# 33. Middle Klamath River Population

Interior Klamath River Diversity Stratum

Non-Core 1, Potentially Independent Population

Moderate Extinction Risk

Population likely above depensation threshold

450 Spawners Required for ESU Viability

1038 $mi^2$ watershed (98% Federal ownership)

113 IP-km (70 IP-mi) (4% High)

Dominant Land Use is Forest Service Public Land

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

Key Limiting Threats are ‘High Severity Fire’ and ‘Dams/Diversions’

*Highest Priority Recovery Actions*

| | |
|---|---|
| • Construct off channel ponds, alcoves, backwater habitats, and old stream oxbows | • Remove, setback, or reconfigure levees and dikes |
| • Re-connect channel to existing off-channel ponds, wetlands, and side channels | • Increase large woody debris (LWD), boulders, or other instream structure |
| • Improve estuary condition | • Protect existing or potential cold water refugia |

## 33.1 History of Habitat and Land Use

Historical mining, excessive timber harvest, and road building activities have contributed to environmental degradation in the Middle Klamath River sub-basin. Throughout the 1850s, hydraulic and placer mining removed gravel and filtered out gold in sections of the mainstem Klamath River. Piles of gravel tailings remain along the mainstem river and tributaries as remnants of these historic practices, continuing to create stress and alter channel structure throughout the watershed. Timber harvest was prevalent in the late 1940s to the 1990s, but has since declined largely due to recent Forest Service policy on maintaining ecosystem health. Today, most timber management projects on Six Rivers and Klamath National Forest include hazard tree removal, fuel reductions, salvage timber harvest, and promoting the development and maintenance of diverse stand structures and species composition. Existing roads used for past timber harvest remain in the watershed and many continue to contribute sediment to tributary and mainstem channels.

Since the early 1900s, water has been diverted from the Klamath River for the U.S. Bureau of Reclamation's Klamath Project. This diversion has altered the historic hydrologic regime of the mainstem Klamath River, as well as reduced the total volume of water available for instream flows; this reduction contributes to water quality degradation and directly affects critical periods of the life history of SONCC coho salmon (NMFS and USFWS 2013). Although unquantified, substantial volumes of water are also diverted for municipal use and to non-Project irrigators from many tributaries in the Klamath River Basin, further reducing cold water inputs into the mainstem. Hydropower dams, constructed upstream of the Middle Klamath River in the early to mid-1900s, also contribute to the alteration of mainstem flows. Although there are no notable dams in the Middle Klamath, the operations of Iron Gate, Copco 1 and 2, JC Boyle and Keno dams in the upper Klamath River block fish passage above Iron Gate Dam, alter sediment transport processes, and contribute to the reduction of flow variability, which create instream conditions that favor disease proliferation and facilitate increased fish infection rates (*Ceratonova shasta*, *Icthyopthirius multifilis* [Ich], *Flavobacterium columnare* [columnaris], Aeromonid bacteria, *Nanophyetus salmonicola*, *Parvicapsula minibicornis*) (Stocking and Bartholomew 2007, NMFS and USFWS 2013). Upper basin agricultural practices contribute to high nutrient levels, low dissolved oxygen levels, and altered water temperature regimes in the Klamath River; these water quality issues are also influenced by the upstream dams (NMFS and USFWS 2013). More information on how agricultural practices and hydropower dams impact water quality and actions being taken to reduce these impacts can be found in the Upper Klamath population profile (Chapter 34) and PacifiCorp's habitat conservation plan (HCP) for coho salmon (NMFS 2012, PacifiCorp 2012).

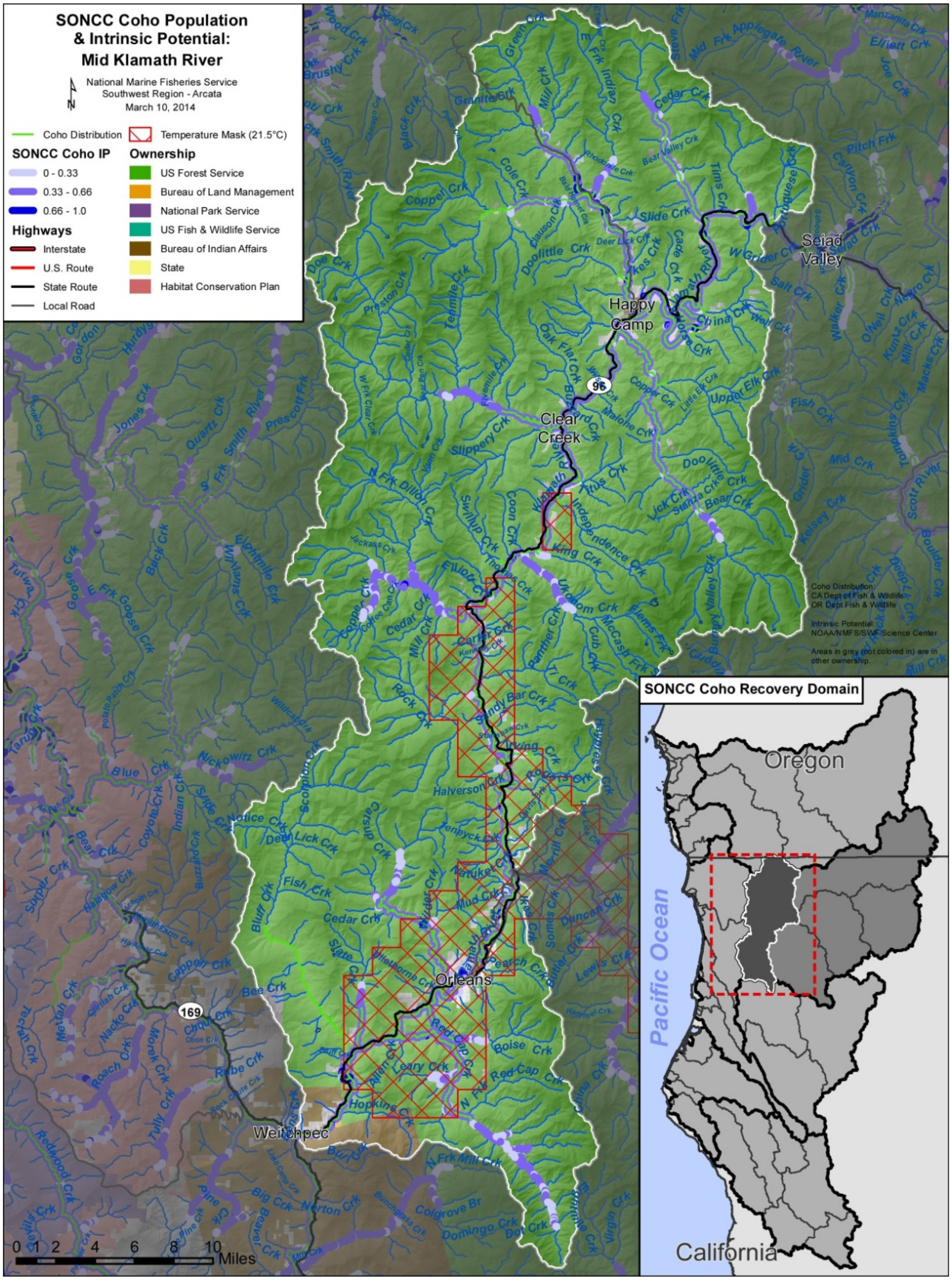


Figure 33-1. The geographic boundaries of the Middle Klamath River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), a temperature mask (indicating areas that are inherently too warm for rearing coho salmon), land ownership, coho salmon distribution (CDFG 2012a), location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Interior Klamath River diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

## 33.2 Historic Fish Distribution and Abundance

Very little historic data exist on coho salmon in the Middle Klamath population area. Within the larger Klamath River basin, early gill net catches were on the order of 11,000 for coho salmon in 1919 (Snyder 1931). Large declines in the basin were thought to occur between 1940 and 1960 due to large-scale timber harvest, mining, and associated habitat loss (Weitkamp et al. 1995). By the 1980s, the annual escapement of coho salmon in the basin was down to around 15,000 to 20,000 fish, and this estimate included a large portion of hatchery fish (Leidy and Leidy 1984). Some have concluded that salmon runs across the ESU declined by over 90 percent between the 1940s and 1980s (Weitkamp et al. 1995, California Department of Fish and Game [CDFG] 2004b). Since many tributaries in the Middle Klamath were affected by land use activities over this same time period, the Middle Klamath River population was likely part of this decline. Historic runs in this population were likely never as large as in some tributaries, such as the Scott or Shasta River populations. The IP model shows that there are approximately 113 IP-km of suitable juvenile rearing habitat spread throughout the mainstem Klamath River and tributaries in the Middle Klamath region. Most of this habitat has moderate IP value (0.33 to 0.66) with a few very isolated patches of high IP value (>0.66). Historic use of Middle Klamath River tributaries by coho salmon has been documented in Aikens, Bluff, Slate, Red Cap, Boise, Camp, Irving, Stanshaw, Sandy Bar, Rock, Ti, Dillon, Swillup, Ukonom, Independence Clear, Oak Flat, Elk, Little Grider, Indian, China, Thompson, Fort Goff, and Portuguese creeks (Brownell et al. 1999). Many other tributaries also likely supported natal and non-natal coho salmon spawning and rearing historically, as evidenced by current juvenile presence in most tributaries of the Middle Klamath River.

## 33.3 Status of Middle Klamath River Coho Salmon

### Spatial Structure and Diversity

There are several monitoring efforts in the Middle Klamath River, including: 1) fish populations, 2) stream flow, 3) water quality, 4) physical habitat, and 5) restoration sites. Monitoring is conducted by a number of entities, including the Karuk Tribe, the U.S. Forest Service (USFS), the U.S Fish and Wildlife Service (USFWS), California Department of Fish and Wildlife (formerly CDFG), the North Coast Regional Water Quality Control Board (NCRWQCB), the U.S. Geological Survey (USGS), and the Mid Klamath Watershed Council (MKWC). These efforts have taken place in many tributaries of the Klamath River since 1986, and have provided information on coho salmon distribution and abundance as well as habitat condition and restoration effectiveness.

Juvenile coho salmon surveys have been conducted over the past several decades by various parties including the Karuk Tribe, MKWC, and USFS. These surveys have found coho salmon juveniles rearing in Hopkins, Aikens, Bluff, Slate, Red Cap, Boise, Camp, Pearch, Whitmore, Irving, Stanshaw, Sandy Bar, Rock, Dillon, Swillup, Coon, Kings, Independence, Titus, Clear, Elk, Grider, Little Grider, Cade, Tom Martin, China, Thompson, Fort Goff, Seiad, Horse, Beaver, and Portuguese creeks (Soto et al. 2008a, Karuk Tribe 2012). Lower Middle Klamath surveys conducted between 2002 and 2009 indicate that juvenile coho salmon are most abundant in Aikens, Bluff, Boise, Camp, Red Cap, Sandy Bar, Slate, and Stanshaw Creeks (Karuk Tribe 2012). Most of the observations are of juveniles using the lower parts of the tributaries and it is likely that many of these fish are non-natal rearing in these refugia areas. Natal rearing is likely confined to those tributaries where spawning is occurring and where sufficient rearing habitat exists (Boise, Aikens, Bluff, Slate, Thompson, Red Cap, Elk, Indian, Independence, Titus, Seiad, Horse, China, Beaver, Clear, and Camp creeks).

Only limited coho salmon spawning surveys have occurred in the Middle Klamath River. Spawning adult coho salmon have been documented in Bluff, Slate, Red Cap, Camp, Boise, Elk South Fork Clear, and Indian creeks (Soto et al. 2008a). The Karuk Tribe surveyed 28 streams in 2011 and found evidence of coho salmon spawning in 13 streams including Aikens, Beaver, Camp, China, East Fork Elk, Grider, Horse, Independence, Seiad, Slate, Titus, and South Fork Clear creeks, as well as the Klamath River at Barkhouse side channel (Corum 2012). Outmigrant trapping between 2002 and 2008 on Red Cap and Camp creeks found juveniles less than 40 mm, indicating that there was likely natal rearing occurring (USFS 2009a, Cyr 2010). In addition, coho salmon have been observed spawning in side channels, tributary mouths, and shoreline margins of the mainstem Klamath River between Beaver Creek (RM 161) and Independence Creek (RM 94) (Magneson and Gough 2006).

Williams et al. (2008) determined that at least 34 coho salmon per-IP-km of habitat are needed (3,900 spawners total) for the Middle Klamath coho salmon population to be at low risk of extinction. Adults and juveniles appear to be well distributed throughout the Middle Klamath; however, use of some spawning and rearing areas is restricted by water quality, flow, access, and sediment issues. Little is known about the genetic and life history diversity of the population, but diversity is expected to be limited because of the depressed population size. The Middle Klamath River coho salmon population spatial distribution appears to be good, but since many of the Middle Klamath tributaries are used for non-natal rearing too little is known for its natal spatial structure and diversity to be evaluated.

**Population Size and Productivity**

Little data exist on the Middle Klamath coho salmon population, but runs are thought to be extremely reduced compared to historic levels. Regional biologists estimate that the total population size is around 1,000-1,500 in strong run years and 0-500 in weaker run years (Ackerman et al. 2006). A few tributaries in the Middle Klamath (e.g., Slate, Boise, Red Cap, Clear, Camp, and Indian Creeks) support significant returns of coho salmon; however total spawner abundance and population productivity is unknown. The Karuk Tribe found at least 64 coho salmon redds and 22 adult coho salmon in Middle Klamath tributaries in the 2013-2014 spawning season (Corum 2014). Tributaries with observed coho salmon spawners or redds in 2013-2014 included Aikens, Camp, China, East Fork Elk, Elk, Independence, Indian, Mill (tributary to Indian), South Fork Clear, and Titus creeks (Corum 2014).

Juvenile counts indicate that productivity is relatively low, with less than 12,000 juvenile coho salmon found between 2002 and 2009 during surveys of Middle Klamath tributaries (USFS 2009a). Outmigrant trapping on Red Cap and Camp Creeks by the USFS exhibited consistent use of these Middle Klamath River tributaries by young-of-the-year (YOY) and age-1 coho salmon. In every year sampled (2002 to 2003 and 2007 to 2009), USFS found YOY and age-1 outmigration from these streams during the late spring and early summer, although the number of outmigrating age-1 smolts was generally less than 100 during most years (USFS 2009a).

Based on adult returns to other Klamath River populations, the 2004/2007/2010 brood year is likely a relatively stronger year class than the other two (i.e., 2003/2006/2009 and 2002/2005/2008) (Ackerman et al. 2006). Generally the returns are more consistent between years in Middle Klamath tributaries than in other populations such as the Scott or Shasta rivers, which have very weak year classes most years (Chesney and Knechtle 2008).

Williams et al. (2008) determined at least 113 coho salmon must spawn in the Middle Klamath each year to avoid the effects of extremely low population sizes. Based on the available data, the Middle Klamath River coho salmon population likely has an average spawner abundance of 200-600 individuals, and is at moderate risk of extinction given the low population size and negative population growth rate (Ackerman et al. 2006). Based on current estimates, the population is likely above depensation, but well below the low-risk threshold of 3,900 spawners.

### Extinction Risk

The Middle Klamath River population is at moderate 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 greater than one, but the ratio is less than the minimum required spawner density (both criteria described in Williams et al. 2008). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, p. 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 Middle Klamath River population is a non-core, Potentially Independent population within the Interior Klamath 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). The Middle Klamath River population is strongly influenced by upstream populations. Adult strays from these populations spawn and interact with coho salmon in the Middle Klamath River. To contribute to stratum and ESU viability, the Middle Klamath River non-core population needs to have at least 450 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and to continue to represent critical components of the evolutionary legacy of the ESU. Furthermore, the Middle Klamath River population will contribute toward stratum and ESU viability by providing rearing, migratory, and refugia habitat to other populations in the Klamath River basin.

## 33.4 Plans and Assessments

### Mid Klamath Watershed Council

Since 2001, the Mid Klamath Watershed Council (MKWC) has been engaged in habitat restoration work along the Klamath River corridor, including the upper Klamath River area.

Reports related to fisheries and aquatic resources, available via MKWC's homepage (http://www.mkwc.org), include the following:

*Middle Klamath Restoration Implementation Plan, Instream Working Group (2013 draft)*

The Instream Working Group's Instream Candidate Actions Table (CAT; Grunbaum et al. 2013) includes recovery actions that specifically address constraints to recovery in 35 tributary watersheds within the Mid Klamath Basin, and in 31 tributary watersheds within the Upper Klamath Basin. Though these tributaries are not all mentioned by name in the SONCC coho salmon ESU recovery plan, the recommended candidate actions in the CAT for each tributary watershed are incorporated into the SONCC recovery plan's recovery actions.

*Middle Klamath Sub-basin Fisheries Resource Recovery Plan, December 1, 2008*

*Off-Channel Coho Salmon Rearing Pond Projects: Seiad Creek and Grider Creek (2012 update)*

*2008 DFG Klamath Tributary Fish Passage Improvement Results*

*Restoring Coho Salmon in the Klamath River, One Beaver At A Time*

*The Effect of the Klamath Hydroelectric Project on Traditional Resource Uses and Cultural Patterns of the Karuk People within the Klamath River Corridor* (Salter 2003)

### Karuk Tribal Fisheries Department and Restoration Division

*Mid Klamath Sub-basin Fisheries Resource Recovery Plan*
http://mkwc.org/publications/index.html#Sub-Basin

In 2003, the Karuk Tribe developed a fisheries resource recovery plan (Soto and Hentz 2003) to identify core variables pertaining to ecological function in the sub-basin, and to provide management priorities and objectives to guide efforts to improve conditions in the sub-basin. The plan was updated in December 2008 by the Karuk Tribe and MKWC (Soto et al. 2008). 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 sub-basin 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 (CDFG 2004b) and is a guide for recovering coho salmon on the north and central coasts of California, including the Middle Klamath River. The Recovery Strategy emphasizes cooperation and collaboration at many levels, and recognizes the need for funding, public and private support for restorative actions, and maintaining a balance between regulatory and voluntary efforts.

*Klamath River TMDL*

The purpose of the Klamath River TMDLs (NCRWQCB 2010) are to estimate the assimilative capacity of the system with respect to the total loads of nutrients and organic matter that can be delivered to the Klamath River without causing an exceedance of the water quality objectives for nutrients and dissolved oxygen. The TMDLs also establish the amount of protection from solar radiation and cold water withdrawals necessary to meet water quality objectives for water temperature. The current TMDLs for the Klamath River in California address temperature, dissolved oxygen, nutrient, and *microcystin* water quality impairments for the Klamath River Hydrologic Unit, Middle HA (Oregon to Trinity River) and Lower HA, Klamath Glen HSA (Trinity River to Pacific Ocean).

### U.S. Forest Service

*Watershed Condition Framework*

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, Bluff Creek was identified as a high priority 6th field sub-watershed in the Six Rivers National Forest (USFS and BLM 2011).

The Klamath (KNF) and Six Rivers National Forests have also conducted various other watershed assessments for National Forest lands within the Middle Klamath region.

## 33.5 Stresses

Table 33-1. Severity of stresses affecting each life stage of coho salmon in the Middle Klamath 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 | High | High | Very High | High | High | Very High |
| 2 | Impaired Water Quality[1] | Low | Medium | Very High[1] | High | Medium | High |
| 3 | Lack of Floodplain and Channel Structure[1] | Low | High | High[1] | High | Medium | High |
| 4 | Barriers | - | High | High | High | High | High |
| 5 | Increased Disease/Predation/Competition | Low | Medium | High | High | Medium | High |
| 6 | Altered Hydrologic Function | Low | Low | High | High | Medium | High |
| 7 | Impaired Estuary/Mainstem Function | - | Low | High | High | Low | High |
| 8 | Adverse Hatchery-Related Effects | Medium | Medium | Medium | Medium | Medium | Medium |
| 9 | Degraded Riparian Forest Conditions | - | Medium | Medium | Medium | Medium | Medium |
| 10 | Adverse Fishery- and Collection-Related Effects | - | - | 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 impaired water quality and lack of floodplain and channel structure, as they have the greatest impact on the population's ability to produce sufficient spawners to support recovery. There are also other stresses that limit the function of habitat for certain life stages in the Middle Klamath and therefore limit productivity of this population (Table 33-1). The lack of quality summer and winter rearing habitat that is protected from warm temperatures and high winter flows, respectively, is one of the most likely factors limiting productivity (Soto et al. 2008a). Summer rearing occurs in cold-water tributaries and other thermal refugia along the mainstem. This type of rearing habitat is limited in terms of its quality, quantity and connectivity within the Middle Klamath River. In the summer, water diversion leads to poor hydrologic function, disconnection and diminishment of thermal refugia, and poor water quality. Accretion of sediment at creek mouths also limits access to important thermal refugia and summer rearing habitat. Winter rearing occurs primarily in mainstem, confluence, and tributary habitats where backwaters, alcoves, off-channel ponds and wetlands have formed. Winter rearing habitat has been primarily impacted by past mining activities and construction of flood control levees in the mainstem and 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, has poor quality, and is poorly connected. In addition to juvenile rearing habitat, mainstem disease issues may be limiting the productivity of the population during certain years.

Looking at the overall productivity of the population, the juvenile life stage is 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 river during migration. In order to improve the viability of this population, addressing these limiting stresses and improving habitat and conditions for the juvenile life stage will be imperative. 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.

Thermal refugia are one of the most important habitat types in the Middle Klamath River due to their role in coho salmon rearing and migration in the Klamath River. USFS biologists in the Orleans and Happy Camp Ranger Districts have been monitoring Klamath mainstem and tributary stream temperatures since 1996 (Cyr 2010). Results from these data and other studies along the Middle Klamath River have shown that once water temperatures in the mainstem become warm they typically remain warm, except for stream reaches receiving significant groundwater inflow. Cool water from these tributaries plays a vital role in reducing salmonid thermal stress and mortality, and cool water from smaller tributaries is as critical as larger tributaries in maintaining water quality in the Klamath River and providing thermal refugia for coho salmon.

The Yurok Tribe and MKWC have collected temperature data in tributaries and the mainstem Middle Klamath River (MKWC 2006) and surveyed potential refugia areas that are available to juvenile coho salmon. Many tributaries serve as thermal refugia because of their cooler water temperatures relative to the warm mainstem Klamath River (MKWC 2006) (Table 33-2). Table 33-2 may not be a complete list of all thermal refugia in the Middle Klamath because tributary confluences change regularly, thereby increasing or decreasing availability and usefulness to coho salmon. Any tributary with water temperatures cooler than the mainstem Klamath River can be considered thermal refugia due to its role in maintaining water quality in the mainstem Klamath River. 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. Other important tributaries for juvenile rearing include Sandy Bar, Stanshaw, China, Little Horse, Pearch, and Boise creeks (Harling 2009). Intact, high quality rearing and spawning tributary habitat is also vital to the recovery of this population. Habitat in Indian, Elk, Camp, Boise, Red Cap, Clear, Thompson, Dillon, Slate, and Bluff creeks provide the highest quality spawning and rearing habitat for coho salmon in the Middle Klamath (Mid Klamath Restoration Partnership 2010).

Table 33-2. Thermal refugia areas in the Middle Klamath River. (MKWC 2006, NCRWQCB 2010).

| Stream Name | Stream Name | Stream Name |
|---|---|---|
| Aikens Creek | Rock Creek | Oak Flat Creek |
| Bluff Creek | Ti Creek | Elk Creek |
| Slate Creek | Dillon Creek | Little Grider Creek |
| Red Cap Creek | Aubrey Creek | Indian Creek |
| Boise Creek | Elliot Creek | Cade Creek |

| | | |
|---|---|---|
| Camp Creek | Swillup Creek | Little Horse Creek |
| Pearch Creek | Ukonom Creek | China Creek |
| Rodgers Creek | King Creek | Thompson Creek |
| Irving Creek | Independence Creek | Ft. Goff Creek |
| Stanshaw Creek | Titus Creek | Portuguese Creek |
| Sandy Bar Creek | Clear Creek | |

### Altered Sediment Supply

Altered sediment supply poses a high or very high stress to all of the life stages of coho salmon. Access to tributary rearing habitat and refugia during some parts of the summer is blocked at times by alluvial barriers. The hydrologic and connectivity issues associated with excess sediment increase the risk of infections from *C. shasta* and *P. minibicornis*. Soils in this area are highly erodible, and in combination with the steep terrain, recent intense fires, and a legacy of past timber harvest and road-building, fine sediment loading has contributed to impaired conditions throughout the Middle Klamath. Excessive fine sedimentation reduces habitat diversity, embeds spawning gravel, and reduces channel stability. Changes in the natural structure of the river and in water flow cause alluvial sills to form at many tributary confluences, which can either physically block fish or force flows subsurface, thereby limiting or eliminating access to important refugia and spawning/rearing habitat. Habitat complexity in many tributaries has been reduced by fine sediment filling of pools, off-channel ponds and wetlands.

### Impaired Water Quality

Coho salmon in the Middle Klamath River sub-basin have numerous interacting stresses. High water temperatures, exacerbated by water diversions and seasonal low flows, restrict juvenile rearing in the mainstem Klamath River and lessen the quality of tributary rearing habitat. Water quality issues are a primary concern due to issues of elevated water temperatures, low dissolved oxygen, and high nutrient levels. Water quality conditions in the Middle Klamath are impaired by seasonal high temperature, low DO, and high pH (NMFS 2012). Seasonal decreases in water quality can be a very high stress for juveniles and a high stress for smolts due to poor rearing and migratory conditions. In general, mainstem habitat in the Klamath River is not suitable for productive summer or winter rearing, making tributary habitats highly valuable for growth and survival of coho salmon (NMFS and USFWS 2013). Benthic macroinvertebrate indicators of water quality (via the IBI and EPT metrics) are good for the watershed. However, other water quality parameters including pH and temperature (>17 ºC MWAT) are poor in the mainstem Klamath River, although several key tributaries were found to have fair water temperatures (16.1 to 17 ºC; NCRWQCB 2010). Grider, Indian, Elk, Sandy Bar, and Whitmore creeks all have had water temperatures above the 17º MWAT recommended as suitable for juvenile fish (MKWC 2006). Dissolved oxygen (DO) levels are fair (6 to 6.75 mg/l 7 DA-min) in the upper Middle Klamath, while DO levels in the lower Middle Klamath are good (6.75- 7 mg/l) to very good (>7 mg/l) (NCRWQCB 2010). Overall, the water quality in the Klamath River is impaired and is on the 303(d) Clean Water Act list due to temperature.

Use of mainstem habitat is most limited by water quality during the summer months (June through September) when water temperatures are high throughout the day. Juveniles must utilize tributaries and other off-channel areas where cooler water can be found. Juvenile foraging and rearing during early summer is most affected by poor mainstem conditions, which force individuals into cold water tributaries (NMFS 2012, NMFS and USFWS 2013); in some years adult migration in the fall may be impacted as well. Dissolved oxygen is also impaired in areas during this same time period and can reach as low as 5.5 mg/L in the mainstem (NCRWQCB 2010). Highly fluctuating DO concentrations are common throughout the mainstem and pH tends to rise throughout the summer, peaking in late August and fluctuating widely between day and night (NMFS 2007b). This fluctuating condition likely further limits use of mainstem areas for juveniles and restricts rearing to tributary and confluence habitat where water quality is better. Disease prevalence and impacts may also be affected by water quality, with recent documented incidences of sub-lethal and lethal effects on juveniles, smolts, and adults associated with elevated temperatures (Bartholomew and Courter 2007). MKWC (2006) 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, most tributary temperatures were suitable for coho salmon (Figure 33-2).

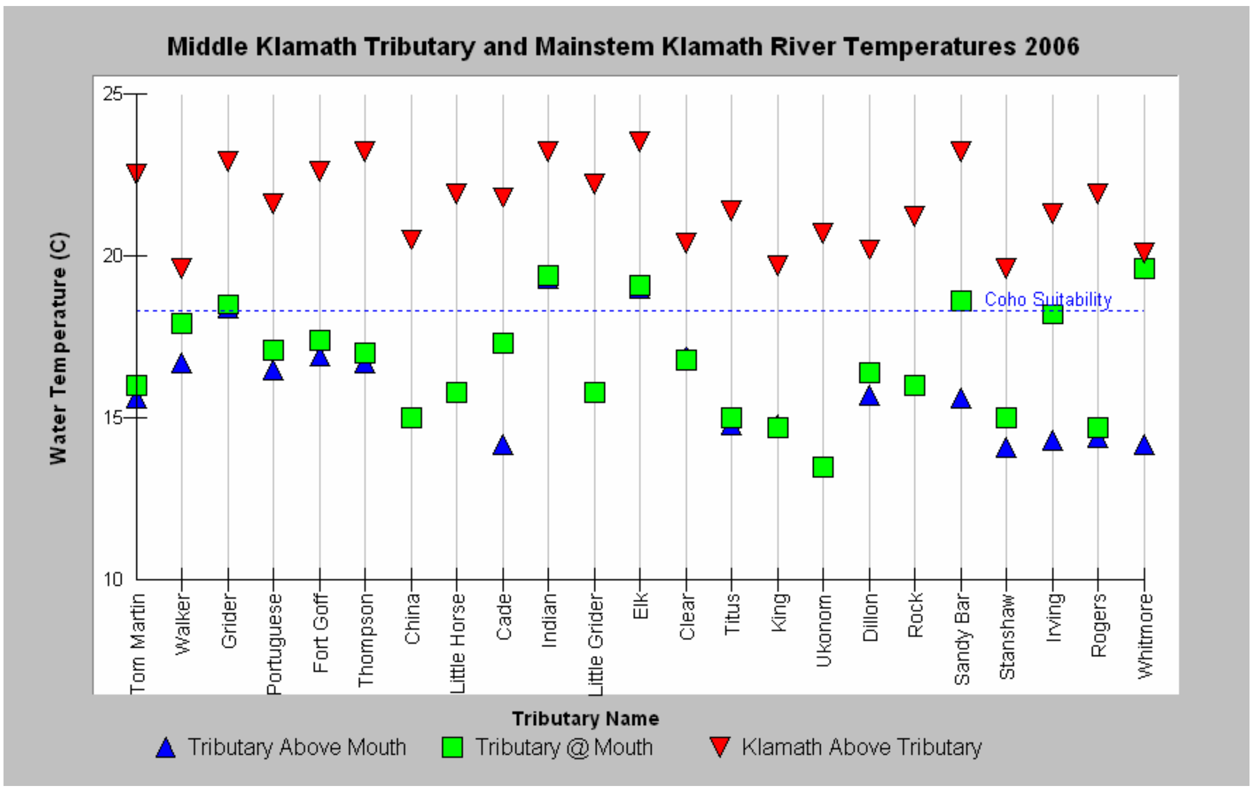


Figure 33-2. Temperature data collected during 2006 surveys (mid-June through mid-October). The data show that most tributaries were cool enough at the time of survey to support coho salmon, while mainstem Klamath River water temperatures were in the highly stressful range (MKWC 2006).

### Lack of Floodplain and Channel Structure

The lack of floodplain and channel structure is also a high stress because juvenile coho salmon need to rear in tributaries, using thermal refugia during summer and velocity refugia during winter. Habitat complexity in the form of pools, LWD cover, and off-channel floodplains is essential for juvenile rearing to optimize prey availability, avoid predation, and access these thermal and velocity refugia. The Middle Klamath River sub-basin generally lacks habitat complexity. The lack of floodplain and channel structure is a high stress for most life stages in this population. Fry, juveniles and smolts frequently use floodplains, side channels, and slow water habitats where available, especially in winter when high flows inhibit use of mainstem channel habitat. Generally, floodplain structure is not available in many Middle Klamath tributaries due to the steeper gradient and channel confinement in these areas, as well as the remnant dredge tailings on the floodplain in many areas. Floodplain connectivity is poor in the Indian Creek sub-watershed and the area between Dillon Creek and the Salmon River confluence. NMFS (2007b) noted that wood was inadequate in many Middle Klamath tributaries, which contributes stress to certain life stages that use more complex habitats. Sediment loading in some tributaries has affected the quality and availability of off-channel habitat as well. Lack of balanced sediment inputs along with the absence of adequate transport flows have filled many off-channel ponds and wetlands and prevent the creation and maintenance of side and off-channel habitat. Adults are impacted through the lack of suitable spawning habitat as a result of poor gravel recruitment and retention.

### Barriers

Alluvial dams, low flow conditions, road-crossings, and diversions cause many seasonal and permanent barriers in the Middle Klamath. Of these, alluvial dams at the mouths of many tributaries present the greatest number of barriers. In total, there are almost 50 known seasonal or permanent barriers in the Middle Klamath blocking or impairing access to over 170 miles of coho salmon habitat (Mid Klamath Restoration Partnership 2010). Hwy 96 has several poorly designed culverts that block upstream and downstream migration in key watersheds (Portuguese, Fort Goff, and Cade creeks) and unscreened diversions in streams are problematic. Overall, barriers pose a high stress for fry, juveniles, smolts, and adults due to the numerous barriers that exist throughout the tributaries of the Klamath. Barriers throughout the Middle Klamath are especially detrimental because they may block access for juvenile coho salmon to summer and winter refugia and rearing areas, as well as blocking spawning grounds for returning adults.

### Increased Disease/Predation/Competition

Disease, predation, and competition are a moderate to high stress for the population. Of these three stresses, disease is the most significant. Pathogens that cause diseases in juveniles and adults include *C. shasta*, *Ichthyopthirius multifilis* (Ich), *Flavobacterium columnare* (columnaris), Aeromonid bacteria, *Nanophyetus salmonicola*, and the kidney myxosporean *P. minibicornis* (Federal Regulatory Energy Commission [FERC] 2007, National Research Council [NRC] 2004). Disease occurs when conditions for the pathogen are favorable and when fish are susceptible. Ich and columnaris were responsible for the die-off event in the Lower Klamath River in the summer of 2002. Infection by *P. minibicornis* may occur at a prevalence of greater than 50 percent of juvenile coho salmon. It is unknown how often *P. minibicornis* causes direct mortality (Bartholomew and Courter 2007). Juvenile mortality rates from short term and longer term exposures at various locations in the Klamath River vary by location and time of year, but are consistently higher at Beaver Creek (Upper Klamath) and Seiad Valley. Between 2008 and 2010, mortality has been less than 10 percent at the Orleans site (Bartholomew 2012). With respect to predation and competition, the presence and abundance of exotic fish species have both increased in the Klamath River since the mid-20th century, creating an additional stress to coho salmon. Exotic fish have changed the ecology of the Klamath River; adverse interactions between exotic fish and coho salmon are poorly understood but may include competition for food/habitat, predation of coho salmon, and disease introduction. The threat of non-native/alien fish species is discussed further in Section 33.6 under Threats.

### Altered Hydrologic Function

Altered hydrologic function poses an overall high stress for the population. The timing, magnitude and volume of flows in the mainstem Klamath River have been altered compared to historical unimpaired conditions. The high stress rank for juveniles and smolts is due to the altered flow regime in the mainstem and human-induced seasonal low flows in many Middle Klamath tributaries. The altered hydrology in the mainstem has led to decreased water quality and reductions in thermal refugia due to lack of access to tributaries and other suitable rearing habitat. Alteration of the natural hydrograph is primarily due to diversions and water withdrawals in the Upper Klamath Basin and in upstream tributaries, as well as the managed flow from Iron Gate Dam. Although the impacts of the agricultural projects and hydropower decrease with distance downstream from Iron Gate Dam, adverse effects can be detected in the Middle Klamath mainstem hydrograph. Generally, spring and summer flows are lower than historically unimpaired flows, and tend to peak approximately a month earlier, subsiding 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 low baseflows also precipitates poor water conditions that now coincide with a greater proportion of the smolt outmigration through the mainstem reach.

Many of the flow impairments in tributary streams are due to the diversion of water for private and municipal use. Diversions cause some tributaries to go subsurface intermittently during the summer and may eliminate or reduce thermal refugia in tributaries or tributary outlets at other times of the year. Also detrimental are the high sediment loads that have caused some reaches to flow subsurface intermittently during the summer. Refugia and off-channel rearing habitat are often cut off from mainstem and tributary streams during low flow conditions in the summer. Summer water diversions can contribute to degraded habitat and/or fish passage issues in tributaries including Indian, Stanshaw, Red Cap, Boise, Camp, Cade, Elk Creek, and Fort Goff creeks during low water years (MKWC 2006).

### Impaired Estuary/Mainstem Function

All anadromous fish natal to Middle Klamath River tributaries must migrate through the Lower Klamath River and estuary to complete its life cycle. The Klamath River estuary plays an important role in providing holding habitat, foraging and refuge opportunities for juvenile coho salmon and smolts from the Middle Klamath. Although the estuary is short and small compared to the large size of the watershed, it does provide complex habitat as well as rearing opportunities for juvenile coho salmon. The degraded conditions that exist throughout the Klamath Basin today may mean that the estuary must play an even greater role for all Klamath populations by providing rare opportunities for juvenile and smolt growth and refugia prior to entering the ocean. The Klamath River estuary suffers from poor water quality, elevated sedimentation and accretion, loss of habitat, and disconnection from tributary streams and the floodplain (Hiner 2006). Additionally, diking and development on the floodplain along the

Lower Klamath has led to the loss and degradation of riparian vegetation and side channel habitat in the estuary. More information about the Klamath River estuary can be found in the Lower Klamath River population profile.

Disease, limited access to and availability of thermal refugia and off-channel habitat, and lack of connectivity between tributaries and the mainstem are all issues that impact the quality of migratory and rearing habitat downstream of the Middle Klamath. Juveniles, smolts, and adults transitioning through estuarine and mainstem habitats are stressed by the degraded conditions in these migratory habitats and suffer from the lost opportunity for increased growth, and consequently, may have a lower survival rate. The loss and degradation of estuarine and mainstem habitat is considered a moderate to high stress for the population, with the most affected life stages being juveniles and smolts due to the degradation of rearing and juvenile migratory habitat.

### Adverse Hatchery-Related Effects

No hatcheries or artificial propagation occur in the Middle Klamath population area, but there are two hatcheries in the Klamath River Basin. Iron Gate Hatchery is upstream on the Klamath River, and Trinity River Hatchery is on the Trinity River, which flows into the Klamath River near the Middle Klamath population area. The proportion of spawning adults of hatchery origin in the Middle Klamath River is unknown. Adverse hatchery-related effects pose a medium risk to all life stages, due to the presence of Iron Gate Hatchery and Trinity River Hatchery in the Klamath Basin.

### Degraded Riparian Forest Conditions

Degraded riparian forest conditions pose a medium stress for all life stages. Aerial photos show that while there are areas of disturbance, the majority of riparian areas surrounding tributaries and high quality refugia contain abundant riparian vegetation and have adequate structure and diversity. The medium rating is due to areas of degraded riparian condition resulting from high severity fires, mining, major floods (such as the 1964 flood), and past timber harvests. These disturbances create localized, short term reductions in riparian vegetation that can have major impacts depending on the degree and extent of coho salmon use of the area. Many riparian areas along the Middle Klamath remain partially barren as a result of historic placer and hydraulic mining activities, as well as lower hillslope road construction. Mining and roads have had a prolonged impact on geologic stability, soil, nutrients, cover, temperature, and riparian plant and animal communities. These barren areas are still apparent in the landscape today. Areas such as Elk Creek, where wildfire has recently denuded riparian vegetation, will experience higher water temperatures and higher sediment loads over the short term, but will slowly recover their riparian function in the long term.

### Adverse Fishery- and Collection-Related Effects

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

## 33.6 Threats

Table 33-3. Severity of threats affecting each life stage of coho salmon in the Middle Klamath. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

| Threats[2] | | Egg | Fry | Juvenile[1] | Smolt | Adult | Overall Threat Rank |
|---|---|---|---|---|---|---|---|
| 1 | High Severity Fire[1] | High | High | High[1] | High | High | High |
| 2 | Dams/Diversions[1] | Low | Medium | High[1] | High | Medium | High |
| 3 | Climate Change | Medium | Medium | High | High | Medium | High |
| 4 | Roads | Medium | Medium | High | Medium | Medium | Medium |
| 5 | Hatcheries | Medium | Medium | Medium | Medium | Medium | Medium |
| 6 | Road-Stream Crossing Barriers | - | Low | Medium | Medium | Medium | Medium |
| 7 | Mining/Gravel Extraction | Low | Low | Low | Low | Low | Low |
| 8 | Fishing and Collecting | - | - | Low | Low | Low | Low |
| 9 | Channelization/Diking | Low | Low | Low | Low | Low | Low |
| 10 | Agricultural Practices | Low | Low | Low | Low | Low | Low |
| 11 | Timber Harvest | Low | Low | Low | Low | Low | Low |
| 12 | Invasive Non-Native/Alien Species | Low | Low | Low | Low | Low | Low |

[1]Key limiting threats and limited life stage.
[2] Urban/Residential/Industrial Development is not considered threats to this population.

### Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are high severity fire and dams/diversions.

### High Severity Fire

High severity fire is a high threat to all life stages in the Middle Klamath. Because of past timber harvest practices and fire-suppression efforts, understory forest fuel loads have become excessive. High severity fires result from excessive forest fuel loads and are seen regularly throughout the area (e.g., Dillon, Pony, Swillup, Stanza, Titus, and Panther creeks). Large, high severity fires can cause chronic sediment transport from upslope sources to stream channels, particularly when coupled with salvage and other timber harvest activities. Landscapes scorched by severe fire loosen soil integrity as plant and tree roots degrade, triggering landslides that introduce large quantities of sediment into creeks and rivers. Areas that are prone to future fire events (based on fuel loading) include important coho salmon habitat in Red Cap, Boise, Bluff, Slate, Camp, Indian, Elk, Goff, Portuguese, Clear, Dillon, and Thompson creeks.

### Dams/Diversions

Dam construction on the mainstem Klamath River has contributed to the degraded instream and floodplain conditions and unnatural sediment loads in the watershed. PacifiCorp's HCP for the operations of the Klamath hydroelectric project includes measures to augment gravel and LWD to enhance habitat conditions below Iron Gate Dam (NMFS 2012, PacifiCorp 2012). Dams and diversions are a high threat to juveniles and smolts, and a medium threat to fry and adults. The threat from dams and diversions primarily stems from agricultural diversions in the Upper Basin and from Middle Klamath tributaries, as well as the influence of upstream dams on mainstem habitat, water quality, fish passage, tributary access, and refugia. Water diversions from tributaries are largely undocumented and are expected to continue to degrade habitat and refugia. Within the Middle Klamath River, there are approximately 170 documented diversions (CalFish 2009). Diversion of water from tributaries diminishes summer base flows, decreases the potential for summer rearing, limits access to thermal refugia, and exacerbates water quality issues. Unscreened, undocumented diversions throughout the Middle Klamath River likely act as fish passage barriers, preventing migration of juveniles.

Marijuana cultivation has become common in many areas of the SONCC coho salmon recovery domain. Although the number of plants grown each year is unknown, the water diversion required to support these plants places a high demand on a limited supply of water (Bauer 2013). 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 2013). Based on an estimate from the medical marijuana industry, each marijuana plant may consume 900 gallons of water per growing season (HGA 2010).

Upstream dams, including Iron Gate, Copco 2 and 1, JC Boyle, and Keno dams, contribute to the water quality and hydrology issues in the Middle Klamath River. These water quality issues facilitate increased infection rates and disease occurrence, and are reflected in low dissolved oxygen levels, altered water temperature regimes, and increased nutrient levels. The operation of these dams affects the hydrologic regime by altering the timing and magnitude of peak flows (when the reservoirs are not at full capacity), as well as curtailing downstream transport of upstream sediment sources. Fish passage or dam removal above Iron Gate Dam is expected to occur in the next 10 years as part of the Klamath Hydroelectric Settlement Agreement, which will reduce the threat posed by the hydroelectric project over the long term. In the interim, efforts will be made to avoid, minimize, or mitigate the impacts from the dams through the PacifiCorp HCP.

Upstream diversions by the Klamath Project in the Upper Klamath River Basin and in the Scott and Shasta rivers decrease flows required to maintain adequate water temperatures in the mainstem Klamath River, and increase the occurrence and severity of alluvial barriers at many tributary mouths. Upstream dams and diversions adversely affects all life stages of coho salmon through their impacts on habitat quality and availability, water quality and quantity, altered sediment supply and transport, and disease/infection rates.

### Climate Change

Climate change has emerged as a high threat to coho salmon in the Middle Klamath River due to predicted changes in fire regimes, snow pack, ambient temperatures, and precipitation. Climate change in this region will likely 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 ambient temperature could increase by up to 3 $^{o}$C in the summer and by 1 $^{o}$C in the winter, while annual precipitation in this area is predicted to trend downward over the next century. Additionally, snowpack in upper elevations of the Klamath Basin is predicted to decrease in response to changes in temperature and precipitation (California Natural Resources Agency 2009). Rearing and migratory habitat are most at risk to climate change. Increasing water temperatures and changes in the amount and timing of precipitation and snowmelt will impact water quality and hydrologic function in the summer and winter. Adults will 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). Overall, the range and degree of variability in ambient temperature and precipitation are likely to increase in this population, creating long term threats to the persistence of coho salmon in this area.

### Roads

Historic timber harvest, road building, and wildfires in the Middle Klamath River have contributed to degraded instream and floodplain conditions and unnatural sediment loads in the watershed. Roads are a high threat to juveniles and a medium threat to eggs, fry, smolts and adults. Road density is high (≥2.5 to 3 mi/sq. mi) or very high (>3 mi/sq. mi) throughout half of the watershed, including areas where limited high IP reaches and high quality refugia areas are located. The majority of these roads are located on U.S. Forest Service land and are being prioritized for treatment and treated as resources allow through upgrading, storm-proofing, and decommissioning). The Klamath and Six Rivers National Forests have developed a Forest Road Analysis and a Motorized Travel Management Plan, which prioritizes road work that will result in benefits to natural resources. Since 1995, approximately 18.5 percent of Forest roads have been decommissioned and 11.5 percent upgraded within key anadromous fisheries' watersheds on the Orleans Ranger District of the Six Rivers National Forest within the Middle Klamath (Cyr 2011). However, because road decommissioning and road improvements are costly, many high priority roads still remain untreated. Currently, the areas with the greatest remaining road densities and greatest risk for slope failure include the China, Cade, Dillon, Rock, Reynolds, and Slate Creek watersheds. The high density of roads is expected to continue to contribute to sedimentation in the Middle Klamath River over the next several decades. Excessive sedimentation leads to simplification of streams, embeds spawning gravel, decreases pool depth for rearing juveniles and reduces channel stability. Such habitat changes hinder successful spawning and emergence, limit access to rearing habitats, increase competition and predation, and affect macro-invertebrate densities.

### Hatcheries

Hatcheries pose a medium threat to other life stages in the Middle Klamath River Basin. The rationale for these ratings is described under the "Adverse Hatchery-Related Effects" stress.

### Road-stream Crossing Barriers

Road-related barriers pose a medium threat and primarily affect juveniles, smolts, and adults in this population and juveniles and smolts from upstream populations that utilize rearing and refugia habitat in the Middle Klamath. Over the past decade, the Klamath and Six Rivers National Forests have removed most of the critical anadromous fish passage barriers on Forest Service roads. However, there are still a number of passage problems associated with Highway 96 (Table 33-4). Road-stream crossings are important because they block access to tributary habitat and refugia, and because they may impact the hydrologic function of tributaries and lead to increased road failures. Some of the remaining road-stream crossing barriers have been prioritized for removal (Fort Goff Creek) and the remaining barriers are being evaluated for removal.

Table 33-4. List of important road-stream crossing barriers in the Middle Klamath River area.

| Barrier Treatment Ranking | Stream Name | Road Name | USFS District | County | Miles of upstream habitat* |
|---|---|---|---|---|---|
| 2 | Portuguese Creek | Hwy 96 | Happy Camp | Siskiyou | 0.4 |
| 2 | Fort Goff Creek | Hwy 96 | Happy Camp | Siskiyou | 0.9 |
| 2 | Cade Creek | Hwy 96 | Happy Camp | Siskiyou | 0.5 |
| 2 | Negro Creek | Private | Happy Camp | Siskiyou | unknown |
| 1 | Crawford Creek | Hwy 96 | Orleans | Humboldt | 0.6 |
| 1 | Stanshaw Creek | Hwy 96 | Orleans | Siskiyou | 0.2 |
| 1 | Sandy Bar Creek | Hwy 96 | Orleans | Siskiyou | 0.4 |

*Miles of habitat and ranking is estimated by the Mid Klamath Restoration Partnership (2010). Ranking is on a scale from 0 to 3 with 3 being the highest priority for removal.

### Mining/Gravel Extraction

Suction dredging mostly affects juveniles and has a number of detrimental effects. Degradation of the channel bed can deplete the entire depth of gravel, exposing other substrates that may underlie the gravel, which would reduce the amount of usable anadromous spawning habitat (Collins and Dunne 1990, Kondolf, 1994, Oregon Water Resources Research Institute 1995). Gravel removal not only impacts the extraction site, but may reduce gravel delivery to downstream spawning areas (Pauley et al. 1989). Other adverse effects of mining include increasing turbidity, modifying spawning channels, decreasing emergent macro-invertebrate prey, and disturbing and displacing juveniles and smolts from refugia. Past mining activities have also left heavy metal contamination (i.e., mercury, copper, arsenic, etc.) at sites on Indian and Copper creeks (a tributary of Dillon Creek). The California Department of Fish and Wildlife is currently prohibited by statute from issuing suction dredge permits, making it unlawful to use any vacuum or suction dredge equipment in any river, stream, or lake in California (see http://www.dfg.ca.gov/suctiondredge).

The Forest Service recently capped the mill tailings with fill at the Siskon Mine superfund site, and plans are underway to revegetate the mill tailing pond and mill site area, and stormproof and stabilize the mine road. No details of the Luther Gulch superfund site near Indian Creek are available. Overall, mining and gravel extraction is considered a low threat for coho salmon in the Middle Klamath River.

### Fishing and Collecting

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

### Channelization/Diking

Channelization and diking is not a major threat in the Middle Klamath River coho salmon population. There is little residential and agricultural development in the Middle Klamath, and therefore only small-scale channelization and diking of tributaries, except for Indian Creek.

### Agricultural Practices

Because of the small number of existing ranches and farms in this watershed, agricultural practices are a low threat to this population and are not thought to cause significant decreases in water quality, are not significantly altering streambanks or floodplains, and are not decreasing riparian habitat in the Middle Klamath sub-basin. However, effects from water withdrawals are seen in these areas, and act cumulatively with withdrawals occurring upstream. These water withdrawals are considered in the threat ranking for Dams/Diversions. Grazing occurs in the Marble Mountain Wilderness and in the Upper Bluff Creek watershed, but, the extent of grazing impacts to these watersheds is not significant. Upstream agricultural practices in the Upper Basin and the Scott and Shasta valleys are affecting water quality and flow volumes in the Middle Klamath River mainstem (See appropriate profiles for more information). In particular, upstream agricultural practices may be contributing to extended summer low flow conditions, reduction in available rearing habitats, and overall increased stress to juveniles.

### Timber Harvest

Timber harvest is not a threat to coho salmon in this area due to the protective measures in place on National Forest timberlands. Timber harvesting has been low throughout this watershed the past few decades, and is not expected to increase in the near future. Under current management practices and the financial, administrative and legal restrictions on timber harvest, the USFS is unlikely to implement large timber sales. Additionally, timber practices are governed by the rigorous protective measures for water quality required under the Northwest Forest Plan.

### Invasive Non-Native/Alien Species

The presence and abundance of invasive non-native/alien fish species have increased in the Klamath River since the mid-20$^{th}$ century. Some of these introduced fish species are: American shad (*Alosa sapidissima*), golden shiner (*Notemigonus crysoleucas*), brown bullhead (*Ameirus nebulosus*), brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis*), brook stickleback (*Culaea inconstans*), black crappie (*Pomoxis nigromaculatus*), green sunfish (*Lepomis cyanellus*), largemouth bass (*Micropterus salmoides*), pumpkinseed (*Lepomis gibbosus*), bluegill (*Lepomis macrochirus*), catfish (*Ictalurus sp.*), spotted bass (*Micropterus punctulatus*), yellow perch (*Perca flavescens*), and wakasagi *(Hypomesus nipponensis*) (Mount and Moyle 2003, Israel 2003). These exotic fish have changed the ecology of the Klamath River, creating an additional "unknown" threat to coho salmon. These species are hardy and tend to adapt well to warm Klamath River summer water temperatures. Adverse interactions between these exotic fish species and coho salmon are poorly understood, but may include: competition for food and/or space, habitat interference, disease and parasites introduction, and predation of coho salmon.

## 33.7 Recovery Strategy

The potential for coho salmon recovery in the Middle Klamath is very high. However, the population abundance is currently depressed and habitat is degraded in many areas. The quality of summer and winter rearing habitat is poor in many areas, and this habitat type is limited in its extent and connectivity. Mainstem conditions during the summer prohibit migration and rearing. Recovery activities in the watershed should focus on improving water quality and increasing floodplain and channel structure for juveniles. Restoration should also include the ongoing long term reduction in sediment through road decommissioning where necessary, timber harvest management, and reduction in high severity fire risks through fuels reduction on private and public lands.

The removal of four mainstem dams in the Upper Klamath River as provided in the Klamath Hydroelectric Settlement Agreement will be important to the improvement of hydrologic function, water quality, and disease conditions in the mainstem Klamath River. The immediate 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. Specific goals for restoration are listed below and in the table of recovery actions that follows.

The highest potential for restoring summer migratory and rearing habitat is in the mainstem Middle Klamath River and in Boise, Slate, Elk, and Indian creeks (Mid Klamath Restoration Partnership 2010). Reducing stream temperatures, maintaining and improving thermal refugia, improving hydrologic function, and removing barriers will all help to increase the opportunity and capacity for summer rearing and migration in the Middle Klamath River. These actions will benefit both the natal population as well as the other populations in the Klamath River basin.

The highest potential for restoring winter rearing habitat is in the mainstem Klamath River and in Elk and Indian creeks (Mid Klamath Restoration Partnership 2010). Improving channel and floodplain complexity and connectivity and reducing sediment supply to tributaries will help to increase the opportunity and capacity for winter rearing. These actions will benefit both the natal population as well as the other Klamath populations in the stratum.

Table 33-5 on the following page lists the recovery actions for the Middle Klamath River population.

Table 33-5. Recovery action implementation schedule for the Middle Klamath 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-MKR.10.3.1 | Water Quality | Yes | Protect cold water | Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows | Population wide | 1 |
| *SONCC-MKR.10.3.1.1* | *Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat* | | | | | |
| *SONCC-MKR.10.3.1.2* | *Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results* | | | | | |
| SONCC-MKR.2.2.4 | Floodplain and Channel Structure | Yes | Reconnect the channel to the floodplain | Re-connect channel to existing off-channel ponds, wetlands, and side channels | All areas that will immediately benefit coho salmon | 1 |
| *SONCC-MKR.2.2.4.1* | *Assess instream flow conditions and side channel connectivity and develop a plan to obtain adequate flows for channel connectivity* | | | | | |
| *SONCC-MKR.2.2.4.2* | *Mechanically alter side channels, off channel ponds and wetlands to achieve connectivity* | | | | | |
| SONCC-MKR.1.2.43 | Estuary | No | Improve estuarine habitat | Improve estuary condition | Klamath River Estuary, including tributaries and off-channel habitats in or near estuary | 1 |
| *SONCC-MKR.1.2.43.1* | *Implement recovery actions for Lower Klamath River population that address the target "Estuary", including the creation/restoration of off-channel rearing habitat throughout the lower Klamath River* | | | | | |
| SONCC-MKR.2.1.6 | Floodplain and Channel Structure | Yes | Increase channel complexity | Increase LWD, boulders, or other instream structure | All areas that will immediately benefit coho salmon | 2c |
| *SONCC-MKR.2.1.6.1* | *Assess habitat to determine beneficial location and amount of instream structure needed* | | | | | |
| *SONCC-MKR.2.1.6.2* | *Place instream structures, guided by assessment results* | | | | | |
| SONCC-MKR.2.1.64 | Floodplain and Channel Structure | Yes | Increase channel complexity | Increase LWD, boulders, or other instream structure | Population wide | 2d |
| *SONCC-MKR.2.1.64.1* | *Assess habitat to determine beneficial location and amount of instream structure needed* | | | | | |
| *SONCC-MKR.2.1.64.2* | *Place instream structures, guided by assessment results* | | | | | |
| SONCC-MKR.10.3.10 | Water Quality | Yes | Protect cold water | Protect existing or potential cold water refugia | All areas that will immediately benefit coho salmon | 2c |
| *SONCC-MKR.10.3.10.1* | *Develop emergency plan and implement measures to protect thermal refugia during warm periods* | | | | | |
| *SONCC-MKR.10.3.10.2* | *Develop program that identifies, designs, and constructs projects that reduce warm tailwater input* | | | | | |
| *SONCC-MKR.10.3.10.3* | *Implement tailwater reduction program* | | | | | |
| *SONCC-MKR.10.3.10.4* | *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-MKR.10.3.61 | Water Quality | Yes | Protect cold water | Protect existing or potential cold water refugia | Population wide | 2d |
| *SONCC-MKR.10.3.61.1* | *Develop emergency plan and implement measures to protect thermal refugia during warm periods* | | | | | |
| *SONCC-MKR.10.3.61.2* | *Develop program that identifies, designs, and constructs projects that reduce warm tailwater input* | | | | | |
| *SONCC-MKR.10.3.61.3* | *Implement tailwater reduction program* | | | | | |
| *SONCC-MKR.10.3.61.4* | *Protect cold water refugia through water conservation efforts (e.g. California Water Code Section 1707, storage, forbearance, etc.)* | | | | | |
| SONCC-MKR.2.2.5 | Floodplain and Channel Structure | Yes | Reconnect the channel to the floodplain | Remove, set back, or reconfigure levees and dikes | Leveed streams that will immediately benefit coho salmon (e.g. Indian Creek, etc.) | 2c |
| *SONCC-MKR.2.2.5.1* | *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 and dikes have been removed or set back* | | | | | |
| *SONCC-MKR.2.2.5.2* | *Remove or set back levees and dikes and restore channel form and floodplain connectivity, guided by the plan* | | | | | |
| SONCC-MKR.10.2.13 | Water Quality | Yes | Reduce pollutants | Remove pollutants | Luther and Baker gulches, Deer Lick Creek in Indian Creek watershed, Copper Creek in Dillon Creek watershed, and other areas that will benefit coho salmon immediately | 2c |
| *SONCC-MKR.10.2.13.1* | *Assess contamination from tailing piles and develop mining activities remediation plan* | | | | | |
| *SONCC-MKR.10.2.13.2* | *Take necessary actions to ensure responsible parties remediate mine tailing piles, guided by the plan* | | | | | |
| SONCC-MKR.10.2.60 | Water Quality | Yes | Reduce pollutants | Remove pollutants | Population wide | 2d |
| *SONCC-MKR.10.2.60.1* | *Assess contamination from tailing piles and develop mining activities remediation plan* | | | | | |
| *SONCC-MKR.10.2.60.2* | *Take necessary actions to ensure responsible parties remediate mine tailing piles, guided by the plan* | | | | | |
| SONCC-MKR.5.1.22 | Passage | No | Improve access | Reduce sediment barriers | All areas that will immediately benefit coho salmon | 2c |
| *SONCC-MKR.5.1.22.1* | *Inventory and prioritize barriers formed by alluvial deposits* | | | | | |
| *SONCC-MKR.5.1.22.2* | *Construct low flow channels, and reduce stream gradient to provide fish passage over alluvial deposits for all life stages* | | | | | |
| SONCC-MKR.5.1.69 | Passage | No | Improve access | Reduce sediment barriers | Population wide | 2d |
| *SONCC-MKR.5.1.69.1* | *Inventory and prioritize barriers formed by alluvial deposits* | | | | | |
| *SONCC-MKR.5.1.69.2* | *Construct low flow channels, and reduce stream gradient to provide fish passage over alluvial deposits for all life stages* | | | | | |

| Action ID | Target | KLS/T | Strategy | Action Description | Area | Priority |
|---|---|---|---|---|---|---|
| *Step ID* | | *Step Description* | | | | |
| SONCC-MKR.3.1.15 | Hydrology | No | Improve flow timing or volume | Increase instream flows | All streams where coho salmon will benefit immediately | 2c |
| *SONCC-MKR.3.1.15.1* | | *Assess diversion impact and develop a program to increase flow during low flow periods* | | | | |
| *SONCC-MKR.3.1.15.2* | | *Increase flows during low flow periods, as described in the program* | | | | |
| SONCC-MKR.3.1.56 | Hydrology | No | Improve flow timing or volume | Increase instream flows | Population wide | 2c |
| *SONCC-MKR.3.1.56.1* | | *Identify and cease unauthorized water diversions* | | | | |
| SONCC-MKR.3.1.58 | Hydrology | No | Improve flow timing or volume | Increase instream flows | All areas that will immediately benefit coho salmon | 2c |
| *SONCC-MKR.3.1.58.1* | | *Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer* | | | | |
| *SONCC-MKR.3.1.58.2* | | *Reduce diversions using a combination of incentives and enforcement measures* | | | | |
| SONCC-MKR.3.1.66 | Hydrology | No | Improve flow timing or volume | Increase instream flows | Population wide | 2d |
| *SONCC-MKR.3.1.66.1* | | *Assess diversion impact and develop a program to increase flow during low flow periods* | | | | |
| *SONCC-MKR.3.1.66.2* | | *Increase flows during low flow periods, as described in the program* | | | | |
| SONCC-MKR.3.1.68 | Hydrology | No | Improve flow timing or volume | Increase instream flows | Population wide | 2d |
| *SONCC-MKR.3.1.68.1* | | *Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer* | | | | |
| *SONCC-MKR.3.1.68.2* | | *Reduce diversions using a combination of incentives and enforcement measures* | | | | |
| SONCC-MKR.10.3.24 | Water Quality | No | Protect cold water | Remove structural barriers | All areas that will immediately benefit coho salmon | 2c |
| *SONCC-MKR.10.3.24.1* | | *Assess barriers and prioritize for removal* | | | | |
| *SONCC-MKR.10.3.24.2* | | *Remove barriers, based on evaluation* | | | | |
| SONCC-MKR.10.3.62 | Water Quality | No | Protect cold water | Remove structural barriers | Population wide | 2d |
| *SONCC-MKR.10.3.62.1* | | *Assess barriers and prioritize for removal* | | | | |
| *SONCC-MKR.10.3.62.2* | | *Remove barriers, based on evaluation* | | | | |

| Action ID | Target | KLS/T | Strategy | Action Description | Area | Priority |
|---|---|---|---|---|---|---|
| *Step ID* | *Step Description* | | | | | |
| SONCC-MKR.7.1.8 | Riparian | No | Improve wood recruitment, bank stability, shading, and food subsidies | Increase conifer riparian vegetation | Population wide | 2d |
| *SONCC-MKR.7.1.8.1* | *Develop an appropriate timber harvest management plan for benefits to coho salmon habitat* | | | | | |
| *SONCC-MKR.7.1.8.2* | *Thin, or release conifers, guided by the plan* | | | | | |
| *SONCC-MKR.7.1.8.3* | *Plant conifers, guided by the plan* | | | | | |
| SONCC-MKR.7.1.9 | Riparian | No | Improve wood recruitment, bank stability, shading, and food subsidies | Reduce fire hazard | Population wide | 2d |
| *SONCC-MKR.7.1.9.1* | *Develop fire hazard reduction educational materials for landowners* | | | | | |
| *SONCC-MKR.7.1.9.2* | *Develop a plan for fire break stewardship and defensible space* | | | | | |
| *SONCC-MKR.7.1.9.3* | *Implement fire-safe community action plans in identified areas* | | | | | |
| *SONCC-MKR.7.1.9.4* | *Reduce stand densities through prescribed burning and thinning to reduce high severity fire* | | | | | |
| SONCC-MKR.26.1.57 | Low Population Dynamics | No | Increase population abundance | Rescue and relocate stranded juveniles | Population wide | 2d |
| *SONCC-MKR.26.1.57.1* | *Survey coho-bearing tributaries and relocate juveniles stranded in drying pools* | | | | | |
| SONCC-MKR.10.3.12 | Water Quality | Yes | Protect cold water | Improve regulatory mechanisms | Population wide | 3c |
| *SONCC-MKR.10.3.12.1* | *Develop regulatory mechanisms that protect critical cold water refugia* | | | | | |
| SONCC-MKR.2.2.2 | Floodplain and Channel Structure | Yes | Reconnect the channel to the floodplain | Increase beaver abundance | All areas that will immediately benefit coho salmon | 3c |
| *SONCC-MKR.2.2.2.1* | *Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort* | | | | | |
| *SONCC-MKR.2.2.2.2* | *Implement education and technical assistance programs for landowners, guided by the plan* | | | | | |
| *SONCC-MKR.2.2.2.3* | *Reintroduce or relocate beaver if appropriate, guided by the plan* | | | | | |
| SONCC-MKR.2.2.65 | Floodplain and Channel Structure | Yes | Reconnect the channel to the floodplain | Increase beaver abundance | Population wide | 3d |
| *SONCC-MKR.2.2.65.1* | *Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort* | | | | | |
| *SONCC-MKR.2.2.65.2* | *Implement education and technical assistance programs for landowners, guided by the plan* | | | | | |
| *SONCC-MKR.2.2.65.3* | *Reintroduce or relocate beaver if appropriate, guided by the plan* | | | | | |

| Action ID | Target | KLS/T | Strategy | Action Description | Area | Priority |
|---|---|---|---|---|---|---|
| *Step ID* | *Step Description* | | | | | |
| SONCC-MKR.5.2.27 | Passage | No | Decrease mortality | Screen all diversions | All areas that will immediately benefit coho salmon | 3c |
| *SONCC-MKR.5.2.27.1* | *Assess diversions and develop a screening program* | | | | | |
| *SONCC-MKR.5.2.27.2* | *Screen all diversions* | | | | | |
| SONCC-MKR.5.2.72 | Passage | No | Decrease mortality | Screen all diversions | Population wide | 3d |
| *SONCC-MKR.5.2.72.1* | *Assess diversions and develop a screening program* | | | | | |
| *SONCC-MKR.5.2.72.2* | *Screen all diversions* | | | | | |
| SONCC-MKR.5.1.26 | Passage | No | Improve access | Reduce flow barrier | All areas that will immediately benefit coho salmon | 3c |
| *SONCC-MKR.5.1.26.1* | *Identify areas where fish stranding occurs and develop a plan to create low flow channels, concentrate existing flows, and prevent stranding* | | | | | |
| *SONCC-MKR.5.1.26.2* | *Implement plan to prevent stranding* | | | | | |
| SONCC-MKR.5.1.71 | Passage | No | Improve access | Reduce flow barrier | Population wide | 3d |
| *SONCC-MKR.5.1.71.1* | *Identify areas where fish stranding occurs and develop a plan to create low flow channels, concentrate existing flows, and prevent stranding* | | | | | |
| *SONCC-MKR.5.1.71.2* | *Implement plan to prevent stranding* | | | | | |
| SONCC-MKR.5.1.23 | Passage | No | Improve access | Remove barriers | All areas that will immediately benefit coho salmon | 3c |
| *SONCC-MKR.5.1.23.1* | *Develop breaching and dam removal program to address man-made rock dams* | | | | | |
| *SONCC-MKR.5.1.23.2* | *Breach or remove man-made rock dams* | | | | | |
| SONCC-MKR.5.1.70 | Passage | No | Improve access | Remove barriers | Population wide | 3d |
| *SONCC-MKR.5.1.70.1* | *Develop breaching and dam removal program to address man-made rock dams* | | | | | |
| *SONCC-MKR.5.1.70.2* | *Breach or remove man-made rock dams* | | | | | |
| SONCC-MKR.3.1.45 | Hydrology | No | Improve flow timing or volume | Determine effects of marijuana cultivation | Population wide | 3c |
| *SONCC-MKR.3.1.45.1* | *Assess cumulative effects (e.g., flow, water quality) of marijuana cultivation* | | | | | |
| *SONCC-MKR.3.1.45.2* | *If needed, develop plan to reduce effects of marijuana cultivation* | | | | | |
| *SONCC-MKR.3.1.45.3* | *Implement plan* | | | | | |

| Action ID | Target | KLS/T | Strategy | Action Description | Area | Priority |
|---|---|---|---|---|---|---|
| *Step ID* | *Step Description* | | | | | |
| SONCC-MKR.3.1.17 | Hydrology | No | Improve flow timing or volume | Improve regulatory mechanisms | All areas that will immediately benefit coho salmon | 3c |
| *SONCC-MKR.3.1.17.1* | *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-MKR.3.1.17.2* | *Implement water dedications to increase instream flows using the streamlined process* | | | | | |
| SONCC-MKR.3.1.59 | Hydrology | No | Improve flow timing or volume | Provide adequate instream flow for coho salmon | Population wide | 3c |
| *SONCC-MKR.3.1.59.1* | *Conduct study to determine instream flow needs of coho salmon at all life stages.* | | | | | |
| *SONCC-MKR.3.1.59.2* | *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-MKR.3.1.59.3* | *Implement coho salmon instream flow needs plan.* | | | | | |
| SONCC-MKR.8.1.20 | Sediment | No | Reduce delivery of sediment to streams | Minimize surface erosion and mass wasting | All areas that will immediately benefit coho salmon | 3c |
| *SONCC-MKR.8.1.20.1* | *Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting* | | | | | |
| *SONCC-MKR.8.1.20.2* | *Implement plan to stabilize slopes and revegetate areas through planting and best management practices* | | | | | |
| SONCC-MKR.8.1.73 | Sediment | No | Reduce delivery of sediment to streams | Minimize surface erosion and mass wasting | Population wide | 3d |
| *SONCC-MKR.8.1.73.1* | *Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting* | | | | | |
| *SONCC-MKR.8.1.73.2* | *Implement plan to stabilize slopes and revegetate areas through planting and best management practices* | | | | | |
| SONCC-MKR.8.1.21 | Sediment | No | Reduce delivery of sediment to streams | Reduce road-stream hydrologic connection | All areas that will immediately benefit coho salmon | 3c |
| *SONCC-MKR.8.1.21.1* | *Assess and prioritize road-stream connection, and identify appropriate treatments* | | | | | |
| *SONCC-MKR.8.1.21.2* | *Decommission roads, guided by assessment* | | | | | |
| *SONCC-MKR.8.1.21.3* | *Upgrade roads, guided by assessment* | | | | | |
| *SONCC-MKR.8.1.21.4* | *Maintain roads, guided by assessment* | | | | | |
| SONCC-MKR.8.1.74 | Sediment | No | Reduce delivery of sediment to streams | Reduce road-stream hydrologic connection | Population wide | 3d |
| *SONCC-MKR.8.1.74.1* | *Assess and prioritize road-stream connection, and identify appropriate treatments* | | | | | |
| *SONCC-MKR.8.1.74.2* | *Decommission roads, guided by assessment* | | | | | |
| *SONCC-MKR.8.1.74.3* | *Upgrade roads, guided by assessment* | | | | | |
| *SONCC-MKR.8.1.74.4* | *Maintain roads, guided by assessment* | | | | | |

| Action ID | Target | KLS/T | Strategy | Action Description | Area | Priority |
|---|---|---|---|---|---|---|
| *Step ID* | *Step Description* | | | | | |
| SONCC-MKR.10.7.55 | Water Quality | No | Restore nutrients | Add marine-derived nutrients to streams | All areas that will immediately benefit coho salmon | 3c |
| *SONCC-MKR.10.7.55.1* | *Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)* | | | | | |
| *SONCC-MKR.10.7.55.2* | *Supply marine-derived nutrients to streams guided by the plan* | | | | | |
| SONCC-MKR.10.7.63 | Water Quality | No | Restore nutrients | Add marine-derived nutrients to streams | Population wide | 3d |
| *SONCC-MKR.10.7.63.1* | *Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)* | | | | | |
| *SONCC-MKR.10.7.63.2* | *Supply marine-derived nutrients to streams guided by the plan* | | | | | |
| SONCC-MKR.3.1.18 | Hydrology | No | Improve flow timing or volume | Improve regulatory mechanisms | Population wide | 3d |
| *SONCC-MKR.3.1.18.1* | *Establish a categorical exemption under CEQA for water leasing to increase instream flows* | | | | | |
| SONCC-MKR.3.1.19 | Hydrology | No | Improve flow timing or volume | Improve regulatory mechanisms | Population wide | 3d |
| *SONCC-MKR.3.1.19.1* | *Establish a comprehensive groundwater permit process* | | | | | |
| SONCC-MKR.3.1.42 | Hydrology | No | Improve flow timing or volume | Increase instream flows | All areas that will immediately benefit coho salmon | 3d |
| *SONCC-MKR.3.1.42.1* | *Install flow gages to ensure appropriate flows* | | | | | |
| *SONCC-MKR.3.1.42.2* | *Maintain flow gages annually* | | | | | |
| SONCC-MKR.3.1.67 | Hydrology | No | Improve flow timing or volume | Increase instream flows | Population wide | 3d |
| *SONCC-MKR.3.1.67.1* | *Install flow gages to ensure appropriate flows* | | | | | |
| *SONCC-MKR.3.1.67.2* | *Maintain flow gages annually* | | | | | |
| SONCC-MKR.16.1.28 | 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-MKR.16.1.28.1* | *Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters* | | | | | |
| *SONCC-MKR.16.1.28.2* | *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-MKR.16.1.53 | 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 | Tribal lands | 3d |
| *SONCC-MKR.16.1.53.1* | *Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters* | | | | | |
| *SONCC-MKR.16.1.53.2* | *Identify level of fishing impacts that does not limit attainment of population-specific viability criteria* | | | | | |
| SONCC-MKR.16.1.29 | 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-MKR.16.1.29.1* | *Determine actual fishing impacts* | | | | | |
| *SONCC-MKR.16.1.29.2* | *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-MKR.16.1.54 | Fishing/Collecting | No | Manage fisheries consistent with recovery of SONCC coho salmon | Reduce fishing impacts to levels that do not limit recovery | Tribal lands | 3d |
| *SONCC-MKR.16.1.54.1* | *Determine actual fishing impacts* | | | | | |
| *SONCC-MKR.16.1.54.2* | *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-MKR.16.2.30 | 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-MKR.16.2.30.1* | *Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters* | | | | | |
| *SONCC-MKR.16.2.30.2* | *Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria* | | | | | |
| SONCC-MKR.16.2.31 | 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-MKR.16.2.31.1* | *Determine actual impacts of scientific collection* | | | | | |
| *SONCC-MKR.16.2.31.2* | *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* | | | | | |

| Action ID | Target | KLS/T | Strategy | Action Description | Area | Priority |
|---|---|---|---|---|---|---|
| *Step ID* | *Step Description* | | | | | |
| SONCC-MKR.10.3.11 | Water Quality | Yes | Protect cold water | Educate stakeholders | Population wide | BR |
| *SONCC-MKR.10.3.11.1* | *Develop an educational program that teaches stakeholders to reduce channel encroachment, reduce usage of toxic chemicals, maintaining septic systems, water conservation, and landscaping with native species* | | | | | |
| SONCC-MKR.2.2.3 | Floodplain and Channel Structure | Yes | Reconnect the channel to the floodplain | Improve regulatory mechanisms | Population wide | BR |
| *SONCC-MKR.2.2.3.1* | *Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups* | | | | | |
| SONCC-MKR.5.1.25 | Passage | No | Improve access | Reduce flow barriers | Dillon Creek, and all areas that will immediately benefit coho salmon | BR |
| *SONCC-MKR.5.1.25.1* | *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-MKR.5.1.25.2* | *Alleviate sediment delivery in areas with low flow conditions and seasonal flow barriers as described in the plan* | | | | | |
| SONCC-MKR.3.1.16 | Hydrology | No | Improve flow timing or volume | Educate stakeholders | Population wide | BR |
| *SONCC-MKR.3.1.16.1* | *Develop an educational program about water conservation programs and instream leasing programs* | | | | | |
| SONCC-MKR.7.1.7 | Riparian | No | Improve wood recruitment, bank stability, shading, and food subsidies | Improve grazing practices | Population wide | BR |
| *SONCC-MKR.7.1.7.1* | *Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement* | | | | | |
| *SONCC-MKR.7.1.7.2* | *Develop grazing management plans to improve water quality and coho salmon habitat* | | | | | |
| *SONCC-MKR.7.1.7.3* | *Plant vegetation to stabilize stream bank* | | | | | |
| *SONCC-MKR.7.1.7.4* | *Fence livestock out of riparian zones* | | | | | |
| *SONCC-MKR.7.1.7.5* | *Remove instream livestock watering sources* | | | | | |