16. Elk Creek Population

- Central Coastal Diversity Stratum
- Dependent Population
- Recovery criteria: 20% of IP habitat must be occupied in years following spawning of brood years with high marine survival
- 8.26 mi^2
- 16 IP km (10 mi) (88% High)
- Dominant Land Use is Urban and Residential Development
- Principal Stresses are 'Degraded Riparian Forest Conditions'
- Principal Threats are 'Channelization and Diking' and 'Urban/Residential/Industrial Development'

16.1 History of Habitat and Land Use

Over the past century, alterations from timber harvest, grazing, and urban, residential, and industrial development have diminished Elk Creek's original stream functions, and reduced the quality of habitat for coho salmon. Intensive logging began in the early 1900s and continued into the 1950s. Although much of the valley was harvested during this time, intact stands of old-growth redwood remain in the hills of the upper basin. These stands are now within Jedediah Smith Redwoods State Park. Logging in the basin likely affected salmonids by destabilizing stream banks, increasing sediment inputs to stream habitat, and increasing water temperatures. These adverse impacts have decreased over time as vegetation has become reestablished in riparian areas. Remnant millponds in the lower basin may also impact aquatic habitat by contaminating water quality; however, their connectivity to Elk Creek, and their contaminant load, is unknown (Burgess 2008). Soil at a mill superfund site in the Crescent City area has been contaminated by numerous chemicals (US Environmental Protection Agency (USEPA) 2008). Although no information on water quality is available for Elk Creek at this time, Elk Creek may be similarly affected.

Historically, most of the land within the population area was used for agriculture and dairy farming, but this has transitioned over time to livestock ranching and hay production within a few large tracts of private land. Remnant stream diversions and dams exist in several locations, but the current connectivity of these structures to Elk Creek is unknown.

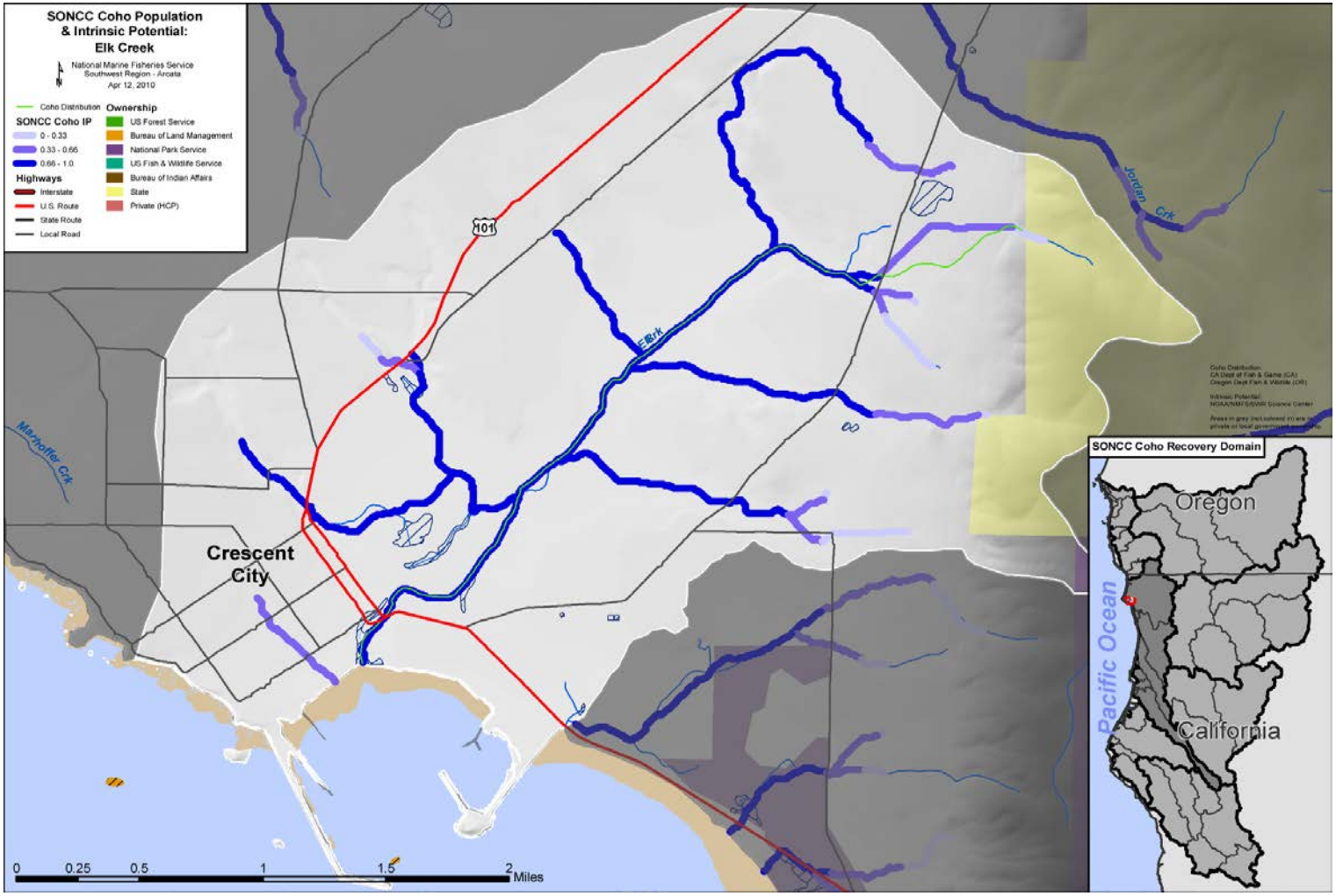

Figure 16-1. The geographic boundaries of the Elk Creek coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2009a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

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Stock watering is accomplished by the pumping of ground water or by diverting water from creeks (Burgess 2008). Land designated for grass and hay cropland is cultivated and mowed seasonally to provide forage for livestock.

Urban, residential, and industrial development within the Elk Valley has had a major impact on aquatic habitat. The growth of Crescent City since the early twentieth century has resulted in approximately 40 percent of the basin being developed (Mintier & Associates et al. 2001). Land use development is confined primarily to Crescent City and to a portion of Del Norte County lands. The greatest degree of habitat alteration from development has occurred in the lower valley. Most of the coastal wetlands and estuarine rearing habitat that might have existed in the lower basin at one time has been dredged, channelized, and/or filled, and the stream in this area is channelized underground through a 500 ft long box culvert under Highway 101.

The types of activities associated with development that affect salmon and salmon habitat include construction of impervious surfaces, removal of riparian vegetation, the building of roads and road-stream crossings, and diking, dredging, and filling of wetland and floodplain areas. Potential threats to water quality have also arisen from urban runoff and roadway pollutants. The North Coast Regional Water Quality Control Board (NCRWQCB) has identified residential sewage systems as a potential water quality concern in the Elk Creek basin (Mintier & Associates et al. 2001).

A small portion of the basin has been protected for natural resource value through various measures. These measures include a zoned Habitat Conservation Area by Del Norte County throughout the Elk Valley, the Jedediah Smith Redwoods State Park in the uppermost part of the basin, and the CDFG's Elk Creek Wetlands Wildlife Area just south-east of Crescent City. Management and regulations in place within these areas provide benefits to aquatic habitat although the degrees of protection vary by ownership.

16.2 Historic Fish Distribution and Abundance

Although little is known about coho salmon use of Elk Creek, the IP model indicates that much of the area has the potential to support juveniles (Figure 16-1). Areas of high IP value (IP>0.66) are spread throughout the entire basin and into all major tributaries entering Elk Creek. In general, the Elk Valley appears to have very good potential for rearing habitat.

The abundance and distribution of coho salmon in the Elk Creek basin is not well studied or documented; however, longtime residents of the basin have commented that both the size and the number of salmonids observed have declined in recent decades (Redwood National and State Parks (RNSP) 2005). There are no historical records of adult coho salmon runs in the basin and only a few small-scale surveys for juvenile coho salmon have been conducted over the past two decades. The oldest known survey data, taken in the late 1980s by CDFG, confirm the presence of juvenile, young-of-the-year (YOY) coho salmon in Elk Creek (Jong et al. 2008). California Department of Fish and Game (CDFG 2004a) juvenile surveys between 2000 and 2003 indicate that coho salmon primarily utilize the eastern portion of the basin and may be concentrated in the Nune's Creek drainage area east of Elk Valley Road (Jong et al. 2008). These surveys demonstrated the presence of young of the year (YOY) every year in the lower part of Nune's Creek near the Elk Valley Road crossing (average of 32 juveniles per year). Age-1+ juveniles

were observed only one year (2001) during this sampling effort. One age-1+ fish was also found lower in the system in the mainstem Elk Creek in 2000 (Jong et al. 2008).

Coho salmon have been found up to about 4 miles from the mouth of Elk Creek. Urban and industrial development in the western and southern portion of the basin may have affected the distribution of coho salmon in these areas. Little information is available about many of the creeks in the basin, but many have been highly degraded and may be accessible only at certain times of the year.

Table 16-1. Tributaries with instances of high IP reaches (IP > 0.66) (Williams et al. 2006).

Subarea	Stream Name
Smith River Plain	Elk Creek[1] (all tributaries)
[1]Denotes a "Key Stream" as identified in the State of California's Coho Salmon Recovery Strategy	

16.3 Status of Elk Creek Coho Salmon

Spatial Structure and Diversity

In assessing the viability of the Elk Creek population, the spatial structure criterion arises as a key concern. The geographic size of the Elk Creek population, occupying a single small coastal basin approximately 21.4 square km, makes it naturally vulnerable to extinction risk. Although historically coho salmon may have used tributaries throughout the basin at various times throughout the year, survey data indicates they may currently occupy only a few smaller tributaries. Much of the historic habitat available to coho salmon in Elk Creek has been lost to development and degradation. The available habitat for both spawning and rearing has been severely restricted and overall opportunity and capacity within the system is low under current conditions.

There is no information on specific population traits, life history characteristics, or genetic diversity of the Elk Creek population and therefore no information to assess the diversity of the population. Because of the small number of individuals, this population is expected to have a low genetic and life history diversity.

Population Size and Productivity

Based on the limited available data on the size and productivity of the Elk Creek population, this population appears to be depressed in abundance and may consist of only a handful of spawning adults each year. A spawner survey in 1999 found just one coho salmon carcass (CDFG 1999), and 16 coho salmon carcasses were found in Nune's Creek in 2005 (Burgess 2008). Considering the information available for this basin, and comparing with other coastal basins in northern California, there are probably fewer than 50 adults that comprise the Elk Creek SONCC coho salmon population (Brown et al. 1994; Weitkamp et al. 1995).

The presence of juveniles in the basin suggests suitable incubating conditions in reaches where coho salmon successfully spawn. Previous data from CDFG juvenile surveys (CDFG 2004a) indicate low number of juveniles (average 32 juveniles per year) distributed throughout a small

portion of the basin (CDFG 2004a). Only a few age-1+ smolt size coho salmon have ever been found. These data indicate rearing capacity for the system may be low, or that juveniles are leaving the system earlier than expected.

With the low number of spawning adults observed in the Elk Creek population, and the relatively few smolt-size juveniles found, it is likely this basin supports a small but potentially consistent population with presumably low overall productivity. As a dependent population, abundance and productivity is highly influenced by nearby populations, which contribute spawners as strays. The Smith River population to the north and the Klamath River population to the south are both likely sources of strays to the Elk Creek population. Both these populations have been severely restricted, have low numbers of returning adults compared to historic runs, and are at moderate to high risk of extinction. The lack of productivity in these neighboring systems and the associated reduction in strays entering Elk Creek further increases this population's risk of extinction.

Extinction Risk

Not applicable because Elk Creek is not an independent population.

Role in SONCC Coho Salmon ESU Viability

The Elk Creek population is considered dependent because it does not have a high likelihood of sustaining itself over a 100-year time period in isolation and receives sufficient immigration to alter its dynamics and extinction risk (Williams et al. 2006; Williams et al. 2008). Although dependent populations are not viable on their own, they do increase connectivity through dispersal among independent populations and provide individuals for other populations, acting as a source of colonists in some cases. By exchanging spawners, the Elk Creek population interacts with other Central Coastal populations and plays an important role in the health and status of the ESU.

16.4 Plans and Assessments

State of California

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The relevant recommendations in the CDFG Recovery Strategy for the Elk Creek population were general for the entire Smith River Plain HSA and did not include any specific analysis for this basin. Any relevant recommendations for the HSA have been considered and incorporated into the recovery strategy and list of recovery actions for this population.

Rural Human Services

16.5 Stresses

Table 16-2. Severity of stresses affecting each life stage of coho salmon in Elk Creek. 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)[2]		Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Degraded Riparian Forest Conditions[1]	-	High	High[1]	High	High	High
2	Altered Sediment Supply	Medium	Medium	Medium	Medium	Medium	Medium
3	Lack of Floodplain and Channel Structure	Medium	Medium	Medium	Medium	Medium	Medium
4	Impaired Water Quality	Low	Medium	Medium	Medium	Low	Medium
5	Altered Hydrologic Function	Low	Medium	Medium	Medium	-	Medium
6	Impaired Estuary/Mainstem Function	-	Low	Medium	Medium	Low	Medium
7	Adverse Fishery-Related Effects	-	-	-	-	Medium	Medium
8	Barriers	-	Low	Medium	Low	Low	Low
9	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low

[1]Key limiting factor(s) and limited life stage(s).
[2]Increased Disease/Predation/Competition is not considered a stress for this population

Limiting Stresses, Life Stages, and Habitat

The key limiting stressor for this population appears to be from degraded riparian forests. Not enough information is available to identify the limiting life stages at this point, but juveniles are believed to be the most limited. There is no current habitat information to indicate the presence of refugial areas or vital habitat areas in the Elk Creek basin.

Degraded Riparian Forest Conditions

Degraded riparian forest condition is the most significant stress affecting coho salmon recovery in Elk Creek. This factor is a high stress across all life stages, except for the egg stage, because of its impact on water temperature, sedimentation, bank stability, and stream complexity. Riparian conditions are most degraded in areas affected by development and agricultural use. Degraded conditions occur throughout the basin, but occur primarily near Crescent City and in agricultural lands in the northwestern portion of the basin. In areas where these impacts are greatest, riparian vegetation has been either completely removed or degraded to the point where it is no longer benefitting stream conditions. Stressors influencing spawning and rearing coho salmon result from loss of canopy cover and shading as well as the loss of large wood.

Altered Sediment Supply

Because Elk Creek is a low gradient coastal system, it naturally stores fine sediment in the meandering mainstem channels and wetlands. Past agriculture and current grazing in the valley along with urban and industrial development have led to increased sediment loads and unnatural storage of sediment in Elk Creek and its tributary streams. The effects have been a simplification of stream habitat, widening and filling of channels and backwater habitats, and reduction in stream flows. The added sediment also reduces or eliminates macro-invertebrate habitat, thereby decreasing foraging opportunities for juveniles.

Lack of Floodplain and Channel Structure

Lack of floodplain and channel structure is considered a medium stress to the Elk Creek population and presents a moderate stress to all life stages, especially in areas that have been highly altered through urbanization and channelization. In the lower part of the basin, development in and around Crescent City has resulted in simplification of tributary streams and the mainstem Elk Creek. Much of the mainstem was channelized and numerous unnatural channels exist within Elk Valley. In many areas, the creek and its tributaries are completely disconnected from the floodplain. This is the case at the mouth where the stream passes under Highway 101 and Crescent City through a 500-foot box culvert. These lower reaches would naturally exhibit complex floodplain and channel characteristics.

Impaired Water Quality

Stresses on coho salmon in Elk Creek from impaired water quality are considered moderate. Impairments likely arise from temperature and chemical contamination. Point source pollution from developed areas and non-point source runoff pollution from roads occurs throughout the valley. Remnant mill sites in the lower basin may also contaminate water quality. Channelization throughout the lower basin and grazing practices in the northern basin likely leads to elevated water temperature in Elk Creek during the summer months. The fry, juvenile, and smolt life stages are most susceptible to the impacts of impaired water quality because juveniles inhabit the basin for extended periods of time. The extent of impaired water quality in Elk Creek is unknown at this time due to a lack of information.

Altered Hydrologic Function

Altered hydrologic function presents a moderate stress to fry and juvenile coho salmon in Elk Creek. The hydrologic regime of the creek has been altered primarily as a result of the development that has occurred in and around Crescent City. Impervious surfaces have led to decreased water storage capacity in the basin, increased frequency of flooding and peak flow volumes, and decreased base flow. Many road-stream crossings are undersized to accommodate natural flows and prevent proper flushing in the system. There are no known water withdrawals within the basin; however, it is likely there are groundwater pumps and diversions associated with the agricultural and rural development north of Crescent City. Overall, the amount of available habitat for juvenile rearing in the basin has decreased and natural biological and physical processes on which these fish depend have been altered due to hydrologic alterations in the basin.

Impaired Estuary/Mainstem Function

Little is known about the historic extent of estuarine area in Elk Creek. Currently this area is confined to six acres of tidal sand flat south of the Hwy 101 culvert. Based on the natural drainage pattern and elevations in the area, much of the historical estuarine tidal area likely has been dredged and filled to accommodate the highway and commercial/industrial development. The reduction in the amount of estuarine habitat and the loss of natural estuarine functions have likely resulted in a loss of foraging and growth opportunities for juveniles as well as the loss of transitional migratory habitat for smolts.

Adverse Fishery-Related Effects

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

Barriers

Overall, barriers present a low stress to the coho salmon in Elk Creek. However, road-related barriers have been found in Nune's Creek and in two other tributaries that pass under Elk Valley Road on the eastern side of the basin (CalFish 2009). These barriers block fish access during certain flows and create unnatural sediment and debris storage.

Adverse Hatchery-Related Effects

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

16.6 Threats

Table 16-3. Severity of threats affecting each life stage of coho salmon in Elk Creek. Threat rank categories and assessment methods are described in Appendix B, and the data used to assess threats for the initial threats assessment (described in Appendix B) is presented in Appendix H.

Threats[1]		Egg	Fry	Juvenile	Smolt	Adult	Overall Threat Rank
1	Channelization/Diking	Medium	High	High	High	High	High
2	Urban/Residential/Industrial	Medium	High	High	High	High	High
3	Agricultural Practices	Low	Medium	Medium	Medium	Medium	Medium
4	Roads	Low	Medium	Medium	Medium	Medium	Medium
5	Timber Harvest	Low	Medium	Medium	Medium	Medium	Medium
6	Fishing and Collecting	-	-	-	-	Medium	Medium
7	Dams/Diversion	Low	Low	Low	Low	Low	Low
8	High Intensity Fire	Low	Low	Low	Low	Low	Low
9	Road-Stream Crossing Barriers	-	Low	Low	Low	Low	Low
10	Climate Change	Low	Low	Low	Low	Low	Low
11	Hatcheries	Low	Low	Low	Low	Low	Low

[1]Invasive Non-Native/Alien Species, and Mining/Gravel Extraction are not considered threats to this population

Channelization/Diking

Development in the Elk Creek basin has resulted in channelization and diking of the mainstem, tributaries, and floodplain of Elk Creek. Most of the channel modification and diking has been confined to central Elk Valley and Crescent City. Remnant channelization and ponding associated with milling near the lower end of Elk Creek have altered the hydrology of the creek in the lower basin. Complex channel networks throughout the valley are likely remnants of past milling activities and agricultural practices. Given the wide floodplain in the lower basin, Highway 101 likely impinges flow and tidal inundation. Currently the creek is channelized at its mouth through a long box culvert that passes under the highway and Crescent City. The result of these alterations has been a simplification of the system and alteration of natural hydrology to the point where relatively few intact reaches remain. Development in the Crescent City area is likely to continue in the future, so channelization/diking is considered a medium stress for eggs and a high stress for all other life stages.

Urban/Residential/Industrial Development

Roughly 40 percent of the Elk Creek basin has been developed for urban, residential, and industrial use and development is likely to continue into the future. Projected annual population growth is approximately 2 percent for Crescent City, which will likely result in more urban and rural development in and around Elk Creek. Although some county zoning restrictions in the central basin limit the type and extent of development, the headwaters of many tributaries are likely to be affected by new residential and urban development. Impacts related to development include increased impervious surface area, loss of riparian vegetation, road construction, and the diking, dredging, and filling of wetland and floodplain areas. Potential threats to water quality also arise from urban runoff, roadway pollutants, and onsite sewage systems. This threat is considered medium for the egg stage and high for all other life stages due to the continuing urban, residential, and industrial use, and ongoing impacts related to development.

Agricultural Practices

Agriculture in the Elk Creek basin primarily includes cattle ranching and associated hay operations. Because agriculture is restricted to only a portion of the basin, it is only a medium threat to coho salmon in Elk Creek. The greatest threat arises from cattle that have unrestricted access to some reaches of Elk Creek. Stream banks in these reaches are mostly denuded of vegetation and bank and streambed (head-cut) erosion have been observed in these areas (Burgess 2008). Impacts to aquatic ecosystems include decreased bank stability, increased sediment inputs, loss of shade- and cover-providing riparian vegetation, and elevated coliform levels in water. Cattle in a live stream channel can also be a physical barrier to migrating salmonids.

Roads

Although roads occur at very high density (>3 mi./sq. mi.) within the basin, they are considered only a moderate threat because the majority are paved. The building of more unpaved roads is unlikely. Existing unpaved roads within the Elk Valley are likely the main source of sediment to Elk Creek.

Timber Harvest

Historically, much of the basin was used for timber harvest; however, harvest is currently limited to small-scale harvest on private lands. Most harvestable tracts are less than 100 acres. More land throughout the valley could be used for timber harvest and therefore considered to be a medium threat.

Fishing and Collecting

California-managed fisheries for species other than coho salmon occur in estuaries, freshwater, and nearshore marine areas. The effects of these fisheries on the continued existence of the SONCC coho salmon ESU have not been formally evaluated by NMFS. As of April 2011, NMFS has not authorized future collection of coho salmon for research purposes in Elk Creek.

Dams/Diversions

Although diversions and dams are known to exist in the basin, these structures are isolated, no longer used, and do not limit fish passage.

High Intensity Fire

The threat of high intensity fire is low because much of the basin is un-forested, fuel loading is low, and climatic conditions do not favor frequent or high-intensity fires.

Road-stream Crossing Barriers

Road-stream crossing barriers are not a significant threat to coho salmon in Elk Creek, based on the few known barriers that exist in the basin. The Five Counties Fish Passage Assessment listed several sites in Elk Creek where fish passage has been compromised by a crossing (Taylor 2001). At least one of these, on Nune's Creek, has been identified as a barrier to juvenile and adult fish passage at certain flows. Other culverts in this drainage likely store fine sediment and create unnatural pooling (NMFS 2005). Several other partial barriers and undersized culverts have been found in tributaries to Elk Creek (See Table 16-4). Given the amount of development and the density of roads in the basin, there are likely many more barriers yet to be identified.

Table 16-4. List of known road barriers in the Elk Creek basin. Length of anadromous habitat was estimated based on IP maps and prioritization (Taylor 2001).

IP priority	Stream Name	Road Name	Miles of habitat
1	Nune's Creek #1	Elk Valley Rd.	0.5 miles
2	Elk Creek Tributary	Elk Valley Rd.	0.5 miles
3	Nune's Creek #2	Elk Valley Rd.	0.5 miles
4	Elk Creek Tributary	Elk View Rd	1.5 miles

Climate Change

Climate change poses a low threat to this population due to its cooler climate, and low risk of temperature increase and precipitation change over the next 50 years (see Appendix B for modeling methods). Overall, the range and degree of variability in temperature and precipitation are likely to increase in all populations. Adults will be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (see Independent Science Advisory Board 2007, Feely et al. 2008, Portner and Knust 2007).

Hatcheries

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

16.7 Recovery Strategy

The Elk Creek basin has a large amount of high IP habitat for its small size. The recovery criterion for this population is that 20% of IP habitat must be occupied in years following spawning of brood years with high marine survival. Although much of the basin has been

developed, numerous opportunities exist to help restore coho salmon in the basin. Coho salmon are known to use much of the available habitat in the basin, but in some areas this habitat has been severely degraded. In order to help increase the size, health, and distribution of the population, actions should focus on increasing the quality and quantity of habitat available. By addressing the major threat to the population - urban, residential, and industrial development in and around Crescent City - many of the major stresses affecting coho salmon will be abated. Improving the condition of riparian areas is the most important step in the recovery of the population, but other important actions include reducing sediment loading, increasing floodplain and channel complexity, improving water quality, restoring hydrologic function, and improving fish passage. Additionally, measures to restrict or control development and to protect habitat and habitat functions are necessary to prevent further degradation.

Table 16-5 on the following page lists the recovery actions for the Elk Creek population.

Table 16-5. Recovery action implementation schedule for the Elk Creek population.

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	***Step Description***					
SONCC-ElkC.7.1.14	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Upper Elk Valley	BR
SONCC-ElkC.7.1.14.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-ElkC.7.1.14.2	*Develop grazing management plan to meet objective*					
SONCC-ElkC.7.1.14.3	*Plant vegetation to stabilize stream bank*					
SONCC-ElkC.7.1.14.4	*Fence livestock out of riparian zones*					
SONCC-ElkC.7.1.14.5	*Remove instream livestock watering sources*					
SONCC-ElkC.7.1.15	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Remove invasive species	Crescent City, Upper Elk Valley, Eastern Tributaries	BR
SONCC-ElkC.7.1.15.1	*Remove invasive species which are inhibiting establishment of native riparian vegetation*					
SONCC-ElkC.7.1.16	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Revegetate riparian areas	Crescent City, Upper Elk Valley, eastern tributaries	BR
SONCC-ElkC.7.1.16.1	*Develop a riparian management plan with landowners that establishes riparian buffers on their property through planting, invasive species removal, or protection measures*					
SONCC-ElkC.7.1.16.2	*Implement the riparian management plan*					
SONCC-ElkC.7.1.17	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve long-range planning	Crescent City, Upper Elk Valley, eastern tributaries	BR
SONCC-ElkC.7.1.17.1	*Review General Plan or City Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*					
SONCC-ElkC.7.1.17.2	*Develop watershed-specific guidance for managing riparian vegetation*					
SONCC-ElkC.1.2.10	Estuary	No	Improve estuarine habitat	Restore estuarine habitat	Estuary, downstream of Highway 101	BR
SONCC-ElkC.1.2.10.1	*Develop a plan to restore historic tidal channels and wetlands*					
SONCC-ElkC.1.2.10.2	*Restore tidal wetlands and tidal channels in historic estuary, guided by the plan*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	***Step Description***					
SONCC-ElkC.2.1.1	Floodplain and Channel Structure	No	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	BR
SONCC-ElkC.2.1.1.1	*Develop a watershed assessment of Elk Creek*					
SONCC-ElkC.2.1.1.2	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-ElkC.2.1.1.3	*Place instream structures, guided by assessment results*					
SONCC-ElkC.2.2.2	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Increase beaver abundance	Elk Valley	3
SONCC-ElkC.2.2.2.1	*Develop program to educate and provide incentives for landowners to keep beavers on their lands*					
SONCC-ElkC.2.2.2.2	*Implement beaver program (may include reintroduction)*					
SONCC-ElkC.2.2.3	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Re-connect channel to existing off-channel ponds, wetlands, and side channels	Central Elk Valley and tributaries in Crescent City	BR
SONCC-ElkC.2.2.3.1	*Develop plan to reconnect priority channelized stream reaches to historic side channels and wetlands*					
SONCC-ElkC.2.2.3.2	*Reconnect historic side channels and wetlands, guided by the plan*					
SONCC-ElkC.3.1.4	Hydrology	No	Improve flow timing or volume	Restore hydrograph	Central Elk Valley and Crescent City	BR
SONCC-ElkC.3.1.4.1	*Complete comprehensive flow study to determine the natural flow regime through Elk Valley*					
SONCC-ElkC.3.1.4.2	*Disconnect unnatural channels and ditches that can not support spawning or rearing.*					
SONCC-ElkC.3.1.5	Hydrology	No	Improve flow timing or volume	Educate stakeholders	Population wide	BR
SONCC-ElkC.3.1.5.1	*Develop an educational program about water conservation programs and instream leasing programs*					
SONCC-ElkC.3.1.6	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	BR
SONCC-ElkC.3.1.6.1	*Prioritize and provide incentives for use of CA Water Code Section 1707*					
SONCC-ElkC.3.1.7	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3
SONCC-ElkC.3.1.7.1	*Establish a categorical exemption under CEQA for water leasing*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID		***Step Description***				
SONCC-ElkC.3.1.8	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	BR
SONCC-ElkC.3.1.8.1		*Establish a comprehensive statewide groundwater permit process*				
SONCC-ElkC.3.2.9	Hydrology	No	Increase water storage	Improve water retention	Central Elk Valley and Crescent City	BR
SONCC-ElkC.3.2.9.1		*Maintain open space lands (e.g., agriculture, forestland) for water retention and limit addition of impervious surfaces in the watershed.*				
SONCC-ElkC.3.2.9.2		*Manage runoff from impervious surfaces in such a way that it does not negatively impact hydrologic function*				
SONCC-ElkC.27.2.22	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3
SONCC-ElkC.27.2.22.1		*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*				
SONCC-ElkC.27.2.22.2		*Measure indicators for spawning and rearing habitat once every 15 years, sub-sampling 10% of the original habitat surveyed*				
SONCC-ElkC.27.1.23	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3
SONCC-ElkC.27.1.23.1		*Conduct presence/absence surveys for juveniles (3 years on; 3 years off)*				
SONCC-ElkC.27.2.24	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3
SONCC-ElkC.27.2.24.1		*Measure the indicators, canopy cover, canopy type, and riparian condition*				
SONCC-ElkC.27.1.25	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3
SONCC-ElkC.27.1.25.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-ElkC.27.1.25.2		*If appropriate, modify population types and targets using revised methodology*				
SONCC-ElkC.27.2.26	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3
SONCC-ElkC.27.2.26.1		*Determine best indicators of estuarine condition*				

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	***Step Description***					
SONCC-ElkC.5.1.20	Passage	No	Improve access	Reduce flow barrier	Population wide, especially Elk Valley Road, Nune's Creek	BR
SONCC-ElkC.5.1.20.1	*Inventory, describe, and map migration and flow barriers and develop a plan to restore passage*					
SONCC-ElkC.5.1.20.2	*Restore passage, guided by plan*					
SONCC-ElkC.5.1.21	Passage	No	Improve access	Remove structural barrier	Population wide, especially Elk Valley Road, Nune's Creek	BR
SONCC-ElkC.5.1.21.1	*Upgrade culverts to accommodate fish passage at all life stages*					
SONCC-ElkC.8.1.11	Sediment	No	Reduce delivery of sediment to streams	Improve land management practices	Central and Upper Elk Valley	BR
SONCC-ElkC.8.1.11.1	*Develop an educational program that shares BMPs for major land practices (e.g. timber harvest agriculture, water treatment, grazing, private roads)*					
SONCC-ElkC.8.1.12	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	BR
SONCC-ElkC.8.1.12.1	*Assess and prioritize road-stream connection, and identify appropriate treatment to meet objective*					
SONCC-ElkC.8.1.12.2	*Decommission roads, guided by assessment*					
SONCC-ElkC.8.1.12.3	*Upgrade roads, guided by assessment*					
SONCC-ElkC.8.1.12.4	*Maintain roads, guided by assessment*					
SONCC-ElkC.10.2.18	Water Quality	No	Reduce pollutants	Reduce point- and non-point source pollution	Central Elk Valley and Crescent City	BR
SONCC-ElkC.10.2.18.1	*Identify point and nonpoint pollution sources throughout the watershed, especially those sites known to have been associated with past milling operations (e.g. Lower Elk Valley ponds)*					
SONCC-ElkC.10.2.18.2	*Implement strategy to prevent pollution such as hydrologically disconnect contaminated sites from Elk Creek (esp. contaminated mill sites)*					
SONCC-ElkC.10.2.19	Water Quality	No	Reduce pollutants	Educate stakeholders	Central Elk Valley and Crescent City	BR
SONCC-ElkC.10.2.19.1	*Reduce or minimize both domestic and municipal sources of nutrient input (i.e., sewage treatment plant discharge and storm drain runoff). Support efforts by cities and rural communities to complete system upgrades to achieve CWA compliance.*					