32. Upper Rogue River Population

- Interior Rogue Stratum
- Core, Functionally Independent Population
- Moderate Extinction Risk
- 16,100 Spawners Required for ESU Viability
- 2,422 mi^2
- 805 IP km (500 mi) (56% High)
- Dominant Land Uses are Agriculture and Urban/Residential/Commercial Development
- Principal Stresses are ‘Altered Hydrologic Function’ and ‘Degraded Riparian Forest Conditions’
- Principal Threats are ‘Roads’ and ‘Agricultural Practices’

32.1 History of Habitat and Land Use

From 1780 to 1840, trappers swept Oregon coastal rivers, including the Rogue River basin, reducing the robust beaver population to remnant levels (Oregon Department of Fish and Wildlife (ODFW) 2005b). Beaver ponds provide excellent rearing habitat for coho salmon, and thus beaver trapping was likely the first negative effect of European settlers on coho salmon. In the mid- to late 1800s, proliferation of gold mining in the Rogue Valley further decreased coho salmon rearing, spawning, and migratory habitat. After the 1850s, settlers began reclaiming and development of the flat, alluvial valley bottoms and wetlands, and increased agricultural production. Many Rogue River streams were straightened and disconnected from their floodplains, wetlands and meanders filled, flows diverted and riparian shade reduced. Due to habitat alteration and flow depletion, summer air temperatures (which often exceed 100° F) in the Upper Rogue River subbasin are now more likely to cause higher stream temperatures than in the past, thereby reducing the quality and quantity of summer rearing habitat, and decreasing juvenile coho salmon survival.

The Upper Rogue River headwaters, primarily managed by the U.S. Forest Service (USFS), are located along the crest of the Cascade Range. Public and private lands in the Upper Rogue River subbasin were extensively logged after World War II, when there were few restrictions on harvesting near streams or using stream beds to skid logs. Channel damage from the 1964 flood was widespread in areas downstream of logging activity (Thompson and Fortune 1970, USFS 1997a).

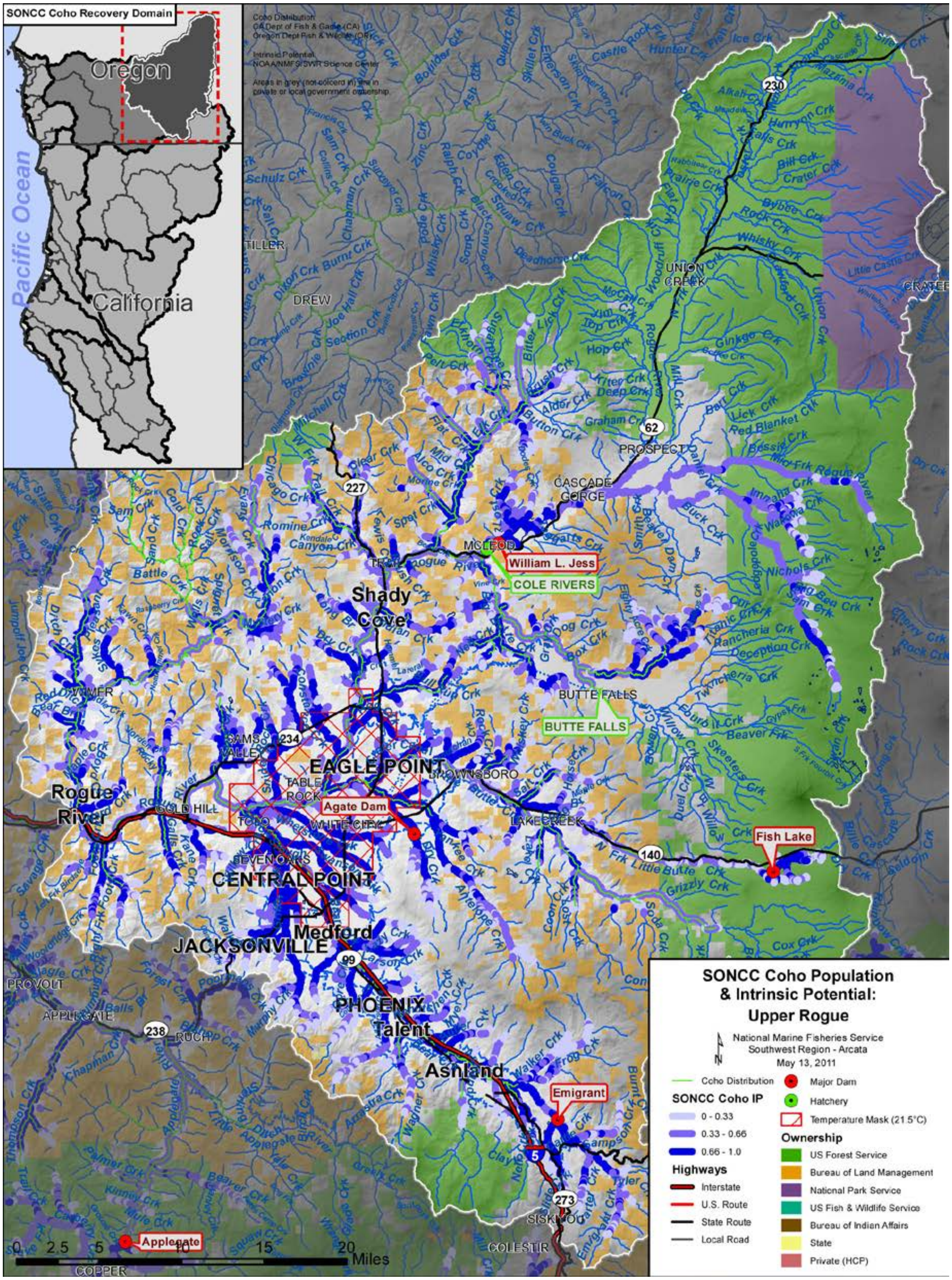

Figure 32-1. The geographic boundaries of the Upper Rogue River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (ODFW 2010a), and location within the Southern-Oregon/Northern California Coast Coho

Salmon ESU and the Interior Rogue diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

The USFS adopted more conservation-based management in 1994 when the Record of Decision for the Northwest Forest Plan was signed, but almost all National Forest lands in the subbasin are above the current range of coho salmon. Lands managed by the BLM are extensive in the watersheds of Evans, Trail, Big and Little Butte, and upper Bear creeks but alternate with private land in a checker board pattern. Urban development is extensive in Lower Bear Creek and the Upper Rogue Valley, where most land is privately owned. In addition, there has been substantial residential development in many parts of the subbasin, accompanied by surface water and groundwater extraction.

The completion of Lost Creek Dam (later renamed William L. Jess Dam) in 1977 created Lost Creek Reservoir, altered the natural hydrograph of the mainstem Rogue River, and the associated Cole Rivers Hatchery mitigation program annually produces 200,000 coho salmon smolts. The notching of the Elk Creek Dam on Elk Creek, an important tributary that joins the Rogue River five miles downstream of Lost Creek Reservoir, in 2008 provided coho salmon with unrestricted access to that watershed after nearly 20 years of trapping and hauling coho salmon upstream (Oregon Wild 2008). Other recent major fish passage improvements include the removal of three diversion dams on the mainstem Rogue River: Savage Rapids Dam in 2009 in the Middle Rogue subbasin (U.S. Bureau of Reclamation (BOR 2009a) and Gold Hill Dam in 2008 (Oregon Water Watch 2008) and Gold Ray Dam in 2010 (Freeman 2010) in the Upper Rogue subbasin

32.2 Historic Fish Distribution and Abundance

The 1977 construction of William L. Jess Dam (Figure 32-2) at river mile (RM) 157 in the Upper Rogue River subbasin reduced coho salmon distribution by only 12 miles (ODFW 2005c) because geologic barriers near Prospect above the dam naturally prevented anadromous fish migration to the uppermost reaches of the mainstem Rogue River (USFS 1998d). Major tributaries below the dam include Evans, Trail, Elk, Bear, Big Butte, and Little Butte creeks; however, some high coho salmon IP habitat is blocked by dams within these watersheds. Dams impounding Emigrant Reservoir on Bear Creek, Agate and Fish Lake Reservoirs on Little Butte Creek, and Willow Lake Reservoir on Big Butte Creek are the most significant barriers.

A cannery operated at the mouth of the Rogue River beginning in 1876. Records from the cannery were used to estimate an annual run size of approximately 114,000 adult coho salmon in the late 1800s (Meengs and Lackey 2005). There is no way to know how many of these fish were returning to the subbasin, rather than elsewhere in the 5,600 square mile Rogue River basin. The subbasin contains 39 percent of the basin-wide IP kilometers of habitat (Williams et al. 2008), suggesting possible returns of 45,000 fish during the time of cannery operation.

Figure 32-2. William L. Jess Dam. The dam blocks anadromous fish access upstream, but provides a perennially cold mainstem Rogue River flows below the dam (at center left). Aerial photo from June 2005.

32.3 Current Status of Coho Salmon in the Upper Rogue River

Spatial Structure and Diversity

Coho salmon juvenile surveys performed in the Upper Rogue River subbasin (ODFW 2005a) confirmed presence and varying levels of abundance in Little Butte, Big Butte, Evans, Trail, Elk, and Antelope creeks (Figure 32-3). Most high density rearing occurs in the upper watersheds and often immediately below public land that supplies cool water. Potential coho salmon habitat periodically lacks sufficient flow (Rogue Basin Coordinating Council (RBCC) 2006), and Trail Creek seasonally has no flow (Nawa 1999).

Densities of juvenile coho salmon throughout the Upper Rogue River population vary by location (Figure 32-3). Most of the juvenile coho salmon observed recently were in the headwater areas of Little and Big Butte creeks, Elk Creek, Trail Creek, and Evans Creek. Historically, Bear Creek had more than 25 miles of estimated high IP habitat (Figure 32-1); however, no juvenile coho salmon were observed during summer sampling (Figure 32-3), likely due to high water temperatures and habitat degradation in this highly urbanized watershed. Coho salmon juveniles died in Bear Creek during an herbicide-related fish kill on May 6, 1996 (Ewing 1999), indicating some juveniles are present in this watershed at least during times of year with lower temperatures. Juvenile coho salmon were documented in Larson Creek (VanDyke 2006a) and Military Slough (VanDyke 2006b), both in the Bear Creek watershed, during sampling with hoop traps from November 2005 to March 2006. No juvenile coho salmon were observed during sampling on Sand Creek during that same period (VanDyke 2006c).

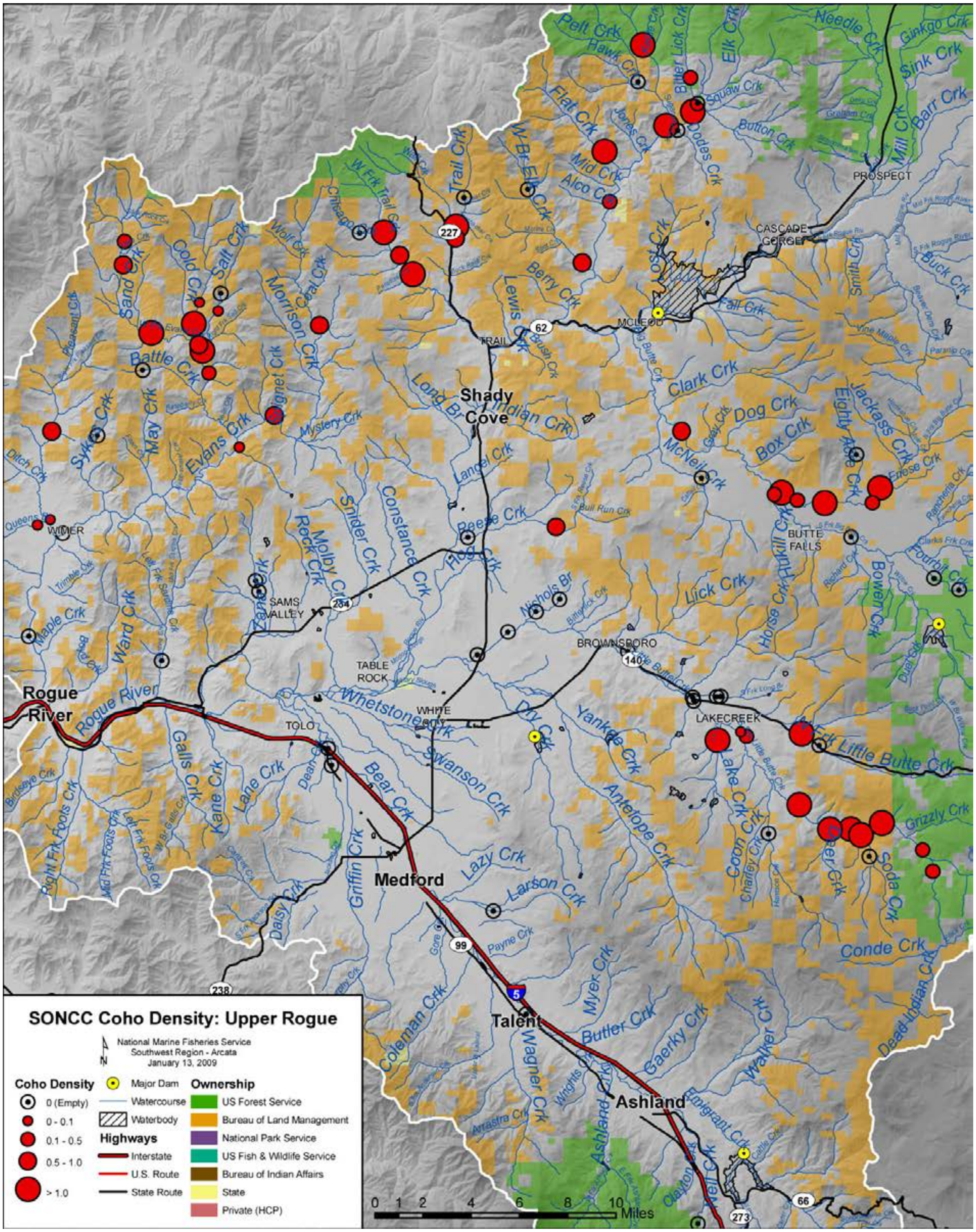

Figure 32-3. Upper Rogue River juvenile coho salmon survey results from 1998 to 2004. Map shows density of fish per square meter. The highest densities were located in upper watershed areas, and coho salmon were absent in lower reaches of all tributaries and at all stations in Bear Creek ODFW (2005a).

During the 2004 to 2008 run years, on average about 17 percent of sites were occupied by wild adult coho salmon with an estimated average of 6 spawners per mile in the Upper Rogue subbasin (hatchery or wild origin unstated) (Lewis et al. 2009).

Williams et al. (2008) expressed concern about potential loss of genetic diversity of Rogue River coho salmon due to very low returns from 1966 to 1990 and the high contribution of hatchery coho salmon to the overall number of returning adults. Overall, Williams et al. (2008) rated the threat of hatchery fish on population diversity as moderate, because although many hatchery fish were observed in surveys of adult coho salmon, few were observed on the spawning grounds.

Population Size and Productivity

ODFW estimated the abundance of wild adult coho salmon from 2002 to 2008 in the Upper Rogue River (Figure 32-4). Data were not collected in 2005, 2009, and 2010 which makes it difficult to track the strength of year classes. From 2002 to 2004, estimates of wild adult coho salmon were above the depensation threshold of 805, but from 2006 to 2008 estimates of wild adult coho salmon returns were low (Figure 32-4). However, interpretation of these data is problematic because the number of miles surveyed in each of the first three years (average 19 miles) was considerably greater than in the second three years (average 8 years; ODFW 2011b).

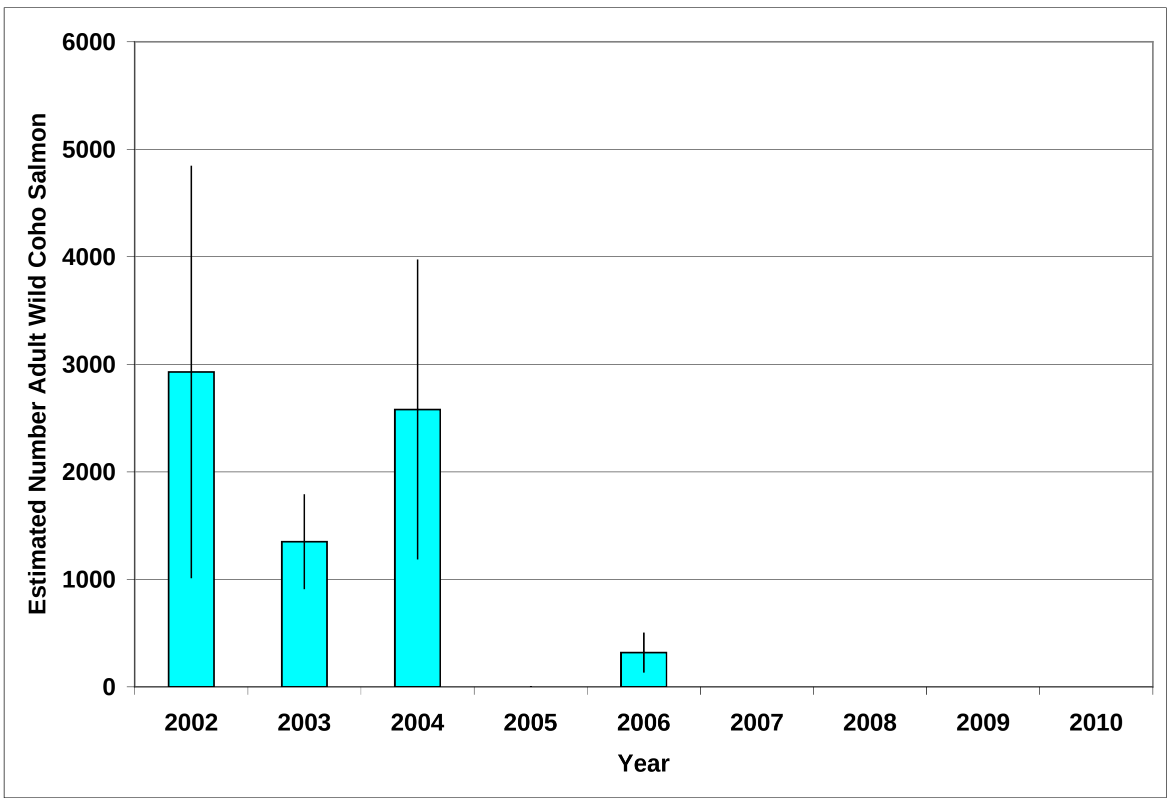

Figure 32-4. Estimated number of adult coho salmon in the Upper Rogue River, 2002 to 2010. No surveys were conducted in 2005, 2009, and 2010. No wild fish were captured in 2007 and 2008. Error bars indicate the 95% confidence interval. Data from ODFW (2011b).

Monitoring of returning adult coho salmon at Gold Ray Dam presents a rare opportunity to evaluate a long-term data set within the Upper Rogue River coho salmon population (Figure 32-6). Between 1942 and the early 1980s, the number of adult coho salmon returns suggested a downward trend. While the average number of adult coho salmon returning (including jacks) to the entire Rogue River from 1942 to 1950 was 3936 adults, populations averaged only 750 adults between 1951 and 1979 (ODFW 2009b). For 15 out of 16 years from 1964 to 1979 fewer than 500 adults returned to the Rogue River (ODFW 2009b). Returns reached their lowest level during the 1976 drought, when only 44 coho salmon were counted at Gold Ray Dam. Hatchery coho salmon began returning to the Upper Rogue River in the late 1970s following the initiation of the hatchery mitigation program associated with the construction of Lost Creek Dam (later renamed William L. Jess Dam). The number of wild and hatchery coho salmon adults peaked in 2000 and 2002, respectively. Thereafter, a declining trend in both wild and hatchery coho salmon escapement has been observed (Figure 32-6). In 2007, approximately 4,500 wild coho salmon returned to Gold Ray Dam. Coho salmon returns declined in the Rogue River basin in 2008, and remained low in 2009 (Oregon State University 2009, ODFW 2009b). In 2008 and 2009, total adult coho salmon returns including both hatchery and wild fish were about 2,500 per year. If we assume the current returns of adult coho salmon contain the approximate proportion of hatchery fish as observed from 1996 to 2007, then 60 percent of these fish, or about 1,500 spawners, were wild fish.

The downward trend in adult abundance over the last four generations (1998-2009) has been weakly negative, but much less than a 10 percent decline. Relying on the population decline criterion found in Williams et al. (2008), we conclude that the extinction risk is moderate relative to abundance.

Using seine mark-recapture data from Huntley Park, ODFW (2005c) calculated productivity for wild adult coho salmon in the Illinois, Middle, and Upper Rogue populations aggregated together for each year from 1980 to 2000. Recruits per spawner were less than replacement levels in eight of the years, indicating low productivity during those years.

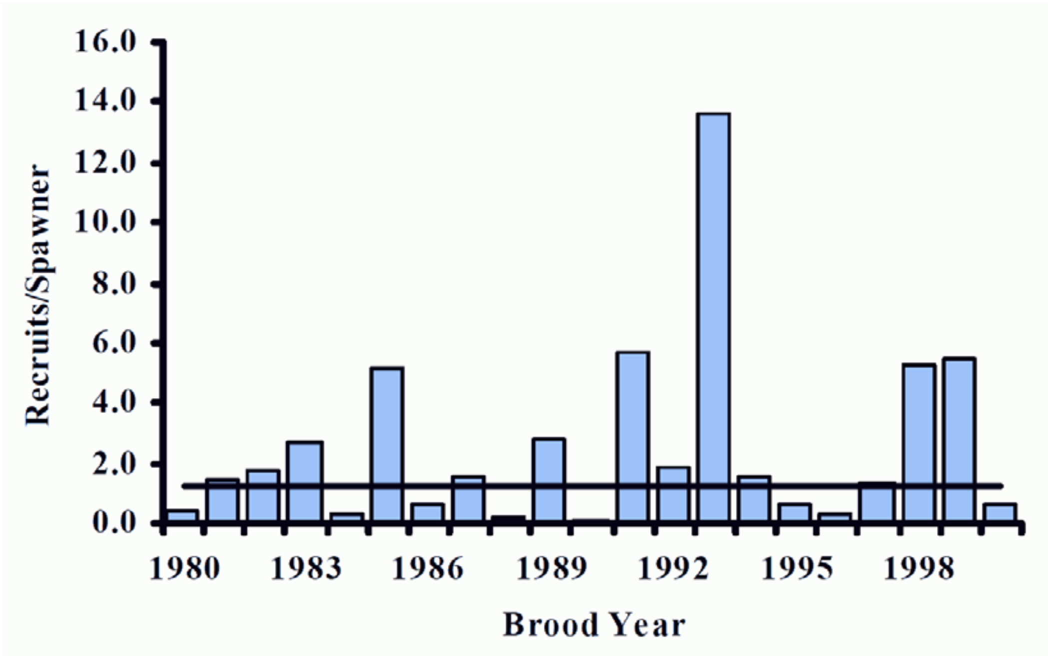

Figure 32-5. Recruit per spawner for brood years 1980 through 2000. Data are for the Rogue River Species Management Unit which includes the Middle Rogue, Upper Rogue, and Illinois River populations. Figure from ODFW (2005c).

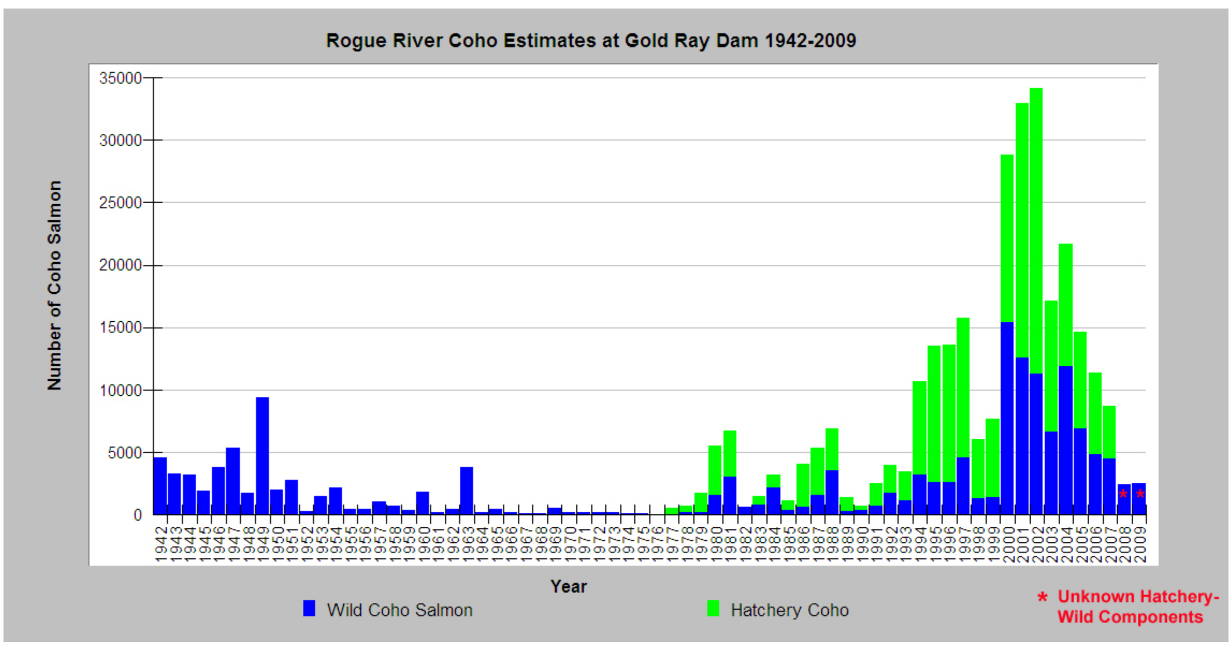

Figure 32-6. Coho salmon returns from 1942 to 2009 at Gold Ray Dam, including jacks (ODFW 2010b). Hatchery fish are not distinguished from wild fish in 2008 and 2009 because estimates are preliminary.

Extinction Risk

In order to be at moderate risk of extinction, the Upper Rogue River population must consistently exceed the annual depensation threshold of 805 adults (Williams et al. 2008). If abundance is below the depensation threshold, the population is at high risk of extinction. Based on Gold Ray Dam data, the running 3-year average of adult returns over the past 12 years (from 1998 to2009) has not fallen below 2,128. Therefore, NMFS concludes that the Upper Rogue River coho salmon population is at a moderate risk of extinction.

Role in SONCC Coho Salmon ESU Viability

The Upper Rogue River coho salmon population is considered functionally independent because of the large amount of IP habitat it contains. As a functionally independent population, we expect that the Upper Rogue River population would contribute recruits to nearby populations, such as those in the Rogue River basin. At present, the capacity of the Upper Rogue River coho salmon population to provide recruits to adjacent independent populations is limited due to its low spawner abundance. Conversely, recruits straying from the nearby Lower Rogue, Middle Rogue/Applegate, and Illinois rivers may enhance recovery of the Upper Rogue River population.

32.4 Plans and Assessments

U.S. Forest Service, Rogue River-Siskiyou National Forest

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

The Watershed Condition Framework (WCF) is a comprehensive approach for proactively implementing integrated restoration on priority watersheds on national forests and grasslands. The WCF provides the Forest Service with an outcome-based performance measure for documenting improvement to watershed condition at forest, regional, and national scales. As part of the WCF, Sugarpine Creek, a tributary of Elk Creek, was identified as a high priority 6th field subwatershed in the Rogue-Siskiyou National Forest (USFS and BLM 2011).

U.S. Bureau of Land Management (Medford District)

U.S. Bureau of Reclamation (BOR)

Rogue River Basin Project Coho Salmon Instream Flow Assessment

BOR (Sutton et al. 2007) modeled stream flow needs of SONCC coho salmon in two drainages in southern Oregon in order to assess the effects of BOR's Rogue River Basin Project on the species. The Rogue River Basin Project (RRBP) is a series of reservoirs and diversions designed to provide water to 35,000 acres of irrigated cropland in Oregon (BOR 2009b). Sutton et al. (2007) was relied upon when analyzing and describing the future effects of the RRBP on SONCC coho salmon and other listed species (BOR 2009b).

State of Oregon

Expert Panel on Limiting Factors for Oregon's SONCC coho salmon populations

ODFW (2008b) convened a panel of fisheries and watershed scientists as an initial step in their development of a recovery plan for Oregon's SONCC coho salmon populations. Deliberations of the expert panel provided ODFW with initial, strategic guidance on perceived limiting factors and threats to recovery. Based on the input of panel members, ODFW (2008b) summarized the concerns the Upper Rogue River are as follows:

> Key concerns were related to loss of over-winter tributary habitat complexity, floodplain connectivity, and access and oversummer water temperatures and habitat access. Over-winter tributary habitat and floodplain connectivity, especially in the lowlands, has been impacted by past and current agricultural, urban, rural residential, and forestry development and practices and an interruption in the transport and presence of large wood. Access to habitat has been limited by road crossings. Summer habitat is limiting because high water temperatures have resulted from land management actions in the riparian zone and straightening of channels and water management actions for agricultural purposes. Water withdrawals and diversions and road crossings have also limited the amount of, and access to, summer habitat and thermal refuge.
>
> Secondary concerns spanned a number of life history stages and locations. Unscreened diversions and non-criteria screens at diversions affect fry, summer parr, and out-migrating smolts. Summer juvenile habitat has been impacted by a loss of tributary habitat complexity, especially in the lowlands, caused by past and current agricultural, urban, rural residential, and forestry development and practices and an interruption in the transport and presence of large wood. Non-native vegetation is a secondary factor contributing to higher water temperatures affecting summer parr by limiting native riparian vegetation. Runoff from urban and agricultural areas impacts summer parr through poor water quality and the presence of toxins. Access to spawning habitat by returning adults is limited by road crossings and diversion structures. Spawners are affected by both a lack of gravel due to alteration of large wood processes (i.e., some tributaries have bedrock) and sedimentation of existing gravel. Finally, reduced estuarine habitat for smolts due to past and current forestry practices and rural residential development is another impact.

Oregon Plan for Salmon and Watersheds
http://www.oregon.gov/OPSW/about_us.shtml

The State of Oregon developed a conservation and recovery strategy for coho salmon in the SONCC and Oregon Coast ESUs (State of Oregon 1997). The Oregon Plan for coho salmon is comprehensive, and includes voluntary actions for all of the threats currently facing coho salmon in these ESUs and involves all relevant state agencies. ODFW implemented fishery harvest and hatchery program reforms in the late 1990s. Many habitat restoration projects have occurred across the landscape in headwater habitat, lowlands, and the estuary. The action plans, implementation, and annual reports can be found on the above web site.

ODFW Coastal Salmonid Inventory Project

ODFW has monitored coho salmon in the Upper Rogue River as part of their Coastal Salmonid Inventory Project. From 1998 to 2004, ODFW dived the Upper Rogue River subbasin to detect juvenile coho salmon (ODFW 2005a) (Figure 32-3). ODFW also estimated the abundance of adult coho salmon in the Upper Rogue River from 2002 to 2004 and from 2006 to 2008

Southwest Oregon Salmon Restoration Initiative

The Southwest Oregon Salmon Restoration Initiative (Prevost et al. 1997) was created to help fulfill a memorandum of understanding between ODFW and NMFS (Northwest Region) to recover coho salmon. The initiative provides the framework for recovery in southwest Oregon and helped foster formation of watershed councils. Prevost et al. (1997) designated upper South Fork Little Butte Creek, West Fork Trail Creek, Sugarpine Creek (Elk Creek), West Branch Elk Creek, and West Fork Evans Creek as "core areas" in the Upper Rogue River watershed that are the highest priority for restoration in the SONCC.

Water Requirements of Rogue River Fish and Wildlife

ODFW fisheries biologists (Thompson and Fortune 1970) conducted widespread surveys of the Rogue River basin to assess water flow and its effect on fish habitat and carrying capacity for salmonids. The study was designed to inform the Oregon Water Resources Board so that a "beneficial water use program" could be developed. The document contains comprehensive flow tables for all major coho-salmon-producing tributaries in the Rogue River basin, including recommended minimum flows. Thompson and Fortune (1970) also provides a summary of the Rogue River basin fish community, including the Upper Rogue River. The report identified flow depletion as a major cause of stress, disease, and predation to Pacific salmonids.

Upper Rogue River Total Maximum Daily Load Reports

A large-scale Rogue River TMDL (ODEQ 2008) covers all tributaries, which are listed as impaired (ODEQ 2002a), but not covered by other TMDLs.

Bear Creek Watershed TMDL

The Bear Creek Watershed TMDL (ODEQ 2007) addresses the listed parameters of temperature, bacteria (fecal coliform and *E. coli*) and sedimentation. The TMDL includes shade targets for the Bear Creek watershed and a water quality management plan.

Rogue River Watershed Health Factors Assessment

The Rogue Basin Coordination Council (RBCC 2006) produced the Rogue River Watershed Health Factors Assessment on behalf of the watershed councils within the basin. The assessment rates aquatic health and watershed conditions, including wildfire risk. Key problems in different Rogue River watersheds are described and potential solutions proposed.

Bear Creek Habitat and Temperature Study 1990-1991

Dambacher et al. (1992) investigated the temperature and habitat in Bear Creek and its tributaries during the summers of 1990 and 1991, and made recommendations for rehabilitation of the watershed. Temperatures in lower Bear Creek and in tributaries approached and exceeded, respectively, 80 °F. Temperature in Bear Creek increased downstream, was strongly influenced by solar input, and reached a maximum in late July. High water temperature was found to be the greatest factor limiting production of salmonids. Redside shiners were found in Bear Creek, and the authors were concerned that they were outcompeting and displacing salmonids.

Upper Rogue Watershed Association

Upper Rogue Watershed Assessment

The assessment (URWA 2006) describes various aspects of the Upper Rogue River subbasin, including hydrology, water quality, fish populations, fish habitat, riparian conditions, and wetland conditions. The assessment also identifies the issues and restoration opportunities within each of five sub-watersheds of the Upper Rogue watershed.

Bear Creek Watershed Council (BCWC)

Ashland Watershed Management & Action Plan

The plan (BCWC 2007) considers the Ashland Creek and Neil Creek drainages in the Bear Creek watershed. BCWC (2007) includes an assessment of hydrology and water use, riparian and wetlands, sediment sources, channel modifications, water quality, and fish and aquatic wildlife. A number of projects are suggested to restore habitat, manage stormwater, address fish passage barriers, and inform and educate the public. The plan focuses on voluntary activities on private and municipal land.

32.5 Stresses

Table 32-1. Severity of stresses affecting each life stage of coho salmon in the Upper Rogue River Subbasin. Stress rank categories and assessment methods are described in Appendix B, and the data used to assess stresses for the initial threats assessment (described in Appendix B) is presented in Appendix H.

	Stresses (Limiting Factors)	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rate
1	Altered Hydrologic Function[1]	Very High	Very High	Very High[1]	Very High	Very High	Very High
2	Degraded Riparian Forest Conditions[1]	-	Very High	Very High[1]	Very High	Very High	Very high
3	Impaired Water Quality[1]	High	Very High	Very High[1]	High	High	Very High
4	Lack of Floodplain and Channel Structure[1]	Medium	Very High	Very High[1]	High	High	Very High
5	Altered Sediment Supply		Medium	Medium	Medium	Very High	Very High
6	Barriers[1]	-	Medium	High[1]	High	High	High
7	Impaired Estuary/Mainstem Conditions	-	Low	High	High	High	High
8	Adverse Hatchery-Related Effects	Medium	Medium	Medium	Medium	Medium	Medium
9	Increased Disease/Predation/Competition	Low	Medium	Medium	Low	Low	Low
10	Adverse Fishery-Related Effects	-	-	-	-	Low	Low

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

Limiting Stresses, Life Stages, and Habitat

The juvenile life stage is most limited and quality winter rearing habitat, as well as summer rearing habitat, is lacking. Juvenile summer rearing habitat is impaired by deficient floodplain and channel structure, high water temperature resulting from degraded riparian conditions, and altered hydrologic function from water withdrawals. Furthermore, the degraded nature of the riparian forests inhibits future input of large wood and cannot provide bank stability that assists in a stable and complex channel. Finally, barriers throughout the basin limit access to rearing habitat. These findings are consistent with those of the Oregon Expert Panel (ODFW 2008b) (Section 32.4).

Altered Hydrologic Function

The Rogue River Basin Project (RRBP) is a series of reservoirs and other facilities used to collect, impound, and divert water from the Rogue River for delivery to irrigated cropland (BOR 2009b). The RRBP adversely affects coho salmon in the Bear Creek and Little Butte Creek watersheds of the Upper Rogue River subbasin. Forty-seven percent of the high-IP habitat in the Upper Rogue River subbasin is located in these watersheds. Another major source of hydrologic alteration affecting the Upper Rogue River coho salmon population is flow depletion due to groundwater extraction. Many types of groundwater uses do not require a water right, including stock watering, lawn or noncommercial garden watering of up to 0.5 acres, and domestic use of up to 15,000 gallons per day (U.S. Bureau of Land Management (BLM) 1998c). Data are lacking regarding groundwater use, its interaction with surface flow, and potential impacts to coho salmon (ODEQ 2008). However, due to the presumed large number of wells, groundwater pumping is likely contributing to inadequate stream flows and reduced groundwater inflow to many streams in the Upper Rogue River subbasin. Streams sometimes lose flow entirely (Thompson and Fortune 1970). The overall stress rating for Upper Rogue River coho salmon from this factor is very high.

Degraded Riparian Forest Conditions

Riparian zones on the mainstem and in tributaries exhibit impacts from 150 years of land use leading to a very high level of stress rating for coho salmon. In forested reaches conifers have been removed (ODEQ 2007, 2008) and early seral species like alder and willows are dominant in the Upper Rogue River. ODFW found low numbers of large conifers in Upper Rogue River riparian surveys, with almost all reaches having fewer than 75 conifers over 36” in diameter per 1,000 feet of stream surveyed. Streams surveyed include Evans, Little Butte, Big Butte, Elk and Trail creeks.

On valley floors where there may have previously been cottonwood gallery forests, marshes, and beaver ponds, the straightening of channels and draining of wetlands has altered the most productive coho salmon habitat (ODEQ 2008). The resulting disruption of surface and groundwater connections has led to stream warming (ODEQ 2008). Downcutting due to channel confinement is widespread in the Rogue River basin. Regional studies (Spence et al. 1996) found that downcutting may change near-stream soil moisture, which can inhibit recovery of riparian forest species. The most degraded streams in the Upper Rogue are channelized urban streams that are nearly devoid of riparian vegetation.

Impaired Water Quality

Thirty-three percent of the 137 sampled reaches in the Upper Rogue River subbasin met water quality standards (Southwest Oregon Resource Conservation and Development Council (SO RC&D) 2003). The most pervasive problem affecting coho salmon is water temperature. Very few reaches in the Upper Rogue River Subbasin meet ODEQ (2008) water standards compatible with coho salmon recovery. Few locations other than the tailwater of William L. Jess Dam contain both cold water temperatures (<64.4 °F) and pools deep enough to harbor coho salmon (>3 feet). The urbanized Bear Creek watershed is listed as temperature impaired (ODEQ 2007), with summer water temperatures in lower Bear Creek and its tributaries approaching 80 °F in 1990 and 1991 (Dambacher et al. 1992). However, in August 2007, detailed surveys detected 13 coldwater springs, seeps, and tributaries in the Bear Creek watershed (Sutton 2007), suggesting that there are some localized areas with temperatures suitable for summer rearing. Most potential thermal refugia were located in the upper half of Bear Creek watershed, with the majority being tributary inflows originating in the southwest portion of Bear Creek watershed.

Flow depletion reduces water volume and slows water velocity, thus promoting warming, stagnation, and depressed dissolved oxygen (D.O.) (Thompson and Fortune 1970). Nawa (1999) documented loss of coho salmon juveniles in Trail Creek due to flow depletion and low D.O. Little Butte Creek is similar to Trail Creek and has both low flow and D.O. problems. Growth of free-floating and attached algae may indicate nutrient enrichment, and algal photosynthetic activity may cause daily fluctuations in pH and D.O. (ODEQ 2007). The Larson and Lazy Creek watersheds are considered impaired due to high pH. It is unlikely that high fecal coliform bacterial levels in the Upper Rogue would directly harm coho salmon; however, the coliform levels might indicate livestock access to creeks or leaking septic systems.

Lack of Floodplain and Channel Structure

The straightening and simplification of streams has reduced the amount of slow, cool edgewater habitats where coho salmon fry and juveniles thrive (ODEQ 2008). Beaver have been greatly reduced along with the pools they create (ODFW 2005b). Although there are patches of functional coho salmon habitat, juvenile surveys indicate that many lower elevation Upper Rogue tributary channels are too altered to support them (Figure 32-7). Channelization of the Upper Rogue River has disconnected it from much of its floodplain, reducing the physical processes that form coho salmon rearing and spawning habitat. These processes include side channel formation, accumulation of large wood jams, formation of slower water velocities, formation of pools, and lower shear stress. Extensive ODFW habitat surveys of Evans, Elk, Trail, Little and Big Butte creeks had poor wood levels (< 1 key piece per 100m), except in headwaters at a few locations, usually on or below USFS and BLM lands. All these factors lead to a high stress ranking for Upper Rogue River coho salmon.

Figure 32-7. The Upper Rogue River running through Shady Cove. This 2005 aerial photo shows channelization, lack of a functional riparian vegetation, and potential risk of non-point source pollution.

Altered Sediment Supply

Sediment contribution from landslides and erosion occurs naturally in the Upper Rogue River basin; however, roads, timber harvest, and bank erosion following removal of riparian vegetation have elevated fine sediment input. Excess fine sediment directly impacts coho salmon egg viability and can reduce food for fry, juveniles and smolts. The majority of stream reaches measured for surface fine sediment in Upper Rogue River habitat surveys rated poor (>17 percent surface fines), with only Little Butte above the confluence with Antelope Creek rated as very good (<12 percent surface fines). Lower Evans Creek has particular problems with sand-sized sediment pollution because its watershed has extensive areas of decomposed granite (BLM 1995b). Other than a short reach of Big Butte Creek, most other tributaries with low levels of fine sediment are steeper, confined channels often on BLM or USFS lands. Poor pool frequency and depth throughout the Upper Rogue River basin (URWA 2006) are likely due to elevated levels of fine sediment partially filling pools, a lack of scour-forcing obstructions such as large wood, and in some reaches diminished scour due to channel widening.

Barriers

The high level of stress caused by barriers to migration in the Upper Rogue River subbasin is a result of high numbers of road stream crossings (i.e., shown in Bredensteiner et al. 2003 maps), small temporary agricultural dams (Prevost et al. 1997), large diversion dams, and seasonal complete loss of stream flow in tributaries such as Trail Creek (RBCC 2006, Nawa 1999).

William L. Jess Dam was constructed in 1977 at river mile 157 in the Upper Rogue basin and blocks passage into the Rogue River headwaters. NMFS believes recovery of the Upper Rogue population of SONCC coho salmon can occur without access to habitat above this dam. Several dams in the Middle and Upper Rogue Subbasin have been evaluated for removal or fish passage improvement (Mosser and Graham 2004). Five of the top ten dams targeted are on Evans Creek, including Freeman (RM 3.0) and Wimer (RM 9.0) which impede passage to nearly the entire Evans Creek watershed.

Impaired Estuary/Mainstem Function

The Rogue River estuary is highly altered and retains little of its historic function. Studies of other rivers in the region have shown that some portion of coho salmon fry and juveniles migrate out of their stream of origin in search of viable habitat patches, and these fish opportunistically use estuarine and slough habitats (Koski 2009, Miller and Sadro 2003). The lack of rearing habitat in the estuary limits the productive potential of the entire Rogue River basin and is rated as an overall high stress for coho salmon. A discussion of the causes of reduced estuarine function can be found in the Lower Rogue River population profile.

Adverse Hatchery Related Effects

The effects of hatchery fish on all life stages of coho salmon are described in Chapter 3. Cole Rivers Hatchery is located in the Upper Rogue River sub-basin, and produces approximately 200,000 coho salmon smolts annually in addition to millions of hatchery spring Chinook, winter steelhead, and summer steelhead (ODFW 2008d). Adult coho salmon are counted at Gold Ray Dam. From 1977, when hatchery production started, to 2007 (last year for which hatchery proportion was available), the proportion of hatchery adults passed as Gold Ray Dam nearly always exceeded 50 percent. However, these data are not a good indicator of the proportion of spawning adults that are of hatchery origin. There are many miles of habitat between Gold Ray Dam and Cole Rivers Hatchery, and hatchery fish are not spawning yet at Gold Ray Dam, they are continuing past it to the hatchery which is their ultimate goal. A trap is maintained at Elk Creek, about 5 miles from Cole Rivers Hatchery. This trap is an ideal location to estimate stray rates, because it is at the terminal end of the current anadromous distribution of coho salmon in the Rogue River basin. From 1995 to 2008, on average 10 percent of adult coho salmon trapped at Elk Creek were of hatchery origin. Adverse hatchery-related effects pose a medium threat to all life stages because greater than or equal to 5 percent and less than or equal to 10 percent of observed adults are of hatchery origin (Appendix B).

Disease/Competition/Predation

Thompson and Fortune (1970) found that salmonids in the Rogue River basin, including the Upper Rogue River, had higher incidences of the fish diseases *furunculosis* and *columnaris* in reaches that were warm due to flow depletion. They also noted that warm water conditions favored introduced species in the mainstem Rogue and Applegate rivers. Warm water and low flows are still pervasive in the Upper Rogue River subbasin; therefore, problems related to disease, competition and predation likely persist for coho salmon.

Adverse Fishery-Related Effects

NMFS determined that federally- and state-managed fisheries in Oregon are not likely to jeopardize the continued existence of the SONCC coho salmon ESU (Appendix B).

32.6 Threats

Table 32-2. Severity of threats affecting each life stage of coho salmon in the Upper Rogue River. Threat rank categories and assessment methods are described in Appendix B, and the data used to assess threats for the initial threats assessment (described in Appendix B) is presented in Appendix H.

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

Roads

Upper Rogue River subbasin road density associated with timber harvest, residential and urban development, and major highway systems are high (Bredensteiner et al. 2003). For example, the lower Big Butte watershed (BLM 1999b) has approximately 4.6 miles of road per square mile of watershed (mi. /sq. mi.). The Bear Creek watershed in the Upper Rogue likely has similar values. NMFS (1995) recommended a road density limit of 2 mi./sq. mi. to protect anadromous salmonids in interior Columbia River basins to limit sediment and damaging cumulative watershed effects. Streamside roads, known to yield chronic fine sediment and elevate the probability of landslides, are common in Upper Rogue watersheds with timber harvest activities (BLM and USFS 1997, BLM 1999b) (Figure 32-8).

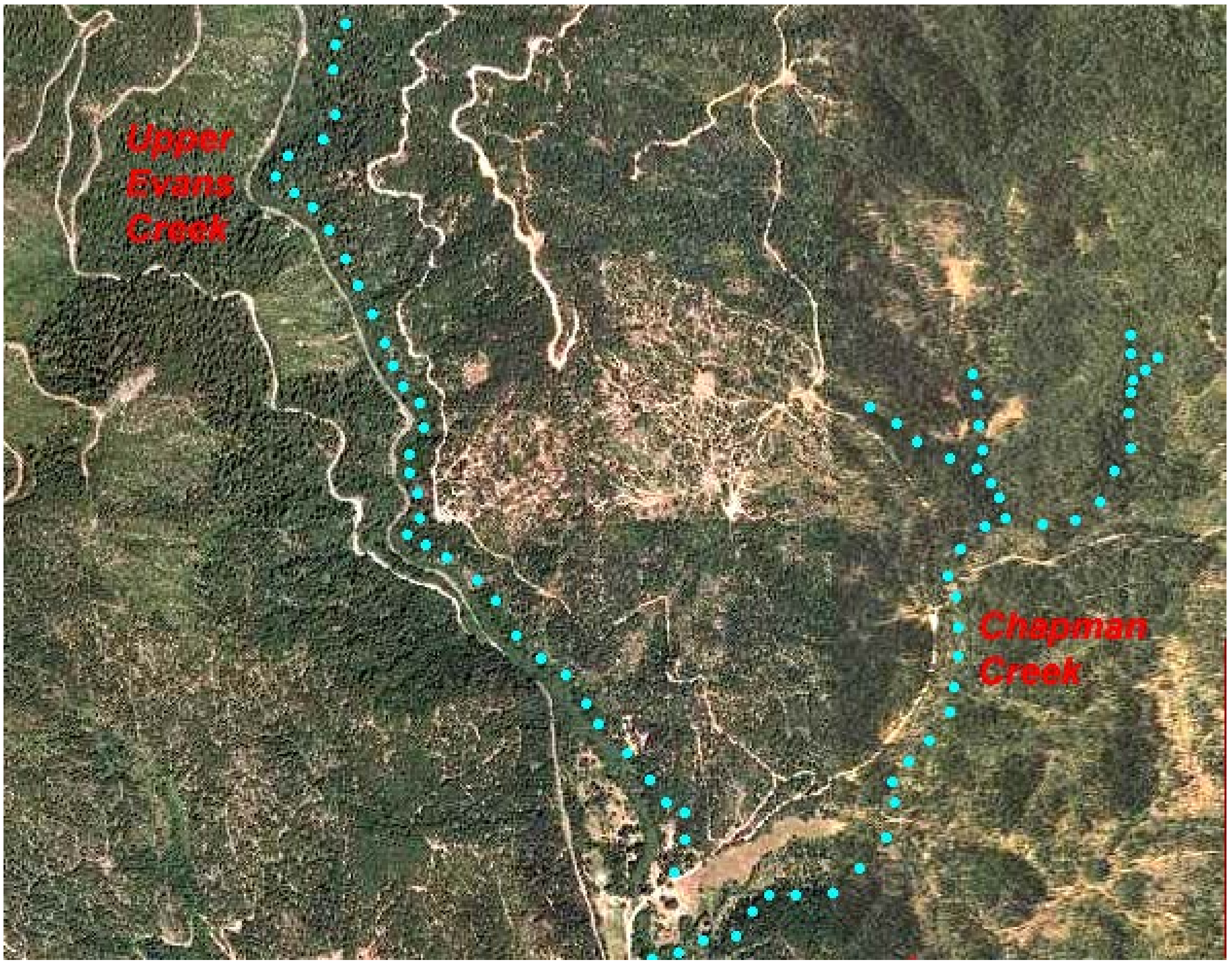

Figure 32-8. Upper Evans Creek and tributary Chapman Creek shown with dots. Logging roads are immediately next to the channel and there is an extensive network of skid trails that can alter watershed hydrology and sediment yield. Stream courses are based on the USGS (1989) topographic map. June 2005.

Agricultural Practices

Although the extent of agriculture in the Upper Rogue River subbasin is not large, these lands substantially overlap high IP (>0.66) coho salmon habitat. Much of the water withdrawals causing insufficient flow are used for agriculture. Other agricultural impacts include wetland filling, channelization and diking, riparian removal, channel simplification, and chemical application. Herbicide use has resulted in fish kills in the Rogue River basin, including juvenile coho salmon in Bear Creek in 1996 (Ewing 1999). Risk to coho salmon resulting from agriculture chemical use has been identified as a concern throughout the Pacific Northwest (Laetz et al. 2009), and it is likely that pesticides known to harm salmonids (NMFS 2008) are used in the region.

Urban/Residential/Industrial

The city of Medford and surrounding areas have grown substantially over the last several decades and future projections suggest that Rogue Valley urban and rural development will continue to increase. Maps of impervious areas (Homer et al. 2004) indicate extensive urbanization occurred in the Upper Rogue River subbasin. For example, total impervious area (TIA) in the lower Bear Creek watershed is greater than 10 percent, a level which studies in other river systems found caused increased peak flows, decreased base flows, simplified channel conditions, increased non-point source storm water pollution, and resulted in loss of aquatic system function (Booth and Jackson 1997). An acute regional example of this phenomenon is that toxic storm water runoff is leading to high pre-spawn mortality of adult coho salmon in tributaries to Washington’s Puget Sound (Booth et al. 2006). Urbanization and commercial development are expected to continue in the Interstate 5 corridor along Bear Creek.

Streams, such as Big Butte Creek and Little Butte Creek, supply water for urban areas and agriculture (RBCC 2006), and new residents add to growing water demand. Rural residential development also uses water and presents potential for pollution from septic systems (SO RC&D 2003). The threat to coho salmon from urban/residential and industrial development in the Upper Rogue River is very high.

Figure 32-9. Jackson Creek with channel altered by agricultural and urban land uses. Bear Creek is at right along the I-5 corridor in the city of Medford. Photo from 2005.

Channelization/Diking

Channelization and confinement of mainstem and tributary reaches of the Upper Rogue River is common and shown in Figure 32-8 and Figure 32-9. Disconnecting high IP coho salmon streams from their floodplains and constricting their channels into straight, narrow stream courses greatly diminishes their summer and winter habitat carrying capacity (BLM 1997). These activities also tend to reduce surface-groundwater connections that help maintain cool stream temperatures (ODEQ 2008).

Timber Harvest

Studies in coastal basins of Oregon found that when timber harvest exceeds approximately 25 percent of a watershed (Reeves et al. 1993) in 30 years (Reeves 2003), aquatic habitat becomes degraded and simplified and Pacific salmon species diversity diminished. The extent of early- to mid-seral-stage forests on private land in the Upper Rogue River subbasin (BLM 1999b) indicates that harvest rates on those lands were typically greater than this threshold. Aerial photos show that harvest rotations on private lands may be as short as 30 to 50 years, with very early seral stand conditions and high road densities near stream areas. Studies in other areas of the region have shown that timber harvest in unstable headwater areas increase sediment yield substantially (PWA 1998), depleting the supply of large wood delivered to streams during natural landsliding (May and Greswell 2003). In addition, the Independent Multidisciplinary Science Team (IMST 1999) concluded that the Oregon Forest Practice Rules for riparian protection, large wood management, sedimentation, and fish passage are not adequate to recover depressed stocks of wild salmonids. The primary timber harvest areas within this population are Evans Creek, Trail Creek, Elk Creek, and some parts of Little Butte Creek.

Dams and Diversions

The high number of dams and diversion systems in the Upper Rogue River subbasin resulted in a high threat score. Agricultural diversions on major low gradient tributaries can impede upstream adult passage or strand downstream-migrating juveniles, if fish screens are not in place. Major diversions by the City of Medford and large agricultural districts are particularly problematic with regard to reduced stream flows (RBCC 2006).

Mining/Gravel Extraction

Large scale gravel operations along the Upper Rogue River have resulted in the river abandoning its channel and forming a new one, and degrading formerly productive coho salmon rearing areas. Off channel ponds formed by pits excavated in the floodplain can capture juvenile coho salmon, coho salmon smolts, and adult coho salmon during high flow. Gravel extraction reduces overall habitat complexity and reduces the quality and quantity of available pool habitat. Given the sensitivity of the channel to disturbance (i.e., due to the current lack of floodplain and channel structure, low levels of instream wood), and the use of the gravel extraction reach by coho salmon juveniles for summer rearing, gravel extraction is a significant threat to rearing juveniles and a moderate threat to adults who require resting habitat in pools during upstream migration.

Climate Change

The current climate is generally warm and modeled regional average temperature shows a large increase over the next 50 years (see Appendix B for the climate change stress assessment methods). Average temperature could increase by over 2.8 ^{o}C in the summer and 1 ^{o}C in the winter. Annual precipitation in this area is predicted to stay within the natural range of current variability; however, seasonal patterns in precipitation may change (Mote and Salathe 2010). Juvenile and smolt rearing and migratory habitat are most at risk from climate change. Rising sea level may reduce the quality and extent of wetland rearing habitat. Adult Upper Rogue River coho salmon will likely be negatively affected 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).

Invasive Non-Native/Alien Species

Thompson and Fortune (1970) noted that warm water favored introduced species in the mainstem Rogue River, with large mouth bass, black crappie, bluegill, pumpkin seed, and brown bullhead present at fishable levels in the mainstem near Shady Cove prior to dam construction. In the Gold Ray Dam pool, carp were previously abundant (Thompson and Fortune 1970), but this dam has now been removed. In the nearby Middle Rogue, BLM (1999b) noted that private farm ponds related to agriculture and rural residential development have been stocked with introduced warm water species such as largemouth bass and sunfish. Umpqua pikeminnow, introduced in the Rogue River, have become established and likely represent the greatest threat to coho salmon of all the non-native species present. The threat of non-native fish species predominately occurs in the mainstem Rogue River. The risk of non-native fish species to the recovery of Upper Rogue River coho salmon is medium.

Hatcheries

Cole Rivers Hatchery releases 200,000 smolts annually, in addition to millions of hatchery spring-run Chinook salmon, winter-run steelhead, and summer-run steelhead (ODFW 2008d). Consequently, Upper Rogue River coho salmon are exposed to risks posed by hatcheries. The greatest hatchery-related concerns for this population are spawning between hatchery coho salmon and wild coho salmon in the wild, and predation by and competition with hatchery fish. The management goal for this population is to have less than 10 percent of the spawning coho salmon be hatchery-origin (ODFW 2008d). There is some uncertainty on whether this goal is being attained because randomized sampling of spawning sites has been sporadic. Available information suggests that the incidence of hatchery fish spawning in the wild is likely in the range of 5 to 15 percent.

Road-Stream Crossing Barriers

Road densities in portions of the Upper Rogue River subbasin are very high and stream side roads are common. Culverts may block upstream migration for adults or passage for juveniles during low flow periods. Watersheds with particularly high road densities, road stream crossings, and associated barriers are Bear Creek, Evans Creek and lower Little Butte Creek. Stream crossings have been, and continue to be, improved on federal lands in the subbasin. .

High Intensity Fire

Fire risk is acknowledged as a regional concern (RBCC 2006, BLM 1998b). Early seral stage forests, which are common in the Upper Rogue River subbasin, lead to dry site conditions and increased fire risk (SO RC&D 2003). Overall, high intensity fire is a medium threat to Upper Rogue River coho salmon.

Fishing and Collecting

The recreational fishery for hatchery coho salmon in Oregon likely encounters more federally listed coho salmon than does the Chinook salmon fishery that accounts for much of the bycatch mortality of SONCC coho salmon. This is because coho salmon are the targeted species in the recreational fishery. NMFS (1999) concluded that the exploitation rate associated with this and other freshwater fisheries in Oregon are not likely to jeopardize the continued existence of SONCC coho salmon (Good et al. 2005). The standard applied to make that determination was a jeopardy standard, not a species viability standard, because no recovery objectives to achieve species viability had been established for SONCC coho salmon at that time (NMFS 1999). Regional-scale effects may be enough to impede recovery of the Interior Rogue River diversity stratum, even if they are not severe enough to jeopardize the continued existence of the ESU. Specifically, wild coho salmon in the Rogue River basin likely experience more exploitation effects than those in other areas, because they co-occur with the adult hatchery coho salmon that were produced in the Rogue's Cole Rivers Hatchery, return to the Rogue River to spawn, and are targeted there by recreational fishermen. As of April 2011, NMS has not authorized future collection of coho salmon for research purposes in the Upper Rogue River.

32.7 Recovery Strategy

The most immediate need for habitat restoration and threat reduction in the Upper Rogue River is in those areas currently occupied by coho salmon in the headwaters of Evans, Trail, Elk, Big Butte, and Little Butte Creeks. Unoccupied areas must also be restored to provide enough habitat for coho salmon to achieve recovery.

The severely degraded conditions of the Upper Rogue River habitat, combined with the depressed coho salmon population size and distribution, significantly increases the risk of extinction of this inland coho salmon population, which is critical to recovery of the Interior Rogue River diversity stratum. The greatest factor limiting recovery of coho salmon in the Upper Rogue River is the lack of suitable rearing habitat for juveniles. The processes that create and maintain such habitat must be restored by restoring flow, increasing habitat complexity within the channel, restoring off-channel rearing areas, and reducing threats to instream habitat.

Table 32-3 on the following page lists the recovery actions for the Upper Rogue River population.

Table 32-3. Recovery action implementation schedule for the Upper Rogue River population.

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-URR.2.2.9	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Reconnect floodplains, wetlands, and off channel habitat	Private lands	3
SONCC-URR.2.2.9.1	*Assess habitat to determine where potential exists for floodplain reconnection. Prioritize sites and determine best means for reconnection at each site using tools such as hydrologic analysis*					
SONCC-URR.2.2.9.2	*Implement restoration projects that improve off channel habitats as guided by assessment results*					
SONCC-URR.2.2.10	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Population wide	3
SONCC-URR.2.2.10.1	*Develop program to educate and provide incentives for landowners to keep beavers on their lands*					
SONCC-URR.2.2.10.2	*Implement beaver program (may include reintroduction)*					
SONCC-URR.2.1.11	Floodplain and Channel Structure	Yes	Increase channel complexity	Improve suction dredging practices	Population wide	3
SONCC-URR.2.1.11.1	*Develop suction dredging regulations that minimize or prevent impacts to coho salmon. Consider special closed areas, closed seasons, and restrictions on methods and operations*					
SONCC-URR.3.1.4	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3
SONCC-URR.3.1.4.1	*Quantify groundwater withdrawal and determine maximum amount available for use without significantly reducing instream flows*					
SONCC-URR.3.1.5	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3
SONCC-URR.3.1.5.1	*Study groundwater withdrawal and prevent development if insufficient supply exists*					
SONCC-URR.3.1.6	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3
SONCC-URR.3.1.6.1	*Establish a comprehensive statewide groundwater permit process*					
SONCC-URR.3.1.7	Hydrology	Yes	Improve flow timing or volume	Educate stakeholders	Population wide	3
SONCC-URR.3.1.7.1	*Develop an educational program about water conservation programs and instream leasing programs*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-URR.3.1.8	Hydrology	Yes	Improve flow timing or volume	Manage flow	William L. Jess Dam	2
SONCC-URR.3.1.8.1	*Review dam management practices to ensure operations benefit the survival of all life stages of coho salmon*					
SONCC-URR.3.1.8.2	*Modify dam management, if needed*					
SONCC-URR.5.1.20	Passage	Yes	Improve access	Remove barriers	Population wide	3
SONCC-URR.5.1.20.1	*Assess and prioritize barriers using the ODFW fish passage barrier database*					
SONCC-URR.5.1.20.2	*Remove barriers*					
SONCC-URR.7.1.12	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve long-range planning	Population wide	3
SONCC-URR.7.1.12.1	*Review General Plan or City Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*					
SONCC-URR.7.1.12.2	*Develop watershed-specific guidance for managing riparian vegetation. Consider larger riparian buffers in coho occupied habitat*					
SONCC-URR.7.1.13	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	USFS and BLM lands	3
SONCC-URR.7.1.13.1	*Determine appropriate silvicultural prescription for benefits to coho salmon habitat*					
SONCC-URR.7.1.13.2	*Thin, or release conifers, guided by prescription*					
SONCC-URR.7.1.13.3	*Plant conifers, guided by prescription*					
SONCC-URR.7.1.14	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Privately held timberlands	2
SONCC-URR.7.1.14.1	*Revise Oregon Forest Practice Act Rules in consideration of IMST (1999) and NMFS (1998) recommendations*					
SONCC-URR.7.1.36	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Private lands	BR
SONCC-URR.7.1.36.1	*Develop HCPs or GCPs with interested owners of private timberlands*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-URR.7.1.37	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	BLM lands	3
SONCC-URR.7.1.37.1	*Manage timber harvest (and associated activities) on Federal lands in accordance with the Aquatic Conservation Strategy of the NWFP to achieve riparian and stream channel improvements for coho salmon*					
SONCC-URR.14.2.19	Disease/Predation/ Competition	No	Reduce predation and competition	Reduce abundance of warm-water, non-native fish species	Population wide	3
SONCC-URR.14.2.19.1	*Determine presence and absence of warm water, non native fish species and develop a plan for eradication or control*					
SONCC-URR.14.2.19.2	*Eradicate or control invasive fish species, guided by the plan*					
SONCC-URR.1.2.39	Estuary	No	Improve estuarine habitat	Improve estuary condition	Rogue River Estuary	3
SONCC-URR.1.2.39.1	*Implement recovery actions to address strategy "Estuary" for Lower Rogue River population*					
SONCC-URR.16.1.21	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3
SONCC-URR.16.1.21.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-URR.16.1.21.2	*Identify fishing impacts expected to be consistent with recovery*					
SONCC-URR.16.1.22	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Limit fishing impacts to levels consistent with recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	2
SONCC-URR.16.1.22.1	*Determine actual fishing impacts*					
SONCC-URR.16.1.22.2	*If actual fishing impacts exceed levels consistent with recovery, modify management so that levels are consistent with recovery*					
SONCC-URR.16.2.23	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3
SONCC-URR.16.2.23.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-URR.16.2.23.2	*Identify scientific collection impacts expected to be consistent with recovery*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-URR.16.2.24	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Limit impacts of scientific collection to levels consistent with recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3
SONCC-URR.16.2.24.1	*Determine actual impacts of scientific collection*					
SONCC-URR.16.2.24.2	*If actual scientific collection impacts exceed levels consistent with recovery, modify collection so that impacts are consistent with recovery*					
SONCC-URR.27.1.25	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3
SONCC-URR.27.1.25.1	*Perform annual spawning surveys*					
SONCC-URR.27.1.26	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life history diversity	Population wide	3
SONCC-URR.27.1.26.1	*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*					
SONCC-URR.27.1.27	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track surrogate for genetic diversity	Cole Rivers Hatchery	3
SONCC-URR.27.1.27.1	*Describe annual ratio of naturally-produced fish to hatchery-produced fish used to produce hatchery fish*					
SONCC-URR.27.1.28	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	2
SONCC-URR.27.1.28.1	*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*					
SONCC-URR.27.1.29	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Hatchery Management'	Population wide	3
SONCC-URR.27.1.29.1	*Annually determine the percent of hatchery origin spawners (PHOS), percent of natural origin spawners (PNOS), and the proportion of natural influence (PNI)*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-URR.27.2.30	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3
SONCC-URR.27.2.30.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-URR.27.2.30.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling 10% of the original habitat surveyed*					
SONCC-URR.27.2.31	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3
SONCC-URR.27.2.31.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-URR.27.2.32	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3
SONCC-URR.27.2.32.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-URR.27.2.33	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3
SONCC-URR.27.2.33.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-URR.27.2.34	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3
SONCC-URR.27.2.34.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-URR.27.2.35	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3
SONCC-URR.27.2.35.1	*Annually measure the hydrograph and identify instream flow needs*					
SONCC-URR.27.1.38	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3
SONCC-URR.27.1.38.1	*Conduct presence/absence surveys for juveniles (3 years on; 3 years off)*					
SONCC-URR.27.1.41	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-URR.27.1.41.1	*Develop supplemental or alternate means to set population types and targets*					
SONCC-URR.27.1.41.2	*If appropriate, modify population types and targets using revised methodology*					
SONCC-URR.5.1.40	Passage	No	Improve access	Remove barriers	USFS lands	3
SONCC-URR.5.1.40.1	*Evaluate and prioritize barriers for removal*					
SONCC-URR.5.1.40.2	*Remove barriers*					
SONCC-URR.8.1.1	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	3
SONCC-URR.8.1.1.1	*Assess and prioritize road-stream connection, and identify appropriate treatment to meet objective*					
SONCC-URR.8.1.1.2	*Decommission roads, guided by assessment*					
SONCC-URR.8.1.1.3	*Upgrade roads, guided by assessment*					
SONCC-URR.8.1.1.4	*Maintain roads, guided by assessment*					
SONCC-URR.8.1.2	Sediment	No	Reduce delivery of sediment to streams	Improve regulatory mechanisms	Population wide	3
SONCC-URR.8.1.2.1	*Develop grading ordinance for maintenance and building of private roads that minimizes the effects to coho*					
SONCC-URR.10.2.15	Water Quality	No	Reduce pollutants	Educate stakeholders	Population wide	3
SONCC-URR.10.2.15.1	*Develop an educational program that promotes Salmon Safe methods for agricultural operations and Integrated Pest Management for rural residents*					
SONCC-URR.10.2.16	Water Quality	No	Reduce pollutants	Increase regulatory oversight	Bear Creek	3
SONCC-URR.10.2.16.1	*Develop local regulatory mechanisms that limits development and reduces amount of total impervious area through incentives*					
SONCC-URR.10.2.17	Water Quality	No	Reduce pollutants	Educate stakeholders	Population wide	3
SONCC-URR.10.2.17.1	*Develop innovative ways to manage stormwater runoff*					
SONCC-URR.10.2.17.2	*Implement stormwater abatement plan*					