34. Upper Klamath River Population

- Interior Klamath Stratum
- Core, Functionally Independent Population
- High Extinction Risk
- 8,500 Spawners Required for Population Viability
- 1,400 mi^2
- 425 IP km (264 IP mi) (49% High)
- Dominant Land Uses are Timber Harvest, Grazing, and Rural Development
- Principal Stresses are 'Impaired Water Quality' and 'Lack of Floodplain and Channel Structure'
- Principal Threats are 'Dams/ Diversions' and 'Roads'

34.1 History of Habitat and Land Use

Severe hydrologic alteration of the Upper Klamath River basin has been occurring for over 100 years. Current facilities and operations for irrigation and hydropower include 5 dams and hundreds of miles of canals and pumps which support significant water withdrawals, transfers, and diversions throughout the subbasin. In 1905, the Bureau of Reclamation began developing the Klamath Irrigation Project (KIP) near Klamath Falls, Oregon. Starting around 1912, construction and operation of the numerous facilities associated with the KIP significantly altered the natural hydrographs of the Upper and Lower Klamath River and continues today. Marshes were drained, dikes and levees were constructed (National Research Council 2008), water withdrawal and transfer infrastructure was developed and in 1922 the level of Upper Klamath Lake was raised. The Link River and Keno dams also support the current irrigation project. The KIP now consists of an extensive system of canals, pumps, diversion structures, and dams capable of routing water to approximately 200, 200 acres of irrigated farmlands in the Upper Klamath River subbasin.

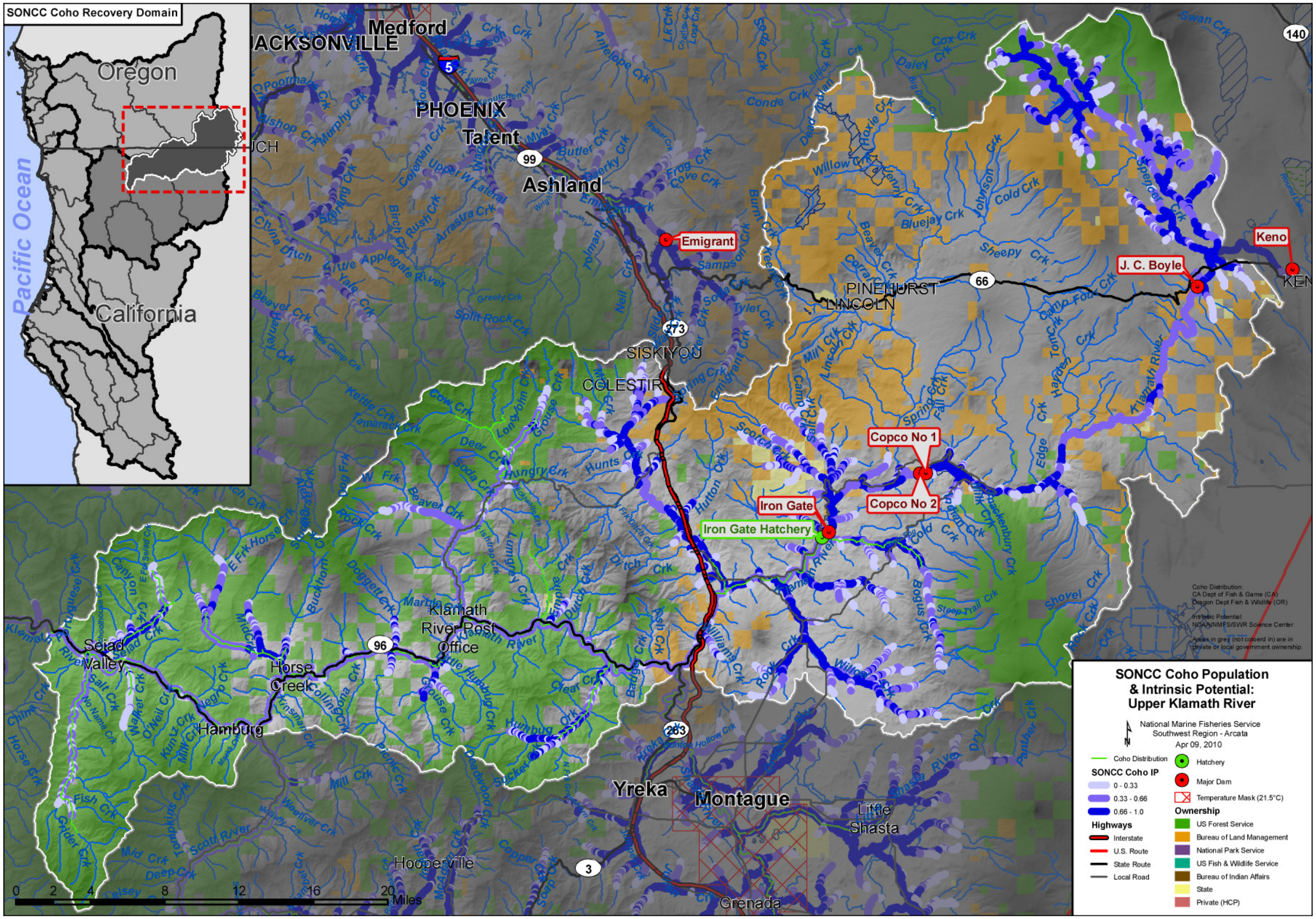

Figure 34-1. The geographic boundaries of the Upper Klamath River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2009a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership).

PacifiCorp operates the Klamath Hydroelectric Project, now consisting of five mainstem dams between river mile 190 and 233. The construction of Copco Dam in 1918 (river mile 199) created the first hydroelectric structure blocking salmon migration into the Upper Klamath River subbasin. The construction of the impassable Copco 2 Dam (1925) and Iron Gate Dam (1962) followed. The reservoir network blocks approximately 58 miles of coho salmon habitat, interrupts the natural passage of flow and sediment, alters the natural hydrograph and degrades Klamath River water quality (Hamilton et al. 2005, NMFS 2007c).

PacifiCorp's license expired on March 1, 2006, and the Project is currently operating on annual extensions granted by the Federal Energy Regulatory Committee (FERC).

Numerous processes are underway to provide long-term fisheries and ecological restoration through fish passage prescriptions or dam removal and to provide interim conservation for coho salmon prior to these large-scale restoration actions.

Hecht and Kamman (1996) analyzed the hydrologic records for similar water years (pre- and post-Project) at several locations throughout the Klamath River basin and concluded that the timing of peak and base flows changed significantly after construction of the KIP, and that the operation unnaturally increases flows in October and November and decreases flows in the late spring and summer as measured at Keno, Seiad, and Klamath. The modeled dataset also clearly shows a decrease in the magnitude of peak flows, a two-month shift in timing of flow minimums from September to July, and a reduction in the amount of discharge in the summer months. Hecht and Kamman (1996) also noted that water diversions in areas outside the Project boundaries occur as well and likely are further influencing the changes in the hydrology in these areas. NMFS (2010) recently analyzed the effects of the KIP on the Upper Klamath population and found impacts to water quality, hydrologic function, habitat quality, access, habitat availability, and disease. In addition to the KIP, agricultural diversions in both the Shasta and Scott Rivers, especially during dry water years, can dewater sections of these rivers, impacting coho salmon making opportunistic use of these streams as well as those in the Klamath River (Moyle 2002). Furthermore, the Bureau of Reclamation's operation of the Rogue River basin project annually diverts an average of 26,973 acre-feet of water from the Klamath River basin (Jenny Creek) to the Rogue River basin (La Marche 2001) further impacting the hydrology in the Klamath River basin.

Timber production has historically been the dominant land use below Iron Gate Dam. Almost all of the Seiad Valley HSA is federally-owned land managed by the Klamath National Forest and approximately half of the Beaver Creek HSA is part of the Klamath National Forest, with the other half composed largely of private timber company holdings. The Klamath National Forest was the principle timber-producing national forest in California during the past several decades, and land in this area continues to be plagued by high road densities and concomitant environmental impacts, namely high watershed erosion rates and compromised fish passage at road/stream crossings. In recent years the Klamath National Forest has aggressively addressed fish passage issues on many of their roads and aquatic conservation policies mandated under the 1994 Northwest Forest Plan have reduced timber harvest activity in sensitive areas and generally improved aquatic function in many Klamath River tributaries. Also, recently in watersheds under private landowner control, habitat conservation plans (HCPs) have begun to be developed to minimize and mitigate timber harvest effects on listed SONCC coho salmon and their habitat (e.g., Fruit Growers HCP). The Hornbrook, Iron Gate and Copco HSAs lie outside the national forest boundaries, but share a similar legacy of human-caused disturbance across the landscape.

34.2 Historic Fish Distribution and Abundance

Historically, coho salmon are thought to have inhabited all accessible stream reaches within the Upper Klamath population unit up to, and including, Spencer Creek (Hamilton et al. 2005, Williams et al. 2008). The current upstream limit for Klamath River salmon is Iron Gate Dam at river mile 190. Based on the historic IP model it appears that coho salmon likely occupied much of the area upstream of the dam and occupied numerous large tributaries. Areas with the highest IP and therefore the likeliest places for historic coho salmon production are listed in Table 34-1.

Table 34-1. Tributaries with instances of high IP reaches. (IP > 0.66).

Subarea[1]	Stream Name	Subarea[1]	Stream Name
Seiad Valley	Seiad Creek	**Iron Gate**	Bogus Creek
	Horse Creek	**Copco**	Scotch Creek
Beaver Creek	Barkhouse Creek		Jenny Creek
	Humbug Creek		Spencer Creek
Hornbrook	Cottonwood Creek	**Hornbrook**	Little Bogus Creek
	Willow Creek		

[1]Subarea refers to hydrologic subarea (HSA) in the CALWATER classification system.

Little information exists to provide insight on the historical abundance of coho salmon within the Upper Klamath River subbasin. Population estimates mostly arose from fishing and canning records within the Lower Klamath River and estuary, and reach-specific estimates for upstream sections of the river do not exist. Snyder (1931) reported the first commercial gill net catch of 11,162 coho salmon in the lower reaches of the Klamath River in 1919 and was the first author to report a concern for declining salmon populations in California, due to commercial fishing, forestry and agricultural practices. Long-term monitoring data suggests a marked decrease in abundance of adult coho salmon by the 1950s, which likely resulted from over-harvest and habitat loss (Klamath River Basin Fisheries Task Force 1991, Weitkamp et al. 1995, California Department of Fish and Game (CDFG) 2004c). By 1983, the annual escapement abundance of Klamath River basin adult coho salmon was estimated to range from 15,000 to 20,000 fish (Leidy and Leidy 1984). These estimates, which include hatchery stocks, could be less than six percent of the abundance in the 1940s (Weitkamp et al., 1995, CDFG 2004b). Ackerman et al. (2006) recently developed a run size approximation for tributaries in the Upper Klamath using reports from the USFWS and making the assumption that approximately 100 fish spawn in the mainstem. The total estimated returns for the population from 2001 to 2004 were between 600 to 4,000 fish and returns and strays from Iron Gate Hatchery make up a substantial portion of the overall population abundance.

34.3 Status of Upper Klamath River Coho Salmon

Spatial Structure and Diversity

The Upper Klamath River population unit is currently comprised of approximately 64 miles of mainstem habitat and numerous tributaries to the mainstem Klamath River upstream of Portuguese Creek to Iron Gate Dam. Historically, the population extended upstream of Iron Gate Dam to Spencer Creek. The PacifiCorp Hydropower Project, of which Iron Gate Dam is the lowest of five mainstem dams, blocks access to approximately 58 miles of spawning, rearing and migratory habitat for anadromous fish. As a result, coho salmon within the Upper Klamath River population spawn and rear primarily within several of the larger tributaries between Portuguese Creek and Iron Gate Dam, namely Bogus, Horse, Beaver, and Seiad Creeks. A small proportion of the population spawns within the mainstem channel, primarily within the section of the river several miles below Iron Gate Dam. A population of coho salmon parr and smolts rear within the mainstem Klamath River by using thermal refugia near tributary confluences to survive the high water temperatures and poor water quality common to the Klamath River during summer months.

Many of the streams comprising the Upper Klamath population unit are small and may go dry near their confluence with the mainstem Klamath River. Yet these intermittent tributaries remain important rearing habitat for coho salmon. Coho salmon have adapted life history strategies (spatial and temporal) to use intermittent streams. For example, adult coho salmon will often stage within the mainstem Klamath River at the mouth of natal streams until hydrologic conditions allow them to migrate into tributaries, where they are able to find more suitable spawning conditions, and juveniles can find adequate rearing conditions and cover. In summer when the lower sections of these tributaries may go dry, the shaded, forested sections upstream provide cold water over-summering rearing habitat for juvenile coho salmon. By early spring, when outmigration of one-year old coho salmon primarily occurs, base flows of these small streams are relatively high and full connectivity to the mainstem Klamath River exists.

Surveys by CDFG between 1979 to 1999 and 2000 to 2004 showed coho salmon as being moderately well distributed downstream of Iron Gate Dam in the Upper Klamath population unit. Juveniles were found in 21of the surveyed 48 tributary streams (Jong et al. 2008). Streams with coho salmon presence in both 1979 to 1999 and 2000 to 2004 included Grider, Seiad, Horse, Walker, Beaver, W. Fork Beaver, Cottonwood, Bogus, Little Bogus, and Dry creeks. Additional juvenile surveys conducted between 2002 and 2005 found fish using Tom Martin, Walker, Seiad, Grider, Beaver, Humbug, O'Neil, and Horse Creeks (Karuk Tribe 2009). No juveniles were found in Lumgrey, Willow, Bittenbender, Barkhouse, Empire, Cottonwood, Bogus, and Kuntz Creeks during these surveys. Adult spawning surveys between 2003 and 2005 found adults spawning in Canyon Creek (tributary to Seiad), Seiad Creek, and Grider Creeks (Karuk Tribe 2009). No evidence of spawning was found in Little Horse Creek.

Little is known about the genetic and life history diversity of the population, however, the population is highly influenced by the hatchery and has likely experienced a loss of life history diversity due to environmental conditions and loss of habitat. Currently, genetic work is being conducted to determine the genetic makeup of wild and hatchery fish from the Upper Klamath and it is likely to show that the combination of high stray rates and inbreeding at the hatchery has reduced the genetic diversity of the population. Given that most of the fish in the population come from the hatchery and the fact that hatchery fish are also known to have reduced life history diversity (e.g., all released as yearling smolts from one location), the overall life history diversity of the population is likely limited. The loss of habitat upstream of Iron Gate Dam and poor conditions in the mainstem between April and September also contribute to the loss of life history diversity. Smolt and adult migration is now confined to a short period of time when conditions in the mainstem are favorable and mainstem rearing and spawning is likely reduced from historic levels given the degradation of mainstem habitat.

In summary, the more restricted and fragmented the distribution of individuals within a population, and the more diversity, spatial distribution, and habitat access diverge from historical conditions, the greater the extinction risk. Williams et al. (2008) determined that at least 20 coho salmon per-IP km of habitat are needed (8,500 spawners total) to approximate the historical distribution of Upper Klamath River coho salmon and habitat. The current population is well below this and has a reduced genetic and life history diversity. Overall, the Upper Klamath River coho salmon population is at an elevated risk of extinction because its spatial structure and diversity are substantially limited compared to historical conditions.

Population Size and Productivity

If a spawning population is too small, the survival and production of eggs or offspring may suffer because it may be difficult for spawners to find mates, or predation pressure may be too great. This situation accelerates a decline toward extinction. Williams et al. (2008) determined at least 425 coho salmon must spawn in the Upper Klamath River each year to avoid such effects of extremely low population sizes (depensation threshold). The low risk spawner threshold for the population is 8,500 spawners.

Based on juvenile surveys in the Upper Klamath between 2002 and 2005 there is low production in the Upper Klamath tributaries with fewer than 200 juveniles found in most tributaries and most years (Karuk Tribe 2009). The greatest number of juveniles was just over 1000, which were found in Horse Creek in 2005. Spawning surveys also give an indication of the population size and productivity. In 2003 the total spawner abundance for surveyed streams was 10 adults and in 2004 it was 108 adults with the majority of fish found spawning in Seiad and Grider Creeks (Karuk Tribe 2009).

A weir on Bogus Creek, monitored returns to the hatchery, and various tributary spawner surveys provide some indication of what the population size might be presently (Figure 34-2). Returns to the hatchery between 2004 and 2009 have averaged around 900 fish with the lowest returns (70) in 2009 and the highest returns (1,495) in 2004. Returns to Bogus Creek are largely driven by hatchery strays but have averaged around 150 fish. Tributary spawner surveys indicate low numbers of coho salmon (<100) in the remaining habitat. Using a variety of methods, including these data and an Intrinsic Potential (IP) database, Ackerman et al. (2006) developed run size approximations for tributaries in the Upper Klamath River reach. Ackerman et al. (2006) estimated the recent abundance of the Upper Klamath River population unit to be between 100 and 4,000 adults, far lower then the 8,500 spawners needed for the low risk spawner threshold that Williams et al. (2008) defined for the Upper Klamath River. Therefore, the Upper Klamath

River population unit is at high risk of extinction given its low population size and negative population growth rate.

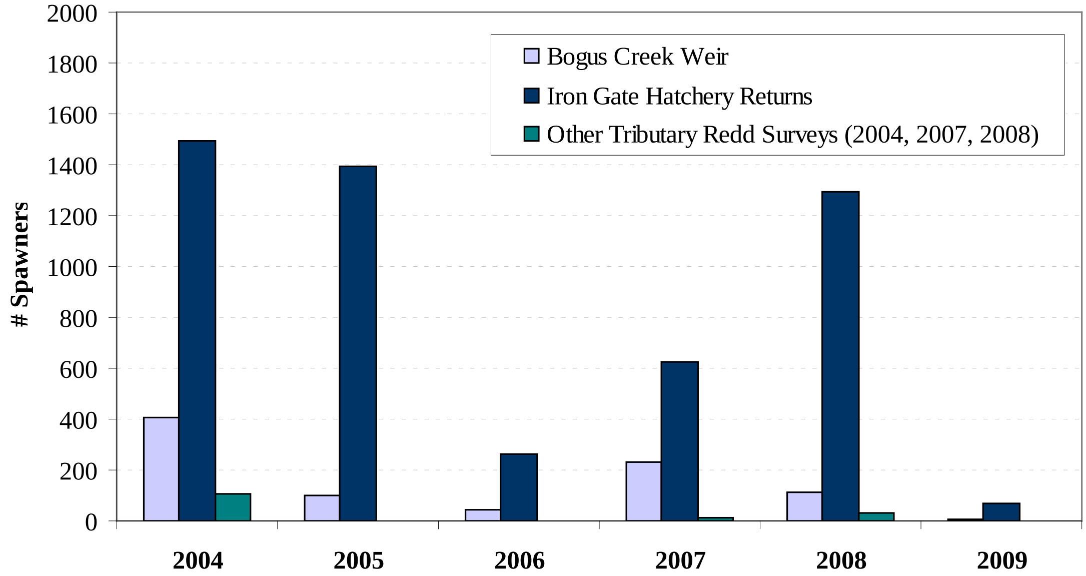

Figure 34-2. Returns of coho salmon to the Upper Klamath population. Based on data from various sources.

The population growth rate of the Upper Klamath population has not been estimated but given the current trends in spawner abundance and the high incidence of hatchery fish and inbreeding depression, it is likely that population growth is negative. The combination of low population abundance and a negative population growth rate mean that the population is at an elevated risk of extinction.

Extinction Risk

The Upper Klamath River coho salmon population of coho salmon is not viable and at high risk of extinction according to the population viability criteria. The number of spawners is below the depensation threshold and more than 5 percent of the spawners were born in a hatchery (Table ES-1 in Williams et al. 2008).

Role in SONCC Coho Salmon ESU Viability

The Upper Klamath population is considered a non-core "Functionally Independent" population within the Interior Klamath diversity stratum. This means 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 (Bjorkstedt et al. 2005, Williams et al. 2006). As a non-core population the recovery target for the population is for it to have at least a moderate risk of extinction according to the population viability criteria (see Chapter 2). 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, the Upper Klamath population fulfills other needs within the Interior Klamath diversity stratum. Upper Klamath tributaries, refugia, and mainstem habitat function as migration and rearing habitat for Scott and Shasta juveniles, smolts, and adults. Therefore restoration of the Upper Klamath is important for recovery of these populations as well.

34.4 Programs and Plans

Mid-Klamath Watershed Council

U.S. Forest Service

The Klamath National Forest (KNF) has conducted numerous watershed assessments and developed a Forest Land and Resource Management Plan (RMP) for National Forest lands within the Upper Klamath River subbasin. Relevant management plans and analysis reports that affect coho salmon in the Upper Klamath include:

Sufficiency Assessment: Forest Service and Bureau of Land Management Programs in Support of SONCC Coho Salmon Recovery (USFS and BLM 2011)

The USFS has adopted a Watershed Condition Framework assessment and planning approach (USFS and BLM 2011). The Watershed Condition Framework (WCF) is a comprehensive approach for proactively implementing integrated restoration on priority watersheds on national forests and grasslands. The WCF provides the Forest Service with an outcome-based performance measure for documenting improvement to watershed condition at forest, regional, and national scales. As part of the WCF, Seiad Creek and Antelope Creek were identified as high priority 6th field subwatersheds in the Klamath National Forest (USFS and BLM 2011)

The Klamath National Forest Land and Resource Management Plan

Klamath National Forest Road Analysis

Forest-Wide Late Successional Reserve Analysis

Watershed Condition Assessment

Thompson/Seiad/Grinder Ecosystem Analysis

Horse Creek Watershed Analysis

Callahan Watershed Analysis

Karuk Tribal Fisheries Department and Restoration Division

Middle Klamath Restoration Partnership (MKRP)

Klamath River Basin Conservation Area Restoration Program

Mid-Klamath Sub-basin Fisheries Resource Recovery Plan

In 2003, the Karuk Tribe developed this fisheries resource plan (Soto et al. 2003) to identify core variables pertaining to ecological function in the subbasin, and to provide management priorities and objectives to guide efforts to improve conditions in the subbasin. The Tribe will administer the long-range plan, in cooperation with federal and state management agencies, private landowners, and local communities. The resource plan focuses on active restoration of those processes most degraded by historic and current land uses and passive restoration for protection of currently functioning subbasin processes.

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 recommendations developed by CDFG for the mid-Klamath population have been considered and incorporated into the recovery strategy and list of recovery actions for this population.

34.5 Stresses

Table 34-2. Severity of stresses affecting each life stage of coho salmon in the Upper Klamath 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[1]	Adult	Overall Stress Rank
1	Barriers[1]	-	Very High	Very High	Very High	Very High	Very High
2	Adverse Hatchery-Related Effects	Very High	Very High	Very High[1]	Very High[1]	Very High	Very High
3	Impaired Water Quality[1]	Low	Medium	Very High[1]	High	High	High
4	Altered Hydrologic Function[1]	Low	Medium	Very High[1]	High	High	High
5	Lack of Floodplain and Channel Structure	Low	High	Very High[1]	High	Medium	High
6	Increased Disease/Predation/Competition	Low	High	High	Very High[1]	Medium	High
7	Altered Sediment Supply	High	High	High	High	High	High
8	Degraded Riparian Forest Conditions	-	Medium	High	High	High	High
9	Impaired Estuary/Mainstem Function	-	High	High	High	High	High
10	Adverse Fishery-Related Effects		-	-	-	Medium	Medium

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

Limiting Stresses, Life Stages, and Habitat

Several factors limit the viability of the Upper Klamath population. The most dominant of these factors stem from the effects of the mainstem hydroelectric dams on water quality, hydrologic function, floodplain and channel structure, disease, and habitat access upstream of Iron Gate Dam. The hatchery also plays an important role in limiting the Upper Klamath population through negative genetic and ecological interactions. Looking at the overall productivity of the population, the juvenile and smolt life stages are most limited due to the degradation of summer and winter rearing habitat and the issues associated with disease and water quality that affect survival and growth in the mainstem Klamath.

Key limiting stresses are barriers, altered hydrologic function, and impaired water quality. The loss of approximately 58 miles of habitat upstream of Iron Gate Dam, much of which is high quality spawning and rearing habitat, severely limits the spatial structure and natural productivity of the population. The presence of the KIP and hydroelectric project has led to additional limiting stresses related to the loss of flow variability and impaired water quality. These impairments have led to the loss of rearing and migratory habitat and an increase in the incidence of disease among other, less significant impacts (NMFS 2007c, NMFS 2010).

In terms of the types of habitat that are limited in the Upper Klamath it appears that summer and winter rearing habitat for juveniles is lacking but that spawning habitat is likely adequate given the number of adult coho salmon returning. The period of time when smolt migratory conditions in the mainstem are adequate has also been shortened and therefore is limited in time. In the summer, the diversion and impoundment of water continues to lead to poor hydrologic function, disconnection and diminishment of thermal refugia, and poor water quality in tributaries and the mainstem. Most tributaries with summer rearing potential are highly impacted by agriculture and past timber harvest. There exist very few remaining areas downstream of Iron Gate Dam with the potential and opportunity for summer rearing. Based on the low abundance of streams with age-1 coho salmon, it appears that overwintering survival may also be low or overwintering habitat may be limited in the Upper Klamath. Five of the nine streams with juvenile coho salmon presence had no age-1 juveniles found (Karuk Tribe 2009). Winter rearing habitat has been primarily impacted by the past mining and diking activities in many tributaries, which has led to the loss and degradation of floodplain and channel structure. The majority of winter habitat that does exist is small, degraded, and poorly connected. Because of the increased incidence of disease and water quality issues in the mainstem in late spring and summer the time period of adequate migratory conditions is limited to early spring (March-May). After this time period, growth and survival are appreciably reduced.

In order to improve the viability of this population it will be imperative to address these limiting stressors and to improve habitat and conditions for the juvenile life stage. Addressing other stresses and threats and improving habitat for all life stages and life history strategies will also be an important component of recovery for this population.

Tributary thermal refugia are one of the most vital habitat types in the Upper Klamath population unit due to its importance for rearing and migration in the Klamath River. The Mid Klamath Watershed Council and Yurok tribe have collected temperature data in tributaries and the mainstem Middle Klamath River (MKWC 2006) and surveyed potential refugia areas to assess where refugial areas are available and used by juvenile coho salmon. These tributaries provide cooler water temperatures important as refuge from the elevated water temperatures in the mainstem Klamath River (Table 34-3). The presence of juveniles in these tributaries, especially when water temperatures in the mainstem Klamath River are high, supports the conclusion that they are used as refugia areas. Based on the estimated 250 cfs of constant cold groundwater accretion to the mainstem Klamath River in the JC Boyle reach, the highest quality refugial habitat likely lies upstream of Iron Gate Dam.

Table 34-3. Potential refugia areas. Areas are within the geographic boundaries of the Upper Klamath population unit.

Subbasin	Stream Name	Subbasin	Stream Name
Hornbrook	Bogus Creek	Hornbrook	Cottonwood Creek
Hornbrook	Willow Creek	Beaver Creek	Barkhouse Creek
Beaver Creek	Humbug Creek	Seiad Valley	O'Neil Creek
Beaver Creek	Beaver Creek	Seiad Valley	Seiad Creek
Seiad Valley	Horse Creek	Seiad Valley	Grider Creek

Other important vital habitat exists in Seiad Creek where habitat conditions are good enough to support consistent coho salmon use throughout the year and from year to year. Its distance from Iron Gate Hatchery also means that it has less hatchery influence than other, more proximate, tributaries. Restoration to improve winter rearing habitat in this watershed will add to its importance in supporting natural fish production in this population.

Barriers

Instream barriers restrict the spatial structure and prohibit access to upstream habitat therefore creating a very high stress to the population. The most significant barriers within the watershed are Iron Gate Dam and Copco 1 and 2 Dams, which have blocked upstream access to approximately 58 miles of coho salmon habitat for several decades. Diversion dams, alluvial barriers, low flow conditions, and poorly functioning road/stream crossings also block passage by juvenile and/or adult fish in several mainstem tributaries within the watershed (e.g., Seiad and Cottonwood Creeks). Records indicate that there are approximately 57 unscreened diversions and 43 total or partial road crossing barriers that could exist in the Upper Klamath population area (CalFish 2009). The most notable road-stream crossing barriers exist on Highway 96 at Tom Martin Creek and on Seiad Creek Road at Canyon Creek. Many push up dams and diversions seasonally block access to high IP habitat and vital cold-water rearing habitat. A push-up dam on Horse Creek acts as a barrier when combined with low flow conditions in the stream, preventing both upstream and downstream access to high quality rearing habitat and refugia. Low flow conditions in Empire, Willow, Cottonwood, Lumgrey, Barkhouse, Seiad, Horse, and Humbug Creeks create flow barriers as well (MKRP 2010). Also, the loss of flushing flows in the mainstem Klamath has caused alluvial barriers to seasonally form at the mouths of mainstem tributaries (e.g., Walker, O'Neil, and Grider Creeks) where they act as barriers to fish migration, further decreasing spatial structure and habitat availability (MKRP 2010).

Adverse Hatchery-Related Effects

The effects of hatchery fish on all life stages of coho salmon are described in Chapter 3. Iron Gate Hatchery (IGH), which is located in the Upper Klamath River population area, releases approximately 6 million Chinook salmon, 75,000 coho salmon, and 200,000 steelhead annually. The hatchery releases Chinook salmon under a volitional release program from the middle of May to the end of June, a time when discharge from Iron Gate Dam is usually in decline and water temperatures are increasing, further increasing stressful conditions for wild, juvenile coho salmon. Adult coho salmon are counted at Iron Gate Hatchery, where the proportion of hatchery fish is likely to be the highest in the entire basin due to the homing of hatchery fish to the place they were born. From 1996 to 2010, on average 77 percent of these adults were born in a hatchery (Chesney and Knechtle 2011a). Adult coho salmon were observed at a video weir on Bogus Creek, a tributary of the Klamath which breaks from the Klamath at Iron Gate Hatchery. From 2004 to 2010, on average 34 percent of observed adults at Bogus Creek were of hatchery origin (Knechtle and Chesney 2010). Adverse hatchery-related effects pose a very high stress to all life stages because hatchery origin adults make up greater than 30 percent of the total number of adults (Appendix B).

Impaired Water Quality

Impaired water quality within the Upper Klamath River watershed creates a high stress for the population and is especially harmful for juvenile coho salmon. Water quality within the Upper Klamath subbasin varies spatially and temporally. Water temperature and quality within both mainstem and tributary reaches are often stressful to juvenile and adult coho salmon during late spring, summer, and early fall months. Generally, water quality conditions are suitable for coho salmon from late fall through early spring. However, by late spring (April-May) water quality can become impaired, especially in the mainstem Klamath River, where the combination of elevated water temperatures and high nutrient loads can create stressful conditions for coho salmon and increase risks to survival of juveniles. Water quality is generally poor within the Upper Klamath watershed during much of the summer and early fall when mainstem water temperatures can exceed lethal thresholds above 25°C. MKWC documented mainstem and tributary temperatures in the summer of 2006 and showed that while mainstem temperatures are often higher than the range of coho salmon suitability (>19 ºC), tributary temperatures are suitable (<19 ºC) in these areas for coho salmon in the summer (MKWC 2006). Upstream impoundments and water withdrawals contribute to seasonal and daily changes in temperature regimes in the mainstem Upper Klamath. Seasonally, these impoundments create a thermal lag resulting in a delay in spring warming and fall cooling of mainstem temperatures. Daily, there is little diurnal variation in temperature and little if any of the natural nighttime cooling that would also help fish to recover. Summer water quality can vary within Upper Klamath River tributaries as well, and is heavily influenced by riparian corridor condition, instream sediment levels, and the extent to which diversions dewater the stream channel. Tributaries tend to have cooler stream temperatures in their upper reaches and warmer temperatures in their degraded lower reaches. Most reaches with IP habitat have fair to poor water temperatures (>16.1 °C MWAT) (CAP data). Elevated seasonal stream temperatures impact juvenile coho salmon growth and survival during the summer, and, to a lesser degree, fry and smolt growth and survival in tributaries during late spring.

During the summer dissolved oxygen (DO) concentrations and pH can also become degraded downstream of Iron Gate Dam due to temperature trends and the decreased quality and quantity of water emanating from reservoirs upstream. The mainstem Klamath generally has fair to poor DO conditions (<6.75 mg/l) (CAP data). Levels of pH in the mainstem are also rated as fair to poor (>8.5 annual maximum based on CAP data). Dissolved oxygen can reach as low as 5.5 mg/L in the mainstem downstream of the dam (North Coast Regional Water Quality Control Board 2010). Related to DO and temperature trends, pH tends to rise throughout the summer, peaking in late August and fluctuating widely between day and night (NMFS 2007b). Elevated levels of nutrients and algae also contribute to poor water quality conditions since nutrient cycles and algae levels are altered by reservoir dynamics and can influence water quality in downstream reaches below Iron Gate. In tributaries, measures of aquatic invertebrates indicate there could be pollution in some reaches of Spencer Creek, Beaver Creek, and Walker Creek. Impaired water quality in the mainstem during the summer likely limits use of these habitats by juveniles and restricts rearing to tributary and confluence habitat where water quality is better. Poor water quality also contributes to increased stress levels, reduced growth, and increased susceptibility to disease.

Altered Hydrologic Function

Coho salmon in the Upper Klamath are negatively impacted by the altered hydrologic function within the Upper Klamath River and its tributaries. Spawning and rearing habitat and individuals in the mainstem are primarily impacted by the irrigation and hydroelectric projects both upstream of Iron Gate Dam and within the Scott and Shasta watersheds. Both the timing and volume of flows is manipulated by diversion and dam activities leading to altered life-history adaptations and degraded rearing and migratory conditions critical to juvenile coho salmon survival. The altered hydrologic regime and poor water quality conditions likely increase disease susceptibility within the upper Klamath River, elevating disease infection rates and ultimately the loss of juvenile coho salmon. The altered hydrologic function is primarily the result of extensive water withdrawals and the impoundment and control of flows in the mainstem as a result of the Klamath Irrigation Project and PacifiCorp Hydroelectric Project (NMFS 2007c, NMFS 2010). These activities have severely altered the natural timing and volume of flows in the mainstem Klamath River. This change in hydrologic function has shifted the timing and duration of the spring peak-flow event, causing spring flows to peak approximately a month earlier and subside to summer baseflow approximately two months earlier during most years. As a result, important life history strategies/traits (e.g., smolt outmigration timing, spring juvenile/fry redistribution) have now been either modified or lost entirely due to the hydrologic shift. The earlier onset of summer baseflow conditions also prolongs poor water conditions and causes them to overlap with the timing of peak smolt outmigration through the mainstem reach. Changes to the flow regime have also been linked to increased incidences of disease (Bartholomew 2008). In addition to altered hydrologic regimes in the mainstem river, several tributary streams also experience significant alterations to their hydrology and summer base flow are often too low to support rearing and migration. Low flow conditions in Empire, Willow, Cottonwood, Lumgrey, Barkhouse, Seiad, Horse, and Humbug Creeks have been shown to create flow barriers and impaired summer rearing conditions (MKRP 2010). Generally the flow regime has been rated as fair (partially functional) in Cottonwood Creek, Seiad Creek, and Walker Creek and poor (non-functional) in Beaver Creek, Humbug Creek, Horse Creek, and

Bogus Creek. Grider Creek and Shovel Creek are thought to have functional flow regimes (CAP data based on USFS judgment).

Lack of Floodplain and Channel Structure

The lack of floodplain and channel structure presents a high stress for the population and primarily affects fry, juveniles, and smolts. Tributary and mainstem habitat complexity is limited by a lack of coarse sediment and wood, modified flows, remnant dredge piles, and impaired riparian function. Additionally, many tributary streams suffer from high sediment levels, poor riparian habitat, and overall poor instream habitat complexity and volume. In many tributaries fine sediment has also filled pools, off-channel ponds, and wetlands. Past mining activities and levy construction have also led to limited floodplain complexity and connectivity (e.g., Seiad and Horse Creeks). The primary issue in the mainstem is the lack of flushing flows which would naturally lead to the creation and maintenance of side and off-channel habitat. Although large wood and complex floodplain habitat were not dominant features of the historic mainstem Klamath River channel, this area continues to lack adequate rearing and spawning habitat. Floodplain connectivity (based on USFS judgment) is generally fair (partially functional) in the Beaver Creek, Seiad Creek, Walker Creek, Bogus Creek, and Shovel Creek watersheds and generally poor (non-functional) in the Humbug Creek, Cottonwood Creek, and Horse Creek watersheds. The one exception was Grider Creek which was rated as having very good (fully functional) floodplain connectivity (CAP data). Wood frequencies have not been quantified in many tributaries but in Camp Creek and at Jenny Creek they were found to be poor (<1 key piece/100m) (ODFW CAP data). Juveniles and smolts are most limited by poor habitat complexity within tributary reaches and refugia due to the need for off-channel winter refugia and complex rearing and refugial habitat. Fry are affected by the lack of refugia from high flows and predation and a lack of complex rearing habitat in tributaries.

Increased Disease/Predation/Competition

The combined effect of increased disease, predation, and competition is a high to very high stress for juveniles and smolts and a medium stress for adults. Of these three stressors, disease is the most significant; however competition and predation by hatchery fish are also issues occurring in all Klamath River populations. Pathogens that cause diseases in juveniles include *Ceratomyxa shasta*, *Flavobacterium columnare* (columnaris), Aeromonid bacteria, *Nanophyetus salmonicola*, and the kidney myxosporean *Parvicapsula minibicornis* (FERC 2007). Of the aforementioned biological vectors, infection by the myxozoan *C. shasta* (and co-infection by a second myxozoan, *Parvicapsula minibicornis*) has the most significant effect on survival of coho salmon in the subbasin (Nichols et al. 2003, Bartholomew 2008). Disease effects vary annually based on water temperature, water year, and other factors (Bartholomew 2008). Spatially and temporally, mortality rates from exposure to disease vary by location and time of year but are consistently higher between Iron Gate Dam and the Scott River and are highest April through July (Bartholomew 2008). Given that most juveniles rear in tributaries (Lestelle 2007) the greatest impacts are to smolts during emigration. Average mortality is estimated to be approximately 50 percent at 17 °C and approximately 12 percent at 15 °C in the Upper Klamath and studies show mortality could be much higher at some sites (Table 34-4). The long migration and exposure of this population to disease means that it is one of the most susceptible to disease and most likely to experiences abnormally high disease-induced mortality (Bartholomew 2008).

Table 34-4. Percent loss of coho salmon exposed at various Upper Klamath River sentinel sites. The salmon were exposed for 72 hours in May or June 2008 and subsequently held for 65 or more days at the Salmon Disease Laboratory in a 16 to18 °C water supply (Bartholomew 2008).

	Percent Loss	
Exposure Sites	**May**	**June**
Klamathon	21.4	20.0
Beaver Creek	82.9	88.6
Seiad Valley	46.0	87.5

Researchers believe modifications to the river's historical hydrologic regime have likely created instream conditions that favor disease proliferation and fish infection (Stocking and Bartholomew 2007). Less frequent fall pulse-flows are likely affecting disease transmission from adult salmon carcasses to the intermediate polychaete host, increasing the potential for juveniles and smolts to become infected. In an unaltered hydrologic regime, fall and winter freshets help distribute salmon carcasses downstream into lower sections of the watershed, effectively dispersing nutrients, as well as infective spores that enter the aquatic environment as the carcass decomposes. The current flow regime does not effectively redistribute carcasses within the reach between Iron Gate Dam and the Shasta River, resulting in high densities of decomposing fish downstream of popular spawning areas.

In addition to disease impacts, there are competition and predation pressures that act to limit coho salmon productivity and survival. Competition with hatchery fish for habitat and refugia may affect the growth and survival of juvenile coho salmon. Chinook, steelhead, and coho salmon fingerling released from Iron Gate Hatchery may not only compete with yearling and sub-yearling wild coho salmon but may also predate on sub-yearling coho salmon. Some steelhead may also remain in the Upper Klamath and exert additional predation pressure on juvenile coho salmon. These types of impacts have been identified in other Klamath tributaries such as the Trinity River (Naman 2008) but their prevalence and impacts are unknown for this population. Another important but unknown impact may be predation by non-native brown trout on juvenile coho salmon. Brown trout are rarely found in the Scott, Shasta, and Bogus Creek but they have been documented to co-occur with juvenile coho salmon and may have seasonal or local effects on juvenile populations (Hampton 2010).

Altered Sediment Supply

Altered sediment supply is considered a high threat to the population due to the excess of fine sediment delivery and the lack of adequate spawning gravel. Past and present land use practices continue to deliver fine sediment into the mainstem and many important tributary streams between Iron Gate Dam and Seiad Creek. High sediment levels degrade tributary rearing habitat by filling in pools and simplifying instream habitat complexity. Many Upper Klamath tributaries contain excessive sediment which, besides degrading habitat quality, can also lower egg survival and spawning success. Furthermore, the supply of spawning gravel has decreased due to blockage by the mainstem dams and tributary road crossings. The volume and quality of spawning gravel available to adult coho salmon is especially compromised below Iron Gate Dam where the majority of mainstem spawning occurs.

Degraded Riparian Forest Conditions

Degraded riparian forest conditions are considered a high stress for this population because of the reduced quality and quantity of riparian forest along the mainstem and in tributaries of the Upper Klamath. The extent of degraded riparian habitat within the Upper Klamath River population is primarily due to grazing, altered hydrology, past mining, fire, and timber harvest. These disturbances create localized, short term reductions in riparian vegetation and/or long-term widespread loss of riparian forest. The extent of impacts to coho salmon depends on the degree and extent of coho salmon use of the area. Most stream reaches within the Upper Klamath are either lacking riparian forest altogether or lack complex, late seral forest. This lack of functional riparian forest has resulted in the degradation of water quality, unstable banks, and simplified channel and floodplain structure. Grazing and flow impairments along the mainstem and in tributaries such as Horse, Humbug, Willow, and Cottonwood Creeks have severely degraded riparian function. Stream corridor vegetation was rated at fair (partially functional) to poor (non-functional) in all surveyed reaches of the Upper Klamath (based on USFS judgment, CAP data). Past mining activities and flood control in areas such as Seiad Valley and along the mainstem Klamath have also altered floodplain sediment, elevation, and connectivity and led to depleted riparian forests. The seasonal diversion of water in many Upper Klamath tributaries limits the availability of areas where riparian vegetation can persist.

Impaired Estuary/Mainstem Function

All salmon that originate from the Upper Klamath River migrate to and from the ocean through the mainstem Klamath River and the Klamath River estuary. The Klamath River mainstem and estuary play an important role by providing holding habitat and foraging and refuge opportunities for juvenile coho salmon and smolts from the Upper Klamath River subbasin (Soto et al. 2008, Hillemeier et al. 2009). Although the estuary is short and small compared to the large size of the watershed, it does provide numerous habitat types and rearing habitat for juvenile coho salmon. The degraded conditions that exist throughout the Klamath River basin today may mean that the estuary plays an even larger role for all Klamath populations by providing the opportunity for juvenile and smolt growth and available refugia prior to entering the ocean.

The estuary, although relatively intact, suffers from poor water quality, elevated sedimentation and accretion, loss of habitat, and disconnection from tributary streams and the floodplain. Levees along the Lower Klamath and development on the floodplain have led to the loss and degradation of habitat in the estuary. Despite the degraded state of habitat in the estuary, research in two tributaries near the mouth of the Klamath River, have shown that juveniles from natal streams in the Upper subbasin disperse to and fully utilize small, coastal tributaries and estuarine habitats before moving out to the ocean, and that these fish are significantly larger and more robust then individuals who move through the system without stopping (Soto et al. 2008, Hillemeier et al. 2009). Mainstem conditions downstream in the Middle and Lower Klamath contribute additional stress to the population because of the propagation of issues related to water quality, disease, and degradation of habitat. The Middle and Lower Klamath River watersheds provide non-natal rearing habitat and refugia for juveniles that disperse into the lower, coastal areas of the watershed when conditions in the Upper subbasin become uninhabitable (Soto et al. 2008).

Adverse Fishery-Related Effects

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

34.6 Threats

Table 34-5. Severity of threats affecting each life stage of coho salmon in the Upper Klamath 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	Dams/Diversion	Very High	Very High	Very High	Very High	Very High	Very High
2	Hatcheries	Very High	Very High	Very High	Very High	Very High	Very High
3	Roads	Very High	Very High	Very High	Very High	Very High	Very High
4	Climate Change	Medium	Medium	Very High	Very High	High	High
5	Agricultural Practices	High	High	High	High	High	High
6	High Intensity Fire	Medium	Medium	Medium	Medium	Medium	Medium
7	Channelization/Diking	Low	Medium	Medium	Medium	Medium	Medium
8	Road-Stream Crossing Barriers	-	Medium	Medium	Medium	Medium	Medium
9	Fishing and Collecting	-	-	-	-	Medium	Medium
10	Mining/Gravel Extraction	Low	Low	Low	Low	Low	Low
11	Timber Harvest	Low	Low	Low	Low	Low	Low
12	Urban/Residential/Industrial	Low	Low	Low	Low	Low	Low
13	Invasive Non-Native/Alien Species	Low	Low	Low	Low	Low	Low

Dams/ Diversions

The Klamath River suffers from numerous threats to coho salmon. Foremost is the over-allocation (as defined by the 1992 Oregon Water Resources Commission) of water resources throughout the mainstem Klamath River and major tributaries. This over-allocation is generally acknowledged as the primary mechanism responsible for the poor water quality, elevated disease incidence, and impaired passage conditions common to much of the Klamath River basin.

Irrigation and hydroelectric dams are a major threat to coho salmon within the Upper Klamath River watershed and cause a very high threat to all life stages. PacifiCorp's series of five mainstem hydroelectric dams, beginning with Iron Gate Dam at RM 190, precludes upstream passage of coho salmon into approximately 58 miles of historic habitat. The threat from these mainstem dams will continue until fish passage or dam removal occurs. This is expected to occur by the end of 2020 either through dam removal if there is an affirmative Secretarial Determination under the terms of the Klamath Hydroelectric Settlement Agreement (KHSA), or through mandatory fishway prescriptions in the Federal Energy Regulatory Commission relicensing process if the Secretarial Determination is negative or the KHSA is terminated for any other reason. Smaller private manmade diversion dams also block passage on several important streams within the Upper Klamath, including Cottonwood Creek and Horse Creek. In addition to seasonal and permanent dams in the Upper Klamath, diversions in tributaries reduce flow and act as fish barriers when unscreened. There have been some efforts to screen diversions in Horse Creek and some other tributaries, however, the California Fish Passage Assessment Database (CalFish 2009) indicates that there could be over 60 additional diversions in the Upper Klamath subbasin. Diversion of water in Empire, Willow, Cottonwood, Lumgrey, Barkhouse, Seiad, Horse, and Humbug Creeks is known to impair and/or eliminate coho salmon habitat and water quality during critical low flow periods. Diversion of water in the Scott and Shasta rivers also impairs hydrologic function and water quality in the mainstem Klamath, further exacerbating low flow conditions, high disease transmission rates, and poor water quality conditions. Flow barriers are common in the Upper Klamath and many of these low flow conditions are a direct result of legal and illegal summer diversions.

Hatcheries

Hatcheries pose a very high threat to all life stages in the Upper Klamath River sub-basin. The rationale for these ratings is described under the "Adverse Hatchery-Related Effects" stress.

Roads

High road densities within the Upper Klamath subbasin pose a very high threat to the coho salmon and its habitat. The construction and maintenance of roads across the landscape have detrimental effects on the essential features of coho salmon habitat primarily through hydrological effects (e.g., disconnecting watercourses) and through erosion and sedimentation. Road-related erosion is a problem in many of the larger tributaries below the Shasta River where timber harvest was historically most pronounced. Watersheds with the highest road densities (>3 mi./sq. mi.) include Beaver, Horse, McKinney, Doggett, O'Neil, Empire-Lumgrey, Cottonwood, lower reaches of Grider Creek, and upper reaches of Humbug Creek and Seiad Creek. Road densities are substantially lower in tributaries upstream of Iron Gate Dam, due largely to the lack of timberland within the hydropower reach. Roads will continue to act as sediment sources to tributaries although the threat from roads is likely to decrease as roads on public land are decommissioned and upgraded.

Climate Change

Climate change poses a high threat to this population. As the result of current fuel loads and the impacts of climate change, fire could have a major impact on habitat quality in the future. The impacts of climate change in this region will have the greatest impact on juveniles, smolts, and adults. The current climate is generally warm and modeled regional average temperature shows a large increase over the next 50 years (see Appendix B for modeling methods). Average temperature could increase by up to 3° C in the summer and by 1.3° C in the winter. Recent studies have already shown that water temperatures in the mainstem Klamath have already been increasing at a rate of 0.4 to 0.6 °C/decade since the early 1960s. The season of high temperatures that are potentially stressful to salmon has lengthened by about 1 month and the average length of mainstem river with cool summer temperatures (<15 °C) has declined by about 5 mi/decade (Bartholow 2005). Annual precipitation in this area is already very low and is predicted to trend downward over the next century (Thieler and Hammer-Klose 2000). Snowpack in upper elevations of the basin will decrease with changes in temperature and precipitation (California Natural Resources Agency 2009). The vulnerability of the Klamath estuary to sea level rise is low to moderate and therefore does not pose a significant threat to estuarine rearing habitat downstream. Juvenile and smolt rearing and migratory habitat in the Klamath River and its tributaries is 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. Overall, the range and degree of variability in temperature and precipitation are likely to increase in all populations. Adults will also be negatively impacted 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

Agricultural practices pose a high threat to Upper Klamath River coho salmon through effects on water quality, flow, bank stability, and riparian function. Runoff from agricultural lands has the potential to negatively impact water quality in the Klamath Basin by increasing nutrient loads, increasing biological oxygen demand, and increasing thermal loading (USGS 1999). Agricultural diversions from Upper Klamath Lake and from the larger tributaries flowing into the Upper Klamath River watershed (e.g., Shasta and Scott rivers) have severely altered the timing, duration and volume of the historic Upper Klamath River hydrologic regime. Summer low-flow conditions now occur at an earlier date and persist for a longer period than historically occurred, subjecting rearing juvenile coho salmon to poor water quality for up to 4 months of the year. Smaller-scale agricultural diversions in tributaries such as Beaver, Willow, Grider, Bogus, Horse, Seiad, Walker, Elliot, Little Girder, Little Horse, and Tom Martin Creeks can lead to the loss of summer rearing habitat and refugia and to stranding in some instances. Another important impact of agricultural practices in the Upper Klamath is the negative effects of grazing on riparian vegetation and instream habitat. Grazing is common in many tributaries but the highest grazing intensity occurs on private land in Cottonwood, Bogus, Willow, Horse, Beaver, and along the mainstem Klamath corridor. Agriculture in general is highest within the lower reaches of the Willow Creek, Cottonwood, and Bogus Creek watersheds where 5 to 10 percent of the subwatershed area is used for agriculture (CAP data).Without the exclusion of cattle from riparian areas and a lower grazing intensity these agricultural practices will continue to lead to poor water quality, bank instability, loss of riparian vegetation, and the simplification of stream habitat. Agricultural operations, if unaltered, will continue to degrade instream habitat in many tributary reaches through impacts to water quality, flow, riparian function, and bank stability (62 FR 24588).

High intensity Fire

High intensity fire is a medium threat to coho salmon in the Upper Klamath population unit and hazardous fuel loads have been identified in Seiad, Barkhouse, and Williams Creek watersheds (Soto et al. 2008). Historically fire played a natural function within the Klamath River watershed, and small, low-intensity forest fires were common. However, more recently the fire regime within the basin has been altered as drought conditions and active fire suppression has increased the amount of understory brush available to burn. The result has been that large-scale, high-intensity forest-fires are more common in the Upper Klamath. High-intensity fire can lead to increased erosion rates, loss of riparian forest, and decreased stability of streambanks and upslope areas in many areas of the basin. Erosion rates can be especially severe on steep hillslopes exposed to high-intensity burn conditions.

Channelization/Diking

Although channelization and diking is not widespread throughout the watershed, some stream reaches in the Upper Klamath have been levied for flood control and agriculture. Roads and dredge tailings from past mining activities also act to channelize and dike some stream reaches in the Upper Klamath. The most affected streams include Seiad and Horse Creek although localized channelization and diking likely occurs in almost every tributary with extensive streamside private land (e.g., Cottonwood, Bogus, and Willow creeks). Dikes in affected reaches lead to floodplain disconnection and reduced habitat capacity. Overall, channelization and diking is a moderate threat to the population since the problem is not widespread in the area and existing channelized and diked reaches are being restored.

Road-Stream Crossing Barriers

Road-stream crossings continue to block fish passage within the Upper Klamath River watershed, although recent restoration efforts have addressed many of the problem culverts on National Forest land. A number of culverts located on private, county, and state roads continue to preclude upstream fish passage and constitute a medium threat to coho salmon. Road crossings on Highway 96 (Tom Martin) and Seiad Creek Road (Canyon Creek) have the greatest known impacts due to the high quality of habitat that exists in these areas.

Table 34-6. List of potential barriers.

IP Priority	Stream Name	Subbasin	County
High	Canyon Creek	Seiad Valley	Siskiyou
High	Tom Martin	Beaver Creek	Siskiyou
Medium	Empire Creek	Beaver Creek	Siskiyou
Medium	Soda Creek	Beaver Creek	Siskiyou
Medium	Clear Creek	Beaver Creek	Siskiyou
Medium	Collins Creek	Beaver Creek	Siskiyou
Medium	Dona Creek	Beaver Creek	Siskiyou
High	McKinney Creek (LB+RB)	Beaver Creek	Siskiyou
Medium	Vesa Creek(LB+RB)	Beaver Creek	Siskiyou
High	Middle Fork Humbug Creek	Beaver Creek	Siskiyou
High	South Fork Humbug Creek	Beaver Creek	Siskiyou
Medium	Little Bogus Creek	Iron Gate	Siskiyou

Fishing and Collecting

California-managed fisheries for species other than coho salmon occur in estuaries, freshwater, and nearshore marine areas. In addition, tribal salmonid fisheries have the potential to cause injury and death to coho salmon in the Klamath/Trinity basin. The effects of the fisheries managed by the State of California and the Yurok and Hoopa Tribes, on the continued existence of the SONCC coho salmon ESU have not been formally evaluated by NMFS. NMFS has authorized future collection of coho salmon for research purposes in the Upper Klamath River. NMFS has determined these collections are not likely to jeopardize the continued existence of the SONCC coho salmon ESU.

Mining/Gravel Extraction

Past and present mining activities pose a moderate to low threat to the population. Hydraulic mining (placer and suction dredging) can degrade habitat through the disturbance and alteration of streambed substrate. Oftentimes, material is excavated into tailing piles, leaving unnatural channel formations where flows are created. The persistence of such features is variable and the impacts are mostly seasonal and site-specific. The number of claims that could be utilized in the future suggests this is a threat that still needs to be addressed. Adverse effects could include increasing turbidity, modifying spawning channels, decreasing emergent macroinvertebrate prey, and disturbing and displacing juveniles and smolts from refugia. The level of this threat is primarily dependent on the types of methods used and the way in which these methods are applied. Currently, mining is regulated by CDFG to ensure safe environmental practices and minimal impacts on salmon and salmon habitat. Regulations include special closed areas, closed seasons, and restrictions on methods and operations (Hillman et al. v. CDFG *et al*. 2009). Mining activities in the region have decreased significantly from historic levels, however recent mining operations had been increasing until the cessation of suction dredging permits by the state of California in 2009. At present, a court order prohibits DFG from issuing suction dredge permits. In 2009, Governor Schwarzenegger signed into law SB 670 (Wiggins), instituting a moratorium on suction dredging (to include existing permit holders), with the exception of dredging for the purpose of maintaining energy or water supply management infrastructure, flood control or navigation. This prohibition will remain in effect until DFG completes a court-ordered environmental review of its permitting program, and institutes any changes that may occur to the former regulations. Careful monitoring of mining activity must continue, to ensure that future regulations are followed such that mining threats remain low to moderate.

Timber Harvest

Although timber harvest and concomitant road building has the potential to adversely affect coho salmon or salmon habitat, most former timber lands in the Upper Klamath River subbasin are now under sustainable timber harvest management. Potential timber resources are also limited in the Upper Klamath and future timber sales are likely to be small-scale. Timber harvest has generally been greatest (>25 percent total area) in the upper reaches of Beaver Creek, Cottonwood Creek, and in Doggett Creek (CAP data). The USFS, BLM, and private timber companies manage most timber land in the watershed and detrimental impacts on fish habitat from timber harvest are expected to remain low to moderate. Federal agencies operate under the Aquatic Conservation Strategy of the Northwest Forest Plan and a portion of private timber lands will be managed under the proposed Fruitgrowers Habitat Conservation Plan (HCP). Overall timber harvest is considered to be a low threat to the population.

Urban/Residential/Industrial Development

The number of people currently living in the Upper Klamath River watershed is small (likely less than a few thousand residents), and is unlikely to change significantly in the near future. Large-scale residential and industrial development is not widespread within the Upper Klamath River watershed and therefore poses only a low threat to coho salmon. The largest cities and towns have populations well under 1,000 residents, and populations have remained unchanged or decreased over the past several decades. Impervious surface area is low throughout the Upper Klamath (0 to 5 percent based on CAP data). Small residential communities on important tributaries, such as Horse, Seiad and Beaver Creeks will likely continue to impact water quality, instream habitat conditions, streamflow, and riparian vegetation. However these impacts are not believed to be increasing. Invasive Non-Native/Alien Species

Several populations of non-native species exist below Iron Gate Dam and could pose a threat to the Upper Klamath population. The extent of this threat is currently unknown but presumed to be low. Brown trout are rarely found in the Scott, Shasta, and Bogus Creek but they have been documented to co-occur with juvenile coho salmon and may have seasonal or local effects on juvenile populations (Hampton 2010). Populations of warm-water species are also established in the mainstem below Iron Gate Reservoir and may exert some competitive and predatory pressure on the population.

34.7 Recovery Strategy

The potential for coho salmon recovery in the Upper Klamath is high, however the population is currently unviable and habitat is degraded and unavailable in many areas. Summer and winter rearing habitat is in poor condition in many areas and is limited in its extent and connectivity. Mainstem conditions during the summer are prohibitive for migration and rearing and hatchery influences on the population are very high. Recovery activities in the watershed should focus on the key limiting stressors and life stages and restoration should include both small-scale, short-term improvement of habitat, as well as long-term restoration of the function of the mainstem river.

Ongoing efforts to develop a PacifiCorp Hydroelectric Power Company settlement package will affect the strategy for recovering the Upper Klamath River population unit. Included in the settlement discussion are proposals to remove four mainstem Klamath River dams (Iron Gate, Copco 1 and 2, and J.C. Boyle). Over the long-term (10 to 20 years), removing the dams would allow coho salmon passage into 58 miles of historic mainstem habitat located above the dams (Hamilton et al. 2005) and help to restore hydrological function through increased flow variability (NMFS 2007c). As a result of restored hydrological function, NMFS anticipates that disease rates in the Upper Klamath River reach will be reduced. Water quality benefits are also expected, which would reduce stressors to juvenile coho salmon that may reside in the mainstem Klamath River during late spring and summer (NMFS 2007b). Overall, the removal of the four mainstem Klamath River dams up to Keno Dam is the most significant action that can be taken to restore the viability of the Upper Klamath population unit. As such, dam removal is the highest priority for recovery of this population. If and when dam removal is complete, new recovery actions for the hydropower reach may need to be developed. PacifiCorp has applied for an incidental take permit under ESA Section 10(a)(1)(b), and plans to initiate several conservation measures, including providing funding for fish disease research to benefit coho salmon, and for the installation of large woody debris below IGD, as well as coordinating efforts with BOR and NMFS to allow for flow variability to the Klamath River.

The KBRA has been signed, and is awaiting a decision by Secretary Salazar, to determine if the Agreement will be implemented. The KBRA was reached through agreements between the Karuk, Klamath, and Yurok Tribes, Commercial Fishermen, downstream irrigators, the Klamath Irrigation Project, the Klamath Hydroelectric Project, BLM, USFS, BOR, USFWS, and NMFS. The KBRA will increase water flows to the Klamath River providing more and higher quality habitat to coho salmon. It will allow for the reintroduction of salmon upstream of the dams. It will provide for large scale habitat restoration in the upper and lower Klamath basin, and it will provide certainty of water deliveries to irrigators.

Over the time period prior to dam remediation, the restoration and maintenance of tributary water quality, hydrologic function, and floodplain and channel structure for spawning and rearing will help increase productivity, abundance, and distribution of the population. Recovery actions should focus on protecting and restoring those tributaries that have been identified as being important to natal and non-natal coho salmon and contain high IP habitat. In addition, hatchery reform at Trinity and Iron Gate hatchery is important to reducing negative interactions and allowing for a more natural population.

Table 34-7 on the following page lists the recovery actions for the Upper Klamath River population.

Table 34-7. Recovery action implementation schedule for the Upper Klamath River population.

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UKR.2.2.1	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Remove, set back, or reconfigure levees and dikes	Seiad and Horse creeks	2
SONCC-UKR.2.2.1.1	*Assess feasibility and develop a plan to remove or set back levees and dikes that includes restoring the natural channel form and floodplain connectivity once the levees have been removed*					
SONCC-UKR.2.2.1.2	*Remove levees and restore channel form and floodplain connectivity*					
SONCC-UKR.2.2.2	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Re-connect channel to existing off-channel ponds, wetlands, and side channels	Seiad, Horse, Little Horse, and Cottonwood creeks	2
SONCC-UKR.2.2.2.1	*Assess instream flow conditions and side channel connectivity and develop a plan to obtain adequate flows for channel connectivity*					
SONCC-UKR.2.2.2.2	*Mechanically alter side channels, off channel ponds and wetlands to achieve connectivity*					
SONCC-UKR.2.2.3	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel ponds, alcoves, backwater habitat, and old stream oxbows	High IP subwatersheds (especially, Seiad, Horse, Little Horse, Cottonwood, and Tom Martin creeks)	2
SONCC-UKR.2.2.3.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-UKR.2.2.3.2	*Implement restoration projects that improve off channel habitats as guided by assessment results*					
SONCC-UKR.2.1.4	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Mainstem Klamath corridor, Seiad, Bogus, Cottonwood, Willow, Barkhouse, Humbug, O'Neil, Beaver, Horse, Tom Martin, and Grider creeks	2
SONCC-UKR.2.1.4.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-UKR.2.1.4.2	*Place instream structures, guided by assessment results*					
SONCC-UKR.3.1.5	Hydrology	Yes	Improve flow timing or volume	Restore peak flows	Mainstem Klamath River	2
SONCC-UKR.3.1.5.1	*Assess current hydrograph and develop a flow variability/environmental water account plan to re-establish a natural hydrograph that reduces alluvial barriers*					
SONCC-UKR.3.1.5.2	*Maintain minimum flow requirements below IGD and implement plan to restore a more natural hydrograph prior to dam removal*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UKR.3.1.6	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Seiad Valley, Beaver, Hornbrook, Cottonwood, Bogus, Grider, Little Grider, Willow, Horse, Little Horse, Walker, Elliott, and Tom Martin creeks	2
SONCC-UKR.3.1.6.1	*Develop program to decrease diversion during critical periods of seasonal low flows*					
SONCC-UKR.3.1.6.2	*Encourage users to reduce stream diversions during the summer by providing educational materials describing how to increase water use efficiency*					
SONCC-UKR.3.1.6.3	*Review water allocations and mandate compliance of water rights through an empowered "water master"*					
SONCC-UKR.3.1.7	Hydrology	Yes	Improve flow timing or volume	Educate stakeholders	Population wide	BR
SONCC-UKR.3.1.7.1	*Develop an educational program about water conservation programs and instream leasing programs*					
SONCC-UKR.3.1.8	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3
SONCC-UKR.3.1.8.1	*Prioritize and provide incentives for use of CA Water Code Section 1707*					
SONCC-UKR.3.1.9	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3
SONCC-UKR.3.1.9.1	*Establish a categorical exemption under CEQA for water leasing*					
SONCC-UKR.3.2.10	Hydrology	Yes	Increase water storage	Improve regulatory mechanisms	Population wide	3
SONCC-UKR.3.2.10.1	*Establish a comprehensive statewide groundwater permit process*					
SONCC-UKR.3.2.11	Hydrology	Yes	Increase water storage	Increase beaver abundance	Seiad, Horse, Cottonwood, Little Horse, Horse, and Beaver creeks	3
SONCC-UKR.3.2.11.1	*Develop program to educate and provide incentives for landowners to keep beavers on their lands*					
SONCC-UKR.3.2.11.2	*Implement beaver program (may include reintroduction)*					
SONCC-UKR.3.2.12	Hydrology	Yes	Increase water storage	Improve regulatory mechanisms	Population wide	BR
SONCC-UKR.3.2.12.1	*Limit hunting or removal of beaver*					
SONCC-UKR.3.1.48	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Seiad, Horse, Little Horse, and Cottonwood creeks	BR

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	***Step Description***					
SONCC-UKR.3.1.48.1	*Install flow gage to ensure appropriate flows for coho salmon*					
SONCC-UKR.3.1.48.2	*Maintain flow gage annually*					
SONCC-UKR.5.1.19	Passage	Yes	Improve access	Remove barriers	Iron Gate, Copco 1 and 2, and JC Boyle dams	2
SONCC-UKR.5.1.19.1	*Implement KHSA/KBRA fish passage strategy or install fish ladders*					
SONCC-UKR.5.1.20	Passage	Yes	Improve access	Reduce sediment barriers	Walker, O'Neil, Humbug, and Grider creeks	2
SONCC-UKR.5.1.20.1	*Inventory and prioritize barriers formed by alluvial deposits*					
SONCC-UKR.5.1.20.2	*Remove alluvial deposits, construct low flow channels, or reduce stream gradient to provide fish passage at all life stages*					
SONCC-UKR.5.1.21	Passage	Yes	Improve access	Remove structural barriers	Highway 96 crossing on Tom Martin Creek and Seiad Creek Road culvert on Canyon Creek (tributary to Seiad)	2
SONCC-UKR.5.1.21.1	*Assess road-stream crossing barriers and prioritize for removal*					
SONCC-UKR.5.1.21.2	*Remove road-stream crossing barriers and upgrade culvert*					
SONCC-UKR.5.1.22	Passage	Yes	Improve access	Remove push-up dam type barriers	Horse Creek	BR
SONCC-UKR.5.1.22.1	*Develop a plan to remove the push up dam and increase flows*					
SONCC-UKR.5.1.22.2	*Remove push up dam, guided by the plan*					
SONCC-UKR.5.1.22.3	*Install flow measuring devices to ensure that water rights and flows are maintained*					
SONCC-UKR.5.1.22.4	*Maintain flow measuring devices*					
SONCC-UKR.5.1.23	Passage	Yes	Improve access	Reduce flow barriers	Empire, Willow, Cottonwood, Lumgrey, Barkhouse, Seiad, Horse, and Humbug creeks	BR
SONCC-UKR.5.1.23.1	*Assess low flow tributaries and their sediment sources that contribute to seasonal flow barriers. Develop a plan to alleviate sediment delivery and remove current barriers*					
SONCC-UKR.5.1.23.2	*Alleviate sediment delivery in areas with low flow conditions and seasonal flow barriers as described in the plan*					
SONCC-UKR.5.2.24	Passage	Yes	Decrease mortality	Screen all diversions	Horse, Cottonwood, and Bogus creeks	2

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UKR.5.2.24.1	*Assess diversions and develop a screening program*					
SONCC-UKR.5.2.24.2	*Screen all diversions*					
SONCC-UKR.10.1.16	Water Quality	Yes	Reduce water temperature, increase disssolved oxygen	Reduce warm water inputs	Bogus, Willow, Horse, Seiad, Beaver, Barkhouse, Tom Martin, Elliott, and Cotttonwood creeks	3
SONCC-UKR.10.1.16.1	*Develop a program that identifies, designs, and constructs projects that will reduce warm tailwater input*					
SONCC-UKR.10.1.16.2	*Implement tailwater reduction program*					
SONCC-UKR.14.1.25	Disease/Predation/ Competition	No	Reduce disease	Disrupt the disease cycle between salmon, myxospore, polychaetes, and actinospore stages.	Population wide	2
SONCC-UKR.14.1.25.1	*Assess all means possible to disrupt disease cycle and develop a plan to do so*					
SONCC-UKR.14.1.25.2	*Disrupt the disease cycle, guided by assessment results*					
SONCC-UKR.14.1.26	Disease/Predation/ Competition	No	Reduce disease	Conduct monitoring and research actions as described in the Klamath River Fish Disease Research Plan	Mainstem Klamath River	3
SONCC-UKR.14.1.26.1	*Develop monitoring plan and research actions as described in the Klamath River Fish Disease Research Plan*					
SONCC-UKR.14.1.26.2	*Implement Klamath River Fish Disease Research Plan*					
SONCC-UKR.1.2.49	Estuary	No	Improve estuarine habitat	Improve estuary condition	Klamath River Estuary	3
SONCC-UKR.1.2.49.1	*Implement recovery actions to address strategy "Estuary" for Lower Klamath River population*					
SONCC-UKR.16.1.30	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-UKR.16.1.30.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-UKR.16.1.30.2	*Identify fishing impacts expected to be consistent with recovery*					
SONCC-UKR.16.1.31	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-UKR.16.1.31.1	*Determine actual fishing impacts*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UKR.16.1.31.2	*If actual fishing impacts exceed levels consistent with recovery, modify management so that levels are consistent with recovery*					
SONCC-UKR.16.2.32	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-UKR.16.2.32.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-UKR.16.2.32.2	*Identify scientific collection impacts expected to be consistent with recovery*					
SONCC-UKR.16.2.33	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-UKR.16.2.33.1	*Determine actual impacts of scientific collection*					
SONCC-UKR.16.2.33.2	*If actual scientific collection impacts exceed levels consistent with recovery, modify collection so that impacts are consistent with recovery*					
SONCC-UKR.17.2.18	Hatcheries	No	Reduce adverse hatchery impacts	Identify and reduce impacts of hatchery on SONCC coho salmon	Iron Gate Hatchery	2
SONCC-UKR.17.2.18.2	*Implement Hatchery and Genetic Management Plan and revise when necessary*					
SONCC-UKR.27.1.34	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate survival of juvenile coho salmon	Population wide	2
SONCC-UKR.27.1.34.1	*Develop comprehensive PIT tagging and retrieval project that assesses habitat use and survival*					
SONCC-UKR.27.1.35	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3
SONCC-UKR.27.1.35.1	*Perform annual spawning surveys*					
SONCC-UKR.27.1.36	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Develop survival estimates	Site to be determined	3
SONCC-UKR.27.1.36.1	*Install and annually operate a life cycle monitoring (LCM) station*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-UKR.27.1.37	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life history diversity	Population wide	3
SONCC-UKR.27.1.37.1		*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*				
SONCC-UKR.27.1.38	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track surrogate for genetic diversity	Iron Gate Hatchery	3
SONCC-UKR.27.1.38.1		*Describe annual ratio of naturally-produced fish to hatchery-produced fish spawned for hatchery production*				
SONCC-UKR.27.1.39	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	2
SONCC-UKR.27.1.39.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-UKR.27.1.40	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Disease'	Population wide	3
SONCC-UKR.27.1.40.1		*Annually estimate the infection and mortality rate of juvenile coho salmon from pathogens, such as Ceratomyxa shasta and Parvicapusla minibicornis*				
SONCC-UKR.27.1.41	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Hatchery Management'	Population wide	3
SONCC-UKR.27.1.41.1		*Annually determine the percent of hatchery origin spawners (PHOS), percent of natural origin spawners (PNOS), and the proportion of natural influence (PNI)*				
SONCC-UKR.27.2.42	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3
SONCC-UKR.27.2.42.1		*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*				
SONCC-UKR.27.2.42.2		*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling 10% of the original habitat surveyed*				
SONCC-UKR.27.2.43	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3
SONCC-UKR.27.2.43.1		*Measure the indicators, pool depth, pool frequency, D50, and LWD*				

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UKR.27.2.44	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3
SONCC-UKR.27.2.44.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-UKR.27.2.45	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3
SONCC-UKR.27.2.45.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-UKR.27.2.46	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3
SONCC-UKR.27.2.46.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-UKR.27.2.47	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3
SONCC-UKR.27.2.47.1	*Annually measure the hydrograph and identify instream flow needs*					
SONCC-UKR.27.1.50	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3
SONCC-UKR.27.1.50.1	*Develop supplemental or alternate means to set population types and targets*					
SONCC-UKR.27.1.50.2	*If appropriate, modify population types and targets using revised methodology*					
SONCC-UKR.7.1.13	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Private lands along the mainstem Klamath Corridor, Horse, Cottonwood, Willow, Bogus, and Beaver creeks	3
SONCC-UKR.7.1.13.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-UKR.7.1.13.2	*Develop grazing management plan to meet objective*					
SONCC-UKR.7.1.13.3	*Plant vegetation to stabilize stream bank*					
SONCC-UKR.7.1.13.4	*Fence livestock out of riparian zones*					
SONCC-UKR.7.1.13.5	*Remove instream livestock watering sources*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UKR.7.1.14	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Reduce fire hazard	Private land in the Upper Klamath Basin	BR
SONCC-UKR.7.1.14.1	*Develop fire hazard reduction educational materials for landowners*					
SONCC-UKR.7.1.14.2	*Develop a plan for fire break stewardship and defensible space*					
SONCC-UKR.7.1.14.3	*Implement fire-safe community action plans in identified areas*					
SONCC-UKR.7.1.15	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Reestablish natural fire regime	Seiad, Barkhouse, and Williams creeks	BR
SONCC-UKR.7.1.15.1	*Identify areas prone to high intensity fire and develop a plan to reestablish a natural fire regime that benefits coho habitat*					
SONCC-UKR.7.1.15.2	*Carry out fuel reduction projects such as thinning and prescribed burning, guided by the strategic plan*					
SONCC-UKR.8.2.27	Sediment	No	Increase spawning gravel	Enhance spawning substrate	Mainstem, downstream of Iron Gate dam	2
SONCC-UKR.8.2.27.1	*Develop a spawning substrate management plan that identifies quantity, quality, location, and timing of gravel supplements*					
SONCC-UKR.8.2.27.2	*Supplement gravel, guided by the plan*					
SONCC-UKR.8.1.28	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Beaver, Horse, Walker, McKinney, Cottonwood, Doggett, Kohl, Empire, Lumgrey, and Dutch creeks	2
SONCC-UKR.8.1.28.1	*Assess and prioritize road-stream connection, and identify appropriate treatment to meet objective*					
SONCC-UKR.8.1.28.2	*Decommission roads, guided by assessment*					
SONCC-UKR.8.1.28.3	*Upgrade roads, guided by assessment*					
SONCC-UKR.8.1.28.4	*Maintain roads, guided by assessment*					
SONCC-UKR.8.1.29	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	Recently burned Humbug Creek	2
SONCC-UKR.8.1.29.1	*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*					
SONCC-UKR.8.1.29.2	*Implement plan to stabilize slopes and revegetate areas*					