42. Mainstem Eel River Population

- Interior Eel River Stratum
- Core, Potentially Independent Population
- High Extinction Risk
- 4,800 Spawners Required for ESU Viability
- 521 mi^2
- 144 IP km (89 mi) (8.5% High)
- Dominant Land Uses are Timber Production and Agriculture
- Principal Stresses are 'Altered Sediment Supply' and 'Lack of Floodplain and Channel Structure'
- Principal Threats are 'Roads' and 'Dams/Diversions'

42.1 History of Habitat and Land Use

Historically, timber harvest was the dominant land-use in the Mainstem Eel River and timber harvest has had a large impact on the landscape. Late-seral stands of conifers are largely absent and historic logging and fire suppression caused the change from conifer-dominated stands to stands with high proportions of oak and shrub species. Erosion from poorly constructed roads in the highly erosive Franciscan geology has contributed to increased sediment loads in the region's rivers, leaving streams shallower, warmer, and more prone to flooding (Bodin et al. 1982; Raphael 1974). Sediment production from the 1955 and 1964 floods choked the channels with sediment and most channels are still recovering from these large flood events. Many areas which were cleared by logging have since been farmed or grazed.

U.S. Forest Service (USFS) land occurs in the headwaters of tributaries in the northeast portion of the population - primarily the Dobbyn Creek and Kekawaka Creek watersheds. USFS land in the Mainstem Eel River is currently used for grazing and recreation. BLM land occurs in a number of areas throughout the Mainstem Eel River, including several smaller watersheds that contain high IP reaches. These include Woodman, White Rock, Drewry, Charlton, Bell Springs, and Chamise Creeks. The dominant land uses on BLM land are primarily recreation and timber production.

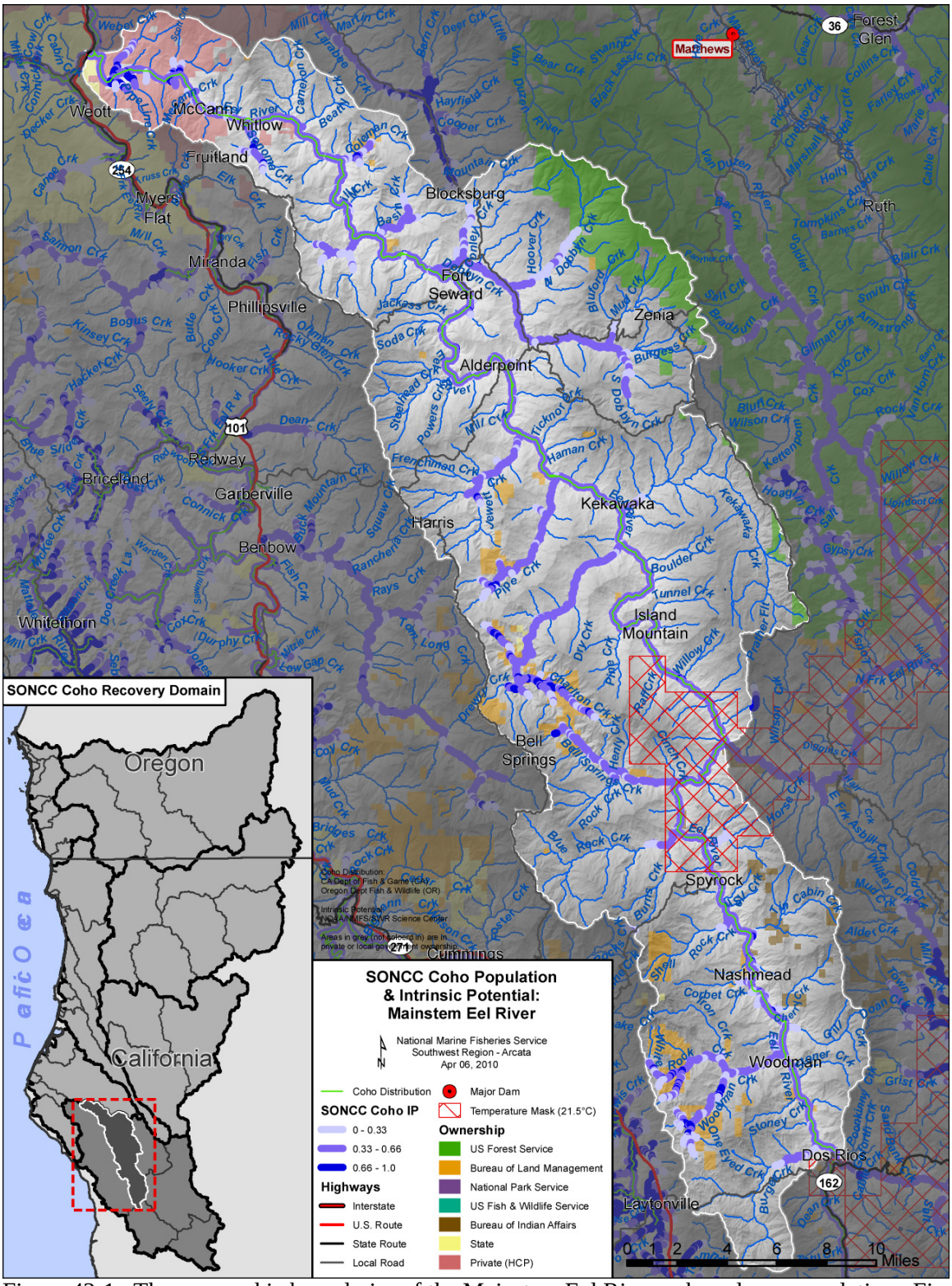

Figure 42-1. The geographic boundaries of the Mainstem Eel River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2009a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

The Mainstem Eel River is isolated and predominantly rural. Small population centers of less than 200 to 500 residents occur throughout the Mainstem Eel River drainage, primarily along the Eel River itself. With the establishment of rural residences and smaller ranches, the need for water has increased. In addition, agriculture results in significant water demands in Mainstem Eel River tributaries. Currently, much of this demand is accommodated through in-stream diversions or shallow wells, which have influenced stream flows during summer low-flow periods.

42.2 Historic Fish Distribution and Abundance

No estimates of the size of the historical (or current) coho salmon population in the Mainstem Eel River are available. Brown and Moyle (1991) documented historical coho salmon presence in Jewett and Kekawaka Creeks, but recent surveys have not documented coho salmon presence in these Mainstem Eel River tributaries (California Department of Fish and Game (CDFG) 2002a).

Table 42-1. Tributaries in the Mainstem Eel population with instances of high IP reaches (IP > 0.66). (Williams et al. 2006).

Subbasin	Stream Name	Subbasin	Stream Name
Sequoia	Coleman Creek	**Spy Rock**	Bell Springs Creek
	Drewry Creek		Chamise Creek
	Jewett Creek		Charlton Creek
	Pipeline Creek		Pipe Creek
	Poison Oak Creek		Pipe Creek
	Sonoma Creek		White Rock Creek
	Thompson Creek		Woodman Creek

42.3 Status of Mainstem Eel River Coho Salmon

Spatial Structure and Diversity

The more restricted and fragmented the distribution of individuals are 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 33 coho salmon per-IP km of habitat are needed (4,800 spawners total) to approximate the historical distribution of Mainstem Eel River coho salmon and habitat. The current distribution of spawners is unknown and observations are few, but expected to be very limited because most of the habitat is extremely degraded. The Mainstem Eel River coho salmon population is at high risk of extinction, in part, because its spatial structure and diversity is limited.

Population Size and Productivity

Williams et al. (2008) determined at least 144 coho salmon must spawn in the Mainstem Eel River each year to avoid depensation effects of extremely low population size.

The Mainstem Eel River coho salmon population size is likely to be extremely reduced compared to historic levels. Breeding groups may have been lost or severely depressed in some Mainstem Eel River streams. The population growth rate is unknown, but expected to be negative in most years given the low numbers of fish observed at Van Arsdale and the degraded habitat conditions available. Therefore, the Mainstem Eel River coho salmon population is at high risk of extinction.

Extinction Risk

The 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). Observations of coho salmon in the Mainstem Eel River and its tributaries have been steadily declining, and no coho salmon have been observed in some years.

Role in SONCC Coho Salmon ESU Viability

The Mainstem Eel River population is a Functionally Independent core population in the Interior Eel River Diversity stratum, meaning that it is sufficiently large to be historically viable-in-isolation and its demographics and extinction risk are minimally influenced by immigrants from adjacent populations (Williams et al. 2006). 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. As a core population, the recovery target for the Mainstem Eel population is for the population to be viable meaning that it has a low risk of extinction according to population viability criteria (see Chapter 2).

42.4 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 their assessment of the Eel River watershed and provided recommendations for restoration of salmonid stocks. Primary recommendations include 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

42.5 Stresses

Table 42-2. Severity of stresses affecting each life stage of coho salmon in the 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	Altered Sediment Supply[1]	Very High	Very High	Very High[1]	High	Very High	Very High
2	Lack of Floodplain and Channel Structure[1]	Medium	High	Very High[1]	Very High	Very High	High
3	Degraded Riparian Forest Conditions	-	High	High	High	High	High
4	Increased Disease/Predation/Competition	Low	High	High	High	Low	High
5	Impaired Water Quality	Low	High	High	High	Medium	Medium
6	Altered Hydrologic Function	Medium	High	Very High	High	Medium	Medium
7	Impaired Estuary/Mainstem Function	-	Low	High	High	Medium	Medium
8	Barriers	-	Medium	Medium	Medium	Medium	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 on the type and extent of stresses and threats affecting the population as well as the limiting factors influencing productivity, it is likely that the juvenile life stage is the most limited and that quality summer and winter rearing habitat is lacking. Juvenile summer and winter rearing success is most limited by unsuitable habitat resulting from high water temperatures and excessive sedimentation. Low summer flows resulting from Scott Dam serve to support the non-native Sacramento pikeminnow by providing ideal low-flow warm conditions for this predator. In addition, 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. Properly

functioning rearing habitat would provide buffers against some of the 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. Available information regarding habitat conditions in the Mainstem Eel River indicates that none of the streams accessible to coho salmon currently are able to function as refugia. Small reaches in streams that could provide a combination of suitable habitat and water temperatures may exist, but these have not been identified and likely possess lower IP values.

Altered Sediment Supply

Excessive sediment was rated as a very high stress to nearly all life stages of coho salmon. The EPA recognized this by listing the Mainstem Eel River as sediment-impaired. The Eel River has the highest natural sediment load in the United States due to the highly erodible soils in the area, and anthropogenic impacts in the Mainstem Eel River have exacerbated these high loads such that pools have filled and substrate quality is poor. High sediment loads, especially fine sediment, have the potential to decrease the amount of suitable habitat by filling in pools, decrease food availability and impair feeding, increase physiological stress, and ultimately reduce the reproductive success and viability of coho salmon.

Lack of Floodplain and Channel Structure

Floodplain and channel structure relates to the depth, substrate, riparian vegetation, and large wood structures found in the floodplain and channels, which create functioning adult and juvenile coho salmon habitat. Where data are available, pool depths, pool frequencies, and substrate embeddedness measurements indicate poor channel structure. The lack of floodplain and channel structure in the Mainstem Eel River is primarily due to the excessive sediment loads, coupled with the paucity of large wood and riparian vegetation. Roads and the railroad constrict the channel where they occur parallel to the stream.

Riparian Forest Conditions

Late-seral conifer stands no longer occur along most of the riparian zone of the Mainstem Eel River. Their absence causes a loss of shade, decreased wood delivery to streams, and reduced sediment filtration and retention, all of which affect the quality of habitat for coho salmon. Riparian stands are currently dominated by willows, alders, and hardwoods. Large flood events which occurred in the 1950's and 1960's have significantly impacted riparian areas due to sedimentation and damage to riparian trees. Riparian habitat has somewhat rebounded from past large flood events as channels are narrowing and trees are recovering.

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.

Increased Disease/Predation/Competition

The non-native Sacramento pikeminnow preys upon all coho life stages except adults, and also competes with juveniles for limited food and habitat. Sacramento pikeminnow are successful in the Eel River because the severely impacted habitat which is less favorable for salmonids, is suitable for the Sacramento pikeminnow, and as such confers a competitive advantage to this species.

Water Quality

Water temperature is rated as a high stress to fry, juveniles, and smolts. Where water temperature has been measured, many of the moderate to high IP reaches throughout the watershed exceed 17 ºC. Water temperature is affected by lack of riparian vegetation, a high width to depth ratio, and flow quantity. Water temperature in the Mainstem Eel River approaches lethal levels in a number of stream reaches and is stressful in most others, and severely limits the amount of habitat available to juvenile coho salmon. Other water quality issues, including toxins and nutrients, are not known to be a widespread problem.

Altered Hydrologic Function

The amount of water available and the altered flow regime reduce the amount of available habitat for fry and juveniles as well as the migration timing of adults. Scott Dam on the Upper Mainstem Eel River alters the amount and timing of water available to the Mainstem Eel River which decreases instream habitat availability, decreases riparian vegetation, affects adult upstream migration and may influence juvenile migration. Summer base flows in tributaries to the Mainstem Eel River are further affected by rural and urban water withdrawals. Altered hydrology due to impervious areas and changes to the drainage network results in higher peak flows and lower base flows.

Table 42-3. List of complete barriers.

Stream Name	Road Name	Subbasin
Bloyd Creek	Dyerville Loop Rd	Sequoia
Jackass Creek	Railroad	Sequoia
Line Gulch	Alderpoint Rd	Sequoia
McCann Creek	Dyerville Loop Rd	Sequoia
Sequoia Creek	Whitlow Rd	Sequoia
Soda Creek	Railroad	Sequoia
Unnamed tributary	McCann Rd	Sequoia

Impaired Estuary/Mainstem Function

All salmon and steelhead that originate from the Mainstem Eel River population migrate to and from the ocean through 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. The degraded function of the Eel River estuary and mainstem migratory corridor is a high stress for this population. The Eel River estuary is severely impaired because of past diking and filling of wetlands for agriculture and flood protection. Approximately 60 percent of

the estuary has been lost through the construction of levees and dikes (CDFG 2010b). There is evidence that the estuary once supported a high degree of estuarine habitat and rearing potential, but very little of that historic function still exists. The estuary provides rearing, refugia, and ocean transition habitat for coho salmon that originate in the Mainstem Eel River population. This habitat is very important given the degraded habitat conditions and predation and competition with Sacramento pikeminnow in the Mainstem Eel River subbasin. Juveniles, smolts, and adults occupying estuarine habitat are stressed by the degraded conditions in these habitats and suffer from the lost opportunity for increased growth and survival.

Barriers

Barriers to fish passage are not a significant impediment to restoration and viability of the Mainstem Eel River coho salmon population. Barriers known to impede access to all life stages of coho salmon in the Mainstem Eel River population are described in Table 42-3. Most of the barriers will not greatly influence the ability of the population to achieve viability because of the minimal habitat present upstream of the barriers.

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 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.

42.6 Threats

Table 42-4. Severity of threats affecting each life stage of coho salmon in the 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		Egg	Fry	Juvenile	Smolt	Adult	Overall Threat Rank
1	Roads	Very High	Very High	Very High	Very High	Very High	Very High
2	Timber Harvest	High	High	High	High	High	High
3	Dams/Diversion	High	High	High	Medium	High	High
4	High Intensity Fire	High	High	High	Medium	High	High
5	Invasive Non-Native/Alien Species	Low	Medium	High	High	-	High
6	Climate Change	Low	Low	High	High	Medium	High
7	Agricultural Practices	Medium	Medium	Medium	Medium	Medium	Medium
8	Channelization/Diking	Medium	Medium	Medium	Medium	Medium	Medium
9	Mining/Gravel Extraction	Medium	Medium	Medium	Medium	Medium	Medium
10	Urban/Residential/Industrial	Medium	Medium	Medium	Medium	Medium	Medium
11	Road-Stream Crossing Barriers	-	Medium	Medium	Medium	Medium	Medium
12	Fishing and Collecting	-	-	-	-	Medium	Medium
13	Hatcheries	Low	Low	Low	Low	Low	Low

Roads

Roads constitute a very high threat across all life stages in most parts of the watershed due to the abundance of roads in the population. Road density is high in the limited area containing high IP habitat. Most roads in the watershed are dirt or gravel, and prone to deliver sediment to waterways, especially given the unstable geologic types in the population area.

Timber Harvest

Timber harvest was ranked as a high threat because, given the percentage of the watershed that is privately owned by timber companies or managed for timber production. Future timber harvest activities will continue to exacerbate the stresses caused by legacy logging activities. In addition, timber harvest is likely in some of the few areas of high IP located in the western portion of the population area.

Dams/Diversions

Scott Dam and the Potter Valley Project have altered the volume and timing of water discharge and changed the hydrologic regime that Mainstem Eel River coho salmon have evolved with. In addition, localized water diversions for rural residential and agricultural use reduce stream flow during critical juvenile rearing and adult migrating periods.

High Intensity Fire

The altered vegetation characteristics throughout the watershed make high intensity fires more likely than they were historically. Such fires alter sedimentation processes, as well as riparian vegetation characteristics, and ultimately degrade coho salmon habitat. Historically, Native American vegetation management and natural fire cycles created a mosaic of fire resistant vegetation that lessened catastrophic fires. However, vegetation management and prescribed fires are no longer common and thus have contributed to the future threat of high intensity fires.

Invasive Non-Native/Alien Species

The non-native Sacramento pikeminnow competes with and preys on young coho salmon. The warm water temperatures in the Eel River and Lake Pillsbury create ideal conditions for this predator. The presence of the Sacramento pikeminnow 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 a major source population for the Eel River. Once the volume and timing of instream flows are restored to conditions more favorable to coho salmon, there should be more habitats available for juveniles to seek refuge from predation. Further, to the extent that water becomes cooler due to restoration activities, conditions will become less ideal for the pikeminnow.

Climate Change

Climate change in this region will have the greatest impact on juveniles, smolts, and adults. The current climate is generally warm. The modeled regional average temperature is projected to increase by up to 2.6 °C in the summer and by up to 1.2 °C in the winter over the next 50 years (see Appendix B for modeling methods). Annual precipitation in this area is predicted to change little over the next century. However, snowpack in the upper elevations of the Eel River basin will decrease with changes in temperature and precipitation (California Natural Resources Agency 2009).

The Eel River estuary is vulnerable to sea level rise (CDFG 2010b). Juvenile 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 freshwater wetland rearing habitat in the estuary. Adults will likely be negatively affected by ocean acidification and changes in ocean conditions and prey availability (Independent Science Advisory Board 2007; Portner and Knust 2007; Feely et al. 2008).

Agricultural Practices

Grazing occurs throughout the watershed and contributes to increased sediment generation and delivery where animals have access to waterways. In addition, agriculture likely results in riparian vegetation impacts, water withdrawals, diesel spills, and pesticide leaching into streams and groundwater. Water withdrawals for agricultural uses, which can be significant, are considered in the "Dams/Diversions" threat above.

Channelization/Diking

Channelization and diking of the Mainstem Eel River and its tributaries is primarily associated with road building and a defunct rail line that parallels the Mainstem Eel River. See the estuarine function section for information on the effects of channelization and diking upon the estuarine environment.

Mining/Gravel Extraction

Gravel extraction occurs in select areas in the Mainstem Eel River and is conducted with state and Federal oversight. The medium ranking for this threat reflects the sensitivity of the channel to additional disturbances (lack of floodplain and channel structure). Although the gravel mining industry is quite regulated, there is potential for adverse impacts as gravel extraction can influence habitat for great distances.

Urban/Residential/Industrial Development

Future rural residential development is likely once large agricultural holdings are subdivided into smaller ranches. However, the isolation of the area and limited infrastructure development may limit population growth. Rural development will lead to more road building, land clearing, well drilling, septic system construction, and other development, with the associated increase in stresses.

Road-Stream Crossing Barriers

The 5 Counties Program identified several barriers in the lower watershed which have not been resolved. Such barriers would prevent coho access to their respective tributaries. Although these barriers preclude fish access to available habitat, they are not likely to pose a significant impediment to recovery because of the limited extent of habitat available upstream of the barriers.

Fishing and Collecting

California-managed fisheries for species other than coho salmon occur in estuaries, freshwater, and nearshore marine areas. The effects of these fisheries on the continued existence of the SONCC coho salmon ESU have not been formally evaluated by NMFS. As of April 2011, NMFS has not authorized future collection of coho salmon for research purposes in the Mainstem Eel River. However, collections of fish originating from the Mainstem Eel River population could occur in studies being conducted in other Eel River population areas.

Hatcheries

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

42.7 Recovery Strategy

The severely degraded condition of the Mainstem Eel River habitat, combined with the very low coho salmon population size and its restricted distribution, significantly increases the risk of extinction of this inland coho salmon population. One of the strategies which may be necessary to achieve viability would require transfer of coho salmon from nearby populations once sufficient habitat is available to sustain such transferred fish. Identification of long-term restoration actions is also imperative to prevent further habitat degradation and reduce the impacts of past activities. Restoration activities that reduce sediment inputs, increase floodplain connectivity, increase riparian vegetation, increase summer instream flows, and reduce the abundance of Sacramento pikeminnow should be immediately implemented.

Table 42-5 on the following page lists the recovery actions for the Mainstem Eel River population.

Table 42-5. Recovery action implementation schedule for the Mainstem Eel River population.

Action ID / Step ID	Strategy / Step Description	Key LF	Objective	Action Description	Area	Priority
SONCC-MER.2.2.8	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel ponds, alcoves, backwater habitat, and old stream oxbows	Mainstem Eel	2
SONCC-MER.2.2.8.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-MER.2.2.8.2	*Implement restoration projects that improve off channel habitats as guided by assessment results*					
SONCC-MER.2.1.9	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2
SONCC-MER.2.1.9.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-MER.2.1.9.2	*Place instream structures, guided by assessment results*					
SONCC-MER.8.1.14	Sediment	Yes	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	3
SONCC-MER.8.1.14.1	*Assess and prioritize road-stream connection, and identify appropriate treatment to meet objective*					
SONCC-MER.8.1.14.2	*Decommission roads, guided by assessment*					
SONCC-MER.8.1.14.3	*Upgrade roads, guided by assessment*					
SONCC-MER.8.1.14.4	*Maintain roads, guided by assessment*					
SONCC-MER.8.1.15	Sediment	Yes	Reduce delivery of sediment to streams	Improve regulatory mechanisms	Population wide	3
SONCC-MER.8.1.15.1	*Develop grading ordinance for maintenance and building of private roads that minimizes the effects to coho*					
SONCC-MER.8.1.16	Sediment	Yes	Reduce delivery of sediment to streams	Minimize mass wasting	Population wide	3
SONCC-MER.8.1.16.1	*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*					
SONCC-MER.8.1.16.2	*Implement plan to stabilize slopes and revegetate areas*					
SONCC-MER.8.1.17	Sediment	Yes	Reduce delivery of sediment to streams	Work with willing landowners to reduce the effects of timber harvesting	Population wide	3
SONCC-MER.8.1.17.1	*Identify landowners with active NTMPs, THPs, and HCPs where there may be opportunities to reduce the effects of timber harvesting*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MER.8.1.17.2	*Offer incentives and technical support to reduce timber harvesting impacts and incorporate recovery objectives utilizing grant funds*					
SONCC-MER.14.2.2	Disease/Predation/ Competition	No	Reduce predation and competition	Reduce abundance of Sacramento pikeminnow	Population wide	2
SONCC-MER.14.2.2.1	*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-MER.14.2.2.2	*Control Sacramento pikeminnow, guided by the control plan*					
SONCC-MER.1.2.31	Estuary	No	Improve estuarine habitat	Improve estuary condition	Eel River Estuary	3
SONCC-MER.1.2.31.1	*Implement recovery actions to address strategy "Estuary" for Lower Eel/Van Duzen River population*					
SONCC-MER.16.1.19	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-MER.16.1.19.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-MER.16.1.19.2	*Identify fishing impacts expected to be consistent with recovery*					
SONCC-MER.16.1.20	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-MER.16.1.20.1	*Determine actual fishing impacts*					
SONCC-MER.16.1.20.2	*If actual fishing impacts exceed levels consistent with recovery, modify management so that levels are consistent with recovery*					
SONCC-MER.16.2.21	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-MER.16.2.21.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-MER.16.2.21.2	*Identify scientific collection impacts expected to be consistent with recovery*					
SONCC-MER.16.2.22	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

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MER.16.2.22.1	*Determine actual impacts of scientific collection*					
SONCC-MER.16.2.22.2	*If actual scientific collection impacts exceed levels consistent with recovery, modify collection so that impacts are consistent with recovery*					
SONCC-MER.3.1.3	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2
SONCC-MER.3.1.3.1	*Review General Plan or City Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*					
SONCC-MER.3.1.4	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2
SONCC-MER.3.1.4.1	*Create water budgets that avoid over allocating water diversions*					
SONCC-MER.3.1.5	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2
SONCC-MER.3.1.5.1	*Provide incentives to reduce water use by reducing diversion during summer*					
SONCC-MER.3.1.6	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2
SONCC-MER.3.1.6.1	*Establish a forbearance program, using water storage tanks to decrease diversion during periods of low flow*					
SONCC-MER.3.1.6.2	*Monitor forbearance compliance and flow*					
SONCC-MER.3.1.7	Hydrology	No	Improve flow timing or volume	Educate stakeholders	Population wide	BR
SONCC-MER.3.1.7.1	*Provide educational materials describing how to most efficiently use water*					
SONCC-MER.26.1.1	Low Population Dynamics	No	Increase population abundance	Develop a rearing enhancement program to increase population abundance	Population wide	2
SONCC-MER.26.1.1.1	*Assess impacts and benefits associated with different enhancement programs such as captive broodstock, rescue rearing, and conservation hatcheries*					
SONCC-MER.26.1.1.2	*Develop a facility to rear fish*					
SONCC-MER.26.1.1.3	*Operate enhancement program as a temporary strategy to increase population abundance*					
SONCC-MER.26.1.1.4	*Monitor fish populations at all life stages including juvenile snorkel counts, downstream migrant counts, spawning surveys, and PIT tagging*					
SONCC-MER.27.1.23	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3
SONCC-MER.27.1.23.1	*Perform annual spawning surveys*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MER.27.1.24	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life history diversity	Population wide	3
SONCC-MER.27.1.24.1	*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*					
SONCC-MER.27.1.25	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	2
SONCC-MER.27.1.25.1	*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*					
SONCC-MER.27.1.26	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the threat 'Invasive Species'	Population wide	3
SONCC-MER.27.1.26.1	*Annually estimate the density of non-native predators, such as the Sacramento pikeminnow in the Eel River basin*					
SONCC-MER.27.1.26.2	*Identify the status and trend of invasive species*					
SONCC-MER.27.2.27	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3
SONCC-MER.27.2.27.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-MER.27.2.27.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling 10% of the original habitat surveyed*					
SONCC-MER.27.2.28	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3
SONCC-MER.27.2.28.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-MER.27.2.29	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3
SONCC-MER.27.2.29.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-MER.27.1.30	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3
SONCC-MER.27.1.30.1	*Conduct presence/absence surveys for juveniles (3 years on; 3 years off)*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MER.27.1.32	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3
SONCC-MER.27.1.32.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-MER.27.1.32.2		*If appropriate, modify population types and targets using revised methodology*				
SONCC-MER.5.1.13	Passage	No	Improve access	Remove barriers	Population wide, especially: Soda, Jackass, Sequoia, McCann, Bloyd, Line Gulch creeks, and unnamed tributary on McCann Road	3
SONCC-MER.5.1.13.1		*Evaluate and prioritize barriers for removal*				
SONCC-MER.5.1.13.2		*Remove barriers*				
SONCC-MER.7.1.10	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Population wide	3
SONCC-MER.7.1.10.1		*Determine appropriate silvicultural prescription for benefits to coho salmon habitat*				
SONCC-MER.7.1.10.2		*Thin, or release conifers, guided by prescription*				
SONCC-MER.7.1.10.3		*Plant conifers, guided by prescription*				
SONCC-MER.7.1.11	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Reestablish natural fire regime	Tributaries	3
SONCC-MER.7.1.11.1		*Identify areas prone to high intensity fire and develop a plan to reestablish a natural fire regime*				
SONCC-MER.7.1.11.2		*Carry out fuel reduction or modification projects such as thinning, prescribed burning, and piling, guided by the plan*				
SONCC-MER.7.1.12	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Population wide	2
SONCC-MER.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).*				