size and current accessibility to anadromous salmonids.
[2] Denotes a stream that lies above Lake Pillsbury and is currently inaccessible to coho salmon.

46.3 Status of Upper Mainstem Eel River Coho Salmon

Spatial Structure and Diversity

Williams et al. (2008) determined that at least 39 coho salmon per-IP habitat km are needed (2,100 spawners total) to approximate the historical distribution of Upper Mainstem Eel River coho salmon. Currently, coho salmon are restricted to the lowermost portions downstream of Lake Pillsbury, totaling 12 IP-km (7 IP-mi) of habitat. It is important to note that all of the 12 IP-km of habitat downstream of Lake Pillsbury are covered by the temperature mask identified in Williams et al. (2006). This means the area is naturally too warm to support rearing coho salmon. Scott Dam precludes access to most of the historic population area. Downstream of Scott Dam, coho salmon are restricted to tributaries with degraded habitat and water quality. Coho salmon genetic and life history diversity is likely low due to the presumed low number of individuals.

Population Size and Productivity

Few coho salmon have been observed at the Van Arsdale Fisheries Station. As of 2011, coho salmon have been recorded only five times since the 1940s, including a high count of 47 adults in 1947 (Jahn 2011). Of the five occurrences of coho salmon at Van Arsdale, four occurrences were within the most recent decade. Coho salmon abundance within the tributaries below the dams is unknown but is presumed to be low. Coho salmon are likely present in numbers well below this high risk threshold. Scott dam limits coho salmon access to much of the population area and the remaining tributaries located downstream of the dam have degraded habitat. As a result, coho salmon productivity has been diminished. Given the extremely low population size and presumed negative population growth rate, the Upper Mainstem Eel River coho salmon population may be functionally extinct.

Extinction Risk

The Upper Mainstem Eel 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). However, because it is a non-core 2 population, the recovery target for the population is not to reduce the risk of extinction; rather, 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival.

Role in SONCC Coho Salmon ESU Viability

The Upper Mainstem Eel River population historically was a Potentially Independent population within the ESU meaning that it had a high likelihood of persisting in isolation over a 100-year time scale but was too strongly influenced by immigration from other populations to exhibit independent dynamics (Williams et al. 2006). As a Non-Core 2 population, the recovery target for the Upper Mainstem Eel River population is to ensure that the population supports offspring of adults expected to stray into the area during years of good marine survival (see Chapter 4). Support of stray adults and their offspring is needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU.

46.4 Plans and Assessments

Environmental Protection Agency

Total Maximum Daily Loads for the Eel River

In January 2006, the USEPA published the final Total Maximum Daily Loads (TMDLs) for temperature and sediment for the Middle Main Eel River and tributaries. The North Coast Regional Water Quality Control Board is required to develop measures which will result in implementation of the TMDLs in accordance with the requirements of 40 CFR 130.6.

State of California

Eel River Salmon and Steelhead Restoration Action Plan

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

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 Recovery Strategy includes analyses and recommendations regarding coho salmon recovery in the Upper Mainstem Eel River.

U.S. Forest Service and Bureau of Land Management

Watershed Analysis Report for the Upper Main Eel River Watershed (USFS and BLM 1995b)

46.5 Stresses

Table 46-2. Severity of stresses affecting each life stage of coho salmon in the Upper Mainstem Eel River. 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	Barriers	-	Very High	Very High	Very High	Very High	Very High
2	Impaired Water Quality[1]	Low	Very High	Very High[1]	Very High	High	Very High
3	Altered Sediment Supply	Very High	Very High	High	Low	Very High	Very High
8	Altered Hydrologic Function[1]	Low	Medium	High[1]	High	Low	High
4	Lack of Floodplain and Channel Structure	High	Low	High	High	High	High
5	Degraded Riparian Forest Conditions	-	High	High	High	High	High
6	Increased Disease/Predation/Competition	Low	High	High	High	Low	High
7	Impaired Estuary/Mainstem Function	-	Low	Very High	High	Medium	High
9	Adverse Fishery- and Collection-Related Effects		-	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

Based upon the type and extent of stresses and threats affecting the population as well as the limiting factors influencing productivity, it is likely that the juvenile life stage is the most limited. The limiting stresses are impaired water quality and altered hydrologic function. Water temperatures in the area are excessive and limit rearing success for all anadromous species. Diversions for marijuana production have exacerbated this problem and resulted in disconnected habitat in tributaries. Access to the most suitable juvenile summer and winter rearing habitat is currently blocked by Scott Dam, and habitat downstream of Cape Horn Dam is limited by high water temperatures and excessive sedimentation. Scott Dam also prevents adult passage, resulting in 35 to 150 miles of potential spawning habitat loss, depending on the source of information being considered. High road densities affect water quality throughout the population area by transporting excess sediment into streams. Channel complexity and a diverse estuary are important to juvenile coho salmon and are crucial for increasing the size and fitness of smolts prior to ocean entry, and improving overall marine survival success.

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. Juvenile coho salmon would be more protected against predation, competition, and warm mainstem water temperatures if there were additional refugia areas. Available information regarding habitat conditions in the Upper Mainstem Eel River indicates that none of the streams accessible to coho salmon currently are able to function as refugia. Soda Creek data suggest a number of stresses prevent it from serving as a refugia area. While Bucknell Creek may have refugia potential, such designation would be based upon 1990s-dated measurements. Small reaches in other streams that could provide a combination of suitable habitat and water temperatures may exist, but these have not been identified. Marijuana production has diminished flows in most tributaries in the population area.

Barriers

Barriers pose a very high stress for all coho salmon life stages. Scott Dam (Lake Pillsbury) precludes access to more than 80 percent of the historic population area, resulting in an estimated loss of 35 to 150 miles of potential anadromous salmonid habitat depending on the information considered. Most tributary habitats in the population area downstream of the dam may become seasonally inaccessible due to a lack of water, channel aggradation, braiding, and high temperatures. Data from Soda Creek quantifying the amount of dry channel length reveal that dry stream reaches are problematic within the lower portion of this sub-basin. There are very few known road stream crossing barriers in the population area; this stress was rated very high due to Scott Dam and the amount of habitat that is no longer accessible.

Impaired Water Quality

Impaired water quality is a high or very high stress for most life stages. Although the benthic macroinvertebrate (IBI) score is rated as good to very good in the upper sub-basin (indicating little or no water quality contamination and good dissolved oxygen levels), stream temperature for summer rearing is poor throughout most of the population area. Extensive water quality monitoring by the Humboldt County Resource Conservation District (HCRCD 1998) confirms that water temperature in many tributaries is marginal, stressful, or lethal (19 °C to >24 °C). Excessively warm water temperatures can occur as early as late May during hot years with low flows, but more commonly occur during late June and early July. Elevated temperatures are problematic throughout the population area. High temperature- induced stress can lead to decreased growth and survival of juveniles and also increase the mortality rate of returning adults.

Altered Sediment Supply

Altered sediment supply poses a high or very high stress to all life stages. Adults, eggs, and fry are most affected by fine sediment prevalence in gravel. Sediment data are limited, but given EPA-reported observations (USEPA 2004), sediment is a key stress throughout the population area. Increased sediment delivery has resulted in a high embeddedness percentage within Soda Creek, which is where the majority of accessible, high IP habitat exists. Sediment supplies have reduced habitat and channel complexity in most of the tributaries and mainstem reaches of the population.

Hydrologic Function

Altered hydrologic function poses a high stress for juveniles and smolts, a medium stress for fry, and a low stress for eggs and adults. Significant reductions in hydrologic function can degrade entire instream and riparian communities. Stream flows affect important ecosystem linkages, including food web interactions among salmonids, their predators, and their prey; nutrient cycles; and overall habitat diversity and quantity (National Research Council 1996).

More recent instream flow requirements increased the minimum Cape Horn Dam release flow from the former 3 cfs constant summer rate and incorporated within-year and between-year variability. Although overall water quantity remains less than that of unimpaired flows, this new flow regime better approximates a more natural hydrograph. As the result of NMFS (2002) Biological Opinion, mainstem Eel River minimum instream flows have increased, and the total water diverted out of the Eel River and into the East Fork Russian River was reduced from 160,000 to between 60,000 and 138,000 acre-feet per year (based on the water year). It is important to note that the reach between the two dams has artificially cold water due to releases from the bottom of Lake Pillsbury. This reach is known to provide good rearing habitat given the cold water releases.

Marijuana cultivation has become abundant in the population area. 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).

Diversions for marijuana growing are significant in the area and are resulting in dry and disconnected stream channels. Disconnected habitat further exacerbates already stressful conditions and prevents fish from migrating into more preferred habitats, often times leaving the summer rearing life stages stranded in warm isolated pools where they are subject to being preyed upon or having to compete with the Sacramento pikeminnow.

Lack of Floodplain and Channel Structure

Floodplain and channel structure evaluations were based upon floodplain connectivity, pool frequency, and pool depth information. Based on this information, the lack of floodplain and channel structure is a high stress for all coho salmon life stages, except for fry. Although it contains approximately 80 percent of the currently accessible historic high IP habitat, Soda Creek lacks adequate pools and pool depths. Immediately below Scott Dam, floodplain connectivity is fair while floodplain connectivity within the upper sub-basin is believed to be very good. Although data on large wood are limited, wood recruitment to the mainstem is presumably low because dams block most wood transport. Moreover, low in-stream flows cannot facilitate wood mobilization and transport downstream. Pools, large wood cover, and floodplains are essential to juvenile rearing because they provide habitat complexity that facilitates forage optimization, predation avoidance, and permits access to thermal and velocity refuges.

Degraded Riparian Forest Conditions

Degraded riparian areas pose a high stress for all coho salmon life stages. Stream corridor vegetation is believed to be very good throughout most of the population area. However, Soda Creek, the tributary containing the majority of accessible, high IP habitat, has poor riparian shade and is dominated by the early seral conditions characteristic of either open or hardwood canopies. Although the steep canyon terrain provides some shading to Soda Creek, it is limited in its spatial extent and results in only certain reaches having adequate temperature regimes.

Sudden oak death (SOD) is an exotic pathogen affecting almost all native species of plants, shrubs, and trees. SOD is in epidemic stages in population areas downstream of the population, in which coho salmon from this population must migrate through. Because the SOD pathogen is water borne and can travel downstream in watercourses, the likelihood of SOD outbreaks in the population area and adjacent populations are high. One of the largest areas infected by SOD occurs near Redway and is growing at a very fast rate. It is likely that SOD will continue to infect native species throughout the Eel River watershed into the future.

Increased Disease/Predation/Competition

Increased disease, predation, and competition are high stresses for fry, juveniles, and smolts. The warm water temperatures in the Eel River and Lake Pillsbury allow Sacramento pikeminnow to thrive. Sacramento pikeminnow prey upon almost all life stages of all salmonids in the Eel River basin. Pikeminnow not only directly kill coho salmon, but they also displace and compete with the juvenile and smolt life stages. Increased competition in an already stressful environment presents a difficult situation for juveniles. The Sacramento pikeminnow's presence in Lake Pillsbury and widespread presence in almost all accessible habitats makes eradication of this species extremely difficult. Any effort to remove this species in the Eel River without successful removal from the lake will only be temporary because the lake will continue to be the source population for the rest of the Eel River basin.

Impaired Estuary/Mainstem Function

All coho salmon that originate from the Upper Mainstem Eel River migrate to and from the ocean through the mainstem Eel River and the Eel River estuary. The Eel River estuary was once a highly complex and extensive habitat area that played a vital role in the health and productivity of all Eel River coho salmon populations. The degraded function of the Eel River estuary and mainstem migratory corridor today constitutes a high stress for this population. The Eel River estuary is severely impaired because of diking and filling of wetlands for agriculture and flood protection. Levees and dikes reduced the size of the estuary by over 60 percent (CDFG 2010b). The estuary once supported a high degree of estuarine habitat and rearing potential but very little of that historic function still exists. Mainstem conditions contribute to coho salmon population stress because of water quality degradation, increased predation, and degraded habitat issues impacting this population area. The long migrations that this population must take through the mainstem Eel River makes the loss of mainstem functions a high to very high stress. Fitness of juveniles, smolts, and adults migrating through estuarine and mainstem habitat is reduced by the degraded conditions.

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 low stress to juveniles, smolts, and adults.

Adverse Hatchery-Related Effects

Hatchery-origin coho salmon may stray into the Upper Mainstem Eel 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).

46.6 Threats

Table 46-3. Severity of threats affecting each life stage of coho salmon in the Upper Mainstem Eel 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]	Very High	Very High	Very High[1]	Very High	Very High	Very High
2	Roads[1]	Very High	Very High	Very High[1]	Very High	Very High	Very High
3	Invasive Non-Native/Alien Species	Medium	Very High	Very High	Very High	Low	Very High
4	Climate Change	Low	Low	Very High	Very High	Medium	Very High
5	High Severity Fire	High	High	Medium	Medium	High	High
6	Agricultural Practices	Medium	Medium	Medium	Medium	Medium	Medium
7	Fishing and Collecting	-	-	Low	Low	Low	Low
8	Timber Harvest	Low	Low	Low	Low	Low	Low
9	Urban/Residential/Industrial Dev.	Low	Low	Low	Low	Low	Low
10	Road-Stream Crossing Barriers	-	Low	Low	Low	Low	Low
11	Hatcheries	Low	Low	Low	Low	Low	Low

[1] Key Limiting Threats and Limited Life Stage
[2] Mining/Gravel Extraction and Channelization/Diking are not considered threats 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 roads.

Dams/Diversions

Dams and diversions pose a very high stress to all life history stages. Further rationale for these ratings may be found in the Altered Hydrologic Function Section. Diversions for marijuana growing along with PG&E's Potter Valley Project dams and diversion are the most significant threats to the Upper Mainstem Eel River coho salmon population. Unscreened diversions for marijuana operations may impinge juveniles seeking shelter in the few pools deep enough to draft water from during the summer season. While Cape Horn Dam possesses a fish ladder, Scott Dam completely blocks access to 35 to 100 miles of potential habitat. Approximately 80 percent of this population's high IP reaches as identified by Williams et al. (2006) are located upstream of Scott Dam.

Near Cape Horn Dam, approximately 60,000 to 138,000 acre-feet of Eel River water has been annually diverted out of the basin and into the East Fork of the Russian River since 2004. Although the NMFS 2002 biological opinion and the 2004 FERC order require PG&E to release more water from both Cape Horn and Scott dams, increased flows in the upper mainstem Eel River are still lower relative to unimpaired flows during certain times of the year. Downstream of the dams, a subdivision along the Upper Mainstem Eel River diverts water for domestic use. The quantity of water diverted for the subdivision and whether there is an adequate fish screen is not known at this time. As human populations expand in Sonoma and Mendocino counties, there may be more demands for Eel River water.

Roads

Roads constitute a very high threat to all the population's life history stages. There are over 175 miles of trails (including about 100 miles of designated off-highway vehicle trails), more than 760 miles of road, and approximately 3900 road/stream crossings. Downstream of Scott Dam, road density is mostly very high (>3 mi/sq. mi). These road and trail networks facilitate sediment transport into streams and increase erosion and sediment availability, especially if the roads and trail networks are not properly maintained. Scott Dam and Lake Pillsbury block most fine particulate matter originating upstream of the dam from traveling into the mainstem Eel River. Unregulated road construction associated with marijuana cultivation contributes to the very high threat rankings of roads in this population.

Invasive Non-Native/Alien Species

Sacramento pikeminnow are a very high threat to fry, juveniles, and smolts and are a medium threat to eggs because they compete with and prey upon young coho salmon. Further rationale for these ratings can be found in the Increased Predation/Disease/Competition discussion above.

Climate Change

Climate change will have the greatest impact upon juveniles, smolts, and adults. The current climate is generally warm and modeled regional average temperature models indicate average temperatures could increase by up to 3 °C in the summer and by up to 1 °C in the winter (see Appendix B for modeling methods). Average annual precipitation is already very low and is predicted to decrease over the next century. Snowpack in upper elevations of the Eel River basin will decrease with changes in temperature and precipitation (California Natural Resources Agency 2009).

The vulnerability of the downstream Eel River estuary to sea level rise is very high. Juvenile and smolt rearing and migratory habitat are most at risk to climate change. Increasing temperatures and changes in the amount and timing of precipitation and snowmelt will impact water quality and hydrologic function in the summer and winter. Rising sea level may also impact the quality and extent of wetland rearing habitat for smolts in the estuary. Overall, the range and degree of variability in temperature and precipitation are likely to increase in all population areas. As with all populations in the ESU, adults will be negatively impacted by ocean acidification, changes in ocean conditions, and prey availability (see Independent Science Advisory Board 2007, Portner and Knust 2007, Feely et al. 2008).

High Severity Fire

High severity fire poses a high threat to most of the life history stages, and a medium threat to juveniles and smolts. Past timber harvest practices coupled with decades-long fire-suppression efforts have rendered understory forest fuel loads excessive. High severity fires may affect coho salmon populations by removing vegetation and litter that protect or minimize soil erosion, leading to increased gullying, and mass wasting events that contribute to high sediment loads and degrade coho salmon habitats. High sediment loads embed spawning gravel, making it less suitable for spawning and bury redds and alevins.

Agricultural Practices

Because of the steepness of the headwaters of the Mainstem Eel River, most agricultural activities are uncommon. However, the area's remoteness has facilitated marijuana cultivation within the Mendocino National Forest. Marijuana may be the primary crop cultivated in the area, and it has been implicated as a source of excessive nutrient inputs to streams. Agricultural activities divert water away from Lake Pillsbury and the Upper Mainstem Eel River. The Mendocino National Forest currently does not allow grazing on their Lake Pillsbury and Ericson Ridge Management Areas; however, there is a grazing allotment in the Pine Mountain Management Area south of the Mainstem Eel River (Stewardship Council 2007). Grazing effects upon the Upper Mainstem Eel River are currently unknown. Vineyard production is expected to expand within Potter Valley which may result in more demand for water diverted from the Eel River.

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 low threat to juveniles, smolts, and adults.

Timber Harvest

Timber harvest is a low threat to this population. Timber harvest primarily occurs on National Forest land and recently has been minimal. Timber harvest is not expected to intensify in the near future because of current management practices and administrative and court challenges.

Forest lands in the population area 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.

Urban/Residential/Industrial Development

Limited small and remote communities exist within the Upper Mainstem Eel River population area. Residential growth is not expected because of the remoteness of this area. The threat of future residential, urban or industrial development is low.

Road-Stream Crossing Barriers

Road-stream crossing barriers pose a low threat to all coho salmon life stages. CDFG's CalFish website shows that a National Forest road culvert crossing on the M-3 Road is the only complete road-stream crossing barrier (CalFish 2009). However, this culvert is not accessible to coho salmon, even if Scott Dam did not exist.

Hatcheries

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

46.7 Recovery Strategy

The amount of currently inaccessible IP habitat combined with elevated water temperatures present throughout most of the Upper Mainstem Eel River population area limit the opportunities for restoration. The recovery criterion for this population is that 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival. Key habitat in areas downstream of Scott Dam where elevated water temperatures are not limiting coho salmon should be improved to facilitate some level of population persistence. Improvements such as establishing and/or protecting cold water refugia and improving channel complexity will be critical for summer rearing juvenile coho salmon. Key components to achieving this population's recovery include: ensuring in-stream flows closely mimic the natural hydrograph; reducing unpermitted water diversions; creating and protecting cold water refugia; suppressing Sacramento pikeminnow abundance and spatial distribution; increasing floodplain connectivity and channel structure; and enhancing the quality and size of the Eel River estuary. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 46-4 on the following page lists the recovery actions for the Upper Mainstem Eel River population.

Table 46-4. Recovery action implementation schedule for the Upper Mainstem Eel 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-UMER.5.2.7	Passage	Yes	Decrease mortality	Screen all diversions	All streams where coho salmon would benefit immediately	2b
SONCC-UMER.5.2.7.1	*Assess diversions and develop a screening program*					
SONCC-UMER.5.2.7.2	*Screen all diversions*					
SONCC-UMER.5.2.59	Passage	Yes	Decrease mortality	Screen all diversions	Population wide	2c
SONCC-UMER.5.2.59.1	*Assess diversions and develop a screening program*					
SONCC-UMER.5.2.59.2	*Screen all diversions*					
SONCC-UMER.10.1.33	Water Quality	Yes	Reduce water temperature, increase dissolved oxygen	Increase cool water and thermal refugia	All streams where coho salmon would benefit immediately	2b
SONCC-UMER.10.1.33.1	*Assess sources of cool water and develop techniques to protect and/or improve cool water habitat*					
SONCC-UMER.10.1.33.2	*Add LWD, boulders, or sources of structure as guided by assessment to augment habitat at cool water sources*					
SONCC-UMER.10.1.52	Water Quality	Yes	Reduce water temperature, increase dissolved oxygen	Increase cool water and thermal refugia	Population wide	2d
SONCC-UMER.10.1.52.1	*Assess sources of cool water and develop techniques to protect and/or improve cool water habitat*					
SONCC-UMER.10.1.52.2	*Add LWD, boulders, or sources of structure as guided by assessment to augment habitat at cool water sources*					
SONCC-UMER.1.2.29	Estuary	No	Improve estuarine habitat	Improve estuary condition	Eel River Estuary	2b
SONCC-UMER.1.2.29.1	*Implement recovery actions for Lower Eel/Van Duzen River population that address the target "Estuary"*					
SONCC-UMER.3.1.39	Hydrology	No	Improve flow timing or volume	Determine effects of marijuana cultivation	Population wide	2b
SONCC-UMER.3.1.39.1	*Assess cumulative effects (e.g., flow, water quality) of marijuana cultivation*					
SONCC-UMER.3.1.39.2	*If needed, develop plan to reduce effects of marijuana cultivation*					
SONCC-UMER.3.1.39.3	*Implement plan*					
SONCC-UMER.3.1.4	Hydrology	No	Improve flow timing or volume	Educate stakeholders	Population wide	2b
SONCC-UMER.3.1.4.1	*Complete comprehensive flow study activities, and use them to educate water managers on how to reduce impacts to coho salmon*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UMER.3.1.5	Hydrology	No	Improve flow timing or volume	Educate stakeholders	Population wide	2b
SONCC-UMER.3.1.5.1	*Provide incentives to landowners to reduce water consumption*					
SONCC-UMER.3.1.6	Hydrology	No	Improve flow timing or volume	Educate stakeholders	Population wide	2b
SONCC-UMER.3.1.6.1	*Provide education and training on water diversion practices and facilitate compliance with pertinent laws and regulations (e.g., FGC §1600 et seq., CFPR 14 CCR 916.9, California water rights law)*					
SONCC-UMER.3.1.3	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Mainstem and tributaries downstream of Scott Dam	2b
SONCC-UMER.3.1.3.1	*Ensure water diversions are within their water rights*					
SONCC-UMER.3.1.34	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	2b
SONCC-UMER.3.1.34.1	*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*					
SONCC-UMER.3.1.34.2	*Increase flows during low flow periods, as described in the program*					
SONCC-UMER.2.1.32	Floodplain and Channel Structure	No	Increase channel complexity	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately	2b
SONCC-UMER.2.1.32.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-UMER.2.1.32.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-UMER.2.1.55	Floodplain and Channel Structure	No	Increase channel complexity	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2d
SONCC-UMER.2.1.55.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-UMER.2.1.55.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-UMER.2.1.10	Floodplain and Channel Structure	No	Increase channel complexity	Identify and enhance non natal rearing sites	Tributaries and their confluences with mainstem where coho salmon would benefit immediately	2b
SONCC-UMER.2.1.10.1	*Investigate coho salmon non-natal rearing and refugia use in lower reaches of tributaries and mainstem confluences. Develop a plan to enhance identified locations*					
SONCC-UMER.2.1.10.2	*Improve rearing locations, guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UMER.8.1.14	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All areas where coho salmon would benefit immediately (downstream of Scott Dam)	2b
SONCC-UMER.8.1.14.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-UMER.8.1.14.2	*Decommission roads, guided by assessment*					
SONCC-UMER.8.1.14.3	*Upgrade roads, guided by assessment*					
SONCC-UMER.8.1.14.4	*Maintain roads, guided by assessment*					
SONCC-UMER.14.2.8	Invasive, Non-native Species	No	Reduce predation and competition	Reduce abundance of Sacramento pikeminnow	Population wide	2b
SONCC-UMER.14.2.8.1	*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-UMER.14.2.8.2	*Suppress Sacramento pikeminnow, guided by the suppression plan*					
SONCC-UMER.3.1.1	Hydrology	No	Improve flow timing or volume	Manage flow	Cape Horn and Scott Dams	2c
SONCC-UMER.3.1.1.1	*Conduct assessments to identify areas of improvement for water management and diversions*					
SONCC-UMER.3.1.1.2	*Make improvements to water management and diversions, based on the assessment*					
SONCC-UMER.5.1.2	Passage	Yes	Improve access	Assess fish passage	Scott Dam	3b
SONCC-UMER.5.1.2.1	*Assess benefits of passage above Scott Dam for coho salmon*					
SONCC-UMER.5.1.2.2	*If passage is determined to be beneficial, develop plan to provide passage*					
SONCC-UMER.5.1.2.3	*Implement plan to provide passage*					
SONCC-UMER.7.1.11	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Population wide (downstream of Scott Dam)	3b
SONCC-UMER.7.1.11.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-UMER.7.1.11.2	*Thin, or release conifers, guided by the plan*					
SONCC-UMER.7.1.11.3	*Plant conifers, guided by the plan*					
SONCC-UMER.2.1.38	Floodplain and Channel Structure	No	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately	3b
SONCC-UMER.2.1.38.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-UMER.2.1.38.2	*Place instream structures, guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UMER.2.1.57	Floodplain and Channel Structure	No	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	3d
SONCC-UMER.2.1.57.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-UMER.2.1.57.2	*Place instream structures, guided by assessment results*					
SONCC-UMER.10.7.51	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3b
SONCC-UMER.10.7.51.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-UMER.10.7.51.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-UMER.10.7.53	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-UMER.10.7.53.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-UMER.10.7.53.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-UMER.3.1.35	Hydrology	No	Improve flow timing or volume	Measure flow	Upstream of Lake Pillsbury	3d
SONCC-UMER.3.1.35.1	*Maintain flow gage annually*					
SONCC-UMER.7.1.12	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Population wide	3d
SONCC-UMER.7.1.12.1	*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-UMER.7.1.13	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Reduce fire hazard	Upland areas adjacent to	3d
SONCC-UMER.7.1.13.1	*Identify forested stands for fire hazard reduction*					
SONCC-UMER.7.1.13.2	*Apply appropriate management techniques (e.g. thinning, burning) to reduce risks of high severity fire*					
SONCC-UMER.16.1.16	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-UMER.16.1.16.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-UMER.16.1.16.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UMER.16.1.17	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-UMER.16.1.17.1	*Determine actual fishing impacts*					
SONCC-UMER.16.1.17.2	*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-UMER.16.2.18	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-UMER.16.2.18.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-UMER.16.2.18.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-UMER.16.2.19	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-UMER.16.2.19.1	*Determine actual impacts of scientific collection*					
SONCC-UMER.16.2.19.2	*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*					