15. Smith River Population

- Central Coastal Stratum
- Core, Functionally Independent Population
- High Extinction Risk
- 6,800 Spawners Required for ESU Viability
- 762 mi^2
- 325 IP km (202 mi) (23% High)
- Dominant Land Uses are Agriculture and Timber Harvest
- Principal Stresses are ‘Impaired Estuary/Mainstem Function’ and ‘Lack of Floodplain and Channel Structure’
- Principal Threats are ‘Roads’ and ‘Channelization/Diking’

15.1 History of Habitat and Land Use

Over the past 120 years, land use has changed less in the Smith River than in many other California watersheds, but changes have still occurred and have affected instream habitat and anadromous fish throughout the area. While most of the upper watershed remains fairly pristine and unaffected by human activities, the areas that have been impacted are in the lower Smith River, where the greatest potential to support coho salmon exists. Human activities that have affected habitat in the Smith River include logging; road building; urbanization; placer, hard rock, and gravel mining; flood control (e.g., levees and tide gates); ranching; and pesticide use. Agriculture in the lower watershed and around the estuary has been, and continues to be the greatest contributor to loss and degradation of coho salmon habitat.

The Lake Earl Watershed may have at one time been connected to the Smith River. However, it is unlikely that there has been any connection in recent history. The Lake Earl Watershed was considered part of the Smith river population in Williams *et al*. (2008). Therefore, the Lake Earl Watershed was removed as part of the Smith river population.

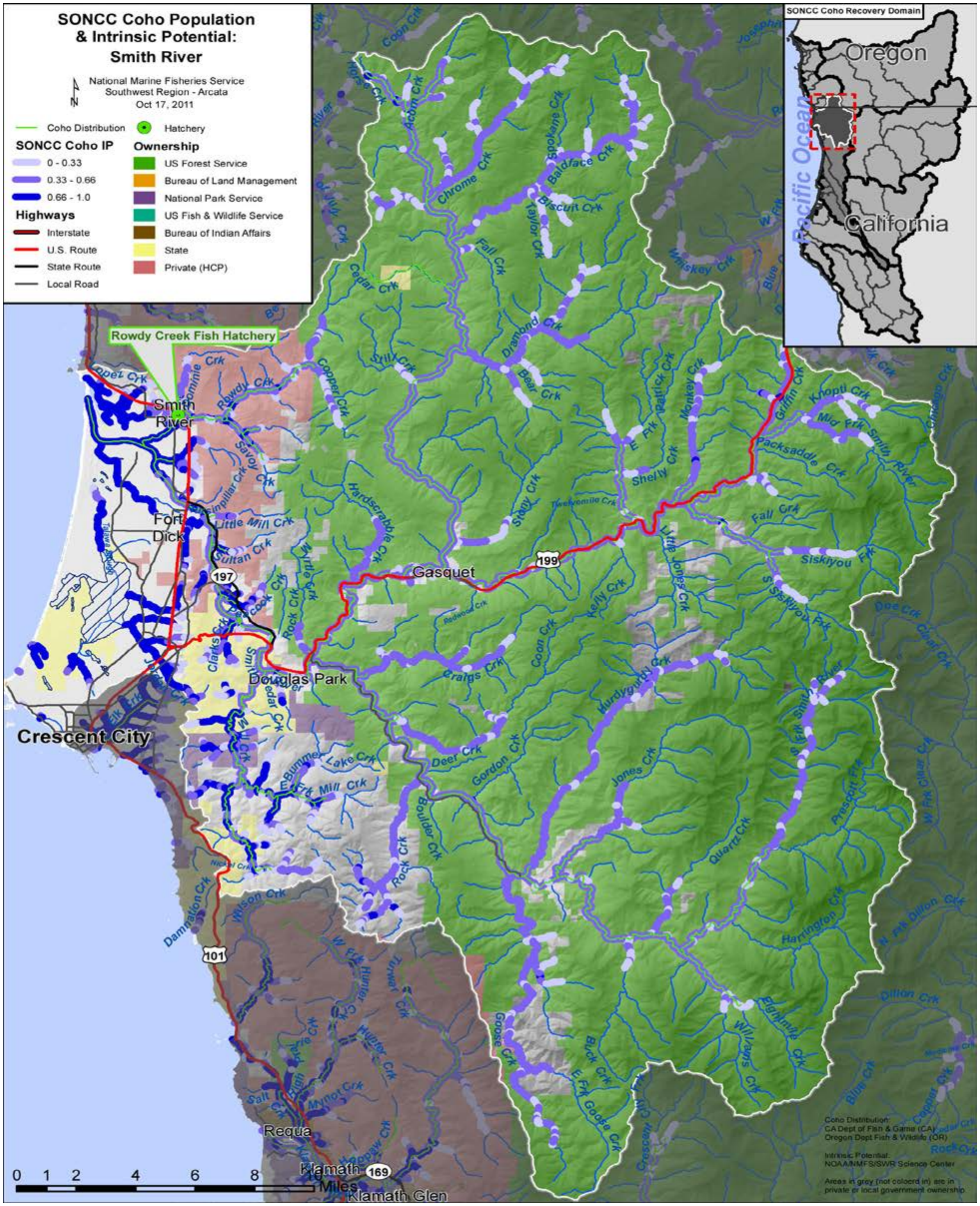

Figure 15-1. The geographic boundaries of the Smith River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2009a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

Land ownership consists of large holdings of private land in the coastal plain, while a majority of the middle to upper watershed is public lands. Much of the private land has been under intensive land uses for the past 100 years and efforts have begun to purchase available property to protect salmonid populations. Rowdy Creek occurs in the lower watershed and is mostly in private ownership, while Mill Creek, another tributary with high IP, is now almost entirely under public ownership since the State Park acquired 25,000 acres of the watershed in 2002. With the exception of small-developed areas near the communities of Fort Dick, land uses in the floodplain are primarily agricultural.

The estuary and lower river have been modified to expedite navigation, transportation, logging, and agriculture. These modifications include diking, channelizing, removing woody debris, removing riparian vegetation, and dredging. Over 40 percent of the estuary has been converted for agricultural uses (Quinones and Mulligan 2005). Large scale, channel-altering floods in 1955 and 1964 added to the loss of habitat in the Smith River by decreasing pool depths, altering channel morphology, and increasing sediment deposition. Overall, these changes greatly reduced habitat diversity and instream cover complexity in the lower river and estuary (McCain et al. 1995).

In the 1940s, most agriculture in the watershed was dairy farming. In the 1950s and 1960s, flower bulb production and other industrial agricultural uses began. By 1970, irrigated pastures and lily bulb farms covered about 4,000 acres on the coastal plain. Today, this area produces 90 percent of the lily bulbs in the United States. The production of lily flowers and bulbs requires pesticide use to control nematodes and diseases, which can impact salmonids.

While agricultural use and rural development have increased to some extent, logging in this watershed has decreased. Like most areas along the coast, timber harvest peaked in the mid-1900s and has decreased over the past 50 years. The effects of past timber harvest in the Smith River watershed continue to impact habitat through increased sedimentation from roads or road-related erosion and reduced recruitment of large wood into the river. Satellite images from 1994 to 1998 show that large sections of forested land in the mid to upper Smith River watershed have undergone significant decreases in forest canopy-cover. Decreases in canopy cover are likely from timber harvesting and forest fire. In the last ten years, this region has experienced a dramatic increase in forest fires that have been exacerbated by higher seasonal temperatures, drought, increased forest fuels (e.g., brush and other understory), and camping-related accidents.

Logging-related erosion, along with debris from hydraulic mining, which began in the area in the 1860s, are thought to be major contributors of continued sediment loading in the Smith River. High gradients throughout the watershed along with high road densities have led to frequent mass-wasting events, which have further added to sediment loads. According to aerial photography analysis, there have been over a thousand landslides in the Smith River watershed, including hundreds over 200 feet wide (McCain et al. 1995; California Department of Fish and Game (CDFG) 1980). These episodic mass-wasting events deliver large amounts of sediment into streams, and high volumes of water washes the sediment downstream.

Although many of the destructive land use practices that once occurred in the area have ceased, their legacy in the Smith River results in an altered sediment supply, impaired water quality, a lack of floodplain and channel structure, and altered estuarine function. The presence of numerous fish passage barriers also impedes spawning and rearing potential in many streams. The majority of poor habitat conditions exists in the Smith River Plain and overlap with areas of high IP value.

15.2 Historic Fish Distribution and Abundance

The Smith River is the largest watershed in the Central Coastal Stratum includes five large tributaries: Rowdy Creek, Mill Creek, and the North Fork, South Fork, and Middle Fork of the Smith River. Although the watershed extends 32 miles inland, the tributaries with the highest intrinsic potential (>0.66) are located completely within the lower 6 miles of the watershed (Figure 15-1).

The distribution of coho salmon is generally limited by the steep channel reaches caused by the Siskiyou Mountains that lie approximately 6 miles from the coast. Forty percent of this watershed is known to be sloped at over 50 percent gradient (Bartson 1997), and does not support coho salmon. Coho salmon are believed to extend throughout the majority of lower tributaries and use middle and upper tributaries to a lesser extent because of the species' preference for inclines less than 3 percent (Bjornn and Reiser 1991). Middle and upper reaches have a significant amount of moderate IP habitat (0.33 to 0.66) and can support coho salmon rearing. Studies conducted in the Smith River from 1979 to 2002 show that nearly all of the tributaries in the lower river were occupied by coho salmon (Jong et al. 2008). The South Fork Smith River has a low gradient, is fully accessible, and is used by spawning coho salmon. Coho salmon have also been observed in a number of tributaries in the North Fork Smith River.

Data from the Smith River indicates that run sizes in this area were large and could have been on the order of more than 7,000 returning adult coho salmon (National Marine Fisheries Service (NMFS) 2006). By 1965, CDFG estimated an escapement of 5,000 and by 1991 escapement was down to just over 800 (NMFS 2005a).

Available information suggests a decline in anadromous salmonid populations of the Smith River; however due to the anecdotal nature of early information, there is little basis for determining the extent of the decline. Observations of the Smith River and its fisheries prior to 1935 were not recorded and subsequent observations were infrequent. A cannery that operated on the Smith River in the late 1800s provides records that indicate the harvest of all salmon species combined between 1893 and 1897 was typically over 50 tons annually (Bartson 1997). There is no way to discern what proportion of this catch was coho salmon, but presumably there was once a thriving run in the accessible tributaries of the Smith River. Rowdy Creek, a tributary of the lower river, supported large runs of anadromous fish (California Assembly 1961) prior to extensive human influences especially logging. Mill Creek, a tributary of the lower river located several miles upstream from Rowdy Creek, has also been a highly productive tributary.

Table 15-1. Tributaries with instances of high IP reaches (IP > 0.66). (Williams et al. 2006).

Subarea	**Stream Name**	**Subarea**	**Stream Name**
Smith River Plain	Tolowa Slough	**Mill Creek[1]**	W. Branch Mill Creek[1]
	Ritmer Creek		Bummer Lake Creek[1]
	Morrison Creek[1]		East Fork Mill Creek[1]
	Little Mill Creek[1]	**North Fork[2]**	Horse Creek
	Peacock Creek[1]	**South Fork[1]**	Rock Creek
	Clarks Creek[1]		Goose Creek
	Tryon Creek	**Middle Fork[1]**	Siskiyou Fork[2]
	Tillas Slough		Griffin Creek[1]
	Sultan Creek[1]	**Rowdy Creek[1]**	S. Fork Rowdy Creek[1]
			Dominie Creek[1]
			Savoy Creek[1]

Current estimates of the abundance and distribution of the Smith River coho salmon population are unknown for the watershed as a whole. However, there is a long-term data set beginning in 1994 that documents salmon abundance in the West Branch and East Fork Mill Creek (McLeod and Howard 2010) In addition Scriven (2001) conducted a juvenile coho salmon distribution study throughout the Smith River watershed. Within West Branch of Mill Creek, adult coho salmon spawner counts have ranged from a high of 175 to a low of three between 1994 and 2009 with decreases in numbers seen in more current years (McLeod and Howard 2010). Estimates of total coho salmon spawners from these watersheds are unknown.

Downstream migrant traps operated on the East Fork and West Branches of Mill Creek from 1994 to 2000 showed numbers of outmigrating smolts ranged from zero to 1,500 with one brood lineage having slightly higher numbers than the other (Albro and Gray 2002). Work by Scriven in 1994 showed that juvenile densities range from 3,905 juveniles/km in West Branch of Mill Creek to 245 per kilometer in Rowdy Creek and 63 per kilometer in Patrick Creek (Scriven 2001). Although all studies indicate that Mill Creek has favorable spawning and rearing conditions for coho salmon and that productivity in this watershed is fairly high, it is far below carrying capacity as indicated by the fact that Hallock et al. (1952) was able to seine 60,602 juveniles from Mill Creek in 1951. Other tributaries where juvenile coho salmon have been found include lower tributaries such as Morrison Creek, Little Mill Creek, Sultan Creek, Peacock Creek, and Clarks Creek as well and upper tributaries including Shelley Creek, Rock Creek, and Jones Creek (Scriven 2001).

15.3 Current Status of Coho Salmon in the Smith River

Spatial Structure and Diversity

Juvenile and adult spawning surveys indicate that coho salmon in the Smith River population occur in many tributaries. Historically, coho salmon occurred in high densities in streams along the Smith River Plain including Mill Creek. Juveniles have been observed most often in Mill Creek, but have also been found further upstream in the watershed. Within the middle and upper watershed of the Smith River, coho salmon occurred at moderate to high densities in many tributaries in the North, South, and Middle Fork drainages. The majority of production appears to occur in Mill Creek where spawning coho salmon have been observed (Rellim Redwood Company 1994; Scriven 2001).

The more restricted and fragmented the distribution of individuals within a population, and the more spatial distribution and habitat access diverge from historical conditions, the greater the extinction risk. Williams et al. (2008) determined that at least 21 coho salmon per IP-km of habitat are needed (6,800 spawners total) to approximate the historical distribution of Smith River coho salmon and habitat. However, juvenile coho salmon do maintain a relatively large distribution in the Smith River (Scriven 2001; Jong et al. 2008).

Population Size and Productivity

If a spawning population is too small, the survival and production of eggs or offspring will suffer because it may be difficult for spawners to find mates or predation pressure is likely to be significant. This situation accelerates a decline toward extinction. Williams et al. (2008) determined at least 325 coho salmon must spawn in the Smith River each year to avoid such effects of extremely low population sizes.

Assuming Mill Creek provides the best spawning habitat in the Smith River basin, recent surveys in Mill Creek (McLeod and Howard 2010) suggest that the total population size for the Smith River basin may be less than the moderate-risk threshold for this population and at a level that puts it at high risk of extinction. Total spawner counts in the Mill Creek watershed ranged from a low of 18 in 2007 to a high of 237 in 2005 based on surveys since 1994 (McLeod and Howard 2010). Assuming Mill Creek data is representative of the entire Smith River population, the coho salmon population is experiencing a decreasing population trend since 2005. Survey of coho salmon escapement estimates in West Branch Mill Creek, East Fork Mill Creek, and Mainstem Mill Creek are shown below (McLeod and Howard 2010).

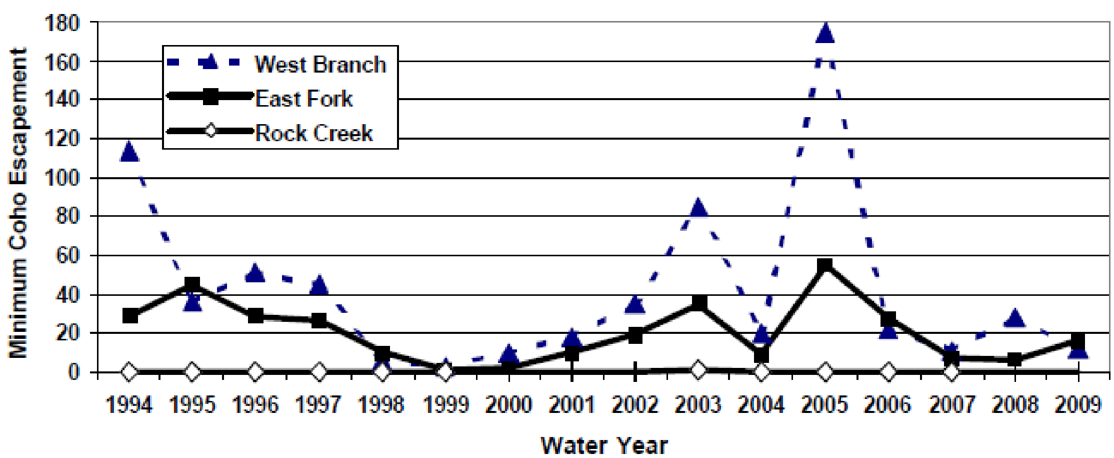

Figure 15-2. Coho escapement estimates. Data are for West Branch Mill Creek, East Fork Mill Creek and Rock Creek for 1994 to 2009 (McLeod and Howard 2010).

The Rowdy Creek Hatchery provides the longest running adult data collected by annual trapping on Rowdy Creek from October 1 through May 1 of every year. The following graph shows total adult coho salmon migrating upstream to Rowdy Creek Hatchery during spawning season from 1977 until 2010, with inconsistent survey efforts between years.

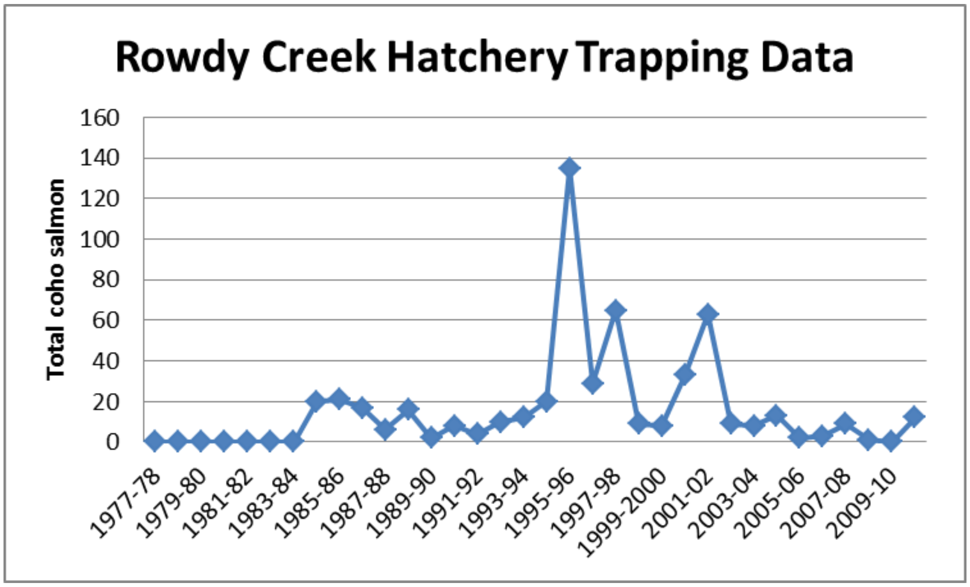

Figure 15-3. Rowdy Creek Hatchery Trapping Data for 1977 to 2010 (Van Scoyk 2011).

Based on the IP-km modeled for the Smith River, the basin is far below its carrying capacity. Because of the low population abundance and productivity, the Smith River population is considered at high risk of extinction.

Extinction Risk

Recent spawning surveys in the Smith River watershed indicate that this population is likely below the depensation threshold (325 spawners). Therefore, it is at high risk of extinction based on the criteria established by Williams et al. (2008). Currently, the population is restricted to 37 tributaries within the Smith River watershed with the largest known spawning population in Mill Creek.

Role in SONCC Coho Salmon ESU Viability

The Smith River population is a "Functionally Independent" population within the Central Coastal diversity stratum, meaning that it was sufficiently large to be historically viable-in-isolation and has demographics and extinction risk that were minimally influenced by immigrants from adjacent populations (Bjorkstedt et al. 2005; Williams et al. 2006). Any straying that does occur into the Smith River population likely occurs because of the number of large populations in close proximity along the coast. As a core population, the recovery target for the Smith River population is to be at low risk of extinction and have more than 6,800 spawners annually.

15.4 Plans and Assessments

U.S. Forest Service, Six Rivers National Forest Assessments

The Six River National Forest has prepared a number of assessments for lands within the Smith River drainage, including:

- The South Fork Smith River Sediment Source Assessment (2003) to evaluate sediment production trends and identify sites for mitigation such as tree planting or toe treatments.
- Smith River ecosystem analysis: Basin and subbasin analyses and late successional reserve assessment (McCain et al. 1995) with recommendations for improving salmon populations, with a focus on upgrading and storm proofing roads and upgrading culverts.
- Roads Analysis and Off-Highway Vehicle Strategy (USFS 2005a) to develop road and OHV management recommendations.

Green Diamond Resource Company (GDRC)

Green Diamond Habitat Conservation Plan (HCP)

The Green Diamond HCP (GDRC 2006) outlines a plan for the conservation of aquatic species in select watersheds in the Smith River. Approximately 25 percent of private land in the Smith River watershed is owned by Green Diamond and managed according to the provisions of the HCP. The plan was developed in accordance with the ESA section 10 regulations, which require Green Diamond to develop a conservation strategy to minimize and mitigate the potential adverse effects of any authorized taking of aquatic species that may occur incidental to Green Diamond's activities; to ensure that any authorized take and its probable impacts will not appreciably reduce the likelihood of survival and recovery in the wild of aquatic species; and contribute to efforts to reduce the need to list currently unlisted species under the ESA in the future by providing early conservation benefits to those species. The plan has a number of provisions designed to protect coho salmon and salmon habitat throughout the company's land in the watershed.

Redwood National and State Parks

General Plan Amendment and Environmental Impact Report for Del Norte Coast Redwood State Park-Mill Creek Addition

Redwood National and State Parks (RNSP) manages a significant amount of land in the Smith River Watershed, including some of the most important coho habitat in Mill Creek. The RNSP has completed a number of restoration projects on their lands including the installation of LWD structures, road decommissioning, and second growth timber management to release conifers.

California Department of Fish and Game

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

The Recovery Strategy for California Coho Salmon was adopted by the California Fish & Game Commission in February 2004. Priority actions in the Recovery Strategy for the Smith River HU include barrier removal, floodplain and channel restoration, estuarine slough and wetland restoration, and study of the impacts of the Rowdy Creek hatchery steelhead on coho salmon.

Smith River Advisory Council (SRAC)

Smith River Anadromous Fish Action Plan (SRAFAP)

In 2002, the Smith River Advisory Council was funded by the Fisheries Restoration Grant Program to publish the SRAFAP, which identified specific actions and funding sources to improve anadromous fish habitat throughout the Smith River basin. The recommendations included decommissioning roads, replacing culverts, planting riparian vegetation, and monitoring. The Plan encourages collaborative involvement and monitoring.

Smith River Project
http://www.bardicmedia.com/smith/index.shtml

Smith River Flood Plain Pesticide Aquatic Ecological Exposure Assessment

Prepared for The Smith River Project by the Center for Ethics and Toxics, the assessment identified high pesticide use in the approximately 11-square-mile area of the Smith River floodplain. The second part of this study found that levels of use exceeded the federal government's established level of concern for endangered aquatic organisms for four of five pesticides studied.

Smith River Fisheries and Ecosystem Report (1997)

Prepared by the Institute for River Ecosystems at Humboldt State University, the Smith River Fisheries and Ecosystem Report summarizes a detailed history and overview of the Smith River along with trends in fisheries and habitat, and a proposed restoration strategy.

Natural Resources of Lake Earl and the Smith River Delta

This report, written by Monroe et al. (1975), identifies specific resources and land uses in the Lake Earl and Smith River Plain; issues in these areas, and recommends courses of action needed to insure resource protection.

Mill Creek Fisheries Monitoring Program

Monitoring for anadromous fishes have been conducted in Mill Creek.

Snorkel surveys for juvenile coho salmon in tributaries to the Smith River, California

A graduate student from Humboldt State University assessed the distribution of juvenile coho salmon in the Smith River for his M.S. thesis (Scriven 2001).

North Coast Salmonid Conservation Assessment

The North coast Salmonid Conservation Assessment provides specific recommendations for improving riparian habitat in the lower Smith River and estuary, encouraging collaborative efforts to remove existing and potential fish barriers, and developing monitoring studies.

Smith River Alliance (SRA)

Save-the-Redwoods League

Siskiyou Land Conservancy

Rural Human Services

Western Rivers Conservancy

15.5 Stresses

Table 15-2. Severity of stresses affecting each life stage of coho salmon in the Smith River. Stress rank categories and assessment methods are described in Appendix B, and the data used to assess stresses for the initial threats assessment (described in Appendix B) is presented in Appendix H.

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

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

Limiting Stresses, Life Stages, and Habitat

Although habitat quality in the middle and upper parts of the basin have not been heavily impacted by land use, many areas in the lower parts of the Smith River and the Smith River estuary are creating limitations on the survival and viability of the Smith River coho salmon population. Degraded estuarine habitat conditions, lack of floodplain and channel structure are the limiting stressors for the population overall, and are most affecting the juvenile life stage. Overall, lack of access to, and decrease in the quantity of high quality winter (Stillwater Sciences 2006) and summer rearing habitat is limiting juvenile survival, and the estuarine rearing life history trait historically found in the population is limited by the degraded conditions in the Smith River estuary. Additionally, the high pesticide use associated with agriculture in the Smith River Plain adjacent to streams and drainages that enter the Smith River Estuary may be affecting the survival of coho salmon.

The majority of refugia habitat in the Smith River occurs in the lower and middle reaches of the watershed, which currently is being affected by agricultural practices and degraded habitat quality. There are also several tributaries in the middle and upper watershed that are known to support coho salmon and likely provide good rearing habitat and refugia from poor water quality in the lower river, both of which are considered vital habitat for the Smith River coho salmon population.

Of particular importance are the five tributaries to the Smith River that flow into the estuary: Rowdy Creek, Ritmer Creek, Delilah Creek, Yontocket Slough, and an unnamed creek. Tributaries and sloughs near the estuary provide vital habitat for juveniles and fry that are swept downstream during high flow events. This habitat increases survival of juveniles, which increases overall productivity and life history diversity of this population. The juveniles in these streams may express an estuarine life history pattern for rearing. Given the high flows and steep conditions found in the middle and upper Smith River watershed, low gradient tributaries near the estuary likely contributes to the success and continued survival of coho salmon in the Smith River. The lower Smith River and its tributaries are critical to the recovery of coho salmon in the Smith River (Frissell 1992). Therefore, the continued degradation of these habitats has a large impact on the entire population. Further upstream, refugia areas with good water quality are likely to be available in most cases, but are not always accessible or usable due to high gradients and barriers. These most likely occur where cold, clean water comes in from tributaries and where groundwater emerges into the stream.

Impaired Estuarine Functions

This stress refers to just the estuary conditions in the Smith River, since this is a single population basin (see Chapter 3 for further description of this stressor).

The estuary is important to the growth and survival of coho and any change or loss of access to estuarine habitat can severely affect the productivity of the population. Overall, the ability of the estuary to provide foraging and refuge opportunities is diminished and estuarine function is limited by existing modifications of the floodplain and channel. Impaired estuarine function is a high threat to juveniles and smolts in the population. A combination of factors has led to a severely degraded estuarine function in the Smith River.

There are several estuary sloughs which contribute valuable rearing habitat for coho salmon, but much of the historic tidal wetland habitat (>70 percent) and nearly all the historic tidal channels have been lost to agricultural and rural development through diking, dredging, the presence of tide gates, and filling. Approximately 40 percent of Smith River estuarine surface area was reduced between 1856 and 1966 (Quinones and Mulligan 2005). Dikes and levees along the channel prevent natural flow and change sediment and wood delivery in and out of the estuary. Behind the levees, filling of the estuary reduces functional rearing and refugia habitat and prey production. Sediment accumulation in accessible estuary areas restricts and simplifies channel habitat by decreasing pool and wetland depths and influencing the distribution and abundance of prey populations such as macro-invertebrate and benthic plankton. Overall, the Smith River estuary has limited cover, especially in the lower reach of the estuary (Quinones and Mulligan 2005). Cover, especially coarse woody debris contributes to estuarine function and habitat value (Koski 2009).

Lack of Floodplain and Channel Structure

The Smith River is degraded from a lack of large woody debris, an accumulation of sediment, levees, and a simplified floodplain and channel structure, which is considered a high threat to the Smith River population. This lack of floodplain and channel structure decreases, pool quality and depth, and off channel habitat, which causes a lack of suitable summer and winter rearing habitat for juveniles. Fry, juveniles, and smolts are impacted by lack of floodplain and channel structure because these life stages depend heavily on complex instream habitat and off-channels rearing habitat. Habitat surveys in Rowdy Creek found an average of only 3.5 large wood pieces per 100 feet of recruitment zone (GDRC 2006) and in some upper reaches of Chrome and Spokane Creeks, large woody debris frequency was rated as poor (<1.5 USFS rating). In a related dataset, pool frequency in some of these upper reaches was also rated as fair (10 to 20 percent by area) and pool depths were found to be less than 3 feet, which is thought to be a suitable depth for use by both juveniles and adults.

Other reaches lower in the watershed were rated as having very good (>35 percent) pool frequency and pool depth in some reaches of Rowdy Creek, had average depths ranging from poor (<2 ft) to very good (>3.3 ft). The lack of floodplain and channel structure affects egg and adult life stages because it reduces the quality and quantity of spawning gravel, changes the channel morphology and flow regime, and creates a lack of instream cover for juveniles. The lack of large woody structures and associated winter rearing habitat has been identified as a key limiting factor for juvenile coho salmon in the Smith River (GDRC 2006; Stillwater Sciences 2006). Tributaries in the lower Smith River and the estuary are particularly affected by a lack of floodplain and channel structure, and the lack of woody structures and floodplain connectivity in the estuary likely severely limits estuarine rearing.

Impaired Water Quality

Water quality in the Smith River is thought to be good in the middle and upper river, but compromised in the estuary and lower river where agricultural and rural road runoff is greatest and a restricted tidal prism prevents sufficient flows to flush sediment and pollutants. The contaminants of concern originate from point and non-point source pollution from farms, dairies, and septic systems that flow directly into the river. Of particular concern is the lily farming that occurs on the floodplain. One study showed that intense use of pesticides between 1996 and 2000 by lily farmers led to high levels of chemicals including carbofuran, chlorothalonil, diurin, disulfoton, and pentachloronitrobenzene. Recent testing in the lower Smith River has revealed copper concentrations that may have acute toxic effects and impair olfaction and reproduction of coho salmon (North Coast Regional Water Quality Control Board (NCRWQCB) 2011). The current level of chemical contamination is a high risk for juvenile salmonids (Bailey and Lappe 2002).

Water quality data including temperature and aquatic insect EPT and IBI provide an indication of water quality in the Smith River. These data show that temperature is generally good (<15 °C) with only isolated reaches in Mill Creek and the South Fork with fair or poor temperature (>17°C). Aquatic insect B-IBI NorCal, which is an indicator of stream health, was rated as good (60 to 80) in sampled locations along the mainstem Smith River from the mouth of Peacock Creek up into the North, Middle, and South Forks. Aquatic Invertebrate EPT on the other hand, indicated that there may be extensive pollutants in some tributaries. Samples from Jones Creek in the South Fork Smith River had a low (<12) number of taxa that may indicate the presence of pollutants in that stream. Other measurements in the upper watershed were either good (≥23; Middle Fork) or fair to poor (<18; Eightmile Creek).

Barriers

Barriers to fish passage in the Smith River are primarily due to road-stream crossings and aggradation or degradation of the channel and are thought to be a high stress for many life stages in the population. According to the California Fish Passage Assessment Database (CalFish 2009) there are approximately 175 diversions, and 150 road-stream crossing barriers within the Smith River Hydrologic Unit (HU). Forty-eight of the road-related barriers, ranging from partial to complete barriers, occur in the lower watershed where stream reaches are characterized as high IP for coho salmon. Known complete barriers identified in the database are in the Tenmile Creek, West Fork Patrick Creek, Yontocket Slough, Shelley Creek and Buck Creek. The majority of these barriers is associated with farm and small county access roads, and creates passage problems through changes in hydrology and creating alluvial sills that block tributary mouths. In addition to tide gates, these crossings prevent access to the already limited amount of overwintering habitat in the coastal plain (Stillwater Sciences 2006). The California Department of Fish and Game (CDFG) has funded several fish passage restoration projects since 2005, including barrier removals on Cedar, Clarks, Peacock, and Rowdy creeks (CDFG 2010a). Nevertheless, there are at least several dozen remaining fish barriers in the lower basin, which are considered a high stress for the juvenile and smolt life stages and a medium stress for the rest of the life stages. Because a large number of barriers remain in the lower basin blocking a large amount of spawning, winter refugia, and summer rearing habitat, the overall impact from barriers is considered high.

Adverse Hatchery-Related Effects

The effects of hatchery fish on all life stages of coho salmon are described in Chapter 3. Rowdy Creek Hatchery produced coho salmon from the 1930s but the species is no longer produced there. The genetic effect of this hatchery on coho salmon produced in the Smith River is unknown. The hatchery still produces 100,000 steelhead and 150,000 Chinook salmon, which are stocked into the Smith River. Hatchery coho salmon from other watersheds, such as the Rogue River, are found in the Smith River. Adverse hatchery-related effects pose a medium risk to all life stages of coho salmon in the Mad River, because of the ongoing in-basin stocking with steelhead and Chinook salmon from Rowdy Creek Hatchery (Appendix B).

Altered Sediment Supply

Altered sediment supply presents a low to medium stressor to coho salmon in the Smith River. Large introductions of sediment originating from historic logging practices, mining in the Gasquet Mountains, and an estimated 2,000 landslides are thought to contribute to increased sediment delivery to the Smith River. Excluding the coastal plain, 90 percent of the basin has high or extreme erosion potential (CDFG 1980), as evidenced by the high number of landslides and debris torrents found throughout the watershed. Although erosion can be high and sediment tends to accumulate in the Smith River Plain, river flows are generally high enough and persistent enough to prevent sediment accumulation and turbidity in the lower parts of the basin. Data on sedimentation indicates that some areas have accumulated fine sediment and suffer from filling of pools and increases in the amount of fine sediment. Measurements of sediment accumulation in pools (V*) in West Branch Mill Creek and Clarks Creek had fair ratings (>0.25), displaying effects from both anthropogenic and natural causes. Other data from a tributary of the North Fork (Cedar Creek) and the East Fork of Mill Creek showed a very good V* rating (<0.15) and did not show that pool depth and quality in this area were altered.

Mean particle size was rated between fair and poor (<50 mm) in Clarks Creek, West Branch Mill Creek, and the North Fork (Cedar Creek), indicating unnatural proportions of fine sediment as compared to background levels. Only the East Fork of Mill Creek was given a good rating (50 to 60 mm). In areas where sediment does tend to accumulate (especially in the estuary), pools are filled, gravels cemented, and stream habitat simplified, creating stress for both adults and juveniles through decreases in available spawning and rearing habitat. Salmon eggs and fry are particularly susceptible to any introduction of fine sediment because it can smother redds and kill eggs by depriving them of oxygen.

Degraded Riparian Forest Conditions

Degraded riparian forest conditions pose a medium stress for most life stages of coho salmon in the Smith River. Riparian vegetation in the lower reaches of the Smith River is inadequate due to the conversion of this area for agriculture, residential development and timber harvest. Inadequate riparian vegetation simplifies instream habitat, elevates water temperatures from increased insolation, increases erosion and sedimentation, and decreases the amount of large woody debris recruitment that is essential to the survival of juvenile salmonids in the lower watershed. In the middle and upper Smith River watershed, most areas have riparian forest dominated by thick hardwood and conifer species and conditions are considered adequate for shading and contributing large woody debris. The USFS rated the middle and upper Smith River as having very good (fully functional) stream corridor vegetation in their habitat surveys of the area.

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).

Increased Disease/Predation/Competition

Currently, juvenile hatchery Chinook and steelhead released from the Rowdy Creek Hatchery are likely exerting predatory and competitive pressure on native coho salmon.

Altered Hydrologic Function

The Smith River experiences a relatively natural hydrologic regime due to the absence of large dams and other significant alterations to channel morphology or hydrology. The USFS rated the upper watershed as having very good (fully functional) water quantity and flow regime, and although areas lower in the watershed exhibit impacts from changes in land use, localized water withdrawal and diversion of flows, altered hydrologic function is considered a low stress to the Smith River coho salmon population. In the lower watershed and estuary, there are numerous diversions for agriculture, but the cumulative effect does not currently result in a shortage of flow in the mainstem needed for salmon, but it is unknown how diversions may affect tributary streams.

Crescent City, including Pelican Bay State Prison, diverts surface water from the mainstem (Katelman 2005) and the Smith River Community Services District (SRCSD) operates three wells to supply water to the Town of Smith River and surrounding developments. The total amount of water extracted for Crescent City and the Smith River Community Services District ranges from two to three million gallons per day, but this amount has had no detectable effect on surface flows of the river (Voight and Waldvogel 2002). Agricultural use is the second largest source of water extraction, but the total amount is minimal and also does not affect surface flows (Voight and Waldvogel 2002). Generally, the hydrologic function in the watershed is good, primarily because of abundant rainfall in the region, which supplies sufficient water for agriculture, municipalities, and salmon.

15.6 Threats

Table 15-3. Severity of threats affecting each life stage of coho salmon in the Smith 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	High	High	High	High	High	High
2	Channelization/Diking	Low	High	High	High	High	High
3	Road-Stream Crossing Barriers	Medium	Medium	Medium	Medium	Medium	High
4	Agricultural Practices	Low	High	High	High	Medium	High
5	Urban/Residential/Industrial	Medium	Medium	Medium	Medium	Medium	Medium
6	Hatcheries	Medium	Medium	Medium	Medium	Medium	Medium
7	Timber Harvest	Medium	Medium	Medium	Medium	Medium	Medium
8	High Intensity Fire	Medium	Medium	Low	Low	Medium	Medium
9	Climate Change	Low	Low	Medium	Medium	Medium	Medium
10	Invasive Non-Native/Alien Species	Low	Medium	Medium	Medium	Low	Medium
11	Fishing and Collecting	-	-	-	-	Medium	Medium
12	Dams/Diversion	Low	Low	Low	Low	Low	Low
13	Mining/Gravel Extraction	Low	Low	Low	Low	Low	Low

Roads

Roads are considered a high threat to coho salmon in the Smith River. Erosion on many abandoned or unmaintained roads is a chronic source of fine sediment input to many streams and is exacerbated in the middle and upper parts of the basin by steep hillsides and an unstable geology. With a history of both agricultural and logging uses, the Smith River Plain is characterized by high road density. Road surveys indicate that a majority of the watershed contains more than 3 miles of road per square mile, and the areas with the highest densities of roads (>3 mi/sq mi) include the Smith River Plain, Rowdy Creek, Mill Creek, the South Fork, the lower North Fork and scattered watersheds in the Upper Middle Fork. The proximity of Highway 199 to stream channels beyond the urban center has also resulted in substantial sediment deposits, which are attributed to causing some of the reaches to go dry in the summer and potential passage problems in other times of the year. Erosion and the associated sediment delivery to streams affect multiple life stages, including the egg life stage, because fine sediment can smother eggs. Fry, juveniles and adults are adversely affected by road-related sedimentation due to the decreases in pool quality and quantity and the simplification of spawning and rearing habitat. When sediment builds up, the channel widens and becomes shallower, pools fill, and gravel is buried, making streams less favorable for spawning and rearing. Overall, logging and mining roads in the mid and upper reaches and farm roads in the coastal plain pose a high threat to all life stages of coho salmon in the Smith River population. This threat will likely reduce in the future as measures are undertaken by public land managers to decommission and upgrade roads throughout the upper Smith River watershed.

Channelization/Diking

The overall threat to coho salmon from channelization and diking is high and will continue as long as dikes and levees remain in place, and large portions of the coastal plain remain as agricultural farms and pastures. The extent of channelization and diking in the historic floodplain and estuary of the Smith River watershed is extensive and interferes directly with ecological function in this area, decreasing rearing quality in the lower reaches of the basin. Although the historic extent of tidal wetlands is not known, it is likely that close to 7,000 acres of tidal wetlands have been converted to agricultural land. Remaining tidal channels are severely truncated and channelized, providing only a fraction of their potential as rearing habitat. The lower reaches of streams, such as Rowdy Creek, are also channelized and important rearing habitat has been reduced and degraded. Low gradient stream channels directly connected to the estuary allow for estuarine life history traits that are unique to this population, and the degradation and inaccessibility of these habitats may have a significant effect on the Smith River coho salmon population. Without restoration of historic tidal wetlands and tidal channels, estuarine function will continue to be limited. The early life stages of coho salmon that rely on the estuary for growth and survival are most affected.

Road-stream Crossing Barriers

Road-stream crossing barriers are a high threat to the population, and although some work has gone into removing barriers throughout the watershed, the current number and extent of barriers mean that it will likely remain at this elevated status in the future, or until all barriers have been removed or remediated. According to the California Fish Passage Assessment Database (CalFish 2009) there are potentially 150 road-stream crossing barriers in the Smith River HU. Of these, roughly half have been assessed, a third have been prioritized and nineteen have been given a high priority for removal. Most road-stream crossing barriers are in tributaries in the middle and upper Smith River, but a few are lower down in tributaries in the Smith River Plain and cause passage problems for the Smith River coho salmon population. Until recently, notable barriers existed in Rowdy Creek and Mill Creek blocking much of the high IP habitat for spawning and rearing coho salmon. Barriers on Jordan Creek were especially restricting until 2001 when a state fish passage restoration project was implemented. Since 2005, the California Department of Fish and Game has sponsored several fish passage restoration projects, including barrier removals on Cedar, Clarks, Peacock, and Rowdy, creeks (CDFG 2010a). Given the high density of agricultural roads in the lower basin; however, road barriers remain one of the most important impediments to recovery efforts. A list of highly ranked road-stream crossing barriers identified in 2002 is given in Table 15-4.

Table 15-4. List of high priority barriers on roads in the Smith River and Lake Earl watersheds. Length of anadromous habitat, when given, was estimated in Taylor (2001) and the Smith River Anadromous Fish Action Plan (Voight and Waldvogel 2002). Prioritization is from the CalFish (2009) and Taylor (2001).

Priority	Stream Name	Road Name	Subarea	County	Miles of habitat
High	Sultan Creek	Culvert Hwy 197	Smith River Plain	Del Norte	1
High	Shelly Creek	Patrick's Creek Road	Middle Fork Smith River	Del Norte	
High	Rock Creek	Culvert Hwy 197	Smith River Plain	Del Norte	0.13
High	Little Mill Creek	Culvert Hwy 197	Smith River Plain	Del Norte	1
Very high	Clarks Creek	Culvert Hwy 199	Smith River Plain	Del Norte	1.3
High	Morrison Creek	Culvert Hwy 101	Smith River Plain	Del Norte	1
High	Ritmer Creek	Oceanview Drive	Smith River Plain	Del Norte	
High	Griffin Creek	Hwy 199	Middle Fork Smith River	Del Norte	0.13
High	Dominie Creek	Culvert Hwy 101	Smith River Plain	Del Norte	1.7
High	Unnamed Tributary to Smith River	Hwy 199	Middle Fork Smith River	Del Norte	0.13
High	Griffin Creek	Hwy 199	Middle Fork Smith River	Del Norte	0.15
High	Griffin Creek	Oregon Mountain Road	Middle Fork Smith River	Del Norte	
High	Unnamed Tributary to Smith River	Hwy 199	Middle Fork Smith River	Del Norte	0.06
High	Unnamed Trib to Smith River	Hwy 197	Smith River Plain	Del Norte	0.04
High	Unnamed Trib to Smith River	Hwy 197	Smith River Plain	Del Norte	
High	Unnamed trib to Morrison Ck	Hwy 101	Smith River Plain	Del Norte	0.3
High	Tryon Creek	Hwy 101	Smith River Plain	Del Norte	0.3
High	Brush Creek	Hwy 101	Smith River Plain	Del Norte	0.4
High	Unnamed trib to Smith River	Hwy 101	Smith River Plain	Del Norte	0.3
High	Peacock Creek	Tan Oak Drive	Smith River Plain	Del Norte	1.2
High	Ritmer Creek	Oceanview Drive	Smith River Plain	Del Norte	0.5
High	Clarks Creek	Walker Road	Smith River Plain	Del Norte	1.5
High	Tryon Creek	At Estuary	Smith River Plain	Del Norte	<.25
High	Huntspilar Creek	Highway 197	Smith River Plain	Del Norte	0.75
High	Morrison Creek	County Road D4	Smith River Plain	Del Norte	1.5
High	Coldwater Creek	Highway 199	Smith River Plain	Del Norte	0.75

Agricultural Practices

Agriculture practices are not common in the middle and upper reaches of the Smith River (0 to 2 percent of land use), but are very prevalent (>10 percent) in the Smith River Plain. Therefore, agricultural practices are considered an overall high threat to coho salmon in the Smith River. The coastal plain is dominated by agricultural activities focused on flower production, produce, and dairy farming. These farms contribute pesticides, herbicides, erosion, and animal waste into the watershed, are commonly associated with levees to protect fields. Poor water quality in the lower basin is primarily the result of pollutants and changes in habitat from alterations in land use have decreased the survival and viability of the Smith River coho salmon population. Because of the land clearings, agricultural practices are responsible for the significant decrease in large woody recruitment in the lower basin. The life stages most affected by agricultural practices are juveniles and smolts because they spend weeks to months rearing in the affected floodplain and estuarine areas and are particularly susceptible to poor water and habitat quality.

Urban/Residential/Industrial Development

Urban, residential, and industrial development is considered a medium threat to coho salmon in the Smith River because it occurs in the Smith River Plain where the highest quality-rearing habitat is located. Communities within the Smith River watershed and Smith River Plain are generally small and rural. The largest community in the Smith River watershed, the Town of Smith River, is surrounded by areas used for agriculture and includes several small communities in the coastal plain near Rock Creek and Peacock Creek. Most communities have fewer than 1,000 residents and do not appear to be undergoing significant growth. Crescent City, the largest city in the county, is located south of the Smith River watershed and supports nearly all of the county's population of nearly 29,000 people. Agricultural areas may be subdivided for rural residential use and future impacts may include the loss of wetlands, degraded water quality, channelization and diking, and altered hydrology. Recent public lands acquisitions, including 9,500 acres of Goose Creek watershed from Green Diamond Resources Company in 2006 and a pending 5,400 acre acquisition from ALCO Holdings, Inc., makes the Smith River Recreation Area approximately 315,000 acres. California State Parks has also expanded by gaining 25,000 acres of the Mill Creek Watershed in 2002. Private lands not managed by a HCP, compose 15.7 percent of the Smith River watershed.

Hatcheries

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

Timber Harvest

Timber harvest is considered a medium threat to coho salmon in the Smith River. Currently logging in the Smith River watershed is conducted in small units on land owned by the California Redwood Company (subsidiary to Green Diamond Resource Company) and the U.S. Forest Service's Six Rivers Ranger District. The area with the greatest extent of timber harvest (>35 percent of land use) is in the upper reaches of Rowdy Creek, Dominie Creek, and Ritmer Creek on industrial timberland. Most of the private land used for timber harvest is managed under the Green Diamond Resource Company's 50 year Habitat Conservation Plan and

Candidate Conservation Agreement with Assurances (HCP) (GDRC 2006) that includes minimization and mitigation measures consisting of road and riparian management, slope stability, and harvesting restrictions. The impacts of timber harvesting, even if carried out under the HCP, would result in the loss of pool habitat, loss of large wood and stream complexity, altered hydrology and nutrient cycling, and increased sediment loads. Changes in habitat conditions will have a negative effect on all life stages of coho salmon utilizing those areas. Timber harvest on public land is minimal and primarily associated with fuels reduction. As part of the aquatic conservation strategy of the Northwest Forest Plan (USDA and USDI 1994), the Smith River was designated as a key watershed, which has restrictions on timber harvest in the watershed.

High Intensity Fire

Fire is considered a medium threat to the Smith River coho salmon population. The inland reaches of the Smith River are thirty-two miles from the coast, forest dominated, and have an inherent risk of wildfire. Unnatural fuel loads due to past timber harvest and fire suppression could make this a greater threat if not fully addressed through fuels reduction and ecological fire management. The effects of high intensity fire could be severely detrimental, creating excessive amounts of erosion, loss of riparian vegetation, and degraded water quality. Overall, the threat from fire is low to medium because of the ongoing efforts in the watershed to reduce fuel loads.

Climate Change

Climate change poses a medium threat to this population. Ongoing and anticipated climate change in this region is likely to add further risk of forest fires, which would contribute to a decrease in canopy closure, increase sedimentation, degrade water quality, and have overall negative impacts to ecosystem processes. Additionally, decreased canopy closure increases the potential for erosion and ground instability, which leads to more sediment in the river system. The impacts of climate change in this region will have the greatest impact on juveniles, smolts, and adults. Modeled regional temperature shows a moderate increase over the next 50 years. Average temperature could increase by up to 2^{o}C in the summer and by up to 1^{o}C in the winter and annual precipitation in this area is predicted to trend downward over the next century. Snowpack in upper elevations of the basin will decrease with changes in temperature and precipitation (California Natural Resources Agency 2009).

The vulnerability of the estuary and coast to sea level rise is moderate to high in this population. Juvenile and smolt rearing and migratory habitat is most at risk to climate change. Increasing temperatures and changes in the amount and timing of precipitation will also likely impact water quality and hydrologic function in the summer. Rising sea level will also impact the quality and extent of estuarine rearing habitat. Overall, the range and degree of variability in temperature and precipitation is likely to increase in all populations. Also, as with all populations in the ESU, adults will be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (Independent Science Advisory Board 2007; Feely et al. 2008; Portner and Knust 2007).

Invasive Non-Native/Alien Species

Of notable concern is the expansion of exotic reed canary grass, *Phalaris arundinacea*, a cool-season perennial grass that grows successfully in northern latitudes. Reed canary grass is considered a serious threat to riparian and streamside corridors, wetlands, marshes, floodplains, and wet prairies by forming large dense stands. These stands exclude and displace desirable native plants, constrict waterways and promote silt deposition and are widely tolerant to degraded conditions (Lyons 1998). Colonies established outside of the water channel are known to promote channel incision through erosion of soil beneath the dense mats of rhizomes, causing cutaways where water flows rapidly between stands (Lyons 1998). This species is widely found in the Smith River watershed and is suspected of inhibiting coho salmon access to the use of tributaries like Yontocket Slough and Tryon Creek.

Also of concern is the establishment of the New Zealand mud snail (NZMS), *Potamopyrgus antipodarum*, which is native to New Zealand, but in the late 1980s was discovered to have spread to North America. This small invasive mollusk is now found in many waters across the West and the spread of this invasive species is believed to occur by migrant fish and waterfowl, and people’s waders, fishing gear, and bait. In September 2008, a sparse number of New Zealand mud snails were found in Tillas Slough of the Smith River watershed. Adverse impacts of this introduction include reduction in the insect species diversity and abundance and diminished availability of critical food resources to fish (Global Invasive Species Database 2010).

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. NMFS has authorized future collection of coho salmon for research purposes in the Smith River. NMFS has determined these collections are not likely to jeopardize the continued existence of the SONCC coho salmon ESU.

Dams/Diversions

Diversions and dams are considered a low threat to the population. There are no known dams that limit coho salmon access in the Smith River. Water diversions predominantly support agriculture, urban areas, rural residences, timber operations and road maintenance in the lower watershed and coastal plain. A hydrologic assessment of the diversions in the Smith River watershed has not been completed, but at this time withdrawals are not thought to significantly alter streamflow and no major diversions are planned for the future in this basin. However, the California State Park operates a diversion on East Branch Mill Creek, one of the most important tributaries for coho salmon in the Smith River and this diversion is considered a threat to coho salmon during some portions of the year.

Mining/Gravel Extraction

Although mining activities have ceased for the most part in the population area, there continues to be numerous metal mining activities along reaches of middle and upper tributaries on Forest

Service lands (McCain et al. 1995) and a gravel mine in the coastal plain. According to Bartson (1997), mining remains a source of sediment to the Smith River, although the extent of the problem remains unknown. Many areas historically disturbed by mining are actively eroding (McCain et al. 1995), and are exacerbated by the steep, unstable geology characteristic of the Smith River watershed. Although mining companies have expressed interest in mining for heavy metals in this watershed, Smith River NRA Act prohibits the formation of any new mining claims. In 1996, the Forest Service formulated administrative rules concerning mining in the NRA. Because of current regulatory standards and mining levels, the overall threat to coho salmon associated with mining in this watershed is considered low (Bartson 1997).

15.7 Recovery Strategy

Coho salmon in the Smith River experience some advantages over other rivers in the region due to the geology of the basin that enables the river to move sediment and to sustain cooler temperatures. The relatively low urban development in the area and the high ratio of public lands to private lands also helps to preserve the river ecosystem. Nevertheless, the coho salmon in the Smith River have declined substantially and are dependent on rearing areas in the lower watershed where development and agriculture have the greatest adverse effects. Although restoration and public land acquisition has resulted in improved habitat and ecosystem functions in the Smith River, the loss of estuary, slough, and floodplain habitats continue to negatively affect the viability of coho salmon.

Recovery of the population will require enhancing existing juvenile coho salmon habitat and expanding the spatial structure of the population. Tributaries in the Smith River Plain have the highest IP habitat, and should therefore be the first place to look for opportunities. Throughout the lower watershed, a focus should be on improving fish passage and floodplain and channel structure, especially where overwintering, low-velocity habitat can be created, improved, or accessed. Therefore, restoration of the Smith River estuary, which lacks extensive wetland and tidal channel rearing habitat, is imperative. In addition, agricultural run-off needs to be addressed to reduce the concentration levels of pesticides reaching the Smith River and its tributaries. On a larger scale, sediment from roads and the paucity of LWD needs to be addressed watershed-wide.

Table 15-5 on the following page lists the recovery actions for the Smith River population.

Table 15-5. Recovery action implementation schedule for the Smith River population.

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SmiR.1.3.12	Estuary	Yes	Increase tidal exchange of water	Improve hydrologic function to restore tidal prism and dilute pollutants	Estuary	3
SONCC-SmiR.1.3.12.1	*Complete a hydrologic study to assess estuary function and identify restoration actions to restore the tidal prism and dilute pollutants*					
SONCC-SmiR.1.3.12.2	*Complete restoration actions identified in the plan*					
SONCC-SmiR.1.2.13	Estuary	Yes	Improve estuarine habitat	Reduce pollutants	Lake Earl, Smith River Plain, Smith River Estuary	BR
SONCC-SmiR.1.2.13.1	*Identify agricultural lands that contribute unacceptable levels of pollutants to the estuary. Develop a plan to hydrologically disconnect the runoff*					
SONCC-SmiR.1.2.13.2	*Hydrologically disconnect agricultural lands guided by the plan*					
SONCC-SmiR.1.2.32	Estuary	Yes	Improve estuarine habitat	Assess estuary and tidal wetland habitat	Estuary	3
SONCC-SmiR.1.2.32.1	*Identify parameters to assess condition of estuary and tidal wetland habitat*					
SONCC-SmiR.1.2.32.2	*Determine amount of estuary and tidal wetland habitat needed for population recovery*					
SONCC-SmiR.2.1.1	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Smith River Plain, Estuary, tributaries, Rowdy, Chrome, and Spokane creeks	3
SONCC-SmiR.2.1.1.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-SmiR.2.1.1.2	*Place instream structures, guided by assessment results*					
SONCC-SmiR.2.2.2	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Restore natural channel form and function	Smith River Plain, Rowdy and Domnie creeks	2
SONCC-SmiR.2.2.2.1	*Assess channelized reaches and develop a plan for reconstructing a natural meandering channel*					
SONCC-SmiR.2.2.2.2	*Reconstruct channelized reaches guided by the plan*					
SONCC-SmiR.2.2.3	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel ponds, alcoves, backwater habitat, and old stream oxbows	Lake Earl, Smith River Plain	2
SONCC-SmiR.2.2.3.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-SmiR.2.2.3.2	*Implement restoration projects that improve off channel habitats as guided by assessment results*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SmiR.2.2.4	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Smith River Plain, tributaries, Rowdy, Chrome, Spokane, and Mill creeks	3
SONCC-SmiR.2.2.4.1	*Develop program to educate and provide incentives for landowners to keep beavers on their lands*					
SONCC-SmiR.2.2.4.2	*Implement beaver program (may include reintroduction)*					
SONCC-SmiR.2.2.5	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Remove, set back, or reconfigure levees and dikes	Lower Mainstem, Smith River Plain, Lake Earl watershed	3
SONCC-SmiR.2.2.5.1	*Assess feasibility and develop a plan to remove or set back levees and dikes that includes restoring the natural channel form and floodplain connectivity once the levees have been removed*					
SONCC-SmiR.2.2.5.2	*Remove levees and restore channel form and floodplain connectivity*					
SONCC-SmiR.10.2.9	Water Quality	Yes	Reduce pollutants	Reduce point- and non-point source pollution	Smith River watershed, Lake Earl watershed, Smith River Plain	3
SONCC-SmiR.10.2.9.1	*Identify pollution sources, and develop a strategy to meet objective*					
SONCC-SmiR.10.2.9.2	*Implement strategy to prevent pollution*					
SONCC-SmiR.10.2.10	Water Quality	Yes	Reduce pollutants	Educate stakeholders	Smith River watershed, Lake Earl watershed, Smith River Plain	3
SONCC-SmiR.10.2.10.1	*Promote pollution reduction*					
SONCC-SmiR.10.2.11	Water Quality	Yes	Reduce pollutants	Remove pollutants	Lake Earl, Smith River Plain, South Fork, North Fork, Middle Fork, Mill and Rowdy creeks	BR
SONCC-SmiR.10.2.11.1	*Locate and prioritize mine tailings and mill sites. Develop a plan for remediation*					
SONCC-SmiR.10.2.11.2	*Take necessary actions to ensure responsible parties remediate mine tailing piles, guided by the plan*					
SONCC-SmiR.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-SmiR.16.1.21.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-SmiR.16.1.21.2	*Identify fishing impacts expected to be consistent with recovery*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SmiR.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-SmiR.16.1.22.1	*Determine actual fishing impacts*					
SONCC-SmiR.16.1.22.2	*If actual fishing impacts exceed levels consistent with recovery, modify management so that levels are consistent with recovery*					
SONCC-SmiR.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-SmiR.16.2.23.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-SmiR.16.2.23.2	*Identify scientific collection impacts expected to be consistent with recovery*					
SONCC-SmiR.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-SmiR.16.2.24.1	*Determine actual impacts of scientific collection*					
SONCC-SmiR.16.2.24.2	*If actual scientific collection impacts exceed levels consistent with recovery, modify collection so that impacts are consistent with recovery*					
SONCC-SmiR.17.2.20	Hatcheries	No	Reduce adverse hatchery impacts	Identify and reduce impacts of hatchery on SONCC coho salmon	Rowdy Creek Hatchery	BR
SONCC-SmiR.17.2.20.1	*Develop Hatchery and Genetic Management Plan*					
SONCC-SmiR.17.2.20.2	*Implement Hatchery and Genetic Management Plan*					
SONCC-SmiR.3.1.17	Hydrology	No	Improve flow timing or volume	Increase instream flows	East Fork of Mill Creek, Smith River watershed, Lake Earl watershed, Smith River Plain	BR
SONCC-SmiR.3.1.17.1	*Evaluate diversions and water use. Develop a plan to reduce diversions*					
SONCC-SmiR.3.1.17.2	*Reduce diversions, guided by the plan*					
SONCC-SmiR.3.1.18	Hydrology	No	Improve flow timing or volume	Remove dams	Craigs, Rowdy, and Patrick creeks, Middle and Upper Smith River	BR

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	***Step Description***					
SONCC-SmiR.3.1.18.1	*Evaluate and prioritize dams for removal. Develop a plan to remove dams*					
SONCC-SmiR.3.1.18.2	*Remove dams, guided by the plan*					
SONCC-SmiR.3.1.19	Hydrology	No	Improve flow timing or volume	Manage flow	Lake Earl	3
SONCC-SmiR.3.1.19.1	*Identify issues preventing natural breaching of the Lake Tolowa/Lake Earl sand bar. Develop a plan to increase breaching events*					
SONCC-SmiR.3.1.19.2	*Implement plan to increase frequency of breaching events*					
SONCC-SmiR.27.1.25	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3
SONCC-SmiR.27.1.25.1	*Perform annual spawning surveys*					
SONCC-SmiR.27.1.26	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3
SONCC-SmiR.27.1.26.1	*Conduct presence/absence surveys for juveniles (3 years on; 3 years off)*					
SONCC-SmiR.27.1.27	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	2
SONCC-SmiR.27.1.27.1	*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*					
SONCC-SmiR.27.2.28	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3
SONCC-SmiR.27.2.28.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-SmiR.27.2.28.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling 10% of the original habitat surveyed*					
SONCC-SmiR.27.2.29	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3
SONCC-SmiR.27.2.29.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-SmiR.27.2.30	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3
SONCC-SmiR.27.2.30.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SmiR.27.2.31	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	All IP habitat	3
SONCC-SmiR.27.2.31.1	*Identify habitat condition of the estuary*					
SONCC-SmiR.27.1.33	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life history diversity	Population wide	3
SONCC-SmiR.27.1.33.1	*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*					
SONCC-SmiR.27.2.34	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3
SONCC-SmiR.27.2.34.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-SmiR.27.1.35	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3
SONCC-SmiR.27.1.35.1	*Develop supplemental or alternate means to set population types and targets*					
SONCC-SmiR.27.1.35.2	*If appropriate, modify population types and targets using revised methodology*					
SONCC-SmiR.27.2.36	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3
SONCC-SmiR.27.2.36.1	*Determine best indicators of estuarine condition*					
SONCC-SmiR.5.1.14	Passage	No	Improve access	Remove barriers	Cedar, Clarks, Rowdy, Patrick, Morrison, Peacock, Sultan, Dominie, Ritmer, Jordon, and Yonkers creeks	3
SONCC-SmiR.5.1.14.1	*Evaluate and prioritize barriers for removal*					
SONCC-SmiR.5.1.14.2	*Remove barriers*					
SONCC-SmiR.7.1.6	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Smith River Plain, Estuary, Mainstem Smith River, tributaries, Rowdy, Chrome, and Spokane creeks	3

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SmiR.7.1.6.1	*Determine appropriate silvicultural prescription for benefits to coho salmon habitat*					
SONCC-SmiR.7.1.6.2	*Thin, or release conifers, guided by prescription*					
SONCC-SmiR.7.1.6.3	*Plant conifers, guided by prescription*					
SONCC-SmiR.7.1.7	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Lower tributaries, Lake Earl watershed, Smith River Plain	3
SONCC-SmiR.7.1.7.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-SmiR.7.1.7.2	*Develop grazing management plan to meet objective*					
SONCC-SmiR.7.1.7.3	*Plant vegetation to stabilize stream bank*					
SONCC-SmiR.7.1.7.4	*Fence livestock out of riparian zones*					
SONCC-SmiR.7.1.7.5	*Remove instream livestock watering sources*					
SONCC-SmiR.7.1.8	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Remove invasive species	Lake Earl, Smith River Plain	3
SONCC-SmiR.7.1.8.1	*Implement an invasive species prevention and removal plan for reed canary grass*					
SONCC-SmiR.8.1.15	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Lake Earl, Smith River Plain, South Fork, North Fork, Middle Fork, Mill and Rowdy creeks	3
SONCC-SmiR.8.1.15.1	*Assess and prioritize road-stream connection, and identify appropriate treatment to meet objective*					
SONCC-SmiR.8.1.15.2	*Decommission roads, guided by assessment*					
SONCC-SmiR.8.1.15.3	*Upgrade roads, guided by assessment*					
SONCC-SmiR.8.1.15.4	*Maintain roads, guided by assessment*					
SONCC-SmiR.8.1.16	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	Population wide	BR
SONCC-SmiR.8.1.16.1	*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*					
SONCC-SmiR.8.1.16.2	*Stabilize landslides with appropriate treatments, guided by the plan*					