42. Mainstem Eel River Population

Interior Eel River Stratum

Core, Potentially Independent Population

High Extinction Risk

Population likely below depensation threshold

2,600 Spawners Required for ESU Viability

521 mi^2 watershed (8% Federal ownership)

68 IP-km (42 mi) (13% High)

Dominant Land Uses are Timber Production and Agriculture

Key Limiting Stresses are 'Impaired Water Quality' and 'Lack of Floodplain and Channel Structure'

Key Limiting Threats are 'Invasive Non-native/Alien Species' and 'Dams/Diversions'

Highest Priority Recovery Actions

• Reduce abundance of Sacramento pikeminnow • Improve regulatory mechanisms that avoid over-allocating water diversions • Increase instream flows by providing incentives to reduce diversions in the summer, or implementing a forbearance program	• Construct off-channel habitats, alcoves, backwater habitat, and old stream oxbows • Increase and protect existing cool water and thermal refugia • Identify and enhance non-natal rearing sites

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 timber harvest 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). 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 timber harvest 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 (see Figure 42-1). 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.

The Mainstem Eel River is isolated and predominantly rural. Small population centers of less than 200 to 500 residents occur throughout the drainage, primarily along the Eel River itself. With the establishment of rural residences and smaller ranches, the need for water has increased. In addition, marijuana cultivation 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.

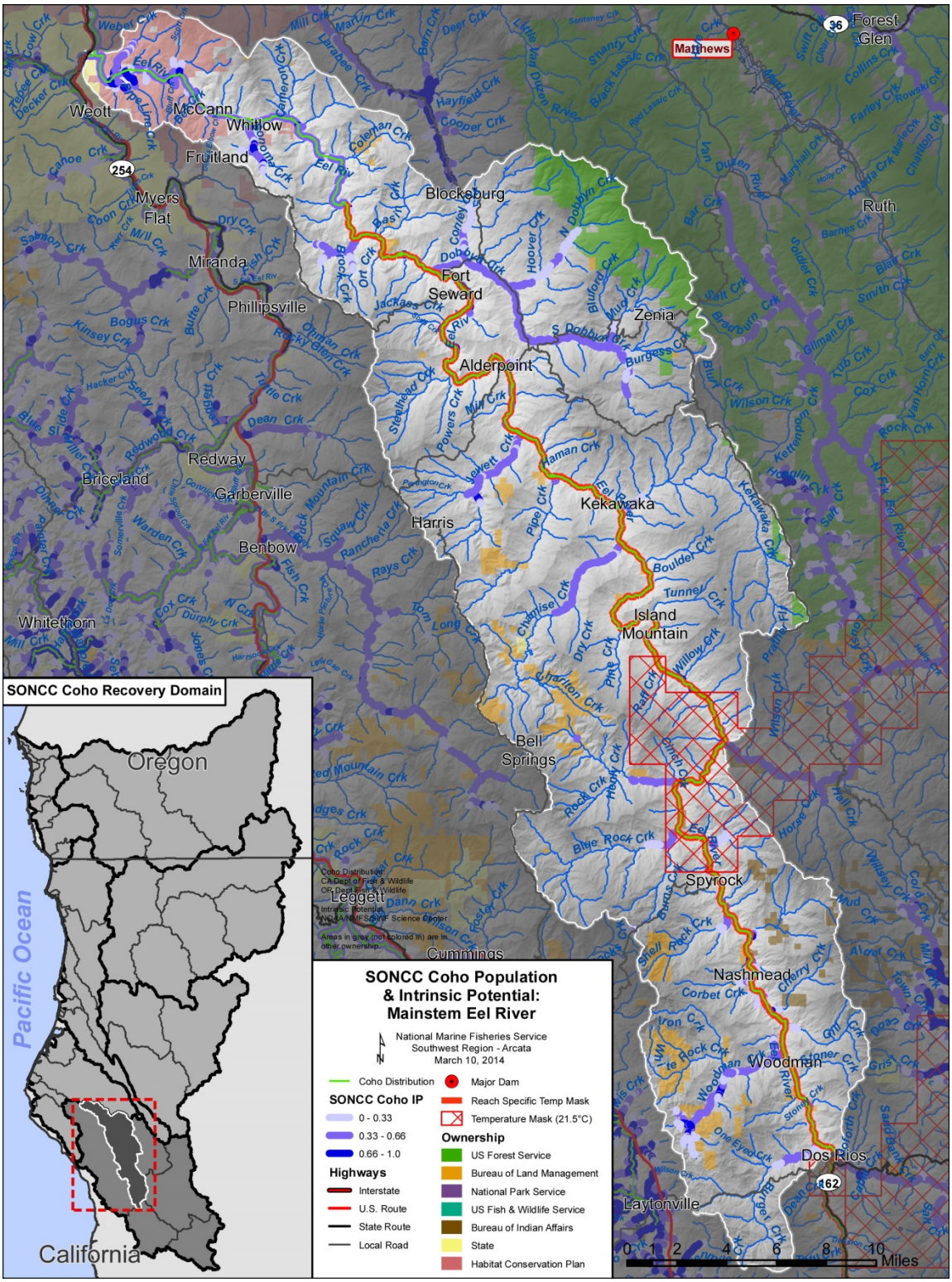

Figure 42-1. The geographic boundaries of the Mainstem Eel River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), a temperature mask (indicating areas that are inherently too warm for rearing coho salmon), land ownership, coho salmon distribution (CDFG 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.

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 with high IP reaches (IP >0.66) (Williams et al. 2006).

Sub-basin	Stream Name	Sub-basin	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 it is expected to be very limited because most of the habitat is extremely degraded. As a result, spatial structure and diversity are limited.

Population Size and Productivity

Williams et al. (2008) determined at least 68 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 it is expected to be negative in most years given the low numbers of fish observed. 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. Therefore, the Mainstem Eel River coho salmon population is at high risk of extinction.

Extinction Risk

The 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). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, pg. 17). These viability criteria reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role in SONCC Coho Salmon ESU Viability

The Mainstem Eel River population is a core, Potentially Independent population within the Interior Eel River diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, but strongly influenced by immigration from other populations such that they did not exhibit independent dynamics (Williams et al. 2006). To contribute to stratum and ESU viability, the Mainstem Eel River core population should have at least 2,600 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. Besides its role in achieving demographic goals and objectives for recovery, as a core population the Mainstem Eel River population may serve as a source of spawner strays for nearby coastal populations. At present, the capacity of the Mainstem Eel River coho salmon population to provide recruits to adjacent independent populations is limited due to its low spawner abundance. Conversely, recruits straying from the nearby South Fork Eel River may enhance recovery of the Mainstem Eel River population.

42.4 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

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 Mainstem Eel River.

Eel River Salmon and Steelhead Restoration Action Plan

In 1997, the California Department of Fish and Game assessed 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 suppressing Sacramento pikeminnow.

42.5 Stresses

Table 42-2. Severity of stresses affecting each life stage of coho salmon in the 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	Altered Sediment Supply	Very High	Very High	Very High	High	Very High	Very High
2	Lack of Floodplain and Channel Structure[1]	Medium	High	Very High[1]	Very High	Very High	Very High
3	Impaired Water Quality[1]	Low	High	Very High[1]	High	Medium	High
4	Degraded Riparian Forest Conditions	-	High	High	High	High	High
5	Increased Disease/Predation/Competition	Low	High	High	High	Low	High
6	Altered Hydrologic Function	Medium	High	Very High	High	Medium	High
7	Impaired Estuary/Mainstem Function	-	Low	High	High	Medium	Medium
8	Barriers	-	Medium	Medium	Medium	Medium	Medium
9	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Medium	Low
10	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low

[1] Key limiting stresses and limited life stage.

Key Limiting Stresses, Life Stages, and Habitat

The key limiting stresses for this population are a lack of floodplain and channel structure and impaired water quality. 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. Juvenile summer and winter rearing success is most limited by unsuitable habitat resulting from high water temperatures and excessive sedimentation. Channel complexity is low due to a lack of deep pools and structure. Low summer flows and warm water temperatures 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 cool water refugia areas. 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 USEPA 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 (Brown and Ritter 1971), 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 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.

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.

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 on banks, 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 1950s and 1960s have significantly impacted riparian areas due to sedimentation and damage to riparian trees.

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 confers a competitive advantage to this species.

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 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. Marijuana is the primary agricultural crop grown in the population area and water diversions to support marijuana growing operations have significantly reduced summer base flows leading to dry and disconnected stream channels. 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).

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 sub-basin. 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.

Table 42-3. Complete barriers in the Mainstem Eel River basin.

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

Adverse Fishery- and Collection-Related Effects

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

Adverse Hatchery-Related Effects

There are no operating hatcheries in the Mainstem Eel River population area or anywhere in the Eel River basin. Hatchery-origin coho salmon may stray into the 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).

42.6 Threats

Table 42-4. Severity of threats affecting each life stage of coho salmon in the Mainstem Eel River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

Threats		Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Roads	Very High	Very High	Very High	High	Medium	Very High
3	Dams/Diversions[1]	High	High	Very High[1]	High	High	High
5	Invasive Non-Native/Alien Species[1]	Low	Medium	High[1]	High	-	High
2	Timber Harvest	High	High	High	High	Medium	High
4	High Severity Fire	High	High	High	Medium	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 Dev.	Medium	Medium	Medium	Medium	Medium	Medium
11	Road-Stream Crossing Barriers	-	Medium	Medium	Medium	Medium	Medium
12	Fishing and Collecting	-	-	Low	Low	Medium	Low
13	Hatcheries	Low	Low	Low	Low	Low	Low

[1]Key limiting threats and limited life stage.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are dams/diversions and invasive non-native/alien species.

Roads

Roads constitute a very high threat across all life stages in most parts of the watershed. 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. Unregulated road construction associated with marijuana cultivation contributes to the very high threat rankings of roads in this population.

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. Marijuana cultivation has become abundant and is likely the primary agricultural crop in the 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).

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.

Timber Harvest

Timber harvest was ranked as a high threat given the percentage of the watershed that is managed for timber production. Future timber harvest activities will continue to exacerbate the stresses caused by legacy timber harvest 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. 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.

High Severity Fire

The altered vegetation characteristics throughout the watershed make high severity 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 this management has contributed to the future threat of high severity fires.

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

Marijuana cultivation has become abundant in many areas of the SONCC coho salmon recovery domain, and marijuana may be the primary crop cultivated in the population area. Although the intensity of marijuana production is unknown each season, the herbicides, pesticides, and fertilizers used to support these plants are likely impairing water quality in coho salmon streams. Water withdrawals for agricultural uses, which can be significant, are considered in the "Dams/Diversions" threat above. Grazing occurs throughout the watershed and contributes to increased sediment generation and delivery where animals have access to waterways.

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 some 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). Even with regulatory oversight, 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 if large agricultural holdings are subdivided into smaller ranches. However, the isolation of the area and limited infrastructure development may limit population growth. Rural development would 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

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

Hatcheries

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

42.7 Recovery Strategy

The degraded condition of the Mainstem Eel River habitat, combined with the very low coho salmon population size and its restricted distribution, 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 increase and protect cold water refugia, reduce sediment inputs, increase the complexity of the channel, increase floodplain connectivity, increase riparian vegetation, increase summer instream flows, and reduce the abundance of Sacramento pikeminnow should be immediately implemented to secure the population and protect it from the effects of low population size. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

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. 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-MER.2.1.37	Floodplain and Channel Structure	Yes	Increase channel complexity	Identify and enhance non natal rearing sites	All streams where coho salmon would benefit immediately, including lower reaches of tributaries and mainstem confluences	2a
SONCC-MER.2.1.37.1	*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-MER.2.1.37.2	*Implement plan to enhance refugia areas*					
SONCC-MER.2.1.62	Floodplain and Channel Structure	Yes	Increase channel complexity	Identify and enhance non natal rearing sites	Population wide	2b
SONCC-MER.2.1.62.1	*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-MER.2.1.62.2	*Implement plan to enhance refugia areas*					
SONCC-MER.2.1.9	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately	2a
SONCC-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.2.1.63	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2b
SONCC-MER.2.1.63.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-MER.2.1.63.2	*Place instream structures, guided by assessment results*					
SONCC-MER.10.3.36	Water Quality	Yes	Protect cold water	Protect existing or potential cold water refugia	All streams where coho salmon would benefit immediately	2a
SONCC-MER.10.3.36.1	*Protect cold water refugia through water conservation efforts (e.g. California Water Code Section 1707, storage, forbearance, etc.)*					
SONCC-MER.10.3.60	Water Quality	Yes	Protect cold water	Protect existing or potential cold water refugia	Population wide	2b
SONCC-MER.10.3.60.1	*Protect cold water refugia through water conservation efforts (e.g. California Water Code Section 1707, storage, forbearance, etc.)*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MER.2.2.8	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately	2a
SONCC-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 to create refugia habitat, as guided by assessment results*					
SONCC-MER.2.2.64	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2b
SONCC-MER.2.2.64.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-MER.2.2.64.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-MER.14.2.2	Invasive, Non-native Species	Yes	Reduce predation and competition	Reduce abundance of Sacramento pikeminnow	Population wide	2a
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 suppression*					
SONCC-MER.14.2.2.2	*Suppress Sacramento pikeminnow, guided by the suppression plan*					
SONCC-MER.10.1.35	Water Quality	Yes	Reduce water temperature, increase dissolved oxygen	Increase cool water and thermal refugia	All streams where coho salmon would benefit immediately	2a
SONCC-MER.10.1.35.1	*Assess sources of cool water and develop techniques to protect and/or improve cool water habitat*					
SONCC-MER.10.1.35.2	*Add LWD, boulders, or sources of structure as guided by assessment to augment habitat at cool water sources*					
SONCC-MER.10.1.35.3	*Increase riparian vegetation and shading at sources of cool water*					
SONCC-MER.10.1.59	Water Quality	Yes	Reduce water temperature, increase dissolved oxygen	Increase cool water and thermal refugia	Population wide	2b
SONCC-MER.10.1.59.1	*Assess sources of cool water and develop techniques to protect and/or improve cool water habitat*					
SONCC-MER.10.1.59.2	*Add LWD, boulders, or sources of structure as guided by assessment to augment habitat at cool water sources*					
SONCC-MER.10.1.59.3	*Increase riparian vegetation and shading at sources of cool water*					
SONCC-MER.1.2.31	Estuary	No	Improve estuarine habitat	Improve estuary condition	Eel River Estuary	2a
SONCC-MER.1.2.31.1	*Implement recovery actions for Lower Eel/Van Duzen River population that address the target "Estuary"*					
SONCC-MER.3.1.53	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2a
SONCC-MER.3.1.53.1	*Work with partners to streamline the process needed for the dedication of water to fish and wildlife resources under CA Water Code section 1707*					
SONCC-MER.3.1.53.2	*Implement water dedications to increase instream flows using the streamlined process*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MER.3.1.58	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	2a
SONCC-MER.3.1.58.1		*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*				
SONCC-MER.3.1.58.2		*Reduce diversions using a combination of incentives and enforcement measures*				
SONCC-MER.3.1.67	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2b
SONCC-MER.3.1.67.1		*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*				
SONCC-MER.3.1.67.2		*Reduce diversions using a combination of incentives and enforcement measures*				
SONCC-MER.5.1.33	Passage	No	Improve access	Remove barrier	Woodman Creek	2b
SONCC-MER.5.1.33.1		*Remove barrier on Woodman Creek*				
SONCC-MER.5.1.13	Passage	No	Improve access	Remove barriers	All streams where coho salmon would benefit immediately, especially: Soda, Jackass, Sequoia, McCann, Bloyd, Line Gulch creeks, and unnamed tributary on McCann Road	2b
SONCC-MER.5.1.13.1		*Evaluate and prioritize barriers for removal*				
SONCC-MER.5.1.13.2		*Remove barriers, based on evaluation*				
SONCC-MER.5.1.68	Passage	No	Improve access	Remove barriers	Population wide	2d
SONCC-MER.5.1.68.1		*Evaluate and prioritize barriers for removal*				
SONCC-MER.5.1.68.2		*Remove barriers, based on evaluation*				
SONCC-MER.3.1.39	Hydrology	No	Improve flow timing or volume	Determine effects of marijuana cultivation	Population wide	2b
SONCC-MER.3.1.39.1		*Assess cumulative effects (e.g., flow, water quality) of marijuana cultivation*				
SONCC-MER.3.1.39.2		*If needed, develop plan to reduce effects of marijuana cultivation*				
SONCC-MER.3.1.39.3		*Implement plan*				
SONCC-MER.3.1.5	Hydrology	No	Improve flow timing or volume	Increase instream flows	All areas where coho salmon would benefit immediately	2b
SONCC-MER.3.1.5.1		*Provide incentives and education to landowners to reduce water consumption and reduce groundwater pumping and surface water diversion by utilizing conservation and storage*				
SONCC-MER.3.1.6	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2b
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*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MER.3.1.56	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	2b
SONCC-MER.3.1.56.1	*Identify and cease unauthorized water diversions*					
SONCC-MER.3.1.65	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2d
SONCC-MER.3.1.65.1	*Provide incentives and education to landowners to reduce water consumption and reduce groundwater pumping and surface water diversion by utilizing conservation and storage*					
SONCC-MER.3.1.66	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2d
SONCC-MER.3.1.66.1	*Identify and cease unauthorized water diversions*					
SONCC-MER.3.1.4	Hydrology	No	Improve flow timing or volume	Provide adequate instream flow for coho salmon	Population wide	2b
SONCC-MER.3.1.4.1	*Conduct study to determine instream flow needs of coho salmon at all life stages.*					
SONCC-MER.3.1.4.2	*If coho salmon instream flow needs are not being met, develop plan to provide adequate flows. Plan may include water conservation incentives for landowners and re-assessment of water allocation.*					
SONCC-MER.3.1.4.3	*Implement coho salmon instream flow needs plan.*					
SONCC-MER.26.1.1	Low Population Dynamics	No	Increase population abundance	Develop a rearing enhancement program to increase population abundance	Population wide	2b
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	*Obtain a permit, and 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 Passive Integrated Transponder (PIT) tagging*					
SONCC-MER.26.1.57	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2b
SONCC-MER.26.1.57.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-MER.3.1.54	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3b
SONCC-MER.3.1.54.1	*Establish a categorical exemption under CEQA for water leasing to increase instream flows*					
SONCC-MER.3.1.55	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3b
SONCC-MER.3.1.55.1	*Establish a comprehensive groundwater permit process*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MER.3.1.34	Hydrology	No	Improve flow timing or volume	Increase instream flows	Woodman Creek	3b
SONCC-MER.3.1.34.1		*Evaluate diversions and water use. Develop a plan to reduce diversions*				
SONCC-MER.3.1.34.2		*Reduce diversions, 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	3b
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)*				
SONCC-MER.8.1.16	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	All streams where coho salmon would benefit immediately	3b
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.8.1.70	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	Population wide	3d
SONCC-MER.8.1.70.1		*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.8.1.70.2		*Implement plan to stabilize slopes and revegetate areas*				
SONCC-MER.8.1.14	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All streams where coho salmon would benefit immediately	3b
SONCC-MER.8.1.14.1		*Assess and prioritize road-stream connection, and identify appropriate treatments*				
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.8.1.69	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	3d
SONCC-MER.8.1.69.1		*Assess and prioritize road-stream connection, and identify appropriate treatments*				
SONCC-MER.8.1.69.2		*Decommission roads, guided by assessment*				
SONCC-MER.8.1.69.3		*Upgrade roads, guided by assessment*				
SONCC-MER.8.1.69.4		*Maintain roads, guided by assessment*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MER.8.1.17	Sediment	No	Reduce delivery of sediment to streams	Work with willing landowners to reduce the effects of timber harvesting	Population wide	3b
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*					
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.10.7.52	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-MER.10.7.52.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-MER.10.7.52.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-MER.10.7.61	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-MER.10.7.61.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-MER.10.7.61.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-MER.3.1.7	Hydrology	No	Improve flow timing or volume	Educate stakeholders	Population wide	3d
SONCC-MER.3.1.7.1	*Provide educational materials describing how to most efficiently use water*					
SONCC-MER.3.1.3	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3d
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.7.1.10	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Population wide	3d
SONCC-MER.7.1.10.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-MER.7.1.10.2	*Thin, or release conifers, guided by the plan*					
SONCC-MER.7.1.10.3	*Plant conifers, guided by the plan*					
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	3d
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 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-MER.16.1.20	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-MER.16.1.20.1	*Determine actual fishing impacts*					
SONCC-MER.16.1.20.2	*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-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	3d
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 level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-MER.16.2.22	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-MER.16.2.22.1	*Determine actual impacts of scientific collection*					
SONCC-MER.16.2.22.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					
SONCC-MER.8.1.15	Sediment	No	Reduce delivery of sediment to streams	Improve regulatory mechanisms	Population wide	3d
SONCC-MER.8.1.15.1	*Develop grading ordinance for maintenance and building of private roads that minimizes the effects to coho*					
SONCC-MER.7.1.11	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Reestablish natural fire regime	Population wide	BR
SONCC-MER.7.1.11.1	*Identify areas prone to high severity 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*					