45. Upper Mainstem Eel River Population

- Interior Eel Diversity Stratum
- Potentially Independent Population
- High Extinction Risk
- Recovery criteria: 20% of IP habitat must be occupied in years following spawning of brood years with high marine survival
- 361 mi^2
- 54 IP km (34 mi.) (27% High)
- Dominant Land Uses are 'Recreation' and 'Agriculture'
- Principal Stresses are 'Barriers' and 'Water Quality'
- Principal Threats are 'Dams/Diversions'

45.1 History of Habitat and Land Use

Land use activities in the Upper Mainstem Eel River include timber harvest, hydropower production, 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 an estimated 100 to 150 miles of potential anadromous salmonid habitat, and the 1922-built Cape Horn Dam fish ladder has proven ineffective. With an approximate 93,000 acre-feet (AF) capacity, Lake Pillsbury is situated upon most of the high IP reaches present in the population area.

The Potter Valley Project diverts the majority of mainstem Eel River flows out of the basin. From 1992 to 2004, up to approximately 160,000 AF of Eel River water were annually diverted into the East Fork of the Russian River for hydropower production and agricultural uses. 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.

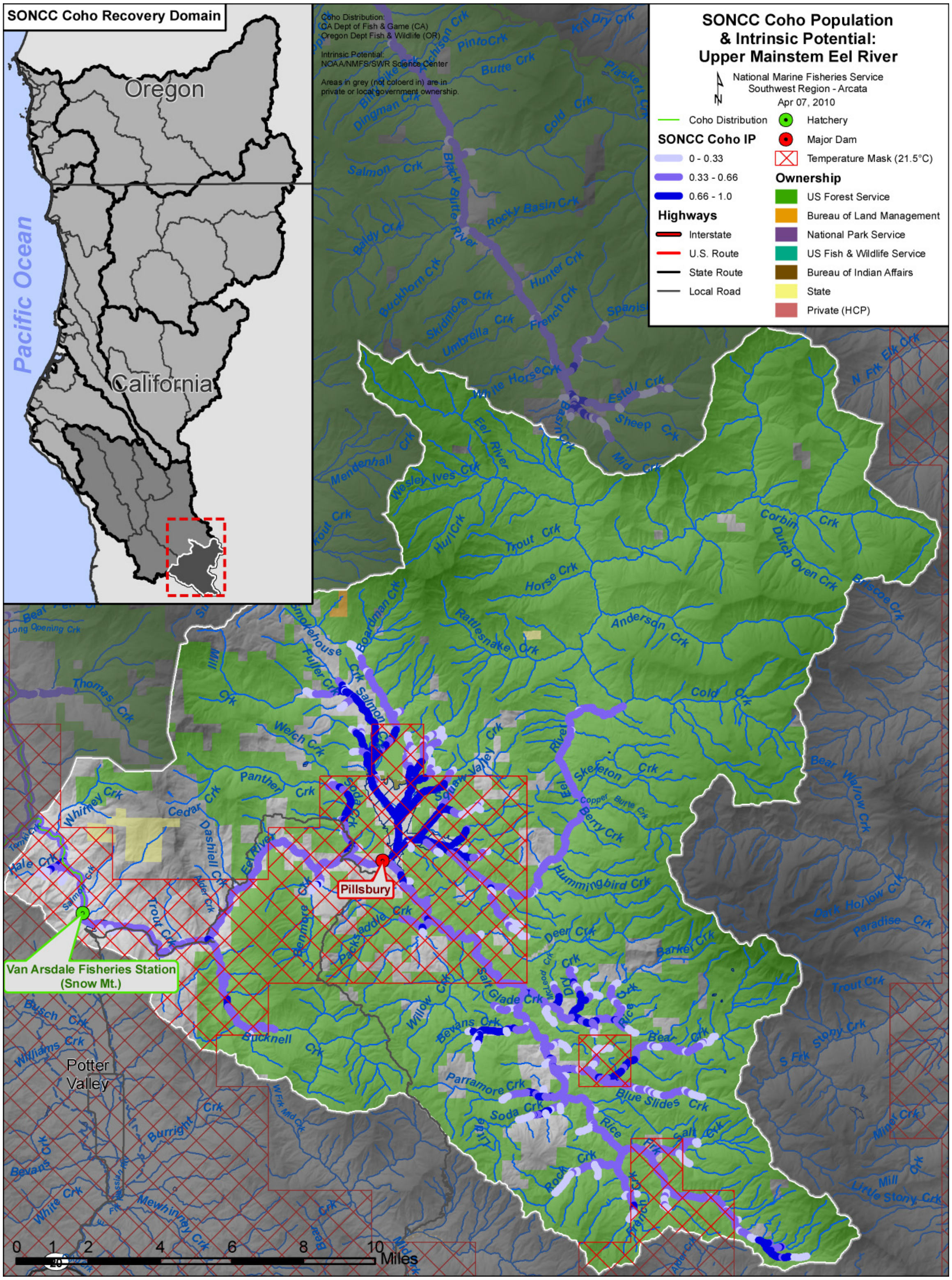

Figure 45-1. The geographic boundaries of the Upper Mainstem Eel River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2009a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

The new flow requirement increased the minimum Cape Horn Dam release flows and incorporated within-year and between-year variability.

Minimum flows are dependent on a number of factors and formulas, including cumulative inflow into Lake Pillsbury, current and previous water year, and time periods. Therefore, specifying actual minimum flows that would be expected is not possible as this varies by too many factors. Water gage data for the Eel River below Van Arsdale Reservoir records a 9 day-long duration of 7 cfs as the lowest mean daily flow since March 2007(California Department of Water Resources (DWR) 2010).

The Potter Valley Project has significantly reduced rearing habitat (Week 1992) and restricted access to many tributaries both upstream of the dams by precluding access to fish as well as downstream of the dams by reducing flows. Important 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).

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 1980, 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 the reservoir, lower instream flows in the mainstem Eel River, and degraded riparian forest conditions. Pools which were formerly high quality refugia which had large woody debris have decreased because of increased sedimentation, dams, and degraded riparian forests. These pools and large woody structures would have provided juveniles some protection from predators.

45.2 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). Neither scientific nor anecdotal coho salmon observation information for the areas above Lake Pillsbury has been discovered. 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. Historically, temperature was likely moderated by intact riparian areas and higher unimpaired flows.

Table 45-1. Tributaries with instances of high IP reaches (IP > 0.66). (Williams et al. 2006).

Subarea	Stream Name	Subarea	Stream Name
Lake Pillsbury	Bear Creek*	**Lake Pillsbury**	North Fork Corbin Creek*
	Bevans Creek*		Packsaddle Creek*
	Bucknell Creek[1]		Perramore Creek*
	Dry Creek*		Rice Creek*
	French Creek*		Rice Fork*
	Hale Creek		Salmon Creek (and tribs.)*
	Little Soda Creek*		Salt Spring Creek*
	McLeod Creek*		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.
* Denotes a stream that lies above Lake Pillsbury and is currently inaccessible to coho salmon.

45.3 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). In addition to elevating water temperatures, Scott Dam precludes access to most of the historic IP area. Downstream of Scott Dam, those few observed coho salmon were restricted to tributaries possessing degraded habitat and water quality. Coho salmon genetic and life history diversity is low due to the low number of individuals. Based upon these observations, the Upper Mainstem Eel River coho salmon population is at high extinction risk because its spatial distribution and diversity are limited.

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. Williams et al. (2008) estimated at least 54 coho salmon must spawn in the Upper Mainstem Eel River each year to avoid extinction resulting from extremely low population sizes.

Coho salmon are likely present in numbers well below this high risk threshold. Cape Horn and Scott dams limit coho salmon access to much of the population area and are responsible for degraded habitat present within remaining downstream tributaries. 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 is at high extinction risk and may already be functionally extinct.

Extinction Risk

The Upper Mainstem Eel River coho salmon population is not viable and at high risk of extinction because the estimated average spawner abundance over the past three years has been less than the depensation threshold (Table ES-1 in Williams et al. 2008).

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 population, the recovery target for the Upper Mainstem Eel River population is to ensure that the population is occupied by coho salmon consistently in the future (see Chapter 4). 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.

45.4 Plans and Assessments

Environmental Protection Agency

Total Maximum Daily Loads for the Eel River

In January 2006, the EPA 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 controlling 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 U.S. Forest Service

Watershed Analysis

The U.S. Department of Agriculture Forest Service (USFS) completed a watershed analysis for the Upper Main Eel River in 1995.

45.5 Stresses

Table 45-2. Severity of stresses affecting each life stage of coho salmon in the Upper Mainstem Eel River. Stress rank categories and assessment methods are described in Appendix B, and the data used to assess stresses for the initial threats assessment (described in Appendix B) is presented in Appendix H.

	Stresses (Limiting Factors)	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Barriers[1]	-	Very High	Very High[1]	Very High	Very High	Very High
2	Impaired Water Quality[1]	Low	Very High	Very High[1]	Very High	High	High
3	Altered Sediment Supply	Very High	Very High	High	Low	Very High	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	Medium
8	Altered Hydrologic Function	Low	Medium	High	High	Low	Medium
9	Adverse Fishery-Related Effects		-	-	-	Medium	Medium
10	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low

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

Limiting Stresses, Life Stages, and Habitat

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, and the quality and quantity of summer and winter rearing habitat is lacking. Access to the most suitable juvenile summer and winter rearing habitat is currently blocked by Scott Dam, and habitat downstream of the dam is limited by high water temperatures and excessive sedimentation. Scott Dam also prevents adult passage, resulting in 100 to 150 miles of potential spawning habitat loss. High road densities affect water quality throughout the population area by transporting excess sediment into streams. Low summer flows resulting from the Potter Valley Project Diversion serve to support non-native, predatory Sacramento pikeminnow populations to the detriment of coho salmon. Channel complexity and a diverse estuary are important to juvenile coho salmon, increasing their size and fitness prior to ocean entry, and 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 stressors 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.

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 100 to 150 miles of potential anadromous salmonid habitat. Downstream of Scott Dam, habitat areas 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 subbasin. There are likely numerous road-stream crossing barriers, but because most of the National Forest roads are upstream and upslope of Scott Dam these crossing barriers have not been inventoried thoroughly and likely have no impact on the population.

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 subbasin (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 many of the tributary water temperatures are 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 very high or 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 (EPA 2004), sediment is likely a key stressor 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. Upper

Bucknell Creek measurements reveal limited sediment deposition within pools; however these data are based upon only one sampling point.

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 subbasin is believed to be very good. Although data on large wood is 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. Essential to juvenile rearing, pools, large wood cover, and floodplains 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, a 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.

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 stress upon fry, juveniles, and smolts. Sacramento pikeminnow thrive in the warmer water temperatures. Sacramento pikeminnow prey upon coho salmon and also displace them from potential pool refugia.

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.

Hydrologic Function

Altered hydrologic functions pose a high stress for juveniles and smolts, a medium stress for fry, and a low stress for eggs and adults. Above Scott Dam, hydrologic function is very good but is only fair below the dam. Significant reductions in hydrologic function 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 increase the minimum Cape Horn Dam release flow from the former 3 cfs constant summer rate and incorporate within-year and between-year variability. Although water quantity remains less than that of unimpaired flows, this new flow regime better approximates a more natural hydrograph. As the result of NMFS 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).

Adverse Fishery-Related Effects

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

Adverse Hatchery-Related Effects

The effects of hatchery fish on all life stages of coho salmon are described in Chapter 3. There are no operating hatcheries in the Upper Mainstem Eel River population area. Hatchery-origin adults may stray into the population area; however, the proportion of adults that are of hatchery origin is unknown. Adverse hatchery-related effects pose a low risk to all life stages, because less than five percent of adults are presumed to be of hatchery origin (Appendix B) and there are no hatcheries in the basin.

45.6 Threats

Table 45-3. Severity of threats affecting each life stage of coho salmon in the Upper Mainstem Eel River. Threat rank categories and assessment methods are described in Appendix B, and the data used to assess threats for the initial threats assessment (described in Appendix B) is presented in Appendix H.

	Threats[1]	Egg	Fry	Juvenile	Smolt	Adult	Overall Threat Rank
1	Dams/Diversion	Very High	Very High	Very High	Very High	Very High	Very High
2	Roads	Very High	Very High	Very High	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	High
5	High Intensity Fire	High	High	Medium	Medium	High	High
6	Agricultural Practices	Medium	Medium	Medium	Medium	Medium	Medium
7	Fishing and Collecting	-	-	-	-	Medium	Medium
8	Timber Harvest	Low	Low	Low	Low	Low	Low
9	Urban/Residential/Industrial	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] Mining/Gravel Extraction and Channelization/Diking are not considered threats to this population.

Dams/Diversions

Dams and diversions pose a very high stress to all life history stages. PG&E's Potter Valley Project dams and diversion are the most significant threats to the Upper Mainstem Eel River coho salmon population as well as to other downstream Eel River coho salmon populations. While the Cape Horn Dam possesses a fish ladder, the Scott Dam completely blocks access to over 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.

During the summer and fall, the Potter Valley Project diverts almost all of the mainstem Eel River water. Near Cape Horn Dam, approximately 60,000 to 138,000 AF 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 significantly lower relative to unimpaired flows. 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 will be more demands for Eel River water.

Roads

Roads constitute a very high threat to all the population's life history stages. Upstream of Van Arsdale Reservoir, the USFS has noted that some of the roads and trails often function as streams by transporting water and sediment to other drainages (USFS and U.S. Bureau of Land Management (BLM) 1995b). 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 from traveling into the mainstem Eel River.

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. The warm water temperatures in the Eel River and Lake Pillsbury allow this voracious predator to thrive. The Sacramento pikeminnow's presence in Lake Pillsbury makes eradication of this species extremely difficult. Any effort to remove this species in the Eel River without treating the lake will only be temporary because the lake will continue to be the source population for the rest of the Eel River basin. As more water is released into the mainstem Eel River, there should be more habitats available for juveniles to seek refuge from predation.

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 Intensity Fire

High intensity 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 intensity fires regularly result from these excessive forest fuel loads. Such high intensity fires threaten coho salmon populations because they remove vegetation and litter that protect or minimize soil erosion, gullying, and mass wasting 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 agriculture within the Mendocino National Forest. 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. Rice and vineyard production is expected to expand within Potter Valley and will require more water diversion from the Eel River.

Fishing and Collecting

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

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.

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 Potter Valley Project's hydropower production completely prevents coho salmon passage to most of the high IP reaches. Depending upon the water year, the Potter Valley Project annual Eel River diversions have been reduced from 160,000 to between 60,000 and 138,000 since 2004. Many of the threats associated with the Potter Valley Project are covered in the Dams/Diversion section above.

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 (CalFish2009). However, this culvert is not accessible to coho salmon, even if Scott Dam was not an issue.

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.

45.7 Recovery Strategy

The amount of currently inaccessible IP habitat combined with elevated air and water temperatures present throughout most of the Upper Mainstem Eel River population area will make recovery of this population extremely difficult. The recovery criterion for this population is that 20% of 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. Key components to achieving this population's recovery include: restoring in-stream flows to that which more closely mimic the natural hydrograph; controlling Sacramento pikeminnow abundance and spatial distribution; increasing floodplain connectivity; and enhancing Eel River estuary quality and size.

Table 45-4 on the following page lists the recovery actions for the Upper Mainstem Eel River population.

Table 45-4. Recovery action implementation schedule for the Upper Mainstem Eel River population.

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UMER.5.2.7	Passage	Yes	Decrease mortality	Screen all diversions	Downstream of Scott Dam	BR
SONCC-UMER.5.2.7.1	*Assess diversions and develop a screening program*					
SONCC-UMER.5.2.7.2	*Screen all diversions*					
SONCC-UMER.14.2.8	Disease/Predation/ Competition	No	Reduce predation and competition	Reduce abundance of Sacramento pikeminnow	Population wide	2
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 control*					
SONCC-UMER.14.2.8.2	*Control Sacramento pikeminnow, guided by the control plan*					
SONCC-UMER.1.2.29	Estuary	No	Improve estuarine habitat	Improve estuary condition	Eel River Estuary	3
SONCC-UMER.1.2.29.1	*Implement recovery actions to address strategy "Estuary" for Lower Eel/Van Duzen River population*					
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	3
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 fishing impacts expected to be consistent with recovery*					
SONCC-UMER.16.1.17	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Limit fishing impacts to levels consistent with recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	2
SONCC-UMER.16.1.17.1	*Determine actual fishing impacts*					
SONCC-UMER.16.1.17.2	*If actual fishing impacts exceed levels consistent with recovery, modify management so that levels are consistent with recovery*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-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	3
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 scientific collection impacts expected to be consistent with recovery*					
SONCC-UMER.16.2.19	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Limit impacts of scientific collection to levels consistent with recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3
SONCC-UMER.16.2.19.1	*Determine actual impacts of scientific collection*					
SONCC-UMER.16.2.19.2	*If actual scientific collection impacts exceed levels consistent with recovery, modify collection so that impacts are consistent with recovery*					
SONCC-UMER.2.1.9	Floodplain and Channel Structure	No	Increase channel complexity	Increase LWD, boulders, or other instream structure	All reaches downstream of Scott Dam	BR
SONCC-UMER.2.1.9.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-UMER.2.1.9.2	*Place instream structures, 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	BR
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*					
SONCC-UMER.3.1.1	Hydrology	No	Improve flow timing or volume	Manage flow	Cape Horn and Scott Dams	2
SONCC-UMER.3.1.1.1	*Conduct assessments to identify areas of improvement for water management and diversions*					
SONCC-UMER.3.1.1.2	*Manage and reduce diversions to restore the natural volume and mimic the natural hydrograph*					
SONCC-UMER.3.1.2	Hydrology	No	Improve flow timing or volume	Remove dams	Cape Horn and Scott Dams	BR
SONCC-UMER.3.1.2.1	*Work with PG&E and stakeholders to develop alternatives that would facilitate removal of large dams on the Eel River*					
SONCC-UMER.3.1.2.2	*Remove dams*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UMER.3.1.3	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Mainstem and tributaries downstream of Scott Dam	BR
SONCC-UMER.3.1.3.1	*Ensure water diversions are within their water rights*					
SONCC-UMER.3.1.4	Hydrology	No	Improve flow timing or volume	Educate stakeholders	Population wide	BR
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.*					
SONCC-UMER.3.1.5	Hydrology	No	Improve flow timing or volume	Educate stakeholders	Population wide	BR
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	BR
SONCC-UMER.3.1.6.1	*Provide education and training on water diversion practices and facilitate compliance with pertinent regulations (e.g., FGC §1600 et. seq., CFPR 916.9, California water rights law).*					
SONCC-UMER.27.1.20	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3
SONCC-UMER.27.1.20.1	*Perform annual spawning surveys*					
SONCC-UMER.27.1.21	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3
SONCC-UMER.27.1.21.1	*Conduct presence/absence surveys for juveniles (3 years on; 3 years off)*					
SONCC-UMER.27.1.22	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	2
SONCC-UMER.27.1.22.1	*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*					
SONCC-UMER.27.1.23	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the threat 'Invasive Species'	Population wide	3

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UMER.27.1.23.1	*Annually estimate the density of non-native predators, such as the Sacramento pikeminnow in the Eel River basin*					
SONCC-UMER.27.1.23.2	*Identify the status and trend of invasive species*					
SONCC-UMER.27.2.24	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3
SONCC-UMER.27.2.24.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-UMER.27.2.24.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling 10% of the original habitat surveyed*					
SONCC-UMER.27.2.25	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3
SONCC-UMER.27.2.25.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-UMER.27.2.26	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3
SONCC-UMER.27.2.26.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-UMER.27.2.27	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3
SONCC-UMER.27.2.27.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-UMER.27.2.28	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3
SONCC-UMER.27.2.28.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-UMER.27.2.30	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3
SONCC-UMER.27.2.30.1	*Annually measure the hydrograph and identify instream flow needs*					
SONCC-UMER.27.1.31	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3
SONCC-UMER.27.1.31.1	*Develop supplemental or alternate means to set population types and targets*					
SONCC-UMER.27.1.31.2	*If appropriate, modify population types and targets using revised methodology*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UMER.7.1.11	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	All reaches downstream of Scott Dam	BR
SONCC-UMER.7.1.11.1	*Determine appropriate silvicultural prescription for benefits to coho salmon habitat*					
SONCC-UMER.7.1.11.2	*Thin, or release conifers, guided by prescription*					
SONCC-UMER.7.1.11.3	*Plant conifers, guided by prescription*					
SONCC-UMER.7.1.12	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Population wide	2
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 streams	BR
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 intensity fire*					
SONCC-UMER.8.1.14	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	BR
SONCC-UMER.8.1.14.1	*Assess and prioritize road-stream connection, and identify appropriate treatment to meet objective*					
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*					