# 38. Lower Trinity River Population

- Interior-Trinity Stratum
- Core Population
- Moderate Extinction Risk
- 3,900 Spawners Required for ESU Viability
- 746 $mi^2$
- 112 IP km (69 mi) (1% High)
- Dominant Land Uses are Forestry and Agriculture
- Principal Stresses are ‘Lack of Floodplain and Channel Structure’ and ‘Altered Hydrologic Function’
- Principal Threats are ‘Channelization/Diking’ and ‘Dams/Diversion’

## 38.1 History of Habitat and Land Use

Prior to 1944, the Lower Trinity River was occupied by Native Americans and turn-of-the century miners (U.S. Forest Service (USFS) 2000d). Their use of these lands probably had relatively minor impacts. Forest Service road construction and timber harvest did not begin until the 1950s (USFS 2000e). Land use activities in the Lower Trinity River watershed today include mining, timber harvesting, road construction, recreation and a limited degree of residential development (U.S. Environmental Protection Agency (EPA) 2001). The construction of Trinity and Lewiston dams in the early 1960s, and water diversion to the Sacramento Valley has had major impacts on the flow and function of the Trinity River (EPA 2001; USFS 2000e). Effects to coho salmon habitat in the Lower Trinity River include degradation of spawning and rearing habitat, lack of deep pools, sedimentation, channelization and channel confinement, and high water temperatures. Some streams with moderate IP value are relatively intact with regards to their historic condition and a few have federally designated Wilderness protection.

Fish habitat, especially anadromous fish habitat, was greatly degraded in the 1964 flood, which affected the Lower Trinity River and most anadromous habitat in California (USFS 2000e). Substantial habitat recovery has occurred since the 1964 flood, but wild anadromous fish populations and salmon habitat has generally not recovered in the Klamath basin (USFS 2000e). Fire has also been a source of catastrophic disturbance. Several high intensity fires have burned through the lower Trinity River since fire suppression activities on USFS land began in the mid 1900s.

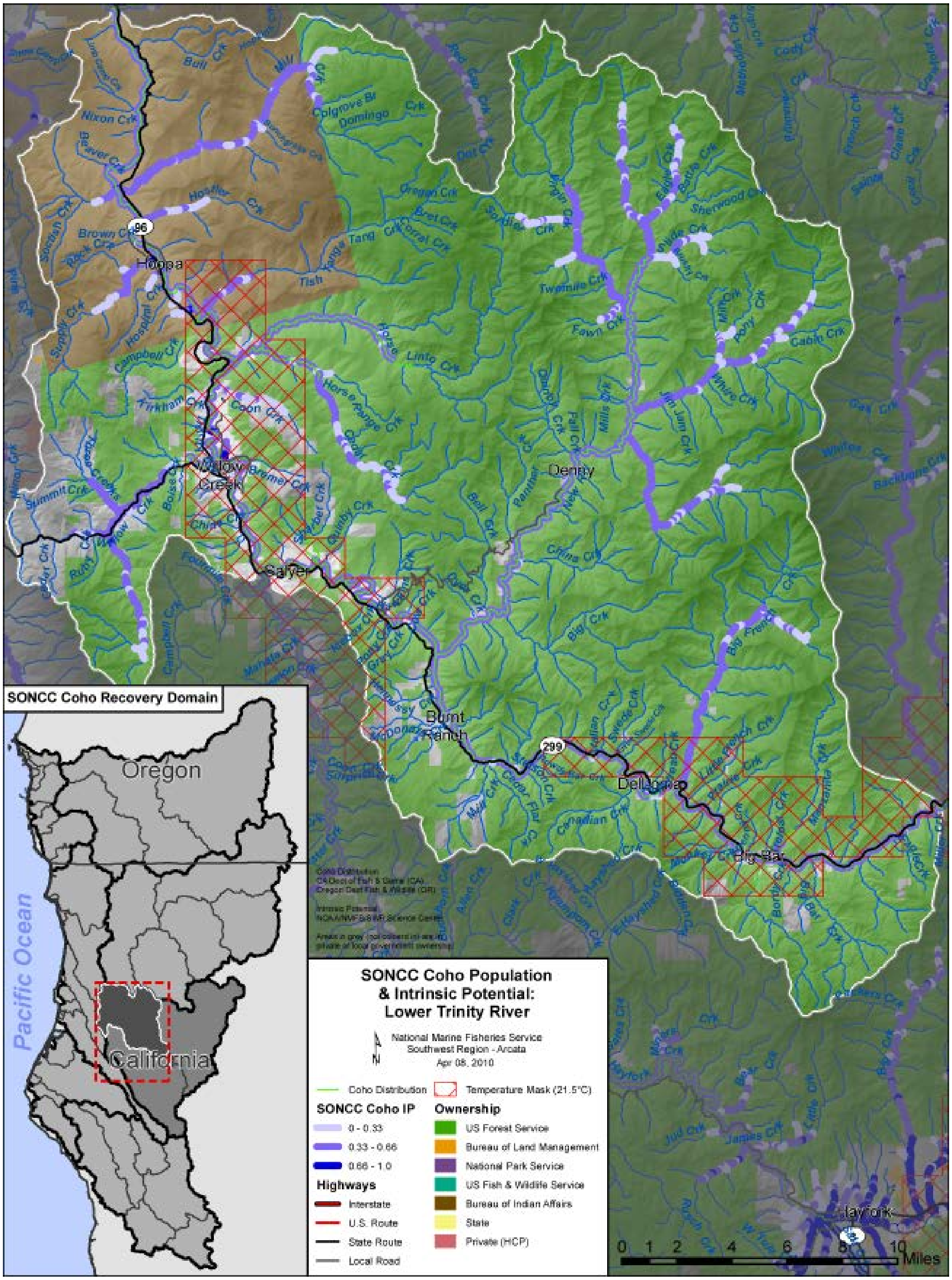


Figure 38-1. The geographic boundaries of the Lower Trinity River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2009a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

For instance, the 1999 Megram Fire, which burned 125,000 acres, and the Big Bar Complex, which burned close to 80,000 acres (53 percent) of the New River watershed in August 1999. Both impacted the riparian communities of some streams and accelerated the delivery of sediment to several streams in the Lower Trinity River drainage (USFS 2000e).

Logging practices and developments on floodplains within the Trinity River watershed have also contributed significantly to habitat degradation (U.S. Department of the Interior (DOI) 1981). A total of 28 percent of the Lower Trinity was harvested between 1940 and 1990 (EPA 2001) as a result of large-scale timber harvesting occurring on private land (especially Willow Creek and Sharber Creek) (USFS 2003). Clearcutting promoted increased sediment loading; removal of streamside vegetation increased water temperatures; and log jams at the mouths of tributaries (DOI 1981). In addition, logging within the subbasin has necessitated the construction of hundreds of miles of unpaved logging roads (DOI 1981). Road networks in the Lower Trinity and many other areas of the Pacific Northwest are the most significant source of anthropogenic sediment input to anadromous fish habitats, often exceeding all other combined sources from forest activities (USFS 2003). Roads have led to decreased hydrologic function and increased sediment loading. The resulting increased yield of sediment in the mainstem Trinity River and its tributaries has reduced the biological productivity and fish carrying capacity of the river (DOI 1981).

Much of the mainstem Trinity River and virtually all tributaries have been subjected to hydraulic mining activities (U.S. Fish and Wildlife Service (USFWS) and Hoopa Valley Tribe (HVT) 1999; EPA 2001). At one time, hydraulic mining destabilized streambanks, changed the channel structure, and caused large amounts of sediment to be washed into tributary streams. However, the form and function of the streams in areas where hydraulic mining has occurred seem to have persisted despite this disturbance. (USFWS and HVT 1999, EPA 2001).

It is likely that many watersheds within the Burnt Ranch and New River hydrologic subarea (HSA) are properly functioning with regard to aquatic habitat and watershed conditions. These streams have a large portion of their watersheds in the Trinity Alps Wilderness and remain in a relatively undisturbed state. Most of these streams remain accessible to coho salmon. Although these streams currently support small populations of anadromous steelhead and some coho salmon, because of their high gradient they may not have historically supported robust populations of coho salmon.

## 38.2 Historic Fish Distribution and Abundance

There is little information on the historic abundance of coho salmon in the lower Trinity River. It was noted by USFWS and California Department of Fish and Game (CDFG) (1956) that “Silver [coho] salmon enter most lower Trinity River tributaries to spawn.” Similarly, Moffet and Smith (1950) stated that “silver [coho] salmon enter the lower Trinity River to spawn” and reported that coho salmon were usually observed in the Hoopa Valley by October. In 1969 and 1970, CDFG estimated the coho salmon run size for the Trinity River to be 3,222 and 5,245, respectively (Smith 1975, Rogers 1973). Since 1978, coho salmon escapement above Willow Creek has ranged from 558 to 32,373 (USFWS and HVT 1999). These returns have largely been comprised of hatchery fish since Trinity River Hatchery (TRH) was built. Spawning surveys by the USFS in the mid to late 1990s have found scattered use of tributaries in the Lower Trinity by coho salmon with between 0 and 100 spawners found during any given year in the few surveyed streams (USFS 2003).

TRH first began releasing coho salmon in 1960. Although substantial efforts were made to trap and haul coho above the dam during the construction of Trinity Dam, adult returns fell to essentially zero during the 1962-63 run (zero females, seven males, nine grilse). Transfer of coho salmon eggs from outside of the Trinity basin often occurred, which imported coho salmon that were likely not as well adapted to the Trinity basin's habitat conditions as were the original stocks. The TRH facility originally used Trinity River fish for broodstock, though coho salmon from Eel River (1965), Cascade River (1966, 1967, and 1969), Alsea River (1970), and Noyo River (1970) have also been reared and released at the hatchery as well as elsewhere in the Trinity River basin. Actual production averaged 496,813 from 1987 to 1991, decreased to 385,369 from 1992 to 1996, then increased again to 527,715 fish from 1997 to 2002. During the period 1991–2001, an average of 3,814 adult coho salmon were trapped and 562 females were spawned at TRH.

Today, on average, over 90 percent of coho salmon spawning between Willow Creek and Lewiston Dam are of hatchery origin (USFWS and HVT 1999). Based on population estimates from 1991-1995, 1998, and 1999 the average escapement of naturally produced fish was approximately 400 fish. During this seven year period of sampling the Trinity coho salmon population experienced two years of no natural production and one additional year of extremely low natural production. The other three years had natural runs on the order of 1,000 coho or less (USFWS and HVT 1999).

Given that several tributary streams in Lower Trinity River provide spawning habitat, it can be inferred that coho salmon were historically widely distributed throughout the Lower Trinity River subbasin. Historically, it was probably rare for coho salmon to spawn in the mainstem Lower Trinity River. The steep nature of the surrounding terrain likely limited the amount of high quality habitat available to coho salmon and the majority of IP habitat is of moderate value (0.33- 0.66). There exist only a few scattered kilometers of high IP habitat (>0.66). The relatively steep nature of the area and the consequent lack of high IP habitat (<2 percent High IP) suggest this population never supported large runs of coho salmon but may have supported a moderately-sized population that was spread throughout most major tributaries (Big French Cr., New River, Willow Cr., Horse Linto Cr., Tish Tang Cr., Mill Cr., and Cedar Cr.)

## 38.3 Status of Lower Trinity River Coho Salmon

### Spatial Structure and Diversity

Good spawning habitat does exist in a few tributaries in the Lower Trinity. The Burnt Ranch and New River HSAs have some of the best known spawning habitat in the population area. Tributaries known to support coho spawning and/or rearing include Mill Creek, Horse Linto Creek, Tish Tang Creek, and Sharber-Peckham Creek. The presence of juvenile coho salmon has also been confirmed within the last five years in Manzanita Creek, Big French Creek, East Fork New River, Cedar, Supply, Campbell, and Hostler creeks, as well as in Willow Creek as far upstream as the Boise Creek confluence (Everest 2008; Boberg 2008). Sharber-Peckham Creek likely supports the highest number of spawning coho salmon (USFS 2001; Boberg 2008). The

Six Rivers National Forest indicated that populations in the lower portions of Mill and Horse Linto creeks are extremely low, particularly in Horse Linto Creek since 1995 (USFS 2001). The USFS (2000f) reported that coho salmon are rarely found in the New River although this is one of the largest watersheds with the potential for coho salmon production based on the availability of IP habitat in the subbasin. Based on this current distribution of coho salmon in the Lower Trinity, most of the historic habitat of the Lower Trinity River remains accessible to coho salmon and coho salmon occur in many of the tributaries with IP habitat.

Although not well documented, there appears to be some diversity of life history strategies in the Lower Trinity River. Data on run timing and outmigration indicate that there is some variation in the life history characteristics of the population. Coho salmon enter the Trinity River between September and November and spawning in the river continues into December (CDFG 2009b). Also, both young-of-the-year and yearling coho salmon are captured at downstream migrant traps located in the Trinity River near Willow Creek (Pinnix et al. 2007). Redistribution of age 0+ coho occurs over a large time period between March and September as does outmigration of age 1+ (Pinnix et al. 2007).

Hatchery influences on the genetic diversity of the population are substantial in the Lower Trinity River subbasin. Each year, TRH releases approximately 500,000 coho salmon smolts. Currently, coho salmon returns to the Trinity River are dominated by hatchery fish (USFWS and HVT 1999). From 2003 to 2005, over 75 percent of adults returning to the Trinity River (as estimated at Willow Creek) were of hatchery origin. Trinity River hatchery coho salmon stray into many of the tributaries on the Six Rivers National Forest, such as Horse Linto Creek (Cyr 2008). Straying of hatchery fish into tributaries of the Trinity River presents a particular threat to the diversity viability parameter, as hatchery fish may reduce the reproductive success of the overall population (Mclean et al 2003) through outbreeding depression (Reisenbichler and Rubin 1999). In 1985, Jong and Mills (1992) found that 35.8 percent of adult coho salmon returning to the South Fork Trinity River were of hatchery origin. We assume that in years of high adult returns of hatchery coho salmon (>10,000), the proportion of hatchery coho salmon adult returns to tributaries in the Lower Trinity River is similar to that found in the South Fork, or greater. Because of the high numbers of adult hatchery coho salmon migrating through the lower Trinity River the Lower Trinity River population of coho salmon is at a moderate risk of extinction.

Table 38-1. Estimates of run sizes of coho salmon. Data are from the Trinity River's Willow Creek weir, 1997 to 2008. Hatchery-origin fish were identified by a mark (right maxillary clip). CDFG (2009).

| **Year** | **Number Unmarked** | **Number Marked** | **% Hatchery** | **% Natural** |
|---|---|---|---|---|
| 1997 | 651 | 7,284 | 92% | 8% |
| 1998 | 1,232 | 11,348 | 90% | 10% |
| 1999 | 586 | 4,959 | 89% | 11% |
| 2000 | 539 | 14,993 | 97% | 3% |
| 2001 | 3,373 | 28,768 | 90% | 10% |
| 2002 | 596 | 15,420 | 96% | 4% |
| 2003 | 4,093 | 24,059 | 86% | 14% |
| 2004 | 9,055 | 29,827 | 77% | 23% |
| 2005 | 2,740 | 28,679 | 92% | 8% |

| Year | Number Unmarked | Number Marked | % Hatchery | % Natural |
|---|---|---|---|---|
| 2006 | 1,624 | 18,454 | 92% | 8% |
| 2007 | 1,199 | 4,551 | 79% | 21% |
| 2008 | 1,312 | 8,671 | 87% | 13% |

### Population Size and Productivity

Williams et al. (2008) determined at least 112 spawners are needed each year in the Lower Trinity River to avoid problems associated with low spawner density such as the failure to find mates leading to a reduced probability of fertilization, and the failure to saturate predator populations (Liermann and Hilborn 2001, Williams et al. 2008). Williams et al. (2008) also determined that there should be a spawner density of at least 35 coho salmon per IP-km of habitat in the Lower Trinity River subbasin, resulting in a total of 3,900 individuals to meet the low risk spawner threshold.

Limited presence/absence and spawning survey data are available from the U.S. Forest Service. Based on spawner surveys by the USFS run sizes in Sharber Creek between 1996 and 2001 ranged from 0 fish in 1999 to almost 150 fish in 2001 (USFS 2003). The average run size during this time was 56 fish (and 27 redds). No coho salmon were found during spawning surveys in Willow Creek between 1991-2000 although juveniles have been found during outmigrating trapping (USFS 2003). Captures of yearling coho salmon in the Trinity River during outmigrant trapping have been consistent, but numbers are generally low (CDFG 2009b). Based on the recent returns at Willow Creek, the Trinity River population is between 5,800 and 39,000 with the majority being hatchery-origin (>90 percent most years) (CDFG 2009b). The proportion of the unmarked run that spawns within the geographic area of the Lower Trinity River population is not known. However, if a moderate percentage (30-50 percent) of the run spawns in the Lower Trinity River population area, the unmarked adult population of the Lower Trinity River is likely to be less than the low risk spawner threshold of 3,900 and likely less than a few hundred fish during some years.

The population growth rate in Lower Trinity River subbasin has not been quantified. Recent data indicate that the amount of recruits produced per female spawner in the Trinity River is substantially less than two, meaning the population is failing to replace itself. The population growth rate for the Lower Trinity River is likely to be negative, and the population relies on the heavy influence of hatchery fish to maintain current abundance levels.

### Extinction Risk

Based on the criteria set forth by Williams et al. (2008) the Lower Trinity River population is at a moderate risk of extinction because the number of spawners is above the depensation threshold. Although the number of spawners is above the depensation threshold, more than 5% of spawners are of hatchery origin. Most spawning areas seem to have relatively low numbers of spawners in any given year. Spatial structure is not thought to be limiting because most of the habitat remains accessible. In terms of diversity, there appears to be some variability in life history strategies that probably bolster the population's resiliency, however, hatchery strays probably reduce population productivity. Little is known about the population's growth rate, but it is thought to be low or negative. It is likely that the naturally-produced adult coho salmon population in the Lower Trinity River during any given year is less than the low risk spawner threshold established by Williams et al. (2008).

The Lower Trinity River coho salmon population is not viable and at moderate risk of extinction. The estimated number of spawners exceeds the depensation threshold, but does not meet the low-risk threshold (Table ES-1 in Williams et al. 2008).

#### Role in SONCC Coho Salmon ESU Viability

The Lower Trinity population is considered to be a core "Potentially Independent" population within the Interior-Trinity diversity stratum meaning that it was sufficiently large to be historically viable-in-isolation and historically had demographics and extinction risk that were minimally influenced by immigrants from adjacent populations (Bjorkstedt et al. 2005; Williams et al. 2006). As a core population, the recovery target for the Lower Trinity population is for the population to be viable and to have a low risk of extinction according to population viability criteria (see Chapter 5). Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU.

### 38.4 Plans and Assessments

#### Hoopa Valley Tribal Fisheries and Hoopa Valley Environmental Program

#### Yurok Tribal Fisheries Program

#### U.S. Forest Service- Shasta-Trinity and Six Rivers National Forests

#### State of California

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

#### North Coast Regional Water Quality Control Board (NCRWQCB)

#### Five Counties Salmonid Conservation Program

## 38.5 Stresses

Table 38-2. Severity of stresses affecting each life stage of coho salmon in the Lower Trinity 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[1] | Overall Stress Rank |
|---|---|---|---|---|---|---|---|
| 1 | Adverse Hatchery-Related Effects[1] | Very High | Very High | Very High[1] | Very High | Very High[1] | Very High |
| 2 | Lack of Floodplain and Channel Structure[1] | Medium | Very High | Very High[1] | Medium | Medium | Very High |
| 3 | Altered Hydrologic Function[1] | Medium | Medium | High[1] | High | High | High |
| 4 | Altered Sediment Supply | High | High | High | Medium | Medium | High |
| 5 | Impaired Water Quality | Low | Low | High | Low | Medium | Medium |
| 6 | Degraded Riparian Forest Conditions | - | Medium | Medium | Low | Medium | Medium |
| 7 | Barriers | - | Low | Medium | Medium | Medium | Medium |
| 8 | Adverse Fishery-Related Effects | - | - | - | - | Medium | Medium |
| 9 | Increased Disease/Predation/Competition | Low | Low | Medium | Medium | Low | Low |
| 10 | Impaired Estuary/Mainstem Function | - | Low | Medium | Medium | Low | Low |

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

### Limiting Stresses, Life Stages, and Habitat

Several factors limit the viability of the Lower Trinity population. The most dominant of these factors stem from negative impacts of the hatchery, altered hydrologic function, and altered floodplain and channel structure. Juveniles are likely the most limited life stage based on the impacts of these stresses on summer and winter rearing habitat. Overall, the capacity of the Lower Trinity to support juveniles and other life stages of coho salmon has been reduced by these impacts. In order to improve the viability of this population it will be imperative to address the issues related to the hatchery and to improve habitat conditions for juveniles and adults. Addressing other stresses and threats and improving habitat for all life stages and life history strategies will also be an important component of recovery.

The Trinity River Hatchery plays a role in limiting the Lower Trinity River population through negative genetic and ecological interactions. Stray rates of hatchery adults onto spawning ground the Lower Trinity are high; use of Lower Klamath rearing and migratory habitat by hatchery juveniles is common; and predation of coho salmon by hatchery fish also occurs. Looking at the overall productivity of the population, the hatchery has a major negative impact on population growth and habitat capacity. Through high stray rates and genetic interactions on the spawning grounds (Reisenbichler and Rubin 1999; Mclean et al 2003) hatchery fish reduce the overall fitness of the population. Competition with hatchery Chinook salmon released from Trinity River Hatchery limits refugia and rearing capacity in the Lower Trinity because competition between hatchery fish with naturally produced fish almost always has the potential to displace wild fish from portions of their habitat (Flagg et al. 2000). Cumulatively and in concert with other habitat-related stresses, adverse hatchery-related impacts are likely a limiting stressor for the population.

Lack of floodplain and channel structure impacts also have a major impact on the productivity of this population. Rearing opportunities and capacity are low due to disconnection of the floodplain, a lack of LWD inputs, poor riparian conditions, and sediment accretion. Low-lying areas of streams such as Supply, Mill, and Willow Creek have been channelized, diked, and disconnected from the floodplain. There exists very little off-channel habitat that can be used for rearing and refugia. Many tributaries in low-gradient areas of the Lower Trinity experience similar habitat characteristics due to development of the floodplain, sedimentation and changes in flow. The mainstem river also lacks side channel, backwater, and wetland habitat where juvenile coho salmon could find habitat in the winter. A lack of floodplain and channel structure impacts winter rearing because high flow events can displace juveniles from streams and there exists very little low-velocity rearing habitat. Lack of complex habitat also impacts summer rearing due to the loss of predatory refugia, low-flow refugia, and foraging habitat.

Given the number of diversions and the potential amount of water withdrawn from the mainstem Trinity River and its tributaries, a lack of hydrologic function could also be potentially limiting coho salmon production in the Lower Trinity population. Many tributaries likely experience unnatural seasonal low flow conditions that prohibit their use during the summer. Thermal refugia on the mainstem may also be impacted by reduced flows through a reduction in the extent, duration, or quality of refugia areas. Given the importance of tributary rearing habitat and thermal refugia on the mainstem a loss of hydrologic function could have a major impact on juvenile coho.

### Adverse Hatchery-Related Effects

The effects of hatchery fish on all life stages of coho salmon are described in Chapter 3. There are no hatcheries in the Lower Trinity River population area, but Trinity River Hatchery is upstream on the Trinity River. Trinity River Hatchery currently releases 4.3 million juvenile and yearling Chinook salmon, 500,000 yearling coho salmon, and 800,000 yearling steelhead. Hatchery-origin coho salmon make up most of the spawning run to the Trinity River each year. On average, only three percent of in-river spawners were not reared in a hatchery (USFWS and HVT 1999). Between 1997 and 2002, hatchery fish constituted between 85 percent and 97 percent of the fish (adults plus grilse) returning to the Willow Creek weir in the Lower Trinity River (CDFG 2009b). Spawning surveys in 1998-99 found a high proportion of hatchery strays (60-100 percent) in all Lower Trinity streams where coho salmon where found (Dutra and Thomas 1999). Adverse hatchery-related effects pose a very high risk to all life stages, because more than thirty percent of adults are of hatchery origin (Appendix B) and there is significant potential for ecological interactions.

### Lack of Floodplain and Channel Structure

The lack of floodplain and channel structure presents a moderate to high stress across life stages. Data on instream large woody debris (LWD) is limited, but it is assumed to be low given the extent of logging in the areas and current lack of late seral riparian forest (e.g., Willow Creek and Sharber Creek; USFS 2003). Lack of LWD has resulted in loss of pool habitat and a reduction in overall habitat and hydraulic complexity in coho salmon streams (CDFG 2002b). Sediment loading in many streams has led to the filling of pools, disconnection from the floodplain, and the overall loss of stream complexity. Diking and channelization in many streams has reduced habitat complexity, connectivity with the floodplain, and increased water velocity, leading to lower survival of the egg, fry, and juvenile life stages. Historic floodplains in the area have been disconnected from tributary streams and converted to agricultural, grazing, or residential lands. This has further limited a relatively scarce yet important habitat type that is used for rearing of coho salmon fry and juveniles. Examples of floodplains that have been diked and simplified are the lower portions of Supply and Mill creeks on the Hoopa Valley Tribe Reservation. Complex floodplain habitats are crucial for overwintering survival and growth of juvenile coho salmon. Overwintering survival of juvenile coho salmon is likely to be low given that few unmarked yearling coho salmon are captured at Willow Creek, despite the prevalence of fry in the catch of the rotary screw traps. Many subyearling coho may be forced downstream into the Lower Klamath and estuary during high flow events due to the lack of adequate refugia from high flows.

### Altered Hydrologic Function

Altered hydrologic function is a medium to high stress for all life stages. There were 381 diversions listed in CDFG's Fish Passage Assessment Database (CalFish 2009), and this does not included unpermitted or illegal diversions or groundwater use. The towns of Willow Creek and Hoopa both get drinking water from the Lower Trinity River subbasin through city water systems. Denny and Burnt Ranch also get water from tributaries in the Lower Trinity. Even when a stream is not fish bearing (e.g., McDonald Creek in Burnt Ranch) it will create vitally important thermal refugia for coho salmon where the creek meets the Trinity River. By reducing the summer stream flow in streams like McDonald Creek that are not fish bearing, water diversion can still have an impact on juvenile rearing by decreasing the size of thermal refugia within the mainstem Trinity River. Other smaller domestic wells also utilize ground water, but the cumulative impact from these various residential uses on surface flows is not well documented. Overall diversions likely impact flow in many tributaries, especially during summer and early fall low flow periods. Sharber Creek, an important stream for coho salmon production in the Lower Trinity, has limited flow during the summer and can go dry in some areas. In addition to water diversion for human uses, the hydrologic regime in the Lower Trinity has been affected by the road system and fire regime. Many streams in the Lower Trinity population unit are impacted by illegal diversions and water use for marijuana cultivation, which is a growing and substantial impact to streamflow in the area. Roads affect subsurface water flow, concentrate flow, and divert or reroute water from paths it would otherwise take (USFS 2003; Gucinski et al. 2001). The high density of roads mean that many streams experience changes in their hydrology as a result of roads. Less frequent fire in tributary watersheds has reduced or eliminated peak flow responses to the removal of duff, understory vegetation, and overstory vegetation by fire.

### Altered Sediment Supply

Water quality of the Trinity River is listed as impaired for sediment throughout its length by California State Water Resources Control Board under Section 303 (d) of the Federal Clean Water Act. Increased sediment loading is thought to have filled pools, widened channels, and simplified stream habitat used for rearing and altered sediment supply presents a moderate to high stress for coho salmon in this population. In many reaches, aggradation has reduced surface stream flows, limiting tributary and habitat access to migrating juveniles. In the Willow Creek and Hoopa HSAs, sediment loading is especially high and likely limits the potential for spawning and rearing in these areas. Campbell and Willow Creek have experienced intensive land management and suffer from high sediment loading. Campbell Creek, Supply Creek, and Willow Creek have been noted as having extremely high rates of sedimentation and are highly impaired due to sediment/turbidity. Supply Creek was also recently impacted by large fine sediment input in winter of 2009. Mill and Tish Tang Creek are also considered impaired due to sedimentation as a result of timber harvest and road-building and experience high rates of sedimentation (EPA 2001). The majority of sediment in the Lower Trinity originates from roads and landslides (EPA 2001).

### Impaired Water Quality

Impaired water quality poses a moderate stress to the Lower Trinity population. In some smaller tributary streams, water temperatures can increase to levels stressful for rearing coho salmon in the summer months (>16° C). Water temperature in the mainstem often reaches >20° C. Mainstem and tributary migratory habitat is impaired by high summer temperatures and thermal barriers. Releases from Lewiston Dam to support North Coast Regional Water Quality Control Board (NCRWQCB) and ROD temperature criteria have substantially improved conditions (USFWS and HVT 1999), however, criteria for the Lower Trinity River do not prohibit temperature increases after July 9 (or June 15 in Dry and Critically Dry Water Years). Temperature readings at Hoopa often exceed the thermal tolerance of coho salmon starting in June and extending into September (USFS 2003). Juveniles often rely on thermal refugia during the summer in areas of the mainstem where water quality is poor. Localized areas of non-point source pollution likely exist (e.g., runoff from roads, parking lots, and agricultural lands). Recent large algae blooms in the Lower Trinity River likely associated with high levels of nutrients in runoff from various agricultural operations, particularly near the town of Willow Creek.

### Degraded Riparian Forest Conditions

Degraded riparian forest conditions pose a low to moderate stresses across all life stages. Evaluations of streamside canopy cover range from fair to very good throughout the watershed based on existing survey data. The Willow Creek HSA appears to have fair riparian conditions, while the Burnt Ranch and New River HSAs have very good riparian conditions. The Hoopa HSA was not rated for streamside canopy cover. Many of the riparian areas in the Lower Trinity have been disturbed through timber harvesting, natural storm events, landslides, and wildfires. Changes in timber management have helped foster recovery of riparian zones, although hardwoods now dominate canopy cover where it was once conifer dominated. While LWD recruitment potential may be reduced, the shade component along tributary streams has been reestablished through encroachment of alders and other riparian vegetation. While riparian canopy closure conditions have substantially recovered, forest openings and degraded riparian forest remain along most tributaries, particularly along Willow Creek. The mainstem Trinity generally does not have extensive shade-producing riparian cover because the width of the channel reduces closure.

### Barriers

Barriers pose a moderate stress to coho salmon in the Lower Trinity River and are especially detrimental to juveniles, smolts, and adults. The extent of impact from barriers is largely unknown due to the number of private diversions in the Lower Trinity, however the impact could be large. There are no large dams in the Lower Trinity River drainage, except on McDonald Creek, where the town of Burnt Ranch gets its water. The dam is upstream of where coho salmon can migrate. There are 25 road-stream crossing structures that are total barriers to juvenile and adult salmonid migration in the Lower Trinity River population area and a total of 33 unscreened diversions (CalFish 2009). More of the remaining 30 diversions on private land may also be unscreened. Two barriers are a high priority for removal and two are a moderate priority (CalFish 2009). The location of most road crossings and diversions suggests that most of the watershed remains accessible to coho salmon and these barriers are not substantially restricting the availability of habitat. One exception is the barrier on Sharber Creek which is blocking access to approximately 2 miles of high quality rearing and spawning habitat on one of the last remaining productive streams. Low water barriers and thermal barriers (e.g., mainstem reaches) may seasonally limit coho salmon rearing and migratory habitat. Permanent natural barriers also prevent access to potential spawning and rearing habitat (e.g., Campbell Creek, Sharber Creek, and Hawkins Creek).

### Adverse Fishery-Related Effects

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

### Increased Disease/Predation/Competition

Disease is a medium to low stress across all life history stages in the Lower Trinity River. Coho salmon smolts may be exposed to diseases like Ceratomyxosis during their downstream migration in the Trinity and Klamath River. The rates of infection for these smolts are likely somewhat low given that disease rates in the Trinity are generally low and the zones with the highest rates of infection in the Klamath are upstream of the Trinity confluence (Bartholomew 2008). By the time adult coho salmon from the Trinity River enter the Lower Klamath River (late fall to early winter), *Ceratomyxa shasta* (Ceratomyxosis) and *Flavobacterium columnare* (Columnaris) are probably not a significant issue. Releases of Chinook salmon from Trinity River Hatchery may result in competition for limited rearing space and food in thermal refugia during the summer months.

### Impaired Estuary/Mainstem Function

All salmon and steelhead that originate from the Lower Trinity River migrate to and from the ocean through the mainstem Lower Trinity, Lower Klamath River, and the Klamath River estuary. The Klamath River estuary may play an important role in providing foraging and refuge opportunities for juvenile coho salmon from the Lower Trinity River. This type of non-natal rearing may be especially important because a lack of summer and winter rearing habitat in the Lower Trinity which may force juveniles to move downstream and rear in the estuary. The degraded conditions that exist throughout the Trinity basin may mean that the estuary plays a very important role by providing the opportunity for growth and refugia prior to entering the ocean. The estuary, although relatively intact, suffers from poor water quality, elevated sedimentation and accretion, loss of habitat, and disconnection from tributary streams and the floodplain. Mainstem conditions contribute to this stress because of the issues with water quality, sedimentation and accretion, and degraded habitat in mainstem reaches of the Lower Klamath River. Juveniles, smolts, and adults transitioning through mainstem habitat are stressed by the degraded conditions in these migratory habitats and suffer from the lost opportunity for increased growth and consequently a lower survival rate. The loss and degradation of estuarine and mainstem habitat is considered a low to medium stress for the population, with the most affected life stages being juveniles and smolts.

## 38.6 Threats

Table 38-3. Severity of threats affecting each life stage of coho salmon in the Lower Trinity 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 | Hatcheries | Very High | Very High | Very High | Very High | Very High | Very High |
| 2 | Channelization/Diking | Low | Very High | Very High | High | Medium | Very High |
| 3 | Climate Change | Low | Medium | Very High | High | High | High |
| 4 | Roads | High | High | High | Medium | Medium | High |
| 5 | Dams/Diversion | Low | High | High | Medium | Medium | Medium |
| 6 | High Intensity Fire | Medium | Medium | Medium | Medium | Medium | Medium |
| 7 | Agricultural Practices | Medium | Medium | Medium | Medium | Medium | Medium |
| 8 | Urban/Residential/Industrial | Low | Medium | Medium | Medium | Low | Medium |
| 9 | Fishing and Collecting | - | - | - | - | Medium | Medium |
| 10 | Timber Harvest | Low | Low | Medium | Low | Low | Low |
| 11 | Road-Stream Crossing Barriers | Low | Low | Medium | Low | Low | Low |
| 12 | Mining/Gravel Extraction | Low | Low | Medium | Low | Low | Low |
| 13 | Invasive Non-Native/Alien Spices | Low | Low | Low | Low | Low | Low |

### Hatcheries

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

### Channelization/Diking

Channelization and diking poses a low to very high threat to coho salmon. Although channelization and diking is not widespread in the population area, localized restrictions where roads parallel streams reduce floodplain connectivity and function. These areas are important for coho salmon rearing and growth. This reduces the amount of spawning and rearing habitat available to coho salmon by reducing habitat complexity and increasing water velocity, particularly during the winter months. For example, lower reaches of tributaries such as Supply and Mill Creeks in the Hoopa HSA have been straightened and diked, reducing the complexity and natural meandering tendency that produces complex habitat, diversity in foraging opportunities, and high quality rearing habitat. In cases where streams have been straightened and confined, swift currents and lack of habitat are expected to reduce survival of rearing juveniles, fry, and cause a reduction in egg-to-fry survival.

### Climate Change

Climate change poses a high threat to this population. The impacts of climate change in this region will have the greatest impact on juveniles, smolts, and adults. The current climate is generally warm and modeled regional average temperature shows a large increase over the next 50 years (see Appendix B for modeling methods). Average temperature could increase by up to 3° C in the summer and by 1° C in the winter. Predictions indicate annual precipitation will have little change in the next century. However, snowpack in upper elevations of the Trinity River basin will decrease with changes in temperature (California Natural Resources Agency 2009). Climate change is expected to reduce the amount of snowpack in the Trinity Alps (Mote et al. 2005; Regonda et al. 2005; Mote 2006) and shift streamflow timing (i.e. peak streamflow) by 20–40 days earlier in many streams during the 21st century (Stewart et al. 2005). NMFS expects that climate change will cause the amount of coldwater thermal refugia habitat and the amount of available rearing area to decline over time. The increase in water temperatures is expected to reduce growth or cause negative growth of juvenile coho salmon in the summer months by elevating metabolism beyond daily ration (McCarthy et al. 2009). The vulnerability of the downstream Klamath estuary to sea level rise is low to moderate and therefore does not pose a significant threat to estuarine rearing habitat downstream. Overall, the range and degree of variability in temperature and precipitation is likely to increase in all populations. Also, with all populations in the ESU adults will be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (see Independent Science Advisory Board 2007, Feely et al. 2008, Portner and Knust 2007).

### Roads

Roads are a moderate to high threat for this population. About one third of the area with high potential to support juveniles occurs in areas with high or very high road densities. Data indicate road density is very high (>3 mi/sq mi) in the Hoopa and Willow Creek HSAs where small tributary streams with high or medium IP value stream reaches are accessible to coho salmon. Given the sedimentation problems observed in the watershed, unpaved roads contribute to landslide potential and chronic sedimentation. It has been estimated that approximately 45 percent of sedimentation in the Lower Trinity originates from roads, especially road-related landslides (EPA 2001). Highway 299 significantly affects Willow Creek, as it runs along much of the stream's mainstem length. At the landscape scale, correlative evidence suggests that roads are likely to influence the frequency, timing, and magnitude of disturbance to aquatic habitats (Gucinski et al. 2001). Roads can act as barriers to migration, lead to water temperature changes, and alter flow regimes (Gucinski et al. 2001). The Road Hazard Potential indicator used by the USFS represents the potential for altered hydrologic regime (changes in runoff response) and stream diversions associated with roads (USFS 2003). USFS (2003) ranked the area from the New River to the South Fork Trinity River as having a high road hazard potential. The area from the South Fork Trinity River Trinity to Tish Tang a Tang Creek was given a moderate hazard rating. Given the large tracts of U.S. Forest Service land in the watershed and the current trends toward decreasing timber harvest and increasing road decommissioning and storm-proofing on public land, the number of new roads and impacts from legacy roads is likely to decrease in the future.

### Dams/Diversions

Dams and diversions are a low to high threat across life history stages. Numerous wells and diversions varying from single domestic spring boxes to community water systems occur throughout the watershed. The impact of these diversions is dependent on the amount and location of the withdrawal. The reduction in surface and subsurface flow in tributaries can reduce the amount of cool water refugia at their confluence with the Trinity River and impacts can increase during dry water years. The towns of Willow Creek, Burnt Ranch, Hawkins Bar and Hoopa obtain water from streams in the Lower Trinity River. The Campbell Creek diversion supplies much of the west-side Hoopa Valley. Additionally, there are vineyards and small farms that utilize water in the Lower Trinity River subbasin, but their effect on stream flows has not been studied. Tributary accretions in the Lower Trinity River subbasin, combined with relatively unconfined floodplain and valley characteristics, probably ameliorate some of the impacts of the Central Valley Project.

### High Intensity Fire

High intensity fire poses a moderate threat to the population due to current level of fire risk and the predicted future increase in fire risk that is expected as a result of climate change. Fires such as the Megram Fire in 1999 and the complex of fires in 2008 have swept through regions of the Lower Trinity River in the recent past. Fuel loads, climate, and vegetative characteristics in the subbasin have resulted in a high to extreme fire risk (USFS 2003). Human-related causes are the predominant type of fire starts within the area especially within the Trinity River corridor. Lightning fire starts, although relatively infrequent when compared to human related starts, are a significant cause of wildfires along the upper slopes and ridges of the watersheds (USFS 2003). Present and future challenges to fire and fuels management include significant areas of private lands which may prohibit fire use and prescribed fire; prevention of unnatural fire starts; limited access due to topography or intermixed ownership; and vegetation mortality and fuel accumulation in the area affected by the Megram Fire (USFS 2003).

### Agricultural Practices

There are several agricultural operations in the Lower Trinity River subbasin, consisting of several small farms, vineyards and small cattle grazing operations. Agriculture is a medium threat to coho salmon in the Lower Trinity River watershed given the current and expected level of agriculture in the area. However, in the area of Willow Creek, where much of the agriculture occurs, localized impacts of reduction in thermal refugia areas and excessive nutrient loads could cause substantial impacts. These impacts may increase in the future as the demand for high quality fruits and vegetables in the area grows. Recent algae blooms in the Lower Trinity River are thought to be associated with agricultural practices near the town of Willow Creek. Also of concern is marijuana cultivation and the associated water, and fertilizer and pesticide use.

### Urban/Residential/Industrial Development

Rural population growth will continue to present a low to moderate threat to coho salmon in the Lower Trinity River. Human population in the Lower Trinity River drainage is tempered by the large amount of publicly-owned land as well as the steep surrounding terrain. The principal communities near the Lower Trinity River are Willow Creek, Hoopa, and Burnt Ranch. There are also a few smaller towns, like Del Loma and Big Flat, which may increase in population during this time. Areas likely to experience the greatest impacts from development include Willow Creek and mainstem river near major population areas. The demand for water in the drainage is expected to increase in the future. Development generally results in floodplain disconnection, removal of vegetation, increased sediment generation and delivery and introduction of exotic species. Subdivision of existing parcels will exacerbate this threat. Increased diversions associated with the population growth were addressed under Dams/Diversions above.

### Fishing and Collecting

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

### Timber Harvest

Data indicate that a medium or low amount of timber harvest presently occurs in the population area, as reflected in the medium threat ranking in the CAP workbook above. Much of the area is in public ownership (USFS) and has a substantial portion of federally-designated wilderness. Current and future timber harvesting on Forest Service land is small in scale and is conducted under strict guideline designed to protect aquatic resources. Based on data from CalFire (2009) a total of 12,287 acres within the Upper and Lower Trinity and Lower Klamath River subbasins have THPs that could potentially be harvested in the future (0.5 percent of total watershed area). The Hoopa Valley Tribe owns 15 percent of the Lower Trinity population area. Timber harvest is ongoing on these lands, and the extent of its environmental impacts are unknown but presumed to be low given Tribal timber management practices. One of the greatest impacts of all timber harvest in the Lower Trinity is the input of sediment. Timber harvest makes up approximately 5 percent of all sedimentation in the Lower Trinity (EPA 2001).

### Road-stream Crossing Barriers

There are 25 road-stream crossing structures that are total barriers to juvenile and adult salmonid migration in the Lower Trinity River watershed (CalFish 2009). There may be additional road-stream crossing barriers on private or Tribal land; however, their status and impacts are unknown at this time. The location of most known road crossings and diversions suggests that most of the watershed remains accessible to coho salmon and these barriers are not substantially restricting the availability of habitat. One exception to this is the barrier on private land on Sharber Creek, which blocks or reduces access to approximately 2 miles of high quality rearing and spawning habitat upstream.

Table 38-4. List of road-stream crossing barriers in IP habitat for coho salmon. (CalFish 2009).

| Priority | Stream Name | Road Name | County | Barrier Status* |
|---|---|---|---|---|
| High | Sharber Creek | Fountain Ranch Rd | Trinity | Total |
| Low | Hawkins Creek | Hawkins Bar Rd | Trinity | Total |
| Low | Hawkins Creek | Flame Tree Rd | Trinity | Total |
| Low | Boise Creek | Hwy 299 | Trinity | Total |
| Low | Bell Creek- New River | Denny Rd | Trinity | Total |
| Low | Panther Creek #1-New River | Denny Rd | Trinity | Total |
| Low | Quinby Creek- New River | Denny Rd | Trinity | Total |
| Low | Hospital Creek | Hwy 96 | Trinity | Total |
| Low | Campbell Creek | Hwy 96 | Trinity | Partial |

### Mining/Gravel Extraction

A number of gravel mining operations occur on private land and on Tribal land in the Lower Trinity River. A total of nine sites are mined on an annual, rotational or intermittent basis. NMFS issued a Biological Opinion on these operations in 2009 (NMFS 2009b) and a new consultation will likely be completed in 2013 when the permits expire. Suction dredge gold mining is common in the Trinity River however this activity was recently prohibited in any California stream, river or lake on public or private property (*Hillman v. CDFG* et al. 2009) until an environmental review is complete (earliest date is likely 2011). If the activity is allowed again, it will likely be modified so as to minimize impacts on protected species such as coho salmon and their habitat. Gravel and dredge mining primarily affect juvenile coho and their habitat and given the extent of mining in the area this is considered a moderate threat to this life stage but a low threat overall.

### Invasive Non-Native/Alien Species

This threat is currently considered to be low for the population but has the potential to increase in the future if exotic species or New Zealand mud snails cause trophic shifts. Brown trout, although in substantial numbers in the Upper Trinity River, do not inhabit the lower Trinity River in substantial numbers.

## 38.7 Recovery Strategy

Naturally-produced coho salmon in the Lower Trinity River are depressed in abundance relative to their historical numbers. An important consideration for recovery of the Lower Trinity River population is how naturally-produced coho salmon interact with the 500,000 coho salmon smolts released annually in the Trinity River, or the 11 million hatchery salmonids that are released into the Klamath Basin. Minimizing these interactions and the stresses that naturally-produced coho salmon experience from residing in a river system with millions of hatchery fish should be a high priority for coho salmon recovery. Protecting and enhancing thermal refugia and streams that are relatively intact and support coho salmon (e.g., Horse Linto and Sharber-Peckham creeks) should be the primary focus of recovery efforts. Protection and restoration of spawning and rearing habitat in potential coho salmon habitat (e.g., Mill Creek, Willow Creek) is also important over the long-term to ensure adequate spatial distribution and productivity. Creeks with the potential for floodplain connectivity include Supply, Mill, Tish Tang a Tang and Willow creeks. Recovery of the Lower Trinity River population of coho salmon will not be possible without significant restoration efforts to reconnect and expand the floodplain habitat in these and other creeks. Activities that reduce sediment delivery, improve water quantity and quality, and promote increased floodplain and channel structure should be the highest priority because these are the primary stresses for the population. Set back or removal of levees and dikes as well as instream habitat projects aimed at increasing floodplain size and connectivity need to be priorities. Removal of the fish passage barrier on Sharber Creek is also a high priority for recovery given the area's importance to coho salmon production in the Lower Trinity.

Vital habitat in the Lower Trinity includes areas that provide thermal refugia for juveniles in the summer, areas of current production, and areas with relatively intact habitat features such as clean spawning gravel, functional floodplain and channel structure, and established riparian forest. Coldwater discharges from tributaries are a key component of the thermal regime of the mainstem of the Trinity River. Localized coldwater refugia are often found where tributary flows enter the Trinity River. Some streams such as Coon, Bremmer, China, Soctish, McDonald, and Kirkham creeks do not provide much anadromous habitat, but they are generally well-shaded and provide high quality thermal refugia and cool clean water for the Trinity River. Juvenile and adult salmonids hold in the Trinity River near the confluence of these tributaries or, when accessible, in the lower reaches of the tributaries during mid- to late summer. The stressful stream temperatures in July, August, and September within the mainstem underscore the importance of maintaining these cool water tributaries for these species. Horse Linto Creek provides an excellent refugia area for juvenile and adult coho salmon (Strange 2008). It has cool, clean water that originates in the Trinity Alps Wilderness, moderating the high temperature of the Trinity River in the summer months at the confluence of the two waterways. At times, hundreds of juvenile salmonids congregate in this area. Other potential refugia areas are given in Table 38-5, although there are numerous unnamed seeps and smaller tributaries, all of which are important to survival of coho salmon in the summer months.

Table 38-5 . Potential coho salmon temperature refugia areas in the Lower Trinity River watershed.

| Watershed | Stream Name | Ownership |
|---|---|---|
| Hoopa | Horse Linto Creek | Public |
| Hoopa | Mill Creek | Tribal |
| Hoopa | Supply Creek | Tribal |
| Hoopa | Soctish Creek | Tribal |
| Hoopa | Coon Creek | Private |
| Hoopa | Tish Tang a Tang Creek | Tribal |
| Hoopa | Hostler Creek | Tribal |
| Burnt Ranch | Sharber Creek | Private |
| Willow Creek | Willow Creek | Private |

It is likely that many watersheds within the Burnt Ranch and New River watersheds are properly functioning with regard to aquatic habitat and watershed conditions. These streams have a large portion of their watersheds in the Trinity Alps Wilderness and remain in a relatively undisturbed state. Given the low abundances of the population all these areas in Table 38-5 are considered vital habitat for the population and should be prioritized for recovery. Horse Linto Creek is a designated Tier-1 Key watershed by the Northwest Forest Plan meaning that it is intended to serve as refugia for maintaining and recovering habitat for at-risk stocks of anadromous salmonids (USDA and USDI 1994).

During recent discussions with personnel from the U.S. Forest Service, it became clear that an unnamed tributary (known to U.S. Forest Service biologists as Sharber-Peckham Creek) has one of the strongest populations of coho salmon in the Lower Trinity River (Cyr 2008, Boberg 2008). Between the area spanning the Hoopa Tribe reservation and the North Fork Trinity River, Sharber-Peckham Creek is the single greatest producer of coho salmon in the Lower Trinity River (Boberg 2008). The Sharber-Peckham Creek area is spring-fed, has side channel and overwintering habitat, and is low gradient (Cyr 2008, Boberg 2008). The coho salmon here are found mainly in an unnamed tributary that emanates from springs between Sharber and Quinby creeks near the Forest Service boundary (Cyr 2008, Boberg 2008). This unnamed tributary is perennial and during winter, part of Sharber Creek is diverted into this unnamed tributary (Cyr 2008, Boberg 2008). This diversion is part of an old mining activity. The rearing habitat is split between Forest Service and private property (Cyr 2008, Boberg 2008). The spawning habitat is on private property. Coho are probably using Sharber Creek, but it is overgrown with brush, is difficult to survey, and likely doesn’t have the spring support for rearing as does Sharber-Peckham Creek (Cyr 2008, Boberg 2008).

In order to recover the Lower Trinity River coho salmon population, special attention should be given to important tributaries discussed above. Creeks with the potential for floodplain connectivity include Supply, Mill, Tish Tang a Tang and Willow creeks. Recovery of the Lower Trinity River population of coho salmon will not be possible without significant restoration efforts to reconnect and expand the floodplain habitat in these and other creeks that are currently confined by diked and channelized reaches. A focus on habitat complexity and connecting off channel ponds, backwaters, and large woody debris should be an essential part of restoring these streams. Several crossing barriers in the population unit should also upgraded in order to maximize habitat area available to coho salmon. Many road systems throughout the population unit need to go through decommissioning or upgrading to limit sedimentation. Consumptive water use within the population unit should be quantified and monitored. Measures should be employed to reduce water consumption by farms, residencies, and municipalities.

Table 38-6 on the following page lists the recovery actions for the Lower Trinity River population.

Table 38-6. Recovery action implementation schedule for the Lower Trinity River population.

| Action ID | Strategy | Key LF | Objective | Action Description | Area | Priority |
|---|---|---|---|---|---|---|
| *Step ID* | *Step Description* | | | | | |
| SONCC-LTR.2.2.7 | Floodplain and Channel Structure | Yes | Reconnect the channel to the floodplain | Construct off channel ponds, alcoves, backwater habitat, and old stream oxbows | New River and Tish Tang a Tang, Hostler, Willow, Mill, Horse Linto, Sharber, Supply, Cedar, and Campbell creeks | 2 |
| *SONCC-LTR.2.2.7.1* | *Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat* | | | | | |
| *SONCC-LTR.2.2.7.2* | *Implement restoration projects that improve off channel habitats as guided by assessment results* | | | | | |
| SONCC-LTR.2.2.8 | Floodplain and Channel Structure | Yes | Reconnect the channel to the floodplain | Re-connect channel to existing off-channel ponds, wetlands, and side channels | New River and Tish Tang a Tang, Hostler, Willow, Mill, Horse Linto, Sharber, Supply, Cedar, and Campbell creeks | 2 |
| *SONCC-LTR.2.2.8.1* | *Assess habitat to determine where potential exists to re-connect existing off-channel ponds, wetlands, and side channels. Map existing features so that connection can be maintained* | | | | | |
| *SONCC-LTR.2.2.8.2* | *Implement restoration projects that improve off channel habitats as guided by assessment results* | | | | | |
| SONCC-LTR.2.2.9 | Floodplain and Channel Structure | Yes | Reconnect the channel to the floodplain | Increase beaver abundance | New River and Tish Tang a Tang, Hostler, Willow, Mill, Horse Linto, Sharber, Supply, Cedar, and Campbell creeks | 3 |
| *SONCC-LTR.2.2.9.1* | *Develop program to educate and provide incentives for landowners to keep beavers on their lands* | | | | | |
| *SONCC-LTR.2.2.9.2* | *Implement beaver program (may include reintroduction)* | | | | | |
| SONCC-LTR.2.2.10 | Floodplain and Channel Structure | Yes | Reconnect the channel to the floodplain | Improve regulatory mechanisms | Population wide | BR |
| *SONCC-LTR.2.2.10.1* | *Limit hunting or removal of beaver* | | | | | |
| SONCC-LTR.2.1.11 | Floodplain and Channel Structure | Yes | Increase channel complexity | Increase LWD, boulders, or other instream structure | New River and Tish Tang a Tang, Hostler, Willow, Mill, Horse Linto, Sharber, Supply, Cedar, and Campbell creeks | 3 |
| *SONCC-LTR.2.1.11.1* | *Assess habitat to determine beneficial location and amount of instream structure needed* | | | | | |
| *SONCC-LTR.2.1.11.2* | *Place instream structures, guided by assessment results* | | | | | |

| Action ID | Strategy | Key LF | Objective | Action Description | Area | Priority |
|---|---|---|---|---|---|---|
| *Step ID* | *Step Description* | | | | | |
| SONCC-LTR.2.2.12 | Floodplain and Channel Structure | Yes | Reconnect the channel to the floodplain | Remove, set back, or reconfigure levees and dikes | New River and Tish Tang a Tang, Hostler, Willow, Mill, Horse Linto, Sharber, Supply, Cedar, and Campbell creeks | 3 |
| *SONCC-LTR.2.2.12.1* | *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-LTR.2.2.12.2* | *Remove levees and restore channel form and floodplain connectivity* | | | | | |
| SONCC-LTR.3.1.2 | Hydrology | Yes | Improve flow timing or volume | Educate stakeholders | Hoopa, Willow Creek, Burnt Ranch, New River HSAs (particularly Willow, Sharber, Mill, and Supply creeks) | 3 |
| *SONCC-LTR.3.1.2.1* | *Perform studies to determine if consumptive water use in specific areas is reducing the amount of rearing habitat or limiting the availability of cold water refugia.* | | | | | |
| SONCC-LTR.3.1.3 | Hydrology | Yes | Improve flow timing or volume | Educate stakeholders | Hoopa, Willow Creek, Burnt Ranch, New River HSAs (particularly Willow, Sharber, Mill, and Supply creeks) | BR |
| *SONCC-LTR.3.1.3.1* | *Develop an educational program about water conservation programs and instream leasing programs* | | | | | |
| SONCC-LTR.3.1.4 | Hydrology | Yes | Improve flow timing or volume | Improve regulatory mechanisms | Population wide | 3 |
| *SONCC-LTR.3.1.4.1* | *Prioritize and provide incentives for use of CA Water Code Section 1707* | | | | | |
| SONCC-LTR.3.1.5 | Hydrology | Yes | Improve flow timing or volume | Improve regulatory mechanisms | Population wide | 3 |
| *SONCC-LTR.3.1.5.1* | *Establish a categorical exemption under CEQA for water leasing* | | | | | |
| SONCC-LTR.3.1.6 | Hydrology | Yes | Improve flow timing or volume | Improve regulatory mechanisms | Population wide | 3 |
| *SONCC-LTR.3.1.6.1* | *Establish a comprehensive statewide groundwater permit process* | | | | | |
| SONCC-LTR.3.1.28 | Hydrology | Yes | Improve flow timing or volume | Improve water management techniques | Population wide | 3 |
| *SONCC-LTR.3.1.28.1* | *Develop plan to manage stream flows and water temperature during periods of drought* | | | | | |

| Action ID | Strategy | Key LF | Objective | Action Description | Area | Priority |
|---|---|---|---|---|---|---|
| *Step ID* | *Step Description* | | | | | |
| SONCC-LTR.3.1.29 | Hydrology | Yes | Improve flow timing or volume | Improve water management techniques | Population wide | 3 |
| *SONCC-LTR.3.1.29.1* | *Develop plan to protect coho salmon from effects of climate change* | | | | | |
| *SONCC-LTR.3.1.29.2* | *Implement plan based on findings* | | | | | |
| SONCC-LTR.5.1.31 | Passage | Yes | Improve access | Remove barrier | Hostler Creek | 3 |
| *SONCC-LTR.5.1.31.1* | *Remove barrier from old water supply system* | | | | | |
| SONCC-LTR.5.1.32 | Passage | Yes | Improve access | Remove barriers | Population wide, particularly tributaries | 3 |
| *SONCC-LTR.5.1.32.1* | *Evaluate and prioritize barriers for removal* | | | | | |
| *SONCC-LTR.5.1.32.2* | *Remove barriers, guided by the assessment* | | | | | |
| SONCC-LTR.14.2.14 | Disease/Predation/ Competition | No | Reduce predation and competition | Reduce abundance of invasive species | Population wide | 2 |
| *SONCC-LTR.14.2.14.1* | *Adopt fishing regulations and educational programs that encourage and allow for the take of an unlimited number of brown trout* | | | | | |
| *SONCC-LTR.14.2.14.2* | *Euthanize all brown trout captured at CDFG weirs* | | | | | |
| SONCC-LTR.1.2.33 | Estuary | No | Improve estuarine habitat | Improve estuary condition | Klamath River Estuary | 3 |
| *SONCC-LTR.1.2.33.1* | *Implement recovery actions to address strategy "Estuary" for Lower Klamath River population* | | | | | |
| SONCC-LTR.16.1.16 | 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-LTR.16.1.16.1* | *Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters* | | | | | |
| *SONCC-LTR.16.1.16.2* | *Identify fishing impacts expected to be consistent with recovery* | | | | | |
| SONCC-LTR.16.1.17 | 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-LTR.16.1.17.1* | *Determine actual fishing impacts* | | | | | |

| Action ID | Strategy | Key LF | Objective | Action Description | Area | Priority |
|---|---|---|---|---|---|---|
| *Step ID* | *Step Description* | | | | | |
| *SONCC-LTR.16.1.17.2* | *If actual fishing impacts exceed levels consistent with recovery, modify management so that levels are consistent with recovery* | | | | | |
| SONCC-LTR.16.2.18 | 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-LTR.16.2.18.1* | *Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters* | | | | | |
| *SONCC-LTR.16.2.18.2* | *Identify scientific collection impacts expected to be consistent with recovery* | | | | | |
| SONCC-LTR.16.2.19 | 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-LTR.16.2.19.1* | *Determine actual impacts of scientific collection* | | | | | |
| *SONCC-LTR.16.2.19.2* | *If actual scientific collection impacts exceed levels consistent with recovery, modify collection so that impacts are consistent with recovery* | | | | | |
| SONCC-LTR.27.1.20 | Monitor | No | Track population abundance, spatial structure, productivity, or diversity | Estimate abundance | Population wide | 3 |
| *SONCC-LTR.27.1.20.1* | *Perform annual spawning surveys* | | | | | |
| SONCC-LTR.27.1.21 | Monitor | No | Track population abundance, spatial structure, productivity, or diversity | Develop survival estimates | Site to be determined | 3 |
| *SONCC-LTR.27.1.21.1* | *Install and annually operate a life cycle monitoring (LCM) station* | | | | | |
| SONCC-LTR.27.1.22 | Monitor | No | Track population abundance, spatial structure, productivity, or diversity | Track life history diversity | Population wide | 3 |
| *SONCC-LTR.27.1.22.1* | *Describe annual variation in migration timing, age structure, habitat occupied, and behavior* | | | | | |
| SONCC-LTR.27.1.23 | Monitor | No | Track population abundance, spatial structure, productivity, or diversity | Track indicators related to the stress 'Fishing and Collecting' | Population wide | 2 |
| *SONCC-LTR.27.1.23.1* | *Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.* | | | | | |
| *SONCC-LTR.27.1.23.2* | *Annually estimate the in-river tribal harvest of wild/natural SONCC coho salmon* | | | | | |
| SONCC-LTR.27.2.24 | Monitor | No | Track habitat condition | Track habitat indicators related to spawning, rearing, and migration | Population wide | 3 |

| Action ID | Strategy | Key LF | Objective | Action Description | Area | Priority |
|---|---|---|---|---|---|---|
| *Step ID* | *Step Description* | | | | | |
| *SONCC-LTR.27.2.24.1* | *Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey* | | | | | |
| *SONCC-LTR.27.2.24.2* | *Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling 10% of the original habitat surveyed* | | | | | |
| SONCC-LTR.27.2.25 | Monitor | No | Track habitat condition | Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure' | All IP habitat | 3 |
| *SONCC-LTR.27.2.25.1* | *Measure the indicators, pool depth, pool frequency, D50, and LWD* | | | | | |
| SONCC-LTR.27.2.26 | Monitor | No | Track habitat condition | Track habitat indicators related to the stress 'Altered Sediment Supply' | All IP habitat | 3 |
| *SONCC-LTR.27.2.26.1* | *Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness* | | | | | |
| SONCC-LTR.27.2.27 | Monitor | No | Track habitat condition | Track habitat indicators related to the stress 'Impaired Hydrologic Function' | All IP habitat | 3 |
| *SONCC-LTR.27.2.27.1* | *Annually measure the hydrograph and identify instream flow needs* | | | | | |
| SONCC-LTR.27.1.34 | Monitor | No | Track population abundance, spatial structure, productivity, or diversity | Refine methods for setting population types and targets | Population wide | 3 |
| *SONCC-LTR.27.1.34.1* | *Develop supplemental or alternate means to set population types and targets* | | | | | |
| *SONCC-LTR.27.1.34.2* | *If appropriate, modify population types and targets using revised methodology* | | | | | |
| SONCC-LTR.8.1.13 | Sediment | No | Reduce delivery of sediment to streams | Reduce road-stream hydrologic connection | Bull, Limb Camp, Soctish, Lower Mill, Hostler, Lower Tish Tang, Lower Cedar, Campbell Ridge, Hospital, Supply, Horse Range, Summit, E.F. Willow, Ruby, Bunchgrass, Mill (Burnt Ranch HSA), Trinity Village, Hawkins, Quinby, and Sharber creeks | 3 |
| *SONCC-LTR.8.1.13.1* | *Assess and prioritize road-stream connection, and identify appropriate treatment to meet objective* | | | | | |
| *SONCC-LTR.8.1.13.2* | *Decommission roads, guided by assessment* | | | | | |
| *SONCC-LTR.8.1.13.3* | *Upgrade roads, guided by assessment* | | | | | |
| *SONCC-LTR.8.1.13.4* | *Maintain roads, guided by assessment* | | | | | |
| SONCC-LTR.10.2.30 | Water Quality | No | Reduce pollutants | Educate stakeholders | Population wide | BR |
| *SONCC-LTR.10.2.30.1* | *Develop an educational program that promotes Salmon Safe methods for agricultural operations and Integrated Pest Management for rural residents* | | | | | |