31. Middle Rogue / Applegate Population

Interior Rogue Stratum

Non-Core 1, Functionally Independent Population

High Extinction Risk

Population likely above depensation threshold

2,400 Spawners Required for ESU Viability

1,561 mi^2 watershed (67% Federal ownership)

603 IP-km (375 IP-mi) (45% High)

Dominant Land Uses are Agriculture and Urban/Residential/Commercial Development

Key Limiting Stresses are 'Lack of Floodplain and Channel Structure' and 'Altered Hydrologic Function'

Key Limiting Threats are 'Dams/Diversions' and 'Urban/Residential/Industrial Development'

Highest Priority Recovery Actions

• Improve agricultural practices • Improve timber harvest practices by revising Oregon Forest Practices Act • Improve flow timing and volume by managing water withdrawals	• Increase large woody debris (LWD), boulders, or other instream structure • Increase conifer riparian vegetation • Re-connect channel to existing off-channel ponds, wetlands, and side channels

31.1 History of Habitat and Land Use

From 1780 to 1840, trappers swept Oregon coastal rivers, including the Rogue River basin, reducing the robust beaver population to remnant levels (Oregon Department of Fish and Wildlife (ODFW) 2005b). Historically, beaver were so prevalent that the Takelma native people called the Applegate River valley "the beaver place" (U.S. Bureau of Land Management (BLM) 1998a). In the mid-to-late 1800s, extensive gold mining in the Rogue and Applegate valleys resulted in major changes to coho salmon habitat that is still evident today. In the 1850s, settlers began developing the flat alluvial valley bottoms and filling wetlands to increase agricultural productivity. Over a period of 150 years, these ideal coho salmon reaches were straightened and disconnected from their floodplains, wetlands and meanders were filled, beaver and their ponds were eliminated, flows were diverted, and riparian shade was reduced (BLM 1998a).

The remoteness of the Rogue River basin delayed widespread forest harvest until railroad lines made it possible to export timber. Profound changes in watershed and streams associated with timber harvest occurred after World War II, when availability of heavy equipment and the high demand for wood led to extensive timber harvest in the Rogue River basin. Channel damage and erosion from the 1964 flood was widespread, exacerbated by timber harvest activities (including using stream channels for skidding logs) and road building activities (USFS 1999b).

For example, gravel beds were scoured down to bedrock on Steves Fork and Sturgis Fork (upper Applegate River tributaries now above Applegate Dam) and Galice Creek (tributary to the Rogue River) (Thompson and Fortune 1970), and large alluvial fans formed at the mouth of Middle Rogue tributaries Billings, Foster, and Shasta Costa creeks (USFS 1999b). Clear-cut timber harvest continued on public lands into the 1970s and 1980s and although harvest technology improved, this activity resulted in another pulse of sediment that further degraded water quality and coho salmon habitat in downstream reaches (BLM 1996a, USFS 1999b). The USFS and BLM manage their lands more conservatively since the adoption of the Northwest Forest Plan (U.S Department of Agriculture (USDA) and U.S. Department of the Interior (USDI) 1994, USFS and BLM 1995a). The eastern portion of the Middle Rogue sub-basin has a checkerboard pattern of BLM and private ownership. Timber harvest is the most common activity on private land.

In 1980, the U.S. Army Corps of Engineers completed construction of the Applegate Dam, on the upper mainstem of the Applegate River. The dam, which was built for irrigation, flood control, and recreation, blocks 154.7 km of high intrinsic potential coho salmon habitat (Williams et al. 2006). Although the dam prevents damaging winter floods which can scour redds, the timing of flow releases, especially in spring, is very different from historic patterns.

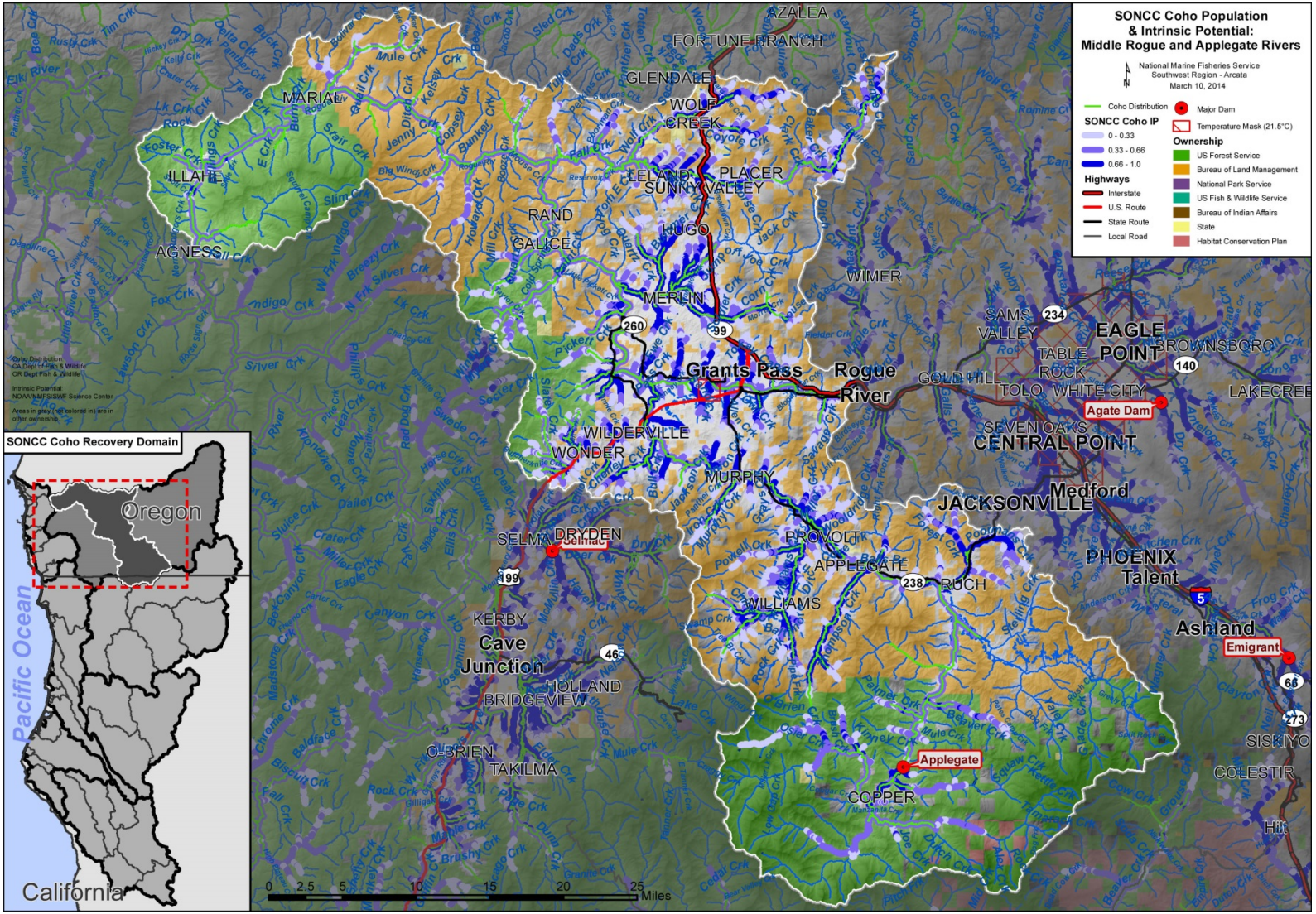

Figure 31-1. The geographic boundaries of the Middle Rogue / Applegate rivers coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (ODFW 2013a), and location within the Southern Oregon/Northern California Coast Coho Salmon ESU and the Interior Rogue River diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

The Middle Rogue River flows through Josephine and Jackson Counties, an area which includes the city of Grants Pass, one of the urban growth centers in southern Oregon (Figure 31-1 and Figure 31-2). In addition, there has been substantial residential development in many parts of the sub-basin, accompanied by surface water and groundwater extraction. Water supply for human, fish, and wildlife use is a critical issue in the entire Rogue River basin.

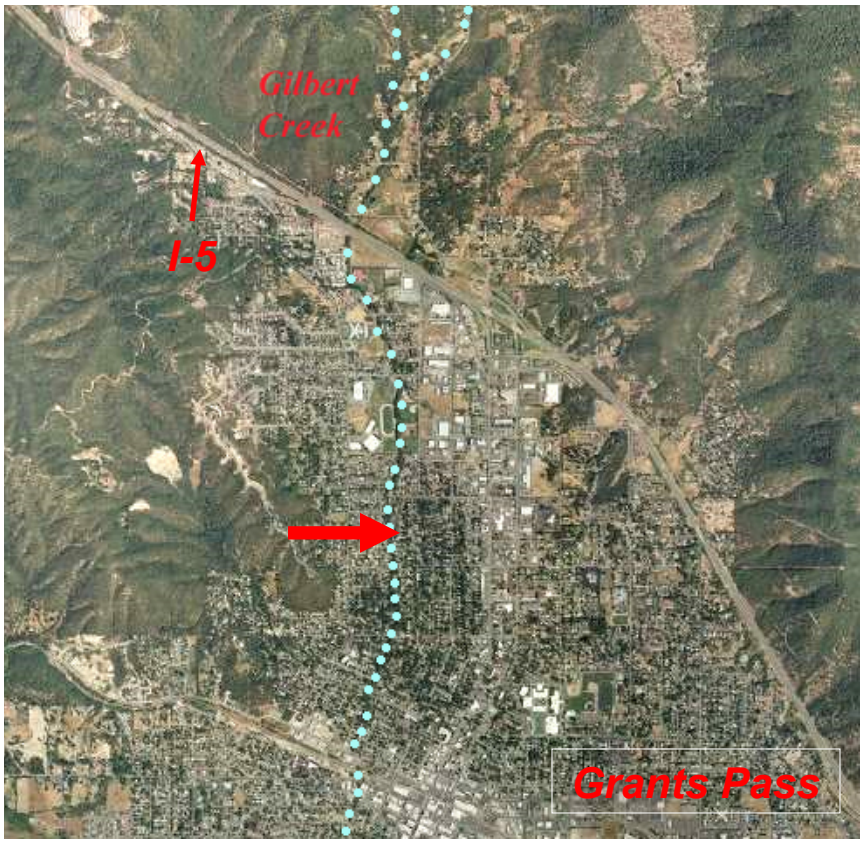

Figure 31-2. Middle Rogue tributary Gilbert Creek. Large arrow points to the creek, flowing south through Grants Pass, Oregon. Dots represent USGS (1984) stream lines. June 2005.

31.2 Historic Fish Distribution and Abundance

There are 603 intrinsic potential (IP) kilometers (km) in the Middle Rogue-Applegate sub-basin (Figure 31-1). Much of the high IP habitat is concentrated in low gradient reaches of Grave, Wolf, Coyote, and Jumpoff Joe creeks, which extend east from the mainstem Middle Rogue between Grave Creek and the Applegate River. Western tributaries important for coho salmon are Taylor, Galice, and Limpy creeks. The Middle Rogue from the Applegate River to its upper boundary at Evans Creek has a number of tributaries with high IP that are now urbanized, including Allen, Fruitdale, Gilbert, Jones, Savage, and Sand creeks. Other concentrations of high IP habitat occur in alluvial reaches of the Applegate River and tributaries such as Slate, Cheney, Murphy, Thompson, Little Applegate, and Beaver Creek. While much of the Rogue River from Grave Creek to Agness is public land and managed under the Northwest Forest Plan, most tributaries do not support coho salmon, likely because they are too steep. Streams with high IP habitat organized by sub-areas are listed below.

Table 31-1. Tributaries with high IP habitat (IP > 0.66) (Williams et al. 2006).

Sub-basin	Stream Name	Sub-basin	Stream Name
Lower Middle Rogue River (Agness to Grave Creek)	Mule Creek	Applegate River	Little Cheney Creek
	Mid Rogue-Lower (Mule Cr. – Agness)		Minnie Creek
Middle Rogue River (Tributaries of Grave Creek)	Benjamin Gulch		Munger Creek
	Brushy Gulch		Murphy Creek
	Coyote Creek		Ninemile Creek
	Flume Gulch		Onion Creek
	Grave Creek		Osler Creek[1]
	Mackin Gulch		Palmer Creek
	Poorman Creek		Poorman Creek
	Salmon Creek		Powell Creek
	Shanks Creek		Rocky Creek
	Sourdough Creek		Round Prairie Creek
	Tom East Creek		Slate Creek
	Unnamed Creek (Trib. of Wolf Cr. below I-5)		Squaw Creek[1]
	Wolf Creek		Sterling Creek
Upper Middle Rogue River (Evans Creek to Applegate River)	Allen Creek		Thompson Creek
	Fruitdale Creek		Williams Creek
	Gilbert Creek		Wooldridge Creek
	Jones Creek		Yale Creek
	Lathrop Creek	Main Middle Rogue (Grave Creek to Applegate River)	Bummer Creek
	Middle Rogue – Upper (Applegate to Evans Creek)		Mid Rogue – Lower (Grave Cr. to Mule Cr.)
	Sand Creek		Dutcher Creek
	Savage Creek		Galice Creek
	Vannoy Creek		Harris Creek
Applegate River	Applegate - Mainstem		Jacks Creek
	Beaver Creek		Jumpoff Joe Creek
	Bishop Creek		Limpy Creek
	Board Shanty Creek		Little Pickett Creek
	Branch Gulch[1]		Louse Creek
	Brush Creek[1]		Madams Creek
	Bull Creek		Cove Creek
	Caris Creek		Pass Creek
	Cheney Creek		Pickett Creek
	Forest Creek		Quartz Creek
	Grays Creek		Shan Creek
	Grouse Creek		Slate Creek
	Humbug Creek		Taylor Creek
	Little Applegate River		Tunnel Creek

[1]Upstream of Applegate Dam

A cannery operated at the mouth of the Rogue River beginning in 1876. Records from that cannery were used to estimate an annual run size of approximately 114,000 adult coho salmon in the late 1800s (Meengs and Lackey 2005). There is no way to know how many of these fish were returning to the Middle Rogue-Applegate area, rather than elsewhere in the 5,600 square mile Rogue River basin such as the Upper Rogue River. The Middle Rogue/Applegate River sub-basin contains 33 percent of the basin-wide IP kilometers of habitat, suggesting possible returns of 38,000 fish during the time of cannery operation, if fish were produced in proportion to IP kilometers.

31.3 Status of Middle Rogue/Applegate River Coho Salmon

Spatial Structure and Diversity

Williams et al. (2006) estimated 760 IP-km of coho salmon habitat in the Middle Rogue-Applegate, but 52 IP-km of that habitat are currently inaccessible due to Applegate Dam. Data for the Middle Rogue sub-basin (Figure 31-3) and the Applegate River sub-basin (Figure 31-4) from 1998 to 2004 show that juvenile coho salmon presence is fragmented and occurs mostly in small patches in upper reaches of alluvial valley streams, just below federal land (ODFW 2005a). Middle Rogue-Applegate reaches currently used by coho salmon represent a fraction of the high IP habitat. High IP habitat farther downstream is substantially dewatered, too warm, or has channels too simplified to support coho salmon rearing. Coho salmon are also mostly absent from Wolf and Coyote creeks, and are present only in the upper-most reaches of Grave Creek (ODFW 2005a). Coho salmon are naturally absent from many steep, lower Middle Rogue tributaries between Mule Creek to Agness; however, coho salmon are present in Foster and Shasta Costa creeks in the lower Middle Rogue (USFS 1999b). Coho salmon are also present in Taylor and Galice creeks, tributaries that join the Middle Rogue from the west below the Applegate River (ODFW 2005a). The spatial distribution of the Middle Rogue-Applegate coho salmon population has been significantly reduced through dam construction and habitat degradation.

During the 2004 to 2009 run years, on average about 47 percent of surveyed sites were occupied by wild adult coho salmon, with an estimated average of 9 spawners per mile (hatchery or wild origin unstated) (Lewis et al. 2009).

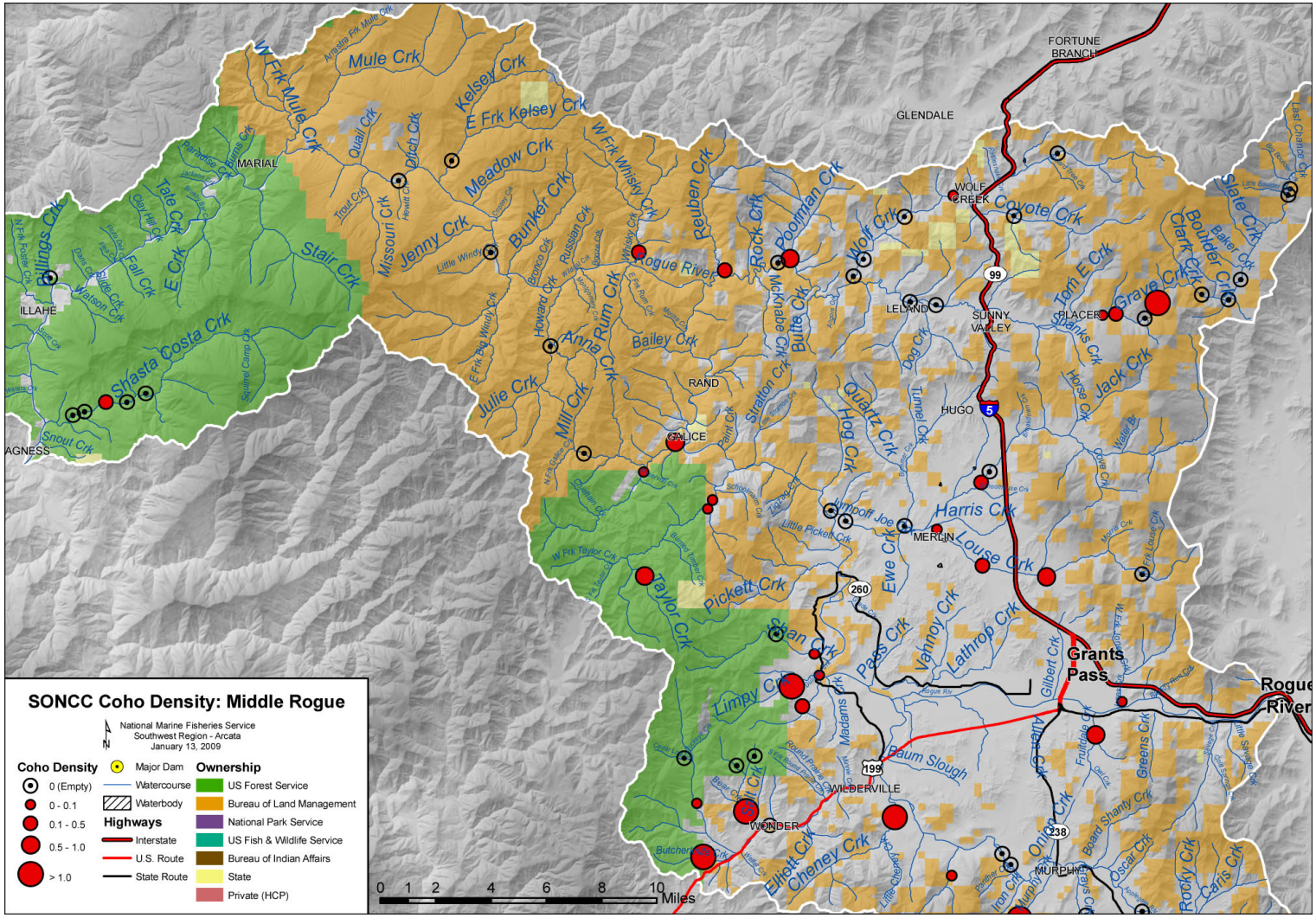

Figure 31-3. Juvenile coho salmon density (fish per square meter) for the Middle Rogue River watershed (ODFW 2005a). Stations with highest densities are in Grave, Taylor, Galice, Limpy and Louse creeks. Note that coho salmon are largely missing from urbanized areas west of I-5.

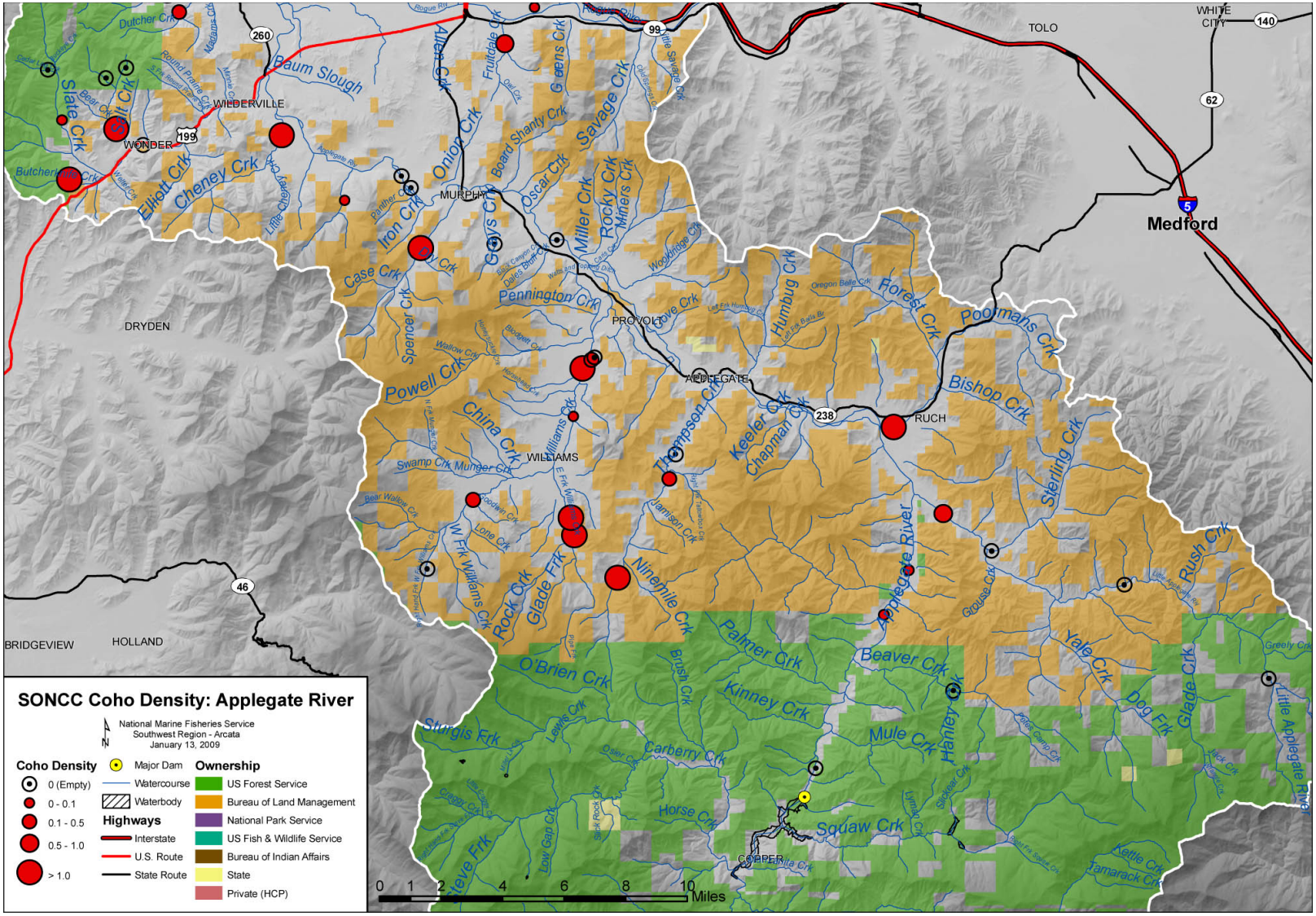

Figure 31-4. Juvenile coho salmon density (fish per square meter) for the Applegate River watershed (ODFW 2005a). Stations with highest densities are located in Williams, Cheney, Slate, and Forest creeks.

Population Size and Productivity

The depensation threshold for the Middle Rogue/Applegate River population is 734 spawners, and the spawner target is 2,400 spawners. Wild adult coho salmon spawner abundance for the Middle Rogue - Applegate population was estimated to be 1,930 in 2007 and 459 in 2008 (ODFW 2013b). The number of coho salmon adults in the Middle Rogue-Applegate river population was likely below the depensation threshold in two of the four years surveyed (Figure 31-5). The Middle Rogue-Applegate population of coho salmon is at moderate risk of extinction in regards to population size because it is above the depensation threshold of 734 and it is below the spawner target of 2,400.

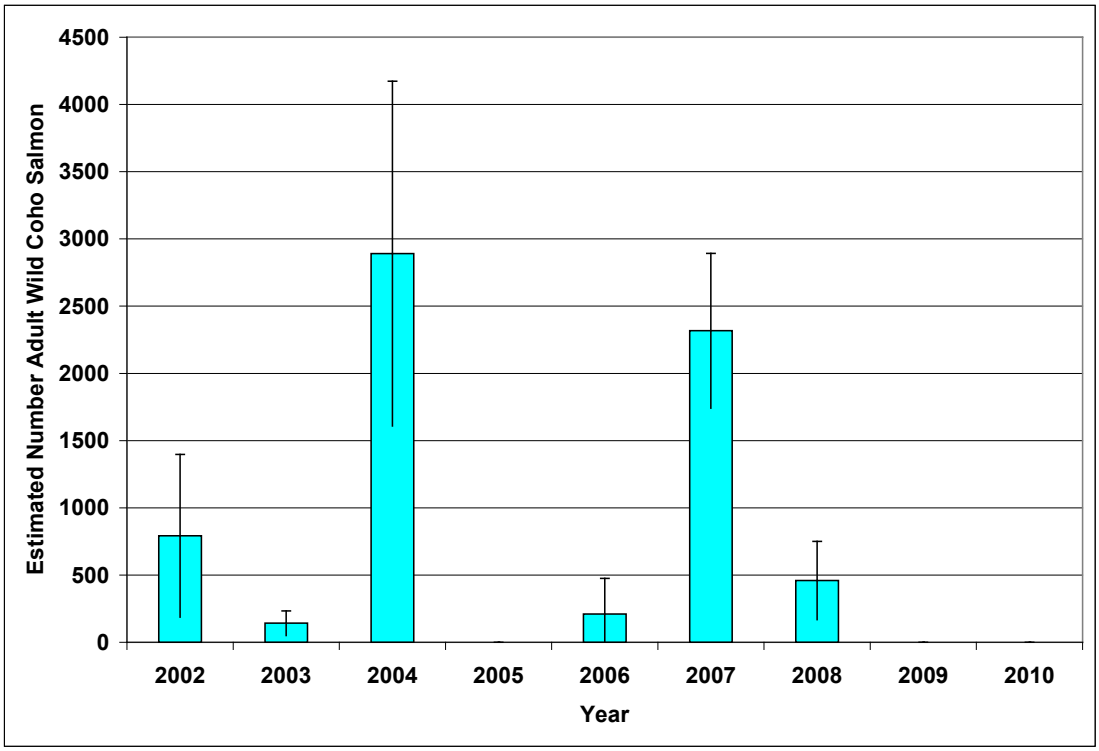

Figure 31-5. Estimated number of adult coho salmon in the Middle Rogue and Applegate rivers population, 2002 to 2010. No sampling occurred in 2005, 2009, or 2010 (ODFW 2011).

Huntley Park seine mark-recapture seine estimates occur in the lower Rogue River (river mile 8) and are the most robust and precise estimates of adult coho salmon abundance in the Rogue River (ODFW 2013b). It is impossible to determine, with existing information, how many of the estimated coho salmon at Huntley Park were returning to the Middle Rogue and Applegate rivers. If the trend in abundance is assumed to reflect trends in the Middle Rogue or Applegate rivers the data can inform whether the population is at high risk of extinction according to the population decline criterion (Williams et al. 2008). The number of adults estimated at Huntley Park has declined at an annual rate of 11% over the last 12 years (Figure 31-6), greater than the 10% decline associated with a high risk of extinction (Williams et al. 2008). Therefore, the population is at high risk of extinction due to its sharply declining productivity.

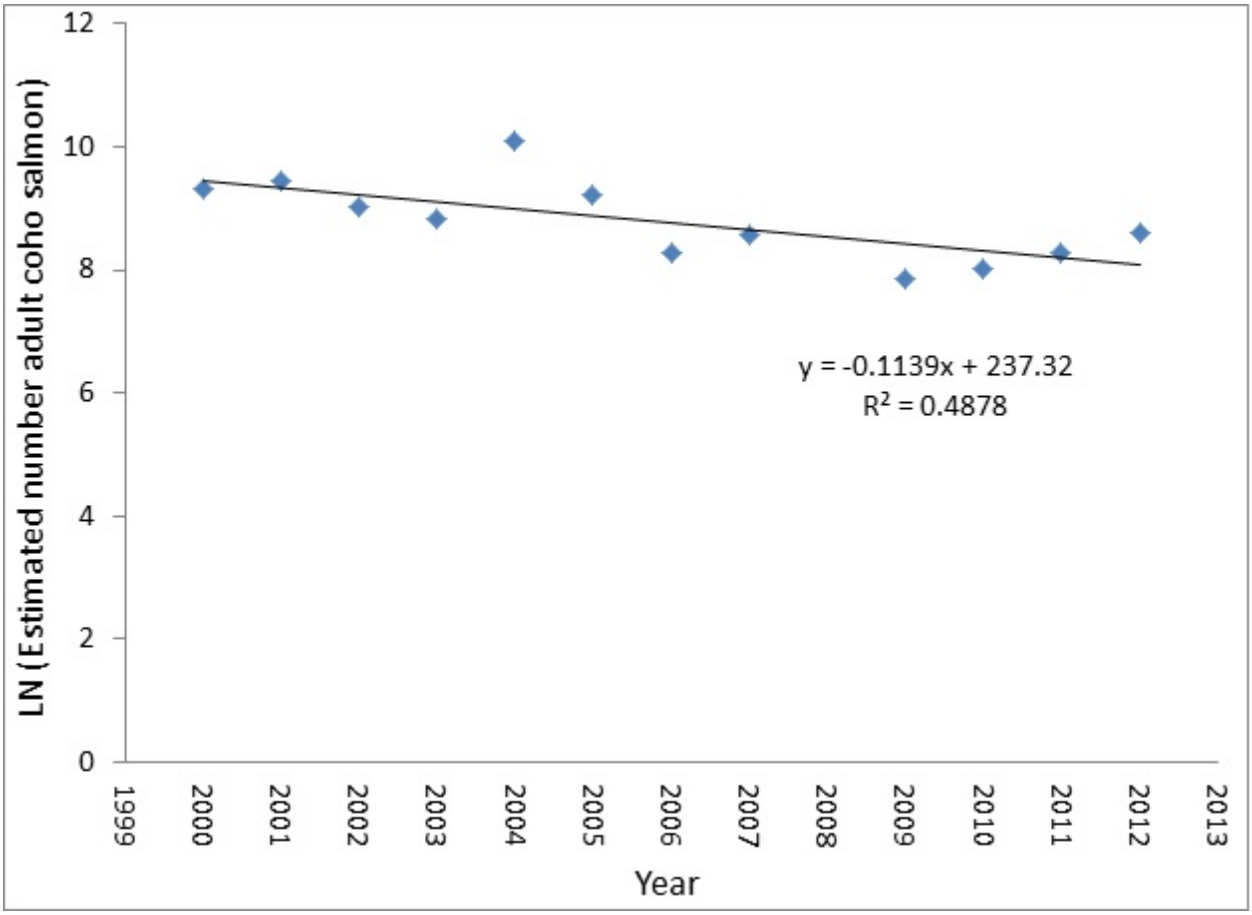

Figure 31-6. Rate of decline of estimated population abundance at Huntley Park, (data source: ODFW 2013b). Using seine mark-recapture data from Huntley Park, ODFW (2005c) calculated productivity for wild adult coho salmon in the Illinois, Middle, and Upper Rogue populations aggregated together for each year from 1980 to 2000. Recruits per spawner were less than replacement levels in eight of the years, indicating low productivity during those years (Figure 31-7).

Extinction Risk

The Middle Rogue-Applegate population is at high risk of extinction. The ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is greater than one; however, the population declined at a rate of ≥10% per year over the last two-to-four generations (both criterion described by Williams et al. (2008)). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, p. 17). These viability criteria are related to population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

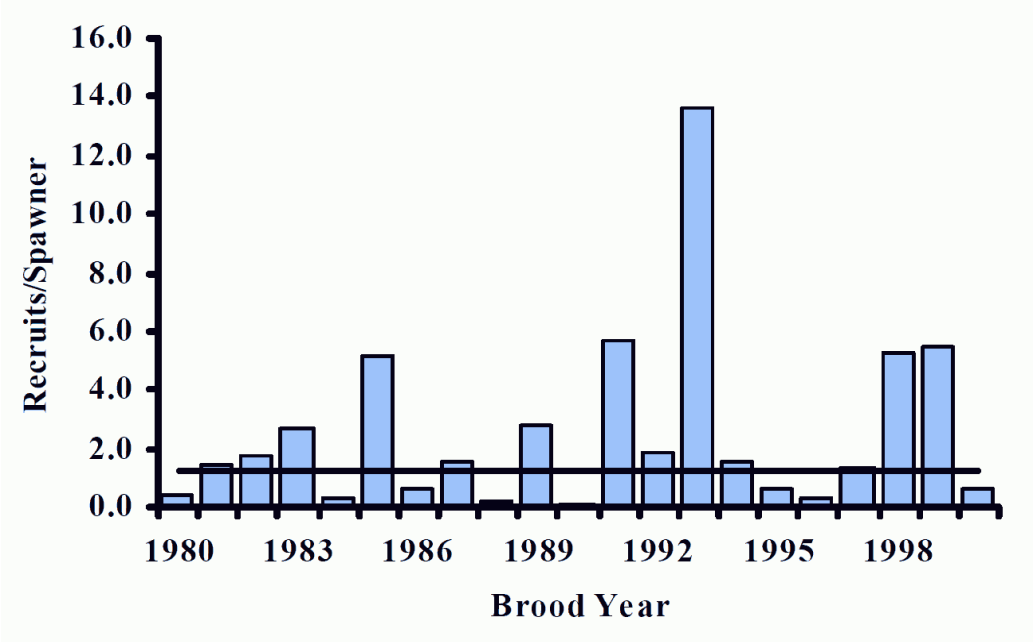

Figure 31-7. Recruit per spawner for brood years 1980 through 2000 for the Rogue River SMU (Species Management Unit), which includes the Middle Rogue, Upper Rogue, and Illinois River populations. Figure from ODFW 2005c.

Role in SONCC Coho Salmon ESU Viability

The Middle Rogue/Applegate River population is a non-core, Functionally Independent population within the Interior Rogue River diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, and with population dynamics or extinction risk over a 100-year time period that are not substantially altered by exchanges of individuals with other populations (Williams et al. 2006). To contribute to stratum and ESU viability, the Middle Rogue/Applegate River non-core population needs to have at least 2,400 spawners. 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. Furthermore, the Middle Rogue/Applegate River population will contribute toward stratum and ESU viability by providing rearing, migratory, and refugia habitat to other populations in the Rogue River basin.

31.4 Plans and Assessments

State of Oregon

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

ODFW (2008b) convened a panel of fisheries and watershed science experts as an initial step in their development of a recovery plan for Oregon's SONCC coho salmon populations. Deliberations of the expert panel provided ODFW with initial, strategic guidance on limiting factors and threats to recovery. Based on the input of panel members, the key concerns for Middle Rogue-Applegate sub-basin are as follows:

> Key concerns were related to loss of over-winter tributary habitat complexity, floodplain connectivity, and access and over-summer water temperatures and habitat access. Over-winter tributary habitat and floodplain connectivity, especially in the lowlands, has been impacted by past and current agricultural practices and an interruption in the transport and presence of large wood. Access to habitat has been limited by road crossings. Summer habitat is limiting because high water temperatures have resulted from land management actions in the riparian zone and straightening of channels and water management actions for agricultural purposes. Water withdrawals and diversions and road crossings have also limited the amount of, and access to, summer habitat and thermal refuge.
>
> *Oregon Plan for Salmon and Watersheds*
> http://www.oregon.gov/OPSW/about_us.shtml

The state of Oregon developed a conservation and recovery strategy for coho salmon in the SONCC and Oregon Coast ESUs (State of Oregon 1997). The Oregon Plan for coho salmon is a non-regulatory document that includes voluntary actions for all of the threats affecting coho salmon at that time in these ESUs and involves all relevant state agencies. Reforms to fishery harvest and hatchery programs were implemented by ODFW in the late 1990s. Many habitat restoration projects have occurred across the landscape in headwater habitat, lowlands, and the estuary. The action plans, implementation, and annual reports can be found at their web site.

ODFW Coastal Salmonid Inventory Project

ODFW has monitored coho salmon in the Middle Rogue River as part of their Coastal Salmonid Inventory Project. From 1998 to 2004, ODFW carried out dives to detect juvenile coho salmon in both the Middle Rogue and Applegate rivers (ODFW 2005a). ODFW also estimated the abundance of adult coho salmon in the Middle Rogue-Applegate population from 2002 to 2004 and from 2006 to 2008 (ODFW 2011).

Southwest Oregon Salmon Restoration Initiative

The Restoration Initiative provides a regional framework for coho salmon recovery in southwest Oregon (Prevost et al. 1997) and has helped foster the formation of watershed councils. Core areas identified include Slate, Cheney and Williams Creek in the Applegate sub-basin, and Quartz Creek in the Middle Rogue.

Water Requirements of Rogue River Fish and Wildlife

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

Middle Rogue-Applegate Total Maximum Daily Load Reports

An Applegate River TMDL (Oregon Department of Environmental Quality (ODEQ) 2003) has been completed for temperature, and includes the Beaver Creek TMDL for temperature, sediment, and habitat impairment. A larger scale Rogue River TMDL (ODEQ 2008) covers all tributaries that are listed as impaired (ODEQ 2002a) but not covered by other TMDLs.

Middle Rogue River Watershed Council

Applegate Partnership and Watershed Council

Rogue River Watershed Health Factors Assessment

The Rogue Basin Coordination Council (RBCC 2006) produced the Rogue River Watershed Health Factors Assessment on behalf of all the watershed councils within the basin. The assessment rates aquatic health and watershed conditions, including wildfire risk. Key problems in different Rogue River sub-basins are described and potential solutions are proposed. Recognized problems in the Middle-Rogue are related to stream flows and summer water temperature.

31.5 Stresses

Table 31-2. Severity of stresses affecting each life stage of coho salmon in the Middle Rogue-Applegate rivers. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

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

[1]Key limiting stresses and limited life stage.

Limiting Stresses, Life Stages, and Habitat

The juvenile life stage is most limited and quality winter rearing habitat, as well as summer rearing habitat, is lacking. Juvenile summer rearing habitat is impaired by deficient floodplain and channel structure, high water temperatures resulting from degraded riparian conditions, and altered hydrologic function from water withdrawals. Furthermore, degraded riparian forests inhibit future potential input of large wood and cannot provide bank stability that assists in a stable and complex channel. Finally, barriers throughout the sub-basin limit access to rearing habitat. These findings are consistent with those of the Oregon Expert Panel (ODFW 2008b) (Section 31.4).

Degraded Riparian Forest Conditions

Many of the old growth conifers that historically lined the banks of the Middle Rogue-Applegate tributaries have been removed (USFS 1995b, 1999b, BLM 1998a, 1998b). Extensive ODFW riparian surveys found fewer than 75 conifers over 36 inches in diameter per 1000 feet of stream length, which rates as poor. These conditions were found in Grave and Jumpoff Joe creeks and their tributaries, and in almost all Applegate River tributaries. In headwater reaches of Mule, Howard, Galice, Pickett, upper Williams, upper Thompson, upper Grave, and Yale creeks, there were 75 to 125 conifers per 1000 feet, which rates as fair. More large conifers provide cooler ambient air temperatures near streams, providing a moderating influence on water temperature (Poole and Berman 2001). Large conifers are also a source of large wood recruitment that helps maintain habitat complexity.

Riparian vegetation along tributaries like Grave, Wolf, and Coyote creeks reflect 150 years of intensive land use; consequently, early seral species like alder and willow are dominant. The same is true of alluvial valley reaches of Applegate River tributaries on private land, such as Slate, Cheney, Williams, Thompson, and Yale creeks, and the Little Applegate River (USFS 1995b, BLM 1996a, ODEQ 2003). Riparian alteration and simplification are also widespread in the mainstem Applegate River (BLM 1998a) and a constraint on coho salmon recovery (Figure 31-8). The riparian condition stress score is consequently very high across all life history phases except egg.

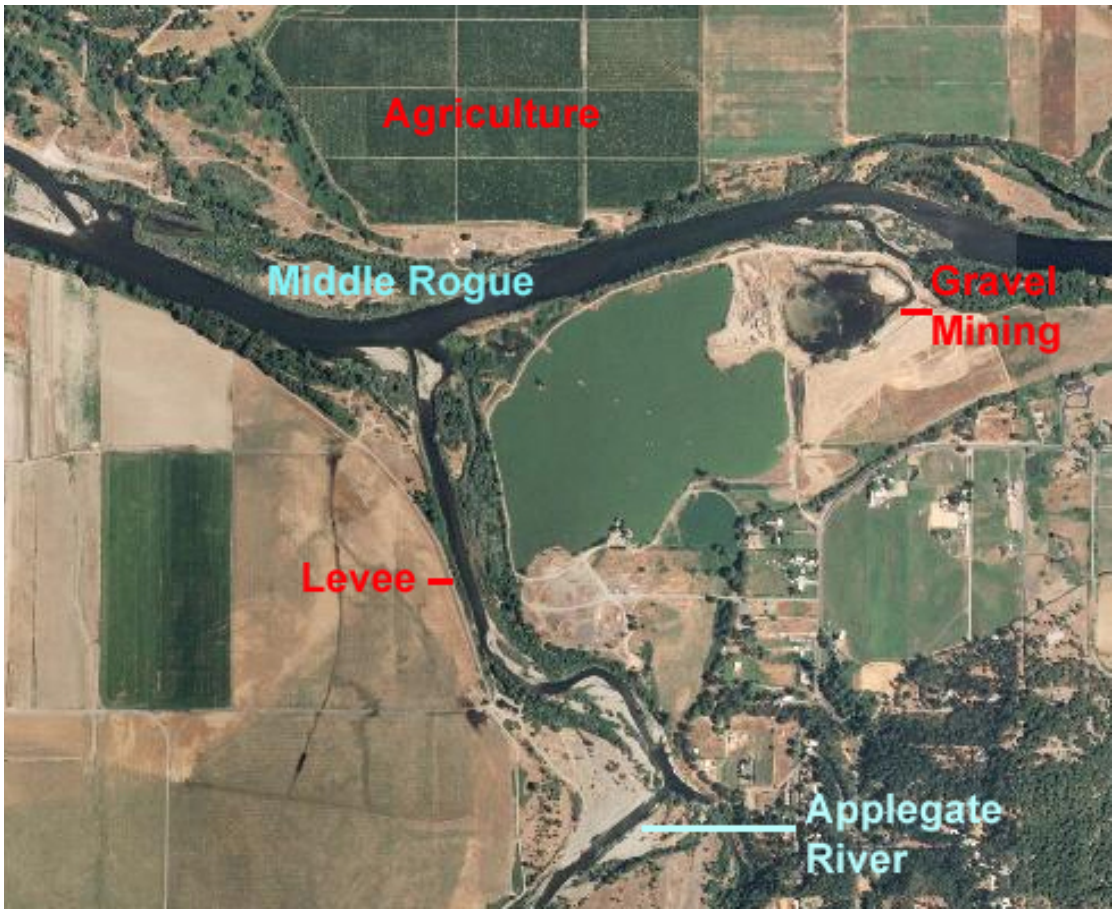

Figure 31-8. Photo of convergence of Applegate and Middle Rogue rivers. Photo shows intensive land use in the floodplain, disconnected channels, and greatly simplified riparian habitat, all contributing to poor ecosystem function.

Altered Hydrologic Function

Altered hydrologic function is a very high stress for the Middle Rogue-Applegate coho salmon population due to several factors but is primarily the result of dewatering tributary streams (Thompson and Fortune 1970, BLM 1996a). Lack of instream flow limits water quality and salmonid production, including coho salmon (Prevost et al. 1997, RBCC 2006). Nearly all of the tributaries are over allocated to water users and do not meet ODFW minimum instream flows (RBCC 2006).

The Applegate Dam on the upper mainstem Applegate River reduces winter flood peaks and eliminates natural spring flow peaks that coho salmon downstream migrants adapted to. The reduced magnitude and frequency of peak flows may have detrimental effects on channel morphology. In the early period of operation of Lost Creek Dam, on the Upper Rogue River (RM 157), flows in the mainstem Middle Rogue were very low which affected Middle Rogue-Applegate River fish on their seaward migration. However, increased releases during the summer and fall from the reservoir have benefited coho salmon (ODFW 1989).

Impaired Water Quality

The state of Oregon (ODEQ 2002a, 2003, 2008) identified extensive water quality problems in the Middle Rogue-Applegate sub-basin that account for the high to very high stress scores for fry, juvenile, and smolt coho salmon life history phases. Only 21 percent of Middle Rogue and 44 percent of Applegate reaches surveyed by ODEQ met water quality standards (SO RC&D 2003). Elevated water temperature is the most pervasive water quality impairment, and is often caused by stream flow diversions (Thompson and Fortune 1970). Other water quality parameters listed as impaired include dissolved oxygen, fecal coliform (Middle Rogue River only in this population area), sedimentation (Beaver Creek only), and biological criteria (Beaver Creek only) (ODEQ 2003, 2008).

Water temperatures in the mainstem Middle Rogue River, Applegate River, and the larger tributaries are elevated during the summer months, likely approaching or exceeding coho salmon tolerance levels in most reaches (Appendix I); one exception is the tailwater below Applegate Dam. Elevated stream temperatures in coho salmon rearing streams decrease the survival and growth of fish and are a key limiting factor in this population area. Tributaries in the Wild Rogue Wilderness Area are cooler, as are headwater streams on public lands; however, most have stream gradients that are too high to provide high quality coho salmon rearing habitat. Water temperature in Forest Creek, Williams Creek below Rock Creek, and Thompson Creek above Nine Mile Creek met ODEQ standards and coho suitability (Applegate River Watershed Council [ARWC] 2007) (Figure 31-9).

It is unlikely that high fecal coliform bacterial levels in the Rogue River (ODEQ 2008) would directly harm coho salmon; however, the coliform levels might indicate livestock access to creeks or leaking septic systems. Dissolved oxygen impairment, which is apparent in the Applegate tributaries Williams, Thompson, Cheney, Forest and Slate creeks is likely related to both nutrient enrichment and decreased flows. Pesticides and herbicides have the potential to harm coho salmon (NMFS 2008), but data are lacking for the Middle Rogue/Applegate River sub-basin.

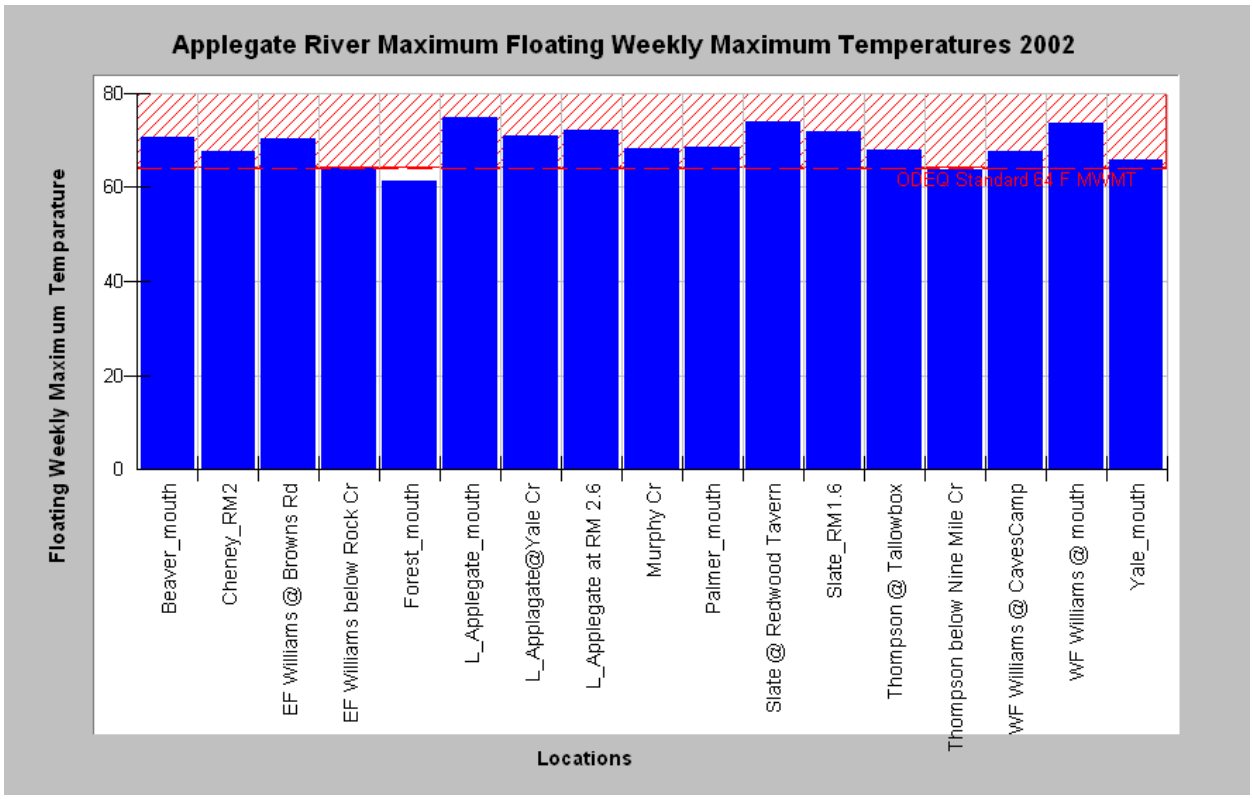

Figure 31-9. Floating weekly maximum temperature (MWMT) for several Applegate River tributaries. Temperatures in nearly all tributaries exceed Oregon Department of Environmental Quality (ODEQ) standards of 64° F (red line) (ARWC 2007).

Lack of Floodplain and Channel Structure

The straightening and simplification of streams has reduced the amount of slow, cool edgewater habitats where coho salmon fry and juveniles thrive (ODEQ 2008). Beaver have been greatly reduced along with the pools they create (ODFW 2005b). Although there are patches of functional coho salmon habitat, many river reaches and tributary channels do not support coho salmon (Prevost et al. 1997, ODFW 2008b). Channelization of the mainstem Rogue and Applegate rivers has disconnected them from much of their floodplain, reducing the physical processes that form coho salmon rearing and spawning habitat. These processes include side channel formation, accumulation of large wood jams, formation of slower water velocities, formation of pools, and lower shear stress. In the Applegate sub-basin, small tributaries on both the east and west sides of the river drain into irrigation canals; consequently, there is no connection of the tributary channel or riparian area to the mainstem (BLM 1998a). Although the hydrologic effects of Applegate Dam on downstream channel morphology have not been studied, research on other river systems with large dams by McBain and Trush (2002) has shown that lack of flushing flows causes channel confinement that increases velocities and diminishes the amount of slow, edgewater habitats favored by rearing juvenile coho salmon. Removal of large woody debris within the stream channels (USFS 1999b), timber harvest in riparian areas and associated road building have all contributed to reducing channel complexity and pool habitat, thus reducing juvenile coho salmon rearing capacity and survival.

Pool frequency and depth are important indicators of channel structure and both show impairment. Although some larger tributary mainstems have very good pool frequency (>35 percent of stream area), many have a rating of good (20 to 35 percent). Although some small headwater streams throughout the sub-basin have cool water temperatures, maximum average pool depths are less than 3 feet and are marginal or unsuitable for coho salmon rearing throughout the summer and winter. Shallow pool depths (<3 feet) also exist in alluvial valley tributaries like the Little Applegate, Thompson, Forest, Cheney, Slate, Murphy, Wolf, Coyote, and Williams creeks. Mainstems of large tributaries like Grave and Jumpoff Joe creeks score well on the 3-foot depth criteria, but since they are larger order streams they likely had much greater depths before disturbance. Some Lower Middle Rogue (Stair and Shasta Costa creeks), Wild Rogue (Mule, Big Windy, Bunker, Howard, and Whiskey creeks) and west-side tributaries that flow from public land (Galice Creek) have average maximum pool depths greater than 3 feet, indicating that their depth and carrying capacity for salmonids is increasing.

Spatial patterns from ODFW and USFS large wood surveys of Middle Rogue-Applegate stream channels are very similar to those observed in the riparian conifer surveys (Appendix B). Most mainstem reaches surveyed on private lands throughout the sub-basin, including most of Grave and Jumpoff Joe creeks, had less than one key piece of large wood per 100 meters, which rates as poor. Reaches in the Applegate River tributaries Thompson, Cheney, Slate, Beaver, and Williams creeks all have poor large wood scores. Upper reaches on private and public lands tend to have slightly better scores with many rated fair (1 to 2 key pieces/100 m), but only USFS and BLM headwater tributaries have good and very good large wood scores).

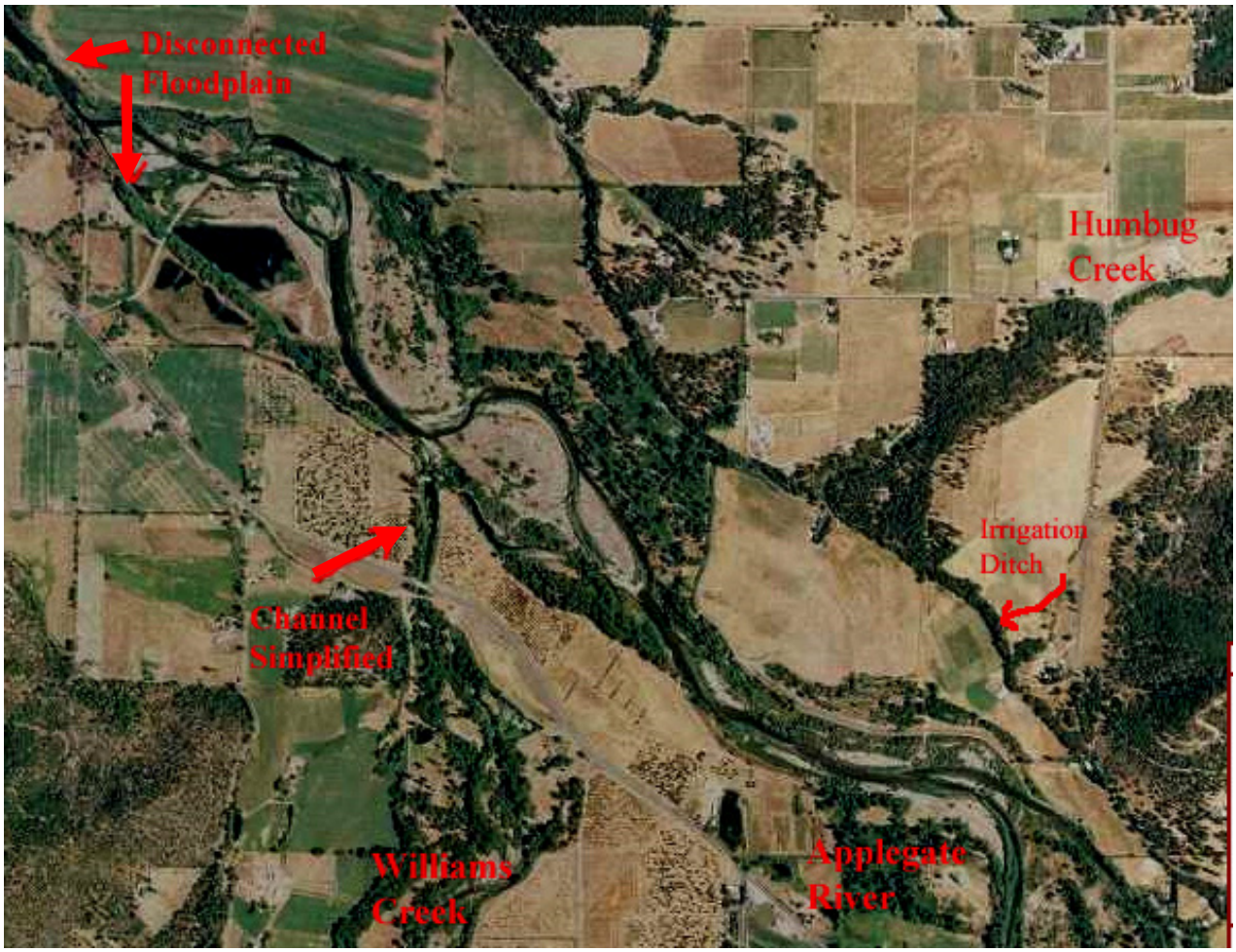

Figure 31-10. Aerial photo of convergence of Applegate River and Williams Creek. In this alluvial valley reach the river has a narrow riparian buffer zone as does Williams Creek at their point of convergence. The channel of Humbug Creek (right) appears to terminate in a diversion ditch.

Impaired Estuary/Mainstem Function

The Rogue River estuary is highly altered and has lost some of its historic function. Loss of rearing habitat in the estuary limits productive potential of the entire basin and is a moderate stress for juveniles in all Rogue basin populations. Insufficient refugia habitat for smolts and adults likely results in high rates of predation from birds and pinnipeds during migration to and from the ocean. These degraded conditions cause impaired estuarine function to be a very high stress for the population overall. A discussion of the causes of reduced estuarine function can be found in the Lower Rogue River population profile.

Barriers

Barriers pose a medium threat to the population overall, but a high stress to juveniles. Access to 19 miles of historic coho salmon habitat in the Applegate Sub-basin is blocked by Applegate Dam (ODFW 2005c, Figure 31-1). This blocked habitat is not essential to this population achieving its spawner target, so NMFS does not recommend removing the dam or providing passage. A substantial amount of historic habitat in the Middle Rogue-Applegate sub-basin may

be inaccessible due to road-stream crossings associated with extensive road networks, and maps indicate barriers in Cheney and Slate creek watersheds (Bredensteiner et al. 2003). The Rogue Basin Fish Access Team (RBFAT) is developing a coordinated plan for assessment and removal of fish passage barriers in the Rogue River basin and nine of the top twenty targets are in the Middle Rogue sub-basin (Mosser and Graham 2004). Temporary gravel agricultural diversion dams, known as push up dams, may impede access in alluvial valley reaches of coho salmon tributaries (Prevost et al. 1997). The USFS (1995b) identified permanent agricultural diversion structures that impede both adult and juvenile salmonid migration. Savage Rapids Dam, which was previously recognized as an impediment to salmonid migration (RBCC 2006), was removed in 2009 (U.S Bureau of Reclamation 2009a).

Altered Sediment Supply

Sediment contribution from landslides and erosion occurs naturally in the Middle Rogue-Applegate River basin; however, roads, timber harvest, and bank erosion following removal of riparian vegetation have elevated fine sediment input. Excess fine sediment directly impacts egg viability and can reduce food for fry, juveniles and smolts. Beaver Creek's headwaters, in the Applegate sub-basin, intersect with a band of decomposed granitic soils that have little cohesion and contribute very large quantities of sand (ODEQ 2003). As a result, Beaver Creek is considered sediment impaired by ODEQ (2003). Poor pool frequency and depth throughout the Middle Rogue-Applegate River basin (USFS 1995b, BLM 1998a) are likely due to elevated levels of fine sediment partially filling pools, a lack of scour-forcing obstructions such as large wood, and in some reaches diminished scour due to channel widening.

Applegate Dam blocks coarse and fine sediment supply to the mainstem Applegate River (Reid Unpub.). Between 1980 and 2010, approximately 5,615 acre-feet of sediment was trapped by the reservoir (Reid Unpub.). Upper Applegate River has shown substantial reduction in the amount of gravel (7 mm – 90 mm) since construction of Applegate (Reid Unpub.). Substrate surveys of the first five miles below the dam revealed gravel was 10 times less abundant in 2009 than in 1972 prior to dam construction (Reid Unpub.).

Disease/Predation/Competition

Water temperatures in Middle Rogue and Applegate tributaries in recent years are above those recognized by McCullough (1999) as causing increased disease risk for juvenile coho salmon. Thompson and Fortune (1970) found that salmonids in the Rogue River basin, including the Upper Rogue River, had higher incidences of the fish diseases *furunculosis* and *columnaris* in reaches that were warm due to flow depletion. The ODFW has documented extensive losses of juvenile steelhead and salmon within the mainstem Rogue River near Grants Pass in 1947 (OSGC 1947), 1955 (OSGC 1955), 1960 (OSGC 1960), and 1977 (ODFW 2001). Starting in the 1955 report, OSGC cited infections of columnaris. These reports do not always indicate what species of salmon were found. While not explicitly documented, it is likely that SONCC coho salmon juveniles in the Rogue River also experienced injury and death during these times due to their similar biology and life history. Thompson and Fortune (1970) also noted that warm water conditions favored introduced species in the mainstem Rogue and Applegate rivers. Competition with and predation by non-native fishes is an ongoing problem, especially in the mainstem Applegate River (Wheeler 2009). In very temperature-impaired streams, such as portions of

Jumpoff Joe Creek, introduced species like redside shiners may predominate (BLM 1998b). Umpqua pikeminnow, an introduced and piscivorous species, is prevalent in the mainstem Rogue River, Jumpoff Joe Creek, Grave Creek, Vannoy Creek and many other low gradient streams within the Middle Rogue.

Adverse Hatchery Related Effects

Cole Rivers Hatchery is located upstream of the Middle Rogue/Applegate population area in the Upper Rogue River sub-basin, and produces approximately 200,000 coho salmon smolts annually in addition to millions of hatchery spring Chinook, winter steelhead, and summer steelhead (ODFW 2008d). Some coho salmon returning to the hatchery stray into the mainstem tributaries and to a lesser extent into the Applegate River. From 1996 to 1998, less than five percent of adults observed in spawner surveys in the Applegate River were of hatchery origin (Jacobs et al. 2002). Adverse hatchery-related effects pose a medium risk to all life stages, due to the presence of Cole Rivers Hatchery in the Rogue River basin (Appendix B).

Adverse Fishery-and Collection-Related Effects

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

31.6 Threats

Table 31-3. Severity of threats affecting each life stage of coho salmon in the Middle Rogue-Applegate rivers. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

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

[1]Key limiting threats and limited life stage.

Key Limiting Threats

The two key limiting threats, those which most affect the recovery of the population by influencing stresses are dams/diversions and urban/residential/industrial development.

Dams/Diversions

Multiple diversions de-water most of the prime coho salmon rearing areas in the Middle Rogue-Applegate sub-basin (Thompson and Fortune 1970, Prevost et al. 1997, RBCC 2006, ODFW 2008b). ARWC (2007) noted that many streams in the Applegate watershed are over-allocated and irrigation withdrawals exacerbate low summer flows. Agricultural diversions diminish flows in alluvial reaches of Middle Rogue tributaries with high IP coho salmon habitat, including Grave, Pickett, Little Pickett, Limpy, Pass, and lower Taylor creeks (Thompson and Fortune

1970). Unscreened diversions may also cause significant loss of downstream migrating coho salmon juveniles (ODFW 2008b). In addition, approximately 19 miles of coho salmon habitat is blocked by Applegate Dam (ODFW 2005c).

Urban/Residential/Industrial Development

Urbanization and rural development pose a very high threat for Middle Rogue-Applegate coho salmon due to existing impacts to high IP habitat that are likely to continue in the future. Grants Pass, Merlin, the Applegate Valley, and Jumpoff Joe, Grave, Wolf, and Coyote creek watersheds contain high IP habitat and the vast majority of the human residences. Effects of urbanization increase with the total impervious area which causes increased peak flow, simplification of downstream channels, increased channel width to depth ratio, and toxic non-point source pollution (Booth and Jackson 1997, Booth et al. 2006). In urban centers such as Grants Pass, industrial development may add to non-point source pollution. Rural residential development is growing rapidly in Jackson County within the Middle Rogue-Applegate sub-basin (SO RC&D 2003), and septic system leakage or failure can lead to pollution. Backyard use of pesticides and fertilizers can also be significant in areas with concentrated development (Booth et al. 2006). Residential development outside cities and towns often relies on surface water from streams or groundwater wells that may deplete nearby surface flows. Rural residential developments are specifically noted as a concern in Jumpoff Joe Creek (BLM 1998b), Little Applegate (USFS 1995b), and Star Gulch (BLM 1998a) in the Applegate sub-basin.

Agricultural Practices

Agricultural impacts include flow depletion, elevated water temperature, channel simplification, riparian removal, and chemical application. The most intensive agricultural land use overlaps substantially with the highest IP coho salmon habitat. Agricultural impacts were assessed in part based on Landsat imagery (Homer et al. 2004). The lower mainstem Applegate, Little Applegate, Baum Slough, Yale, Williams, and East Fork Williams creeks all have high (5 to 10 percent of land area) or very high (>10 percent) agricultural land-use. Middle Rogue River tributaries that were rated high for agricultural land-use include Lathrop, Vannoy, Pass, Madams, Dutcher, Pickett, Little and Pickett, creeks. Significant grazing occurs routinely on private lands and by permit on Federally administered lands. Grazing may change soil infiltration rates and can cause deleterious channel changes (Spence et al. 1996). Riparian vegetation alteration occur with grazing as well. It is likely that pesticides known to harm salmonids (NMFS 2008, Laetz et al. 2009) are used in the region. However, information regarding pesticide and herbicide use in the Middle Rogue-Applegate sub-basin and the SONCC coho salmon ESU is generally unavailable (Riley, S. pers. comm. 2009). Herbicide use in the nearby Upper Rogue sub-basin has resulted in fish kills that included coho salmon (Ewing 1999).

Roads

Very high road densities, numerous road-stream crossings, and roads on steep slopes combine to pose a high to very high threat to all coho salmon life stages in the Middle Rogue-Applegate sub-basin. Road densities are very high (>3 mi/mi^2) in almost all areas of the sub-basin. The only Middle Rogue watersheds with low (0 to 1.6 mi/mi^2) road densities are Rogue Wilderness areas between Agness and Mule Creek, and the Howard Creek watershed. In the Applegate sub-basin,

Palmer Creek is the only watershed below Applegate Dam with low road density. The aggregated Wild Rogue tributary watersheds near Whiskey Creek on BLM lands have high (2.5 to 3.0 mi/mi^2) road densities, as does Taylor Creek, a USFS Key Watershed.

The greatest road densities are in urban areas near Grants Pass, in some cases exceeding 7 mi/mi^2 (Bredensteiner et al. 2003). BLM (1998b) found road densities in the urbanized lower Jumpoff Joe watershed to be 8.29 mi/mi^2, but 4.63 mi/mi^2 on BLM land. Upper Grave Creek has nearly 6 mi/mi^2 due to a combination of urban, rural residential and timber management roads. Private forest lands, such as Cheney and Slate creeks in the lower Applegate sub-basin, have road densities of 4 to 5 mi/mi^2. Rural residential, forest, and agricultural roads combine to elevate the road density in Williams Creek in the Applegate sub-basin to near 5 mi/mi^2. There are far more un-surfaced than paved roads in the western Middle Rogue and Applegate watersheds. East-side tributaries in urban areas have mostly paved roads. While paved roads yield less fine sediment than dirt roads, they have greater hydrologic impacts (Booth and Jackson 1997) and can contribute toxic runoff (Booth et al. 2006).

Channelization and Diking

Channelization and diking threat is a high to very high threat across all Middle Rogue-Applegate coho life stages, and high overall, because of extensive channel changes related to historic mining, agriculture and urbanization (Prevost et al. 1997). Disruptions include key locations such as the convergence of the Applegate and Middle Rogue (Figure 31-8) and Williams Creek and the Applegate River (Figure 31-10). When a channel is disconnected from its floodplain, slow water habitats in the stream margins preferred by coho salmon are reduced or eliminated. Channelization of streams and disconnection from wetlands (Figure 31-11) has resulted in decreased water storage and disrupted surface water connections to cooler groundwater, causing loss of summer and fall rearing refugia (ODEQ 2008). This type of disruption is typical in the entire reach from Evans Creek downstream to the Applegate River. Applegate tributaries impacted by agriculture, such as Williams, Thompson, Slate, Cheney, and Yale creeks are channelized or confined, as is the Little Applegate River. Channelization in Jumpoff Joe Creek by agriculture, mining, and road construction has resulted in substantial negative impacts to coho salmon habitat (BLM 1998b).

Timber Harvest

Reeves et al. (1993) found that the rate of timber harvest in Oregon coastal watersheds should not exceed 25 percent of a watershed to minimize risks and disturbances to aquatic resources. The study covered a period of 30 years (Reeves, G., pers. comm. 2003) and watersheds exceeding that level of harvest did not maintain channel integrity or Pacific salmon species diversity. Middle Rogue-Applegate sub-basin timber harvest rates are typically greater than this threshold on private timber land; therefore, the threat from timber harvest on private land will likely remain high. This private land encompasses most of the high IP coho habitat. The greatest risk from timber harvest is on private industrial timberlands that are managed under the Oregon Forest Practices Act, such as in private in-holdings in upper Slate Creek, Cheney Creek, and the decomposed granitic soils of the upper Beaver Creek watershed. Timber harvest on public land is now largely restricted to selective harvests in previously logged areas in order to improve forest health.

Figure 31-11. The middle mainstem Rogue River is disconnected from its floodplain and wetlands. Red arrows point to disconnected portions. This eliminates stable side channels that provide coho salmon rearing habitat. June 2005.

Road-Stream Crossing Barriers

The high threat scores for fish passage at culverts and stream crossings is a result of high road densities in urban areas, industrial timber lands, and rural residential areas of the Middle Rogue-Applegate watershed. Bredensteiner et al. (2003) show particularly high road densities, road stream crossings, and associated potential barriers in watersheds of Mule, Grave, Wolf, Coyote, Jumpoff Joe, and Upper Middle Rogue tributaries (Grants Pass). In the Applegate sub-basin, road stream crossings are highest in the Cheney Creek and Slate Creek watersheds.

High Severity Fire

Fire risk is acknowledged as a regional concern (RBCC 2006, BLM 1998b). Early seral stage forests, which are common in this population's range, lead to dry site conditions and increased fire risk (SO RC&D 2003). Of all areas in the sub-basin, elevated fire risk poses the greatest threat to watershed recovery in the Wild Rogue tributaries between Mule and Grave creeks. Large areas of even-age plantations and areas converted from Douglas fir to hardwood or chaparral may have elevated fire risk.

Hatcheries

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

Invasive Non-Native Species

Thompson and Fortune (1970) documented large populations of warm water fish in the lower Applegate River and in the mainstem Rogue River upstream of diversion dams such as Savage Rapids and Gold Ray dams. Non-native Umpqua pikeminnow, a coldwater predator, is present in the mainstem Rogue River and many tributaries. Removal of Gold Hill Diversion Dam in the Upper Rogue sub-basin in 2008 and Savage Rapids dam in the Middle Rogue sub-basin in 2009 are expected to have made this habitat less favorable for these invasive species. Agricultural and residential ponds provide a source of warm water game fish. Although the magnitude of competition and predation by introduced warm water species has not been assessed recently, NMFS believes it is a continuing problem in the lower Applegate River.

Mining/Gravel Extraction

Legacy effects from past gold mining may persist in some reaches (BLM 1999a) and there are still many active mining claims. Potential impacts of mining on salmonids include alteration of ecological integrity of the area (Bredensteiner et al. 2003). Significant occupied habitat in the Middle Rogue/Applegate River population occurs on federal lands (Figure 30-1), where mining access is permitted under the 1872 Mining Law. Gold mining on federal lands often occurs on those lower gradient stream reaches that are located just upstream of private lands. These reaches are very important to coho salmon and they represent the best low gradient habitat available. The location of such mining contributes to the severity of the threat to coho salmon in this population. The USFS alone has 64 active mining claims within one mile of SONCC coho salmon critical habitat (USFS 2013), the impacts of which will continue into the future for at least the next ten years.

BLM (1998b) notes that gravel extraction is widespread in the vicinity of the I-5 corridor and in urban areas of the Jumpoff Joe Creek watershed. The gravel operations adjacent to the mainstem Rogue River at the mouth of the Applegate occupy what was likely a wetland complex and salmonid refugia before disturbance. The ARWC (2007) expressed concern regarding gravel extraction because mainstem reaches are already depleted of coarse substrate due to Applegate Dam. One commercial operator removes approximately 500,000 cubic yards from the lower Applegate River annually, but much now comes from pits outside of the ordinary high water mark (Wheeler 2009). Pits excavated in the floodplain can capture juvenile coho salmon, coho salmon smolts, and adult coho salmon during high flow events. Most of these stranded fish perish if no outlet is available when flows recede.

Climate Change

Climate change scenarios for Middle Rogue-Applegate sub-basin (Independent Science Advisory Board (ISAB) 2007, Feely et al. 2008, Portner and Knust 2007) predict increasing air temperature for the years 2030 to 2050. Impacts of climate change in this region may affect all

life history stages, but the greatest impact will likely be on juveniles. The projected increase in July air temperature ranges from 1.5 to 3.0 °C, and January temperatures are predicted to increase 1.0 to 1.5 °C at all elevations. This will likely result in less snow accumulation throughout most of the Middle Rogue-Applegate sub-basin, and the resulting decreased flow will directly diminish available habitat.

Van Kirk and Naman (2008) documented decreasing snow pack below 6,000 feet over the last 20 years in the Klamath Mountains just south of the Applegate sub-basin. Warming may increase rain-on-snow events, which result in increased runoff that can scour redds and eggs and can flatten channel profiles, resulting in loss of rearing habitat. Overall, the range and degree of variability in temperature and precipitation are likely to increase in all populations. Adults may be negatively impacted by ocean acidification and changes in ocean conditions and prey.

Fishing and Collecting

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

31.7 Recovery Strategy

The most immediate need for habitat restoration and threat reduction in the Upper Rogue River is in those areas currently occupied by coho salmon. Particularly streams with good restoration potential and a high likelihood of success are Pickett, Shan, Limpy, Galice, Dutcher, Madams, and Taylor Creeks, including tributaries Minnow and Burnt Timber creeks. Unoccupied areas must also be restored to provide enough habitat for coho salmon recovery.

The degraded condition of the Middle Rogue-Applegate River habitat, combined with the depressed coho salmon population size and distribution, increases the risk of extinction of this important, inland coho salmon population. The most important factor limiting recovery of coho salmon in the Middle Rogue-Applegate River is a deficiency in the amount of suitable rearing habitat for juveniles. The processes that create and maintain such habitat must be restored by restoring flow, increasing habitat complexity within the channel, restoring off-channel rearing areas, and reducing threats to instream habitat. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 31-4 on the following page lists the recovery actions for the Middle Rogue/Applegate rivers population.

Table 31-4. Recovery action implementation schedule for the Middle Rogue/Applegate rivers population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MRAR.7.3.49	Riparian	No	Improve agricultural practices	Improve regulatory mechanisms	Population wide	1
SONCC-MRAR.7.3.49.1	*Determine the best way to revise the Agricultural Water Quality Management Act (AWQMAP) so that it does not limit recovery of SONCC coho salmon and recommend appropriate revisions*					
SONCC-MRAR.7.3.49.2	*Ensure basin rules are specific and linked to implementing AWQMAP recommendations, including developing specific standards for riparian buffers*					
SONCC-MRAR.7.3.49.3	*Ensure that AWQMA plans address both impaired areas and proactive prevention of water quality impairment*					
SONCC-MRAR.7.3.49.4	*Adopt interim buffers equal to the buffer standards NMFS is recommending in Washington state until the state establishes its own buffers*					
SONCC-MRAR.7.3.49.5	*Develop a process in the AWQMA Program that tracks and evaluates implementation*					
SONCC-MRAR.7.3.49.6	*Change the complaint-based compliance monitoring process to a focused compliance program*					
SONCC-MRAR.7.2.50	Riparian	No	Improve timber harvest practices	Improve regulatory mechanisms	Population wide	1
SONCC-MRAR.7.2.50.1	*Determine how to revise Oregon Forest Practice Rules so that they do not limit recovery of SONCC coho salmon and make appropriate revisions*					
SONCC-MRAR.7.2.50.2	*Adopt rules for fish-bearing streams sufficient to protect both water quality and fish habitat*					
SONCC-MRAR.7.2.50.3	*Adopt rules to increase protection of non-fish-bearing streams that address practices that adversely impact water quality and fish habitat*					
SONCC-MRAR.7.2.50.4	*Ensure management measures for landslide prone areas include protection of water quality and fisheries habitat*					
SONCC-MRAR.7.2.50.5	*Until more permanent regulatory mechanisms can be put in place, immediately adopt interim rules that increase protection for salmon habitat in forested areas, including increased natural recruitment of large wood on perennial and intermittent streams, increased shade on perennial streams, and protective buffers on intermittent streams.*					
SONCC-MRAR.3.1.5	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2a
SONCC-MRAR.3.1.5.1	*Quantify groundwater withdrawal and ensure urban/residential/industrial development does not limit recovery of SONCC coho salmon*					
SONCC-MRAR.3.1.5.2	*Establish a comprehensive groundwater permit process*					
SONCC-MRAR.2.1.12	Floodplain and Channel Structure	Yes	Increase channel complexity	Improve suction dredging practices	All streams where coho salmon would benefit immediately	2a
SONCC-MRAR.2.1.12.1	*Develop suction dredging regulations that minimize or prevent impacts to coho salmon. Consider special closed areas, closed seasons, and restrictions on methods and operations*					
SONCC-MRAR.2.1.71	Floodplain and Channel Structure	Yes	Increase channel complexity	Improve suction dredging practices	Population wide	2b
SONCC-MRAR.2.1.71.1	*Develop suction dredging regulations that minimize or prevent impacts to coho salmon. Consider special closed areas, closed seasons, and restrictions on methods and operations*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MRAR.2.1.13	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately within private lands	2a
SONCC-MRAR.2.1.13.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-MRAR.2.1.13.2	*Place instream structures, guided by assessment results*					
SONCC-MRAR.2.1.72	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2b
SONCC-MRAR.2.1.72.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-MRAR.2.1.72.2	*Place instream structures, guided by assessment results*					
SONCC-MRAR.2.2.10	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately	2a
SONCC-MRAR.2.2.10.1	*Assess habitat to determine where potential exists for floodplain reconnection. Prioritize sites and determine best means for reconnection at each site using tools such as hydrologic analysis*					
SONCC-MRAR.2.2.10.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-MRAR.2.2.73	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2b
SONCC-MRAR.2.2.73.1	*Assess habitat to determine where potential exists for floodplain reconnection. Prioritize sites and determine best means for reconnection at each site using tools such as hydrologic analysis*					
SONCC-MRAR.2.2.73.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-MRAR.2.2.11	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	All streams where coho salmon would benefit immediately	2a
SONCC-MRAR.2.2.11.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-MRAR.2.2.11.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-MRAR.2.2.11.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-MRAR.2.2.74	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Population wide	2b
SONCC-MRAR.2.2.74.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-MRAR.2.2.74.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-MRAR.2.2.74.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MRAR.2.2.47	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Re-connect channel to existing off-channel ponds, wetlands, and side channels	Mainstem Applegate River and major tributaries, Jumpoff Joe Creek, and all streams where coho salmon would benefit immediately	2a
SONCC-MRAR.2.2.47.1	*Develop a plan to remove levees and reconnect priority channelized stream reaches to historic side channels and wetlands*					
SONCC-MRAR.2.2.47.2	*Remove levees, guided by the plan*					
SONCC-MRAR.2.2.47.3	*Restore the historic side channels and wetlands, guided by the plan*					
SONCC-MRAR.2.2.75	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Re-connect channel to existing off-channel ponds, wetlands, and side channels	Population wide	2b
SONCC-MRAR.2.2.75.1	*Develop a plan to remove levees and reconnect priority channelized stream reaches to historic side channels and wetlands*					
SONCC-MRAR.2.2.75.2	*Remove levees, guided by the plan*					
SONCC-MRAR.2.2.75.3	*Restore the historic side channels and wetlands, guided by the plan*					
SONCC-MRAR.3.1.42	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams with ODFW water rights for fish and all streams where coho salmon would benefit immediately	2a
SONCC-MRAR.3.1.42.1	*Secure adequate instream flows to fulfill ODFW water rights for fish*					
SONCC-MRAR.3.1.66	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	2a
SONCC-MRAR.3.1.66.1	*Identify and cease unauthorized water diversions*					
SONCC-MRAR.3.1.78	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2b
SONCC-MRAR.3.1.78.1	*Identify and cease unauthorized water diversions*					
SONCC-MRAR.3.1.4	Hydrology	Yes	Improve flow timing or volume	Educate stakeholders	Population wide	2b
SONCC-MRAR.3.1.4.1	*Develop an educational program about water conservation programs and instream leasing programs*					
SONCC-MRAR.22.3.45	Urban, Residential, Industrial Development	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Increase regulatory oversight	All coho salmon bearing	2b
SONCC-MRAR.22.3.45.1	*Strengthen city and county ordinances to limit development within the 100 year channel migration zone*					
SONCC-MRAR.22.3.45.2	*Strengthen city and county ordinances to limit development within the 50 year flood elevation*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MRAR.22.1.46	Urban, Residential, Industrial Development	Yes	Reduce pollutants	Increase regulatory oversight	Population wide	2b
SONCC-MRAR.22.1.46.1	*Strengthen city and county ordinances to minimize new impervious surfaces and require treatment to current standards*					
SONCC-MRAR.22.1.46.2	*Strengthen city and county ordinances to require treatment to current standards when existing impervious surfaces are expanded, reconditioned, reconstructed or replaced*					
SONCC-MRAR.22.1.46.3	*Develop local regulatory mechanisms that limit development and reduce amount of total impervious area through incentives*					
SONCC-MRAR.2.3.39	Floodplain and Channel Structure	Yes	Reduce sediment mobilization and effects to channel morphology	Improve placer mining practices	All streams where coho salmon would benefit immediately, Moderate and high IP stream reaches on BLM and USFS lands in: Applegate River, Little Applegate River, Wolf Creek, Jumpoff Joe Creek, Quartz Creek, Taylor Creek	2b
SONCC-MRAR.2.3.39.1	*Assess the actual impacts of suction mining for gold*					
SONCC-MRAR.2.3.39.2	*Develop regulations that minimize or prevent impacts to coho salmon from placer mining. Consider special closed areas, closed seasons, and restrictions on methods and operations*					
SONCC-MRAR.2.3.39.3	*Educate miners regarding the ESA, coho salmon, and effects to habitat from proposed mining activities*					
SONCC-MRAR.2.3.39.4	*If impacts cannot be avoided, limit placer mining*					
SONCC-MRAR.2.3.77	Floodplain and Channel Structure	Yes	Reduce sediment mobilization and effects to channel morphology	Improve placer mining practices	Population wide	2c
SONCC-MRAR.2.3.77.1	*Assess the actual impacts of suction mining for gold*					
SONCC-MRAR.2.3.77.2	*Develop regulations that minimize or prevent impacts to coho salmon from placer mining. Consider special closed areas, closed seasons, and restrictions on methods and operations*					
SONCC-MRAR.2.3.77.3	*Educate miners regarding the ESA, coho salmon, and effects to habitat from proposed mining activities*					
SONCC-MRAR.2.3.77.4	*If impacts cannot be avoided, limit placer mining*					
SONCC-MRAR.3.1.68	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	2b
SONCC-MRAR.3.1.68.1	*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*					
SONCC-MRAR.3.1.68.2	*Reduce diversions using a combination of incentives and enforcement measures*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MRAR.3.1.79	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2c
SONCC-MRAR.3.1.79.1	*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*					
SONCC-MRAR.3.1.79.2	*Reduce diversions using a combination of incentives and enforcement measures*					
SONCC-MRAR.7.1.43	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Private lands where coho salmon would benefit immediately	2b
SONCC-MRAR.7.1.43.1	*Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions*					
SONCC-MRAR.7.1.43.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-MRAR.7.1.43.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					
SONCC-MRAR.7.1.81	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Population wide	2c
SONCC-MRAR.7.1.81.1	*Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions*					
SONCC-MRAR.7.1.81.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-MRAR.7.1.81.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					
SONCC-MRAR.26.1.67	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2b
SONCC-MRAR.26.1.67.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-MRAR.10.2.41	Water Quality	No	Reduce pollutants	Increase regulatory oversight	Population wide	2b
SONCC-MRAR.10.2.41.1	*Increase application of Low Impact Development (LID) techniques through education and incentives*					
SONCC-MRAR.10.2.41.2	*Incorporate LID in Clean Water Act permits for projects that result in stormwater discharge*					
SONCC-MRAR.10.2.29	Water Quality	No	Reduce pollutants	Set standard	Applegate River RM 0 to 32.4, tributaries to Applegate River	2b
SONCC-MRAR.10.2.29.1	*Develop TMDLs for water bodies listed under Clean Water Act Section 303(d)*					
SONCC-MRAR.2.1.2	Floodplain and Channel Structure	Yes	Increase channel complexity	Educate stakeholders	Population wide	2c
SONCC-MRAR.2.1.2.1	*Develop an educational program that promotes Salmon Safe methods for agricultural operations and Integrated Pest Management for rural residents*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MRAR.2.2.63	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Improve regulatory mechanisms	Population wide	2c
SONCC-MRAR.2.2.63.1	*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*					
SONCC-MRAR.7.1.44	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Federal lands	2d
SONCC-MRAR.7.1.44.1	*Monitor effects of livestock grazing on coho salmon habitat and adjust or discontinue grazing if effects of livestock grazing on salmon habitat are limiting coho recovery*					
SONCC-MRAR.7.1.9	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve long-range planning	Population wide	2d
SONCC-MRAR.7.1.9.1	*Review General Plan or City Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*					
SONCC-MRAR.7.1.9.2	*Develop watershed-specific guidance for managing riparian vegetation. Consider larger riparian buffers in coho occupied habitat*					
SONCC-MRAR.7.1.8	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Wild Rogue tributaries, Galice, Taylor, Pickett, Limpy, Williams, Thompson, Forest, and Beaver creeks, Little Applegate River, Federal forest lands	2d
SONCC-MRAR.7.1.8.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-MRAR.7.1.8.3	*Plant conifers, guided by the plan*					
SONCC-MRAR.8.2.51	Sediment	No	Increase spawning gravel	Improve gravel availability	Upper Applegate River	3a
SONCC-MRAR.8.2.51.1	*Develop a gravel augmentation plan that removes gravel from upstream of the Applegate Dam and places is downstream*					
SONCC-MRAR.8.2.51.2	*Implement gravel augmentation project, guided by the plan*					
SONCC-MRAR.5.1.15	Passage	No	Improve access	Remove barriers	All streams where coho salmon would benefit immediately, except USFS lands	3b
SONCC-MRAR.5.1.15.1	*Assess and prioritize barriers using the ODFW fish passage barrier database*					
SONCC-MRAR.5.1.15.2	*Remove barriers, guided by the assessment*					
SONCC-MRAR.5.1.35	Passage	No	Improve access	Remove barriers	USFS lands	3b
SONCC-MRAR.5.1.35.1	*Evaluate and prioritize barriers for removal*					
SONCC-MRAR.5.1.35.2	*Remove barriers, based on evaluation*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MRAR.5.1.80	Passage	No	Improve access	Remove barriers	Population wide	3d
SONCC-MRAR.5.1.80.1	*Assess and prioritize barriers using the ODFW fish passage barrier database*					
SONCC-MRAR.5.1.80.2	*Remove barriers, guided by the assessment*					
SONCC-MRAR.8.1.6	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All basins with road densities greater than 3 miles/square mile	3b
SONCC-MRAR.8.1.6.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-MRAR.8.1.6.2	*Decommission roads, guided by assessment*					
SONCC-MRAR.8.1.6.3	*Upgrade roads, guided by assessment*					
SONCC-MRAR.8.1.6.4	*Maintain roads, guided by assessment*					
SONCC-MRAR.8.1.82	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	3d
SONCC-MRAR.8.1.82.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-MRAR.8.1.82.2	*Decommission roads, guided by assessment*					
SONCC-MRAR.8.1.82.3	*Upgrade roads, guided by assessment*					
SONCC-MRAR.8.1.82.4	*Maintain roads, guided by assessment*					
SONCC-MRAR.10.2.37	Water Quality	No	Reduce pollutants	Reduce pesticides	All areas where coho salmon would benefit immediately	3c
SONCC-MRAR.10.2.37.1	*Develop a pesticide management plan*					
SONCC-MRAR.10.2.37.2	*Implement pesticide management plan and technical assistance program*					
SONCC-MRAR.10.2.69	Water Quality	No	Reduce pollutants	Reduce pesticides	Population wide	3d
SONCC-MRAR.10.2.69.1	*Develop a pesticide management plan*					
SONCC-MRAR.10.2.69.2	*Implement pesticide management plan and technical assistance program*					
SONCC-MRAR.10.7.65	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-MRAR.10.7.65.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-MRAR.10.7.65.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-MRAR.10.7.70	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-MRAR.10.7.70.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-MRAR.10.7.70.2	*Supply marine-derived nutrients to streams guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MRAR.3.1.31	Hydrology	Yes	Improve flow timing or volume	Manage flows	Applegate Dam	3d
SONCC-MRAR.3.1.31.1	*Evaluate the effect of Applegate Dam flow releases on juvenile salmon rearing habitat*					
SONCC-MRAR.3.1.31.2	*Revise flow releases as necessary to minimize effects on coho salmon, based on the evaluation.*					
SONCC-MRAR.1.2.34	Estuary	No	Improve estuarine habitat	Improve estuary condition	Rogue River Estuary	3d
SONCC-MRAR.1.2.34.1	*Implement recovery actions for Lower Rogue River population that address the target "Estuary"*					
SONCC-MRAR.7.1.32	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	BLM lands	3d
SONCC-MRAR.7.1.32.1	*Manage timber harvest (and associated activities) on Federal lands in accordance with the Aquatic Conservation Strategy of the NWFP, or with the updated ACS guidance contained in newly revised Resource Management Plans or Land and Resource Management Plans, in order to achieve riparian and stream channel improvements for coho salmon.*					
SONCC-MRAR.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	3d
SONCC-MRAR.16.1.16.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-MRAR.16.1.16.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-MRAR.16.1.17	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MRAR.16.1.17.1	*Determine actual fishing impacts*					
SONCC-MRAR.16.1.17.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-MRAR.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	3d
SONCC-MRAR.16.2.18.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-MRAR.16.2.18.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MRAR.16.2.19	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MRAR.16.2.19.1	*Determine actual impacts of scientific collection*					
SONCC-MRAR.16.2.19.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					
SONCC-MRAR.14.2.14	Invasive, Non-native Species	No	Reduce predation and competition	Reduce abundance of warm-water, non-native fish species	Population wide	3d
SONCC-MRAR.14.2.14.1	*Determine presence of warm water, non-native fish species and develop a plan for eradication or control*					
SONCC-MRAR.14.2.14.2	*Eradicate or suppress invasive fish species, guided by the plan*					