RECOVERY PLAN
Volume I

FOR THE SOUTHERN OREGON NORTHERN CALIFORNIA COAST EVOLUTIONARILY SIGNIFICANT UNIT OF

COHO SALMON
(*Oncorhynchus kisutch*)

Public Review DRAFT

Version: January, 2012
Southwest Regional Office
National Marine Fisheries Service
Arcata, CA

Disclaimer

Recovery plans delineate such reasonable actions as may be necessary, based upon the best scientific and commercial data available, for the conservation and survival of listed species. Plans are published by the National Marine Fisheries Service (NMFS), sometimes prepared with the assistance of recovery teams, contractors, State agencies and others. Recovery plans do not necessarily represent the views, official positions or approval of any individuals or agencies involved in the plan formulation, other than NMFS. They represent the official position of NMFS only after they have been signed by the Assistant Administrator. Recovery plans are guidance and planning documents only; identification of an action to be implemented by any public or private party does not create a legal obligation beyond existing legal requirements. Nothing in this plan should be construed as a commitment or requirement that any General agency obligate or pay funds in any one fiscal year in excess of appropriations made by Congress for that fiscal year in contravention of the Anti-Deficiency Act, 31 U.S.C 1341, or any other law or regulation. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery actions.

LITERATURE CITATION SHOULD READ AS FOLLOWS:

National Marine Fisheries Service. 2012. Public Draft Recovery Plan for Southern Oregon/Northern California Coast Coho Salmon (Oncorhynchus kisutch). National Marine Fisheries Service. Arcata, CA.

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Executive Summary

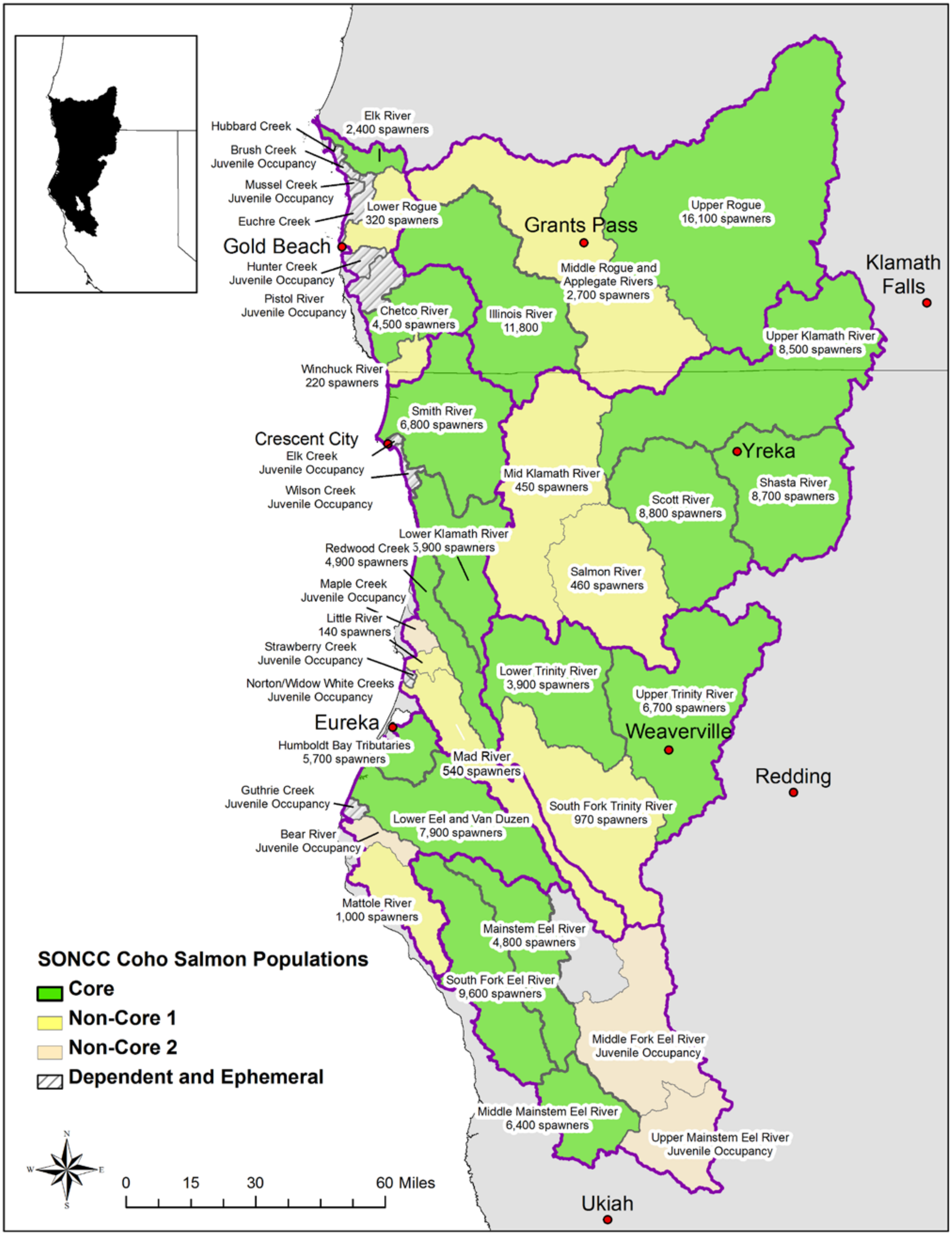
Why the Plan is Needed

Many coho salmon once returned to spawn in the rivers and streams found in Northern California and Southern Oregon. Not long ago, these watersheds provided conditions that supported robust and resilient populations of coho salmon that could withstand changes in environmental conditions. Since, the combined effects of fish harvest, hatcheries, hydropower operations, and habitat alterations caused from land management led to extraordinary declines in these populations. Evaluations of declining coho abundance, productivity, range reductions and diminished life history diversity due these threats, supported the decision to list coho salmon populations from the Mattole River in California to the Elk River in Oregon as a threatened species under the Endangered Species Act (ESA) in 1997.

The Southern Oregon/Northern California Coast (SONCC) Coho Recovery Plan (Plan) serves as the federal recovery plan for coho populations within the ESA-listed SONCC Coho Salmon evolutionarily significant unit (ESU), where an ESU is comprised of groups of populations with geographic and evolutionary similarities that are considered a "species" under the ESA. The figure below presents bounds of ephemeral, independent and dependant populations. The Plan is designed to guide implementation of prioritized actions needed to conserve and recover the species by providing an informed, strategic, and voluntary approach to recovery that is based on the best available science, supported by stakeholders, and built on existing efforts.

Plan Development

The National Marine Fisheries Service (NMFS), with the assistance of co-managers throughout the range of the SONCC Coho Salmon ESU, created the Plan. The Plan's development benefited from the cooperative efforts of the California Department of Fish and Game, Oregon Department of Fish and Wildlife, the U.S. Forest Service, the National Park Service, Yurok Tribe, Karuk Tribe, Hoopa Valley Tribe, and Siskiyou County Board of Supervisors, among others. NMFS used other existing plans, documents, and assessments in developing the Plan, notably, California's 2004 *Recovery Strategy for California Coho Salmon*, and Oregon's *Native Fish Conservation Policy* (NFCP). For much of the scientific framework of the Plan, NMFS relied upon Williams et al. 2006 and 2008, namely *Historical Population Structure of Coho Salmon in the SONCC Coasts ESU* and *Framework for Assessing Viability of Threatened Coho Salmon in the SONCC Coast ESU.* NMFS considered about 2,500 comments received from co-managers for substantive issues and new information, and revised the Plan. All co-managers offered support for Plan development and its implementation.


Elk River
2,400 spawners
Hubbard Creek
Brush Creek
Juvenile Occupancy
Mussel Creek
Juvenile Occupancy
Euchre Creek
Lower Rogue
320 spawners
Gold Beach
Grants Pass
Upper Rogue
16,100 spawners
Hunter Creek
Juvenile Occupancy
Pistol River
Juvenile Occupancy
Middle Rogue and
Applegate Rivers
2,700 spawners
Klamath
Falls
Chetco River
4,500 spawners
Illinois River
11,800
Upper Klamath River
8,500 spawners
Winchuck River
220 spawners
Smith River
6,800 spawners
Crescent City
Elk Creek
Juvenile Occupancy
Yreka
Wilson Creek
Juvenile Occupancy
Mid Klamath River
450 spawners
Shasta River
8,700 spawners
Scott River
8,800 spawners
Lower Klamath River
3,900 spawners
Redwood Creek
4,900 spawners
Salmon River
460 spawners
Maple Creek
Juvenile Occupancy
Little River
140 spawners
Strawberry Creek
Juvenile Occupancy
Lower Trinity River
3,900 spawners
Norton/Widow White Creeks
Juvenile Occupancy
Upper Trinity River
6,700 spawners
Eureka
Weaverville
Humboldt Bay Tributaries
5,700 spawners
Mad River
540 spawners
Redding
Guthrie Creek
Juvenile Occupancy
South Fork Trinity River
970 spawners
Lower Eel and Van Duzen
7,900 spawners
Bear River
Juvenile Occupancy
Mattole River
1,000 spawners
Mainstem Eel River
4,800 spawners
SONCC Coho Salmon Populations
Core
Non-Core 1
Non-Core 2
Dependent and Ephemeral
South Fork Eel River
9,600 spawners
Middle Fork Eel River
Juvenile Occupancy
Middle Mainstem Eel River
6,400 spawners
Upper Mainstem Eel River
Juvenile Occupancy
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60 Miles
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Plan Goals, Objectives, Criteria

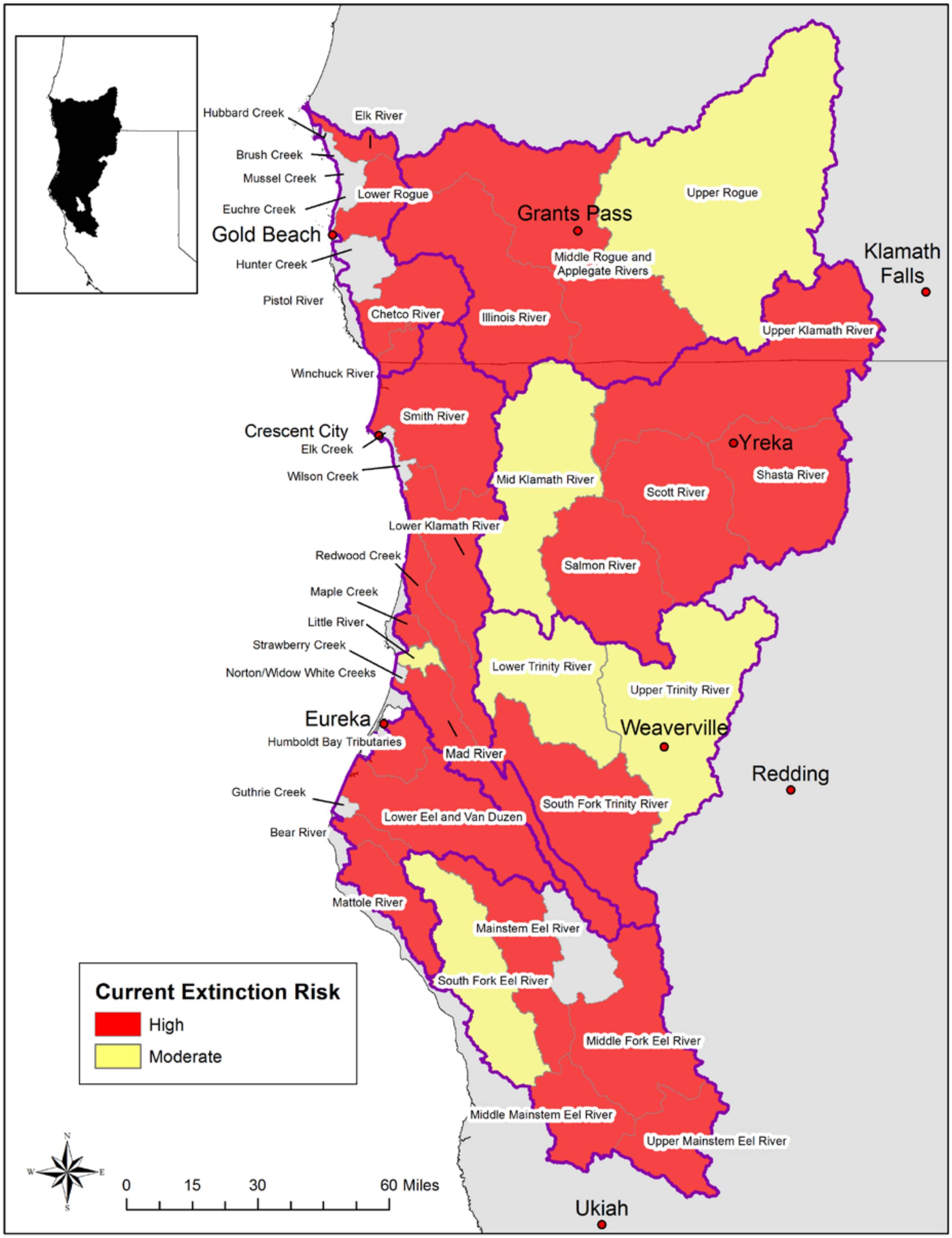
The goal of this Plan is to recover the SONCC coho salmon ESU to the point where the species no longer needs the protections afforded by the federal ESA and can be delisted from the ESA threatened and endangered species list. A recovered SONCC coho salmon ESU will be naturally self-sustaining, and the factors that caused it to be listed will be abated.

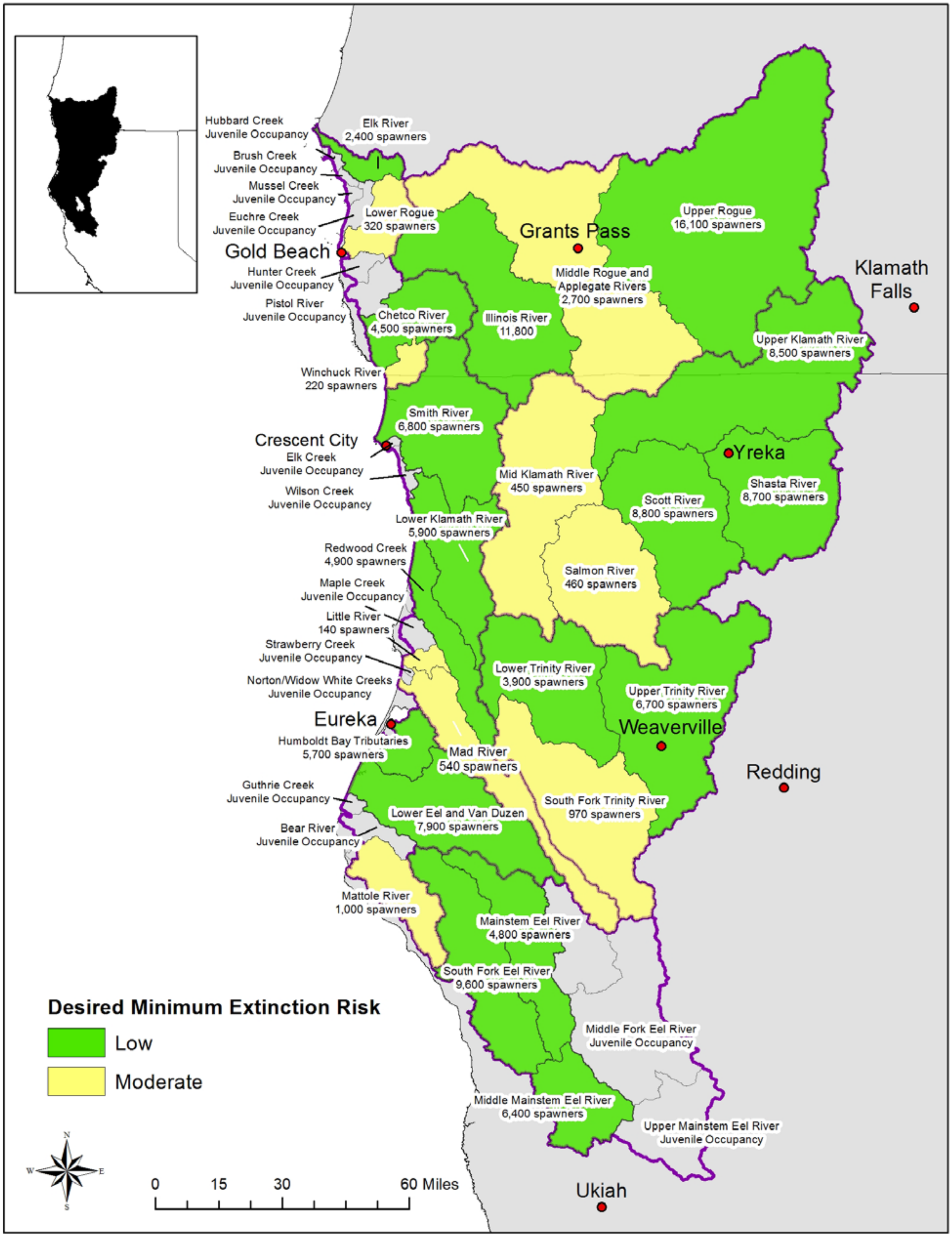
The Plan's recovery objectives describe the biological parameters of the species-level recovery goal by adopting the concept of viable salmonid populations (VSP) – abundance, productivity, spatial structure, and diversity. At the ESU level, SONCC coho salmon must demonstrate representation, redundancy, connectivity, and resiliency. The Plan also establishes criteria at the ESU, diversity strata, and population scales to measure whether the recovery objectives are met. The Plan identifies measurable biological roles for each of the four VSP parameters for each population to meet the recovery goal of the species, ranging from low to moderate risks of extinction or providing connectivity between adjacent populations.

VSP Parameter	Population Type	Recovery Objective	Recovery Criteria
Abundance	Core	Low risk of extinction.	The geometric mean of wild spawners over 12 years at least meets the "low risk threshold" of spawners for each core population
	Non-Core 1	Moderate or low risk of extinction	The annual number of wild spawners meets or exceeds the moderate risk threshold for each non-core population
Productivity	Core and Non-Core 1	Population growth rate is not negative.	Slope of regression of the geometric mean of wild spawners over the time series $\geq$ zero
Spatial Structure	Core and Non-Core 1	Ensure populations are widely distributed	Annual within-population distribution $\geq$ 80% of habitat (outside of a temperature mask)
	Non-Core 2 and Dependent	Achieve inter- and intra-stratum connectivity	20% of accessible habitat is occupied in years following spawning of cohorts that experienced good marine survival
Diversity	Core and Non-Core 1	Achieve low or moderate hatchery impacts on wild fish.	Proportion of hatchery-origin spawners (pHOS) $\leq$ 0.10
	Core and Non-Core 1	Achieve life history diversity.	Variation is present in migration timing, age structure, size and behavior. Variation in these parameters is retained.

The following maps identify the current and desired status in terms of risk of extinction of individual populations comprising the SONCC coho salmon ESU. The desired minimum adult spawner abundance is noted for each population.

The goal of broad-sense restoration is to maximize the viability and production of SONCC coho salmon, and achieve a low risk of extinction for all populations. Criteria are not established for broad-sense restoration.





Hubbard Creek Juvenile Occupancy
Elk River 2,400 spawners
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Humboldt Bay Tributaries 5,700 spawners
Mad River 540 spawners
Redding
Guthrie Creek Juvenile Occupancy
South Fork Trinity River 970 spawners
Lower Eel and Van Duzen 7,900 spawners
Bear River Juvenile Occupancy
Mattole River 1,000 spawners
Mainstem Eel River 4,800 spawners
South Fork Eel River 9,600 spawners
Desired Minimum Extinction Risk
Low
Moderate
Middle Fork Eel River Juvenile Occupancy
Middle Mainstem Eel River 6,400 spawners
Upper Mainstem Eel River Juvenile Occupancy
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Threats and Limiting Factors

The Plan describes limiting factors (stressors) as the physical, biological, or chemical conditions and associated ecological processes that SONCC coho salmon are exposed to that may be impeding recovery. General categories of limiting factors (stressors) include competition, disease, food web, habitat access, instream flows, water quality, physical habitat quality/quantity, and predation. The Plan describes threats as human impacts that cause or contribute to factors that limit recovery of the species, including: flood control/hydropower, land management, other species, harvest management, and hatchery management. While the Plan includes necessary recovery actions to abate threats from a wide variety of human activities, SONCC coho salmon recovery depends on ongoing efforts to change past and current practices that diminish salmon habitat.

Recovery Program and Actions

Nearly 2,000 recovery actions, and their respective priority or importance, are identified, aiding conservation partners in selecting which actions to implement. Recovery actions are designed to address both acute issues, and restore processes which promote coho salmon habitat. Recovery action specificity spans a wide spectrum from very detailed and location-specific to population-wide concepts, each intended to address identified stressors and associated threats at play. Recovery actions include removal of or passage at both large and small dams; promote sufficient water quantity and quality; restoring in-channel habitat and upslope ecological function; and create suitable estuarine nurseries. In addition, managing fisheries and other collection, demoting disease and non-native predator species, and operating hatcheries consistent with recovery goals are essential.

Monitoring & Adaptive Management

Monitoring is necessary to assess the recovery of SONCC coho salmon by determining if specific recovery criteria are met, and evaluate whether changes in the recovery strategy are necessary. The Plan identifies acceptable sampling standards, and three progressively intensive data collection phases – initial, delisting, post-delisting – which employ efficient placement of life cycle monitoring stations across the ESU. The adaptive management element offers a feedback loop for continuous scientific evaluation of the foundational scientific framework, monitoring, and recovery action aspects of the Plan so that new information can guide adding or discontinuing actions or strategies. Web-based recovery action implementation tracking tools are under development.

Implementation Schedule and Cost

Numerous public and private entities have contributed to recovery actions in all identified threat and stress categories since SONCC coho salmon ESU listing, and many ongoing and planned recovery programs throughout the ESU hold great promise. Nevertheless, a recent 5-year status review found that SONCC coho salmon abundance has decreased since 2005, population abundance trends are downward, the majority of independent populations are well below low-risk of extinction adult spawner abundance targets, and several populations may be extirpated. Implementation of recovery actions needs to accelerate in order to prevent further decline in the species' status and to achieve recovery. The intent of this Plan is to focus actions in the most important areas and provide a prioritized roadmap for future actions.

The Plan guides recovery action implementation through 5-year intervals over the next 25 years. While the Plan urges immediate implementation of many recovery actions, defining a timeframe for Plan implementation is necessary to structure action implementation needs and overall recovery action cost. A scheduled revision, or more frequent updates, to the Plan is planned every 5 years to account for new information, science, or policy direction.

The overall cost of achieving delisting of SONCC coho salmon by implementation of the recovery actions identified in the Plan is estimated at approximately $3.6 billion over 25 years. While a significant investment, the recovery of SONCC coho salmon will concurrently result in a wide array of economic, societal and ecosystem benefits. Many of the actions identified are designed to improve watershed-wide processes which benefit many native species of plants and animals (including other state and federally protected species) by restoring ecosystem functions. In addition, restoration of habitat provides substantial benefits for human communities such as: improving and protecting the quality of important surface and ground water supplies; reducing damage from flooding resulting from floodplain development; and controlling invasive exotic animal and plant species which can threaten water supplies and increase flooding risk. Restoring and maintaining healthy watersheds also enhances important human uses of aquatic habitats, including outdoor recreation, ecological education, field based research, aesthetic benefits, and the preservation of tribal and cultural heritage.

Conclusion

The Plan provides a comprehensive roadmap for the recovery of SONCC coho salmon. Recovery will require actions that conserve and restore the key biological, ecological, and landscape processes that support the ecosystems upon which coho salmon populations depend. The Plan identifies specific recovery actions that protect or restore coho salmon or their habitat, provides an implementation plan and outlines a monitoring and evaluation program to guide its adaptive management elements so that the most effective means of achieving recovery will be utilized. Biological recovery goals, objectives and measurable criteria, and web-based management tools, will provide for a mechanism to track recovery progress. Recovery can only be ultimately achieved through coordinated efforts to build strong conservation partnerships. Conservation partners may be individuals, groups, government or non-government organizations, industry, or tribes who have an interest in the recovery of SONCC coho salmon. While investment in implementing the Plan may be substantial, recovery of SONCC coho salmon will concurrently result in a wide array of economic, societal and ecosystem benefits. Salmon recovery is best viewed as an opportunity to diversify and strengthen the economy while enhancing the quality of life for present and future generations.

SOUTHERN OREGON NORTHERN CALIFORNIA COAST COHO SALMON RECOVERY PLAN SUMMARY

Keys to Understanding

habitat

definition

recovery

Photo: Thomas Dunklin

BACKGROUND

NOAA's National Marine Fisheries Service (NMFS) prepared a draft Recovery Plan for the protection and restoration of coho salmon in the Southern Oregon Northern California Coast (SONCC) Evolutionarily Significant Unit (ESU). SONCC coho were listed as a threatened species under the Endangered Species Act (ESA) in 1997. The ESA requires the National Marine Fisheries Service (NMFS) to develop recovery plans for all listed salmon species; therefore, this recovery plan was developed to comply with the law.

The SONCC coho salmon ESU includes all populations of coho salmon in coastal streams from the Elk River near Cape Blanco, Oregon, through and including the Mattole River near Punta Gorda. Critical habitat for SONCC coho salmon was designated on 1999 as all accessible reaches of rivers (including estuarine areas and tributaries) within the ESU. The SONCC ESU spans two states (Oregon and California) and 13 counties (Coos, Douglas, Curry, Josephine, Jackson, Klamath, Del Norte, Siskiyou, Humboldt, Trinity, Mendocino, Lake, Glen). Land ownership is primarily public but much of the ESU is under private ownership, concentrated in the low-lying valleys. Major land uses on private land include agriculture, ranching, timber harvest, and urban and residential development.

The plan identifies actions that may be taken to stop the downward trend of the species and return the species to a viable, naturally self-sustaining condition.

The Plan establishes criteria for delisting SONCC coho salmon and presents recovery actions necessary to reduce stresses and threats for species recovery. Using the biological foundations and framework developed by NMFS and other scientists (e.g., Technical Recovery Team), the plan focuses on coho salmon populations as the fundamental unit for recovery, as well as on the physical and ecological processes that form the habitat conditions necessary for fulfilling life stage needs. Implementation of the plan will allow limited resources to be applied to the highest priority recovery actions. Although not regulatory, recovery plans are the central organizing tool for guiding each species' progress towards recovery.

The development of this plan is an iterative process which relies upon input and comments from NMFS staff, co-managers, and the general public. Previous drafts were reviewed by personnel from State and Federal agencies, tribes, and the Center for Independent Experts (CIE). The information and issues raised by the co-managers and the CIE were considered during preparation. After the comment period, all comments will be considered and the plan will be finalized.

Why Southern Oregon Northern California Coast (SONCC) coho salmon?

- The SONCC coho salmon ESU is a species listed under the Endangered Species Act because they are in danger of becoming extinct. Although a wide range of important protective efforts have been implemented in both Oregon and California prior to listing, these efforts have not yet sufficiently reduced threats or restored populations.
- They are evolutionarily unique and are an important part of our national heritage.
- Their numbers have dramatically declined from historical levels.

What about other species of fish in the same geographic area?

Other fish species will also benefit from improvements to coho salmon habitat.

Why a recovery plan?

Because the ESA requires NMFS to develop recovery plans for all listed species as a means by which to organize and coordinate recovery of the species.

Didn't the states already prepare recovery plans?

The state of California released the Recovery Strategy for California Coho Salmon in 2005, and the Oregon Department of Fish and Wildlife held an expert panel to assess the limiting factors and threats affecting SONCC coho salmon in Oregon and released their report in 2010**.** These documents were key resources while developing this draft plan. Because the documents were not developed to meet the same legal requirements NMFS must meet, they did not include all the elements needed for a federal recovery plan.

Is this plan voluntary or required?

NMFS is required to prepare a plan. Implementation of specific recovery actions is voluntary. The plan is not a law and it is not a regulation; it is a roadmap, guidance, and resource for people, organizations, and governments willing and able to take action to help the fish.

What does "viable" mean?

To be viable, an ESU must be sufficiently resilient to be likely to persist for the next 100 years even without the protections of the ESA. When SONCC coho salmon are viable, enough fish will spawn in the wild and return year after year so they are likely to persist in the long run. The species also has to be resilient enough to survive periodic catastrophic changes in the environment, including natural events such as floods, earthquakes, storms, and decreases in ocean productivity.

What is the goal of this recovery plan?

The primary goal is to be able to "delist" the coho salmon – improve its status so that it is naturally self sustaining and no longer threatened with extinction.

What's delisting? Who makes the decision?

Under the ESA, listing and delisting of marine species, including salmon, are the responsibility of NMFS. If a fish or other species is listed as threatened or endangered, legal requirements to protect it come into play. When NMFS decides through scientific review that the species is doing well enough to survive without ESA protection, NMFS will "delist" it. This decision must be based on the best available science concerning the current status of the species and its prospects for survival.

What is broad-sense recovery?

Broad-sense recovery is a state past ESU viability in which an ESU is sufficiently abundant, productive, and diverse that the ESU as a whole is self-sustaining, and provides significant ecological, cultural, and economic benefits to society.

A FRAMEWORK FOR RECOVERY

Conceptual foundations and context

NMFS appointed a team of scientists with expertise in salmon species to provide scientific support for SONCC coho salmon recovery planning. This technical recovery team (TRT) included biologists from state, federal and tribal government agencies. The TRT produced two documents: the historic population structure of the SONCC coho salmon ESU (Williams et al. 2006) and the viability framework (Williams et al. 2008).

The TRT documents are the foundation of the recovery plan. They established demographic delisting criteria. These criteria, along with rules as to which combinations of populations could be used, led to the number of adults needed in each population. These population targets, along with the threats assessment, drove development of recovery actions.

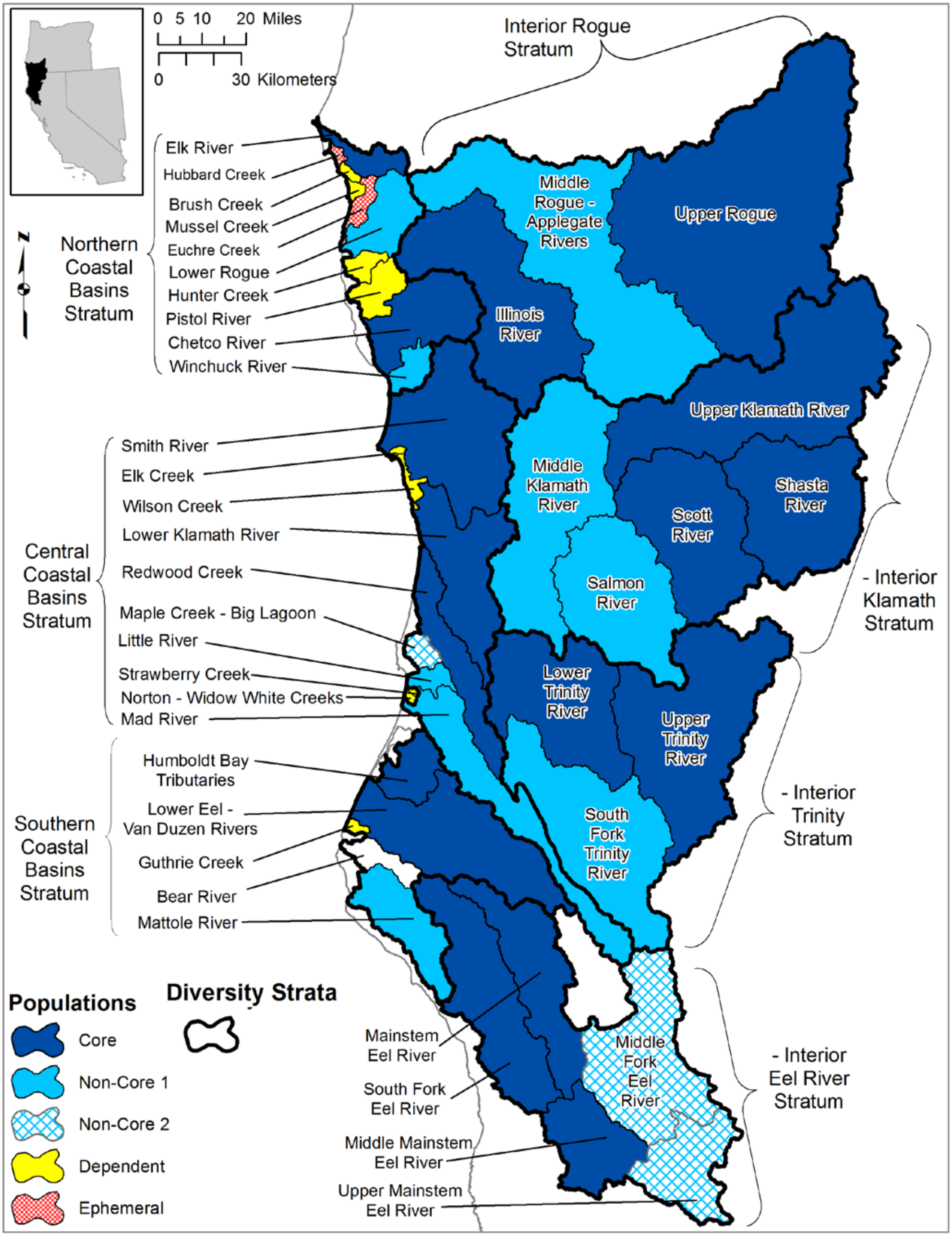
Williams et al. (2006) designated 45 populations of coho salmon in the SONCC coho salmon ESU. These populations were further grouped into seven diversity strata based on the geographical arrangement of the populations and basin-scale genetic, environmental, and ecological characteristics. Six of the populations are not described in detail because further information showed they are too small to qualify as populations. A map showing the populations and diversity strata is shown on the following page.

What is an "Evolutionarily Significant Unit" (ESU)?

Most of the time, salmon return to spawn in the streams where they were born. However, they occasionally "stray" and mate where conditions are right, perhaps in an adjacent stream. The result is that salmon populations that are geographically widespread may have some amount of genetic similarity within portions of their range. They are linked because of straying, and differentiated because of long-term adaptation to different environments.

An ESU is defined as a group of Pacific salmon or steelhead trout that (1) is substantially reproductively isolated from other groups of the same species and (2) represents an important component of the evolutionary legacy of the species. ESUs are defined on the basis of geographic range as well as genetic, behavioral, and other traits.

All Pacific salmon belong to the family Salmonidae and the genus *Oncorhynchus*. Coho salmon are the species *Oncorhynchus kisutch*. NMFS identified seven ESUs within this species, including The Southern Oregon Northern California Coast (SONCC) coho salmon ESU.



This map shows the populations and diversity strata in the SONCC coho salmon ESU. NMFS classified each of the populations (excluding ephemeral populations) in the SONCC coho ESU into one of three categories: core (C), non-core independent (NCI), and dependent (D).

Extinction and Recovery Trajectories

The abundance of fish is low in many of the populations in the SONCC coho salmon ESU. Populations with few individuals are not only more vulnerable to environmental variations (e.g. drought), they are also subject to particular dynamics resulting from small population size. For example, there are genetic issues, including genetic drift and inbreeding, spawners may have difficulty finding mates, and predation pressure may be higher because there are fewer fish for predators to eat. The longer a population remains small, the more likely it is to succumb to these factors and go extinct. Such dynamics are sometimes referred to as an "extinction vortex" in which once a population is reduced to a small size, it is difficult for that population to recover. In such cases, improvement in habitat conditions alone may be insufficient; it may be necessary to use artificial propagation (conservation hatcheries) to replenish population numbers.

How did NMFS classify populations, and what are the recovery targets for each type?

Core: These independent populations are judged most likely to become viable most quickly. As described in Appendix C, core populations were chosen based on factors such as current habitat quality, current abundance and distribution of coho salmon, land use, and prospects for future improvement. Recovery targets are in the thousands of fish, and will result in a low risk of extinction for each population.

Non-core 1: These independent populations are judged to have lesser potential for rapid recovery than the core populations. Recovery targets are in the hundreds of fish, and will result in a moderate risk of extinction for each population.

Non-core 2: These populations are judged to have low potential to recover as self-sustaining populations. The recovery target is juvenile occupancy in years following spawning of cohorts that experienced good marine survival. This occupancy will demonstrate the populations are supporting the independent populations.

Dependent: These populations probably played a supporting role in the ESU historically due to their small size, and were likely not always occupied by coho salmon. The recovery target is the same as for Non-Core 2 populations.

PLAN DEVELOPMENT METHODOLOGY

Population Classification

The TRT utilized the concept of the Viable Salmonid Population (VSP) (McElhany et al. 2000) to describe the characteristics of a healthy salmonid population. The VSP concept includes four parameters: abundance, productivity or growth rate, spatial structure, and diversity (defined in recovery criteria section, below). All four parameters must be met to maintain diversity throughout the ESU, provide connectivity among populations to maintain long-term viability and genetic processes, and provide a buffer against potential catastrophic risks.

Populations were classified as dependent or independent based on their historic population size (Williams et al. 2006). Williams et al. (2006) provided guidelines for which populations could be at low risk of extinction and moderate risk of extinction and still make up a viable ESU. To apply these guidelines, NMFS further classified populations into four categories. These categories were defined by the first VSP parameter: the number of adults each population must produce in order to achieve a viable ESU (see box at left for more information). These classifications were combined with the TRT's population-specific adult spawner targets to determine the population size criterion for each population. These criteria, which are a type of delisting criteria, are detailed in Chapter 6.

What is a population profile?

A population profile is a description of one of the populations in the SONCC coho salmon ESU, including a summary of available habitat data, population data, an assessment of stress and threats, and a list of recovery actions. Profiles were prepared for every independent and dependent population. The 39 profiles make up Chapters 7 to 43 of the recovery plan.

Why were population profiles created?

Population profiles were prepared so that NMFS could better understand all the available information about each population's status, its habitat condition, and the stresses and threats affecting it. This information was used to identify the role each population would play in recovery of the ESU.

Limiting Factor (Stress) and Threat Assessment

When the SONCC coho salmon ESU was listed, NMFS identified the factors that had led to its decline. These factors are associated with specific stresses and threats, which were assessed for each population to determine the extent to which they limit that population. The methods used for the threats assessment are described in Appendix B.

The following sections list the stresses and threats included in the assessment. These stresses and threats are explained in detail in Chapter 3.

The most critical, wide-ranging factor in the decline of SONCC coho salmon is habitat loss and degradation. The sustainability of anadromous salmonid populations depends upon suitable habitat conditions. Accordingly, most of the stresses and threats relate to habitat characteristics.

What is a limiting factor?

A limiting factor is an environmental factor that limits the growth or activities or an organism or that restricts the size of a population or its geographic range.

What is a stress?

Stresses are attributes of the ecology of a particular life stage of coho salmon that are impaired, directly or indirectly, by human activities. For example, impaired water quality, specifically high water temperature, can impair growth of or kill juvenile coho salmon.

Why Limiting Factor (Stress)? Why not one or the other?

Both terms are used in order to bridge differences in terminology used between concepts.

What is a threat?

A threat is an activity or process that has causes, is causing, or may cause a stress. For example, land management activities may require withdrawal of water from a river. This reduced flow can result in higher water temperature, impairing water quality and harming or killing coho salmon.

Stresses

- Lack of Floodplain and Channel Structure
- Impaired Water Quality
- Altered Hydrologic Function [timing of volume of water flow]
- Impaired Estuary/Mainstem Function
- Degraded Riparian Forest Conditions
- Altered Sediment Supply
- Increased Disease/Predation/Competition
- Barriers [to migration]
- Adverse Fishery-Related Effects
- Adverse Hatchery-Related Effects

Threats

- Dams/Diversions
- Agricultural Practices
- Channelization/Diking
- Timber Harvest Practices
- Roads
- Urban/Residential/Industrial Development
- Road-Stream Crossing Barriers
- Climate Change
- Invasive/Non-Native Alien Species
- Hatcheries
- Fire (High Intensity)
- Mining/Gravel Extraction

Identification of recovery actions

Problematic stresses and threats must be reduced to be consistent with the threat abatement criteria. These criteria are a type of delisting criteria and are explained in detail in Chapter 6. Stress and threat abatement criteria describe the extent of threat or stress reduction necessary for ESU recovery, which defined the scope, intensity, and priority of the stress- and threat-related recovery actions.

RECOVERY GOALS, OBJECTIVES, AND CRITERIA

The goal of the recovery plan is to restore and recover SONCC coho salmon and their habitat to the point where the ESU no longer needs the protections of the ESA and can be delisted. There are two kinds of delisting criteria:

- Biological viability criteria and
- Stress and threat abatement criteria.

Biological Viability Criteria

Biological Viability Criteria for the Southern Oregon Northern California Coast Coho Salmon ESU

Abundance: The number of individuals in a population. Abundance targets are shown on page 10 of this summary. *The numeric criteria for number of spawners in each core and non-core independent population must be met, on average, over a 12 year period.*

Productivity: The population growth rate, measured as the spawner-to-spawner ratio (returns per spawner or recruits per spawner). *On average in a 12-year period, the population growth rate in core populations must be positive, even during poor marine survival conditions.*

Spatial Structure: The geographic distribution of individuals in the population. *For all core and non-core-1 populations, on average over a 12 year period at least 70% of the accessible habitat must support juveniles. For all non-core 2 and dependent populations, 20% of accessible habitat must support juveniles in years following spawning of cohorts that experienced high marine survival.*

Diversity: All the genetic and phenotypic (life history, behavioral, and morphological) variation within a population. The proportion of hatchery-origin spawners (pHOS) must not exceed 0.10 in any population, and documented variation in migration timing, age structure, size and behavior must be retained.

Photo: Thomas Dunklin

Coho salmon spawning in the Jacoby Creek watershed (Humboldt Bay population) on 12/16/2010.

Stress and Threat Abatement Criteria

In order to achieve viability of the ESU, the stresses and threats affecting SONCC coho salmon and their habitat must be abated to levels that allow for long-term self-sustainability. In order to make a delisting decision, NMFS will examine whether the listing factors (described above in the Current Stresses and Threats section) have been addressed, such that delisting is not likely to result in reemergence of the threats. The major stress and threat abatement criteria are described on the following pages.

Stress Abatement Criteria

- All stresses are abated to the point where habitat conditions are within the range of conditions suitable for all life stages of coho salmon in targeted areas. These targeted areas will be identified as part of a comprehensive habitat survey to occur in each population after the recovery plan is final.
- Barriers do not limit access to targeted areas.
- All estuaries contain estuarine wetland habitat and connected off-channel habitat (back and side channels, tidal channels, wetlands, beaver ponds, etc) to support needed population sizes.

Threat Abatement Criteria

- For threats to habitat, threats are reduced so that stress abatement criteria are achieved.
- Regulatory programs that govern land use and resource extraction have been enacted, enforced, monitored, and adaptively managed and are adequate to ensure effective protection of SONCC coho salmon habitat, including water quality, water quantity, stream structure, and function, and to attain and maintain the biological viability criteria in this recovery plan.
- Regulatory programs are in place and are being adequately implemented, monitored, evaluated and adaptively managed to manage fisheries at levels consistent with the biological recovery criteria of the recovery plan.

Photo: Thomas Dunklin

Coho salmon digging redd in the Jacoby Creek watershed (Humboldt Bay population) on 12/16/2010.

The following table shows population type and minimum number of spawners needed for ESU recovery. Populations are categorized into core (C) (**bold** in table), non-core 1 (NC-1), non-core (NC-2) and dependent (D).

Diversity Stratum	Population Name	Population Type	Number Spawners Needed for Recovery
Northern Coastal Basins	**Elk River**	C	2,400
	Lower Rogue River	NC-1	320
	Chetco River	C	4,500
	Winchuck River	NC-1	230
	Mill Creek	D	none*
	Brush Creek	D	none*
	Hunter Creek	D	none*
	Pistol River	D	none*
Central Coastal Basins	**Smith River**	C-	6,800
	Lower Klamath River	C	5,900
	Redwood Creek	C	4,800
	Maple Creek/Big Lagoon	NC-2	none*
	Little River	NC-1	140
	Mad River	NC-1	550
	Elk Creek	D	none*
	Wilson Creek	D	none*
	McDonald Creek	D	none*
	Strawberry Creek	D	none*
	Norton/Widow White Creek	D	none*
Southern Coastal Basin	**Humboldt Bay tributaries**	C	5,700
	Lower Eel/Van Duzen rivers	C	7,900
	Bear River	NC-2	none*
	Mattole River	NC-1	1,000
	Guthrie Creek	D	none*
	McNutt Gulch	D	none*
Interior – Rogue River Basin	**Illinois River**	C	11,800
	Mid. Rogue/Applegate Rivers	NC-1	2,700
	Upper Rogue River	C	16,100
Interior – Klamath River	Middle Klamath River	NC-1	450
	Upper Klamath River	C	8,500
	Salmon River	NC-1	460
	Scott River	C	8,800
	Shasta River	C	8,700
Interior – Trinity River	South Fork Trinity River	NC-1	970
	Lower Trinity River	C	3,900
	Upper Trinity River	C	7,300
Interior – Eel River	**South Fork Eel River**	C	9,600
	Mainstem Eel River	C	4.700
	Mid. Fork Eel River	NC-2	none*
	Mid. Mainstem Eel River	C	6,400
	Upper Mainstem Eel River	NC-2	none*

*delisting criterion: 20% of accessible habitat is occupied in years following spawning of cohorts that experienced good marine survival.

RECOVERY ACTIONS

The plan describes a series of voluntary actions to improve prospects for recovery of the Southern Oregon Northern California Coast coho salmon.

Recovery of healthy, abundant coho salmon populations within the of SONCC coho salmon ESU is likely to happen only if people are willing to work together. The proposed recovery actions are designed to address the full range of limiting factors for all life cycle stages of SONCC coho salmon and are intended to improve the health and habitat.

This section provides of a brief overview of the types of actions that are proposed, organized by stress and threat. The full plan provides additional details. For a summary of recovery actions, see the Recovery Strategy section. A comprehensive list of actions, organized by population, is in the last table of each population profile. The cost for each action, and the potential lead, is shown in Appendix F.

Riparian Forest Conditions

Increase wood recruitment, bank stability, shading, and food subsidies by increasing coniferous riparian vegetation (plant conifers or thin vegetation as needed, remove invasive species), developing planning guidelines or ordinances that protect riparian stands and the wood already in the stream, amending California and Oregon Forest Practice Rules, improving grazing practices, improving long-range planning, educating landowners, and reducing fire hazards.

Why are riparian forests important to coho salmon?

Riparian (near-stream) forests are essential components of salmon habitat and provide a variety of benefits:

- Shade helps maintain cool water temperatures
- When large trees die and fall into the water, they create pools and shelter
- Roots stabilize stream banks and reduce erosion
- Vegetation provides habitat for insects that can fall into the stream and become salmon prey.

Riparian restoration in the Thompson Creek watershed (Applegate River) with willow and alder trees established following planting in February 2004.

Photo Applegate River Watershed Council

Floodplain and Channel Structure

Increase channel complexity by increasing large woody debris. In the short-term, this can be accomplished by adding wood to channels. A more permanent solution is to let riparian trees mature and grow larger (see Riparian Forests Conditions below), providing natural replenishment of wood as trees die and fall into stream channels. Where feasible, expanding the range of beavers could substantially improve habitat complexity (see photo at right) and have other beneficial effects to habitat.

Reconnect the floodplain by removing or setting back (move away from stream channel) levees and dikes. This will provide coho salmon juveniles with access to slow-water habitats such as side-channels and off-channel ponds that are critically important during winter and spring high flows.

What is floodplain connectivity?

Floodplains are the relatively low-lying lands alongside rivers and streams that are occasionally inundated during high flows and floods. Floodplain connectivity refers to the ability of the stream to periodically overflow its banks. Although we call this "flooding" and perceive it as something to avoid, especially when houses and roads are at stake, it is flooding that makes the soil fertile, replenishes wetlands with nutrients, seeds, and organic matter, and enriches the rivers and streams for the fish and other aquatic life.

Upstream floodplains can also diminish the force of the floodwaters and prevent more extensive flooding downstream. Planning realistically and providing undeveloped areas for rivers to flood can protect adjacent property from damage.

Photo: Eli Asarian

Channel-spanning large wood jam on East Fork Mill Creek (Smith River population), provides excellent summer and winter rearing habitat for coho salmon. With many pieces of wood, this restoration project created habitat much more complex than conventional projects that use only a few pieces.

Photo: Yurok Tribe

Waukell Creek side channel near the Klamath River Estuary during high flow event on 12/13/2006, demonstrating good floodplain connectivity.

Why is large wood important to salmon?

Large woody debris (LWD) means big chunks of wood, such as root wads or trees fallen into or across the channel.

- In all forested rivers and streams, large wood plays a key role in shaping the channel.
- It creates pools and hiding places, providing salmon with protection from predators.
- It helps filter sediment to provide clean gravel for spawning.
- It provides organic matter to feed the small invertebrates that salmon feed on.

Hydrologic Function (Water Flow)

Improve timing or volume of flow by conserving water, improving agricultural practices, establishing a statewide groundwater permitting process, changing the timing or volume of flow releases, and reducing diversions.

Increase water storage by increasing water retention and recharge through maintaining open space lands, managing runoff, and maintaining water storage structures.

Photo: Brock Dolman

Beaver pond provides excellent cover and slow-water habitat on Boise Creek near its confluence with the Klamath River on 5/14/2010. Beaver ponds improve hydrologic function by raising water tables and increasing connectivity between groundwater and surface water.

Water Quality

Reduce water temperature and increase dissolved oxygen by increasing flow, increasing the amount of cold water, reducing warm water inputs, and increasing coniferous riparian vegetation to provide shade.

Protect cold water by developing an emergency plan to protect cold water refugia during warm periods, and developing an educational program about the best land management practices.

Reduce pollutants by developing educational programs for conservation partners, removing pollutants from streams, reducing point- and non-point source pollution, and improving regulatory mechanisms.

Why is water quality important to coho salmon?

One of the most important ecological requirements of coho salmon is cold, clean, well-oxygenated water.

High summer water temperature is one of the most widespread (and greatest) stressors in the SONCC coho salmon ESU. Increased water temperature, even at sub-lethal levels can inhibit migration, reduce growth, stress fish, reduce reproductive success, inhibit smoltification, contribute to outbreaks of disease, and alter competitive dominance.

Other water quality parameters of concern in some coho salmon populations are elevated turbidity, low dissolved oxygen, and high pH. Pesticides and other toxins are also potential concerns in watersheds with urban areas and/or agriculture.

Photo: NMFS

Fencing to keep cattle out of the riparian area of Big Springs Creek (Shasta River population). The stream is a critically important coldwater refugia.

Sediment

Reduce the amount of sediment (dirt) that gets to streams by maintaining, upgrading, or decommissioning roads; improving grazing practices, developing grading ordinances, improving timber harvest practices, stabilizing slopes, and reducing the risk of catastrophic fire.

Improve spawning habitat by adding spawning gravels to river reaches below dams, because dams prevent replenishment of gravels from upstream sources.

Photos: Pacific Coast Fish, Wildlife and Wetlands Restoration Association

Before (top) and after (bottom) road decommissioning in Salmon Creek watershed (Humboldt Bay population) in the Headwaters Forest Reserve. This project will reduce fine sediment delivery to Salmon Creek.

Fish Passage

Improve access to watershed by removing barriers including structural, thermal, flow, and sediment barriers.

Decrease mortality associated with barriers by screening diversions.

Photo: Five Counties Salmonid Conservation Program

Improved stream crossing on Lindsay Creek (Mad River population) with arch culvert and natural stream bottom. Previous culvert was undersized and impeded fish passage.

What causes excess fine sediment?

Erosion is natural process but human activities such as road construction, timber harvest, agriculture, and development can disturb land and make it more vulnerable to erosion. Rain and melting snow then wash fine sediment (silt and sand) into streams, especially during major storms.

How does it harm coho salmon?

Excess fine sediment is detrimental to coho salmon in several ways:

- Reduced water clarity, making it more difficult for juvenile salmon to feed.
- Filled pools, simplifying salmon habitat.
- Clogged pore spaces in gravels and cobbles, depriving salmon of place to hide from predators and swift currents. This can also retard intergravel flow, reducing the formation of beneficial pockets of cold water.
- Reduced populations of invertebrates that are the preferred prey of salmon.

Estuary/Mainstem

Protect existing estuarine habitat by limiting development and fill, and maintaining and strengthening current estuarine protection measures.

Restore connectivity of tidally influenced habitat by reconnecting slough and tidal wetlands to estuary where opportunities exist, removing or replacing tidegates, setting back or removing dikes and levees, and increasing coniferous riparian vegetation.

Improve estuarine habitat by developing and implementing site-specific plans to restore this habitat.

Increase tidal exchange of water by removing barriers, installing bridges, and setting back dikes or levees

Photo: Thomas Dunklin

Klamath River estuary.

Photo: Pacific Coast Fish, Wildlife and Wetlands Restoration Association

Connection between Hookton Slough and Salmon Creek (Humboldt Bay population) was restored with a new tide gate.

Disease/Predation/Competition

Reduce disease by disrupting the disease cycle for identified pathogens, and conducting research and monitoring to better understand the disease cycle.

Reduce predation and competition by reducing the abundance of predatory or competing species such as Sacramento pikeminnow, brown trout, and New Zealand mud snail.

Fishery-Related Effects

Reduce effects of fishing by incorporating SONCC coho salmon VSP delisting criteria when formulating fishery management plans for fisheries that affect SONCC coho salmon, and limiting fishing impacts to those consistent with recovery.

Hatchery-Related Effects

Reduce adverse genetic effects of hatcheries by changing hatchery practices and reducing the number of hatchery origin spawners.

Reduce adverse ecological effects of hatcheries by changing hatchery practices and reducing competition with and predation from stocked salmonids.

Low Population Dynamics

Prevent extirpation by reducing mortality of coho salmon and considering implementation of enhancement programs (conservation hatcheries).

Monitoring and Research

Increase knowledge and understanding of population status, trends, habitat by monitoring the number and distribution of coho salmon, the condition of their habitat, and the status of threats affecting them.

MONITORING AND ADAPTIVE MANAGEMENT

Monitoring

The recovery plan describes monitoring to assess population status and trends, and the extent of stress reduction and threat abatement.

Population status and trends monitoring

Monitoring of population status and trends would occur over four phases: The initial phase, the intermediate phase, the delisting phase, and the post-delisting phase. Monitoring varies depending on whether a population is core, non-core 1, non-core 2, or dependent, and on how close populations are to meeting their delisting criteria.

One life cycle monitoring station (LCM) would be established in each diversity stratum. The number of adults, number juveniles, and survival rates would be measured annually at each LCM, beginning in the initial phase and continuing through the post-delisting phase. In addition, the following monitoring would occur in each phase.

Initial Phase

The initial phase would begin as soon as possible. During the initial phase, juvenile occupancy surveys would be carried out in all core and non-core 1 populations, except those with LCMs. These surveys would alternate three years on, three years off, during an initial phase and a delisting phase.

Intermediate phase

The intermediate phase begins when the 12-year geometric mean of approximately 50 percent of the core populations with LCMs meet the low-risk spawner threshold (e.g., 4 of 7 populations). Alternatively, this phase would be triggered when the number of spawners in all of the core populations with LCMs is at least 50% of the low-risk spawner threshold. During the intermediate phase, the number of coho salmon spawners in each core population would be estimated each year. In addition, juvenile occupancy would be estimated in each non-core 1 population, for three consecutive year classes, in every other generation.

Delisting Phase

The delisting phase would be triggered when the 12-year geometric mean of approximately 90 percent of the core populations meets the low-risk spawner threshold (e.g., 15 of 17 populations). Alternatively, this phase would be triggered when the number of spawners in all of the core populations is at least 90% of the low-risk spawner threshold. During the delisting phase, spawner, juvenile occupancy, and life history diversity surveys would be carried out in all core and non-core 1 populations each year, and juvenile occupancy surveys would be carried out in all non-core 2 and dependent populations each year.

Post-Delisting Phase

The post-delisting phase would be triggered when the species is delisted and would continue for 12 years to assess whether SONCC coho salmon can continue to be viable without the protections of the ESA.

Photo: U.S. Forest Service

A rotary screw trap in lower Grayback Creek (Illinois River population).

Stresses and threats monitoring

Stresses

The following summary describes recommended monitoring in order track stresses. Additional monitoring is described in Chapter 5.

- Conduct a comprehensive survey of habitat in all populations, as soon as possible in both freshwater and estuarine areas. After this survey is complete, monitor habitat indicators for applicable limiting factors (stresses) every ten years in core and non-core 1 populations, and every fifteen years in non-core 2 and dependent populations.
- Annually monitor the hydrograph in core and non-core 1 populations where altered hydrologic function was ranked a high or very high limiting factor (stress).
- Annually estimate bycatch from commercial, recreational, and tribal fisheries in all freshwater, tidal, and ocean areas.

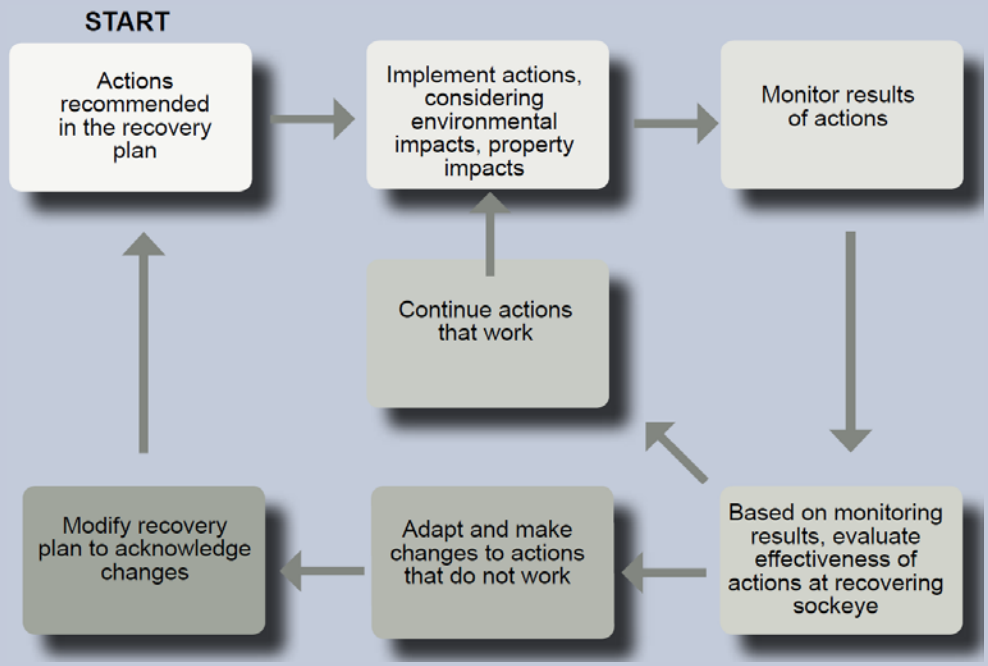
Humboldt Fish Action Council snorkel survey in Freshwater Creek (Humboldt Bay population), 2004.

Threats

The following summary describes recommended monitoring in order track threats. This monitoring would be carried out every five years as part of the status review.

- Describe the status and trend of limiting factors (stresses) related to timber harvest, high-intensity fire, agricultural practices, channelization/diking, urban/residential/industrial development, mining/gravel extraction, hatcheries, and climate change.
- Describe the status and trends of road treatments and road density, barriers, high-intensity fires, urban/residential/industrial development, channelization/diking, mining/gravel extraction, and invasive species.

What is Adaptive Management?



Adaptive management is the process of adjusting management actions and/or directions based on new information. The new information comes from monitoring the results of actions and evaluating their effects against existing hypotheses. Then the recovery actions can be continued or changed to be more effective.

Adaptive Management

An adaptive management framework is proposed to use monitoring information to evaluate the effectiveness of recovery plan implementation. Hypotheses will be tested with data collected during monitoring, and management actions will be guided by the results of these tests. See boxes above and at right for more information.

Data collection, evaluation, and reporting

There are a large number of federal, tribal, state, and local entities collecting data relevant to SONCC coho recovery planning. The recovery plan calls for these efforts to be better coordinated and for data to be compiled into centralized databases.

What is a hypothesis?

A hypothesis is a statement that can be proved or disproved by further inquiry. It is an invitation to look for more information. A scientific hypothesis is based on some kind of evidence or observation, and it describes either a possible causal relationship or just a relationship of some sort.

It does not matter whether a hypothesis is precise or wildly speculative; the important thing is whether it can be proven or disproven, and how the evidence is obtained. For example, a hypothesis about the trend in habitat condition may be “Water temperature is getting cooler”. The question is not where the hypothesis came from but what can be done with it. What’s the evidence? How can it be proved or disproved?

IMPLEMENTATION

The Priority and Importance of Recovery Actions

When choosing recovery actions to implement, conservation partners should consider both the priority and importance rankings. Each recovery action has been assigned a priority number, designed to call out those actions necessary to prevent extinction or a significant negative impact to the ESU. Each recovery action can also be assigned an importance ranking. This ranking takes into account the priority of the action as described above, whether the action addresses a key limiting factor (one which has the greatest impact on current population viability), and whether the population size is low enough for it be subject to detrimental population processes.

Implementation Schedule

The last table in Chapters 7 through 45 lists the population-specific recovery actions that make up the SONCC coho salmon recovery program, along with information about each action. Appendix F provides additional information about each action. Together, the tables and Appendix F make up the implementation schedule. Example rows from the tables are included on the following page.

Conservation Partners

To achieve success, the plan must be implemented. NMFS alone has neither the resources nor the authority to implement most recovery actions. Communication, coordination, and collaboration with a wide variety of conservation partners is essential to the implementation of the recovery plan. In addition, recovery plans must be designed so that all conservation partners, whether they were involved in writing the plan or not, understand the rationale behind the recovery program, buy into the program, and recognize their role in its implementation. NMFS is committed to working with stakeholders throughout the entire recovery process, from planning through implementation to recovery and delisting.

The primary roles of NMFS in plan implementation will be to champion the recovery strategy, and provide the needed technical information and expertise to other entities implementing the plan or contemplating actions that may impact the species' chances of recovery, and implement recovery actions where practicable.

Who are the "conservation partners"?

A conservation partner is anyone who has an interest in the recovery of the species.

Conservation partners may include other bureaus within NMFS, other government agencies, affected landowners, academic scientists, conservation organizations, industry, etc.

Future of the Recovery Plan

Planning for the recovery of a threatened or endangered species is tantamount to trying to capture a moving target that is rapidly diminishing over the horizon. Coaxing the species back from the brink and then adapting conditions so it can remain requires flexibility and the ability to alter course midstream while at the very least maintaining a stable population to allow time for research and management actions to take hold. A recovery plan must do all of this and more. In so doing a recovery plan must be a living document, easily refocused on the changing needs of the listed species. This recovery plan will be a living document, which will change in response to new information.

Coordination among State, Tribal or Federal agencies, academic institutions, private individuals and organizations, commercial enterprises, and other affected parties is perhaps the most essential ingredient for recovering a species. In view of such a broad scope of conservation partners, it is imperative that each become vested and active in the continuing efforts to promote and implement the recovery plan. This can be accomplished throughout the recovery process by facilitating a sense of ownership and accomplishment as each recovery action is fulfilled.

Example rows from the recovery action implementation schedule for the Smith River (Table 15-5 at end of Chapter 15):

Action ID	Strategy	Key LF	Objective	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SmiR.2.1.1	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Smith River Plain, Estuary, tributaries, Rowdy, Chrome, and Spokane creeks	3
SONCC-SmiR.2.1.1.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-SmiR.2.1.1.2	*Place instream structures, guided by assessment results*					
SONCC-SmiR.2.2.2	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Restore natural channel form and function	Smith River Plain, Rowdy and Domnie creeks	2
SONCC-SmiR.2.2.2.1	*Assess channelized reaches and develop a plan for reconstructing a natural meandering channel*					
SONCC-SmiR.2.2.2.2	*Reconstruct channelized reaches guided by the plan*					

Example rows from Appendix F, providing additional details (costs and lead entities) for each recovery action:

Appendix F: Cost and Lead Agency for Recovery Actions

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Lead Entity
Population: Smith River									
SONCC-SmiR.2.1.1									
	SONCC-SmiR.2.1.1.1	$34,015						$34,015	CDFG
	SONCC-SmiR.2.1.1.2	$10,957,000						$10,957,000	CDFG
	Action Total:	*$10,991,015*						*$10,991,015*	
SONCC-SmiR.2.2.2									
	SONCC-SmiR.2.2.2.1	$34,015						$34,015	CDFG
	SONCC-SmiR.2.2.2.2	$290,700						$290,700	CDFG
	Action Total:	*$324,715*						*$324,715*	

BROAD-SENSE RECOVERY STRATEGY

The plan defines what is believed to be necessary for the SONCC ESU to be viable and potentially delisted. Successful delisting involves achieving the level of recovery defined in Chapter 4 (Recovery Goals, Objectives, and Criteria) and will result in a few populations in each stratum being viable and the other populations being at moderate, high, or very high risk of extinction. Viable core populations may someday be able to withstand some level of incidental impact from commercial fisheries targeting hatchery fish, but will have little ability to withstand direct harvest. Returning wild coho spawners will number in the several thousands, but will not be numerous enough to be seen spawning throughout the ESU. Cultural and ecological benefits of having numerous coho salmon and other salmon and steelhead populations spawning throughout the ESU will likely not be achieved under a scenario where just delisting is afforded.

For many people, delisting is not enough. For example, the Oregon Plan for Salmon and Watersheds and the public advisory group that helped develop Oregon's Native Fish Conservation Policy recognized the importance of conserving healthy, diverse populations of salmon and steelhead at levels that provide recreational, economic, cultural and aesthetic benefits to present and future citizens. Such a desired status is also considered in ESA recovery plans (see Lower Columbia River Recovery Plan; NMFS 2009) and has been called "broad sense recovery". The term "broad sense recovery" represents the long-term goal of this plan.

In contrast to ESA recovery, "broad-sense" salmon recovery is a more open-ended concept that does not have a single definition; rather, it can mean different things to different people. "Broad sense recovery goals" reflect societal values in addition to biological ones. ESA recovery and broad sense recovery are not inconsistent; in fact, they share a common vision of ensuring that naturally sustainable salmon populations persist into the future.

NMFS is committed to pursuing both types of salmon recovery and one of the guiding principles for SONCC coho salmon recovery planning was to make the ESA and broad-sense recovery processes as congruent as possible. Chapter 4 of the plan includes more information about broad-sense recovery of the SONCC ESU.

What is "Broad-Sense Recovery"?

Broad sense-recovery is the goal of having populations of naturally produced salmon sufficiently abundant, productive, and diverse (in terms of life history and geographic distribution) that they ESU as a whole (a) will be self-sustaining, and (b) will provide significant ecological, cultural, and economic benefits (. This goal is consistent with ESA delisting, but is designed to achieve a level of performance for the ESU and its constituent populations that is more robust than that needed to remove the ESU from ESA protection. Broad sense recovery will require additional resources and effort; however, with larger population numbers, salmon in the SONCC coho ESU could provide valuable additional benefits to society.

Photo: NMFS

Coho salmon adult in Freshwater Creek (Humboldt Bay population).

1. Background

1.1 Introduction

Populations of coho salmon (*Oncorhynchus kisutch*) once ranged across the western part of North America from the coastal river basins of Alaska to interior areas of Washington and probably inhabited most coastal streams in Washington, Oregon, and northern and central California (62 FR 24588, May 6, 1997). These populations were sufficiently large that they were able to withstand changing environmental conditions. Fisheries for these and other salmonids supported vibrant communities across the Pacific Northwest. Salmon were a critical part of healthy ecosystems in rivers and the ocean.

Part of the range of coho salmon occurs in the Southern Oregon/Northern California Coast (SONCC) Recovery Domain, which encompasses the rivers from Punta Gorda, California to Cape Blanco, Oregon. The coho salmon which occupy this area make up the SONCC coho salmon Evolutionarily Significant Unit (ESU). An ESU is a population of organisms that is considered distinct for purposes of conservation. An ESU must meet two criteria: it must be substantially reproductively isolated from other nonspecific population units, and it must represent an important component of the evolutionary legacy of the species (57 FR 58612, November 20, 1991).

In the late 1990s, the populations that make up the SONCC Coho Salmon ESU were small and poorly distributed and subject to factors that threatened their continued existence. Consequently, the ESU was first listed as threatened under the Endangered Species Act (ESA) in 1997. “Threatened” status means the species is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range (ESA Section 3(20)). An “endangered” species is one that is in danger of extinction throughout all or a significant portion of its range (ESA Section 3(6)). The status of the species has continued to worsen since listing (Good et al. 2005, Williams et al. 2011), despite fishing prohibitions and habitat improvements.

The Rogue River has the longest time series of coho salmon adult abundance information in the ESU, and its populations are among those in the best condition. Nonetheless, coho salmon returns there are a small fraction of what they once were. Based on extrapolations from cannery pack data, up to 114,000 adult coho salmon returned to the Rogue River in the late 1800s even after heavy fishing pressure had occurred for years (Meengs and Lackey 2005). Figure 1-1 shows the estimated number of adult coho salmon spawners that returned to the Rogue River from 1980 to 2010, based on counts at Huntley Park (Oregon State University (OSU) 2010), as well as the recovery target for all populations in the Rogue River as presented in this recovery plan. The number of adults has been consistently below that needed for the Rogue River to play its role in recovery of the SONCC coho salmon ESU.

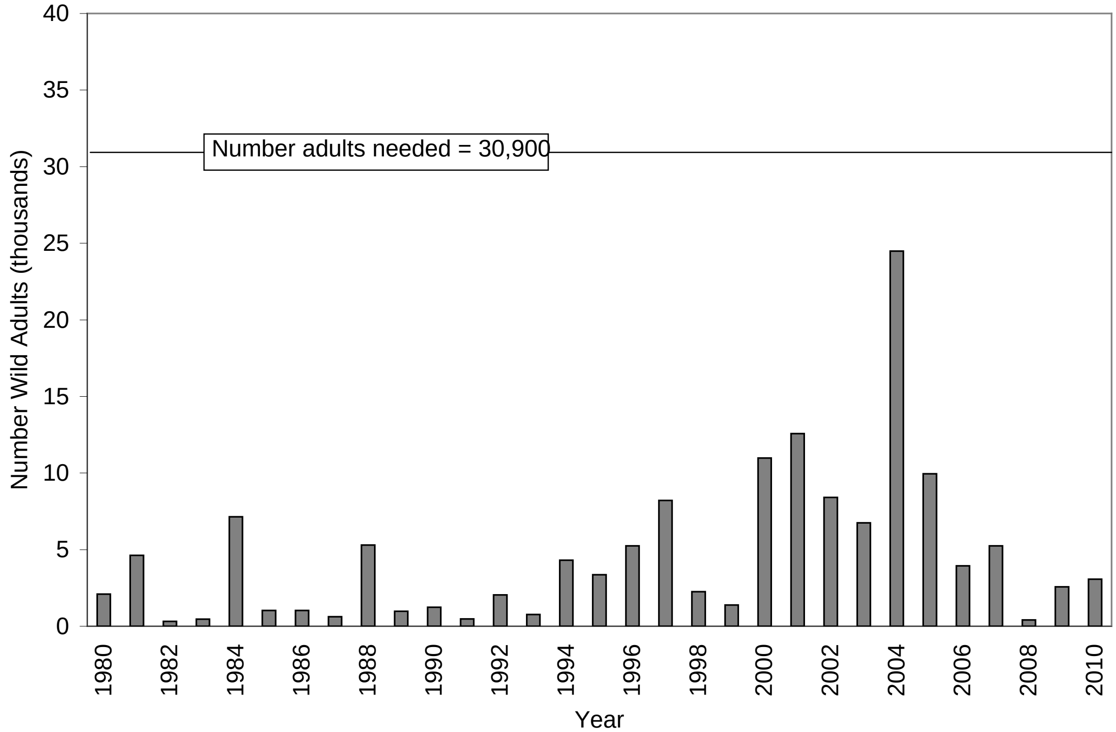


Figure 1-1. Estimates of the run size of wild Rogue basin coho salmon past Huntley Park, 1980-2010 (ODFW 2011), compared to number needed from Rogue River for ESU recovery.

1.2 What is a recovery plan?

"Recovery" is the process by which listed species and their ecosystems are restored and their future is safeguarded to the point that protections under the ESA are no longer needed (NMFS 2004). When a species is listed under the ESA, a recovery plan generally must be prepared (ESA Section 4(f)(1)). The ESA envisions recovery plans as the central organizing tool for guiding each species' recovery process. The recovery plan is a road map to recovery – it lays out where we need to go and how best to get there. The plan organizes, coordinates, and prioritizes the many possible actions that may be taken to achieve recovery of a species. Use of a recovery plan ensures that recovery efforts target limited resources effectively and efficiently.

Recovery plans are guidance documents. No agency or entity is required by the ESA to implement a recovery plan. However, recovery plans describe how Federal agencies can best meet their responsibilities under the ESA. Specifically, section 7(a)(1) of the ESA calls on all Federal agencies to "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species…" In addition to outlining strictly proactive measures to achieve the species' recovery, plans provide context and a framework for implementation of other provisions of the ESA with respect to a particular species, such as section (7)(a)(2) consultations on Federal agency activities, development of Habitat Conservation Plans or Safe Harbor agreements under Section 10, or special rules for threatened species under section 4(d).

1.3 Achieving Recovery

Even with NMFS and other Federal agencies doing all within their power to achieve recovery of SONCC coho salmon, recovery will likely not occur. Federal agencies have neither the funds nor the authority to bring about all the actions necessary to sufficiently improve the condition of this species. Partnerships are a critical component of SONCC coho salmon recovery: partnerships between private landowners, tribes, and local, state, and federal government agencies; between non-governmental organizations and landowners; and between federal, state, and local agencies. A recovered ESU can provide ecosystem, recreation, and economic benefits to communities. All of these entities have a common interest in bringing healthy coho salmon populations and their ecosystems back to California's north coast. The states of California and Oregon have been proactive in determining the recovery needs of coho salmon.

1.3.1 Oregon Plan for Salmon and Steelhead

The Oregon Coastal Salmon Restoration Initiative (OCSRI) is a planning process which began in 1995 with the following mission " To restore our coastal salmon populations and fisheries to productive and sustainable levels that will provide substantial environmental, cultural, and economic benefits." In 1997, the State of Oregon released the Oregon Plan, a conservation plan designed to restore salmon to a level at which they can once again be a part of people's lives (State of Oregon 1997). The Oregon Plan included the following goals:

- Goal 1: An infrastructure will exist to provide long-term continuity in leadership, direction, and oversight of salmon restoration.
- Goal 2: Opportunities will exist for a wide range of natural resource uses that are consistent with salmon restoration.
- Goal 3: Achievement of overall OCSRI goals will be based to the greatest extent on existing laws and environmental protections, rather than new ones.
- Goal 4: An adequate funding base will be established and maintained to support the OCSRI.
- Goal 5: Oregon's expectations for sustainability of interrelated natural resources will more accurately reflect a scientific understanding of the physical and biological constraints of the ecosystem.
- Goal 6: Sufficient freshwater and estuarine habitat will be available to support healthy populations of anadromous salmonids throughout coastal riverbasins.
- Goal 7: Populations of salmonids in coastal river basins will achieve levels of natural production consistent with overall restoration goals.
- Goal 8: A science-based system will support evaluation of progress of the OCSRI Conservation Plan and will provide a basis for making appropriate future changes to management programs.

ODFW concerns with recovery framework

ODFW has concerns that the methods used to produce Williams et al. (2006) may overestimate the extent of historic coho production in the populations within the Northern Coastal and Interior Rogue diversity strata. Further, ODFW believes these methods may have led to inaccurate characterizations of historic populations as larger than they likely were. Finally, ODFW believes the low-risk targets for core populations may not need to be achieved if the other 3 VSP criteria are being met. This has been identified as a critical research need in Chapter 5 and ODFW intends to reevaluate the population structure, and associated recovery criteria, within the Northern Coastal and Interior Rogue diversity strata as part of a conservation planning process. ODFW is in general agreement with NMFS on the recovery actions needed for Oregon populations, including a recovery action (present in all populations) which calls for refinement of the methods used to delineate populations and set population targets.

Report of Oregon Expert Panel

ODFW (2008b) convened a panel of fisheries and watershed scientists as an initial step in their development of a recovery plan for Oregon's SONCC coho salmon populations. Deliberations of the expert panel provided ODFW with initial, strategic guidance on limiting factors and threats to recovery. The panel identified limiting factors and threats affecting each SONCC coho independent and dependent population in Oregon by considering the impacts across the entire life cycle. The results of the expert panel deliberations are described in each Oregon population profile.

1.3.2 Recovery Strategy for California Coho Salmon

Coho salmon north of San Francisco were listed as threatened under the California Endangered Species Act in 2002. In 2004, the California Fish and Game Commission approved the Recovery Strategy for California Coho Salmon (CDFG 2004). The plan identified six goals to achieve delisting:

- Goal I: Maintain and improve the number of key populations and increase the number of populations and cohorts of coho salmon.
- Goal II: Maintain and increase the number of spawning adults.
- Goal III: Maintain the range, and maintain and increase distribution of coho salmon.
- Goal IV: Maintain existing habitat essential for coho salmon.
- Goal V: Enhance and restore habitat within the range of coho salmon.
- Goal VI: Reach and maintain coho salmon population levels to allow for the resumption of Tribal, recreational, and commercial fisheries for coho salmon in California.

1.4 Listing of Species

The SONCC coho salmon ESU was listed as threatened in 1997, and this status was reaffirmed in 2005 (62 FR 24588, May 6, 1997 and 70 FR 37160, June 28 2005). This ESU includes all coho salmon populations between Punta Gorda, California and Cape Blanco, Oregon) and all coho salmon produced by hatcheries in that range in 2005. The decision to list the SONCC coho salmon ESU was largely based on information regarding decreased abundance, reduced distribution, and degraded habitat. There are far fewer streams and rivers supporting coho salmon in this ESU now compared to historic conditions, and numerous basin-specific extirpations of coho salmon have been documented (Brown et al. 1994, NMFS 1996, CDFG 2004, Good et al. 2005, Gustafson et al. 2007). At the time of listing, the major factors in the decline of the species were thought to originate from long-standing, human-induced actions (e.g., habitat degradation, harvest, water diversions, and artificial propagation), combined with natural environmental variability (62 FR 24588, May 6, 1997). .

The SONCC coho salmon ESU is made up of 45 ephemeral, dependent, and independent populations (Williams et al. 2006). Five of these populations are not part of the recovery strategy described in this plan: Three were excluded due to reductions in IP (see Appendix A), and two are ephemeral.

According to Section 4(a)(1) of the ESA and NMFS listing regulations (50 CFR Part 424), a species may be found to be endangered or threatened based on any one or a combination of five factors: (A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; and (E) other natural or human-made factors affecting its continued existence. The effect of these factors on SONCC coho salmon was considered when the species was listed. The descriptions of each of the factors that follow summarize the final rule from the listing of the SONCC coho salmon ESU (62 FR 24588, May 6, 1997). Chapter 3, as well as Chapters 8 to 48, describe the state of current stresses and threats.

1.4.1 Factor A: Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range

The habitat factors for the decline of SONCC coho salmon are as follows: Channel morphology changes, substrate changes, loss of instream roughness, loss of estuarine habitat, loss of wetlands, loss/degradation of riparian areas, declines in water quality (e.g., elevated water temperatures, reduced dissolved oxygen, altered biological communities, toxics, elevated pH, and altered stream fertility), altered streamflows, fish passage impediments, elimination of habitat, and direct take (62 FR 24588, May 6, 1997). The major activities responsible for the decline of coho salmon were identified as follows: logging, road building, grazing and mining activities, urbanization, stream channelization, dams, wetland loss, beaver trapping, water withdrawals, and unscreened diversions for irrigation (62 FR 24588, May 6, 1997).

1.4.2 Factor B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Overfishing in non-tribal fisheries was identified as a significant factor in the decline of coho salmon (62 FR 24588, May 6, 1997). Significant overfishing occurred from the time marine survival turned poor for many stocks (ca. 1976) until the mid-1990s when harvest was substantially curtailed. This overfishing compromised escapement levels. The contribution of recreational fisheries to the decline was unknown at the time of listing. Tribal harvest was not considered to be a major factor for the decline of coho salmon in either the Klamath River basin or Trinity River basin (62 FR 24588, May 6, 1997). Collection for scientific research and educational programs was believed to have little or no impact on coho salmon populations in the SONCC coho salmon ESU at the time of listing (62 FR 24588, May 6, 1997).

1.4.3 Factor C: Disease or Predation

At the time of listing, disease and predation were not believed to be major factors contributing to the overall decline of coho salmon, although it was recognized that they may have had substantial impacts in local areas (62 FR 24588, May 6, 1997).

1.4.4 Factor D: Inadequacy of Existing Regulatory Mechanisms

Habitat Management

Federal lands owned by the U.S. Forest Service (in California and Oregon) and Bureau of Land Management (in California) are managed under the Northwest Forest Plan. NMFS determined the Northwest Forest Plan has important benefits for coho salmon, but that its overall effectiveness in conserving SONCC coho salmon is limited by the extent of federal lands and the fact that Federal land ownership is often not uniformly distributed. Federal lands are often located in the upper reaches of watersheds or river basins, upstream of much of the most suitable coho salmon rearing habitat. In addition, in some areas Federal lands are distributed in a checkerboard fashion, which results in fragmented landscapes.

NMFS determined California’s forest practice rules (CFPRs) contained provisions that can be protective of coho salmon if fully implemented, but found the ability of these rules to protect coho salmon could be improved (62 FR 24588, May 6, 1997). In particular, the CFPRs did not adequately address large woody debris recruitment, streamside tree retention to maintain bank stability, and canopy retention standards that assure stream temperatures are properly functioning for all life stages of coho salmon. NMFS was not able to assess the adequacy of the CFPRs due to the lack of published documentation that the CFPRs are functioning to protect coho salmon (62 FR 24588, May 6, 1997). The CFPRs were revised in 2009 and renamed the Anadromous Salmonid Protection Rules, which are described in Chapter 3.

NMFS determined that Oregon’s Forest Practices Act (OFPA) did not have implementing rules that adequately protect coho salmon habitat. NMFS determined that there was a low probability that adequate LWD recruitment could be achieved under the requirements of the OFPAs. The OFPA was also found to not adequately consider and manage timber harvest and road construction on sensitive, unstable slopes subject to mass wasting, nor did it address cumulative effects. In particular, the OFPA was found to not provide adequate protection for the production and introduction of large woody debris (LWD) to medium, small, and non-fish bearing streams.

The Army Corps of Engineers regulates removal and fill activities under section 404 of the Clean Water Act (CWA), and the Oregon Division of State Lands (DSL) manages the state-permitted portion of the removal fill laws. At the time of listing, neither the ACOE nor the DSL had in place any process to address the additive effects of the continued development of waterfront, riverine, coastal, and wetland properties (62 FR 24588, May 6, 1997).

Implementation of the CWA was found to have not been effective in adequately protecting fishery resources, especially with respect to non-point sources of pollution (62 FR 24588, May 6, 1997). Total Maximum Daily Loads (TMDLs) are calculations of the maximum amount of pollutant (e.g., sediment, temperature) that a waterbody can receive and still safely meet water quality standards. TMDLs are a method for quantitative assessment of environmental problems which affect drinking water, aquatic life, recreation, and other uses of rivers, lakes, and streams. The ability of TMDLs to protect SONCC coho salmon was expected to be significant in the long-term, but their effectiveness was as yet unknown because few, if any, TMDLs had been developed for water bodies in the range of SONCC coho salmon at the time of listing (62 FR 24588, May 6, 1997).

At the time of listing, the impacts to fish habitat from agricultural activities had historically not been closely regulated, but Oregon's Department of Agriculture had recently completed guidance for development of Agricultural Water Quality Management Plans (AWQMPs). It was unknown whether AWQMPs would adequately address salmonid habitat factors (62 FR 24588, May 6, 1997).

Harvest Management

The final rule described fishery regulations implemented in 1994 which are more protective of SONCC coho salmon than were historical regulations (62 FR 24588, May 6, 1997). Specifically, in 1994 the Pacific Fishery Management Council (PFMC) recommended harvest rates below those allowed, and the PFMC recommended prohibiting the retention of coho salmon south of Cape Falcon, Oregon, resulting in the closure of commercial ocean fishing for coho salmon in California in 1994. Oregon began marking all hatchery fish, to aid in more accurate estimates of natural returns. State regulations for ocean fisheries within 3 miles of shore had generally conformed to these more protective regulations. In 1995, ocean recreational fishing was closed from Cape Falcon to Horse Mountain. Amendment 13 to the Pacific Fishery Management Council (PFMC) Fishery Management Plan (FMP), approved in 1999, limited marine fishery impacts on SONCC coho to no more than 13.0 percent (PFMC 1999).

1.4.5 Factor E: Other Natural or Human-made Factors

NMFS determined that long-term trends in rainfall and marine productivity associated with atmospheric conditions in the North Pacific Ocean likely have a major influence on coho salmon production (62 FR 24588, May 6, 1997). The effects of extended drought on water supplies and water temperatures were recognized as a major concern for California populations of coho salmon. Poor ocean conditions were believed to have played a prominent role in the decline of coho salmon populations in Oregon and California (62 FR 24588, May 6, 1997).

The widespread use of artificial propagation of coho salmon was recognized to have had a significant negative impact on the production of West Coast coho salmon (62 FR 24588, May 6, 1997). Potential problems associated with hatchery programs include: genetic impacts on indigenous, naturally-reproducing populations, disease transmission, predation on wild fish, depletion of wild stock to increase brood stock, and replacement rather than supplementation of wild stocks through competition and continued annual introduction of hatchery fish. Advancement and compression of run timing has also been a common effect of hatchery programs.

1.5 Critical Habitat Designation

Critical habitat for SONCC coho salmon was designated as all accessible reaches of rivers (including estuarine areas and tributaries) between the Cape Blanco, Oregon, and Punta Gorda, California (64 FR 24049, May 5, 1999) . Critical habitat includes all waterways, substrate, and adjacent riparian zones below longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). Tribal lands that were excluded in the critical habitat designation include: Big Lagoon Rancheria, Blue Lake Rancheria, Elk Valley Rancheria, Hoopa Valley Indian Reservation, Karuk Reservation, Laytonville Rancheria, Quartz Valley Reservation, Resighini Rancheria, Round Valley Reservation, Sherwood Valley Rancheria, Smith River Rancheria, and Yurok Reservation.

In the critical habitat designation, NMFS identified five essential habitat types for SONCC coho salmon: (1) spawning areas; (2) adult migration corridors; (3) juvenile summer and winter rearing areas; (4) juvenile migration corridors; and (5) areas for growth and development to adulthood. Spawning and rearing are often located in small headwater streams and side channels. Adult and juvenile migration corridors include these tributaries as well as mainstem reaches and estuarine zones. Growth and development to adulthood occurs primarily in near-and off-shore marine waters, although final maturation takes place in freshwater tributaries when the adults return to spawn (64 FR 24049, May 5, 1999). Within these areas, essential features of coho salmon critical habitat include adequate substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions. In addition, designated freshwater and estuarine critical habitat includes riparian areas that provide the following functions: shade, sediment, nutrient or chemical regulation, stream bank stability, and input of large woody debris or organic matter (64 FR 24049, May 5, 1999).

1.6 4(d) Protective Regulation

NMFS regulations under ESA Section 4(d) of the ESA (50 CFR § 223.203) exempt or “limit” a range of activities from the take prohibitions for certain threatened salmon, including SONCC coho salmon. Section 4(d) of the ESA directs NMFS to issue regulations to conserve species listed as threatened. This applies particularly to “take”. The ESA prohibits any take of species listed as endangered, but some take of threatened species that does not interfere with salmon survival and recovery can be allowed. NMFS initially promulgated a 4(d) protective regulation for this ESU in 2000 (65 FR 42422, July 10, 2000) and subsequently amended the regulations which are codified at 50 CFR § 223.203.

The rule's principal function is to prohibit actions that take threatened species without a specific approval or authorization (NMFS 2003). The rule applies to ocean and inland areas and to any authority, agency, or private individual subject to U. S. jurisdiction. The rule does not prohibit actions or programs—it prohibits illegal take. Activities that do not kill or injure protected salmon and steelhead do not require any special authorization and are not affected by the rule. The limits can be thought of as exceptions to the take prohibitions. To be approved for a limit on ESA take prohibitions, a program must adequately contribute to the conservation of salmon and meet their biological requirements. The limits represent programs or activities, or criteria for future programs or activities, for which take prohibitions are not applied.

1.7 Addition of hatchery stocks to SONCC coho salmon ESU

NMFS established a policy on the role of artificially propagated Pacific salmon and steelhead in listing determinations under the ESA (70 FR 37204, June 28, 2005). Specifically, this policy: (1) establishes criteria for including hatchery stocks in ESUs and DPSs; (2) provides direction for considering hatchery fish in extinction risk assessments of ESUs and DPSs; (3) requires that hatchery fish determined to be part of an ESU be included in any listing of an ESU or DPS; (4) affirms our commitment to conserving natural salmon and steelhead populations and the ecosystems upon which they depend; and (5) affirms our commitment to fulfilling trust and treaty obligations with regard to the harvest of some Pacific salmon and steelhead populations, consistent with the conservation and recovery of listed salmon ESUs and steelhead DPSs.

To determine whether a hatchery program was part of an ESU or DPS, NMFS convened the Salmon and Steelhead Hatchery Advisory Group (SSHAG), which divided existing hatchery programs into categories (SSHAG 2003). Because the new hatchery listing policy changed the way NMFS considered hatchery fish in ESA listing determinations, we completed new status reviews and ESA-listing determinations for many West Coast salmon ESUs and steelhead DPSs. NMFS issued final listing determinations (70 FR 37160, June 28, 2005) for 16 ESUs of Pacific salmon, including the SONCC coho salmon ESU. This listing determination added three artificial propagation programs to the SONCC coho salmon ESU: The Cole Rivers Hatchery, Trinity River Hatchery, and Iron Gate Hatchery coho hatchery programs. NMFS determined these artificially propagated stocks were no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU.

1.8 Status reviews

1.8.1 2005 Status Review

In 2004, NMFS convened a biological review team (BRT) to evaluate the status of SONCC coho salmon. The BRT report (Good et al. 2005) concluded that the SONCC Coho Salmon ESU remained at a threatened status. The BRT found that data did not suggest any marked change, either positive or negative, in the abundance or distribution of coho salmon within the SONCC coho salmon ESU. They stated that coho salmon populations continued to be depressed relative to historical numbers, and there were strong indications that breeding groups had been lost from a significant percentage of streams within their historical range (Good et al. 2005). The BRT noted that the 2001 broodyear appeared to be one of the strongest perhaps of the last decade, following a number of relatively weak years (Good et al. 2005). Risk factors identified in previous status reviews such as severe declines from historical run sizes, the apparent frequency of local extinctions, long-term trends that were clearly downward, and degraded freshwater habitat and associated reduction in carrying capacity continued to concern the BRT. The BRT noted that several risk factors had been reduced, including termination of hatchery production of coho salmon at Mad River and Rowdy Creek and restrictions on recreational and commercial harvest of coho salmon since 1994 (Good et al. 2005). A new risk identified by the BRT was the introduction of nonnative Sacramento pikeminnow (*Ptychocheilus grandis*) to the Eel River (Good et al. 2005).

1.8.2 2011 Status Review

The most recent status review concluded the ESU remains threatened (NMFS 2011). Monitoring indicates that abundance of coho salmon decreased for many populations in the ESU since the last status review. Population trends are downward. Additionally, a majority of independent populations are well below low-risk abundance targets, and many may also be below the high-risk depensation thresholds. None of the seven diversity strata appear to support a single viable population. However, all of the diversity strata are occupied by coho salmon.

The authors of the status review expressed concern about these recent declines in abundance of coho salmon across the ESU, regardless of what the contributing factor(s) may have been (e.g., marine survival conditions and drought). The negative short-term trends observed in the limited number of time series were not unexpected given the apparent low marine survival in recent years (<1% for the 2004 to 2006 year classes). However, as population sizes have decreased other factors (e.g., small population dynamics) may be adversely affecting coho salmon populations in spite of the improved ocean conditions that occurred from 2007 to 2009. The declining abundance trends and low spawner abundance for most populations in the ESU underscore the importance of addressing freshwater habitat conditions across the ESU so that all populations are sufficiently resilient to withstand fluctuations in marine survival.

The threats discussed in the five factor analysis were found to be largely unchanged since the last status review with the exception of those associated with natural or manmade factors (NMFS 2011). In particular, threats from poor ocean conditions, drought, climate change, and small population size (depensation and stochastic processes) have or are likely to have increased and may be responsible for the observed declines in abundance. The marine survival of hatchery fish from the Cole Rivers Hatchery on the Rogue River was extremely low for the 2005 and 2006 brood years (i.e., 0.05% and 0.07%, respectively) and the average ocean conditions in 2010 (NWFSC 2011) suggest there may be poor marine survival for the 2011 spawning season. Drought conditions occurred for three consecutive years (2007-2009) that decreased instream flows and habitat conditions for juvenile coho salmon and very likely reduced their freshwater survival. Although whether significant habitat changes are occurring from climate change is unclear, the authors expect a wide range of future detrimental changes to coho salmon habitat. Lastly, because many coho salmon populations in this ESU are low in abundance, and may well be below their depensation thresholds, their risk of extinction may also be increasing.

1.9 Species Description and Taxonomy

The coho salmon generally exhibit a relatively simple 3-year life cycle. Adults typically begin their freshwater spawning migration in the late summer and fall, spawn by mid-winter, and then die. The run and spawning times vary between and within populations. Depending on river temperatures, eggs incubate in ‘‘redds’’ (gravel nests excavated by spawning females) for 1.5 to 4 months before hatching as ‘‘alevins’’ (a larval life stage dependent on food stored in a yolk sac). Following yolk sac absorption, alevins emerge from the gravel as young juveniles or ‘‘fry’’ and begin actively feeding. Juveniles rear in fresh water for up to 15 months, then migrate to the ocean as ‘‘smolts’’ in the spring. Coho salmon typically spend 2 growing seasons in the ocean before returning to their natal stream to spawn as 3 year-olds. Some precocious males, called ‘‘jacks,’’ return to spawn after only 6 months at sea.

1.9.1 Life History

Spawning and Incubation

Most coho salmon spawning streams flow directly into the ocean or are tributaries of large rivers. Females tend to prepare their redds (gravel nests) and spawn soon after arriving on spawning grounds between November and January with spawning timing varying by watershed within the ESU (Weitkamp et al. 1995). Coho generally choose sites to spawn in near the head of a riffle, just below a pool where there is abundant small to medium gravel (Shapovalov and Taft 1954) and the number of fertilized eggs deposited in each redd is based on the fecundity of the female and their individual fertilization success. Fecundity ranges between 1,400 to 3,000 eggs and these eggs are dispersed among pockets within the redd (Sandercock 1991). Larger females tend to produce larger and a greater number of eggs. Migration distance can also influence egg production, with longer migrations inhibiting egg size and/or quantity (Kinnison et al. 2001). All these differences drive population-specific differences in fecundity and egg size (Beacham 1982, Hjort and Schreck 1982,Taylor and McPhail 1985, Swain and Holtby 1989, Fleming and Gross 1990, Murray et al. 1990).

Once spawning is complete the female will cover the redd with gravel and guard it until she dies (approximately 4 to 15 days) (Weitkamp et al. 1995). Ultimately the success of reproduction depends on a number of environmental and biological factors that occur within the redd, the spawning site, and within the watershed. Many of these factors are linked to the timing of reproduction, one of the most critical adaptations coho salmon make to their spawning environment.

Embryonic development begins when the egg is fertilized and developmental rate and incubation period are inversely related to water temperature. In most streams in Oregon and California incubation takes place between November and April and lasts between 38 to 48 days depending on water temperature (Shapalov & Taft 1954). The time between hatching and fry emergence is also dependent on temperature and dissolved oxygen levels in the redd, and can last between 4 and 10 weeks. The percentage of eggs and alevins (a larval life stage dependent on food stored in a yolk sac) that survive to emergence is dependent on stream and riverbed conditions with winter flooding, with its associated scour and gravel movement accounting for a high proportion of losses. Low flows, freezing, heavy silt loads, bird and insect predation, and infections can also lead to mortality. Over their entire lives, from egg to adult, the majority of salmon mortality takes place during this period in the gravel. Under very harsh conditions, no eggs or alevins will survive. Under average conditions between 15 to 27 percent will survive to emergence (Neave 1949, Crone and Bond 1976) and in favorable conditions between 65 to 85 percent will survive (Shapovalov and Taft 1954). Studies from California and Oregon found average survival to be between 27.1 percent and 74.3 percent (Briggs 1953, Koski 1966).

At the end of incubation, once the yolk sac absorption is nearly or fully complete, alevins emerge from the gravel at night as "fry". Emergence of coho salmon in California starts two to three weeks after hatching but can take up to 2 to 7 weeks longer for late developers. The total emergence period can last between 10 and 47 days. Fry emergence takes place between March and July, with peak emergence in March and May (Shapovalov and Taft 1954, Koski 1966). Fry are approximately 30 mm in length when they emerge with earlier emergence linked to larger size and greater growth opportunity (Mason and Chapman 1965,Sandercock 1991).

Rearing and Outmigration

After emergence, fry seek out shallow water along stream margins. The dominant life history pattern is for juvenile coho salmon to feed and rear within the streams of their natal watershed for a year before migrating to the ocean. However, they may spend up to two years rearing in freshwater (Bell and Duffy 2007), or emigrate to an estuary shortly after emerging from spawning gravels (Tschaplinski 1988). The occurrence of age-0 "ocean-type" coho salmon migrants to the estuary, stream-estuary ecotone, or lower main-stem reaches has been documented throughout the range of coho salmon and is thought to be another alternative life history (Chapman et al. 1961; Chapman 1962; Hartman et al. 1982; Murphy et al. 1984; Rodgers et al. 1987, Au 1972, Kahler et al. 2001, Ryall and Levings 1987). In California and Oregon some of these fish rear in the estuary during the summer then return upstream to overwinter (Miller and Sadro 2003). This primarily occurs in watersheds with adequate estuarine rearing habitat (Merrell and Koski 1978). Extended freshwater residence in California streams has also been recently documented for age-1+ coho salmon (Ransom 2007). The proportion of a cohort that exhibited extended rearing ranged from 0 percent to almost 30 percent among streams and was linked most strongly to peak winter streamflow. Coho salmon have also been shown to utilize non natal streams for rearing and to redistribute into riverine ponds following fall rains (Peterson 1982). The extent to which fish utilizing these alternative life history patterns contribute to adult returns is not known. However, they demonstrate the diversity of strategies that are potentially used by juvenile coho salmon in the ESU.

For juvenile coho salmon that spend at least a year rearing in freshwater streams, this habitat offers the opportunity to grow prior to migration to larger rivers and the ocean. While rearing in such environments, salmon experience slow growth but a relatively low predation risk compared with downstream habitats (Quinn 2005). Depending on the size of the stream in which it emerged, coho salmon fry may move upstream or downstream to rear after emergence. The most productive coho areas tend to be small streams but other rearing areas include lakes, sloughs, side channels, estuaries, beaver ponds, low-gradient tributaries to large rivers, and large areas of slack water (PFMC 1999). During this time, juveniles set up territories for feeding, especially in pool areas of streams (Hartman 1965). The abundance of coho salmon in streams is limited by the number of suitable territories available and streams with more complex habitat support larger numbers of fry (Scrivener and Andersen 1982, Larkin 1977).

During summer, juvenile coho move into deep pools and areas with dense shade and large woody debris (LWD) for refuge from high summertime temperatures (Nickelson et al. 1992; Brown et al. 1994). A study of coho salmon occurrence in tributaries of the Mattole River suggested that a MWMT (maximum weekly maximum temperature) greater than 18.1°C or a MWAT (highest average of mean daily temperature over any seven-day period (MWAT) greater than16.8°C would preclude the occurrence of coho salmon.

During winter, subyearling coho salmon depend on smaller tributary streams, deeper pools, and other types of flow refugia for survival (Tripp and McCart 1983, Skeesick 1970, Narver 1978). During this period of stream rearing the most factors influencing survival and growth include water discharge rate, temperature, and predation. Predation rates and predators vary by stream but important predator species include rainbow trout and cutthroat trout. Most mortality takes place in the first summer. Fry-to-smolt survival rates average between 1.27 percent and 1.71 percent (Godfrey 1965).

Weitkamp et al. (1995) found no regional pattern for either smolt outmigration timing or smolt size for West Coast coho salmon. Downstream migration of coho salmon in the SONCC coho salmon ESU begins in the spring sometime between April and May and continues into June. Most smolts measured between 90 and 115 mm fork length. Factors affecting the onset of emigration include the size of the fish, flow conditions, water temperature, dissolved oxygen (DO) levels, day length, and the availability of food (Shapovalov and Taft 1954). Because of smolt size and migration timing are related to small-scale habitat variability, size and migration timing have been shown to be affected by anthropogenic activities, including habitat degradation (Moring and Lantz 1975, Scrivener and Andersen 1984, Holtby and Scrivener 1989), habitat restoration (Johnson et al. 1993, Rodgers et al. 1993), and flow control (Fraser et al. 1983). Variability in these conditions leads to strong inter-annual and stream-specific differences in smolt size and migratory timing (Weitkamp et al. 1995).

A juvenile's downstream migration to the ocean is accompanied by a series of internal changes in morphology, physiology, and behavior needed for a transition to saltwater. Travel rates to reach the ocean are determined by flow rates, date, and distance as well as individual based characteristics such as the extent of parr-smolt transformation. Travel rates increase with flow rates and travel distance. Fish migrating later in season also move faster than fish migrating earlier in the year (Dawley et al. 1986). Mortality from downstream migration is positively correlated to the distance traveled and has been linked to predation and hydropower operations in past studies (Quinn 2005). Once fry reach the estuary they will spend a variable amount of time completing the fry-to-smolt transformation. Estuarine residence is variable and is dependent on variety of factors, many of which remain unknown for this species of salmon. Growth rates in estuaries are generally higher than freshwater habitats and many juvenile coho salmon take advantage of feeding opportunities and time to transition to salt water while in the estuary. Depending on the opportunity and capacity of the estuary, coho salmon on the Oregon and California coast will spend anywhere from a few days to a few weeks in the estuary (Miller and Sadro 2003).

The synchrony of arrival timing in coastal waters and the availability of food is especially critical for determining the survival rates of different cohorts (Walters et al. 1978). Many studies have shown that the timing of outmigration can have a large impact on the survival of coho salmon at sea (Pearcy 1992). Depending on marine productivity and food availability when coho salmon first enter the ocean (based on strong winds, upwelling, and cool water), conditions will either reduce or enhance survival and growth. Because these conditions can be highly variable year to year, the ideal ocean entry date varies as well. The SONCC coho salmon ESU has evolved to have multiple life history strategies with a range in timing of outmigration. The earliest outmigration in the SONCC coho salmon ESU occurs in Roach Creek on the Klamath River and Ten Mile Creek on the Eel River (March or earlier). The latest occur in the South Fork of the Eel River (mid June or later). Because of this, the Eel River has the broadest range of outmigrant timing (March to August) (Weitkamp et al. 1995). The average size of outmigrating coho salmon is approximately 128 mm with the largest smolts originating from the Trinity River (mean 147 mm) and the smallest originating from Blue Creek on the Klamath River (mean 104 mm). The large sizes of Trinity River smolts likely results from hatchery operations in that basin, which produce larger than average smolts. The range of smolts sizes in the SONCC coho salmon ESU is between 90 and 200 mm (Weitkamp et al. 1995).

Ocean Migration

Early ocean migration patterns of young coho salmon have been described in a number of studies (e.g., WeitkampBrodeur et al. 2004, Van Doornik et al. 2007, Weitkamp et al. 1995). By the beginning of their first winter at sea, coho salmon begin to move more broadly into feeding grounds. Studies using coded wire tags (CWT) have shown that this dispersal at sea is regionally-specific with coho salmon from northern California and Oregon south of Cape Blanco dispersing locally (Weitkamp and Neely 2002). These fish were recovered primarily in California (65 to 92 percent), with some recoveries in Oregon (7 to 34 percent) and almost none (<1 percent) further north. Compared with other coho salmon populations, the SONCC coho salmon ESU has a comparatively small marine distribution. Coho salmon occur in the upper part of the water column in the open ocean, at observed depths of from about 10 to 25 m (summarized by Quinn 2005).

One potential reason SONCC coho salmon do not move farther north is the productivity associated with upwelling areas off the coast of California, which provide high densities of food (Moyle 2002). When they first enter coastal areas, coho salmon feed primarily on marine invertebrates; as they grow larger, they shift to more piscivorous diets (Shapovalov and Taft 1954). Coho salmon feed opportunistically on a variety of prey items including small pelagic fishes, shrimp, crab and crab larvae, and other pelagic invertebrates (Sandercock 1991). Growth associated with feeding opportunities at sea is rapid and most fish can double their length and increase their weight more than tenfold their first summer.

While there are many opportunities for growth at sea, coho salmon experience high predation pressures and steep mortality. Studies of smolt-to-adult survival place estimates between 1 percent and 10 percent with the greatest mortality during the first summer at sea. Factors such as size, physiological condition, migration date, and ocean conditions can all influence mortality and under optimum conditions survival can be as high as 40 percent (Sandercock 1991). In addition to ocean entry timing as a factor influencing survival (as discussed above), size is also important in minimizing mortality since much of the predation that occurs at sea is size-selective (McGurk 1996, Shapavalov and Taft 1954). Generally, small fish have higher mortality rates than larger fish up until about 100 mm (Koenings et al. 1993). Predation is also thought to be an important cause of mortality on smaller fish in their first year at sea and has less of an impact on adult populations.

Maturation

The growth and survival of adult coho salmon is closely linked to marine productivity, which is controlled by complex physical and biological processes that are highly dynamic and vary greatly over space and time. Shifts in salmon abundance due to climatic variation are known to be large and sudden (Beamish et al. 1999). Short and long-term cycles in climate [e.g., El Niño/La Niña and the Pacific Decadal Oscillation (PDO)] are thought to affect adult coho salmon size, abundance, and distribution at sea, as does inherent year-to-year variation in environmental conditions not associated with climatic cycles. Several studies have related ocean conditions specifically to coho salmon production (Cole 2000), ocean survival (Ryding and Skalski 1999, Koslow et al. 2002), and spatial and temporal patterns of survival and body size (Hobday and Boehlert 2001, Wells et al. 2006). The link between survival and climate could be operating via the availability of nutrients regulating the food supply and hence competition for food (Beamish and Mahnken 2001). For example, the 1983 El Niño event off the Pacific coast of North America resulted in increased adult mortality and decreased average size for Oregon's returning coho salmon. Juvenile coho salmon entering the ocean in the spring of 1983 also had low survival, resulting in low adult returns in 1984 (Johnson 1988). Larger-scale decadal to multi-decadal events also have been shown to affect ocean productivity and coho salmon (Hare and Francis 1995; Mantua et al 1997; Beamish et al. 1997a; Beamish et al. 1999; Pearcy 1992; Lawson 1993). Although salmon evolved in this variable environment and are well suited to withstand climactic changes, the resiliency of the adult population has been reduced by the loss of life history diversity, lower population abundance, cohort loss, and fragmentation of the spatial population structure. Changes in the freshwater environment (e.g., loss and degradation of habitat) have also weakened the ability of coho salmon to respond to the natural variability in ocean conditions.

The age composition and size of coho salmon at maturity is influenced by a number of factors including growth rate, sex, origin (either hatchery or wild and population), and genetics (Quinn 2005). Based on these factors, coho salmon exhibit a range of ages and sizes at maturation. The most common life history strategy for coho salmon in the SONCC coho salmon ESU is a fairly strict 3-year life cycle, with most coho salmon spending approximately 18 months at sea before returning to their natal rearing grounds to spawn (Gilbert 1912, Briggs 1953, Shapovalov and Taft 1954, Loeffel and Wendler 1968, Weitkamp et al. 1995). The most recent data show that the average size of returning adults in Oregon and California is between 56.4 and 64.6 cm (average 62.7). Variations to this life history do exist and some fish return after only 5 to 7 months at sea. These "jacks" that return early act to keep runs from being genetically isolated based on a strict 3-year return year. In general, coho salmon that migrate earlier than average and at a size larger than average are believed to produce a higher rate of jack returns (Bilton et al. 1984). The proportion of jacks returning to spawn is more common in populations at the southern range of the ESU and the proportion of jacks is higher than those in other coho salmon ESUs. Studies have shown highly variable numbers of returning jacks to Oregon and California streams. Jacks in the Klamath River made up to 97 percent of returns in one year between 1984 and 1987 (average 59 percent) (Hopelain 2001). Other studies have shown the jacking rate ranges from 7 percent to 34 percent (e.g., Murphy 1952).

The size of coho salmon when they reach maturity also exhibits spatial and temporal variability along with the age at maturity. Size is dependent on factors related to growth and genetic heritage with the sex, origin, age, and run timing all influencing the size of a fish when it reaches maturity. In general, coho salmon in later runs tend to be larger than those in earlier runs (Sandercock 1991), coho salmon from mainstem areas are often larger than those spawning in tributaries (Lister et al. 1981), males tend to be larger than females, and older fish are larger than younger fish. Of available data from southern Oregon and northern California streams and rivers, the smallest spawners tend to come from the Rogue River (average 56 cm between 1976 to 1986) and the largest tend to come from Redwood Creek (average 76.1 cm between 1950 to 1951). The range for this area is between 30 and 91 cm (Weitkamp et al. 1995).

One overall trend across the range of coho salmon is the observed decrease in size of mature fish over the past 50 years. Harvest practices, effects of fish culture, declining ocean productivity, and density-dependent effects in the marine and freshwater environments attributable to large numbers of hatchery releases are potential factors leading to this decline. Weitkamp et al. (1995) noted that the rate of this decline are population, or area, specific with the highest rates of decline in Oregon and California being observed in Rogue River spawners (Slope = -1.50). The CA and OR troll data on coho size also supports a regional decline in size (Slope = -0.05). In the few creeks within the SONCC coho salmon ESU with historic and current data for comparison, average declines averaged between 1.1 and 4.2 cm per decade. These declines in adult size have direct implications for individual reproductive success and population viability because smaller spawners have lower fecundity.

Homeward Migration and Spawning

Timing and location of reproduction are two of the most critical adaptations salmon populations make to their environment. Salmon are uniquely evolved in their ability to take advantage of feeding and growth opportunities at sea and optimal spawning conditions in freshwater streams and rivers. Once a salmon starts the process of maturation, it begins a homeward migration to the location in which it was spawned. Once adult coho salmon reach nearshore and estuarine waters they are able to use imprinted chemical cues to help guide them. Imprinting in fry occurs shortly after emergence and is based on stream-specific or population-specific characteristics of their natal stream.

About 95 to 99 percent of all salmon return to their natal stream using these imprinted cues, however a small percentage (the magnitude of which varies temporally and by population) are “strays,” meaning they exhibit non-natal spawning (Quinn 2005). Whether this characteristic of adult coho salmon is genetically, behaviorally, or environmentally influenced is unknown, but ultimately the occurrence of straying contributes to the persistence and distribution of populations and the entire ESU. As a general rule, straying is linked to the stability and degree of specialization of a population or its spawning habitat. Populations occupying “flashy” or steep, unstable coastal streams are more likely to exhibit non-natal rearing as are small ubiquitous coastal streams that require little or no specialization for spawning. Information on straying rates for coho salmon in California are sparse but Shapavalov and Taft (1954) reported values between 15 percent and 27 percent for Scott and Waddell Creek. Other genetic studies of California coho salmon populations show differences among populations that suggest lower effective straying rates. Fish that do stray are most commonly found in spawning areas near their natal stream (Shapovalov and Taft 1954, Jacobs 1988, Labelle 1992).

Upriver migration of adults to spawning areas normally occurs from October to March for populations in the SONCC coho salmon ESU, with a peak between November and January. For most populations, the duration of spawning migration is at least three months or more. Coho salmon river entry timing is influenced by many environmental and genetic factors, the most important of which is river flow (Shapovalov and Taft 1954, Salo and Bayliff 1958, Sumner 1953, Eames et al. 1981, Lister et al. 1981). Coho salmon generally wait for freshets before entering rivers, so a delay in fall rains delays river entry and, potentially, spawn timing as well. Many of the small coastal streams in California are barred over by sand at their mouths, and coho salmon in these streams have to wait to ascend until the sand barriers are breached by high stream flows that follow heavy winter rains. Once a fish enters a river, if conditions in the stream are unsuitable for entry, fish will often hold in the vicinity of the stream mouth for conditions to change, usually marked by a decreasing temperature and increasing flow. This holding allows coho salmon to reach further into headwater streams where good spawning and rearing conditions may exist.

Because of the environmental drivers affecting run timing, this trait shows considerable spatial and temporal variability. Large river systems are especially diverse in terms of coho salmon run timing. For example coho salmon runs in the Klamath River can last over four months with various populations entering the system from late August to mid January (Washington Department of Fisheries (WDF) 1951, Leidy and Leidy 1984, WDF et al. 1993, Polos 1994 App.). In terms of large-scale spatial patterns in run timing, Weitkamp et al. (1995) found some regional patterns that define the SONCC coho salmon ESU. Coho populations in southern Oregon and northern California tend to have later run timing than population to the north. There also appears to be a wider range of timing, with some runs starting in late August (Klamath) and most lasting into mid January.

Once conditions are favorable, adult coho salmon migrate into spawning areas along the coast and in small tributaries of larger rivers. Coho migrate further upstream than chum salmon but not usually as far as Chinook. In general, coho spawning grounds are within 240 km of the coast (Godfrey 1965). Large river systems like the Rogue, Trinity, Klamath, and Eel all historically supported coho salmon in their upper tributaries. Once adult fish reach the spawning grounds, they can spend days, weeks, or months waiting to spawn. During this time salmon are subject to predation and disease prior to spawning.

2. Structure, Viability, and Status of the SONCC Coho Salmon ESU

Much of the plan is drawn from the technical foundations describing the demographic process of species decline and recovery, characteristics of viable salmonid populations, historic structure and function of the ESU, and criteria for SONCC coho salmon viability (e.g., McElhany et al. 2000, Beechie et al. 2003, Williams et al. 2006, Williams et al. 2008). The historic structure and function of the ESU along with the current viability of the ESU provide the biological setting for recovery, and are summarized below.

2.1 Historic Structure and Function of the ESU

Williams et al. (2006) described the population structure of SONCC coho salmon based on the location and amount of potential coho salmon habitat and identified specific populations in the ESU and their demographic characteristics. NMFS considers the approach used, and the outcome of the Williams et al. (2006) analysis, as the best available scientific information on which to base recovery planning. The approach the TRT used was an experimental approach to determining historical abundance. ODFW has concerns that the approach did not accurately reflect what areas were historically used by coho salmon, and as a result has concerns with the criteria that were based on that.

A population is defined as a group of fish of the same species that spawns in a particular location at a particular season and does not interbreed substantially with fish from any other group (McElhany et al. 2000). An integral component for determining the historical population structure for the ESU was estimating the distribution of potential juvenile rearing habitat within each basin. This was accomplished using both historical records and a GIS model. The model used measures of channel gradient, valley width, and mean annual discharge to estimate the potential for a particular stream reach to provide suitable rearing habitat (on a species and life-history basis). This estimated rearing potential is the Intrinsic Potential (IP) of the reach. The IP estimate for each reach was multiplied by its respective reach length, and these values were added together to determine the intrinsic potential-kilometers (IP-km) for the basin. The IP-km is an estimate of the historic rearing habitat carrying capacity, and thus potential habitat carrying capacity for each population in the ESU. A detailed description of the model is provided in Williams et al. (2006), Agrawal et al. (2005), and Burnett et al. (2003).

Basins across the ESU vary greatly in size. Large watersheds, such as the Klamath River watershed, may support multiple populations because they have several large rivers or streams, each supporting unique populations. Small watersheds (e.g., < 4 km of stream) probably did not historically support viable populations, but are not necessarily a part of a larger population. In the development of the historic population structure, Williams et al. (2006) recognized the full range of coho salmon habitat in the SONCC coho salmon ESU. Therefore, each basin would naturally form a separate demographic unit (e.g., population). Since there is a strong tendency for coho salmon to return to their natal stream to spawn (Quinn 1993), the resulting population structure is largely determined by the spatial arrangement of their natal streams, including the structure of freshwater spawning and rearing habitats and migration pathways that allow dispersal among these habitats. Therefore, historical populations are generally based on points of saltwater entry. In addition, spawning groups within a large watershed may comprise multiple discrete populations if sufficient barriers to effective migration exist within that watershed. Large watersheds have substantial gaps in the distribution of suitable spawning and rearing habitats and watershed-scale heterogeneity in environmental conditions that can limit effective migration and therefore result in discrete populations.

Williams et al. (2006) adopted a population classification system that extends the concept of an "independent population" to consider the place of each population with respect to expected viability-in-isolation and self-recruitment. Viability-in-isolation is assessed as a function of population size using IP-km as a surrogate. Modeling by Nickelson and Lawson (1998) showed that extinction probabilities consistently rose sharply as available habitat decreased below 24 km of high quality habitat. Because 24 km of high quality habitat, on average, equals 34 IP-km, a basin with a minimum of 34 IP-km is designated as an independent population. Self-recruitment reflects the proportion of a population's spawners that are native, and is a function of the size of the population, the size of potential donor populations and the distance between populations.

The IP-km and the self-recruitment data define each population into four types. Except for large basins, independent populations that have 95 percent fidelity (0.95 self-recruitment) are designated as Functionally Independent, while populations that have less than 95 percent fidelity are Potentially Independent. Large subbasins in the Trinity, Eel, Rogue, and Klamath River that have over 200 IP-km are designated as Functionally Independent while basins that have less than 200 IP-km are designated as Potentially Independent. Populations that have at least 5 but less than 34 IP-km are designated as Dependent if they have less than 95 percent fidelity, or Ephemeral if they have more than 95 percent fidelity. Basins with less than 5 IP-km are not recognized as populations. Although Williams et al. (2008) recognized a total of 45 populations in the ESU, subsequent modifications to the IP-km for several populations result in a total of 41 populations (i.e., one independent and three dependent populations are eliminated because their revised IP-km were below 5). These modifications are described in Appendix A. Of the 41 total populations, 30 are independent, 9 are dependent, and 2 are ephemeral. Ephemeral populations were not included in the recovery strategy. The role of each population type in the ESU is as follows:

> *Functionally Independent Populations* are those with a high likelihood of persisting in isolation over a 100-year time scale and are not substantially altered by exchanges of individuals with other populations.
>
> *Potentially Independent Populations* have a high likelihood of persisting in isolation over a 100-year time scale, but are too strongly influenced by immigration from other populations to exhibit independent dynamics.
>
> *Dependent Populations* have a substantial likelihood of going extinct within a 100-year time period in isolation, yet receive sufficient immigration to alter their dynamics and extinction risk, and presumably increase persistence or occupancy.
>
> *Ephemeral Populations* have a substantial likelihood of going extinct within a 100-year time period in isolation, and do not receive sufficient immigration to affect this likelihood. Habitats that support such populations are expected to be occupied only for relatively short periods of time, and rarely at high densities.

With the identified historic population structure of the ESU, the populations were separated into seven diversity strata that likely exhibit genotypic and phenotypic similarity due to exposure to similar environmental conditions or common evolutionary history and the geographical arrangement of the populations (Table 2-1; Williams et al. 2006). A map showing the historic and structure and function of the SONCC ESU is presented below (Figure 2-1).

Table 2-1. Arrangement of historical populations of the Southern Oregon/Northern California Coast coho salmon ESU. Population types are functionally independent (F), potentially independent (P), dependent (D) and, ephemeral (E).

Diversity Stratum	Pop. Type	Population unit	Diversity Stratum	Pop. Type	Population unit
Northern Coastal	F	Elk River	Southern Coastal	F	Humboldt Bay tributaries
	P	Lower Rogue River		F	Low. Eel/Van Duzen rivers
	F	Chetco River		P	Bear River
	P	Winchuck River		F	Mattole River
	E	Hubbard Creek		D	Guthrie Creek
	E	Euchre Creek	Interior – Rogue	F	Illinois River
	D	Brush Creek		F	Mid. Rogue/Applegate rivers
	D	Mussel Creek		F	Upper Rogue River
	D	Hunter Creek	Interior – Klamath	P	Middle Klamath River
	D	Pistol River		F	Upper Klamath River
Central Coastal	F	Smith River		P	Salmon River
	F	Lower Klamath River		F	Scott River
	F	Redwood Creek		F	Shasta River
	P	Maple Creek/Big	Interior – Trinity	F	South Fork Trinity River
	P	Little River		P	Lower Trinity River
	F	Mad River		F	Upper Trinity River
	D	Elk Creek	Interior – Eel River	F	South Fork Eel River
	D	Wilson Creek		P	Mainstem Eel River
	D	Strawberry Creek		P	Mid. Fork Eel River
	D	Norton/Widow White		F	Mid. Mainstem Eel River
				P	Upper Mainstem Eel River

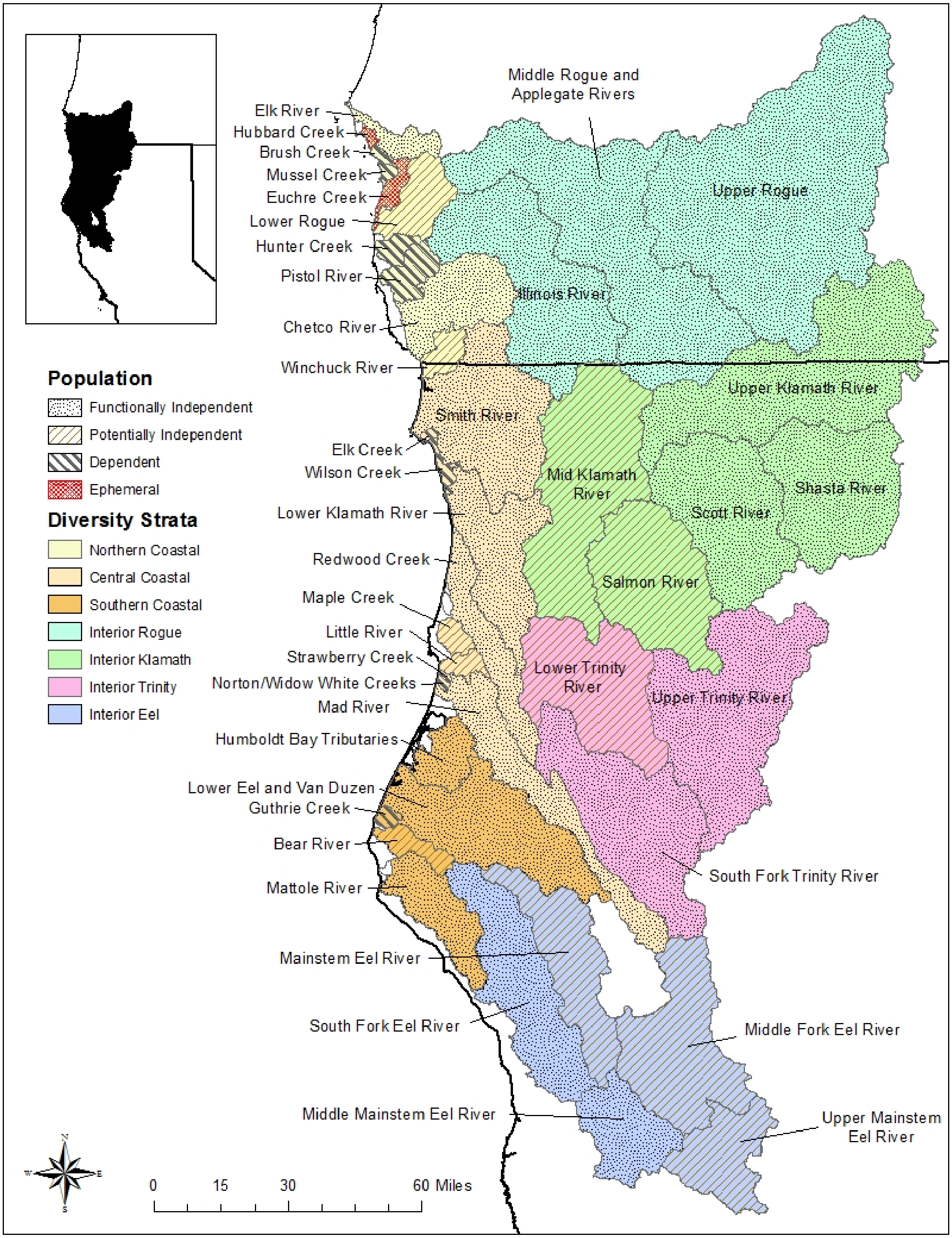


Figure 2-1. Historic population structure of the SONCC coho salmon ESU (Modified from Williams et al. 2006).

2.2 Viability Criteria

Viability criteria are the means by which a viable ESU is defined. Viability criteria are used to develop the delisting criteria described in Section 4.3 of the Recovery Strategy chapter. ODFW expressed concern with the historic population size and viability framework documents that underly these criteria (Williams et al. 2006 and 2008), and their concerns are summarized in Section 1.3.1.

2.2.1 Population

Williams et al. (2008) built on the population structure and the concepts of VSP (McElhany et al. 2000) to establish viability criteria at the population and ESU level. The population viability criteria represent an extension of an approach developed by Allendorf et al. (1997), and include metrics related to population abundance (effective population size), population decline, catastrophic decline, spawner density, hatchery influence, and population viability assessment. Populations that fail to satisfy several viability metrics are likely at greater risk than those that fail to satisfy a single metric. A viable population must have a low extinction risk for all of the population metrics (Table 2-2). For a population to be at moderate risk of extinction, it must meet the moderate risk description for each of the criteria shown in Table 2-2.

Four population categories were identified: Core, Non-Core 1, Non-Core 2, and and Dependent. For delisting, core populations must be at low risk of extinction, non-core 1 populations must be at moderate risk of extinction, and non-core 2 and dependent populations must support immigration from core populations but have no target extinction risk.

Table 2-2. Viability criteria for assessing extinction risk for SONCC coho salmon populations. For a given population, the highest risk score for any category determines the population's overall extinction risk (Williams et al. 2008).

Criterion	**Extinction risk**		
	High	Moderate	Low
	- any One of -	- any One of -	- all of -
Effective population size[a]	$N_e \leq 50$	$50 < N_e < 500$	$N_e \geq 500$
- or -	*- or -*	*- or -*	*- or -*
Population size per generation[b]	Ng ≤ 250	$250 < N_g < 2500$	$N_g \geq 2500$
- or -	*- or -*	*- or -*	*- or -*
Population size per year[c]	*Average* $N_a \leq 83$	$83 <$ *Average* $N_a < 830$	*Average* $N_a \geq 830$[d]
Population decline[e]	Precipitous decline[f]	Chronic decline or depression[g]	No decline apparent or probable
Catastrophic decline	Order of magnitude decline within one generation	Smaller but significant decline[h]	Not apparent
Spawner density (adults/IP km)	$N_a/IP\ km \leq 1$	$1 < N_a/IP\ km \geq$ 4*depensation threshold[i]	$N_a/IP\ km \geq$ MRSD[j]
Hatchery influence			Hatchery fraction <5%

Criterion	Extinction risk		
			- in addition to above -
Extinction risk from PVA[k]	≥20% within 20 yrs	≥5% within 100 yrs but <20% within 20 yrs	< 5% within 100 yrs[l]

[a] The effective population size (N_e) is the number of breeding individuals in an idealized population that would give rise to the same variance in gene frequency under random genetic drift or the same rate of inbreeding as the population under consideration (Wright 1931). N_e =50 is the number needed to minimize random genetic effects of small population size (Allendorf et al. 1997), and N_e =500 is the number that retains long-term adaptive potential (Allendorf et al. 1997).
[b] The total number spawners per generation (number for all years of generation combined) is N_g.
[c] N_a is the mean annual spawner abundance; the generation time for SONCC coho salmon is approximately three years therefore $N_g = 3\ N_a$.
[d] The required spawner density is always greater than this number.
[e] The population decline criteria require the calculation of two parameters, N_a and the population trend (T). Williams et al. (2008) recommends using the geometric mean of the most recent four generations (i.e., 12 years) to estimate annual population abundance, so N_a is equal to the geometric mean of 12 years of spawner abundance.
[f] Population has declined within the last two generations or is projected to decline within the next two generations (if current trends continue) to annual run size of $N_a \leq 500$ spawners (historically small but stable populations not included) or $N_a > 500$ but declining at a rate of ≥10% per year over the last two-to-four generations.
[g] Annual spawner abundance N_a has declined to ≤500 spawners, but now stable **or** number of adult spawners (N_a) > 500 but continued downward trend is evident.
[h] Annual spawner abundance decline in one generation < 90% but biologically significant (e.g., loss of year class).
[i] Williams et al. (2008) defines this category of risk as "$1< N_a/IP\ km <$ MRSD". The target NMFS has adopted is the depensation threshold multiplied by four. Williams et al. (2008) defines the depensation threshold as 1 spawner per IP km.
[j] MRSD, or minimum required spawner density, is dependent on the amount of IP km of habitat per population. MRSD is the same as the low risk threshold.
[k] "If a credible PVA [Population Viability Analysis] can be constructed, results should be compared to results of the general criteria we propose, and by comparison of the outcomes, potential limitations of either approach identified and examined. A PVA is not required to determine a low-risk designation, but a PVA alone does not supersede the general criteria. For high-risk and moderate-risk determination, a PVA result alone can be used to establish risk level, although we strongly recommend that the PVA results be compared to results of the general criteria we propose. We also caution against using PVA analysis alone to assess population viability (Williams et al. 2008)."
[l] For population to be considered at low-risk of extinction, all criteria must be satisfied (i.e., not just a PVA). A population viability analysis (PVA) can be also included for consideration, but must estimate an extinction risk <5% within 100 years *and* all other criteria must be met. If discrepancies exist between PVA results and other criteria, results need to be thoroughly examined and potential limitations of either approach are carefully identified and examined.

A population is at high risk of extinction if the number of spawners is less than 1 per IP km (depensation threshold) (Table 2-2). All independent populations which aren't extirpated must not be at high risk of extinction, and so their spawner numbers must be greater than the depensation threshold. To provide a reasonable buffer to protect against falling below the threshold, the moderate risk threshold has been identified as the target to be met by non-core 1 populations. The moderate risk threshold is the depensation threshold multiplied by four. Four was chosen as the multiplier based on the following rationale.

Wainwright et al. (2008) chose a value of 0.6 spawners/km to the density at which a population of salmon would be very likely to have significant demographic risks. This was the lowest of four bins the Wainwright et al. (2008) workgroup used to populate a decision support system. Williams et al. (2008) essentially chose this value then divided it by 0.6, which is equivalent to the average ratio of IP km to total km in the SONCC ESU. The resulting value of 1 adult per IP km was deemed to be the threshold for *high risk* of depensation by Williams et al (2008).

Other authors have identified values below which depensation occurs, and these values are typically much higher (Table 2-3). Wainwright et al. (2008) considered a population with value of 4.2 spawners/IP km to have an uncertain probability of incurring depensation, a value similar to that of Sharr et al. (2000) and Chilcote (1999). Barrowman et al. (2003) note that there is little evidence for depensation in coho salmon, unless fewer than one female per kilometer of river (3.33 spawners/IP km) returned to spawn (Table 2-3). Parameter estimates for the upper 95% confidence interval presented in Barrowman et al. (2003) are given in Table 2-3. According to Sharr et al. (2000), four spawners per IP km would translate into an extinction risk of approximately 10% over four generations (Table 2-3).

Table 2-3 Depensation levels identified by various authors. Results are standardized to IP km.

Reference	**Value below which depensation occurs**
Barrowman et al. (2003) 95% Upper CI Type 2 BH	2.26 spawners/IP km
Barrowman et al. (2003) 95% Upper CI Type 2 LHS	1.6 spawners/IP km
Sharr et al. (2000)	4.2 spawners/IP km
Chilcote (1999)	4.1 spawners/IP km

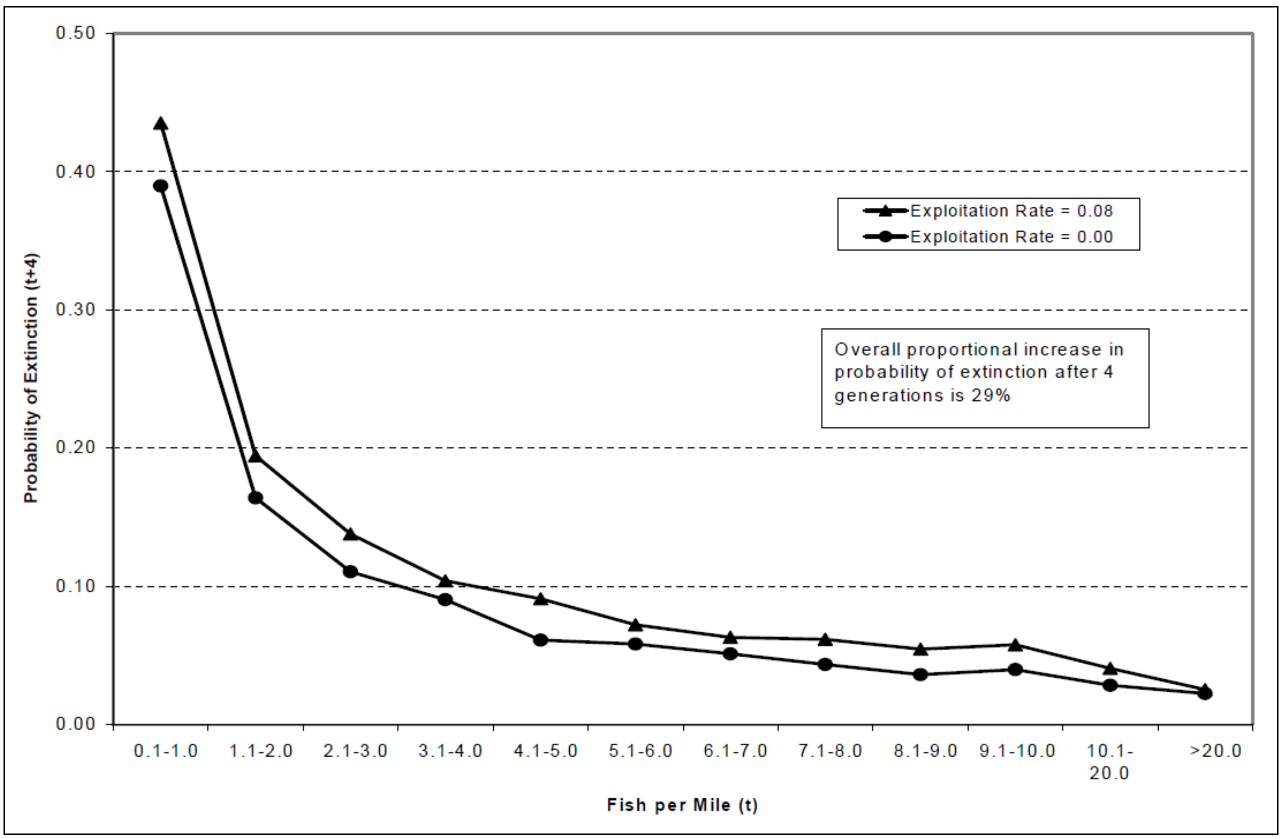


Figure 2-2. Probability of basin level extinction in four generations as a function of spawner density. For fishery exploitation rates of 0.0 and 0.8 in all Oregon coastal basins combined. Figure from Sharr et al. (2000).

2.2.2 ESU

The viability of an ESU depends on several factors, including the number and status of populations, spatial distribution of populations, the characteristics of large-scale catastrophic risk, and the collective diversity of the populations and their habitat (Lindley et al. 2007). In order for the SONCC coho salmon ESU to be viable, every diversity stratum needs at least 50 percent of its independent populations (i.e., Functionally Independent or Potentially Independent) to be viable, and the abundance of these viable independent populations collectively must be at least 50 percent of the total abundance modeled for all of the independent populations in that stratum (Table 2-2). The independent populations that are chosen to meet the population viability criteria are called "core." NMFS' rationale for its choice of core populations is explained in Appendix C. Independent populations which are not core are called "non-core 1" or "non-core 2". Non-core 1 populations must reach at least a moderate risk of extinction. All dependent and non-core 2 populations must exhibit occupancy patterns that indicate sufficient emigration is occurring from the core populations to maintain connectivity within and among diversity strata.

Although not all populations are required to be viable, the ESU viability criteria are intended to ensure representation of the diversity throughout the ESU, buffer the ESU against potential catastrophic risks, and provide sufficient connectivity among populations to maintain long-term demographic and genetic processes. The ESU viability criteria incorporate the principles of representation, redundancy, connectivity, and resiliency. Representation relates to the genetic and life history diversity of the ESU, which is needed to conserve its adaptive capacity. Redundancy addresses the need to have a sufficient number of populations so the ESU can withstand catastrophic events (NMFS 2010). Connectivity refers to the dispersal capacity of populations to maintain long-term demographic and genetic processes. Resiliency is the ability of populations to withstand natural and human-caused stochastic events, and it depends on sufficient abundance and productivity. The overarching goal of these rules was to determine an appropriate number and arrangement of populations that allow populations to track changes in environmental conditions, and therefore be viable at the ESU level (Williams et al. 2008).

Table 2-4. ESU viability criteria for SONCC coho salmon. (Williams et al. 2008).

ESU viability characteristic	**Criteria**
Representation	1. All diversity strata should be represented by viable populations
Redundancy and Connectivity	2.a. At least fifty percent of historically independent populations in each diversity stratum should be demonstrated to be at low risk of extinction according to the population viability criteria. AND 2.b. Total aggregate abundance of the populations selected to satisfy 2a must meet or exceed 50% of the aggregate viable population abundance predicted for the stratum based on the spawner density 3. All dependent and independent populations not expected to meet low-risk threshold within a stratum should exhibit occupancy indicating sufficient immigration is occurring from the "core populations".

ESU viability characteristic	Criteria
Redundancy and Connectivity	4. The distribution of extant populations, both dependent and independent, needs to maintain connectivity across the stratum as well as with adjacent strata.

Williams et al. 2008 wrote about Criterion 3: "We propose that recovery planners place a high priority on populations that are remnants of historically independent populations **with a minimum standard that most historically independent populations should be at no greater than moderate risk of extinction (i.e., not at high risk) when evaluated as independent populations** [Emphasis added]. This recommendation would require a higher standard for occupancy than just presence of individuals. It should be recognized that these independent populations no longer fulfill their historical role within the ESU, but they can play a critical role in connectivity and have the potential for representing critical components of the evolutionary legacy of the ESU."

To meet this recommendation, we set the delisting criteria for most non-core independent populations at the depensation threshold multiplied by four, which is the minimum number needed for a population to be at moderate (not high) risk of extinction with regard to the spawner density criterion (Table 2-2). These populations were called "non-core 1". "Non-core 2" populations were identified in response to the requirement that "most" (not all) independent populations should be at moderate risk of extinction. For some independent populations, there is little to no documentation of coho salmon presence in the last century, and prospects for recovery to the moderate-risk threshold are low. These populations were made non-core 2 populations, and so had a lower threshold (juvenile occupancy) than if they were non-core 1 populations.

2.3 Current Status of the ESU

In order to determine the current risk of extinction of the SONCC coho salmon ESU, the population viability criteria (Table 2-2) and the concept of Viable Salmonid Populations (VSP) for evaluating populations described by McElhany et al. (2000) are utilized. A viable salmonid population is defined as one that has a negligible risk of extinction over 100 years. Viable salmonid populations are described in terms of four parameters: abundance, population productivity, spatial structure, and diversity. These parameters are predictors of extinction risk, and reflect general biological and ecological processes that are critical to the growth and survival of salmon (McElhany et al. 2000).

Information about population size provides an indication of the type of extinction risk that a population faces. For instance, smaller populations are at a greater risk of extinction than large populations because the processes that affect populations operate differently in small populations than in large populations (McElhany et al. 2000). One risk of low population sizes is depensation. Depensation occurs when populations are reduced to very low densities and per capita growth rates decrease as a result of a variety of mechanisms [e.g., failure to find mates and therefore reduced probability of fertilization, failure to saturate predator populations (Liermann and Hilborn 2001)]. Depensation results in negative feedback that accelerates a decline toward extinction (Williams et al. 2008).

The productivity of a population (i.e., production over the entire life cycle) can reflect conditions (e.g., environmental conditions) that influence the dynamics of a population and determine abundance. In turn, the productivity of a population allows an understanding of the performance of a population across the landscape and habitats in which it exists and its response to those habitats (McElhany et al. 2000). In general, declining productivity equates to declining population abundance. Understanding the spatial structure of a population is important because the population structure can affect evolutionary processes and, therefore, alter the ability of a population to adapt to spatial or temporal changes in the species' environment (McElhany et al. 2000).

Diversity, both genetic and behavioral, is critical to success in a changing environment. Salmonids express variation in a suite of traits, such as anadromy, morphology, fecundity, run timing, spawn timing, juvenile behavior, age at smolting, age at maturity, egg size, developmental rate, ocean distribution patterns, male and female spawning behavior, and physiology and molecular genetic characteristics. The more diverse these traits (or the more these traits are not restricted), the more diverse a population is, and the more likely that individuals, and therefore the species, would survive and reproduce in the face of environmental variation (McElhany et al. 2000). However, when this diversity is reduced due to loss of entire life history strategies or to loss of habitat used by fish exhibiting variation in life history traits, the species is in all probability less able to survive and reproduce given environmental variation.

Because some of the parameters are related or overlap, the evaluation is at times necessarily repetitive. Viable ESUs are defined by some combination of multiple populations, at least some of which exceed "viable" thresholds, and that have appropriate geographic distribution, protection from catastrophic events, and diversity of life histories and other genetic expression. The following subsection provides the evaluation of the risk of extinction for SONCC coho salmon based the four VSP parameters. For information on the status of specific populations, refer to Volume II.

2.3.1 Population Abundance

Quantitative population-level estimates of adult spawner abundance spanning more than 9 years are scarce for SONCC coho salmon. New data since publication of the previous status review (Good et al. 2005) consists of continuation of a few time series of adult abundance, expansion of efforts in coastal basins of Oregon to include SONCC coho salmon populations, and continuation and addition of several "population unit" scale monitoring efforts in California. Other than the Shasta River and Scott River adult counts, reliable current time series of naturally produced adult spawners are not available for the California portion of the SONCC ESU at the "population unit" scale.

Although long-term data on coho salmon abundance are scarce, the available monitoring data indicate that spawner abundance has generally declined for populations in this ESU. The longest existing time series at the population unit scale began in 1994 in the Smith River (Figure 2-3).

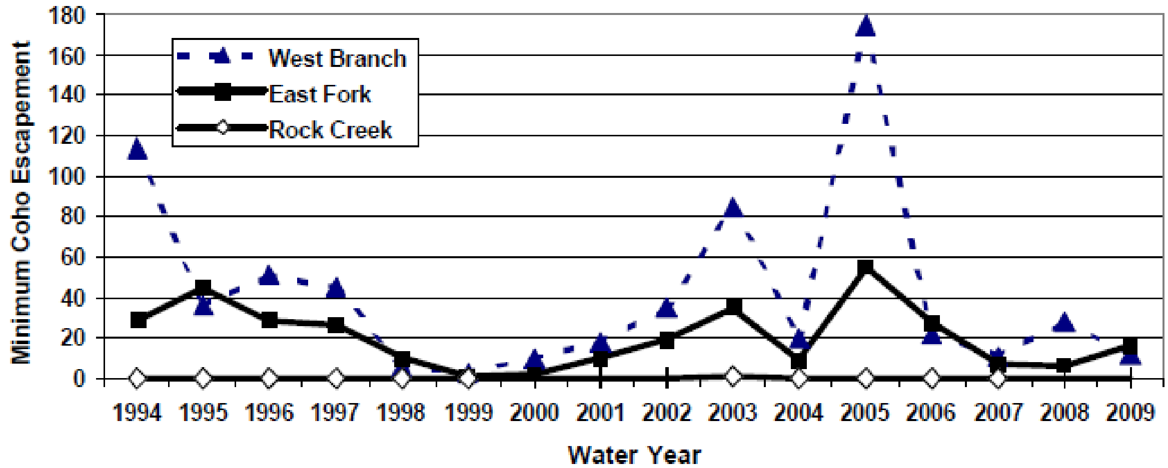


Figure 2-3. Coho salmon minimum escapement estimates for three sites in the Mill Creek watershed of the Smith River basin. Water years 1994 through 1999 (Figure from McLeod and Howard 2010).

The number of adult coho salmon at the video weir on the Shasta River decreased from 2001-2010 (Figure 2-4). Available time series data on the Shasta River show low adult returns, of which two out of three cohorts are considered to be nearly extirpated (Chesney et al. 2009). The Shasta River population has declined in abundance by almost 50 percent from one generation to the next (Williams et al. 2011).

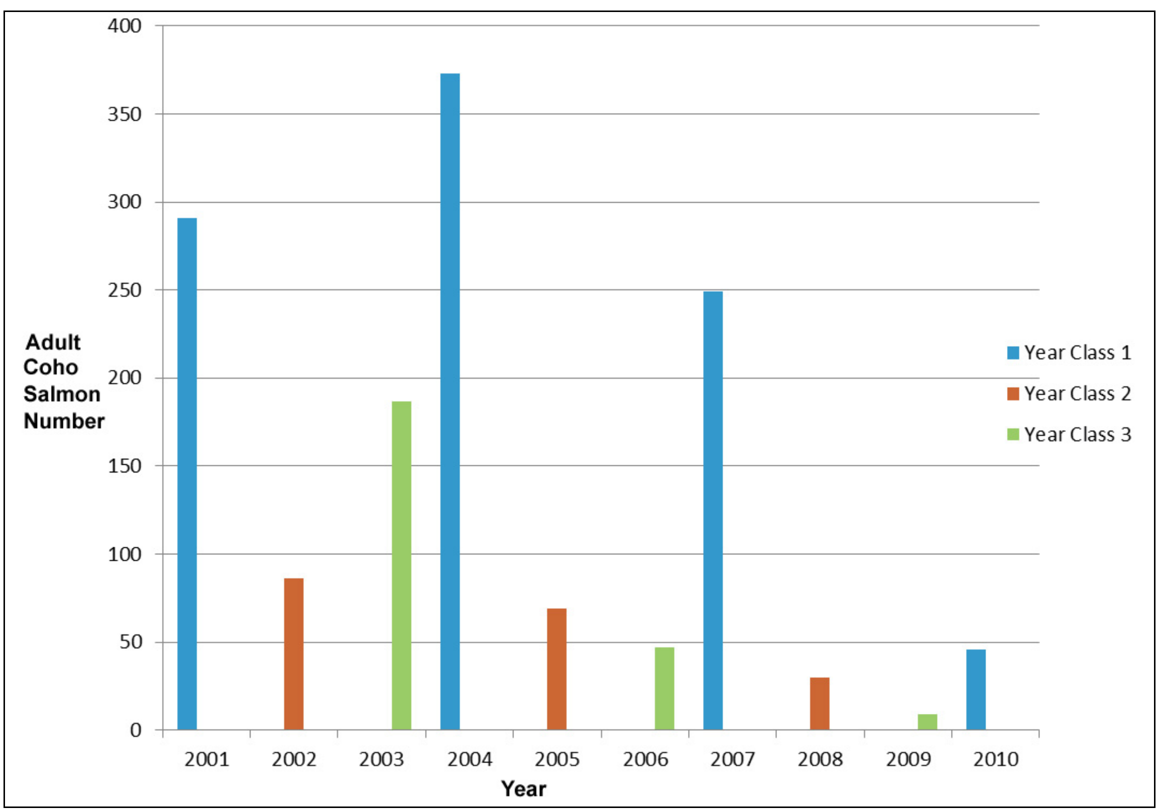


Figure 2-4. Video weir estimates of adult coho salmon in the Shasta River. This is an independent population. Data are for 2001 to 2010. (data from M. Knechtle, California Department of Fish and Game).

Two partial counts from Prairie Creek, a tributary of Redwood Creek, and Freshwater Creek, a tributary of Humboldt Bay show a negative trend (Figure 2-5 and Figure 2-6, respectively). Data from the Rogue River basin also show recent negative trends. Estimates from Huntley Park in the Rogue River basin show a strong return year in 2004, followed by a decline to 2,566 fish in 2009 (Figure 2-7). The Huntley Park seine estimates provide the best overall assessment of naturally produced coho salmon spawner abundance in the basin (Oregon Department of Fish and Wildlife (ODFW) 2005a). Four independent populations contribute to this count (Lower Rogue River, Illinois River, Middle Rogue and Applegate rivers, and Upper Rogue River). The 12 year average estimated wild adult coho salmon in the Rogue River basin between 1998 and 2009 (excluding 2008) is 8,050, which is well below historic abundance. 2008 data were excluded from the average because the extremely low numbers were not consistent with that seen upstream at Gold Ray Dam, suggesting other reasons (sampling issues, data errors, etc.) for the dramatic drop in fish numbers from 2007 to 2008. Based on extrapolations from cannery pack, the Rogue River had an estimated adult coho salmon abundance of 114,000 in the late 1800s (Meengs and Lackey 2005).

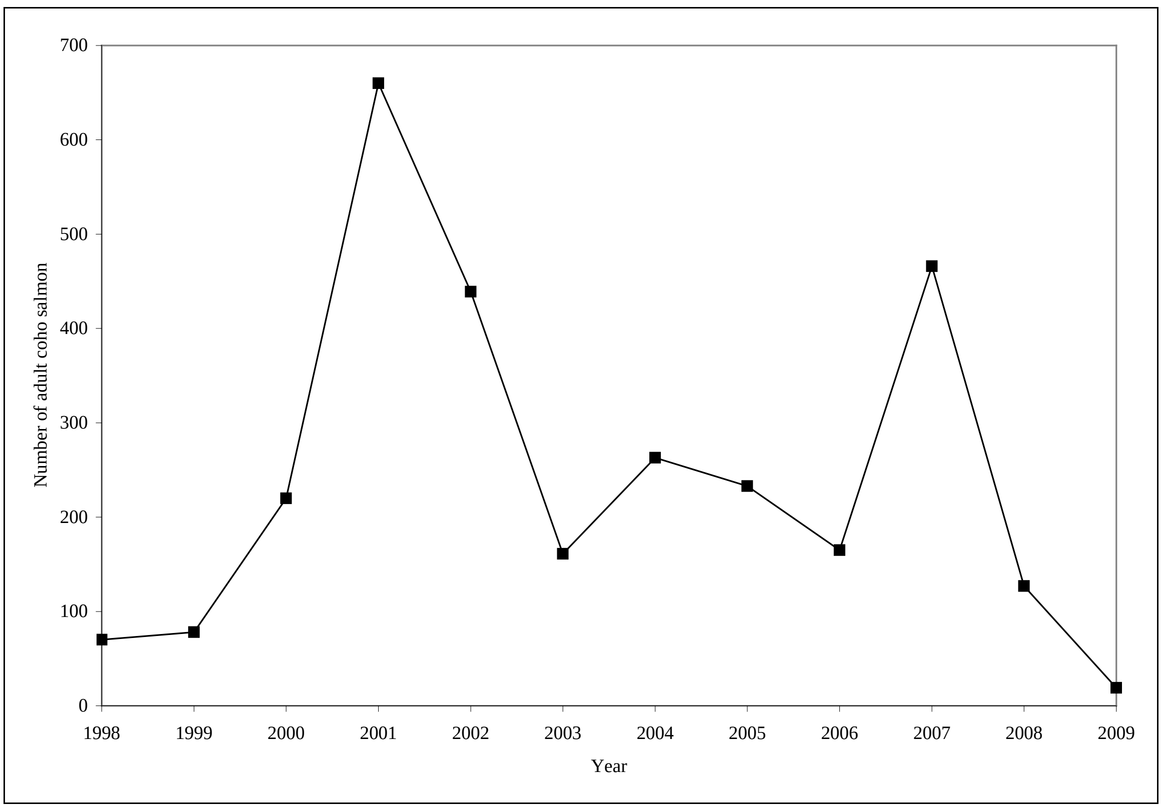


Figure 2-5. Estimate of spawning coho salmon in Prairie Creek. This is a tributary to Redwood Creek (Humboldt County, California). Data are for 1998 to 2009 (Williams et al. 2011).

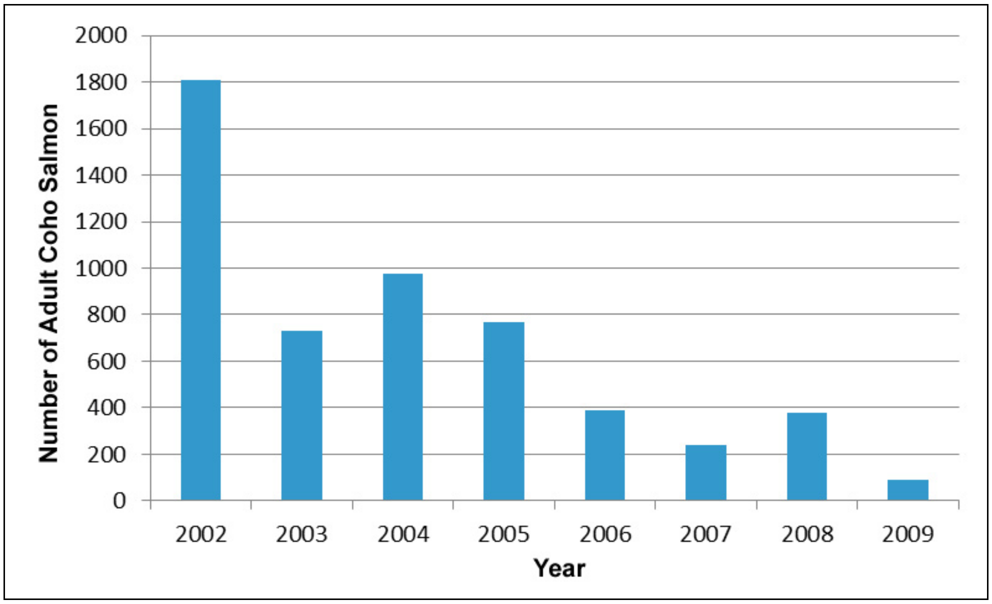


Figure 2-6. Adult coho salmon estimate for Freshwater Creek. This is a tributary to Humboldt Bay. Data are for 2002 to 2009. Data are from Ricker and Anderson (2011).

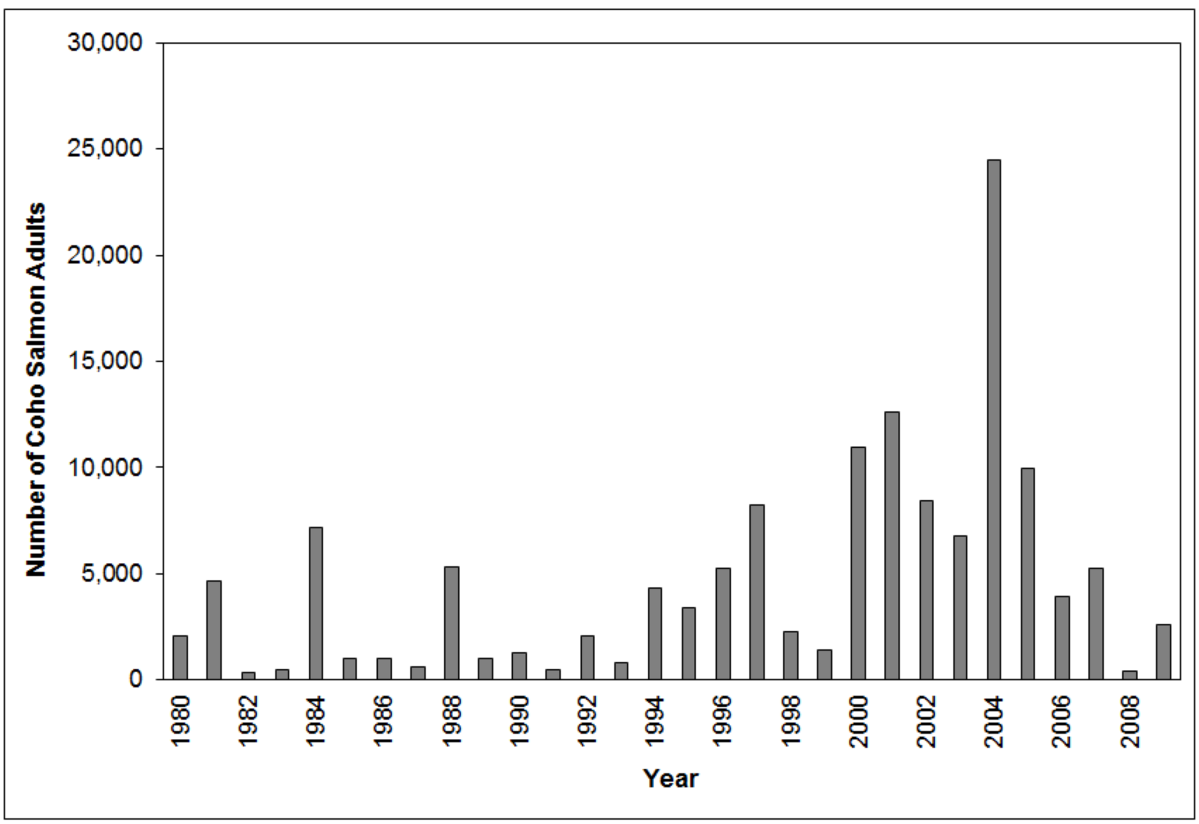


Figure 2-7. Estimated number of wild adult coho salmon in the Rogue River basin. (Huntley Park sampling), 1980 to 2009 (ODFW 2011b).

Though population-level estimates of abundance for most independent populations are lacking, the best available data indicate that none of the seven diversity strata appears to support a single viable population as defined by in the viability criteria (Table 2-2). In fact, most of the 30 independent populations in the ESU are at high risk of extinction because they are below or likely below their depensation threshold (Table 2-4).

Populations that are below depensation have increased likelihood of being extirpated. Coho salmon spawners in the Eel River watershed, which historically supported significant spawners (e.g., 50,000 to 100,000 per year; Yoshiyama and Moyle 2010), have declined. Yoshiyama and Moyle (2010) concluded that coho salmon populations in the Eel River basin appear to be headed for extirpation by 2025. One of the four independent populations in this basin have already been extirpated (i.e., Middle Fork Eel River; Moyle et al. 2008, Yoshiyama and Moyle 2010) and one population contains critically low numbers (i.e., Upper Mainstem Eel River; with only a total of 7 coho salmon adults counted at the Van Arsdale Fish Station in over six decades; Jahn 2010). Although long term spawner data are not available, both NMFS and CDFG believe the Lower Eel/Van Duzen River, Middle Mainstem Eel and Mainstem Eel River populations are very likely below the depensation threshold, and thus are at a high risk of extinction. The only population in the Eel River basin that is likely to be above its depensation threshold is the South Fork Eel River, which also has significantly declined from historical numbers (Figure 2-8).

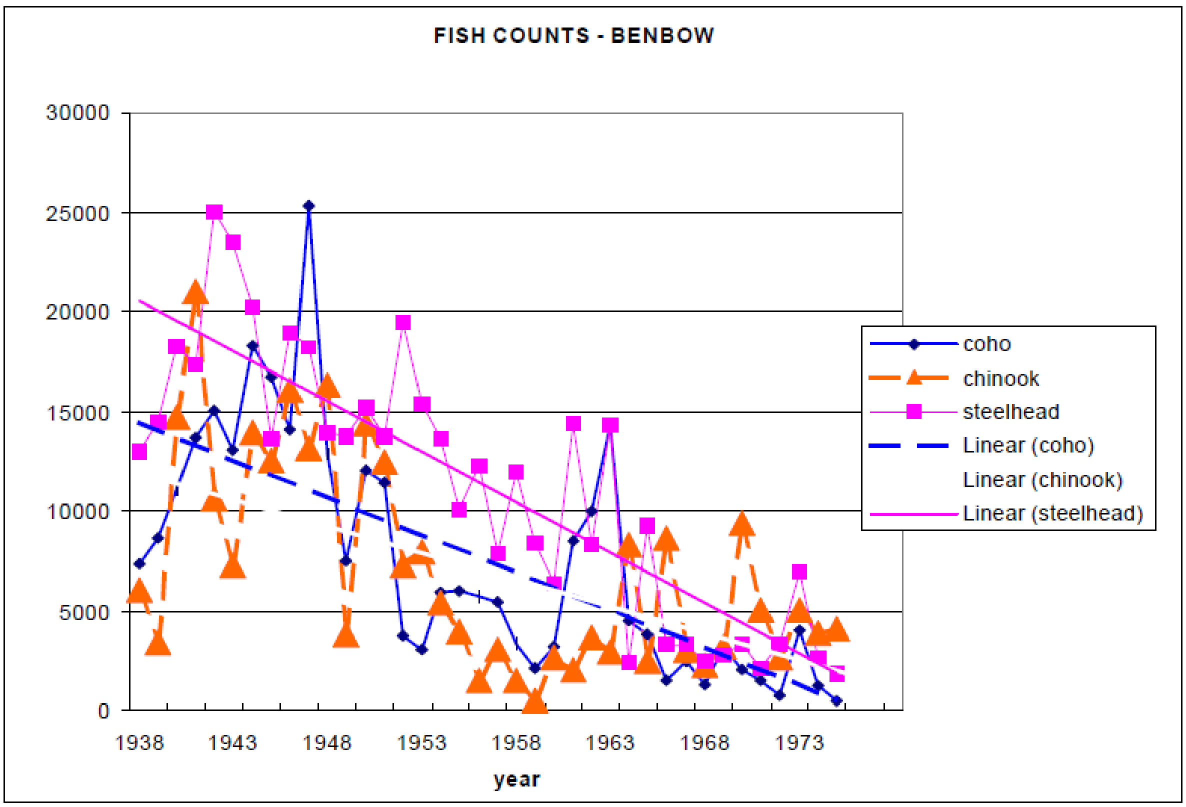


Figure 2-8. Fish counts at Benbow Fish Station, in the South Fork Eel River. Data are from 1938 to 1975. Figure from EPA (1999).

In addition to the Eel River basin, two other independent populations south of the Eel River basin, the Bear River and Mattole River populations, have similar trajectories. The Bear River population is likely extirpated or severely depressed. Despite multiple surveys over the years, no coho salmon have been found in the Bear River watershed (Bliesner et al. 2006, Ricker 2002).

In 1996 and 2000, the California Department of Fish and Game (CDFG) surveyed most tributaries of the Bear River, and did not find any coho salmon (CDFG 2004). In addition, CDFG sampled the mainstem and South Fork Bear River between 2001 and 2003 and found no coho salmon (Jong et al. 2008). In the Mattole River, surveys of live fish and carcasses since 1994 indicate the population is severely depressed and well below the depensation threshold of 250 spawners. Recent spawner surveys in the Mattole River resulted in only 3 and 9 coho salmon for 2009 and 2010, respectively. These low numbers, along with a recent decline since 2005, indicate that the Mattole River population is at a high risk of extinction.

Because the extinction risk of an ESU depends upon the extinction risk of its constituent independent populations (Williams et al. 2008) and the population abundance of most independent populations are below their depensation threshold, the SONCC coho salmon ESU is at high risk of extinction and is not viable.

2.3.2 Productivity

The productivity of a population (i.e., production over the entire life cycle) can reflect conditions (e.g., environmental conditions) that influence the dynamics of a population and determine abundance. In turn, the productivity of a population allows an understanding of the performance of a population across the landscape and habitats in which it exists and its response to those habitats (McElhany et al. 2000). In general, declining productivity equates to declining population abundance. As discussed above in the population abundance section, available data indicates that many populations have declined, which reflects a declining productivity. For instance, the Shasta River population has declined in abundance by almost 50 percent from one generation to the next (Williams et al. 2011 and (Figure 2-4). Two partial counts from Prairie Creek, a tributary of Redwood Creek, and Freshwater Creek, a tributary of Humboldt Bay show a negative trend (Figure 2-5 and Figure 2-6). Data from the Rogue River basin also show recent negative trends. In general, SONCC coho salmon have declined substantially from historic levels. Because productivity appears to be negative for most, if not all SONCC coho salmon populations, this ESU is not currently viable in regard to population productivity.

2.3.3 Spatial Structure

The viability report for the SONCC coho salmon ESU concluded data were insufficient to set specific population spatial structure targets (Williams et al. 2008). In the absence of such targets, McElhany et al. (2000) suggested the following: “As a default, historical spatial processes should be preserved because we assume that the historical population structure was sustainable but we do not know whether a novel spatial structure will be”, where “historical” means “before the recent or severe declines that have been observed in many populations (McElhany et al. 2000).”

An ESU persists in places where it is able to track environmental changes, and becomes extinct if it fails to keep up with the shifting distribution of suitable habitat (Thomas 1994, Williams et al. 2008). If freshwater habitat shrinks due to climate change (Battin et al. 2007) or habitat degradation, certain areas such as inland rivers and streams could become inhospitable to coho salmon, which would change the spatial structure of the SONCC coho salmon ESU, having implications for the risk of species extinction.

Data is inadequate to determine whether the spatial distribution of SONCC coho salmon has changed since 2005. In 2005, Good et al. (2005) noted that they had strong indications that breeding groups have been lost from a significant percentage of streams within their historical range. Relatively low levels of observed presence in historically occupied coho salmon streams (32 to 56 percent from 1986 to 2000) indicate continued low abundance in the California portion of the SONCC coho salmon ESU. The relatively high occupancy rate of historical streams observed in brood year 2001 suggests that much habitat remains accessible to coho salmon (70 FR 37160, June 28, 2005). Brown et al. (1994) found survey information on 115 streams within the SONCC coho salmon ESU, of which 73 (64 percent) still supported coho salmon runs while 42 (36 percent) did not. The streams Brown et al. (1994) identified as lacking coho salmon runs were all tributaries of the Klamath River and Eel River basins. CDFG (2002b) reported a decline in SONCC coho salmon occupancy, with the percent reduction dependent on the data sets used. All the assessments based on fish presence described above were affected by the often poor hydrologic conditions present in the survey years.

Although there is considerable year-to-year variation in estimated occupancy rates, it appears that there has been no dramatic change in the percent of coho salmon streams occupied from the late 1980s and early 1990s to 2000 (Good et al. 2005). However, the number of streams and rivers currently supporting coho salmon in this ESU has been greatly reduced from historical levels, and watershed-specific extirpations of coho salmon have been documented (Brown et al.1994, CDFG 2004, Good et al.2005, Moyle et al. 2008, Yoshiyama and Moyle 2010). In summary, recent information for SONCC coho salmon indicates that their distribution within the ESU has been reduced and fragmented, as evidenced by an increasing number of previously occupied streams from which they are now absent (NMFS 2001). However, extant populations can still be found in all major river basins within the ESU (70 FR 37160; June 28, 2005).

2.3.4 Diversity

The primary factors affecting the genetic and life history diversity of SONCC coho salmon appear to be low population abundance and the influence of hatcheries and out-of-basin introductions. Although the operation of a hatchery tends to increase the abundance of returning adults (70 FR 37160; June 28, 2005), the reproductive success of hatchery-born salmonids spawning in the wild can be less than that of naturally produced fish (Araki et al. 2007a). As a result, the higher the proportion of hatchery-born spawners, the lower the overall productivity of the population, as demonstrated by Chilcote (2003). Williams et al. (2008) considered a population to be at least at a moderate risk of extinction if the contribution of hatchery coho salmon spawning in the wild exceeds 5 percent. Populations have a lower risk of extinction if no or negligible ecological or genetic effects resulting from past or current hatchery operations can be demonstrated. Because the main stocks in the SONCC coho salmon ESU (i.e., Rogue River, Klamath River, and Trinity River) remain heavily influenced by hatcheries and have little natural production in mainstem rivers (Weitkamp et al. 1995; Good et al. 2005), some of these populations are at high risk of extinction relative to the genetic diversity parameter. The extent of hatcheries in the ESU, and a discussion of their effects, is described in Chapter 3. Table 2-5 shows those populations with stress and threat ranks of high (greater than 10 percent and less than 30 percent hatchery-origin adults) and very high (greater than 30 percent hatchery-origin adults).

Table 2-5. Populations with hatchery effects rated as a high or very high stress and threat. Table shows % hatchery spawners, and source.

Population	**Stress and Threat Rank**	**% Hatchery origin adults**
Upper Klamath River	Very High	77% from 1996 to 2010; Chesney and Knechtle 2011a 34% at Bogus Creek; Knechtle and Chesney 2011
Shasta River	High	16% in 2001, 2003, 2004; Ackerman and Cramer 2006 23% from 2001 to 2004 and 2007 to 2010; Ackerman et al. 2006 and Chesney and Knechtle 2011b.
Lower Trinity River	Very High	85-97% from 1997 to 2002; CDFG 2009 60-100% from 1998 to 1999; Dutra and Thomas 1999
South Fork Trinity River	Very High	36% in 1985; Jong and Mills 1992.
Upper Trinity River	Very High	97%, USFWS and HVT 1999.

In addition, some populations are extirpated or nearly extirpated (i.e., Middle Fork Eel, Bear River, Upper Mainstem Eel) and some brood years have low abundance or may even be absent in some areas (e.g., Shasta River, Scott River, Mattole River, Mainstem Eel River), which further restricts the diversity present in the ESU. The ESU's current genetic variability and variation in life history likely contribute significantly to long-term risk of extinction. Given the recent trends in abundance across the ESU, the genetic and life history diversity of populations is likely very low and is inadequate to contribute to a viable ESU.

2.3.5 Oregon Assessment

The Oregon Department of Fish and Wildlife assessed the status of the Rogue Coho Species Management Unit (SMU), which includes the Upper Rogue, Middle Rogue, and Illinois River populations (ODFW 2005a) using five interim criteria defined in their Native Fish Conservation Policy. These criteria were designed to identify cases of significant near-term conservation risks. The Rogue Coho SMU was found Not At Risk because all three populations met all six criteria (Table 2-6). The criteria used by ODFW and NFMS to assess the status of the ESU were different, leading to different results. In addition, the NMFS assessment included all populations within the ESU, while the ODFW assessment included the three interior Rogue populations within the Rogue Coho SMU.

Table 2-6 Interim criteria and standards. As defined in the Native Fish Conservation Policy risk assessment of Oregon salmon and steelhead SMUs (ODFW 2005a).

Attribute	**Criteria**
Existing populations	At least 80% of historical populations are still in existence (i.e., not extinct) *and* not at risk of extinction in the near future.
Habitat use distribution	Naturally produced members of a population occupy at least 50% of the historically-used (pre-development) habitat in at least three of the last five years for at least 80% of existing populations.

Attribute	**Criteria**
Abundance	Number of naturally-produced fish is greater than 25% of average levels in at least three of the last five years for at least 80% of existing populations.
Productivity	Population replacement rate for at least 80% of existing populations is at least 1.2 naturally-produced adult offspring per parent in three of the last five years when total abundance was less than average returns of naturally produced fish.
Reproductive independence	90% or more of spawners are naturally produced in at least three of the last five years for at least 80% of existing populations.
Hybridization	Hybrization with non-native species is rare or nonexistent in three of the last five years for at least 80% of existing populations.

2.3.6 Summary

Though population-level estimates of abundance for most independent populations are lacking, the best available data indicate that none of the seven diversity strata appears to support a single viable population as defined by the TRT's viability criteria (low extinction risk). Further, 25 out of 30 independent populations are at high risk of extinction and 5 are at moderate risk of extinction (Table 2-7).

Table 2-7. SONCC coho salmon independent populations and their risk of extinction based on number of adults.

Stratum	Independent Populations	Extinction Risk	Population Viability Metric (Williams et al. 2008)
Northern Coastal Basin	Elk River	High	Population likely below depensation threshold[1]
	Lower Rogue River	High	
	Chetco River	High	
	Winchuck River	High	
Interior Rogue River	Illinois River	High	600
	Middle Rogue/Applegate rivers	High	675
	Upper Rogue River	Moderate	800
Central Coastal Basin	Smith River	High	325
	Lower Klamath River	Moderate	205
	Redwood Creek	High	150
	Maple Creek/Big Lagoon	High	40
	Little River	Moderate	35
	Mad River	High	135
Interior Klamath	Middle Klamath River	Moderate	112
	Upper Klamath River	High	425
	Shasta River	High	500
	Scott River	High	450

Stratum	Independent Populations	Extinction Risk	Population Viability Metric (Williams et al. 2008)
	Salmon River	High	115
Interior Trinity	Lower Trinity River	High	112
	South Fork Trinity River	High	242
	Upper Trinity River	High	375
South Coastal Basin	Humboldt Bay tributaries	High	190
	Lower Eel and Van Duzen rivers	High	400
	Bear River	High	50
	Mattole River	High	250
Interior Eel	Mainstem Eel River	High	145
	Middle Mainstem Eel River	High	250
	Upper Mainstem Eel River	High	55
	Middle Fork Eel River	High	75
	South Fork Eel River	Moderate	47

Based on the above discussion of the population viability parameters, and qualitative viability criteria presented in Williams et al. (2008), NMFS concludes that the SONCC coho salmon ESU is currently not viable and is at high risk of extinction.

The precipitous decline in abundance from historical levels and the poor status of population viability metrics in general are the main factors behind the extinction risk faced by SONCC coho salmon. The primary cause of the decline is likely the widespread degradation of habitat, particularly those habitat attributes that support the freshwater rearing life-stages of the species. The demographic response to this impaired habitat has been a reduction in the number of fish and their range, which has made them less resilient to environmental stressors such as poor ocean conditions. The stressors and threats that contribute to the current status of SONCC coho salmon are discussed in Chapter 3.

2.4 Extinction and Recovery Trajectories

Population dynamics are extremely important to consider for recovery of species because the time-to-extinction decreases as the population size decreases (Caughley 1994, Fagan and Holmes 2006). This long standing theoretical prediction and empirically observed phenomenon of small populations (Fagan and Holmes 2006) highlights the importance of keeping currently healthy salmonid populations from reaching low abundance levels. In addition, it adds urgency to recovery efforts for those populations that are depressed.

Small populations are often defined as those having approximately 100 individuals (Treuren et al. 1991; Thomas 1990). For anadromous salmonids, small populations are defined as those that fall near or below the depensation (high risk) threshold. These populations can be affected by multiple forms of stochasticity, not all of which affect large populations (Lande 1993). The fact that small populations can be affected by multiple forms of stochasticity results in extinction probabilities substantially greater than the extinction probabilities that would occur from of a single form of stochasticity (Melbourne and Hastings 2008). Williams et al. (2008) provides more specific guidance on assessing extinction risk for SONCC coho salmon populations given the state of various population parameters.

There are two broad classes of stochasticity: demographic stochasticity and environmental stochasticity (Caughley 1994). Demographic stochasticity occurs because the birth or death of an individual is a random event (Melbourne and Hastings 2008). Therefore, individuals that are identical in their probability distributions for reproduction or longevity can differ by chance in how many offspring they produce or when they will die (Melbourne and Hastings 2008). Environmental stochasticity occurs because fluctuations in external environmental factors (e.g., ocean condition and precipitation) drive population level fluctuations in birth and death rates (May 1973, Melbourne and Hastings 2008).

Two components of demographic stochasticity, are stochastic sex determination (Engen et al. 2003) and demographic heterogeneity (Kendall and Fox 2003, Melbourne and Hastings 2008). Stochastic sex determination, which can be viewed an extreme form of demographic heterogeneity, occurs because the sex of offspring is randomly determined, which gives rise to a stochastically fluctuating sex ratio in populations (Melbourne and Hastings 2008). Demographic heterogeneity refers to variation in birth or death rates among individuals within a population such as might occur among individuals of different size (Kendall and Fox 2003, Melbourne and Hastings 2008). This contrasts with demographic stochasticity which refers to chance events assuming a fixed value of the birth or death rate of an individual (Roughgarden 1975, Melbourne and Hastings 2008).

Fagan and Holmes (2006) found that the year-to-year rates of decline for a population were larger for smaller values of time-to-extinction, implying that the population dynamics of a species deteriorated as extinction neared. That is, a population size of n individuals within a decade of extinction is less valuable to the persistence than the same population size was earlier (Fagan and Holmes 2006). The findings of Fagan and Holmes (2006) are well supported by those of Frankham (2005), who found very strong evidence that inbreeding and loss of genetic variation contribute to extinction risk and species are impacted by genetic factors before extinction occurs. Similarly, Treuren et al. (1991) found that as a consequence of genetic drift, inbreeding and restricted gene flow, small and isolated populations (>119 individuals) show decreased levels of genetic variation.

If a population is too small, the survival and production of eggs or offspring may suffer because it may be difficult for spawners to find mates (Liermann and Hilborn 2001). Inbreeding, loss of genetic variation, and failure to find mates are all forms of depensatory mechanisms which cause depensation (Liermann and Hilborn 2001). The strict definition of depensation is when the per-capita population growth rate of a population decreases as the density or abundance of the population decreases to low levels (Liermann and Hilborn 2001). This is to be distinguished from the mechanisms that can contribute to depensation (i.e., failure to saturate predators and inbreeding). Even though there has been a lack of empirical evidence of depensation, the lack of evidence should not be interpreted as evidence that depensatory mechanisms are rare or unimportant (Liermann and Hilborn 2001).

Melbourne and Hastings (2008) found that when a population is small, the population could be at much higher risk from undetected demographic variance, even though risk of extinction from environmental stochasticity is typically viewed as being a greater threat to the population. This demographic variance is driven by sex ratio variation (e.g., in 1925, 91% of 295 coho salmon arriving below Copco Dam on the Klamath River were males; Snyder 1931) and demographic heterogeneity that has been mistakenly attributed to environmental stochasticity (Melbourne and Hastings 2008). The increased extinction risk is a consequence of the fact that, for the same overall level of variance in abundance for one generational step, sex ratio stochasticity and demographic heterogeneity give rise to greater variance than environmental stochasticity when population sizes are small and vulnerable (Melbourne and Hastings 2008). Therefore, fisheries managers which oversee small populations must recognize that these populations are likely to be at greater risk of extinction from genetic drift, inbreeding, restricted gene flow, failure to find mates, failure to saturate predators, and other depensatory mechanisms than they are from environmental stochasticity and other exogenous factors.

In the first phase of extinction, population instability occurs with population abundance fluctuating with a higher than normal amplitude (Figure 2-9). Anadromous salmonid populations are known to have large swings in abundance that are usually linked to variations in ocean productivity (Northcote and Atagi 1997; also see Chapter 3). This makes identifying the instability stage difficult for fisheries managers because they rarely have sufficient population abundance data with which to distinguish between population instability and natural population variability. In the decline phase there is a sustained period in which death rates exceed birth rates within one or more populations (Figure 2-9). Depending on the robustness the data and length of the dataset, the decline in the phase may or may not be evident by examining the trend in abundance over time. The collapse phase is characterized by reductions in the number or extent of occurrence. The extent of the occurrence of a species may erode from the edges (i.e., range contraction) or from gaps closer to the center of its range (i.e., fragmentation; Ewers and Didham 2005). In the terminal phase (Figure 2-9), a population is not likely to increase in abundance over any time interval before extinction (Fagan and Holmes 2006). Any increases in abundance are likely to be very short-lived (Fagan and Holmes 2006) and the reproductive success of the population depends on the success of a small number of individuals (Caughley 1994, Fagan and Holmes 2006). The longer a population stays in the small dynamics phase (Figure 2-9), the more likely it will go extinct.

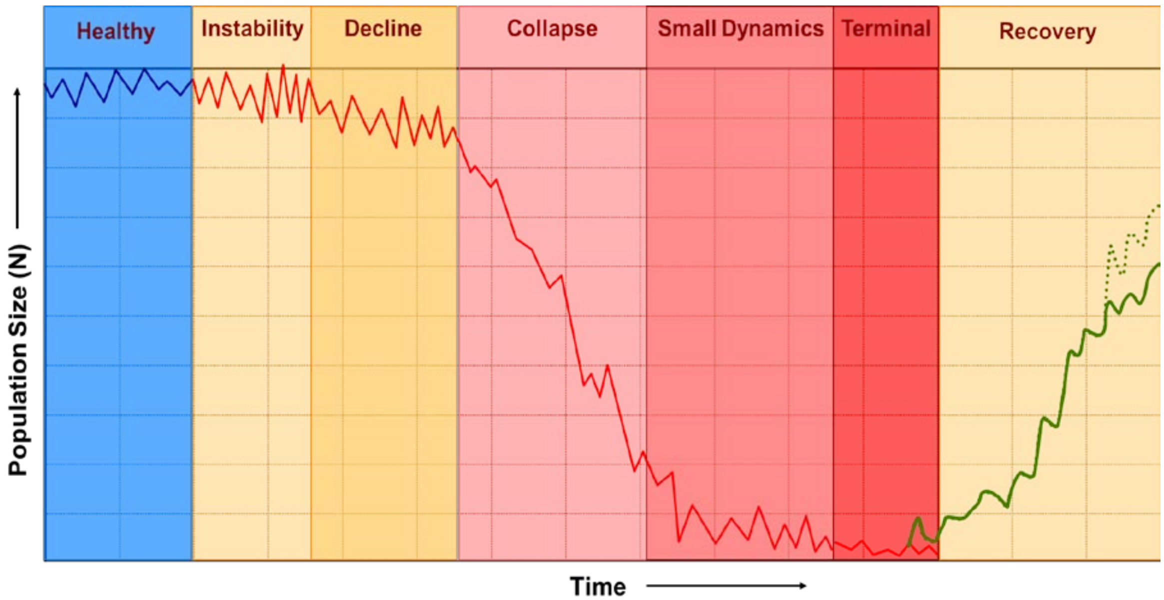


Figure 2-9. Conceptual diagram of the demographic extinction process. Diagram shows the size of a population over time through different stages. In the terminal phase, two possible trajectories for the population are extinction or recovery. Figure adapted from Johnson (2010).

For Snake River coho salmon which were monitored for 20 years preceding their extinction, the population size at which the final decline began (terminal phase) was 404 individuals (Fagan and Holmes 2006). After the population reached 233, there were no increases in the population in subsequent years, with a final population size preceding extinction of 6 individuals (Fagan and Holmes 2006).

In terms of recovery of small populations (those with fewer individuals than the depensation threshold) of anadromous salmonids, it is important to recognize that these populations are subject to both environmental and demographic stochasticity. This is unlike large populations which are, in general, only subject to environmental stochasticity (Lande 1993). Because small populations can be affected by more than one form of stochasticity, they have a much greater probability of extinction than large populations (Lande 1993, Caughley 1994, Melbourne and Hastings 2008). Once a population enters the small population dynamics phase it is equally important, if not more so (Melbourne and Hastings 2008), to recognize and consider that the population is at a substantial risk of extinction resulting from the demographic factors originating from within the population.

3. Stresses and Threats

In 1997, NMFS listed the SONCC coho salmon ESU as threatened (62 FR 24588, May 6, 1997). In the final rule, NMFS summarized the status of coho salmon based on the five listing factors identified in section 4(a)(1) of the ESA, and described for each factor the associated stressors and threats. In 2005, NMFS reaffirmed the threatened status of SONCC coho salmon (70 FR 37160, June 28, 2005). The final rule for the latter decision, included the biological review team's (BRT) assessment of population- and ESU-level extinction risk utilizing the four viable salmonid population (VSP) parameters (McElhany et al. 2000) including abundance, population productivity, spatial structure, and diversity. The BRT concluded that "these four parameters are universal indicators of species viability, and individually and collectively function as reasonable predictors of extinction risk," including SONCC coho salmon.

This chapter describes, relative to the five listing factors, the past and present natural and anthropogenic activities that continue to contribute to physical and biological degradation of coho salmon habitat and ESU-wide population reductions. Ongoing anthropogenic activities—and future natural events or anthropogenic activities—determined to affect one or more coho salmon life stage are termed threats. The resultant physical or biological (or combination of both) responses to these threats are considered stresses or limiting factors. Any plans, programs or other mechanisms that are expected to alleviate a threat are discussed as part of the evaluation of the current status of threats. These vary from local watershed restoration plans to regional conservation strategies. Listing factors (via stresses and threats) are addressed and described for each population in the population profiles (Volume II). Table 3-1, Table 3-2, and Table 3-3 display the relationship between listing factors, threats and stresses that resulted in the current ESU-wide status of SONCC coho salmon.

Table 3-1. Relationship between listing factors, stressors and resultant threats for the ESU-wide status of SONCC coho salmon.

Threat	**Listing Factor**				
	Habitat Destruction, Modification or Curtailment	Over-Utilization for Commercial, Recreational, Scientific, or Educational Purposes	Disease and Predation	Inadequate Regulatory Mechanisms	Other Natural and Man-made Factors
Roads	X[a]			X	
Timber Harvest	X			X	
Channelization/Diking	X			X	
Agricultural Practices	X		X	X	
Dams/Diversions	X		X	X	
Mining/Gravel Extraction	X		X	X	
Urbanization	X		X	X	
Fishing and Collecting		X		X	
Climate Change			X	X	X
Hatcheries				X	X
Fire	X			X	
Invasive/Non-native Alien Species	X		X	X	

[a] Indicates a stress resulting from a threat

Table 3-2. Matrix of interrelated threats and stresses in the SONCC coho salmon ESU.

Threats	**Stresses**									
	Adverse Hatchery-Related Effects	Impaired Water Quality	Degraded Riparian Forest Conditions	Increased Disease/ Predation/ Competition	Altered Sediment Supply	Lack of Floodplain and Channel Structure	Altered Hydrologic Function	Barriers	Adverse Fishery-Related Effects	Impaired Estuary/ Mainstem function
Climate Change		X	X	X			X			X
Roads		X	X		X	X	X	X		X
Channelization/Diking		X	X		X	X	X			X
Agricultural Practices		X	X		X	X	X	X		X
Timber Harvest		X	X		X	X	X	X		X
Urban/Residential/ Industrial Development		X	X		X	X	X	X		X
High Intensity Fire		X	X		X		X			
Mining/Gravel Extraction		X	X		X	X	X	X		X
Dams/Diversions		X	X	X	X	X	X	X		X
Fishing and Collecting									X	
Invasive/Non-Native/Alien Species				X						X
Hatcheries	X			X						

Table 3-3. Threats at the time of listing as compared to current threats and stresses as identified in the SONCC coho salmon recovery plan.

Threat or stress		Threats identified at the time of listing.												
		Logging	Road Building	Grazing and Mining Activities	Urbanization	Stream Channelization	Dams	Wetland Loss	Beaver Trapping	Water Withdrawals	Unscreened Diversions	Overfishing in non-tribal fisheries	Natural Factors (Drought/floods)	Artificial Propagation
Threats														
	Roads	X	X		X	X		X						
	Timber Harvest	X	X				X	X	x					
	Channelization/Diking			x		X								
	Agricultural practices			X			X		X	X	X			
	Dams/Diversions			X			X	X	X					
	Mining/Gravel Extraction			X		X								
	Urbanization				X			X	X					
	Fishing and Collecting											X		X
	Climate Change												X	
	Hatcheries											X		X
	Fire				X									
	Invasive/Non-native Alien Species				X		X							
Stresses														
	Adverse Hatchery Related Effects													X
	Impaired Water Quality	X	X	X	X		X	X	X	X	X			
	Degraded Riparian Forest	X	X	X	X	X		X	X					
	Increased Disease/Predation/Competition				X		X			X				X
	Altered Sediment Supply	X	X	X	X	X	X	X					X	
	Lack of Floodplain and Channel Structure		X	X	X	X		X	X					
	Altered Hydrologic Function	X	X	X	X	X	X	X	X					
	Barriers			X	X	X	X			X				
	Impaired Mainstem/Estuary Function	X	X	X	x	X	X	x	X	X			x	
	Adverse Fishery related Effects											X		X

NMFS assessed the viability of individual populations within the SONCC coho salmon ESU and the current condition of their habitats using five steps: (1) identify conservation targets; (2) assess population viability; (3) identify potential threats and stresses; (4) compile available literature, data and best professional knowledge on the condition of the landscape; and (5) determine the severity and impact of stresses and threats affecting each population. This methodology is detailed in Appendix B.

Stresses are related to habitat conditions that resulted directly or indirectly from past anthropogenic activities and natural phenomenon, while threats are the sources of these stresses and are the expected potential for future stresses. Most stresses are due to anthropogenic uses of land, water and natural resources, and sometimes these activities indirectly cause stress to populations by exacerbating natural processes (e.g., increasing the rate of landslides). A threat is the proximate cause of a stress and is typically generated by human land use. The stresses and threats considered in the assessment are either current stresses, or have high potential to occur in the next 10 years under current circumstances and management (Appendix B). In addition to those stresses identified at the time of listing, additional stresses that are currently affecting SONCC coho salmon were identified and ranked using the CAP workbook for each life stage of coho salmon.

In addition to the CAP assessment process, NMFS used the best available science regarding the impacts of predicted shifts in climate, effects from fishing and collecting activities, and estuary and mainstem condition on the ability of the species' to recover. Additional categories (either stresses or threats) were created for *Climate Change*, *Impaired Estuary/Mainstem Function*, and *Fishing and Collecting*. Information regarding the severity of these threats, and the stresses they create in each population, can be found in Volume II of this Recovery Plan. The threat posed by climate change was considered when developing and recommending each recovery strategy, and when developing recommended recovery actions. Recommended recovery actions to address changing marine environmental conditions are included within recovery actions designed to support other objectives.

3.1 Stresses (Limiting Factors)

In each population profile we summarize and rank the stresses (limiting factors) and threats (Volume II). Each stress (limiting factor) assessment includes a summary table of the stress (limiting factor) rankings by coho salmon life stage, the overall stress (limiting factor) ranking, and a narrative discussing the effects on the population. In addition to the stresses (limiting factors) identified during listing, we performed a stress (limiting factor) ranking and assessment for *Impaired Estuary/Mainstem Function*. Whenever available, empirical data were used to populate the summary tables and CAP tables, and were used in the stress (limiting factor) assessment. Where this information was not available, NMFS staff relied on best professional judgment to assign a severity ranking to each stress (limiting factor) by life stage. Refer to Appendix B for more-detailed information on the methodologies used. Stresses (limiting factors) are listed in Table 3-4.

Table 3-4. Stress (limiting factor) severity ranking by population. Stress ranking represent CAP results as follows: L = Low, M = Medium, H = High, VH = Very High. See Appendix B for definition of severity rankings.

Stresses (Limiting Factors)											
Population	Adverse Hatchery Related Effects	Impaired Water Quality	Degraded Riparian Forest	Increased Disease/Predation/ Competition	Altered Sediment Supply	Lack of Floodplain and Channel Structure	Altered Hydrologic Function	Barriers	Impaired Mainstem/Estuary Function	Adverse Fishery related Effects	Total High or Very High
Elk River	L	H[1]	H	L	M	VH[1]	H	M	M	L	4
Lower Rogue River	M	H[1]	H	L	H	H[1]	M	L	H	L	5
Chetco River	NA	H[1]	VH[1]	NA	M	H[1]	H[1]	L	H[1]	L	5
Winchuck River	NA	H[1]	H	NA	H	VH[1]	H	L	M	L	5
Hubbard Creek	NA	M	H[1]	NA	M	VH[1]	L	L	H	L	3
Brush Creek	NA	L	H[1]	NA	M	VH[1]	L	L	L	L	2
Mussel Creek	NA	L	VH[1]	NA	M	VH[1]	L	L	L	L	2
Hunter Creek	NA	H[1]	H[1]	NA	H	VH[1]	L	L	M	L	4
Pistol River	NA	H[1]	H[1]	NA	VH[1]	VH[1]	H	L	M	L	5
Smith River	L	H[1]	M	L	M	H[1]	L	H	H[1]	M	4
Lower Klamath River	M	M	H	M	VH[1]	VH[1]	H	M	H	M	5
Redwood Creek	L	VH[1]	H	NA	H	VH[1]	M	L	VH	M	5
Maple Creek/Big Lagoon	NA	L	M	L	H[1]	VH[1]	M	L	H	M	3
Little River	NA	M	H	NA	VH[1]	H[1]	M	M	M	M	3
Mad River	L	H[1]	H	M	H	H	M	L	H	M	5
Elk Creek	NA	M	H[1]	NA	M	M	M	L	M	M	1
Wilson Creek	NA	L	H[1]	NA	H	H[1]	M	L	M	M	3
Strawberry Creek	NA	M	M	NA	M	M	M	H[1]	H[1]	M	2
Norton/Widow White Creek	NA	M	VH[1]	NA	M	H[1]	M	M	L	M	2

Stresses (Limiting Factors)											
Population	Adverse Hatchery Related Effects	Impaired Water Quality	Degraded Riparian Forest	Increased Disease/Predation/ Competition	Altered Sediment Supply	Lack of Floodplain and Channel Structure	Altered Hydrologic Function	Barriers	Impaired Mainstem/Estuary Function	Adverse Fishery related Effects	Total High or Very High
Humboldt Bay tributaries	L	H	H	L	VH[1]	VH[1]	M	H	H[1]	M	6
Low. Eel/Van Duzen rivers	NA	H	H	H	VH[1]	H	L	L	H[1]	M	6
Bear River	NA	H	VH[1]	NA	H	VH[1]	L	L	H	M	5
Mattole River	NA	VH[1]	H	NA	H	H	VH[1]	L	H	M	6
Guthrie Creek	NA	M	M	NA	H[1]	M	L	L	M	M	1
Illinois River	M	H[1]	VH[1]	M	H	H[1]	VH[1]	H[1]	H	L	7
Mid. Rogue/Applegate Rivers	M	VH[1]	VH[1]	L	L	VH[1]	VH[1]	M[1]	H	L	5
Upper Rogue River	M	VH[1]	VH[1]	L	H	H[1]	VH[1]	H	H	L	7
Middle Klamath River	M	H[1]	M	H	H[1]	H[1]	H	H	H	M	7
Upper Klamath River	VH	H[1]	H	H	H	H	H	VH[1]	H	M	9
Salmon River	L	M[1]	M[1]	L	M	M[1]	M	L	M	M	0
Scott River	M	H	VH[1]	L	H	VH	VH[1]	L	VH	L	6
Shasta River	H	VH[1]	H	VH	M	VH[1]	VH	M	VH	L	7
South Fork Trinity River	M	H[1]	H	L	H[1]	H	H[1]	M	M	M	5
Lower Trinity River	H[1]	M	M	L	H	VH[1]	H[1]	M	L	M	4
Upper Trinity River	VH[1]	M	M	H	M	H	H[1]	H[1]	M	M	5
South Fork Eel River	L	H	H	H	VH[1]	VH[1]	H	H	M	M	6
Mainstem Eel River	NA	M	H	H	VH[1]	H[1]	M[1]	M	M	M	3
Mid. Fork Eel River	NA	M	H[1]	H	H[1]	M	M	M	M	M	2
Mid. Mainstem Eel River	L	H[1]	VH[1]	H	VH[1]	H	H	M	M	M	5
Upper Mainstem Eel River	L	H[1]	H	H	H	H	M	VH[1]	M	M	5

In the following subsection we summarize the stresses (limiting factors)existing within the SONCC coho salmon ESU, with a brief description of effects to coho salmon and their habitat associated with each stress. In addition, each population profile (Volume II) provides a detailed description of each stress (limiting factor) at the population level, and recovery strategy and actions recommended to achieve viability.

3.1.1 Adverse Hatchery-Related Effects

Potential problems associated with hatchery programs include genetic impacts on naturally reproducing wild populations, competition for prey resources and available habitat, disease transmission, predation of wild fish, difficulty in determining wild stock status due to incomplete marking of hatchery fish, depletion of wild stock to the demand for increases in brood stock, replacement rather than supplementation of wild stocks, and continued annual introduction of hatchery fish (Hindar et al. 1991, Steward and Bjornn 1990, Waples 1991). Simply put, the more hatchery fish released, the greater the natural populations are effected, and the longer that these effects will occur. Even if all the hatcheries in the ESU were to stop producing fish, legacy genetic effects from past hatchery practices would continue to impact wild fish populations for many generations to come. Additionally, hatchery effects are exacerbated when populations are at or below depensation levels, as many are in the SONCC coho salmon ESU. Adverse hatchery-related effects from the high production of hatchery salmonids are a high or very high stress (limiting factor) in three populations in the SONCC coho salmon ESU (Table 3-4).

Three artificial propagation programs are considered to be part of the ESU: the Cole Rivers Hatchery (Rogue River), Trinity River Hatchery, and Iron Gate Hatchery (Klamath River) coho salmon programs (70 FR 37160, June 28, 2005). These hatcheries produce not only coho salmon but also Chinook salmon and steelhead for release into the wild, further impacting native coho salmon populations. In 2004 to2008, Iron Gate and Trinity River hatcheries volitionally released an average of 570,000 yearling coho salmon (<20/lb) in March through May. Collectively, these three hatcheries release about 14,215,000 hatchery salmonids (coho salmon, Chinook salmon, and steelhead) into the Rogue, Trinity and Klamath rivers annually, with approximately 5.6 and 6 million fish coming from the Trinity River and Iron Gate hatcheries alone (ICF/Jones & Stokes 2010). Annual coho salmon production goals at the Cole Rivers, Trinity River, and Iron Gate hatcheries are 200,000, 500,000, and 75,000, respectively.

All three hatchery programs release smolts on site, use volunteers as brood stock, include unclipped fish as brood stock and use various combinations of fin clips to mark their production. The proportion of wild origin recruits used as brood stock varies by hatchery and year. The proportion of wild brood stock at Cole Rivers Hatchery over the years 1995 to 1998 ranged from 24 percent to 72 percent, while the proportion of wild brood stock at Iron Gate Hatchery from 1998 to 2004 ranged from 8.8 percent to 48.3 percent. The release strategy for Chinook salmon at Trinity River and Iron Gate hatcheries may result in competition for limited habitat during the late spring between hatchery fish and naturally produced coho salmon. The potential for adverse effects on natural coho salmon populations is highest in late spring when lower flows and higher water temperatures may increase competition for suitable rearing habitat (CDFG and NMFS 2001). Naturally produced coho salmon juveniles may be preyed on by hatchery steelhead that may be residualizing in the Klamath and Trinity Rivers below Iron Gate and Trinity River hatcheries. Additionally, residualization of hatchery steelhead and predation on naturally produced salmon and steelhead fry has been demonstrated in the Trinity River (Naman 2008), representing a potential threat to natural salmon and steelhead populations. Good et al. (2005) noted that 80 percent of the coho returning to Iron Gate Hatchery in 2001 were clipped hatchery fish, although the significance of this observation is unclear because of the location of the hatchery at the upstream end of the anadromous corridor. Good et al. (2005) also noted that hatchery fish comprised from 63 percent to 86 percent of the total fish harvested in the Yurok tribal coho harvest between 1997 and 2000. Iron Gate Hatchery fish represented 8 percent or less of the harvest of hatchery fish, but Trinity River Hatchery fish accounted for 87 percent to 95 percent of hatchery fish harvested from 1998 to 2001, and 40 percent of the hatchery fish captured in 1997. Finally, Good et al. (2005) noted that between 1997 and 2002, hatchery fish constituted between 89 percent and 97 percent of the coho (adults plus grilse) returning to the Willow Creek weir in the lower Trinity River (Sinnen 2002). The information available indicates that the influence of the hatchery stocking program on the genetic fitness of wild coho populations in the Klamath and Trinity rivers is significant. Moreover, because the Klamath and Trinity watersheds represent a large proportion of spawning and rearing habitat in this ESU, it is concluded that hatchery impacts are significant at the ESU level.

In addition to the aforementioned hatcheries, the Mad River and Rowdy Creek hatcheries (in California) and the Elk River Hatchery (in Oregon) are located within the ESU and produce steelhead and Chinook salmon, which also interact with SONCC coho salmon. The ICF/Jones & Stokes (2010) reported that in March of 2004 through 2008, Mad River Hatchery released an average of 200,000 steelhead yearlings into the Mad River.

Table 3-5. Production levels at hatcheries throughout the SONCC coho salmon ESU. Only those programs that influence natural populations are include

State	Hatchery	Coho Salmon Production	Chinook Salmon Production	Steelhead Trout Production
Oregon	Cole Rivers	200,000 (released into Rogue River)*	1.6 million (spring-run released into Rogue River)*	220,000 (summer-run released into Rogue River)*
				132,000 (winter-run released into Rogue River)*
				132,000 (winter-run released into Applegate River)*
	Elk River	Not Applicable**	110,000 (fall-run released into Chetco River)**	50,000 (winter-run released into Chetco River)**
			295,000 (fall-run released into Elk River)**	
California	Iron Gate	79,710***	6,280,978***	104,324***
	Trinity River	502,617***	4,434,995***	800,000***
	Mad River	Not Applicable	Not Applicable	203,943***
* Data from Cole Rivers Hatchery Operations Plan 2011				
** Data from Elk River Hatchery Operations Plan 2011.				
***Data from ICF/Jones & Stokes : 2010 CDFG Hatchery Operations Final Environmental Impact Report (EIR)/(EIS)				
***Average Numbers and Pounds of Fish Produced and Stocked Annually from 2004 to 2008				

Hatchery operations in Oregon and California were influential in the listing of SONCC coho salmon. Natural populations in the Klamath River, Trinity River, and Rogue River basins are heavily influenced by hatcheries (Weitkamp et al. 1995, Good et al. 2005). Hatchery practices have been shown to have altered the genetic composition (Reisenbichler and Rubin 1999, Ford 2002), phenotypic traits (Hard et al. 2000, Kostow 2004) and behavior (Berejikian et al. 1996, Jonsson 1997) of wild fish in these basins. Genetic changes in hatchery populations may be transferred to natural populations if hatchery fish spawn in the wild with non-hatchery fish, causing reduced fitness and productivity of the natural population. The potential magnitude of genetic effects depends on the species, number, size and location of the hatchery fish released, as well as the potential overlap in spawn timing and habitat preferences between hatchery and native salmonid populations (ICF/Jones & Stokes 2010).

Hatcheries are artificial rearing environments that subject fish to substantially different conditions than those that wild fish have adapted to, and, as a result, apply different selection pressures on fish than would be encountered in natural environments (ICF/Jones & Stokes 2010). Interactions between hatchery and wild fish may result in two types of genetic hazards to wild salmon and steelhead populations: (1) loss of genetic diversity within and among populations, and (2) reduced fitness of a population affecting productivity and abundance. These different selective pressures may cause hatchery fish to change genetically with associated declines in fitness occurring as quickly as within one or two generations of captive rearing (Araki et al. 2008). Araki et al. (2008) summarized a number of studies that reported a loss of reproductive success ("fitness") of hatchery fish in nature. Additional problems from genetic interactions occur when hatchery fish stray into natural spawning grounds and spawn with wild fish. Straying of hatchery coho salmon is a frequent occurrence in all river systems where hatchery fish are propagated (Reisenbichler and Rubin 1999). The subsequent genetic interactions between hatchery and naturally produced stocks can decrease the amount of genetic and phenotypic diversity of a species by homogenizing once disparate traits of hatchery and natural fish. The result can be progeny with lower survival (McGinnity et al. 2003, Kostow 2004) and ultimately, a reduction in the reproductive success of the natural stock (Reisenbichler and McIntyre 1977, Chilcote 2003, Araki et al. 2007b), potentially compromising the viability of natural stocks via out breeding depression (Reisenbichler and Rubin 1999; HSRG 2004). It is believed that genetic risks associated with out-of-basin and out-of-ESU stock transfers have largely been eliminated since these activities have ceased. However, two significant genetic concerns from continuing practices remain: (1) the potential for domestication selection in hatchery populations such as the Trinity River, where there is little or no infusion of wild genes, and (2) out-of-basin straying by large numbers of hatchery coho salmon.

Additional concerns stem from the lack of quality control and management of released hatchery fish. Spawning by hatchery salmonids in rivers and streams is often not controlled (ISAB 2002) and hatchery fish can stray into rivers and streams, transferring genes from hatchery populations into naturally spawning populations (Pearse et al. 2007). Straying of hatchery fish in the Klamath Basin is common. Chesney and Knechtle (2010) found straying rates of hatchery fish into the Shasta River as high as 73 percent in 2008, and as low as 2 percent in 2007. Carcass surveys done in the 2009-2010 season found that out of 5 fish collected, one was marked with a left maxillary clip, indicating that it originated from Iron Gate Hatchery (Chesney and Knechtle 2010). Annual monitoring in the Scott River in the 2010-2011 season found all 81 coho observed to be marked. Three fish were observed during spawning ground surveys, and one was marked with a clip indicating it had originated from the Trinity River Hatchery (Chesney and Knechtle 2010). Non-native stock transfers are thought to have contributed to the low diversity and weak population genetic divergence observed in coho salmon stocks and likely was a factor when considering hatchery effects during listing (Brown and Moyle 1991, Bartley et al. 1992, Brown and Moyle 1994, Weitkamp et al. 1995, NMFS 2001).

Flagg et al. (2000) found that, depending on the carrying capacity of the system, increasing the number of hatchery fish released often decreases the number of naturally produced fish because the wild fish can get displaced from portions of their habitat. Kostow et al. (2003) and Kostow and Zhou (2006) found that over the duration of the steelhead hatchery program on the Clackamas River, Oregon, the number of hatchery steelhead in the upper basin regularly caused the total number of steelhead to exceed carrying capacity, triggering density-dependent mechanisms that impacted the natural population. Similar effects can be found for the effects of hatcheries on coho salmon populations. Competition between hatchery and naturally-produced salmonids can also lead to reduced growth of naturally produced fish (McMichael et al. 1997). Competition between hatchery and natural salmonids in the ocean can also lead to density-dependent mechanisms that affect natural salmonid populations, especially during periods of poor ocean conditions (Beamish et al. 1997b, Levin et al. 2001, Sweeting et al. 2003). Competition for food, space, and other necessary resources can occur through two mechanisms:

- Individuals may preempt other fish from obtaining limited resources by depleting the resources first (‘scramble’ or ‘exploitative’ competition), or by actively preventing them from accessing resources (‘contest’ or ‘interference’ competition)” (ICF/Jones & Stokes 2010).

- Competition may result in reduced growth, displacement into suboptimal habitats, increased susceptibility to predation, and mortality (ICF/Jones & Stokes 2010).

Several hatchery species, including brown, brook, and lake trout, are exceptionally predatory or competitive with native salmonids. Brown trout are highly competitive and predatory with other fish species, particularly native trout, and “generally win, all things being equal (Sorenson et al. 1995). In the case of juvenile salmonids, competition is primarily for space rather than for food and other resources (Fresh 1997, Hearn 1987). Both juvenile and fresh water–resident adult salmonids are territorial and form distinct social hierarchies through aggressive interactions (i.e., interference competition) between individuals from the same species. Dominant individuals occupy preferred stream positions (i.e., locations where food can be acquired for the least amount of energy and where cover is nearby) and have the highest growth rates (Jenkins 1969, Griffith 1972). Introduced rainbow trout have been shown to disrupt these social hierarchies, resulting in reduced growth rates in Atlantic salmon (Blanchet et al. 2007). Comparable interactions may occur with native trout, such as various cutthroat races. Aggressive interactions between stocked and native salmonids may lead to a shift in the habitat niches used by native species and cause native fish to occupy suboptimal habitat or be displaced downstream, resulting in reduced growth or an increased susceptibility to predation. Once initial habitat shifts are made, differences in life stage timing, growth, and microhabitat preferences may reduce competition between species, given low fish densities (Blanchard 2002).

Another effect from the existence of hatcheries is the domestication of wild fish. Domestication occurs because, over time, hatchery populations become genetically adapted to their artificial environment, resulting in increased fitness under artificial conditions (domestication) but decreased fitness under natural conditions (Price 1984, Kohane and Parsons 1988, Hemmer 1990 *in* Hatchery Scientific Review Group (HSRG) 2004). Domestication results in morphological, physiological, and behavioral changes in hatchery fish that can affect both the fitness of the hatchery fish themselves and of the natural populations into which they are released. According to the HSRG (2004), some differences in hatchery fish that have been demonstrated include:

reduced expressions of morphological characters important during breeding, such as secondary sexual characters (Fleming and Gross 1989, 1994; Petersson and Järvi 1993); greater swimming activity, greater surface orientation, increased agonistic feeding behavior relative to natural fish (Ruzzante 1994; Campton 1995; Berejikian et al. 1996, Reinhardt 2001); increased vulnerability to predators under natural conditions (Berejikian 1995); behavioral dominance and aggression of juveniles that may result in competitive displacement of native fish from preferred habitats (Berejikian et al. 1996); earlier age at maturation, reduced egg size and numbers, and spawning hatchery adults that are generally less aggressive and more submissive to natural origin adults (Fleming and Petersson 2001); and hatchery females that show increased delays in the onset of breeding (Fleming and Gross 1994), fewer nests and greater retention of unspawned eggs (Fleming and Gross 1994; Fleming et al. 1996), and more likely for their eggs to be fertilized by several secondary males (most likely parr) than wild females (Thompson et al. 1999); and hatchery males that tend to be less aggressive and accomplish fewer spawnings than wild males (Fleming 1994).

In recent years, state guided efforts have begun to improve hatchery management practices, and work to decrease the potential negative effects of hatcheries and non-wild fish. The state of Oregon has developed several management policies and guidelines to decrease the negative impacts of hatchery fish on wild populations. In 1998, ODFW developed operational protocols with an emphasis on genetics and conservation management for coho stock in the Rogue River Cole Rivers Hatchery (ODFW 1998), and other management policies have been put into place to reduce the impacts of hatchery fish on SONCC coho salmon. More recently, Oregon adopted a Fish Hatchery Management Policy (ODFW 2003a) to guide many aspects of hatchery use, broodstock protocols, and the degree of interaction between hatchery and wild fish. ODFW's fish hatchery rearing programs are guided by the Native Fish Conservation Policy, the Fish Hatchery Management Policy and the Fish Health Management Policy (ODFW 2003a). Additionally, current fish management goals and hatchery program planning must respond to and adhere to the Oregon Plan for Salmon and Watersheds [formerly the OCSRI]. Some of the ways that the State of Oregon is decreasing negative effects of hatcheries and hatchery fish is by closely controlling broodstock origin. The Cole Rivers Hatchery coho salmon broodstock is of local origin with no out-of-basin stock introductions. This hatchery maintains broodstock and progeny are genetically and ecologically similar to wild populations, and this is maintained by incorporating a substantial number of wild coho salmon into the broodstock annually, with the goal of reducing genetic and ecological risks associated with hatchery spawning in the wild and interacting with wild juvenile coho salmon in the Rogue River basin (ODFW 2009).

In California, CDFG operates artificial propagation programs for coho salmon at two hatcheries (Iron Gate and Trinity River hatcheries) in the SONCC coho salmon ESU. These two hatcheries produce a large number of coho salmon (Table 3-5), with the percentage of hatchery fish exceeding desired ratios of hatchery to wild fish. A USFWS study conducted from 1995 to 2003 monitored relative smolt abundance in the Klamath River at Big Bar, above the confluence of the Trinity River. The study found that hatchery smolts comprised from zero to 66.7 percent of all captured coho salmon yearlings, reflecting the high Iron Gate Hatchery production. Between 1998 and 2000, Yurok Tribal Fisheries operated a downstream migrant trap in the lower Klamath River, below the confluence of the Klamath and Trinity rivers. The Yurok study estimated marked Trinity River Hatchery smolts comprised 91 percent, 97 percent, and 65 percent of the catch in 1998, 1999, and 2000, respectively (Good et al. 2005). In 1998, a second trap was operated on the lower Trinity River. Only nine percent of the smolts captured at this trap were unclipped and considered naturally produced (ICF/Jones & Stokes 2010). Assuming that this proportion accurately reflected the relative contributions of naturally produced and hatchery Trinity River Hatchery fish to total catch at the Lower Klamath trap, the percent of hatchery fish exiting the Klamath River proper (above the Trinity confluence) was approximately 58 percent (ICF Jones & Stokes 2010). Hatchery fish make up an average of 16 percent of recovered carcasses in the Shasta River (Ackerman and Cramer 2006) and Trinity River Hatchery has a significant portion of fish straying and interacting with Trinity River wild populations (NMFS 2001). This high number of hatchery fish has been shown to have negative impacts on wild fish through genetic, behavioral, and physical changes. CDFG (2002b) found that 29 percent of coho salmon carcasses recovered (100 percent mark) at the Shasta River fish counting facility (SRFCF) had left maxillary clips in 2001, indicating IGH progeny. Although the actual percentages of hatchery fish in the river changes from year to year and depends largely on natural returns, these data indicate that substantial straying of IGH fish occurs in important tributaries of the Klamath River, and this straying has the potential to reduce the reproductive success of the natural population (Chilcote 2003, Mclean et al. 2003, Araki et al. 2007a) and negatively affect the diversity of the interior Klamath populations via outbreeding depression (Reisenbichler and Rubin 1999, HSRG 2004).

3.1.2 Impaired Water Quality

One of the most important ecological requirements of coho salmon is cold, clean, well-oxygenated water. Current water quality parameters reduce populations throughout much of the SONCC coho salmon ESU. Impaired water quality parameters include increased water temperature, changes in pH above or below optimum levels, reduced dissolved oxygen, increased nutrient loading, and increased extent or duration of turbidity, or both. Some of the activities that impair water quality include water diversions, in-channel construction, riparian vegetation reduction, agriculture, alteration of the streambed and banks, components of timber management, and the introduction of point- and non-point source pollution from urbanization and industrialization. NMFS concluded that impaired water quality is either a high or very high stress (limiting factor) in 24 out of 41 populations in the SONCC coho salmon ESU, and is largely characterized by increased in water temperature, decreased dissolved oxygen, and increased turbidity (Table 3-4; Volume II).

Increased water temperature is one of the most widespread (and greatest) stresses (limiting factors) in the SONCC coho salmon ESU. Water temperature influences coho salmon growth and feeding rates (partly through increased metabolism), development of embryos and alevins (McCullough 1999),as well as timing of life history events such as freshwater rearing, seaward migration (Holtby et al. 1989), upstream migration and spawning (Spence et al. 1996). Increased water temperature can be detrimental to the survival of most life stages of coho salmon, but in the SONCC coho salmon ESU summer-rearing juveniles are the most likely to be affected by elevated water temperatures. Elevated water temperature can result in increased levels of stress hormones in coho salmon, often resulting in mortality (Ligon et al. 1999). Increased water temperature, even at sub-lethal levels can inhibit migration, reduce growth, stress fish, reduce reproductive success, inhibit smoltification, contribute to outbreaks of disease, and alter competitive dominance (Elliott 1981). Increases in water temperature may result from changes in the quantity and quality of riparian vegetation, the presence of dams, water diversions, other anthropogenic activities, and have also been correlated to large-scale (or localized) climate change and precipitation. Additionally, threats including timber harvest, urbanization, roads, and other land use activities are expected to continue to affect water temperatures within the SONCC coho ESU.

In addition to appropriate water temperatures, salmonids need adequate concentrations of dissolved oxygen for the survival of all life stages (Spence et al. 1996). Reduced levels of dissolved oxygen can impair the growth (Herrmann et al. 1962) and developmental (Silver et al. 1963) processes of various life stages of salmon, including eggs and fry. Low dissolved oxygen can also decrease the swimming (Davis et al. 1963), feeding and reproductive ability of juveniles and adults (Bjornn and Reiser 1991). Such impacts can affect fitness and survival by altering embryo incubation periods, decreasing the size of fry, increasing the likelihood of predation, and decreasing feeding activity (Carter 2005). Under extreme conditions, low dissolved oxygen concentrations can be lethal to salmonids (Bjornn and Reiser 1991).

Nutrient contributions from sources such as fertilizer run-off, livestock, and septic systems may foster algae blooms that can contribute to elevated pH levels, increase ammonia toxicity, and depressed dissolved oxygen levels. Algae and other aquatic plants create diel (24 hour) cycles in which photosynthesis causes high pH during daylight hours and respiration causes low dissolved oxygen at night (Nimick et al 2011), which may be stressful or lethal to salmonids. Additional water quality impairments may be caused when large algae blooms begin to decay and increase the biological oxygen demand (Lathrop et al. 1998, Landsberg 2002). These water quality problems may exacerbated by reduced flows.

Both acidic (pH <6.5) or alkaline conditions (pH >8.5) can cause salmonid stress (Spence et al. 1996). Adverse effects from low pH can occur at levels that are not lethal to adult fish, but which can impair reproduction and other processes. Reproductive impairments include altered spawning behavior, reduced egg viability, decreased emergence success and reduced survival of the early life stages which are known to be the most vulnerable to low pH (Jordahl and Benson 1987). Conversely, chronic high pH levels in freshwater streams can also decrease activity levels of juvenile salmonids, induce stress responses, cause decreased or cessation of feeding, and may lead to a loss of equilibrium (Murray and Ziebell 1984). Prolonged exposure to pH levels of 8.5 or greater may exhaust the ion exchange capacity at gill membranes and lead to increased alkalinity in the bloodstream of salmonids (Wilkie and Wood 1995). If water temperatures are high (e.g. 25°C), then high pH may also cause conversion of ammonium ions to highly toxic dissolved ammonia (Goldman and Horne 1983).

One of the most wide scale changes in water quality in the SONCC coho salmon ESU is increased turbidity and suspended sediment. Increases in turbidity, changes in the quantity and quality of suspended sediment, and associated decreases in water quality can be caused by a variety of activities including logging, grazing, agriculture, mining, road building, urbanization, and construction (Bash et al. 2001). These activities, when performed in excess or without proper management, have been shown to have the ability to contribute to periodic pulses or chronic levels of suspended sediment in streams (Bash et al. 2001) and likely have a wide range of effects on all life stages of salmonids. Effects from increasing sediment loads and turbidity range from lethal to sublethal (Newcombe and McDonald 1991), and arise from physiological stress (e.g., gill trauma, changes in blood sugar levels and osmoregulatory function, susceptibility to disease), loss of spawning and rearing habitat, and alteration of behaviors (e.g., avoidance, territoriality, and foraging) that affect salmonid growth and survival.

The most common behavioral alteration associated with increased turbidity is reduced juvenile salmonid feeding behavior. Data indicate that there is an inverse relationship between turbidity and feeding efficiency or prey ingestion (Berg 1982, Berg and Northcote 1985, Sweka and Hartman 2001)-and as turbidity increases, feeding efficiency decreases. Salmonids are visual predators that feed largely on drifting invertebrates, and changes in efficiency can be correlated to a decrease in their reactive distance to prey as turbidity increases. Published data suggest that feeding efficiency of juvenile coho salmon may drop by 45 percent at a turbidity level of 100 Nephelometric Turbidity Units (NTUs) (Berg 1982) and that turbidity as low as 70 NTU reduced salmonid foraging effectiveness and delayed their response to food (Bisson and Bilby 1982).

Water Quality Programs

Federal and state programs exist to maintain and improve water quality conditions throughout the SONCC coho salmon ESU. Both California and Oregon have statewide water quality programs aimed at improving current water quality conditions, and the U.S. Environmental Protection Agency (USEPA) works closely with both states to identify and improve conditions in impaired watersheds.

In 1969, the California Legislature enacted the Porter-Cologne Water Quality Control Act (the Act) to preserve, enhance and restore the quality of the State's water resources. The Porter-Cologne Act is the principal law governing water quality in California. Unlike the Clean Water Act, Porter-Cologne applies to both surface water and ground water. Beyond establishment of the state framework, this act has been revised to comply with the federal Clean Water Act.

The Act established the State Water Resources Control Board and nine Regional Water Quality Control Boards (RWQCBs) as the principal state agencies with the responsibility for controlling water quality in California. Under the Act, water quality policy is established, water quality standards are enforced for both surface and ground water, and the discharges of pollutants from point and non-point sources are regulated. The Act authorizes the State Control Board to establish Water quality principles and guidelines for long range resource planning including ground water and surface water management programs and control and use of recycled water. The California Coastal Act of 1976 extended the California Coastal Commission's authority indefinitely. The California Coastal Commission was established by a voter initiative in 1972, and provides oversight for projects that impact water resources along the California coast. The California Coastal Commission has joint responsibility with the State Board and Regional Boards for implementation of the state's Nonpoint Source Program (see section 319 of the Clean Water Act, section 309 of the Coastal Zone Management Act of 1972, and section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990).

The Oregon Department of Environmental Quality (ODEQ) is the state agency responsible for protecting Oregon's surface waters and groundwater. The ODEQ's Water Quality Program develops water quality standards for Oregon's waters, monitors water quality in designated river basins, regulates point source discharges, regulates injection systems by issuing permits to protect groundwater, and controls nonpoint sources of pollution through statewide management plans (available at: http://www.deq.state.or.us/wq/nonpoint/plan.htm). Oregon has established both numeric and narrative water quality criteria, but does not have streamflow criteria to protect streamflow at this time. Antidegredation rules exist in areas around the state and help to maintain water beneficial uses of water. ODEQ is the state agency tasked with developing and implementing TMDLs.

Using the Oregon Water Quality Index to monitor trends in water quality, ODEQ regularly collects water samples at over 150 sites on more than 50 rivers and streams across the state. ODEQ visits most sites six times annually and test a number of water quality variables at each visit. The state has monitored some sites routinely since the late 1940s (available at http://www.deq.state.or.us/lab/wqm/docs/09-LAB-004.pdf). The data are used to determine whether there is too much pollution in a water body, and set limits on how much pollution a water body can receive. The ODEQ also maintains a volunteer water quality monitoring program around the state, providing equipment and assistance to volunteers and groups wanting to assist in water quality data collection (available at: http://www.deq.state.or.us/lab/wqm/docs/08-LAB-015.pdf). Oregon's Water Quality Nonpoint Source Control Program Plan (ODEQ 2000) identified the pollution management programs, strategies, and resources that were currently in place or that were needed to minimize nonpoint source pollution effects. The plan integrates a variety of other state and federal initiatives, and the state is currently completed the process of re-evaluating the program.

The Clean Water Act (CWA) is the most well known federal policy aimed at improving and protecting water resources around the United States. The CWA was adopted "to restore and maintain the chemical, physical and biological integrity of the Nation's waters" (33 U.S.C. § 1251 et seq.). Under section 303(d) of the CWA, States are required to identify those waters that are not meeting water quality standards or supporting beneficial uses, including fisheries resources. Section 303 of the federal Clean Water Act (33 USC §1313) defines water quality standards as consisting of both the uses of the surface (navigable) waters involved and the water quality criteria which are applied to protect those uses. These waters are placed on the State's Section 303(d) list and submitted to USEPA for review and approval. Under the Clean Water Act the Oregon Department of Environmental Quality (ODEQ) and the WQCBs must develop total maximum daily loads (TMDLs) to limit the pollutants that are impairing those water bodies.

Since the initial listing of SONCC coho salmon many TMDLs have been completed (Table 3-6), and California and Oregon are working to manage excessive pollutants and other water quality impediments. TMDLs in California are developed either by Regional Water Quality Control Boards (RWQCBs) or by the USEPA. TMDLs developed by RWQCBs are designed as Basin Plan amendments and include implementation provisions. TMDLs developed by USEPA typically contain the total load and load allocations required by Section 303(d), but do not contain comprehensive implementation provisions. This stems from the fact that USEPA authorities related to implementation of nonpoint source pollution control measures are generally limited to education and outreach as provided by CWA Section 319. The beneficial use of salmonid fishes is most often affected by non-point source sediment and temperature impairments, so development of non-point source TMDLs is important. The ability of these

TMDLs to protect coho salmon in Oregon and California is expected to be significant in the long term, however, it is difficult to implement them. Ultimately their efficacy in protecting coho salmon habitat will depend on how well the protective measures are implemented, monitored, and enforced.

Table 3-6. List of total maximum daily loads (TMDLs) in the range of the SONCC coho salmon ESU and their status. Data from the North Coast Regional Water Control Board website.

Watershed	Pollutant(s)	TMDLs Status	Watershed	Pollutant(s)	TMDL Status
Mattole River	Sediment and Temperature	Completed - 2004	Redwood Creek	Sediment and Temperature	Completed - 1998
Lower Eel River	Sediment and Temperature	Completed - 2007	Klamath River	Nutrients, Temperature, Low Dissolved Oxygen	Completed - 2010
Van Duzen River	Sediment	Completed - 1999	Salmon River	Temperature	Completed - 2005
Middle Fork Eel River	Sediment and Temperature	Completed - 2003	Scott River	Sediment and Temperature	Completed - 2005
Middle Mainstem Eel River	Sediment and Temperature	Completed - 2004	Shasta River	Organic enrichment, Low DO, Temperature	Completed - 2007
North Fork Eel River	Sediment and Temperature	Completed - 2002	Trinity River	Sediment	Completed - 2001
South Fork Eel River	Sediment and Temperature	Completed - 1999	South Fork Trinity River	Sediment and Temperature	Completed - 1998
Upper Mainstem Eel River	Sediment and Temperature	Completed - 2004	Upper Rogue River	Bacteria, DO, pH, Sediment, Temperature	Completed - 2008
Elk River	Sediment	In Progress	Middle Rogue River	Bacteria, Sediment, Temperature	Completed - 2008
Freshwater Creek	Sediment	In Progress	Lower Rogue River	Bacteria, Temperature	Completed - 2008
Humboldt Bay	PCBs	In Progress	Illinois River	Temperature	Completed - 2008
Jacoby Creek	Sediment	In Progress	Chetco River	Bacteria, DO, pH, Temperature	Initiated
Mad River	Sediment, Turbidity, Temperature	Completed - 2007	Applegate River	Temperature, DO	Completed - 2004

In addition to federal water quality policy, tribes along the Klamath River have developed water quality standards for their lands, and developed their own water quality control plans. Under CWA section 518(e) (33 U.S.C. § 1377(e)), tribes may apply to the USEPA to be treated as a State for purposes of various listed sections of the CWA, and USEPA-approved tribal water quality standards are similar to USEPA TMDLs, and help protect fish and water quality both upstream and downstream of tribal lands. The Hoopa Valley, Yurok, and Karuk tribes have all developed water quality control plans (Hoopa Valley Tribe Environmental Protection Agency

2008, Yurok Tribal Environmental Program (YTEP) 2004, Karuk Tribe of California 2002) and the Quartz Valley and Resighini Rancherias have developed water quality programs (Quartz Valley Indian Reservation 2009, Resighini Rancheria Environmental Department 2006).

3.1.3 Degraded Riparian Forest Conditions

Riparian habitat provides significant benefits to freshwater aquatic systems and the biota that live within and around it (Welsch 1991). Riparian area structure and composition throughout the ESU has changed due to irrigation diversions, timber harvest, farming, grazing, wildfire, and urbanization, which all contribute to a high or very high ranking of *degraded riparian forest conditions* in 34 populations in the ESU (Table 3-4; Volume II). Aquatic functions and processes dependent upon properly functioning riparian areas have been reduced accordingly. Major floods occurring in the years 1955, 1964, 1974, 1986, 1997, and 2006 caused significant damage to riparian areas in almost every population area in the ESU. Consequently, species diversity has been reduced and channel functions—such as sediment transport and storage—have been severely altered or is lacking in many areas. As mentioned above, there are myriad anthropogenic activities that can contribute to the degraded riparian conditions, many of which are occurring in populations within the SONCC coho salmon ESU. Livestock grazing, urbanization, and certain timber harvest practices, can, and do, affect the riparian environment by reducing the amount and composition of riparian vegetation, or may eliminate sections of riparian areas. Eliminating or decreasing riparian areas may result in stream channelizing and straightening, channel widening, channel aggradation, and lowering of the water table (Belsky et al. 1999). Effects on fish habitat from these activities include: reduction of streamside shade and cover, decreases in large wood recruitment, decreases in allochthonous materials (material formed or introduced from somewhere other than the place it is presently found), increases in stream temperature, changes in water quality and stream morphology, and the addition of sediment through bank degradation and off-site soil erosion (Cohen 1997, Forest Ecosystem Management Team (FEMAT) 1993, Spence et al. 1996). Riparian vegetation helps to maintain instream water quality by filtering nutrient runoff, and this process is altered or completely absent when riparian vegetation is cleared for agricultural activities or urban development (Welsch 1991). In addition, coarse woody debris associated with riparian corridors provides structure for shade, cover, bank stabilization, breeding sites for some amphibians and invertebrates, and these functions are lost when trees are removed from an area (Moseley et al. 1998).

3.1.4 Increased Disease/Predation/Competition

Disease and predation are locally significant throughout the ESU, and are likely limiting the recovery of some SONCC coho salmon populations. Currently, disease and predation are listed as a high or very high stress to 4 populations in the ESU (Table 3-4). Impacts from diseases are likely being exacerbated by human induced environmental impacts and activities, such as alteration of hydrologic functions (damming and diverting), impaired water quality conditions, hatchery practices, habitat alterations, and changing climatic conditions. Coho salmon are exposed to numerous bacterial, protozoan, and parasitic pathogens throughout their lives, and have evolved with exposure to these and other organisms (Stocking and Bartholomew, 2004). Susceptibility to disease changes according to fitness level, environmental condition, and overall health. When water quality deteriorates, diminished flows cause crowding and stress, or when parasite spore loads are extremely high, then lethal disease outbreaks can occur (Foott 1995, Spence et al., 1996, Guillen, 2003,CDFG 2003, YTEP 2004, Nichols and Foott 2005). Disease issues arise when the interaction between host and pathogen is altered and when natural resistance levels become impaired by stressful environmental conditions or decreased fitness levels. Within the last few decades, the prevalence of diseases in wild stocks has become of increasing concern, and has begun to be a factor in the continuing survival and viability of wild stocks of coho salmon (CDFG 2002a).

Diseases can affect coho salmon in almost any life stage where exposure occurs. Some diseases infect returning adults as they enter bays and estuaries, while other diseases attack or kill juveniles rearing upstream. Many pathogens may remain dormant in juveniles, or when conditions are not stressful, and then appear symptomatically when fish return to freshwater and conditions become stressful. Different life stages have different susceptibilities, making it difficult to discern time of infection or disease infection rates and causes. Known diseases and disease agents that can cause significant losses to adults include: bacterial kidney disease (BKD) (*Renibacterium salmoninarum*), furunculosis (*Aeromonas salmonicida*), columnaris (*Flexibacter columnaris*), *pseudomonas/aeromonas*, and *ichthyopthirius* or “Ich” (*Ichthyopthirius multifilis*). Juvenile salmonids are primarily affected by furunculosis, columnaris (*Flavobacterium columnare*), coldwater disease (*Flexibacter psychrophilis*), *Nanophyetus salmonicola*, Aeromonid bacteria, pseudomonas/aeromonas, ichthyopthirius, the kidney myxosporean *Parvicapsula minibicornis*, and ceratomyxosis (*Ceratomyxa shasta*) (CDFG 2002a, Federal Energy Regulatory Commission (FERC) 2007).

These diseases proliferate when fish are stressed by high water temperatures, crowding, environmental contaminants, or decreased oxygen (Warren 1991). In addition, it has been shown that water quantity and quality during the late summer months is critical in controlling or triggering disease epidemics, and that decreases in these variables may trigger the onset of epidemics in fish that are carrying the infectious agents (Holt et al. 1975, Wood 1979, Matthews et al. 1986, Maule et al. 1988). As epidemic disease breakouts occur more frequently, problems remain in identifying the proximate and ultimate causes of death, and the subsequent effect that these are having on population survival numbers. The lack of data continues to hamper the efforts of managers to understand the full effect that disease is having on coho salmon populations.

Although not emphasized in the original listing document, ceratomyxosis, which is caused by C. shasta, is one of the most significant diseases for affecting juvenile coho salmon due to its prevalence and impacts in the Klamath Basin (Nichols et al. 2003). Bartholomew et al. (2006) believes that the recent increases in air temperature may be compounding the disease potential in the Klamath basin. High water temperature, low dissolved oxygen, high pH (alkalinity) and possibly unionized ammonia in the mainstem Klamath River create stressful conditions for all ages and types of salmonids which in turn can increase disease transmission and potential effects to individuals. Severe infection of juvenile coho salmon by C. shasta may be contributing to declining adult coho salmon returns in the Klamath basin (Foott et al. 2010). Mortality rates from temporary and longer term exposures at various locations in the Klamath River vary between location, months and years, but are consistently high (10 to 90 percent) (Bartholomew 2008). In addition, parasitic infections by *Parvicapsula minibicornis* have been detected in 65 percent of young of the year of a year class and 71 percent of yearling coho salmon in the mainstem Klamath River (Nichols et al. 2008). Additionally, the Klamath River below Iron Gate Dam supports large populations of the intermediate host (a polychaete worm) of *Ceratomyxa shasta* due to an abundant food supply (particulate organic matter) and ample amounts of its two favored substrates (fine particulate organic matter that settles on the bottom of the river bed and mats of the attached algal species *Cladophora* which are stimulated by high nutrient levels). Ceratomyxosis has been responsible for most of the mortality of Klamath River juvenile salmonids in recent years. Mortality rates from temporary and long-term exposures at various locations in the Klamath River vary between location, months and years, but are consistently high (between 10 and 90 percent; Bartholomew 2008). Adults in the Klamath basin are also largely impacted by other diseases, primarily from the common pathogens *Ichthyopthirius multifilis* (Ich) and *Flavobacterium columnare* (columnaris) (National Research Council (NRC) 2004). These pathogens were partially responsible for the 2002 adult fish kill on the Klamath River (USFWS 2003). During this event over 300 coho salmon and 34,000 Chinook salmon were killed by a disease epizootic from Ich and columnaris, which was exacerbated by stressful conditions in the Klamath River (CDFG 2004). Adult mortality from ich and columnaris are not as common as juvenile mortality from *C. Shasta* or *Parvicapsula minibicornis* (Bartholomew et al. 2003).

At the time of listing, predation had been listed as a factor contributing to the decline and listing of coho salmon in the SONCC ESU, but more recent data suggests that it is a bigger problem than originally thought. Notable predators include non-native Sacramento Pikeminnow and hatchery fish, as well as predation by other non-native species in some areas. These impacts are exacerbated by habitat modification, impaired water quality, hatchery practices, and other anthropogenic activities (Marine and Cech 2004).

In some watersheds, the rapid expansion of invasive predator populations was facilitated by alterations in habitat conditions (particularly increased water temperatures) that favor these species (Brown et al. 1994). Non-native fishes such as Sacramento pikeminnow (*Ptychocheilus grandis*), smallmouth bass (*Micropterus dolomieu*), brown trout (*Salmo trutta morpha fario*) and channel catfish (*Ictalurus punctatus*) can consume significant numbers of juvenile salmon (NMFS 1998). Sacramento pikeminnow have been observed throughout the Eel River basin and are thought to be a serious predator that is likely limiting juvenile coho salmon survival (CDFG 1994, 2004; NMFS 1996). In the Trinity River, brown trout are abundant enough to make up a substantial proportion of observations by biologists collecting juvenile salmonid habitat utilization data (Martin 2009) and it is likely that they consume naturally produced fry and juvenile coho salmon. Without adequate avoidance habitat (deep pools and undercut banks), and adequate flows for migration and rearing, predation can have a significant negative effect on juvenile salmonid growth (Quinn and Peterson 1996, Schlosser 1987, Bugert and Bjornn 1991, Bjornn and Reiser 1991, Brown 1999).

In addition to non-native species, hatchery fish can exert predation pressure on juvenile coho salmon. Native fishes in coastal streams and rivers have generally co‑evolved with native salmon and steelhead, which are also used for hatchery stocks. Under natural conditions native fishes may subsist with minimal, if any, negative interactions with salmon and steelhead in rivers and streams. The addition of large numbers of hatchery fish at one time and location, such as that which occurs under salmon and steelhead stocking programs, may potentially result in locally elevated rates of predation and competition (ICF/Jones & Stokes 2010). The potential for predation and competition between hatchery - reared and naturally produced salmonids depends on the degree of spatial and temporal overlap, differences in size and feeding habitats, migration rate and duration of freshwater residence, and the distribution, habitat use, and densities of hatchery and natural juveniles (Mobrand et al. 2005). Recently, concern has been expressed about the potential for hatchery - reared salmon and steelhead to prey on or compete with wild juvenile Pacific salmonids (Oncorhynchus spp.) and the impact this may have on threatened or endangered salmonid populations (Williams 2006). Released at larger sizes and in great quantity, hatchery-reared salmonids prey on naturally-produced juvenile coho salmon (Kostow 2009). For example, predation by hatchery fish may result in the loss of tens of thousands of naturally produced coho salmon fry annually in some areas of the Trinity River (Naman 2008). Nickelson (2003) demonstrated that the productivity of wild coho salmon in 14 Oregon coastal basins was negatively correlated to the average number of hatchery smolts released into these basins, suggesting strong ecological interactions between hatchery and wild fish. Nickelson (2003) also reviewed evidence for the role of behavior and concluded that large numbers of hatchery fish likely increase mortality of wild fish by attracting predators and/or increasing their exposure to predators.

Predation by marine mammals (principally seals and sea lions) is of concern in areas experiencing dwindling run sizes of salmon (69 FR 33102, June 14, 2004). However, salmonids appear to be a minor component of the diet of marine mammals and therefore this type of predation is likely not contributing significantly to further decreases in run sizes (Scheffer and Sperry 1931, Jameson and Kenyon 1977, Graybill 1981, Brown and Mate 1983, Roffe and Mate 1984, Hanson 1993, Goley and Gemmer 2000, Williamson and Hillemeier 2001). Among other mammalian predators that can impact salmonid populations in freshwater areas, mink (*Mustela vison*) and otter (*Lutra canadensis*) can take significant numbers of overwintering coho salmon juveniles and migrating smolts, although this is dependent upon conditions favorable to predators and the availability of other prey (Sandercock 1991).

3.1.5 Altered Sediment Supply

The alteration in the quantity and composition of the sediment supply into streams and rivers is a stress created through a variety of human induced threats. These threats include roads, agricultural practices, mining and gravel extraction, timber harvest, and urbanization. Impacts caused by these activities include changes to the size and composition of sediment entering the stream(Kaufmann et al. 2009, Opperman et al. 2005), changes to the quantity of sediment (Reid et al. 2010), and alterations in the timing of sediment entering stream channels (Cordone and Kelley 1961). Throughout the ESU, changes in the quantity of fine sediment have been one of the most documented effects of changes in land use. Altered sediment supply is a high or very high stress in 29 populations in the SONCC coho salmon ESU (Table 3-4). Increased sedimentation has been shown to have direct negative effects on coho salmon through interfering with their physiological and biological processes, have indirect effects through degradation of their habitat (Cordone and Kelley 1961, Koski 1966, Kondolf 2000), as well as decreasing the production of macroinvertebrates that are an important food source for fry, juveniles, and smolts (Suttle et al. 2004, Cover et al. 2008). Elevated rates of suspended sediment from increases in fine sediment may result in gill abrasion, suffocation of eggs (Greig et al. 2005), impaired water quality, and reduced feeding success (Newcombe and McDonald 1991). Increased fine sediment levels can reduce juvenile salmonid growth rates by decreasing macroinvertebrate prey and increasing metabolic demands due to reduced availability of sheltered microhabitats (Suttle et al. 2004). Conversely, a reduced sediment supply can limit the availability of spawning substrate, alter availability of velocity refugia and macroinvertebrate habitat, and can cause large scale changes in the morphology of downstream reaches (Cordone and Kelley 1961).

High concentrations of suspended solids degrade water quality by reducing water clarity and decreasing light available to support photosynthesis. Reduction in photosynthesis and the subsequent reduction in plant matter may then lead to decreased food and habitat (ICF/Jones & Stokes 2010). Furthermore, as photosynthesis slows, less oxygen is released into the water during daytime. These impacts can culminate in the death and decay of aquatic plants, resulting in further DO depletion and exacerbating already reduced DO levels (ICF/Jones & Stokes 2010).

Many of the historic and ongoing anthropogenic activities in the ESU have caused changes to the amount and timing of sediment delivery to streams. This is most often seen as an increased amount of fine sediment and associated aggradation within the stream channel. Accelerated rates of erosion and increased sediment delivery to streams after timber harvest and road construction are common occurrences in the mountainous, forested watersheds that are common in the ESU (Sidle et al. 1985, Montgomery et al. 2000), and have been shown to deliver higher than average quantities of fine sediment. Such increases in the timing and quantity of the supply of sediment to streams can cause dramatic changes to channels, including increased fine sediment, aggradation (sediment deposition), widening, changes in the timing and intensity of flows, and pool filling, especially in lower gradient reaches (Kelsey 1980, Lisle 1982, Roberts and Church 1986, Knighton 1991). It can take decades for channels to recover following large aggradation events (Madej et al. 2009). As stream velocities decrease, these large quantities of suspended solids may be deposited within the streambed and alter aquatic habitat (ICF/Jones & Stokes 2010). Settling fine sediments also fill spaces between rocks, thereby reducing the habitat value for benthic organisms, and decreasing prey availability (ICF/Jones & Stokes 2010). In this way, reduced water clarity from high suspended sediment loads can affect predator-prey relationships, clog or abrade sensitive fish gills, and abrade soft tissues (ICF/Jones & Stokes 2010). There is also the potential for alteration of floodplains and other flood prone areas, where large amount of sediment can bury riparian vegetation, increase the height of stream banks, and disconnect floodplain and floodprone areas. These alterations in geomorphology (i.e. excess sediment buildup, changes in proportion of fines) can result in increases in the frequency and magnitude of localized flood events, causing cumulative damage. In small instances, increased sediment loads can affect the near stream environment in other ways by positively altering the diversity and density of riparian vegetation and indirectly altering water temperature and other aquatic habitat parameters (Birtwell 1999).

Changes have also been documented in the size and quantity of coarse bed materials being delivered to streams throughout the ESU. Many of the activities discussed above have the ability to alter the quantity and composition of coarse sediment in streams. Coarse sediment serves an important function to river systems by being an essential feature of spawning and rearing habitat for coho salmon (Lorenz and Eiler 1989). Alluvial rivers, such as found in the SONCC ESU, can function properly only if continuously supplied with this coarse bed material. This supply is cut off when dams are built, mining removes excessive amounts of gravel, or the hydrology of the system is altered to decrease frequency and magnitude of flows that mobilize these sediments. Coarse sediment is an essential component of geo-fluvial mechanisms such as scouring and gravel bar development, and it has been shown that dams and other man-made barriers trap this coarse sediment that historically was delivered downstream (Kondolf 1997), permanently altering channel bed morphology and impacting instream habitat. Within the SONCC coho salmon ESU, major dams on the Eel, Klamath, Applegate, Rogue, Shasta and Trinity rivers are of particular concern because they impede coarse sediment transport downstream into areas inhabited by coho salmon. When occasional high flow releases from dams scour the channel bed and mobilize bed material downstream without replacement from upstream sources, the net effect can be channel downcutting. These occasional high flow releases tend to transport only the finer fraction of the stream channel, leaving the coarser particles behind, and can eventually create an immobile channel (Kondolf 1997). Changes such as these create a significant stress on coho salmon, which rely on the natural dynamic structure of a river for instream cover, deep pools, appropriately sized spawning substrate and off-channel habitats, all of which cease to be created when the channel bed becomes immobile. These changes can last long after the dam or other structures are removed, and work to restore these areas may take years and even decades.

3.1.6 Lack of Floodplain and Channel Structure

Low-gradient rivers and streams with active floodplains are ecologically important to coho salmon, but are highly susceptible to anthropogenic land use changes and alterations in channel morphology. Changes in floodplain and channel structure may result from a number of activities, such as agricultural practices, timber harvest, mining and gravel extraction, building of dams, the building of roads, and urbanization and development of riparian areas. Legacy impacts continue through projects that were originally built to protect urban, residential, transportation and agricultural land uses, but continue to alter channel migration, block off channel habitat, and impact side channel habitats. Unconstrained reaches of lowland rivers provide diverse, slow water habitats for salmonids, including side-channels, lakes, backwaters, alcoves, sloughs, and beaver ponds (Independent Multidisciplinary Science Team (IMST) 2002) that are essential for juvenile survival and rearing success. In unconstrained stream reaches, valley walls do not impede lateral channel migration. The resulting complex structure provides important habitats for salmonids (IMST 2002) and allows for rearing in floodplain areas and off channel habitats that may not be available in other areas of the watershed. Reduced hydrological connectivity may render these areas disproportionately susceptible to inter-annual variations in winter and summer stream flows (Sommer et al. 2005). When floodplains and off-channel habitats become disconnected, juvenile fish can be displaced downstream during high flow events, can encounter mortality from physical damage caused during high flows, and experience a decrease in the ability to survive through the winter from decreases in prey resources and slow water rearing and holding areas.

Many areas within the SONCC coho salmon ESU have been straightened, diked and leveed to allow for urbanization, road building, and increases in the quantity of agricultural areas. Stream channels that have been straightened, diked, and leveed cause harmful effects to salmonids through decreases of natural pool, winter rearing, and spawning habitats, while channel simplification also indirectly causes changes in the timing of peak flows, increases in the quantity of scour events, and changes in the movement of sediment through the system (IMST 2002). Lack of floodplain and channel structure was ranked as a high or very high stress (limiting factor) for 37 populations in the SONCC ESU (Table 3-4). This is a huge stress for the

ESU as a whole, because unconstrained, low elevation reaches often have the greatest abundance of salmonids, the greatest diversity of habitats, and the greatest potential to be impacted by anthropogenic activities (Reeves et al. 1998).

One the most important contributors to lack of floodplain and channel structure in the SONCC coho salmon ESU is a paucity of instream large wood. Large wood plays a critical role in creating and maintaining the habitat complexity necessary for high quality coho salmon rearing habitat. Coho salmon juveniles favor pools that contain shelter provided by large wood (Reeves et al. 1989). Research from across the Pacific Northwest has shown that streams with more large wood have more pools because large wood provides scour-forcing obstructions that create pools (Montgomery et al. 2003, Buffington et al. 2002). Larger pieces of wood are more stable than smaller pieces of wood, and ratio of log length to channel width can be used as a gauge of stability (Montgomery et al. 2003). Past and current timber harvests have degraded riparian forests across the SONCC coho salmon ESU, decreasing the number of large conifers in riparian zones and reducing the potential for recruitment of long-lasting large wood. Hardwood trees like alder and willow are now the most abundant species in many riparian zones. These hardwood species do not provide long lasting large wood for channel forming processes (Cederholm et al. 1997) and their maximum potential size, and therefore stability, is much smaller than conifers. Further contributing to the lack of instream large wood were misguided attempts to improve fish habitat by removing wood from streams during second half of the twentieth century. As a result, the amount of large wood in streams is currently far lower than historical levels, resulting in serious degradation of the capacity of stream habitats to support coho salmon rearing due to lack of pools and reduced habitat complexity.

The historic decline in beaver (*Castor canadensis*) populations is another major contributor to lack of floodplain and channel structure. Beaver ponds provide excellent winter and summer rearing habitat for coho salmon (Reeves et al. 1989, Pollock et al. 2004). Beavers were highly valued for their fur pelts and from the 1780s to 1840s, trappers swept through the Pacific Northwest, reducing the formerly robust beaver population to remnant levels (ODFW 2005b). The resulting effect of decreased beaver abundance on coho salmon populations was likely very significant. For example, a study of the Stillaguamish River Basin in Washington compared current conditions with estimated historical conditions and concluded that the loss of beaver ponds accounted for most of the estimated 86 percent reduction in smolt production potential (SPP) of winter habitat and most of the 61 percent reduction of SPP for summer habitat (Pollock et al. 2004). Although still much reduced from pre-trapping levels, beaver populations have rebounded somewhat since the end of the era of intensive trapping. Recent studies in the Lower Klamath, Middle Klamath and Shasta subbasins confirm that beaver ponds provide high quality summer and winter rearing habitat for coho salmon (Chesney et al. 2009, Silloway 2010). Information regarding the distribution and abundance of beavers within the SONCC coho salmon ESU is relatively limited (Riverbend Sciences 2011). In Oregon, ODFW fish habitat surveys detected beaver dams in the Rogue River basin but not in the Brush Creek, Mussel Creek, Hunter Creek, Pistol River, or Chetco River basins (although only a small portion of the Chetco basin was surveyed); there are no survey data available for Elk River or Winchuck River. In California, beavers are present in the Smith River, Klamath River, Redwood Creek, and Mad River basins but it is unknown whether they are present in the other coastal streams between the Smith River and Mad River. Beavers are absent in Humboldt Bay, Bear River, Mattole River, and most of the Eel River basin with the exception of Outlet Creek and mainstem Eel River in the vicinity of Cape Horn Dam (Riverbend Sciences 2011). Despite their considerable contribution to creating and maintaining rearing habitat for endangered coho salmon, beavers are classified as a predatory species in Oregon and current regulations allow private landowners to destroy beavers and their habitat without notification to state agencies. In California, recreational trapping is allowed and depredation permits are issued by CDFG to private landowners to destroy problematic beavers.

3.1.7 Altered Hydrologic Function

Throughout the ESU, the hydrologic function of many rivers and streams has been severely altered by dam building, road building, channelizing, water diversion, diking for urbanization and agricultural practices, and timber harvest. All life stages are potentially affected by the alteration of hydrologic function in a system. While adults are affected by the changes in flow timing, eggs, juveniles and smolts may be affected by changes in seasonal cues and increases in water temperature and salinity. By changing the flow of water, sediment, nutrients, energy, and biota, dams and water diversions interrupt and alter most of a river's important ecological processes, and therefore most aquatic organisms living in the river. There are numerous dams and diversions that occur throughout the SONCC coho salmon ESU and these populations experience stress through a multitude of direct and indirect effects. More information on the effects of altered hydrologic function can be found in section 3.2.9 describing the impact of dams and diversions, as well as being described throughout the stress section where it is appropriately described. Altered hydrologic function is a high or very high stress (limiting factor) in 17 of 41 populations throughout the ESU (Table 3-4). The populations encountering the most severe stress (limiting factor) include the mainstem Klamath River populations, the Trinity River populations, Eel River populations, and tributary populations in all these basins, although other populations are impacted by water diversions and channel morphology changes that alter the hydrologic function in them as well.

The alteration of the hydrology of a basin can create both environmental and physical changes that affect salmon. Environmental changes include changes in timing and duration of high and low flows, alterations in temperature and dissolved oxygen levels, and changes in the occurrence of environmental cues. Physical changes from modified hydrology include aggradation of the stream channel, scouring of the stream bed, disconnection of channel and floodplains, and damage to riparian vegetation from flooding events. Habitat can be severely altered by floods, sometimes requiring decades to recover. During flood events, land disturbances resulting from logging, road construction, mining, urbanization, livestock grazing, agriculture, fire, and other uses may contribute sediment directly to streams or exacerbate sedimentation from natural erosive processes (California Advisory Committee on Salmon and Steelhead Trout 1988; California State Lands Commission (CSLC) 1993; FEMAT 1993). In some California streams, the pool-riffle sequence and pool quality still have not fully recovered from the 1964 regional flood. In fact, Lisle (1982) and Weaver and Hagans (1996) found that many Pacific coast streams continue to show signs of harboring debris flows from the 1964 flood. Such streams have remained shallow, wide, warm, and unstable. While legacy effects continue to impact coho salmon throughout the ESU, major strides need to be taken to begin working on the stresses (limiting factors) and threats that are likely to continue or exacerbate these mechanisms.

3.1.8 Barriers

Fish passage barriers in some way restrict the amount of available stream habitat on virtually all SONCC coho salmon rivers and are listed as a high or very high threat in seven out of 41 populations (Table 3-4). The most common types of barriers include road-stream crossings (e.g., culverts), dams, tidegates, and agricultural diversions (Volume II). Unscreened diversions in particular were mentioned at the time of listing as a threat to SONCC coho salmon and are still a concern today (CDFG 2004). Barriers can be inhibitive through the physical blocking of stream reaches (e.g., dams, sediment buildup, changes in gradient at tributary mouths, etc.) or through water temperatures that increase to such an extent that salmonids cannot pass through the area during a portion of the year (Richter and Kolmes 2003, McElhany et al. 2000). These thermal barriers can be created by the removal of riparian vegetation, the simplification of stream channels, or from climate change, while physical alterations are mostly created by anthropogenic changes in land use.

While many road-stream crossing structures and diversions have been upgraded with structures that are designed to accommodate fish passage, several hundred road-related barriers and unscreened diversions still exist throughout the ESU, blocking access to hundreds of miles of freshwater habitat (CalFish 2009, ODFW 2008). Many efforts are currently underway to improve or remove fish passage barriers in as many places as feasible. Large dams used for water storage or hydroelectric purposes have also eliminated high quality habitat that was once accessible to coho salmon, in addition to changing the hydrologic function. Efforts are being made around the ESU to remove or retrofit these structures, and return accessibility to previously blocked historic salmonid habitat. Dry stream reaches resulting from changes in stream flow, diversions, or channel aggradation can also present seasonal barriers to migration. The current lack of high quality habitat available within many populations has made the issue of barriers even more significant as many barriers block some of the highest quality habitat and remaining refugia within key watersheds.

Approximately 450 manmade total barriers are known to remain throughout the California portion of the ESU (CalFish 2009), and block access to historic spawning and rearing areas. Since the last status update, several significant fish passage improvements have occurred throughout the ESU. In the Rogue River, three dams were recently removed (Savage Rapids Dam in 2009, Gold Hill Dam in 2008, and Gold Ray Dam in 2010) and one was notched (Elk Creek Dam in 2008) to restore natural flow and fish passage. Although the Rogue River now flows unimpeded from the Cascade foothills to the ocean, there still remain several barriers on the mainstem Rogue, and dams are still a concern in the Rogue River Basin. Since 2005, 661 miles of stream have been opened to fish passage by removing 440 barriers (available at: http://www.dfg.ca.gov/fish/Administration/Grants/FRGP/index.asp). Overall, coho salmon passage has improved from the last status update, but barriers remain a major threat because many are still unaddressed and continue to block passage. More information regarding the direct and indirect effects of barriers can be found in other sections of this chapter and geographically-specific information can be found in each population profile (Volume II) where applicable.

3.1.9 Impaired Estuary/Mainstem Function

Estuarine habitats, including marshes, forested swamps, eelgrass beds, mudflats, and tidal channels, are vitally important to the life cycles of anadromous coho salmon (Koski 2009). As juveniles and smolts, coho salmon move from freshwater rearing habitats downstream into estuaries and the ocean. As adults, coho salmon return to these areas, moving upstream through the same interconnected habitats. Many estuaries and associated low gradient stream reaches have been physically altered and degraded. Impacts from changes in land use activities and other anthropogenic activities include decreases in the quantity and quality of estuary habitat, decreases in water quality from timber harvest, road construction, riparian vegetation removal, non-point source pollution, and changes in estuary productivity from alterations in nutrient levels and sediment supply (Bowen and Valiela 2001). Juvenile salmonids often utilize estuaries as rearing areas, but preferences vary with life history types and age of juveniles as they pass along the estuary gradient (Miller and Sadro 2003). In addition to estuaries, low energy, off-channel areas and flooded marshes (tidal channels, backwater sloughs, marshes, and swamps) appear to be important habitats and provide for a unique life history adaptation in many areas. These slow and backwater habitats are sites for the production and accumulation of organic matter that forms the basis for a macrodetrital food web, providing food for juvenile salmonids (Sibert et al. 1977). Additionally, lowland marshes in the brackish zone of estuaries are important habitat for salmonids as refuge and as feeding areas, while the fish adapt to a saltwater environment where they will spend most of their adult life (Iwata and Kotamtsu 1984, Macdonald et al. 1988, Cornwell et al. 2001).

Coho salmon habitat in many watersheds in the ESU has been affected by dikes and levees. These structures constrain and alter the natural hydrology, change instream channel morphology, and disconnect the channel from the surrounding floodplain. Dikes and levees are seen in many low gradient reaches throughout the ESU, and are often found in highly productive estuaries and off-channel areas.

For example, Redwood Creek is flanked for the first 3.4 miles by flood control levees that confine the channel to a 250-foot-wide channel migration zone, which bisects the estuary. The construction of this flood control levee resulted in extensive loss of estuarine area and decreases in habitat value (Cannata et al. 2006). Levees were also constructed along portions of the lower Van Duzen and Eel rivers to protect agricultural land and urban areas from flooding. Tideland reclamation and the construction of dikes and levees for agricultural purposes have changed the natural function of the Eel River estuary considerably. Slough and creek channels that once meandered throughout the Eel River delta are now confined by levees, sufficiently slowing flow to a point that many have become filled with sediment. Levees occur across the ESU, and impaired estuary/mainstem function results in a high to very high impact in 21 out of 41 SONCC coho salmon populations (Table 3-4). Loss and degradation of these habitats have significant impacts on populations that exhibit estuary rearing life history traits, because other adequate rearing and feeding areas may not exist or not be able to provide adequate conditions.

Global warming is expected to result in an acceleration of current rates of sea level rise, inundating many low lying coastal and intertidal areas. This could have important implications for organisms that depend on these sites. Galbraith et al. (2005) found that even assuming a conservative global warming scenario of 2ºC within the next century, there would be major intertidal habitat losses at four out of the five study sites in the United States. These losses typically range between 20 percent and 70 percent of current intertidal habitat, and substantial areas of tidal flats would be lost in Humboldt Bay as soon as 2050 (Galbraith et al. 2005). The National Wildlife Federation looked at a range of climate change scenarios depicting differing heights of sea level rise to produce a forecast of impacts from sea level rise along the Pacific Northwest Coast of the United States. Results vary but overall the region will see a dramatic shift in the extent and diversity of its coastal marshes, swamps, beaches, and other habitats due to sea level rise. If global average sea level rise increases by 0.69 meters the following impacts are predicted by 2100 for the sites investigated:

Estuarine beaches will undergo inundation and erosion to the tune of 65 percent loss; as much as 44 percent of tidal flat will disappear; 13 percent of inland fresh marsh and 25 percent of tidal fresh marsh will be lost; 11 percent of inland swamp will be inundated with saltwater, while 61 percent of tidal swamp will be lost; 52 percent of brackish marsh will convert to tidal flats, transitional marsh and salt marsh; 2 percent of undeveloped land will be inundated or eroded to other categories across the study area (National Wildlife Federation (NWF) 2007). Changes in the composition of tidal wetlands could significantly diminish the capacity for those habitats to support salmonids (NWF 2007). Sea level rise will contribute to the expansion of open water in some areas – not just along the coast but inland where the water table has risen. Sea level rise will lead to significant beach erosion and make coastal areas more susceptible to storm surges. For example, estuaries and bays that experience a net loss in coastal marsh habitat are more likely to face declining water quality because marshes play a critical role in regulating nutrients and filtering pollutants. For a 27.3 inch increase in sea level rise, the area of swamp, and inland and tidal fresh marsh will decrease, while at the same time, the area of salt marsh will increase, and transitional marsh will expand (NWF 2007). Additionally, a recent analysis of sea-level rise in the Skagit Delta estimates that rearing capacity in marshes for threatened juvenile Chinook salmon would decline by 211,000 and 530,000 fish respectively, for a 45 and 80 centimeter sea level rise (Hood 2005).

3.1.10 Adverse Fishing-Related Effects

Historic Fishing Impacts

In the final rule to list SONCC coho salmon (62 FR 24588, May 6, 1997) overfishing was recognized as a contributing factor in the compromised escapement levels seen between 1950 and 1990. Exploitation of SONCC coho salmon is also expected to negatively influence recovery. Adult fish are of particularly high value to recovery because they have survived the stresses (limiting factors) and threats affecting egg, fry, juvenile, and smolt life stage and will soon reproduce. The number of fish arriving at a natal stream or river to spawn, or the spawning escapement, is critical to SONCC coho salmon recovery. Fishing regulations were changed to be more protective of coho salmon beginning in 1993, when the retention of coho salmon in ocean commercial fisheries was prohibited from Cape Falcon, Oregon (which is south of the Columbia River) to the U.S./Mexico border. The following year, coho salmon retention was prohibited in ocean recreational fisheries from Cape Falcon, Oregon to Horse Mountain, California, and expanded to include all California marine waters in 1995. Inland California waters were closed to fishing in 1998. These prohibitions remain in effect, with two exceptions: A mark-selective recreational coho salmon fishery in Oregon waters has occurred since 1998 at varying quotas depending upon specified fisheries criteria, and tribal harvest has occurred under federal reserved fishing rights in the Klamath River and Eel River basins.

Federally Managed Fisheries

SONCC coho salmon are managed as part of the Oregon Coast Natural (OCN) stock aggregate, which includes coho salmon produced from Oregon river and lake systems south of the Columbia River and contribute primarily to ocean fisheries off Oregon and California (Pacific Fishery Management Council (PFMC) 1999). OCN coho salmon are part of a larger aggregate of natural and hatchery production south of Leadbetter Point, Washington known as the Oregon Production Index (OPI) (Sharr et al. 2000). SONCC coho salmon that migrate north of Cape Blanco, Oregon are vulnerable to incidental morality due to hooking and handling in the recreational ocean fishery targeting Chinook salmon. The extent of this mortality is estimated using hatchery-produced coho salmon stocked into the Rogue and Klamath rivers (R/K coho salmon).

The prohibition of retention of coho salmon, along with management of other fisheries to maintain acceptable incidental exploitation rates on coho salmon from other fisheries, led to consistently low exploitation rates after 1993 (Figure 3-1). Amendment 13 to the PFMC Pacific Coast Salmon Plan, which was adopted in 1997, was designed to ensure that fishery related impacts do not act as a significant impediment to the recovery of depressed Oregon Coastal Natural (OCN) coho stocks (Sharr et al. 2000). In contrast to previous management approaches, fishery management under Amendment 13 is based upon exploitation rates, not escapement targets. These exploitation rates are based upon estimates of habitat production potential that incorporate effects of both freshwater and marine environments and are derived from habitat-based assessment and modeling of OCN coho production (Sharr et al. 2000). Amendment 13 considers recovery of OCN stocks by ensuring sufficient spawner escapement to seed spawning habitat. A review of the effectiveness of Amendment 13 proposed more conservative allowable exploitation rates at very low levels of spawner abundance and marine survival and slightly higher rates when conditions of spawner abundance and marine survival are favorable (Sharr et al. 2000). This proposal was adopted by the PFMC (Kruzic 2011). In 1999, NMFS issued a biological opinion requiring that the overall annual ocean exploitation rate for R/K hatchery coho salmon remain less than 13 percent (NMFS 1999). PFMC adopted this limit, and since 1999 projected exploitation rates on R/K hatchery coho salmon have been considerably lower than 13 percent (Figure 3-1). Spawner escapement has accounted for a greater proportion of adult fish each year after 1993 than occurred before 1993 (Figure 3-2).

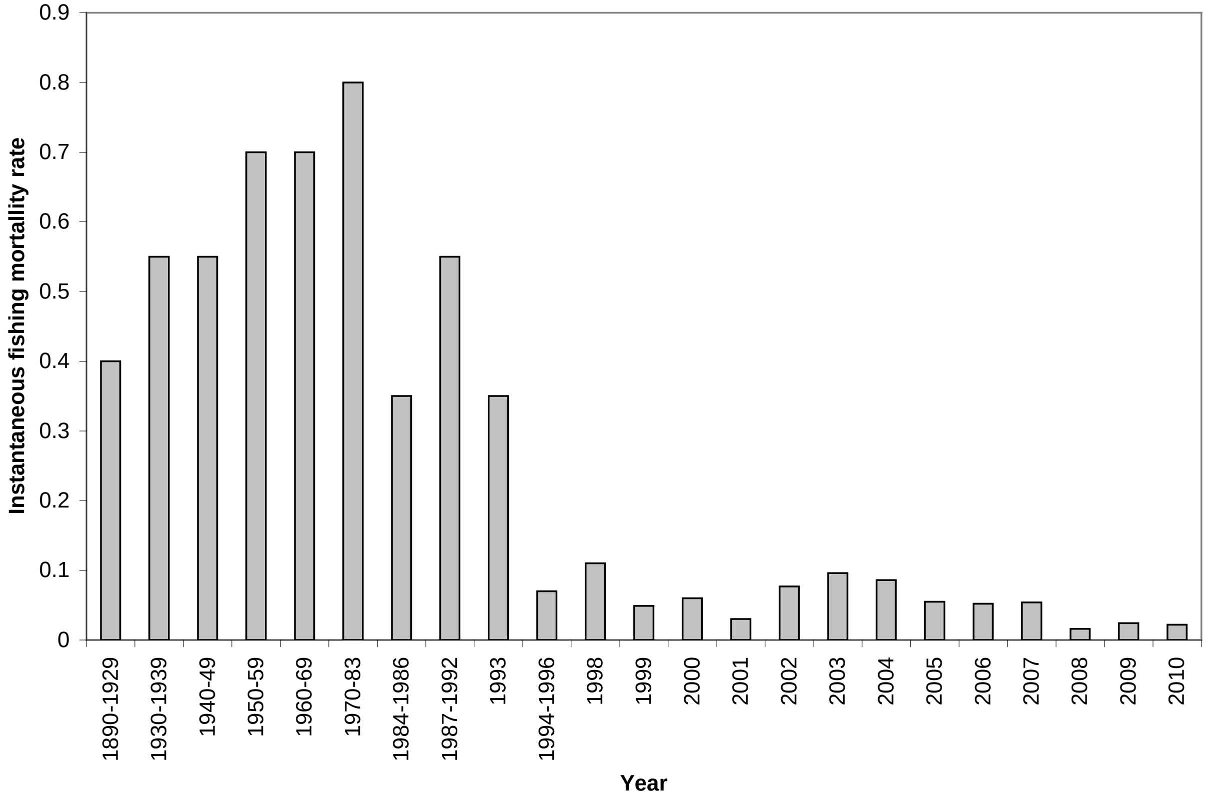


Figure 3-1. Estimated instantaneous fishing mortality rate on coho salmon in southern Oregon and northern California, 1890-2010. 1890 to 1996 rates on OCN stock aggregate are from ODFW 1997; 1998 rate is a preseason estimate for the OCN stock aggregate (PFMC 1999); 1999 through 2006 rates are pre-season estimates for Rogue/Klamath (R/K) coho salmon (PFMC 2000 to PFMC 2007, respectively); and 2007 through 2010 rates are preliminary post-season estimates for R/K coho salmon (PFMC 2008 to PFMC 2011, respectively)].

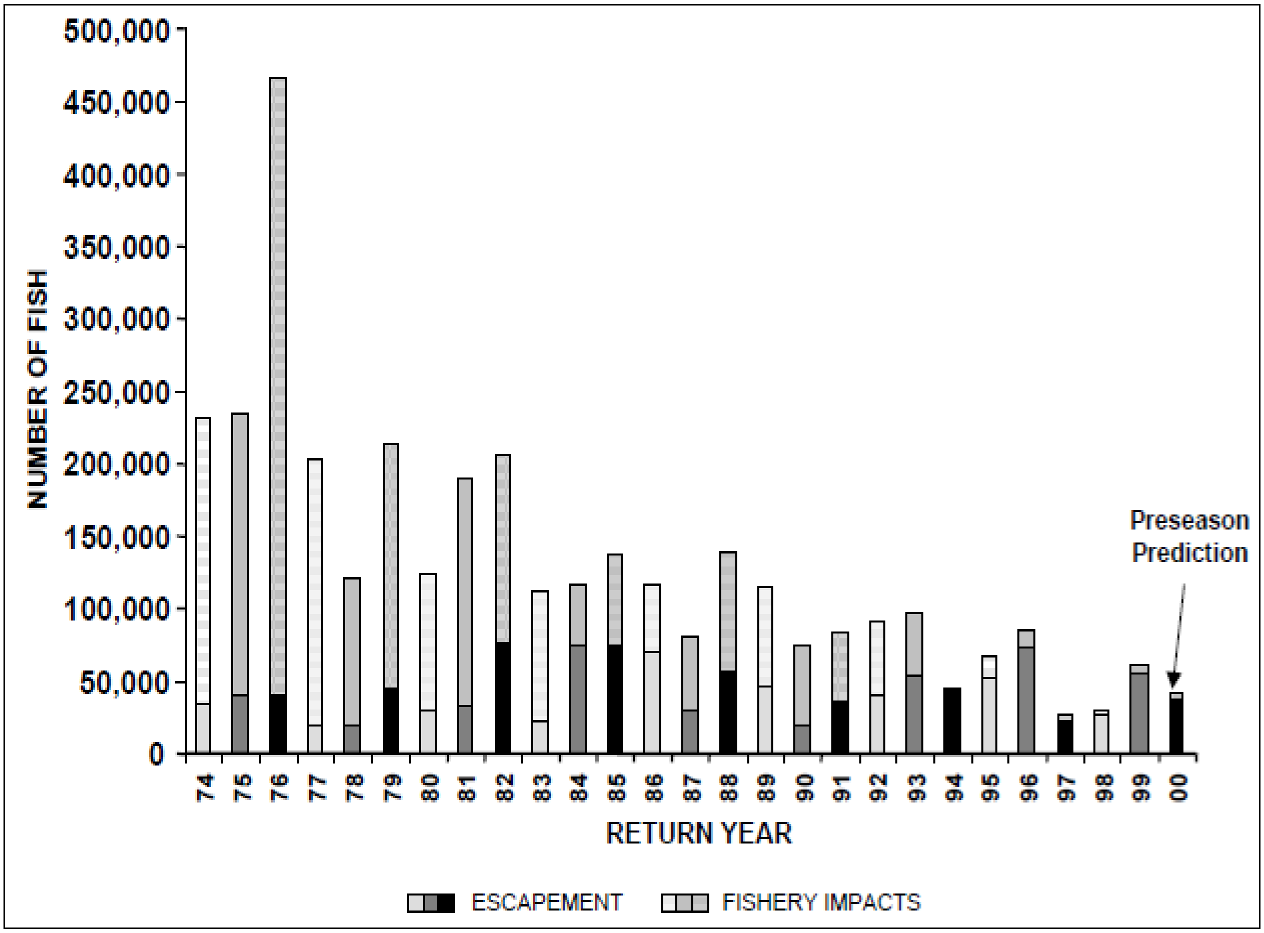


Figure 3-2. Total annual pre-fishery ocean population size of adult OCN coho, 1974 to 2000. (Figure from Sharr et al. 2000). The population for each return year is shown as stacked bars, with hatched portions depicting fishery-related impacts and solid portions depicting spawning escapement. The cohorts originating from the 1971, 72, and 73 brood cycles are depicted by light gray, gray, and black, respectively.

State-Managed Fisheries

In Oregon, adipose-fin-clipped coho salmon (hatchery coho salmon) can be retained when caught recreationally in state-managed waters (streams, rivers, tidewaters and bays), subject to areas-specific season and bag restrictions (ODFW 2011a). The 1999 NMFS biological opinion on the effects of federal fisheries on SONCC coho salmon also considered the effects of Oregon-managed fisheries on this ESU and required the exploitation rate in those fisheries to remain below 13 percent (NMFS 1999). NMFS (2007a) estimated that 3.3 percent of R/K hatchery coho salmon caught in this mark-selective fishery would die on release. Retention of coho salmon caught in any California-managed fisheries in the range of the SONCC coho salmon ESU is prohibited (CDFG 2011). The impact of California-managed fisheries on SONCC coho salmon has not been formally evaluated by NMFS.

Tribal-Managed Fisheries

The Yurok and Hoopa tribes have federally recognized fishing rights and pursue subsistence, ceremonial, and commercial fisheries for Chinook salmon and steelhead in the Klamath River basin (CDFG 2002a). Tribal harvest of coho salmon by these tribes is primarily incidental to Chinook salmon subsistence fisheries in the Klamath River and the Trinity River. The Karuk tribe uses dip nets to catch salmonids at Ishi Pishi Falls on the Klamath River. The Round Valley tribe holds a federally recognized right to pursue fisheries for salmon in the Eel River (Langridge 2002). The impact of in-river tribal fishing on the SONCC coho salmon ESU has not been formally evaluated by NMFS.

Fishing for coho salmon within the Yurok tribe's reservation on the Lower Klamath River, which extends from about 2 miles upstream of Weitchpec, California, to the Pacific Ocean, has been monitored since 1992. During that time the Yurok Tribe harvested about 70 percent of their catch below the Highway 101 bridge. The median Yurok harvest from the entire area from 1992 to 2009 was 418 coho salmon (Williams 2010), which approximates an average annual harvest of four percent of the total run. The total run size for the Klamath basin was determined by combining adult counts at the Trinity River, Iron Gate Hatchery, and Shasta and Scott river weirs (Williams 2010). On average, about 42 percent of the coho salmon harvested by the Yurok Tribe were progeny of coho salmon that spawned in the wild (Williams 2010). The effect of the Yurok fishery on particular populations within the SONCC coho salmon ESU is unknown, because all nine of the Klamath River basin coho salmon populations migrate through the lower Klamath River.

Trinity River coho salmon are harvested by the Yurok and Hoopa tribes. Table 3-7 describes the estimated percentage of the total run harvested by each tribe.

Table 3-7. Estimated number coho salmon harvested by Yurok and Hoopa tribes. Includes percentage of total adult run size harvested by Yurok and Hoopa tribes, from 1997 to 2008. M= Marked, U = Unmarked.

Year	Estimated Yurok harvest		Estimated Hoopa harvest[2]		Estimated total Trinity River adult run size[3]		Percentage total harvest taken by Yurok tribe		Percentage total harvest taken by Hoopa tribe	
	M	U[1]	M	U	M	U	M	U	M	U
1997	22	2	39	3	1,885	271	1.2%	0.7%	2.1%	1.1%
1998	117	6	88	54	10,285	1,297	1.1%	0.5%	0.9%	4.2%
1999	120	9	65	36	4,785	630	2.5%	1.4%	1.4%	5.7%
2000	70	1	211	22	10,586	386	0.7%	0.3%	2.0%	5.7%
2001	1214	111	506	100	28,139	3,389	4.3%	3.3%	1.8%	3.0%
2002	327	4	327	20	15,653	526	2.1%	0.8%	2.1%	3.8%
2003	121	23	85	17	22,963	4,352	0.5%	0.5%	0.4%	0.4%
2004	553	302	312	80	27,167	10,092	2.0%	3.0%	1.1%	0.8%
2005	640	24	153	21	27,947	2,856	2.3%	0.8%	0.5%	0.7%
2006	241	24	442	38	18,774	1,734	1.3%	1.4%	2.4%	2.2%
2007	61	17	68	14	4,436	1,257	1.7%	1.4%	1.5%	1.1%
2008	147	13	262	53	6,864	1,302	2.1%	1.0%	3.8%	4.1%
Median 1997-2008	134	15	182	29	13120	1300	1.9%	0.9%	1.7%	2.6%

[1] Calculated as follows: (Estimated harvest of marked Trinity River Hatchery (TRH) fish, provided by Yurok Tribal Fisheries Program) / estimated abundance of TRH coho salmon that migrated upstream of the Willow Creek weir) - estimated harvest of marked TRH fish. Jacks were excluded.

[2] Source: Hoopa Tribal Fisheries Program, unpublished data.

[3] Calculated as follows: Est. ocean incidental mortality[4] + Est. Yurok marked harvest + Est. Hoopa marked harvest + Est. recreational harvest upstream of WC weir (source: CDFG, unpublished data) + Est. recreational harvest downstream of WC weir (source: Hoopa Tribal Fisheries Program, unpublished data).

[4] Calculated as follows: (Est. Yurok marked harvest + Est. Hoopa marked harvest + Est. recreational harvest upstream of WC weir + Est. recreational harvest downstream of WC weir)* pre-season projected ocean incidental mortality rate (source: PFMC 2011).

Karuk fishermen are allowed by CDFG to catch salmon using dip nets at Ishi Pishi Falls on the Klamath River if they adhere to the same limits as Chinook salmon sport fishermen (CDFG 2002a). A Karuk tribe representative stated “its members rarely harvest more than 200 salmon and steelhead per year, that protected species such as coho salmon are never kept, and that these protected species are released alive” (Driscoll 2009).

Fishing Impacts

There are several reasons why the exploitation rates on SONCC coho salmon are expected to negatively influence recovery. Adult fish are of particularly high value to recovery because they have survived the stresses (limiting factors) and threats affecting egg, fry, juvenile, and smolt life stage and will soon reproduce. Since the biological opinion was completed (NMFS 1999), NMFS has developed viability criteria for SONCC coho salmon, which are explained in this plan. Therefore, the viability criteria in this plan were not specifically considered in the biological opinion (NMFS 1999).

Collection for Research Purposes

Section 9 of the ESA prohibits 'take' of listed species. To take means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct (ESA Section 3(19)). When NMFS re-affirmed the listing of SONCC coho salmon in 2005 (70 FR 37160, 37196; June 28, 2005), NMFS identified collection or handling of fish among activities that may harm certain listed salmon ESUs and thus result in violation of the ESA Section 9 take prohibition.. Information on SONCC coho salmon populations is needed for the NMFS 5-year status reviews, as well as to determine the effectiveness of habitat restoration actions, and ultimately for de-listing. This information is derived from research studies of life history strategies, abundance, distribution, and genetics, and involves take of individuals.

Within the ESA, there are two mechanisms to enable listed fish to be taken for research purposes, and exempt the permit holder from the prohibitions of the ESA. Under Section 10(a)(1)(A) and NMFS implementing regulations at 50 CFR § 222.308 section 9, NMFS may issue permits for scientific research purposes or to enhance the propagation or survival of species listed as threatened or endangered under the ESA. The permitted activities must not operate to the disadvantage of the listed species and must provide a bona fide and necessary or desirable scientific purpose or enhance the propagation or survival of the listed species. NMFS traditionally issues permits for up to five years, although permits for longer periods of time have been issued.

NMFS regulations under ESA Section 4(d) of the ESA (50 CFR § 223.203(b)(7)), provide that take prohibitions for certain listed threatened species of anadromous salmonids, which includes SONCC coho salmon, do not apply to scientific research activities conducted by employees or contractors of certain state fish and wildlife agencies, including the California Department of Fish and Game and the Oregon Department of Fish and Wildlife, or as a part of a monitoring and research program overseen by or coordinated with that agency, if the agency meets specific requirements listed in these regulations.

Specific activities authorized for research purposes by either a permit issued under ESA section 10(a)(1)(A) or the ESA section 4(d) regulations described above may include: direct observation, capture (electrofisher, nets, trawls, and traps), handling, anesthetizing, marking, tagging, tissue sampling, and other activities necessary to conduct various studies to promote the conservation of the species, enhance the species' survival, or add significantly to the body of knowledge of SONCC coho salmon. The primary effects of these activities are in the form of harassment associated with intentional take. Harassment generally leads to stress and other sub-lethal effects and is caused by observing, capturing, and handling fish. Unintentional mortality may occur during handling or after the fish has been released. Depending on the activities and life stage, NMFS anticipates from one to five percent of handled fish may die. Permits may include any conditions deemed necessary by NMFS, including reporting or inspection requirements for monitoring the impacts of permitted activities

Prior to issuance of either a permit under ESA section 10(a)(1)(A) or approval of a research program under the ESA section 4(d) regulations described above, NMFS must determine whether the action is likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat.

3.2 Threats

Threats are the activities or processes that have caused, are causing, or may cause the stresses (limiting factors) and thus the destruction, degradation and/or impairment of the focal conservation targets: SONCC coho salmon and their habitat. The major factors listed in 1997 as responsible for the decline of SONCC coho salmon were timber harvest, road building, grazing and mining activities, urbanization, stream channelization, dams, wetland loss, beaver trapping, water withdrawals and unscreened diversions for irrigation (62 FR 24588 May 6, 1997). Many of these continue to threaten coho salmon populations in this ESU while additional threats have emerged as significant factors that need to be addressed for recovery. An analysis of current threats has identified the following as currently contributing to the destruction, modification, or curtailment of habitat or range: timber harvest, roads, agricultural operations, urban/industrial/residential development, dams and diversions, fish passage barriers, channelization and diking, high intensity fire, disease/predation, adverse effects from hatcheries, invasive species, fishing and collecting, and mining and gravel extraction (See Volume II).

These threats have led to significant stresses on coho salmon populations throughout the ESU (Volume II) and have contributed to the decline of the species. The following threats (Table 3-8) occur throughout the ESU and are believed to be the main causes of the previously described stresses (limiting factors) (Table 3-4).

Table 3-8. Threat severity ranking by population.

Population	Threats													
	Climate change	Roads	Channelization/Diking	Agricultural Practices	Timber Harvest	Urban/Residential/ Industrial Development	High Intensity Fire	Mining/Gravel Extraction	Dams/Diversions	Invasive/ Non Native Alien Species	Hatcheries	Road Stream Crossing Barriers	Fishing and Collecting	Total High or Very High
Elk River	M	M	H	H	M	L	L	L	H	M	L	M	L	3
Lower Rogue River	M	VH	H	M	H	H	L	H	M	M	M	L	L	5
Chetco River	M	H	H	M	H	H	M	M	M	L	M	L	L	4
Winchuck River	L	M	H	M	M	H	M	M	H	M	NA	M	L	3
Hubbard Creek	L	M	M	M	M	M	L	NA	L	NA	NA	L	L	0
Brush Creek	M	VH	H	NA	M	L	L	NA	L	NA	NA	L	L	2
Mussel Creek	L	VH	VH	M	VH	H	L	NA	M	NA	NA	L	L	4
Hunter Creek	M	VH	VH	H	VH	H	M	L	M	L	NA	M	L	5
Pistol River	M	VH	VH	H	VH	M	M	L	M	NA	NA	L	L	4
Smith River	M	H	H	H	M	M	M	L	L	M	L	H	M	4
Lower Klamath River	M	H	M	H	H	M	L	L	H	L	L	L	L	4
Redwood Creek	M	VH	H	M	H	M	M	H	M	M	NA	L	L	4
Maple Creek/Big Lagoon	L	VH	M	L	VH	L	M	NA	M	L	NA	L	L	2
Little River	L	VH	M	H	VH	M	M	NA	M	NA	NA	L	M	3
Mad River	M	VH	H	M	H	M	M	H	M	NA	L	L	M	4
Elk Creek	L	M	H	M	M	H	L	NA	L	NA	NA	L	M	2

	Threats													
Wilson Creek	L	H	L	L	M	L	L	NA	L	NA	NA	L	M	1
Strawberry Creek	L	M	M	M	L	M	NA	NA	L	NA	NA	VH	M	1
Norton/Widow White Creek	L	VH	VH	M	M	VH	M	NA	M	L	NA	H	M	4
Humboldt Bay tributaries	M	VH	H	VH	VH	H	L	NA	M	M	L	L	M	5
Low Eel/Van Duzen Rivers	M	VH	H	H	VH	H	H	M	H	H	NA	L	M	8
Bear River	M	VH	L	H	VH	NA	M	L	L	NA	NA	L	M	3
Mattole River	M	H	M	M	H	H	H	L	VH	NA	NA	L	M	5
Guthrie Creek	L	M	L	M	H	L	L	NA	L	NA	NA	L	M	1
Illinois River	H	VH	H	H	H	M	M	H	VH	M	M	H	L	8
Mid. Rogue/Applegate Rivers	M	H	H	VH	H	VH	M	M	VH	M	M	M	L	6
Upper Rogue River	H	VH	H	VH	H	VH	L	H	H	M	M	M	L	8
Middle Klamath River	H	M	L	L	L	NA	H	M	M	NA	M	M	M	2
Upper Klamath River	H	VH	M	H	L	L	M	L	VH	L	VH	M	M	5
Salmon River	VH	M	NA	L	L	L	M	M	L	L	L	L	M	1
Scott River	VH	H	VH	VH	VH	M	H	M	VH	NA	L	L	L	7
Shasta River	H	H	H	VH	M	M	M	M	VH	NA	H	L	L	6
South Fork Trinity River	H	VH	L	M	L	L	M	L	H	L	M	L	M	3
Lower Trinity River	H	H	VH	ML	L	M	M	L	M	L	H	L	M	5
Upper Trinity River	H	H	M	M	L	M	M	L	H	M	VH	H	M	4
South Fork Eel River	M	VH	M	M	H	H	H	M	H	H	NA	H	M	7
Mainstem Eel River	H	VH	M	M	H	M	H	M	H	H	NA	M	M	6
Mid. Fork Eel River	H	VH	L	M	NA	M	H	NA	M	M	NA	M	M	3
Mid. Mainstem Eel River	H	VH	M	H	M	M	H	M	H	H	NA	L	M	6
Upper Mainstem Eel River	H	VH	NA	M	L	L	H	NA	VH	VH	NA	L	M	5

3.2.1 Climate Change

Climate change is having, and will continue to have, an impact on salmonids throughout the Pacific Northwest and California (Battin et al. 2007). While variations in model output exists, the overwhelming majority of climate models predict a warming trend resulting from rising levels of greenhouse gases in the atmosphere (Barnett et al. 2005). Population and ecological characteristics that influence vulnerability to climate change include snowpack reliance, current water temperature regime (e.g., how close to upper threshold levels are current water temperatures), the extent of barriers blocking access to cold water refugia, the range of intact ecological processes, and the current life history strategies and genetic diversity. For example, reduced genetic variability may limit the ability of individuals to adapt to changing climactic conditions. In addition, as climate change reduces the carrying capacity of the habitat within the range of SONCC coho salmon, species viability may be more difficult to achieve. The threat and stress (limiting factor) assessment included consideration of climate change and resultant environmental conditions. Although SONCC coho salmon have evolved and adapted to historic climate change, the currently low population numbers and existing poor environmental conditions are causing these climatic shifts to be increasingly worrisome (Battin et al. 2007). The declining abundance of SONCC coho salmon decreases the ability of the species to achieve viability. [Figure 3-3 and Figure 3-4] illustrate the relationship between climate variability and salmon stocks.

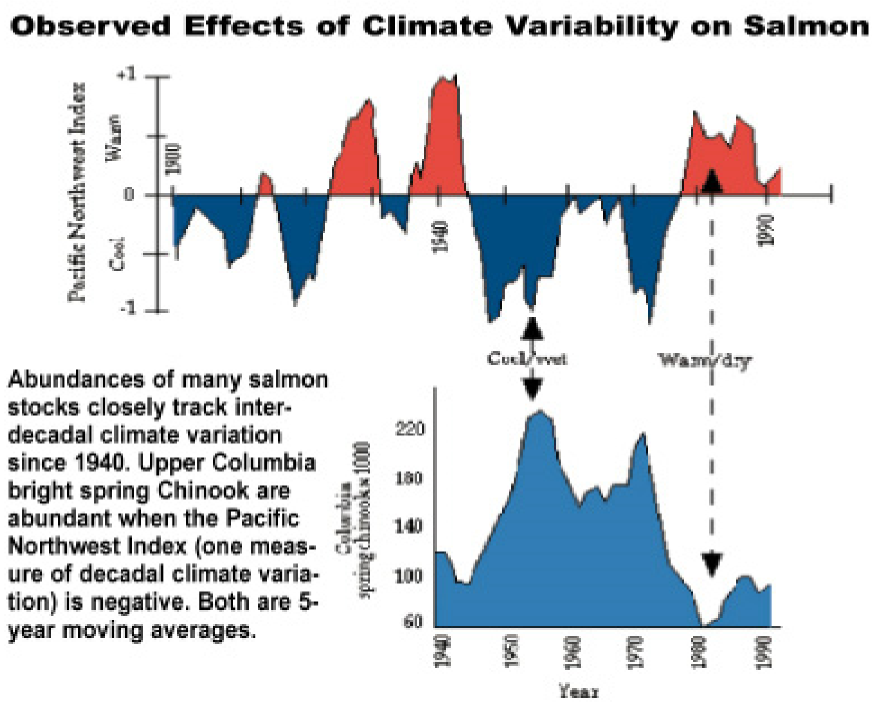


Figure 3-3. Observed effects of climate variability on salmon. Source: US National Assessment of the Potential Consequences of Climate Variability and Change, Educational Resources Regional Paper: Pacific Northwest. http://www.usgcrp.gov/usgcrp/nacc/education/pnw/pnw-edu-3.htm

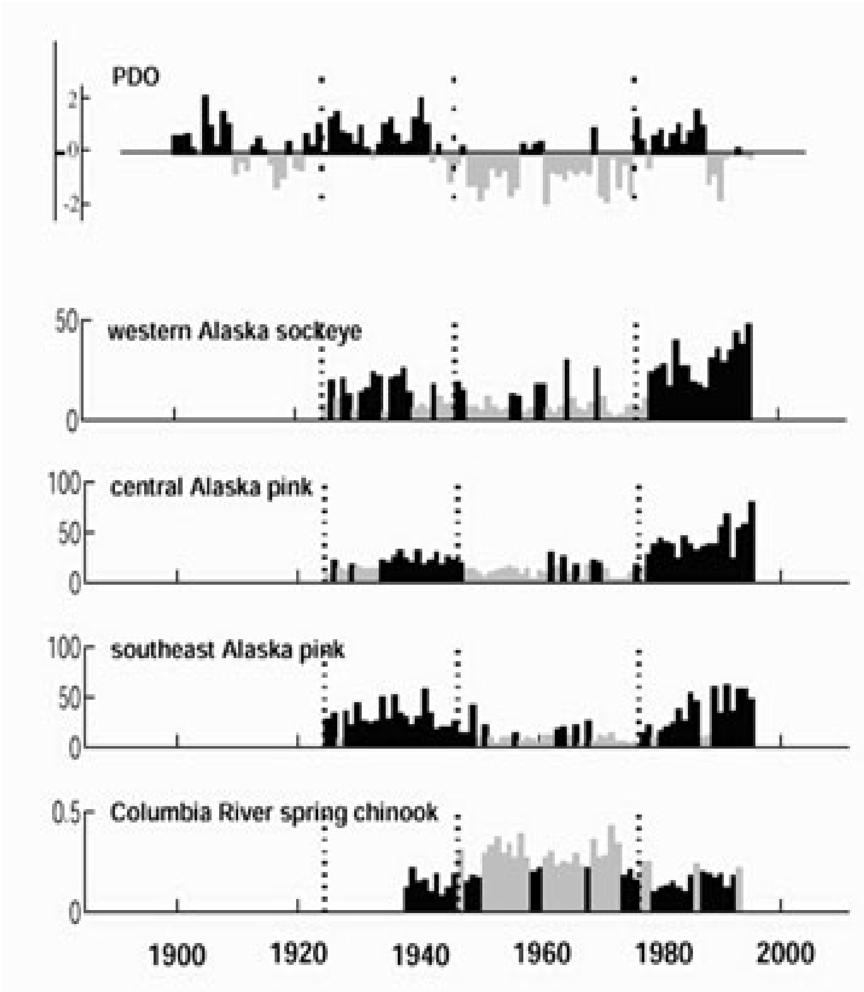


Figure 3-4. Salmon catches and inter-decadal climate variability. Twentieth century catches of Northwest and Alaska salmon stocks show clear influence, in opposite directions, of the Pacific Decadal Oscillation. Source: Mote et al (1999), Figure 36, p. 56.

Some of the effects of increased air temperature include changes in precipitation (amount of rain versus snow), the amount of snowpack, water quality (for example, temperature) and quantity (for example, more frequent, high intensity storms; and lower summer flows), and overall seasonal streamflow patterns (Bates et al. 2008). An increase in winter air temperature will result in the snowline moving up in elevation, and will thereby reduce the amount of water stored as snowpack. This will both result in higher winter runoff, and lower (and warmer) spring, summer and fall streamflows. In the Klamath Basin, Bartholow (2005) observed a 0.5 ºC per decade increase in water temperature since the early 1960s. As water temperatures rise, the amount of cold water refugia decreases.

Future climate change projections show that the impact of global warming on the western United States will include the reduction in the volumes and persistence of snowpacks across the region (Gleick 1987, Lettenmaier and Gan 1990), reduction in the fraction of precipitation that falls as snow rather than rain, and hastening of the onset of snowmelt once snowpacks have been formed (Knowles et al. 2006). In California, observations reveal trends in the last 50 years toward warmer winter and spring temperatures, a smaller fraction of precipitation falling as snow, a decrease in the amount of spring snow accumulation in lower and middle elevation mountain zones, and an advance in snowmelt of 5 to 30 days earlier in the spring (Knowles et al. 2006). Higher atmospheric temperatures will also increase the ratio of rain to snow, shorten and delay the onset of the snowfall season, and accelerate the rate of spring snowmelt, which may lead to more rapid and earlier seasonal runoff relative to current conditions (Kiparsky and Gleick 2003).

Snow accumulation within the upper elevation of the SONCC coho salmon ESU acts as a natural reservoir by delaying runoff from winter months when precipitation is high, and shifts in climate will shift the timing and duration of releases from these natural reservoirs, altering instream conditions that salmon have evolved with (Kiparsky and Gleick 2003). Additionally, some newer General Circulation Models (GCMs), including those used in the National Weather Assessment, predict increases in California precipitation (Roos 2003), which may also cause shifts in flows and flood frequencies. These shifts will impact SONCC coho salmon populations by altering the timing of spring freshets, potentially increasing severity and quantity of flood events, increasing water temperatures, and altering the intensity of winter storms, thereby changing habitat accessibility, run timing, and egg development (Roos 2003). High flows associated with flood events can impact salmon through a variety of mechanisms, both beneficial and not. High flows and associated flooding are a natural process and can be beneficial to salmon and salmon habitat as a disturbance mechanism for scouring fine sediment from gravel, distributing large wood, recharging aquifers, allowing fish passage, transporting sediment and organic matter, and maintaining channel features (Lisle 1989). Conversely, high flows and flooding can cause the loss of eggs and alevins if they are scoured from the gravel or buried in sediment. Sedimentation of stream beds has been implicated as a principal cause of declining salmonid populations throughout their range and floods can result in mass wasting of erodible hill slopes and failure of roads on unstable slopes causing catastrophic erosion (Frissell 1992). Juveniles and smolts can be stranded by flood events, washed downstream out of rearing habitat, or washed out to sea prematurely. High flows can also prevent adults from reaching spawning areas.

Sea level rise is another effect of climate change, and will likely have a significant effect on estuaries and salmon habitat in low lying areas. Global mean sea-level rise is expected to reach between 14 and 44 cm within this century and is projected to inundate estuaries, and coastal wetlands, changing the amount and location of critical estuarine and brackish habitats for salmon. Rising sea levels will inundate wetlands and other low-lying lands, erode beaches, intensify flooding, and increase the salinity of rivers, bays, and groundwater tables (IPCC 2007). Some of these effects may be further compounded by other effects of a changing climate. Coastal wetland ecosystems, such as salt marshes and mangroves are particularly vulnerable to rising sea level because they are generally within a few feet of sea level (IPCC 2007). Many habitats such as wetlands, estuaries, and brackish marshes, which have been shown to be vital for salmon survival in some areas, will be physiologically altered, or completely cease to exist. Wetlands provide habitat for many species, play a key role in nutrient uptake, serve as the basis for many communities' economic livelihoods, provide recreational opportunities, and protect local areas from flooding. The IPCC suggests that by 2080, sea level rise could convert as much as 33 percent of the world's coastal wetlands to open water (IPCC 2007). Sea-level rise will also extend areas of salinization of groundwater and estuaries, resulting in a decrease in freshwater availability for fish and wildlife that inhabit these coastal areas (Kundzewicz et al. 2007). As a result of sea level rise, low lying coastal areas will eventually be inundated by seawater or periodically over-washed by waves and storm surges. Coastal wetlands will become increasingly brackish as seawater inundates freshwater wetlands. New brackish and freshwater wetland areas will be created as seawater inundates low-lying inland areas or as the freshwater table is pushed upward by the higher stand of seawater (Pfeffer et al. 2008).

Coho salmon are sensitive to the above described changes in climate because they spend an extended period rearing in freshwater. Additionally, SONCC coho salmon are near the southern end of their distribution and often reside in streams already near the upper limits of their thermal tolerance. For these reasons, climate change poses a serious threat to the viability of SONCC coho salmon populations (NRC 2004). Changes in the climate across the landscape have been observed. While future climate predictions are forecasting increases in precipitation, many areas of the Pacific coast have experienced periodic drought conditions during much of the past 50 years, a situation that has undoubtedly contributed to the decline of many salmonid populations. Drought conditions reduce the amount of water available, resulting in reductions (or elimination) of flows needed for adult coho salmon passage, egg incubation, and juvenile rearing and migration (Bates et al. 2008). The drought conditions in the decade prior to listing were identified as a factor for listing and since that time, droughts have continued to affect coho salmon by creating poor spawning and rearing conditions. The spring of 2008 was listed as the driest on record for some areas of northern California, and 2001 and 2009 were “critically dry years. Additionally, the entire ESU experienced drought conditions during 2006 and 2007). Drought conditions may become more severe and more common as the climate continues to shift and seasonal changes become more pronounced. Additional changes in climate can be seen when looking at small scale regional weather characteristics, like the frequency of fog on the California coast. Data from 1901 to 2008 indicate that coastal temperatures have increased more than inland temperatures, accompanied by a reduced number of hours of coastal fog (Johnstone and Dawson 2010). If coastal fog continues to diminish there will be increased drought stress and potentially a reduction in the range of coast redwoods and associated fish and wildlife communities. In the coming years climate change will have an affect our ability to influence the recovery of some salmon species in most or all of their watersheds.

3.2.2 Roads

Roads are a pervasive feature throughout the ESU and reflect a legacy of land use activities. Nearly all populations that comprise the SONCC coho salmon ESU are affected by high road density, with some populations having greater than 10 miles of road per square mile. Roads are ranked as a high or very high threat in 33 populations. Roads can affect salmon populations by blocking migration, through interrupting and disrupting natural drainage patterns, increasing peak flow (Ziemer 1998), and increasing stream bed and bank instability (Chamberlin et al. 1991, McIntosh et al. 1994). Roads have been shown to impact spawning habitat, channel form, sediment inputs, and alter prey production. Additionally, roads placed immediately adjacent to watercourses can affect coho salmon through the removal of riparian vegetation, floodplain disconnection, and non-point source pollution inputs. Armentrout et al. (1998) used a reference of 2.5 mi/mi^2 of roads as a watershed management objective to maintain hydrologic integrity in Lassen National Forest watersheds harboring anadromous fish. Cederholm et al. (1981) found that fine sediment in salmon spawning gravels increased between 260 to 430 percent over background levels in watersheds with more than 4.1 mi/mi^2. Although some roads have been decommissioned, there are still many miles of existing roads and maintenance is often lacking, leading to chronic impacts on habitat. Across the ESU, sediment from roads has contributed to decreased emergence survival, reduced carrying capacity for juvenile salmonids due to the filling of pools, channel simplification, and reduced feeding and growth due to high turbidity levels. Landslides triggered from road building related activities are large sources of sediment (Spence et al. 1996) and can create large scale episodic, mass wasting events that can severely impact a year class. Cederholm et al. (1981) reported that the percentage of fine sediments in spawning gravels increased above natural levels when more than two and a half percent of a basin area was covered by roads.

In addition to contributing fine sediment, roads can also affect water quality through the addition of heavy metal, gas, oil and other pollutants deposited on roads and subsequently washed into streams (Sandahl et al. 2007). These pollution inputs are difficult to remedy since they come from a variety of sources and can be spread out along the entire road length. Many pollution inputs occur during the winter months, which may have an effect on embryo and alevin salmon life stages, further decreasing survival and altering reproductive success.

Despite recent efforts to address impacts associated with = roads, there still remains inadequate funding for road maintenance and rehabilitation projects, inadequate regulations for maintenance and building on private roads, and a large number of existing problems associated with private and public roads throughout the ESU.

Plans Addressing Road Sediment

While management programs and plans to help alleviate effects from road development are lacking in many areas of the ESU, several counties within northern California have worked collaboratively to develop a comprehensive manual to guide road installation, maintenance, and remediation. To qualify their road programs under Limit 10 of the SONCC coho salmon 4(d) rule, Humboldt, Del Norte, Trinity, Siskiyou and Mendocino counties (Five Counties) collaboratively developed the “Water Quality and Stream Habitat Protection Manual for County Road Maintenance in Northwestern California Watersheds” (Five Counties Salmon Conservation Program 2002; hereafter referred to as “Manual”), which is based largely on the Oregon Department of Transportation (ODOT) Road Maintenance Handbook (ODOT 1999). The Manual includes design and construction guidelines and best management practices that minimize erosion and maintain or improve fish passage. This manual is the first to be developed in California and represents a collaborative effort in addressing road maintenance impacts on coho salmon. Since 1998, the Five Counties effort has assessed and prioritized 245 road crossings for repair or replacement, using the biological needs of salmonids as their main driving factor. This program has repaired or replaced 56 road culverts, improved or enabled access to 137 miles of fish habitat, and completed Road Erosion Inventories on over 2,000 miles of road (Five Counties Salmonid Conservation Program 2010). In 2007, NMFS approved the Five Counties’ Manual under the 4(d) rule.

Similarly, ODOT’s *Routine Road Maintenance Water Quality and Habitat Guide Best Management Practices* (ODOT 1999) is utilized across the state of Oregon to identify and implement measures, or best management practices, that minimize potential environmental impacts associated with ODOT activities. In California, the state transportation agency

(Caltrans) utilizes the *Caltrans Storm Water Quality Handbook*, and *Construction Site Best Management Practices Manual* to provide contractors and Caltrans staff with detailed information of construction site BMPs. These documents allow for road and transportation related projects to be implemented while minimizing effects to fish and wildlife.

Other important programs to address road-related sediment issues include the Northwest Forest Plan for land administered by U.S. Forest Service and Bureau of Land Management, and the Habitat Conservation Plans (HCPs) for land managed by Humboldt Redwood Company and Green Diamond Resource Company, the two largest private timber companies within the SONCC coho salmon ESU. Information about these programs is included in Section 1.2.4.

3.2.3 Channelization and Diking

NMFS identified stream channelization and diking as threats at the time of listing SONCC coho salmon, and remain a threat today in approximately 50 percent of the populations. Diking and channelization are especially prominent in the low-lying areas of most watersheds (Ricks 1995). Diking leads to the direct loss of habitat through disconnection of channel, floodplain, and wetland habitat and contributes to the loss of connectivity and hydrologic function. Channelization often occurs in association with agriculture and development and leads to the simplification and degradation of habitat (Kukulka and Jay 2003). Channelization and diking associated with flood control and agriculture reduces habitat, limits stream complexity, and increases stream velocities, which can be detrimental to both adult and juvenile coho salmon (May et al. 1997). Stream reaches have been channelized and diked to aid in the conversion of land from forest and riparian to agricultural, industrial and urban land use. In nearly all the lowlands and estuaries within the ESU, the majority of historic floodplain and off-channel habitat were diked for agriculture purposes and flood protection (Chapman and Knudsen 1980). In many upstream areas, floodplain and riparian habitats were disconnected from the channel for the construction of homes and industrial facilities, further impacting watercourses and channel morphology. Channelized reaches often lack floodplain connectivity and riparian vegetation, rarely contain complex habitat features such as pools, and experience high flows and degraded water quality (Ricks 1995). These areas provide little if any rearing or spawning habitat and can contribute to degraded water quality and hydrologic function within the watershed.

For example, Redwood Creek is flanked for the first 3.4 miles by flood control levees that confine the channel to a 250-foot-wide channel migration zone, which also bisects the estuary. This levee has resulted in profound loss of estuarine area and habitat value (Cannata et al. 2006). Levees were also constructed along portions of the lower Van Duzen and Eel rivers to protect agricultural land and urban areas from flooding. Tideland reclamation and the construction of dikes and levees for agricultural purposes have changed the natural function of the Eel River estuary considerably. Slough and creek channels that once meandered throughout the Eel River delta are now confined by levees, sufficiently slowing flow to a point that many have filled with sediment.

3.2.4 Agricultural Practices

Conversion of many lowland areas to agricultural use has dramatically altered the form and function of streams and their riparian corridors. In addition, irrigated agriculture and livestock grazing also negatively impacts coho salmon habitat (Nehlsen et al. 1991) and directly impacts juvenile coho survival and fitness. Agricultural operations located immediately adjacent to watercourses and stream channels have degraded habitat and limited both water quality and quantity through the filling and diking of wetlands, installation of irrigation diversions, channelization, grazing in riparian areas, compaction of soils in upland areas, and indirectly through the use of pesticides and fertilizers (Botkin et al. 1995, Spence et al. 1996). A large proportion of estuaries and floodplains have been converted to agricultural land through the diking and filling of floodplain habitat (see section 3.2.3). The loss of these areas has had major impacts on the form and function of watersheds and their ability to support salmon, especially juvenile coho salmon, which require diverse, complex rearing habitats and floodplain connectivity.

One of the major stresses (limiting factors) associated with agricultural practices has been the diversion and consumptive water use on many streams, which has led to reduced stream flows in the summer and fall, including seasonal loss of surface flow in some streams. Water is the most essential component of fish habitat; without adequate water, coho salmon cannot survive. Water diversions can cause fragmented habitats and increase stream temperatures while impeding the geomorphological processes that maintain stream health (Cone and Ridlington 1996). Decreased water availability can create stressful situations for salmonids, and can decrease fitness and survival of juveniles rearing in areas with degraded water quality (Bjornn and Reiser 1991). For instance, water use in the Scott River Valley, California, has been associated with reductions in summer and fall base flows (Van Kirk and Naman 2008), which has been cited as a limiting factor in coho salmon production in this system (NRC 2004). Consumptive water use has also lowered the water table near affected streams, which has limited the ability of riparian plant species to proliferate and contributes to low flow barriers. In some areas, seasonal and permanent dams are constructed to provide water for agricultural operations and have resulted in altered stream function, migration barriers, changes in stream temperature, and temporary increases in sedimentation.

Agricultural practices can result in the degradation or elimination of riparian areas. Within many riparian areas, the vigor, composition, and diversity of natural vegetation have been, and continue to be, altered by livestock grazing and agriculture. This in turn has affected the ability of riparian areas to control erosion, provide stability to stream banks, and provide shade, cover, and nutrients to the stream (Mundy 1997). Mechanical compaction in riparian and upland areas has reduced the productivity of the soils appreciably and caused bank slough and erosion (Bellows 2003). Mechanical bank damage often leads to channel widening, lateral stream migration, increases in water temperature, and sedimentation (Scholz et al. 2000).

Agricultural practices are also a key producer of non-point-source pollution including nutrients and sediments, which can enter streams with runoff from livestock areas or cultivated fields, and agricultural chemicals. Risk to coho salmon resulting from agriculture chemical use has been identified as a concern throughout the Pacific Northwest (Laetz et al. 2009), and it is likely that pesticides known to harm salmonids (NMFS 2008b) are used within the SONCC coho ESU. For example, herbicide use has resulted in fish kills in the Rogue River basin, including juvenile coho salmon in Bear Creek in 1996 (Ewing 1999).

Agricultural Regulations

Historically, the impacts to fish habitat from agricultural practices have not been closely regulated. Oregon's Agricultural Water Quality Management Act, also known as Senate Bill 1010, was enacted in 1993 (requirements are currently codified at Oregon Revised Statutes 568.900 to 568.933), and is the basis for the Oregon Department of Agriculture's Agricultural Water Quality Program, which includes Agricultural Water Quality Management Area Plans (see Oregon Administrative Rules Chapter 603, Divisions 90 and 95). Although these plans are intended to reduce the impacts of agricultural practices on water quality, progress have been insufficient and state water quality standards are still unmet. The state of California does not have regulations that directly manage agricultural practices, but relies on the TMDL process to improve water quality from all applicable parties. See section 3.1.2 for more information on the TMDL process. The TMDL process is one way that the federal government, through state agencies, are able to regulate the amount of pollutants and other contaminants that enter a watercourse.

Another more direct federal regulation is the registration of fertilizers and pesticides by the Environmental Protection Agency (USEPA). USEPA has established a program to monitor and regulate pesticides and other chemicals that may harm listed species (Washington State Department of Agriculture (WSDA) 2010). USEPA has accomplished this through the implementation of a pesticide registration and registration review program for a suite of chemical fertilizers used across the United States. USEPA's strategy is to address listed species concerns within the context of the pesticide Registration and Registration Review process. The intent of this program is to provide appropriate protection to listed species and their critical habitat from pesticides while avoiding unnecessary burden on pesticide users and agriculture (WSDA 2010). In order to address the ESA during the pesticide Registration and Registration Review process, USEPA developed the Endangered Species Protection Program (ESPP). The ESPP requires refinements to geographic and biological components of the ecological risk assessment as they apply to listed species. The USEPA may use Bulletins to mitigate risk to listed species either prior to initiation of consultation or as a mechanism to implement Reasonable and Prudent Alternatives (RPAs) and Reasonable and Prudent Measures (RPMs) identified through consultation with the Services (WSDA 2010).

As risks to listed species are identified through either the USEPA registration process or consultation with the NMFS and U.S. Fish and Wildlife Service, USEPA issues Endangered Species Protection Bulletins (Bulletins) that specify mitigation or protective measures. Bulletins describe specific geographic areas within individual U.S. counties where use limitations exist. When needed, Bulletins are referenced in pesticide label statements that inform users the product may harm a threatened or endangered species or their critical habitat (WSDA 2010). The use limitations specified in Bulletins are supplemental label language enforceable for the county specified.

3.2.5 Timber Harvest

Substantial timber harvest has occurred throughout the ESU. Timber harvest is ranked as a high or very high threat in 22 populations (Table 3-8). In many of these populations, while timber harvest activity has decreased since the peak over 50 years ago, and practices and management have improved, the effects of future timber harvest continues to be a potential threat to coho salmon. In many streams, logging in the riparian areas has resulted in reduced inputs of leaf litter, terrestrial insects, and large wood (Reeves et al. 1993, Nakamoto 1998,). Reduction of large wood from the harvest of streamside timber has resulted in the reduction of cover and shelter from turbulent high flows, and large wood needs to be reintroduced wherever possible (Cederholm et al. 1997). The threat from future timber harvest lies in the inability of already damaged landscapes to rebound from continued impacts, and if detrimental timber harvest (i.e., clear cutting, decreased age of trees removed) continues, cumulative effects and large scale, landscape size problems will begin to occur on a more regular basis. Renewing or continuing harmful logging practices will result in decreased cover, reduced storage of gravel and organic debris, and will likely result in continued loss of pool habitat and a reduction in overall hydraulic complexity (CDFG 2002a). While harmful logging practices have been shown to be detrimental to salmon populations, new logging methods that promote stand diversity, thin overcrowded plantations, and help restore fire-damaged lands must be implemented to provide an active recovery for damaged systems throughout the ESU. Appropriate timber harvest can, and will, aid in the re-establishment of riparian vegetation, sediment storage, and stand diversity, all ecosystem characteristics that are beneficial to salmonid populations.

By altering hydrology and slope stability, timber harvest can increase the amount of fine sediment delivered to streams and impair water quality. There is a strong relationship between the percent of a watershed harvested in the past 15 years and the duration of stream turbidity exceeding thresholds of salmonid feeding impairment (Klein et al. 2008). Timber harvest reduces the amount of precipitation intercepted by vegetation, resulting in increased peak flows during storm events (Grant 2010). Increased peak flows have only been detected during storms with a return period of 6 years or less (Grant 2010), and the effect diminishes over time as vegetation recovers (Keppeler et al. 2003). Long-term paired watershed studies in Caspar Creek on the Mendocino Coast, where road-related erosion is only a minor contributor to sediment, found that despite robust riparian buffer strips, increased peak flows induced by timber harvest increased gully erosion in small stream channels, expanding drainage networks and contributing significantly to suspended sediment yields (Reid et al. 2010). Timber harvest can also affect slope stability and increase the frequency of shallow landslides. Studies on the Oregon Coast found reduced root strength in clear cuts and industrial forests relative to old-growth conifer forests (Schmidt et al. 2001), and that shallow landslides tended to occur in localized areas with reduced root strength such as gaps in the root network between large trees or in areas lacking large trees (Roering et al. 2003).

One of the greatest continuing stresses from past timber harvest is the residual effects of increased input of fine sediment into streams. This impact does not cease when timber harvest activities are complete, but instead continues a legacy of negative effects that begin anew during each winter storm event or high flow. Road building and other timber harvest activities have resulted in mass wasting and surface erosion that will continue to elevate the level of fine sediments in spawning gravels and fill the substrate interstices inhabited by invertebrates (Platts et al. 1989, Suttle et al. 2004). Changes in channel morphology will continue to alter the hydrology and timing of flows in areas affected by these chronic events. Bisson et al. (1997) estimated that, due to anthropogenic activities such as logging, the frequency of major floods was 2 to10 times greater, debris flows and dam-break floods were 5 to 10 times more frequent, and slumps and earth flows were 2 to 10 times more frequent, than natural, background conditions. This increase in catastrophic events will continue to dramatically alter the conditions in which coho salmon spawn and rear and cause a reduction in food supply, reduced quality of spawning gravels, and an increased severity of peak flows during heavy precipitation. Additionally, the continued removal of riparian canopy cover from these events will result in increased solar radiation, which will create further increase in water temperature (Spence et al. 1996).

USFS and BLM Land Resource Management Plans

The Northwest Forest Plan (NWFP) is a comprehensive ecosystem management strategy for Federally managed lands administered by the U. S. Forest Service (USFS) and Bureau of Land Management (BLM) within the range of the northern spotted owl (USDA-FS and USDI-BLM 1994). Approximately 53 percent of the land area within the SONCC coho salmon ESU is managed under the NWFP. Over 70 percent of the land in the Trinity River basin is managed by the USFS, and within that area, about 85 percent is designated as critical habitat. Additionally, within the Six Rivers National Forest, which is within the NWFP jurisdiction, there are four independent SONCC coho salmon populations, and public lands account for 75 percent of the population areas.

A primary component of the NWFP, the Aquatic Conservation Strategy (ACS), was designed to protect salmon and steelhead habitat on federal lands managed by the USFS and BLM by maintaining and restoring ecosystem health at watershed and landscape scales (NMFS 1997). The ACS contains nine objectives that describe general characteristics of functional aquatic and riparian ecosystems, and these objectives are intended to maintain and restore good habitat in the context of ecological disturbance. The ACS is intended to prevent further degradation of aquatic ecosystems and restore habitat over broad landscapes (Lanigan et al. 2011). While the NWFP covers a very large area, the overall effectiveness of the NWFP in conserving Oregon and California coho salmon is limited by the extent of USFS and BLM federal land ownership, which is not uniformly distributed in watersheds within the ESU. However, where administered, the NWFP has made improvements on the landscape through better management of both timber harvesting and road maintenance and construction. A report by Lanigan et al. (2011) documented trends in watershed, riparian and upslope condition throughout the area of the NWFP. Ten percent of watersheds displayed a positive change in indicator categories, with these changes attributed to the combined effects of natural vegetation growth, and road decommissioning. A greater proportion of positive changes in watershed condition occurred on late-successional reserve (LSR) and matrix lands than on congressionally reserved lands (e.g., wilderness areas and national parks), which were already in good condition (Lanigan et al. 2011). Declines in watershed condition were seen in some areas, with declines attributed to the Biscuit Fire of 2002, and other fire complexes that occurred during the 15 years of the study. Overall road density changed only slightly across the area of the NWFP; however, dramatic changes were accomplished in targeted watersheds. For example, road density in Lower Fish Creek in the western cascades declined from 3.3 mi/mi^2 in 1994 to 0.8 mi/mi^2 in 2008 through the decommissioning of 118 miles of roads (Lanigan et al. 2011). Overall, Lanigan et al. (2011) stated that road decommissioning in landslide prone areas provided the most benefits.

Although public lands tend to be located in the upper reaches of watersheds or river basins, and upstream of the highest quality coho salmon habitat, the above mentioned report documents that efforts made by both the USFS and BLM through the NWFP have begun to improve coho salmon habitat, and provided improved water quality conditions starting in headwater areas. In other areas, public lands are distributed in a checkerboard fashion, resulting in fragmented landscapes that are more difficult to improve.

State Forest Practices Acts

State Forest Practices Acts (FPAs) in both Oregon (1971) and California (1973) along with their associated forest practice rules (FPRs) were designed to promote the continuous economic activity of growing and harvesting forest trees while meeting federal and state environmental standards, rules, and regulations (e.g., CWA, ESA). The FPAs and FPRs apply to all non-federal forestland, including private, state-owned and local, government-owned forestlands. Because of the preponderance of private timberland and timber harvest activity in the range of this ESU, and potential adverse effects, careful consideration of state forest practices rules and regulations is prudent. At the time of listing, most reviews of the FPRs indicated that implementation and enforcement of these rules did not adequately protect coho salmon or their habitats (CDFG 1994, Murphy 1995). FPAs and FPRs in both Oregon and California continually go through reviews and the regulatory agencies receive recommendations for improved aquatic habitat protection. Neither has fully adopted recent recommendations, and both remain inadequate for the complete protection of salmon in the SONCC coho salmon ESU. Although the FPRs have a requirement for disapproval of Timber Harvest Plans that would result in a ‘taking’ or finding of jeopardy for listed species (14 CCR § 898.2(c)), the rules do not explicitly describe the method for effectively implementing this requirement.

In 1997, at the time of the original listing of SONCC coho salmon ESU (62 FR 24588, May 6, 1997), timber harvest was identified as a significant threat to the species and their habitat. Specifically, NMFS identified inadequacies of the FPRs to address large wood recruitment, streamside tree retention, canopy retention standards, monitoring of timber harvest operations, and salvage logging. In July 2000, CDF adopted interim *Threatened or Impaired Watershed Rules* (T&I rules) to protect and restore watersheds with threatened or impaired values. The T&I rules were intended to minimize impacts to salmonid habitat resulting from timber harvest by requiring special management actions in watersheds with either state or federally listed threatened, endangered or candidate populations of anadromous salmonids present or where they can be restored. Examples of special management actions required by the T&I rules include constructing watercourse crossings that allow for unrestricted fish passage, increasing large wood recruitment, and increasing soil stabilization measures. The T&I rules also required coordination between CDF and the State and Regional Water Quality Control boards to minimize sediment discharge. The Board of Forestry (BOF) never permanently adopted the T&I rules. Rather, the BOF readopted the T&I rules six times subsequent to 2000. The T&I rules expired in December 2009, and the Anadromous Salmonid Protection (ASP) rules replaced them in 2010. The BOF’s primary objectives in adopting the ASP rules were to: (1) ensure rule adequacy in protecting listed anadromous salmonid species and their habitat, (2) further opportunities for restoring the species’ habitat, (3) ensure the rules are based on credible science, and (4) meet Public Resources Code (PRC) § 4553 for review and periodic revisions to the forest practice rules (FPRs).

NMFS staff have actively engaged and participated in BOF meetings and expressed concern to the BOF that the ASP rules, while resulting in some improvements to riparian protections, would not adequately protect anadromous salmonids until several inadequacies in the FPRs are addressed. Specifically, take of listed salmonids resulting from timber harvest operations in California could be minimized (but not entirely avoided) if the following protections were added to the existing ASP rules: (1) provide Class II-S (standard) streams with the same protections afforded Class II-L (large) streams, (2) include provisions to ensure hydrologic disconnection between logging roads and streams, and (3) include provisions to avoid hauling logs on hydrologically connected roads during winter periods. In addition, NMFS believes the use of scientific guidance will provide additional limitations on the rate of timber harvest in watersheds to avoid cumulative impacts of multiple harvests, and provide greater protections to ensure the integrity of high gradient slopes and unstable areas. This may include limiting the areal extent of harvest in such areas.

ASP rules do not apply where there is an approved Habitat Conservation Plan (HCP) that addresses anadromous salmonid protection; a valid Incidental Take Permit (ITP) issued by DFG; a valid Natural Community Conservation Planning (NCCP) permit approved by DFG; or project revisions, guidelines, or take avoidance measures pursuant to a Memorandum of Understanding (MOU) or a planning agreement between the plan submitter and DFG in preparation of obtaining a NCCP that addresses anadromous salmonid protection. These rules also do not apply to upstream watersheds where permanent dams block anadromy and reduce the transport of fine sediment downstream, or watersheds that do not support anadromy and feed directly into the ocean.

The California FPRs (BOF 2011) include an Article 6 on Watercourse and Lake Protection under the Coast, Northern, and Southern Forest District Rules subchapters, and the section on Intent of Watercourse and Lake Protection (14 CCR §§ 916, 936, and 956) under this Article and each of these subchapters provides, in relevant part:

> The purpose of this article [6] is to ensure that timber operations do not potentially cause significant adverse site-specific and cumulative impacts to beneficial uses of water, native aquatic and riparian-associated species, and the beneficial functions of riparian zones; or result in an unauthorized take of listed aquatic species; or threaten to cause violation of any applicable legal requirements. This article also provides protective measures for application in watersheds with listed anadromous salmonids and watersheds listed as water quality limited under Section 303(d) of the Federal Clean Water Act.

It is the intent of the BOF to restore, enhance and maintain the productivity of timberlands while providing appropriate levels of consideration for the quality and beneficial uses of water relative to that productivity. Protections include: guidelines for the removal of debris and soil, prohibition of road construction, prohibition of use of tractor roads, requirements to comply with TMDLs, objectives for streamside bank protection, riparian buffers, and providing appropriate shading.

In summary, NMFS is working collaboratively with the BOF to limit the effects of forestry operations on threatened and endangered salmonid populations in California, including the

SONCC coho salmon ESU. At this time, however, the effects of past and present timber harvest activities in California continue to be an ongoing threat to the ESU.

The Oregon Forest Practices Act (OFPA), while modified in 1995 and improved over the previous OFPA, did not have implementing rules that adequately protected coho salmon habitat at the time of listing. In particular, the OFPA did not provide adequate protection for the production and introduction of large wood to medium, small and non-fish bearing streams. Since the listing of SONCC coho, the Oregon Plan for Salmon and Watersheds (Oregon Executive Order 99-01; 1999) has directed the creation of the Forest Practices Advisory Committee (FPAC) to help the Oregon Board of Forestry assess forest practices changes that may be needed to meet state water quality standards and protect and restore salmonids. As of 2003, draft water protection rules and non-regulatory recommendations based on the recommendations of FPAC had been developed but had not been adopted by the Board of Forestry. A review of Oregon's FPA and FPRs (IMST 1999) showed the regulations in place may be ineffective at protecting water quality and promoting riparian function and structure, especially in small- and medium-sized streams. In their review of the FPRs, the Oregon IMST (1999) found that one of the greatest shortcomings of the current rules is that they are dominated by site- and action-specific strategies which taken together are insufficient for salmon recovery.

Habitat Conservation Plans

Two habitat conservation plans (HCPs) within the range of SONCC coho salmon have been finalized, and have enhanced management of private timberlands in northern California. Finalized in 1999 and valid through 2049, the Humboldt Redwood Company (HRC) HCP (formerly PALCO HCP) covers approximately 210,000 acres of industrial timberlands in northern California and includes activities related to timber management, forest road construction and maintenance, and rock quarrying (Palco 1999). The major watersheds covered by the HRC HCP include portions of Freshwater Creek, Elk River, Eel River, Van Duzen River, and the Mattole River. The HRC HCP is habitat-based, having a defined goal of achieving or trending towards properly functioning aquatic conditions. This HCP relies heavily on watershed analysis, monitoring, and adaptive management tools to ensure achievement of habitat goals. The most recent HRC HCP monitoring report (HRC 2009) indicated that approximately 44 percent of habitat objectives in the HCP are being met, a 4 percent improvement since 2002, and a 3 percent improvement since 2008.

Finalized in 2006 and valid through 2056, the Green Diamond Resource Company HCP applies to approximately 410,000 acres in coastal northern California. This HCP includes portions of all coastal coho salmon population areas from the Oregon border south to, and including, the Eel and Van Duzen rivers (Green Diamond 2006). The HCP calls for removing 50 percent of the high and moderate priority road sites within the first 15 years of plan implementation. These measures, coupled with provisions for riparian protection, mass wasting avoidance, and adaptive management ensure that adverse impacts to coho salmon rearing, migration, and spawning habitats are minimized or avoided. The first biennial report for the Green Diamond HCP was submitted to NMFS in 2009 (GRDC 2009). In the report, Green Diamond focused primarily on laying a foundation for future monitoring efforts, and reported baseline environmental conditions (e.g., turbidity levels, stream temperatures) for future comparison. At this time, it is not possible to evaluate changes in coho salmon habitat conditions resulting from HCP implementation, and probably will not be for at least another 10 to 15 years.

3.2.6 Urban/Residential/Industrial Development

Substantial development and urbanization has contributed to habitat impairment through the ESU and 15 populations of SONCC coho salmon currently have development ranked as a high or very high threat (Table 3-8). Although most of the range of the SONCC coho salmon ESU is considered to be rural, there are three highly urbanized population centers. The Humboldt Bay and Yreka areas in California and the Medford/Grants Pass area in Oregon all have urban centers with high percentages of impervious surfaces that contribute to the degradation of habitat and coho salmon viability. Development and urbanization often leads to degraded habitat through stream channelization, floodplain disconnection, damage or loss of riparian and wetland areas, point and non-point source pollution, bank hardening, and consumptive water use (Botkin et al. 1995). When watersheds are developed, natural vegetative ground cover is removed and/or replaced by impervious surfaces or structures, water infiltration is reduced and runoff from the watershed is flashier, with increased flood hazard (Leopold 1968). Flood control and unnatural drainage patterns may concentrate runoff, resulting in increased bank erosion, which causes an additional loss of riparian vegetation and undercut banks, and eventually causes widening and downcutting of the stream channel. Streams that are channelized and/or diked frequently lack native riparian vegetation and provide little coho salmon habitat value.

In developed areas, point source and nonpoint source pollution are common. Sediments washed from urban and industrial areas often contain trace metals such as copper, cadmium, zinc, and lead (CSLC 1993, Sandahl et al. 2007). An acute example of this phenomenon is that toxic storm water runoff from urban and industrial sources is leading to high pre-spawn mortality of adult coho salmon in tributaries to Washington's Puget Sound (Booth et al. 2006). In addition, improperly maintained underground septic systems in residential areas can leach bacteria and nutrients into the water table. One significant emerging issue is the input of pharmaceuticals, endocrine disruptors, and personal care products, which are not effectively removed in standard treatment processes (Sumpter and Johnson 2005). These, together with pesticides, herbicides, fertilizers, gasoline, and other petroleum products, contaminate drainage waters and harm juvenile coho salmon and their aquatic invertebrate prey (Crisp et al. 1998, Flaherty and Dodson 2005). The North Coast Regional Water Quality Control Board (NCRWQCB 2001) reported that non-point-source pollution is the cause of 50 to 80 percent of impairment to water bodies in California.

Additionally, the magnitude of peak flow and pollution increases with increases in total impervious area (TIA; e.g., rooftops, streets, parking lots, sidewalks). Spence et al. (1996) recognized that channel damage from urbanization is clearly recognizable when TIA exceeds 10 percent, and that reduced fish abundance, fish habitat quality and macroinvertebrate diversity are seen with TIA levels from 7 to12 percent (Klein 1979, Shaver et al. 1995). May et al. (1997) showed almost a complete simplification of stream channels as TIA approached 30 percent and measured substantially increased levels of toxic storm water runoff in watersheds with greater than 40 percent TIA. Booth and Jackson (1997) found that total impervious area greater than 10 percent caused increased peak flows, decreased base flows, simplified channel conditions, increased non-point-source storm water pollution, and resulted in a loss of aquatic system function.

Urban Growth Management

Urban growth management in both Oregon and California has some significant shortcomings that prevent the full protection of coho salmon habitat. Inside Oregon's urban growth boundaries, some upgraded riparian area protection was afforded under the Oregon Coastal Salmon Restoration Initiative (The Oregon Plan; State of Oregon 1997) and local governments amended their local comprehensive county general plans to implement these new requirements. Unfortunately, this goal only provides general guidance and does not require establishment and protection of riparian vegetation and wetlands. Buffer widths or types for riparian and wetlands are not included in these guidelines, leaving stream bank and riparian vegetation protection lacking, and continuing to allow for the degradation of coho salmon habitat. California urban growth management was not cited as a reason for listing SONCC coho salmon in 1997, however, the rapid population growth in California has caused harm to coho salmon and their habitat and may constitute a reason to evaluate urban growth management practices and their effectiveness at protecting SONCC coho salmon.

County and city planning in both Oregon and California (Mendocino, Humboldt, Siskiyou, Trinity, Del Norte, Lake, Curry, Josephine, Jackson, and Klamath counties) benefit from the development and implementation of comprehensive general plans that include some protective measures for fish and wildlife species and habitat. The Humboldt County General Plan helps to sustain and enhance water resources throughout Humboldt County, which is part of the SONCC coho salmon ESU. Through its policies and standards, it is an effective tool to ensure that new development occurs without damaging water resources on an individual and cumulative basis. The Plan also serves to guide the County in its interaction with neighboring counties, state, and federal agencies and lawmakers. It also directs the County's activities and commitment of resources. The plan includes a water resources element which addresses water planning issues including river and stream water quality, stormwater runoff, groundwater management, water needs of fish and wildlife, water consumption, conservation and re-use methods, and state and federal regulations. The goals of the water resources element include: High quality and abundant surface and groundwater water resources that satisfy the water quality objectives and beneficial uses , river and stream habitat capable of supporting abundant salmon and steelhead populations and sufficient water flows, support of salmon and steelhead recovery plans, recreation activities, and the economic needs of river dependent communities, and no additional upper or mid-level watershed exports from rivers flowing through the county. Siskiyou County also has a comprehensive General Plan that works towards protection of water quality, ecosystem processes and the natural environment.

3.2.7 High Intensity Fire

High intensity fires affect salmon and salmon habitat in a number of ways. Although over the long-term fire can have beneficial impacts on salmon habitat, over the short-term catastrophic fires are known to denude riparian areas, which in turn increase water temperatures through the loss of riparian shading (Dwire and Kauffman 2003, Minshall 2003, Spencer et al. 2003). Snow pack and water retention are also reduced in denuded areas affecting the hydrology of the basin

(Minshall 2003). Fire in upslope areas can also lead to increased soil erosion and sediment delivery, which in turn can result in stream aggradation, pool filling, and in extreme cases landsliding, debris torrents, or other forms of mass wasting (Elder et al. 2002). Many watersheds have experienced a change in their fire regime due to past land use, drought and climate change (Fried et al. 2004). Limited information suggests that the vulnerability of a population to fire stems from the quality of habitat, the amount and distribution of habitat, and habitat connectivity (Gresswell 1999, Dunham et al. 2003).

Fires pose the greatest threat to coho salmon in dry, inland areas where high intensity fire naturally occurs across large areas. Low intensity fires are considered beneficial to coho salmon habitat because they burn on the ground and remove many of the smaller trees and shrubs, while leaving the larger, more fire resistant trees (Minshall 2003). This type of fire prevents fuel loading and forest crowding while potentially boosting invertebrate production (Minshall 2003). Currently fire is listed as a high or very high threat in nine populations (Table 3-8).

Fire risks will continue to increase in the future due to climate change as conditions become drier and hotter in susceptible areas. Higher temperatures, reduced snowpack, and earlier spring snowmelt all contribute to the frequency, intensity, and extent of fires. The fire season has already begun to stretch longer into the spring and fall with an increase of 78 days over the last three decades across the western United States. Fire seasons will continue to increase and conditions will continue to favor large-scale, high intensity fires. Studies have shown that the probability of large fires (more than 500 acres) will increase by more than 75 percent in areas within the Klamath and Smith River basins with increases of 50 percent seen throughout inland areas of northern California and southern Oregon (Luers et al. 2007). Elevated fire frequency and intensity will continue to degrade stream conditions through sedimentation and loss of riparian vegetation.

3.2.8 Mining and Gravel Extraction

Currently, mining within the SONCC coho salmon ESU is primarily in the form of instream gravel mining, placer mining, suction dredging and upslope hardrock mining. The greatest threat from instream gravel mining is the alteration of channel morphology and hydraulic processes which alter the quantity and quality of instream habitat (e.g., pools and riffles) available (Kondolf 1997). The greatest threat from upslope mining is the increased potential for chemical, sediment or other types of contaminants to enter watercourses. Threats from placer mining and suction dredging include the rearrangement or destabilization of substrate and subsequent changes to macroinvertebrate assemblages (Kondolf and Wolman 1993). Mining and gravel extraction are listed as a high or very high threat in five populations.

Gravel extraction has the potential to impact channel form, sediment delivery, and hydrologic functions in a river or stream (Brown et al. 1998). The level of this threat is primarily dependent on the location in which it takes place, the intensity, and the types of methods used. Instream gravel mining affects habitat primarily through the skimming of gravel bars. Lowered bars result in unstable riffles that scour redds, wider and shallower channels that present migration barriers, and simplified habitat with fewer pools for juvenile rearing and adult holding (Kondolof and Swanson 1993).

Instream gravel mining is regulated at the federal, state, and county levels in California and Oregon. Federal regulations that apply in both states include permitting under Section 404 of the Clean Water Act (administered by the Army Corps of Engineers), the General mining Act of 1872, the Federal Land Policy and Management Act (FLPMA), ESA consultation regulations on the issuance of the federal permit to mine, and the Hardrock Mining and Reclamation Act.

Hydraulic mining (placer and suction dredging) can have a negative effect on habitat quality and lead to direct mortality through entrainment of eggs and offspring and the disturbance and alteration of streambed substrate (Griffith and Andrews 1981). Seasonal protections to minimize these effects have been effective by making the timing of permitted suction dredging when eggs and larvae will not be entrained. Material is often deposited into tailing piles, creating unnatural channel formations and flows. The persistence of such features is variable and the impacts can be seasonal and site-specific or long-term and widespread. Tailings piles are unstable and egg-to-fry survival was found to be reduced for Chinook salmon that spawn in tailings (Harvey and Lisle 1999), a finding that likely also applies to coho salmon. Lode or hard-rock mining in upland areas has the potential to unearth contaminants, which can eventually make their way into tributary and river systems.

Placer mining has the potential to alter riparian areas, damage instream habitat, and input fine sediment and pollutants. Past placer mining has damaged some riparian areas to the point where future recruitment of vegetation is impossible. Additional threats from placer mining include removal of riparian vegetation leading to long-term increases in water temperature and lack of wood recruitment, potential water diversions, potential streambank failures and increased sediment. When stream channels are changed or sediment concentrations are increased through placer mining, it can affect benthic invertebrates in the stream. Their populations can decline, or the species types may change and these changes can place stress on fish populations (Wagener and LaPerriere 1985). Results showed that placer mining caused increased turbidity and increased amounts of settleable solids and suspended sediments. These effects were correlated with decreased density and biomass of invertebrates (Wagener and LaPerriere 1985).

Federal Regulations

The Bureau of Land Management (BLM) has the primary responsibility for administering the laws and regulations regarding the disposal of all minerals from all federally owned lands. The BLM's statutory authority here is derived from the General Mining Law of 1872, as amended (30 U.S.C. §§ 22 et seq.), the original public land authority in 43 U.S.C. §§ 2, 15, 1201 and 1457, and FLPMA (43 U.S.C. 1701 et seq.). These statutes, together with the implementing regulations (43 CFR Parts 3710-3870) generally make up the body of the mining law system. Most Federal agencies have regulations to protect the surface resources of Federal lands during exploration and mining activities. In addition, CWA section 404 and Army Corps of Engineers (Corps) implementing regulations require a permit from the Corps for placement of material, impoundments, or other control of water in waters of the United States

California Regulations

In California, state regulations include the requirement to obtain a Streambed Alteration Agreement from CDFG, and the Surface Mining and Regulation Act (SMARA). SMARA is implemented by each individual County through the issuance of Conditional Use Permits (including the recognition of vested rights that were in place prior to SMARA). For suction dredging, new regulations in California including special closed areas, closed seasons, and restrictions on methods and operations have been developed to minimize and prevent negative impacts from mining operations. These new regulations in place to help protect habitat, but careful monitoring of mining activity must occur to ensure that there is compliance.

In August 2009, all California instream suction dredge mining was suspended following enactment of state law SB 670 (Wiggins) which prohibits the use of vacuum or suction dredge equipment in any California river, stream or lake, regardless of whether the operator has an existing permit issued by DFG. The moratorium does not apply to suction dredging operations performed for the regular maintenance of energy or water supply management infrastructure, flood control, or navigational purposes. While DFG was in the process of completing a court-ordered environmental review of its permitting program, a new state law, AB 120, was enacted to extend the moratorium until June 30, 2016. Two other specifications of AB 120 are that any "new regulations fully mitigate all identified significant environmental impacts." and that the suction dredge permit fees be increased to fully fund all of DFG's costs for administrating the suction dredge program.

Oregon Regulations

The State of Oregon has a number of mining regulations. Many state prohibitions exist, and most public lands are off limit to exploration or development of mining claims. The Oregon Department of Environmental Quality requires a permit to be issued before mining can begin. Operating an in-stream suction dredge and discharging the resultant wastewater into the water requires a NPDES General Permit 700-J. Persons assigned to the NPDES 700-PM permit must not operate a suction dredge more than 16 horsepower or with an inside diameter intake nozzle greater than four inches in essential salmon habitat (ESH). Suction dredging is allowed only during the in-water work schedule (Timing of In-Water Work to Protect Fish and Wildlife Resources) as set by ODFW, and measures must be taken to prevent the spread of invasive species. Suction dredging is prohibited on any stream segment that is listed as water quality limited for sediment, turbidity, or toxics on the list published by DEQ.

Mining must not cause any measureable increase in turbidity in selected wilderness and reserve areas. Measureable increase in turbidity is measured as visible turbidity. Performing small-scale, non-chemical off-stream placer mining adjacent to a waterway requires a Water Pollution Control Facility (WPCF) General Permit 600, which prohibits discharge of wastewater generated by the operation to the waters of the state. These permit requirements were set in place to protect and preserve fish and wildlife species inhabiting the waterways of the state of Oregon (Oregon Division of State Lands 1999).

Oregon state law also restricts equipment size, nozzle diameter, and suction speed and efficiency. In the SONCC coho salmon ESU, as of June 1998, portions of the Rogue, Illinois, and Elk rivers, as well as areas of the North Fork of the Smith River are closed to mineral entry except for federal mining claim holders working within valid claims under approved Plans of Operations. While these prohibitions and requirements help curtail mining activities, illegal mining has been recently documented in the SONCC coho salmon ESU (e.g., Preusch 2009, Learn 2011).

3.2.9 Dams and Diversions

Besides often acting as fish passage barriers (with impacts discussed below), dams and diversions lead to altered hydrologic function and can lead to water quality issues (Raymond 1979, Levin and Tolimieri 2001). As human population growth continues, the number of water diversions increase and threaten SONCC coho salmon populations. Currently, dams and diversions are a high or very high threat in 16 populations. Permanent dams are almost always associated with water control features for flood control, municipal or agricultural water uses, and/or hydropower operations. Temporary dams are usually built for recreational or agricultural purposes on private land. Many dams are associated with water diversions. Dams and diversions alter the hydrologic regime and shift the timing and magnitude of flow events (such as the spring freshet) (Levin and Tolimieri 2001). These changes can lead to reduced survival and production of coho salmon.

Reduced stream flows from dams and water diversions in the summer and fall months cause fragmented habitats and increased stream temperatures while impeding the geomorphological processes that maintain stream health (Ligon et al. 1995). In some areas, seasonal and permanent dams are installed to provide water for agricultural operations and lead to altered stream function, migration barriers, changes in stream temperature, and temporary increases in sedimentation (Ligon et al. 1995). Both juveniles and adults use flow events as migrational cues and depend on natural flow regimes for migration and access to habitat. Water quality can also be impaired by low flow through lack of flushing, water stagnation, and concentration of pollutants and nutrients.

Recent dam removal projects throughout the ESU have allowed for improved passage in the Rogue River, and efforts towards installing fish screens have led to significantly decreased impacts to salmonids. Many diversions in the Shasta basin now have CDFG and NMFS approved fish screens installed, and Scott Valley has 100 percent of the diversions located in coho habitat screened to prevent impacts to SONCC coho salmon.

Recent efforts in the Klamath Basin have brought about the creation of the Klamath Basin Hydroelectric Settlement Agreement and the Klamath Basin Restoration Agreement. The Klamath Hydroelectric Settlement Agreement, or KHSA, lays out the process for conducting necessary additional studies, environmental reviews, and a decision by the Secretary of Interior (Secretarial Determination) as to whether removal of the lower four dams on the Klamath River owned by PacifiCorp 1) will advance restoration of the salmonid fisheries of the Klamath Basin, and 2) is in the public interest, which includes but is not limited to consideration of potential impacts of on affected local communities and Tribes. The KHSA includes provisions for the interim operation of the dams prior to dam removal as well as the process to transfer, decommission, and remove the dams if the Secretarial Determination is affirmative. The KHSA establishes 2020 as the target date for dam removal. This timeline allows for completion of necessary environmental and regulatory reviews and the collection of $200 million for dam removal from PacifiCorp customers if the Secretarial Determination is affirmative.

The Klamath Basin Restoration Agreement, or KBRA, is a settlement agreement among many diverse parties that creates a solid path forward on long-standing, resource disputes in the Klamath Basin. The KBRA takes a multi-dimensional approach that resolves complex problems by focusing on species recovery while recognizing the interdependence of environmental and economic problems in the Basin's rural communities. The goals of the KBRA are to 1) restore and sustain natural production and provide for full participation in harvest opportunities of fish species throughout the Klamath Basin; 2) establish reliable water and power supplies which sustain agricultural uses and communities and National Wildlife Refuges; and 3) contribute to the public welfare and the sustainability of all Klamath Basin communities. The key negotiated outcomes of the KBRA include mutually-beneficial agreements for the Klamath, Karuk, and Yurok Tribes not to exercise water right claims that would conflict with water deliveries to Reclamation's Klamath Project water users and for project water users to accept reduced water deliveries. As a result, there would be more support for fisheries restoration programs, greater certainty about water deliveries at the beginning of each growing season, and agreement and assurances that certain of the parties will work collaboratively to resolve outstanding water-right contests pending in the Oregon Klamath Basin Adjudication process. In addition, the KBRA includes an Off-Project voluntary Water Use Retirement Program in the Upper Basin, three restoration projects intended to increase the amount of water storage in the Upper Klamath Basin, regulatory assurances, county and tribal economic development programs, and tribal resource management programs. Copies of the KHSA and KBRA in their entirety are available electronically at: http://klamathrestoration.gov/. The implementation of these two agreements will be a significant step forward in restoring fish populations in the Klamath River Basin, once a stronghold for SONCC coho salmon.

Acts

Federal statutes that include provisions relevant to instream flow protection include the ESA, CWA, National Environmental Policy Act (NEPA), and the Federal Power Act.

Water Allocation

Given the lack of federal regulatory authority over instream flow in many areas and waterbodies, state water laws are the primary mechanism for protecting instream flow in many areas. In the area of the SONCC coho salmon ESU, the states of Oregon and California are charged with allocating and adjudicating water quantities to qualified users, as well as enforcing water rights. Oregon's water rights system is based primarily on the doctrine of prior appropriation, although some form of riparian water rights still exist (Oregon Water Resources Department (OWRD) 2009) and instream flow rights can be established through water right purchase or lease. Surface and groundwater use in Oregon is administered by the Water Resources Department (OWRD), which is responsible for implementing Oregon's water policy.

Oregon was one of the first western states to recognize instream flow as a beneficial use. In 1955 the state adopted minimum stream flows to support aquatic life through administrative rules, and in 1983 amendments were adopted that authorized ODFW, ODEQ, and the Oregon Department of Parks and Recreation to apply for minimum instream flow rights. Then, in 1987 and 1993, further amendments strengthened instream flow rights, allowing for transfers and for the use of water markets to acquire instream flow rights (OWRD 2009).

State resource managers in Oregon have also attempted to protect and conserve instream flows, and promote water conservation, through the implementation of voluntary programs for private water users. The allocation of conserved water program, administered by OWRD, allows a water user who conserves water to use a portion of the conserved water on additional lands, lease or sell the water, or dedicate the water to instream use. The program is intended to promote the efficient use of water to satisfy current and future needs, both out of stream and instream. Oregon's instream leasing program is also designed to provide a voluntary means to aid the restoration and protection of streamflow. This arrangement provides water users with options that protect their water rights while leasing water for instream benefits. The success of this program is largely dependent on the participation of landowners and therefore the program may be unable to meet the instream flow needs of coho salmon populations in some areas.

Responsibility for water allocation and use enforcement in California is shared among several agencies. California courts have jurisdiction over the use of percolating ground water, riparian use of surface waters, and the appropriate use of surface waters initiated prior to 1914 (California Department of Water Resources (CDWR) 2001). The State Water Resources Control Board (SWRCB) is responsible for the water rights and water quality functions of the state (CDWR 2001). The SWRCB has the jurisdiction to issue permits and licenses for appropriation of water from surface and underground streams. This board also has the authority to declare watercourses fully appropriated. Many of the streams and rivers in the California portion of the ESU have been deemed to be fully appropriated by the SWRCB (Table 3-9). A declaration that a stream system is fully appropriated means that the supply of water in the stream system is being fully applied to beneficial uses, and the SWRCB has determined that no water remains available for appropriation. From and after the date of adoption of a declaration that a stream system is fully appropriated, and subject to subdivision the board shall not accept for filing any application for a permit to appropriate water from the stream system and the board may cancel any application pending on that date.

Table 3-9. Declaration of fully appropriated stream systems according to the California State Water Resources Control Boards.

County	Stream	Tributary to	Critical Reach
Del Norte County			
	Smith River	Pacific Ocean	refer to Section 5093.54 of California Wild and Scenic Rivers Act for specific critical reaches
	Jordan Creek	Lake Earl	from the confluence with Lack Earl upstream
Humboldt County			
	Eel River	Pacific Ocean	The main stem from 100 yards below Van Arsdale Dam to the Pacific Ocean
	Klamath River	Pacific Ocean	from the main stem about 100 yards below Iron Gate Dam to the Pacific Ocean
	South Fork Eel River	Eel River	the south fork of the Eel from the mouth of Section Four Creek near Branscomb to the river mouth below Weott
	South Fork Trinity River	Trinity River	from the junction of the river with State Highway Route 36 t the river mouth near Salyer
	Trinity River	Klamath River	the main stem from 100 yards below Lewiston Dam to the river mouth at Weitchpec
	Van Duzen River	Eel River	from Dinsmore Bridge downstream to the river mouth near Fortuna
	Jacoby Creek	Humboldt/Arcata Bay	from the confluence of Jacoby Creek and Humboldt/Arcata Bay upstream
	Mad River	Pacific Ocean	from the mouth of the Mad River at the Pacific Ocean upstream
Mendocino County			
	Brush Creek	Pacific Ocean	from the mouth at the Pacific Ocean upstream
	Middle Fork Eel River	Eel River	from the intersection of the river with the southern boundary of the Middle Eel-Yolla Bolly Wilderness Area to the river mouth at Dos Rios
	North Fork Eel River	Eel River	from the Old Gilman Ranch downstream to the river mouth near Ramsey
	Mill Creek	Middle Fork Eel River	from the SE corner of Section 16, T22N, R12W, MDB&M where the accretion flow comes into Mill Creek upstream

County	Stream	Tributary to	Critical Reach
Siskiyou County			
	North Fork Salmon River	Salmon River	from the intersection of the river with the south boundary of the Marble Mountain Wilderness Area to the River mouth
	Scott River	Klamath River	from the mouth of Shackleford Creek west of Fort Jones to the river mouth near Hamburg
	Wooley Creek	Salmon River	from the western boundary of the Marble Mountain Wilderness Area to its confluence with the Salmon River
	French Creek	Scott River	from the confluence of French Creek and the Scott River upstream
	Scott River	Klamath River	at the U.S. Geological Survey located on the Scott River near Fort Jones upstream
	Shackleford Creek	Scott River	from the confluence of Shackleford Creek and the Scott River upstream
	Willow Creek	Klamath River	from the York Bridge Road located within Section 8, T46N, R5W, MDB&M, upstream
	Seiad Creek	Klamath River	From the confluence of Seiad Creek and the Klamath River upstream
	Shasta River	Klamath River	from the confluence of the Shasta River and the Klamath River upstream
	Shasta River	Klamath River	from the confluence of Willow Creek located within Section23, T44N, R6W, MDB&M upstream
	McKinney Creek	Klamath River	about 1 1/2 miles downstream from the point of diversion on McKinney Creek upstream
	East Fork of SF of the Salmon River	Salmon River	at a point on the East Fork of South Fork Salmon River located within T39N, R10W, (Shadow Creek Campground(upstream
	Douglas Creek	Klamath River	from a point on Douglas Creek located within the NE1/4, Section 19, T15N, R7E, MBD&M upstream
Trinity County			
	New River	Trinity River	from the intersection of the river with the southern boundary of the Salmon-Trinity Primitive Area downstream to the river mouth near Burnt Ranch
	North fork Trinity River	Trinity River	from the intersection of the river with the southern boundary of the Salmon-Trinity Primitive Area downstream to the river mouth at Helena
	Mule Creek	Trinity River	from Clair Engle Lake upstream

The CDWR is responsible for planning the use of state water supplies, and consults with the California Water Commission to develop rules and regulations for this purpose (CDWR 2001). The vast majority of California's groundwater is unregulated and the state does not have a comprehensive groundwater permit process to regulate ground water withdrawal. The lack of groundwater regulation has led to overutilization of this resource, which has had major impacts on surface flow and constitutes a major shortcoming of California water law.

In 1991, California adopted changes to its water laws that permitted the transfer of existing consumptive water rights to the purpose of instream flow through either purchase or lease. State law does not permit new appropriations of water for instream flow. When a new water use permit application is submitted, the State Water Board must notify CDFG, which has the authority to recommend amounts of water necessary to preserve fish, wildlife, and recreation in the affected stream. The board then considers these recommendations and may set instream flow requirements as conditions for the new permit. In this way, current flows can be protected even though new appropriations for instream flow rights are prohibited (California Environmental Protection Agency 2011).

More recent efforts to protect instream flows include the adoption of California Water Code section 1259.4, and the adoption and use of Section 1707. California Water Code section 1259.4 addresses the 2002 draft guidelines that CDFG and NMFS presented to the SWRCB for maintaining instream flows downstream of water diversions in mid-California coastal streams. The draft joint guidelines call for limiting new water diversions to only the winter period from December 15 to March 31, establishing bypass flows for new dams, establishing a cumulative maximum rate of withdrawal, and restricting construction of new on-stream dams. Water transfers for dedicated instream uses are accomplished through Section 1707. An instream flow dedication under Section 1707 allows a water user to transfer all or a portion of any water right to instream uses – for example, designating that such conserved water must remain in the watercourse for the benefit of aquatic habitat. It is available to owners of either riparian or appropriative water rights, and can be crafted for either short-term (less than a year) or long-term duration. These transfers may be used to ensure that water flows downstream to satisfy any applicable federal, state, or local regulatory requirements governing water quantity, water quality, instream flows, fish and wildlife, wetlands, recreation, and other instream beneficial uses. Additionally, in November of 2009, the California State Legislature passed a series of bills that encourage stricter groundwater monitoring and enforcement of illegal diversions, more ambitious water conservation policy, and water recycling and conservation programs. If effectively implemented, these California water bills should contribute to improved instream habitat in the future.

Instream Flow Requirements

Many rivers within the SONCC coho salmon ESU contain large dams. Dam operators at most of these dams have regulatory mandates to maintain adequate instream flows for the protection of fish and wildlife species. Examples of dams with flow requirements include J.C. Boyle, Copco 1, Copco 2, and Iron Gate dams on the Klamath River; Trinity and Lewiston dams on the Trinity River; R.W. Matthews Dam (Ruth Lake) on the Mad River, and Scott Dam (Lake Pillsbury) in the Eel River. Large dams lacking instream flow requirements include William L. Jess Dam (Lost Creek Reservoir) on the Rogue River, Applegate Dam on the Applegate River, and Dwinnell Dam on the Shasta River.

On the Trinity River, the Bureau of Reclamation is required to release between 369,000 and 815,000 acre feet to the Trinity River annually depending on the water year type. Discharge from

Lewiston Dam remains at 450 cfs during the summer months, 300 cfs during the winter months, and has a variable flow regime in the spring depending on the water year type.

The total volume of water impounded and diverted by the Humboldt Bay Municipal Water District (HBMWD) represents a small percentage of the natural yield of the Mad River watershed. The Mad River's average annual discharge into the Pacific Ocean is just over 1,000,000 acre-feet (available at http://www.hbmwd.com/water_supply). Ruth Lake, in its entirety, represents less than 5 percent of the total average annual runoff from the Mad River basin. The entire 48,030 AF capacity of Ruth Lake is not drawn down each year, so the amount of winter-season runoff captured in the reservoir is yet a smaller percentage of the total runoff. With respect to diversions, the current withdrawal rate at Essex is approximately 25 to 30 MGD (28,000 to 34,000 acre-feet per year), which is only 3 percent of the total annual average runoff of the Mad River watershed (available at http://www.hbmwd.com/water_supply). The full diversion capacity of 75 MGD (84,000 acre-feet per year) is just 8 percent of the total annual average runoff of the watershed.

The Potter Valley Project diverts the majority of upper mainstem Eel River flows out of the basin. From 1992 to 2004, up to approximately 160,000 AF of Eel River water were annually diverted into the East Fork of the Russian River for hydropower production and agricultural uses. Until 2004, flows released downstream of Cape Horn Dam were approximately 3 cubic feet per second (cfs) during most of the summer. In 2004, the Federal Energy Regulatory Commission issued an order requiring Pacific Gas and Electric (PG&E) to implement an instream flow regime consistent with the Reasonable and Prudent Alternative in the NMFS 2002 Biological Opinion. The new flow requirement increased the minimum Cape Horn Dam release flows and incorporated within-year and between-year variability. Minimum flows are dependent on a number of factors and formulas, including cumulative inflow into Lake Pillsbury, current and previous water year, and time periods.

3.2.10 Invasive/Non Native Alien Species

Invasive or non-native alien species pose a threat to several populations in the SONCC coho salmon ESU (Table 3-8). Sacramento pikeminnow are prevalent throughout much of the Eel River basin and have recently been discovered in Martin Slough, a tributary to Elk River in Humboldt Bay and brown trout have been observed in the Upper and Lower Trinity River (CDFG 1997, Waters 1983, Dewald and Wilzbach 1992, Wang and White 1994, McHugh and Budy 2006). Both species reduce native coho salmon populations by increasing competition for food resources, increasing predation on juveniles, and utilizing less than desirable water quality conditions to flourish and become more abundant, and out-competing native salmonids. Additionally, recent reports have shown that the New Zealand Mud Snail has been observed in Redwood Creek (Benson 2010), although little if any information exists on the effects that these animals have on local salmonids.

Reed canary grass is an invasive non-native perennial grass that was not identified as a threat at the time of SONCC coho salmon federal listing. The grass has been identified to prohibit native riparian growth, choke stream channels, provide poor to non-existent habitat for fish and other native aquatic wildlife, inhibit the mobility of fish at lower flows, increase sedimentation, contribute to low levels of dissolved oxygen, and cause overbank flooding during winter and spring base flow conditions (Miller et al. 2008). In addition, over 150 adult unspawned coho salmon were found dead in a field dominated by reed canary grass, likely stranded by the dense reed canary grass when high flows receded quickly in an ill-defined channel (Carrasco 2000). Although that mortality event occurred outside of the SONCC coho salmon range, the invasive grass is found throughout southern Oregon and northern California and is a threat to SONCC coho salmon and their habitat. Overall, the threat of reed canary grass has increased since the last status review.

Some basins in the SONCC coho salmon ESU, including Hunter, Strawberry, and Norton/Widow White creeks, have extensive residential development in their lower floodplains and riparian areas. In these areas, it is likely that invasive plant species will spread from residential landscaping into riparian areas, particularly if there are pre-existing gaps in the riparian vegetation. Some of these species could impede restoration of riparian forests and wetlands. The extent to which this has already occurred is unknown.

3.2.11 Hatcheries

Hatcheries are believed to pose a significant threat to populations where they occur in the SONCC coho salmon ESU. As discussed in section 3.1.1, hatcheries and the introduction of hatchery fish into wild populations can have direct and indirect effects on wild, native fish populations. More information regarding hatcheries can be found under the adverse hatchery related effects in the above mentioned stress (limiting factor) section.

3.2.12 Fishing and Collecting

Fisheries Harvest Management

Significant changes in harvest management have occurred since the late 1980s, resulting in substantial reductions, and in most cases, cessation in harvest of SONCC coho salmon. Historically, ocean harvest of SONCC coho salmon has occurred in coho- and Chinook-directed commercial and recreational fisheries off the coasts of California and Oregon and SONCC-origin coho salmon have been shown to experience incidental morality due to hooking and handling in other fisheries, especially the Chinook salmon fishery north of Humbug Mountain (PFMC 1999, 2000, 2001, 2002, 2003).

Originally enacted in 1976, the Magnuson-Stevens Fishery Conservation and Management Act (MSA) established the conservation and management of marine fisheries in the U.S, and created eight regional fishery management councils, of which the Pacific Fisheries Management Council (PFMC) oversees the fisheries along the western states. Because of the decline of coho salmon, the PFMC closed the commercial and recreational fisheries for coho salmon in 1994 and 1995, respectively. Because coho-directed fisheries and coho salmon retention have been prohibited off the coast of California since 1996, the SONCC coho ocean exploitation rate is very low and attributable to non-retention impacts (bycatch) in California and Oregon Chinook salmon directed fisheries and in Oregon’s mark-selective directed coho salmon fisheries.

When amended in 1996, the MSA established essential fish habitat protection and reduced bycatch limits. The MSA requires NMFS to provide conservation recommendations to conserve essential fish habitat. In response, federal action agencies are then required to respond to

NMFS's conservation recommendations and indicate that the recommendations will be implemented or to provide alternatives to the recommendations that would avoid, mitigate, or offset the impact of the activity on the habitat. Additionally, the PFMC is working to reduce bycatch impacts by setting the bycatch limit of coho salmon to 13 percent in the Chinook salmon ocean fisheries. In 1999, NMFS issued a biological opinion requiring that the overall annual ocean exploitation rate for Rogue and Klamath rivers (R/K) hatchery coho salmon remain less than 13 percent (NMFS 1999). In 2001, the PFMC adopted management measures for Federal ocean waters under which all key coho salmon management objectives, based on the 1999 NMFS biological opinion, the Pacific Coast Salmon Plan, and the OCN Coho Salmon Work Group recommendations, were met. Current regulations include time and area closures, seasonal quotas, minimum sizes, gear restrictions, and allowable take.

In establishing fishing seasons and regulations each year, the Pacific Fishery Management Council (PFMC) considers the potential impacts on various ESA-listed stocks within the region. Because there are no data on exploitation rates on wild SONCC coho salmon, Klamath and Rogue River (KR) hatchery stocks have traditionally been used as a fishery surrogate stock for estimating exploitation rates on SONCC coho. Current coho salmon exploitation rates based on the Rogue/Klamath time series (2000 to 2010) show a decrease from 6 percent on average from 2000 to 2007, to between 1 and 3 percent in 2008 and 2009. This decrease is believed to be due to the closure of nearly all salmon fisheries south of Cape Falcon, Oregon. Recreational fishing was resumed in 2010. California's statewide prohibition of coho salmon retention keeps the impacts from freshwater recreational fisheries on SONCC coho salmon low, including allowance for sporadic mark-selective coho salmon retention in the Oregon part of the ESU. The available information indicates that the level of SONCC coho salmon fishery impacts have not significantly changed since the 2005 salmon and steelhead status review update (Good et al. 2005), except for small decreases in 2008 and 2009.

3.2.13 Inadequate Regulatory Mechanisms

Inadequate regulatory mechanisms were identified as a factor for listing when SONCC coho salmon were listed in 1997, and the problems associated with these regulations continues to hinder salmon recovery to this day. The set of regulatory mechanisms which will govern this future recovery span a full range of protective strengths and weaknesses and provide a varying degree of protection for populations in the SONCC coho salmon ESU. Since 1997, many regulatory mechanisms that were originally cited as being inadequate have been strengthened in their ability to protect coho salmon and their habitat. In addition, many new management plans and programs have been implemented which either directly or indirectly benefit coho salmon. However, because of the lack of coordination in implementation and management, some regulations are not fully implemented or monitored for compliance and therefore do not provide adequate, or even minimal protection. In addition, there is an overall lack of regulations to fully address the range and magnitude of current and future threats to recovery. As discussed below, the regulatory landscape in which recovery will take place has both strengths and weaknesses in terms of its ability to protect and restore SONCC coho salmon and habitat.

Although some of the current land and resource management policies in place are specifically designed to protect coho salmon and their habitat (e.g., Federal and State Endangered Species Acts), many are designed for other purposes and only indirectly protect SONCC coho salmon populations (e.g., state forest practice rules). To achieve recovery, federal and state land managers will need to work together to provide comprehensive upland and instream habitat protection across the landscape and work together to implement a more cohesive set of land and resource management policies and plans. Several federal and state land management regulations and acts have been enacted to protect and preserve public lands for current and future public use, and to ensure that these lands are held in good condition, and species utilizing these lands are protected to ensure continued survival. Additionally, many federal and state regulations and acts aid in the protection of private lands and also work towards the protection of salmonids and other species not protected under state and federal laws for public lands. These regulatory mechanisms are in place to control and regulate mining activities, timber harvesting, instream dredging and construction, and urban growth. Many aspects of these regulations are regulated and monitored by both Federal and State agencies, and may apply to both public and private lands in both Oregon and California. Several inadequate regulatory mechanisms identified in the final rule listing the SONCC Coho Salmon ESU (62 FR 24588, 24596-24598; May 6, 1997) are discussed elsewhere in this chapter: Northwest Forest Plan (Section 3.2.5), State Forest Practices (Section 3.2.5), Water Quality Programs (Section 3.1.2), State Agricultural Practices (Section 3.2.4), Harvest Management (Section 3.2.12), and Hatchery Management (Section 3.2.11).

Dredge, Fill, and In-water Construction Programs

The Army Corps of Engineers (ACOE) regulates removal/fill activities under section 404 of the Clean Water Act (CWA) (see http://www.epa.gov/OWOW/wetlands/laws/). When listing the SONCC coho salmon ESU, NMFS noted that ACOE did not a methodology to adequately assess the cumulative effects in issuing permits for removal/fill activities under CWA section 404 (62 FR 24588, 24596; May 6, 1997). Although currently the ACOE requires an evaluation of cumulative impacts from these permits, the effectiveness of such evaluations at preventing cumulative impacts is unknown. Similarly, the section 401 water quality certification program, which is regulated by the states of California and Oregon, applies only to activities that require a federal permit or license (i.e., 404 permit or FERC license, respectively). Because the 401 certification requirements depend on the initiation of the 404 permitting or FERC licensing process, the 401 program also does not address exclusively upland activities. Therefore, the lack of review and jurisdiction for upland activities limits the ability of the 404 and 401 regulatory programs to provide adequate protection for coho salmon and its habitat. Other state and federal agencies are tasked with monitoring and addressing upland activities, but little oversight and manpower are put to these regulatory programs and processes. While the availability of regulatory agencies is useful in protecting salmon and their habitat, more could be done to provide greater protections in more areas to increase the authority and strength of these regulations.

California Endangered Species Act

In 2005, the state of California listed coho salmon between Punta Gorda and the Oregon border as threatened. The California listing protects coho salmon from direct take, and helps to ensure that projects or activities that have incidental adverse effects to coho salmon are reviewed and take is mitigated. In connection with the California state listing, a coho salmon recovery strategy was formally approved and adopted by the California Fish and Game Commission on February 4, 2004 (CDFG 2004). The recovery strategy includes over 700 conservation recommendations covering a wide variety of land use activities, and over 200 more related to agricultural practices within the Scott and Shasta rivers, tributaries to Klamath River. To facilitate implementation, the CDFG has integrated the recovery strategy with the Fisheries Restoration Grant Program (FRGP) by increasing the likelihood that high priority actions receive funding. Currently the recovery plan is being implemented throughout the California portion of the ESU and a 5-year progress report is being developed. Limited funding and staff have impacted the state's ability to fully implement the plan in recent years. The state of Oregon has not listed coho salmon in southern Oregon.

Federal Endangered Species Act Protections

The major provisions of the Endangered Species Act of 1973, as amended,16 U.S.C. § 1531 et seq., set forth eligibility and procedural requirements for listing species as endangered or threatened, provides protections for those listed species, prohibits federal agencies from engaging in actions that jeopardize listed species or result in the destruction or adverse modification of their designated critical habitat without special exemption (section 7(h)(1)), and creates a framework for cooperation with states to conserve listed species and their habitat. The most direct mechanism for protection under the ESA is the section 9 take prohibition. Section 7(a)(1) makes it clear that Federal agencies must utilize their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of endangered species and threatened species. Although Federal agencies have an affirmative obligation to conserve, an agency's 7(a)(1) actions are discretionary and priorities are often obligated to other management objectives.

Section 7(a)(2) states, in part, "[e]ach Federal agency shall, in consultation with and with the assistance of the Secretary [of Interior or Commerce, as appropriate], insure that any action authorized, funded, or carried out by such agency…is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of critical habitat of such species...unless such agency has been granted an exemption for such action…by the Committee pursuant to subsection (h) of this section." Since the time of listing, NMFS has conducted over 1,000 consultations on the effects of Federal actions on SONCC coho salmon and their critical habitat, including major projects on the Rogue, Trinity, Klamath, and Eel rivers. Interagency consultation, including technical assistance and section 7 consultations (both informal and formal) have often reduced or eliminated adverse effects to SONCC coho salmon, their designated critical habitat, or both.

Section 10(a)(1)(B) of the ESA allows NMFS to issue permits to non-Federal parties for incidental take of listed species, as long as, among other requirements, the impacts of the taking are minimized and mitigated to the maximal extent practicable and the taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild. Neither section 7(a)(2) consultations nor section 10 permits are intended to require Federal agencies or permit holders to contribute to the recovery of listed species. However, in section 7(a)(2) consultations and in issuance of section 10(a)(1)(B) permits, the action or taking must not appreciably reduce the likelihood of survival and recovery of the listed species in the wild. Further, in biological opinions, NMFS frequently provides discretionary conservation recommendations, which, if implemented, would assist the action agency in meeting its section 7(a)(1) responsibilities.

Whenever a species is listed as threatened under the federal ESA, section 4(d) authorizes the Secretary to issue regulations as he deems necessary and advisable to provide for the conservation of such species, including taking prohibition or limitation of identified activities. Currently, the 4(d) rule for SONCC coho salmon (50 CFR § 223.203) does not necessarily streamline the regulatory process for review of activities that may benefit coho salmon, because NMFS has less experience reviewing activities under the 4(d) rule compared to experience in consultations under section 7(a)(2) or permits under section 10(a)(1)(B), and NMFS' approval of activities under the 4(d) rule requires an internal consultation under ESA section 7(a)(2)(d) review is less well established than section 7 or 10 programs and the current 4(d) rule also requires an internal section 7 consultation.

3.2.14 Ocean Conditions

Survival rates in the marine environment are strong determinants of population abundance for Pacific salmon (NMFS 2003). Poor ocean conditions have played a prominent role in the decline of coho salmon in California and Oregon and will greatly influence the ability to recover SONCC coho salmon. In general, coho salmon marine survival is about 10 percent (Bradford 1995), although there is a wide range in survival rates (from less than one percent to about 21 percent) depending upon population location and ocean conditions (Beamish et al. 2000, Quinn 2005). Marine survival and successful return as adults to spawn in natal streams is considered to be critically dependent on an individual's first few months at sea (Peterman 1982, Unwin 1997, Ryding and Skalski 1999, Koslow et al. 2002). In a detailed study of Puget Sound hatchery coho salmon, Mathews and Buckley (1976) estimated that 13 percent survived the first six months at sea, survival dropped to 9 percent after twelve months, and increased to 99 percent during the second year at sea.

Changes in the marine environment over the past decade demonstrate the impacts that changing ocean conditions can have on coho salmon populations (Beamish et al. 2000, Logerwell et al. 2003). For at least two decades, beginning about 1977, marine productivity conditions were unfavorable for the majority of salmon populations in the Pacific Northwest. Recent data from across the range of coho salmon on the coast of California and Oregon reveal there was a 72 percent decline in returning adults in 2007/08 compared to the same cohort in 2004/05 (MacFarlane et al. 2008). The Wells Ocean Productivity Index, a measure of Central California ocean productivity, revealed poor conditions during the spring and summer of 2006, when juvenile coho salmon from the 2004/05 cohort entered the ocean (McFarlane et al. 2008). Poor ocean productivity can be especially detrimental to coho salmon along the Oregon and California coast, because these regions lack extensive bays, straits, and estuaries, which could buffer adverse oceanographic effects (Bottom et al. 1986). Strong ocean upwelling in the spring of 2007 may have resulted in better ocean conditions for the 2007 coho salmon cohort (NMFS 2008a).

3.2.15 Stochastic Pressure from Small Population Size

A recent evolution in the field of conservation biology is the hypothesis that random events in small populations may have a large impact on population dynamics and population persistence. The peril that small populations face may be either deterministic (the result of systematic forces that cause population decline such as overexploitation, development, deforestation, loss of pollinators, inability to find mates, or inability to defend against predators) or stochastic (the result of random fluctuations that have no systematic direction). These forces have been shown to reduce population size and when populations are reduced to very low densities, they can experience reduced rates of survival and reproduction (Allee 1938, Wood 1987). Over the long term, a series of unlucky generations in which there are successive declines in population size can lead to extinction even if the population is growing, on average.

Several populations in the SONCC coho salmon ESU have declined in numbers to such a low point that they are being influenced by natural stochastic processes that may make recovery of the ESU more difficult than currently thought (CDFG 2004). As natural populations get smaller, the number of interacting stochastic processes which influence the population increases. These stochastic processes can create alterations in genetics, breeding structure, and population dynamics that may interfere with recovery efforts and need to be considered when evaluating how populations within the ESU are going to respond to recovery actions. This stochastic pressure can express itself in three ways: genetic, demographic and environmental.

Genetic stochasticity refers to changes in the genetic composition of a population unrelated to systematic forces (selection, inbreeding, or migration), i.e., genetic drift. Genetic stochasticity can have a large impact on the genetic structure of populations, both by reducing diversity within populations and by increasing the chance that deleterious recessive alleles are expressed. When populations are at levels below depensation, stochasticity can make both population viability and survival difficult to predict, due to the random variables that are now acting on the population. These processes, when working together, can cause reduced genetic diversity in a population (or populations), further decreases in population size, or shifts in life history traits. Reduced diversity could limit a population's ability to respond adaptively to future environmental changes. In addition, the increased frequency with which deleterious recessive alleles are expressed (because of increased homozygosity) could reduce the viability and reproductive capacity of individuals.

Demographic stochasticity refers to the variability in population growth rates arising from random differences among individuals in survival and reproduction within a season. This variability will occur even if all individuals have the same expected ability to survive and reproduce and if the expected rates of survival and reproduction don't change from one generation to the next. Even though it will occur in all populations, it is generally important only in populations that are already fairly small. Environmental stochasticity is the type of variability in population growth rates that refers to variation in birth and death rates from one season to the next in response to weather, disease, competition, predation, ocean conditions, or other factors external to the population.

In these small populations, recovery from low densities may be significantly delayed or not occur at all and be displayed through a decrease in per-capita growth rate. This reduced per-capita growth rate at low densities is also known as depensation (Liermann and Hilborn 2001). Many mechanisms can lead to depensation and are usually displayed through changes in the following mechanisms: reduced probability of fertilization, impaired group dynamics, conditioning of the environment and predator saturation (Liermann and Hilborn 2001). A population’s dynamics are depensatory if the growth rate decreases along with density or abundance decreasing to low levels. Components of the life history, such as fecundity or survival, or the mechanisms that affect these components are called depensatory if they decrease the growth rate along with density or abundance. At extremes, these depensatory dynamics have negative per-capita growth rates at low densities and are called critical depensation (Clark 1985). The critical density at which the per-capita growth rate becomes negative is of particular interest since populations reduced below this density face further decline and possibly extinction (Liermann and Hilborn 2001) and therefore being able to recognize when populations are entering or are in a depensatory state is vitally important in the efforts leading to recovering a species. However, recognizing when depensation is occurring has proven to be difficult, but current research utilizing parametric statistical analyses is beginning to be used to help better understand the population dynamics occurring in these small populations, similar to the SONCC coho salmon ESU.

These stochastic processes are likely influencing populations throughout the SONCC ESU. These processes and pressures need to be taken into account when prioritizing watersheds and associated recovery actions to ensure that efforts made to recover extremely small populations are successful, and that other processes are not hindering or defeating recovery efforts. These processes, while not serious when acting alone, can become significant contributors to population instability and decline when acting synergistically with other threatening processes. It may be difficult to know when a population is at a point that additional stochastic factors are playing a role in its recovery and viability, and so including, where possible, statistical population models to determine current pressures and threats is needed. Models like the Population Viability Analysis (PVA) have been shown to be extremely useful in obtaining a better understanding of the processes and pressures that are affecting small populations like those seen in the SONCC ESU.

4. Conservation and Recovery Goals, Objectives, and Criteria

Chapter 4 describes the goals that frame the State of Oregon's, the State of California's and NMFS's path toward recovery of SONCC coho salmon.

- First, the populations must reach desired levels of biological viability and the recovery effort must reduce the impact of the stresses (limiting factors) and threats in order to warrant removal of the SONCC coho salmon ESU from the threatened and endangered species list (referred to in this plan as either delisting or ESA recovery). Chapter 4 describes the goals and proposed criteria that must be met to delist.

- Second, the States of California and Oregon seek to rebuild wild populations to reach 'broad sense recovery' to provide for sustainable fisheries and other ecological, cultural and social benefits. Section 3.2 describes broad sense recovery goals.

Each population serves a role in recovery. Williams et al. (2008) described the characteristics of a viable ESU which includes different roles for core, non-core, and dependent populations (as explained in Chapter 2). Based on an assessment of the stresses (limiting factors) and threats affecting each of the 39 populations in the ESU (methodology in Appendix B, results in Volume II), as well as a number of other factors such as the current population status, NMFS determined which independent populations were likely to most rapidly respond to recovery actions and meet spawner abundance targets (Appendix C). These populations are designated "core populations." The remaining independent populations are designated "non-core populations." In a fully recovered ESU, core populations must be at low risk of extinction, and non-core populations which are not extirpated must be at a moderate risk of extinction. Basins that once supported dependent populations, as well as basins that once supported independent populations which are extirpated, must support emigrants from other populations. The delisting criteria for each population are described below.

NMFS expects that as habitat is restored and key threats are abated, more coho salmon will be produced. Therefore, the recovery strategy relies on restoration of sufficient habitat to produce the minimum number of spawners needed for each independent population, and in some areas abatement of threats (such as hatcheries in the Trinity basin) which can confound recovery efforts even if habitat is restored. To restore habitat, related stresses (limiting factors) and threats must be sufficiently reduced. The delisting criteria associated with each stress (limiting factor) and threat are detailed below.

Many recovery actions are identified to abate the stresses (limiting factors) and threats in each population. If all these actions are implemented and additional stresses (limiting factors) and threats do not arise, the SONCC coho salmon ESU will have a high probability of meeting the delisting criteria.

4.1 ESA Recovery Goals

The goal of this recovery plan is to prevent the extinction of Southern Oregon/Northern California Coast Coho Salmon (Oncorhynchus kisutch) in the wild and to ensure the long-term persistence of viable, self-sustaining populations of coho salmon distributed across the SONCC

Recovery Domain. . When the SONCC coho salmon ESU is viable, NMFS will consider it recovered, and delist. A viable SONCC coho salmon ESU will be naturally self-sustaining, with a low risk of extinction. To delist, the recovery criteria for both biological and stress (limiting factor) and threat abatement must be met. Recovery of SONCC coho salmon require not only a viable ESU, but also a demonstrated reduction in the stresses (limiting factors) and threats affecting SONCC coho salmon. The specific recovery objectives and criteria are provided below

Delisting criteria are objective, measurable criteria that, when met, would result in a determination by NMFS that the ESU is not likely to become endangered within the foreseeable future throughout all or a significant portion of its range. The delisting criteria described here are not necessarily the only set of criteria that would result in delisting. In addition, as new information emerges, NMFS may revisit the delisting criteria. The status review process is described in Chapter 6.

4.1.1 Biological Objectives

NMFS developed biological objectives based on ESU and population viability metrics established by Williams et al. (2008) and McElhany et al. (2000). At the ESU level, SONCC coho salmon must demonstrate representation, redundancy, connectivity, and resiliency. Representation relates to the genetic and life history diversity of the ESU, which is needed to conserve its adaptive capacity. Redundancy addresses the need to have a sufficient number of populations so the ESU can withstand catastrophic events (NMFS 2010). Connectivity refers to the dispersal capacity of populations to maintain long-term demographic and genetic processes. Resiliency is the ability of populations to withstand natural and human-caused stochastic events, and it depends on sufficient abundance and productivity. For the SONCC coho salmon ESU to demonstrate representation, redundancy, connectivity, and resiliency; core populations must be viable and well distributed; the risk of extinction for non-core populations must be at least moderate; and dependent populations must contain functioning habitat for all life stages of coho salmon.

At the population level, biological recovery objectives are based on the viable salmonid populations (VSP) parameters ((McElhany et al. 2000). SONCC coho salmon populations must achieve sufficient abundance, growth rate, spatial structure, and diversity. Spawner abundance is an important parameter because, all else equal, small populations are at greater risk of extinction than larger populations. Large populations are generally better able to withstand the detrimental effects of environmental variation, genetic processes, demographic stochasticity, ecological feedback, and catastrophes than small populations (Shaffer 1981). Productivity describes the growth rate of a population. Spatial distribution is important to reduce extinction risks from genetic risks and demographic stochasticity. A population's spatial distribution depends on habitat quality (including accessibility), population dynamics, and dispersal characteristics of individuals in the population. Genetic diversity allows species to adapt to a variety of environments that provide for the needs of the species and protects against short-term environmental change while also providing the genetic material necessary to survive environmental change.

4.1.2 Biological Recovery Criteria

The biological criteria highlight the need for a continuous set of functional populations across the ESU, which together form the basis for a viable ESU. Because core and noncore populations provide the foundation of a viable ESU, specific biological criteria (Table 4-1 and Table 4-2) were developed for these populations based on the viability criteria described in Chapter 2. The viability criteria describe what is needed for the ESU to be viable, but do not prescribe particular criteria for each population, allowing recovery planners to determine the best means to meet the viability criteria. The biological recovery criteria, which are described in Table 4-1, describe what populations must look like to meet the viability criteria. Populations must meet the biological recovery criteria described in Table 4-1 in order for the ESU to be delisted. The biological recovery criteria described in this section reflect NMFS' opinion of how to best achieve a viable ESU most quickly. These biological recovery criteria require that populations demonstrate sufficient abundance, productivity, spatial structure, and diversity. The proposed NMFS approach, built upon the foundation provided by Williams et al (2006 and 2008), allows for refining viability thresholds and perhaps even criteria as critical monitoring and research of biological and habitat attributes is implemented across the ESU. As more information becomes available and NMFS gains greater understanding of the dynamics of these populations and the ESU, updated viability assessments can be conducted and appropriate refinements can be made. New information, data, research, and time series information longer than several generations could suggest either greater or lower values for the various criteria.

Table 4-1. Biological recovery objectives and criteria for SONCC coho salmon.

VSP Parameter	Population Type	Recovery Objective	Recovery Criteria
Abundance	Core	Achieve a low risk of extinction[1].	The geometric mean of wild spawners over 12 years at least meets the "low risk threshold" of spawners for each core population[1, 2]
	Non-Core 1	Achieve a moderate or low risk of extinction[1]	The annual number of wild spawners meets or exceeds the moderate risk threshold for each non-core population[1, 2]
Productivity	Core and Non-Core 1	Population growth rate is not negative.	Slope of regression of the geometric mean of wild spawners over the time series $\geq$ zero[2]
Spatial Structure	Core and Non-Core 1	Ensure populations are widely distributed	Annual within-population distribution $\geq$ 70%[4] of habitat[3,4] (outside of a temperature mask[5])
	Non-Core 2 and Dependent	Achieve inter- and intra-stratum connectivity	20% of accessible habitat[4] is occupied in years following spawning of cohorts that experienced good marine survival[6]
Diversity	Core and Non-Core 1	Achieve low or moderate hatchery impacts on wild fish.	Proportion of hatchery-origin spawners (pHOS) $\leq$ 0.10
	Core and Non-Core 1	Achieve life history diversity.	Variation is present in migration timing, age structure, size and behavior. Variation in these parameters which is documented in recovery plan is retained.

[1] See Table 4-2 for specific spawner abundance requirements.

[2] Assess for at least 12 years, striving for a coefficient of variation (CV) of 15% or less at the population level (Crawford and Rumsey 2011).

[3] Based on available rearing habitat within the watershed (Wainwright et al. 2008). In NMFS' definition, "available" means accessible. 70% of habitat occupied relates to a truth value of approximately 0.60, providing a "high" certainty that juveniles occupy a high proportion of the available rearing habitat (Wainwright et al. 2008).

[4] The average for each of the three year classes over the 12 year period used for delisting evaluation must each meet this criterion. Strive to detect a 15% change in distribution with 80% certainty (Crawford and Rumsey 2011).

[5] Williams et al. (2008) identified a threshold air temperature above which juvenile coho salmon generally do not occur, and identified areas with air temperatures over this threshold. These areas are considered to be within the temperature mask.

[6] High marine survival is defined as 10.2% for wild fish and 8% for hatchery fish; Sharr et al. 2000.

Table 4-2. The minimum number of spawners (combination of males and females) needed in each independent (Ind.) population to meet delisting criteria for SONCC coho salmon.

Diversity Stratum	Independent Population	Population Type	Minimum Number of Spawners[1]
Northern Coastal Basins	Chetco River	Core	4,500
	Elk River	Core	2,400
	Lower Rogue River	Non-Core 1	320
	Winchuck River	Non-Core 1	230
Interior-Rogue River	Upper Rogue River	Core	16,100
	Illinois River	Core	11,800
	Middle Rogue and Applegate rivers	Non-Core 1	2,700
Central Coastal Basins	Lower Klamath River	Core	5,900
	Redwood Creek	Core	4,800
	Mad River	Non-Core 1	550
	Smith River	Core	6,800
	Maple Creek/Big Lagoon	Non-Core 2	None- Juv. Occupancy
	Little River	Non-Core1	140
Interior Klamath River	Shasta River	Core	8,700
	Scott River	Core	8,800
	Upper Klamath River	Core	8,500
	Salmon River	Non-Core 1	460
	Middle Klamath River	Non-Core 1	450
Interior-Trinity River	Upper Trinity River	Core	7,300
	Lower Trinity River	Core	3,900
	South Fork Trinity River	Non-Core 1	970
Southern Coastal Basins	Mattole River	Non-Core 1	1,000
	Humboldt Bay tributaries	Core	5,700
	Lower Eel and Van Duzen rivers	Core	7,900
	Bear River	Non-Core 2	None- Juv. Occupancy
Interior-Eel River	South Fork Eel River	Core	9,600
	Middle Mainstem Eel River	Core	6,400
	Mainstem Eel River	Core	4,700
	Middle Fork Eel River	Non-Core 2	None- Juv. Occupancy
	Upper Mainstem Eel River	Non-Core 2	None- Juv. Occupancy

[1] See Table 4-1 for recovery criteria. Abundance estimates should strive for a CV of 15 percent or less at the population level (Crawford and Rumsey 2011).

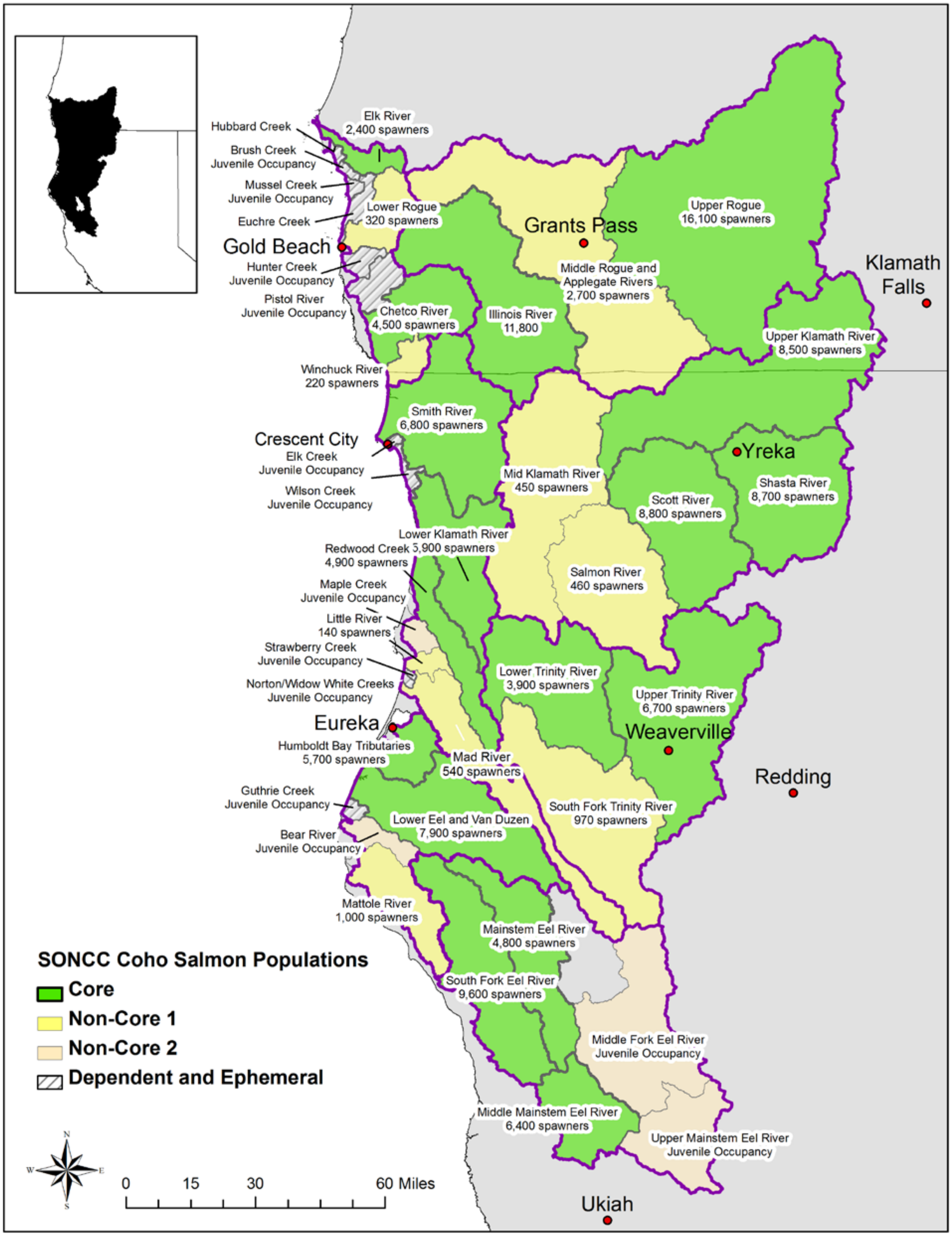


Figure 4-1. Location of core, non-core, and dependent populations and their minimum spawner requirements.

Choice of low-risk threshold

Rationale for choice of low-risk threshold

The following text, excerpted from Williams et al. 2006, explains the rationale behind the low-risk threshold value.

> The establishment of the low-risk threshold of 40 spawners/IP km for the smallest populations was largely dictated by the threshold for viability-in-isolation proposed by Williams et al. (2006) and supported by empirical data and various modeling efforts reported in the literature. To accommodate our assumption that for larger populations a comparable percentage reduction in habitat is less likely to result in a substantial increase in extinction risk as it would in smaller populations, we assume that a population with ten-fold additional habitat potential than the smallest population requires an average spawner density of half that of the smallest population. This captures our general conclusion that the larger the historical population, the more it can depart from historical conditions and remain viable. The function we propose to capture this is a linear decline in required density between 40 spawners/IP km in the smallest populations to 20 spawners/IP km in the watersheds with greater than 10-fold the habitat potential of the minimum watershed (i.e., IP km > 340). The development of this latter reference point was by the NCCC TRT (Spence et al. 2008) after much review and discussion, and although it is based largely on expert opinion, it provides results that are qualitatively consistent with the general hypotheses relating watershed size and density to spatial structure, diversity, and other factors that influence population persistence. The benefits of our approach for these criteria are that it establishes a population-specific abundance that is scaled to the amount of potential habitat and avoids the use of fixed abundance criteria. In addition, this approach captures the elements of spatial structure and diversity that contribute to viability without rigidly defining what the spatial structure must look like. For instance, in a large watershed the density criteria could be satisfied either by having fish distributed throughout the watershed at moderate densities or by having high densities in portions of the available habitat. Each of these scenarios has advantages and disadvantages for population persistence perspective. For example, moderate densities spread throughout a watershed may be more resilient to localized disturbances than populations with more localized groups of fish at densities near carrying capacity densities. Conversely, localized areas of high productivity may be critical for population persistence during periods of unfavorable environmental conditions (Nickelson and Lawson 1998). The amount and distribution of productive habitat available to a population is dynamic and may change over time, especially given the dynamic nature of the geographic area of the SONCC ESU. Currently, we lack the appropriate data to make more spatially explicit criteria on spatial structure, but believe our approach captures the essence of the spatial structure and diversity elements outline by McElhany et al. (2000) for viable salmon populations. Future research and monitoring may allow for the development of explicit population-specific distribution criteria.

Comparison of targets to historical abundance estimates

The following text, excerpted from Williams et al. 2008, describes how the low-risk threshold abundance targets compare to historical fish abundance data.

> Comparisons of historical abundance estimates and hypothetical density-based abundance targets for coastal watersheds in Oregon suggest that our methods do not overestimate the historical carrying capacities of coho salmon populations. Historical abundance estimates for Oregon populations were based on cannery records from 1892 to 1915 (Meengs and Lackey 2005). Meengs and Lackey (2005) estimated historical run sizes from cannery pack records through a series of steps including 1) converting salmon pack data (in cases) into pounds of salmon caught (by assuming a certain constant "waste" in processing); 2) converting pounds of salmon captured into numbers of adult fish (by assuming an average weight for adult fish of 4.46 kg); 3) converting numbers of harvested salmon into an estimate of total population sizes (assuming a specific catch efficiency rate); and 4) using the five years of highest abundance in each watershed as indicative of run size. The abundance targets that would result from application of our density-based criteria are well below, by an order of magnitude, historical estimates of abundance (Table 4-3). In all cases, the target abundance expressed as a percent of the historical estimates of abundance range between 3% and 12% (Table 4-3).

> Meengs and Lackey (2005) also estimated salmon run sizes for the Rogue River for the late 1800s based on extrapolations from cannery pack. The historical estimate of coho salmon for the Rogue River was 114,000 and for Chinook salmon it was 154,000 (Meengs and Lackey 2005). The TRT has delineated four independent populations in the Rogue River Basin. The Lower Rogue River population unit is part of the Northern Coastal Basin diversity stratum. The Illinois River population unit, the Middle Rogue/Applegate rivers population unit, and the Upper Rogue River population unit make up the Interior – Rogue River diversity stratum. The ESU viability criterion (detailed in Section 3.2) requires 50% of the stratum total for the spawner density criteria be met for a stratum to be viable, which equates to 22,650, or about 20% of the estimated historical abundance for the greater watershed.

> In summary, where there are estimates of historical abundances of coho salmon to compare with abundance targets based on spawner density, the methods described in Williams et al. (2008) do not appear to overestimate the historical carrying capacities of coho salmon populations.

Table 4-3. Comparison of abundance estimates and hypothetical density-based abundance targets for coastal watersheds in Oregon. IP km are integrated IP km values as described by Williams et al. (2006).

Population	Historical estimates of abundance derived from cannery records (Meengs and Lackey 2005)	IP km	Estimated historical spawner density (spawners/IP km)	Projected abundance target based on MRSD (20 spawners/IP km)[a]	Projected abundance target as percent of historical estimate
Nehalam	236,000	1,116	211	22,300	9.3%
Tillamook	234,000	537	436	10,700	4.7%
Nestucca	107,000	299	358	6,800	6.4%
Siletz	122,000	310	394	6,800	5.6%
Siuslaw	547,000	902	607	18,000	3.3%
Yaquina	65,000	385	169	7,700	12.3%
Alsea	153,000	466	328	9,300	5.9%
Coquille	342,000	883	387	17,700	5.3%
Coos	161,000	552	292	11,000	6.8%

[a] – The Nestucca and Siletz populations have less than 340 IP km, therefore the MRSD values used for these calculations were 23 spawners/IP km for the Nestucca population and 22 spawners/IP km for the Siletz population.

Possible change to low-risk threshold

NMFS developed biological recovery criteria based on the productivity, spatial structure, and diversity components of the viability salmonid population (VSP) framework described by McElhany et al. (2000). Chapter 4 describes the abundance biological recovery criteria for all four VSP parameters, including the low-risk threshold abundance targets identified by Williams et al. (2008). Future research is needed to determine whether the low-risk threshold abundance target could be decreased if the other VSP parameters are well-estimated. Recovery actions for this research are identified for each core population in its respective population profile, to be carried out after these VSP parameters have been monitored for twelve years during the delisting phase.

4.1.3 Stress (Limiting Factor) and Threat Abatement Objectives and Criteria

A number of stresses (limiting factors) currently affect the quantity and quality of habitat for SONCC coho salmon and limit their abundance, spatial structure, diversity, and productivity. Establishing criteria for the listing factors helps ensure that the causes of decline have been abated prior to delisting SONCC coho salmon. To delist SONCC coho salmon, the objectives and criteria for stresses and threats abatement must be met. These stresses and threats abatement objectives and criteria are presented below (Table 4-4 and Table 4-5), and organized according to the five listing factors introduced in Chapter 3. Criteria for some stressors are based on reference data values which reflect the habitat needs of coho salmon. Use of these indicators to determine the stress ranks is described in Appendix B and is summarized in Table 4-4 and Table 4-5.

Table 4-4. Recovery objectives and criteria for the stress (limiting factor) and threat abatement.

Listing Factor	Stress/Threat	Recovery Objective	Recovery Criteria
A. Habitat Destruction, Modification or Curtailment	Lack of floodplain and channel structure	*Good*[1] quality habitat must be available to support SONCC coho salmon populations.	Floodplain and channel structure has at least *good*[1] conditions suitable for all life stages of coho salmon in targeted areas (to be determined)[2].
	Altered sediment supply		Sediment supply has at least *good*[1] conditions suitable for all life stages of coho salmon in targeted areas (to be determined)[2] of core and non-core independent populations[2].
	Altered hydrologic function		Hydrologic function has at least *good*[1] conditions suitable for all life stages of coho salmon in targeted areas (to be determined)[2] of core and non-core independent populations[2].
	Impaired water quality		Water quality has at least *good*[1] conditions suitable for all life stages of coho salmon in targeted areas (to be determined)[2].
	Degraded riparian forest		Riparian forest conditions has at least *good*[1] conditions suitable for all life stages of coho salmon in targeted areas (to be determined)[2].
	Barriers		Barriers do not limit access to targeted areas (locations to be determined)[2].
	Impaired Estuary Function		All estuaries in the ESU contain estuarine wetland habitat and connected off-channel habitat (e.g., back and side channels, sloughs, tidal channels, alcoves, wetlands, beaver ponds) suitable for supporting rearing coho salmon[3].
A. Habitat Destruction,	Roads, Timber	Threats must be	The recovery criteria for all the stresses (limiting

Listing Factor	**Stress/Threat**	**Recovery Objective**	**Recovery Criteria**
Modification or Curtailment	Harvest, Channelization, Diking, Agricultural Practices, Dams, Diversions, Mining, Gravel Extraction, and Urbanization	sufficiently abated to result in *good*[1] quality habitat for all life stages of SONCC coho salmon in all populations.	factors) associated with Listing Factor A are met.
B. Over-utilization for commercial, recreational, scientific or educational purposes	Fisheries Bycatch	Commercial, recreational and tribal fisheries impacts must not exceed those levels consistent with SONCC coho salmon recovery.	Commercial, recreational and tribal fisheries impacts do not exceed those levels consistent with SONCC coho salmon recovery.
	Collection	Collection impacts must not exceed those levels consistent with SONCC coho salmon recovery.	Collection impacts do not exceed those levels consistent with SONCC coho salmon recovery.
C: Disease and predation	Disease	Disease and predation must not limit SONCC coho salmon recovery.	Mean mortality and infection from diseases is not higher than natural background levels[4] for coho salmon juveniles and adults in populations where disease is identified as a high or very high stress (limiting factor).
	Predation		Predation and competition from introduced species and hatchery-origin salmonids do not impede recovery of SONCC coho salmon.

Listing Factor	Stress/Threat	Recovery Objective	Recovery Criteria
D: The inadequacy of existing regulatory mechanisms	Land and resource management	Regulatory mechanisms have been maintained and/or established and are being implemented in a way that allows the desired status of the ESU and its constituent populations, as defined by the biological criteria in this recovery plan, to be attained and maintained.	• Regulatory programs that govern land use and resource extraction are in place, enforced, monitored, and adaptively managed and are adequate to ensure effective protection of salmon and steelhead habitat, including water quality, water quantity, and stream structure and function, and to attain and maintain the biological recovery criteria in this recovery plan. • Regulatory programs are in place and are being implemented, monitored, evaluated and adaptively managed adequately to manage fisheries at levels consistent with the biological recovery criteria of this recovery plan. • Regulatory programs have adequate funding, prioritization, enforcement, coordination mechanisms, and research, monitoring, and evaluation to ensure habitat protection and effective management of fisheries.
Factor D: The inadequacy of existing	Hatchery management		All hatcheries affecting SONCC coho salmon have NMFS-approved HGMPs, and the effects[5] of the

Listing Factor	Stress/Threat	Recovery Objective	Recovery Criteria
regulatory mechanisms			hatchery are within the levels described in the respective HGMP.
Factor E: Other natural or man-made factors affecting continued existence	Climate change	Natural or anthropogenic threats must not limit SONCC coho salmon recovery.	Recovery criteria for parts of Listing Factor A (altered hydrologic function, impaired water quality, degraded riparian forest conditions, impaired estuary/mainstem function, disease/predation/competition) and parts of Listing Factor D (land and resource management) are met[6].
	Invasive species		Regulatory measures to prevent additional or minimize spread of existing exotic species have been developed and implemented.

1 Based on all of the applicable indicators outlined in Table 4-5.

2 Specific targeted areas will be identified through the habitat assessment identified as the first step of the habitat monitoring protocol (Chapter 5).

3 The location and extent of habitat needed will be identified by studies to completed during recovery plan implementation. These studies are described in the recovery actions identified for each population with an estuary.

Background levels of Ceratomyxa shasta are likely to be in the lowest range of disease we currently observe. In 2011, under good flow and water quality conditions, Ceratomyxa shasta was detected in 16.5 percent (106/644) and Parvicapsula minibicornis was detected in 45.4 percent (133/292) of Klamath Chinook salmon juveniles (True 2011). Chinook salmon are a reasonable surrogate for coho salmon.

5 The concept of the proportion of natural influence (PNI), developed by the Hatchery Science Review Group (HSRG 2004), may be a useful tool for limiting the risks of fitness loss in natural populations due to straying of hatchery fish.

6 These portions of these listing factors were chosen to meet this criterion because they address the stresses (limiting factors) associated with the threat of climate change, as identified in Table 3-2.

Table 4-5. Indicators of aquatic habitat suitability for coho salmon for applicable stresses (limiting factors). (Kier Associates and NMFS 2008 for all stress indicators but disease; True 2011 for disease stress indicators).

Stress (Limiting Factor)	Indicators	Good	Very Good
Lack of Floodplain and Channel Structure	Pool Depths	3-3.3 ft	> 3.3 ft.
	Pool Frequency (length)	41-50%	>50
	Pool Frequency (area)	21-35%	>35%
	D50 (median particle size)	51-60 & 95-110 mm	60-95 mm
	LWD (key pieces[1]/100 m)	2-3	>3
	LWD <20 ft. wide[2]	54-84 pieces[3]/mi	>85 pieces[3]/mi
	LWD 20-30 ft. wide[2]	37-64 pieces[3]/mi	>65 pieces[3]/mi
	LWD >30 ft. wide[2]	34-60 pieces[3]/mi	>60 pieces[3]/mi
Altered Sediment Supply	% Sand <6.4mm (wet)	15-25%	<15%
	% Sand <6.4mm (dry)	12.9-21.5%	<12.9%
	% Fines <1mm (wet)	12-15%	<12%
	% Fines <1mm (dry)	8.9-11.1%	<8.9%
	V Star (V*)	0.15 - 0.21	<0.15
	Silt/Sand Surface (% riffle area)	12-15%	<12%
	Turbidity (FNU)[4]	120-360 hrs > 25 FNU	<120 hrs >25 FNU
	Embeddedness (%)	25-30	<25
Impaired Water Quality	pH (annual maximum)	8.25-8.5	<8.25
	D.O. (COLD) (mg/l 7-DAMin)	6.6-7.0 mg/l	>7.0 mg/L
	D.O. (SPAWN) (mg/l 7-DAMin)	10.1-11 mg/l	>11.0 mg/l
	Temperature (MWMT[5])	16-17° C	<16° C
	Aq Macroinverts (EPT)	19-25	>25
	Aq Macroinverts (Richness)	31-40	>40
	Aq Macroinverts (B-IBI)	60.1-80	>80
Degraded Riparian Forest Conditions	Canopy Cover (% shade)	71-80%	>80%
	Canopy Type (% Open + Hardwood)	20-30%	<20%
	Riparian Condition (conifers >36" dbh / 1000ft for 100 ft wide buffer)	125.1-200	>200
Disease	Ceratomyxa shasta juvenile infection rate	No greater than background levels: As of 2011, background level was 17%	

Stress (Limiting Factor)	Indicators	Good	Very Good
Disease	Parvicapsula minibicornis juvenile infection rate	No greater than background levels: As of 2011, background level was 45%	

1 Key pieces of large woody debris are pieces with a minimum diameter of 60 cm (2 feet) and a minimum length of 100 m (33 feet) (Foster et al. 2001).
2 The number of pieces of wood in streams with a wetted width of less than 20 feet, between 20 and 30 feet, or greater than 30 feet (TNC 2006).
3 Pieces of wood are defined as all wood pieces that are greater than 12 inches in diameter at 25 feet from the large end (TNC 2006).
4 Formazin Nephelometric Units.
5 Maximum weekly maximum temperature: Average of the daily maximum temperatures during the warmest 7-day period of the year.

4.2 Broad-Sense Restoration

Once SONCC coho salmon is delisted, returning wild coho salmon spawners may number in the tens of thousands, but may not be numerous enough to maximize all available spawning habitat throughout the ESU. Many streams may remain unoccupied by coho salmon. Tens of thousands of fish may not be enough to maintain a fishery. Cultural, economic, and ecological benefits of having numerous coho salmon spawning throughout the ESU are not maximized under a scenario where only delisting is achieved. While the delisting criteria need to be specific and measurable, broad-sense restoration is open-ended.

The recovery objectives and criteria define which populations must be at low risk of extinction to delist, but other populations have the potential to achieve a low risk of extinction as well. Broad-sense restoration means maximizing the viability of all populations. The goal of broad-sense restoration is to achieve a low risk of extinction for all independent populations in the SONCC, both core and non-core populations. Broad sense restoration is a long-term goal. Enhancing the abundance, spatial structure, diversity and productivity of the non-core and dependent populations beyond the recovery objectives and criteria is not required. However, doing so would increase resiliency of SONCC coho salmon, with associated opportunities for cultural, economic, and ecological benefits.

All 39 populations of SONCC coho salmon have a profile that summarizes available scientific data and other pertinent information, including the stresses (limiting factors) and threats affecting that population. These population profiles help guide restoration and recovery efforts for coho salmon and their habitats. Not only are the population profiles useful for guiding recovery, but they are also available for stakeholders to use to implement broad-sense restoration. The recovery action table in each profile includes actions needed for each population to contribute to ESU viability. Implementing recovery actions that are necessary to provide for recovery of the species/ESU (i.e., actions with priorities 1-3) pertain to the delisting criteria. Implementing all recommended actions (i.e., non-prioritized actions [NA]) in addition to the actions necessary to provide for recovery of the species/ESU would facilitate broad-sense restoration.

4.2.1 Oregon's Broad-Sense Recovery Goal

Oregon's broad sense recovery goal is to achieve populations of naturally produced salmon and steelhead which are sufficiently abundant, productive, and diverse (in terms of life histories and geographic distribution) that the ESU as a whole (a) will be self-sustaining, and (b) will provide significant ecological, cultural, and economic benefits.

This recovery goal was developed under Oregon's native fish conservation policy (ODFW 2003b) to fulfill the mission of the Oregon Plan for Salmon and Watersheds (State of Oregon 1997). The Oregon Plan for Salmon and Watersheds is founded on the principle that citizens throughout the region value and enjoy the substantial ecological, cultural and economic benefits that derive from having healthy, diverse populations of salmon and steelhead. The goal is consistent with ESA delisting but is designed to achieve a level of performance for the ESU and its constituent populations that is more robust than needed to remove the ESU from ESA protection. Broad-sense recovery incorporates ESA delisting goals in the sense that ESA delisting goals would be achieved first during an extended and stepwise process of achieving broad sense recovery goals.

Oregon's broad-sense recovery goal for the SONCC coho salmon ESU has not yet been agreed upon by a public advisory committee. The goal described above was developed for other recovery plans in Oregon and will be used as a placeholder until a public advisory committee has been formed and provided guidance on the broad-sense goal for Oregon SONCC coho populations.

Oregon's broad-sense recovery goal is consistent with one of the goals in the State of California's Recovery Strategy for California Coho Salmon (CDFG 2004). Goal VI of that plan reads: "Reach and maintain coho salmon population levels to allow for the resumption of Tribal, recreational, and commercial fisheries for coho salmon in California."

4.2.2 Oregon's Broad Sense Recovery Criteria

The State of Oregon developed broad-sense criteria that go beyond the criteria for ESU delisting. These broad-sense criteria are designed to attain population goals that will provide significant ecological, cultural, and economic benefits consistent with the Oregon Plan (State of Oregon 1997).

Oregon's broad-sense recovery criteria are:

• All SONCC coho salmon populations have a "very low" extinction risk and are "highly viable"[1] over 100 years throughout their historic range; and

• The majority of SONCC coho salmon populations are capable of contributing social, cultural, economic and aesthetic benefits on a regular and sustainable basis.

[1] Having a "very low" extinction risk is equivalent to being "highly viable" in the parlance of population status assessment for recovery plans. A "highly viable" naturally-producing salmonid population with a "very low" extinction risk has less than a 1% probability of extinction over a 100-year period, corresponding to at least a 99% persistence probability. Probabilities result from an integrated assessment of the population's abundance, productivity, spatial structure, and diversity statuses

5. Monitoring and Adaptive Management

Monitoring is necessary to assess recovery of coho salmon by determining if specific recovery criteria are met. Monitoring coho salmon and their habitat will provide data on the viable salmonid population (VSP) parameters (i.e., abundance, distribution, diversity, and productivity) and the severity of limiting factors (stresses) and threats (Crawford and Rumsey 2011). Adaptive management elements will provide a feedback loop for continuous scientific evaluation of the monitoring, recovery actions, and restoration elements of this recovery plan. Both monitoring and implementation of on the ground recovery actions must be flexible to changes in the environment, status of populations, new research results, and technological advances. Adaptive management will facilitate the use of the best available information to make appropriate adjustments.

Methods for collection of the adult and juvenile coho salmon data are described in Adams et al. (2011) (for California) and Stevens (2002) (for Oregon). Methods for assessing coho salmon habitat in Oregon are described in Rodgers et al. (2005). These documents describe the ability to characterize coho salmon and its habitat at different spatial scales. For the purposes of describing SONCC coho salmon and its habitat, the spatial scale to be characterized is the population. Sampling to achieve a coarser spatial scale (e.g., diversity stratum) would not provide the information needed to assess the status and trends of SONCC coho salmon. In addition, a minimum ability to detect change with a minimal certainty is required (Chapter 4); for example, spawner abundance estimates should achieve a coefficient of variation (CV) of 15% or less at the population level (Crawford and Rumsey 2011).

5.1.1 Information needed to delist a species

Evaluating a species for potential de-listing requires an explicit analysis of both the population or demographic parameters (the biological recovery criteria) and the physical or biological conditions that affect the species' continued existence, categorized under the five ESA listing factors in ESA section 4(a)(1) (listing factor or "threats" criteria). Together these make up the "objective, measurable criteria" required under the ESA (NMFS 2007b). Chapter 4 describes the objective, measurable criteria by which NMFS will determine whether the SONCC coho salmon ESU should be removed from the list of threatened and endangered species. Specifically, the information needed to assess the biological recovery criteria are detailed in Tables 4-1 and 4-2 of Chapter 4. The information needed to assess the limiting factor (stress) and threat abatement criteria are described in Tables 4-4 and 4-5 of Chapter 4. Information on the status of the VSP parameters and the status of the threats and listing factors (which include stresses) will be considered as part of NMFS' listing status decision framework, as shown in Figure 5-1.

NMFS ultimately bases a decision to de-list an ESU on a determination that it is no longer in danger of extinction or likely to become endangered in the foreseeable future. This determination must be based on an evaluation of both the ESU's status and the extent to which the threats facing the ESU have been addressed. The decision framework is designed to elicit the information needed to meet the statutory and regulatory requirements for de-listing (NMFS 2007b). NMFS recommends the monitoring described in this chapter to obtain the necessary information to evaluate the listing status of SONCC coho salmon. Other means to obtain this information may also be appropriate.

Monitoring Parameters of Viable Salmonid Populations (VSP)

Monitoring spawner abundance, juvenile distribution, diversity, and productivity is essential for assessing progress towards recovery, as well as tracking the status of SONCC coho salmon after delisting. Recovery-based monitoring should occur in four phases: initial, intermediate, delisting, and post-delisting. Sampling intensity should increase incrementally from the initial and intermediate phases to the delisting phase. The delisting phase monitoring data will be used to determine whether the delisting criteria are met. Monitoring needs are described for each population in Table 5-4 and Table 5-5.

The initial phase should begin as soon as possible in order to increase our understanding of the status of core populations within the ESU, and continue until the intermediate phase is triggered. Specifically, the intermediate phase may begin when the 12-year geometric mean abundance of approximately 50 percent of the core populations with life-cycle-monitoring (LCM) stations meet the low risk spawner threshold (e.g., 4 out of 7 populations meet the low risk spawner threshold). Alternatively, the intermediate phase may begin when the 12-year geometric mean abundance in all seven populations with LCM stations is at least 50 percent of the low risk spawner threshold for those populations. Use of a 12-year period is based on NMFS guidance (Crawford and Rumsey 2011). The delisting phase may begin when the 12-year geometric mean abundance of approximately 90 percent of the core populations meets the low risk spawner threshold (e.g., 16 out of 18 core populations meet their low risk spawner requirement; Chapter 4). Alternatively, the delisting phase could begin when the 12-year geometric mean abundance in all 18 populations with LCM stations is at least 90 percent of the low risk spawner threshold for those populations. The post-delisting phase may begin when the SONCC coho salmon ESU is delisted. All monitoring of adult and juvenile coho salmon should strive for an average coefficient of variation (CV) of 15 percent or less at the population level and should strive to detect a 15 percent change with 80 percent certainty (i.e., have high statistical power; Crawford and Rumsey 2011).

Life Cycle Monitoring Stations

Life Cycle Monitoring (LCM) stations are places where smolt and adult abundance are monitored. LCM stations are an integral component of monitoring for SONCC coho salmon. LCM stations can be used to: (1) estimate abundance of adult coho salmon and downstream migrating juveniles; (2) estimate marine and freshwater survival rates; and (3) track abundance of juveniles coincident with habitat modifications. These stations should be located and designed for complete counts of smolts and adults using weirs, fences, traps, live mark/recapture techniques, sonar, or other techniques. Adult counts may be used to calibrate spawning ground surveys used to estimate live adult abundance, redd abundance, and carcass abundance for the "abundance" VSP parameter. One LCM station should be monitored in each diversity stratum so that a regional estimate of freshwater survival is available for every diversity stratum, and a regional estimate of marine survival is available for every coastal diversity stratum.

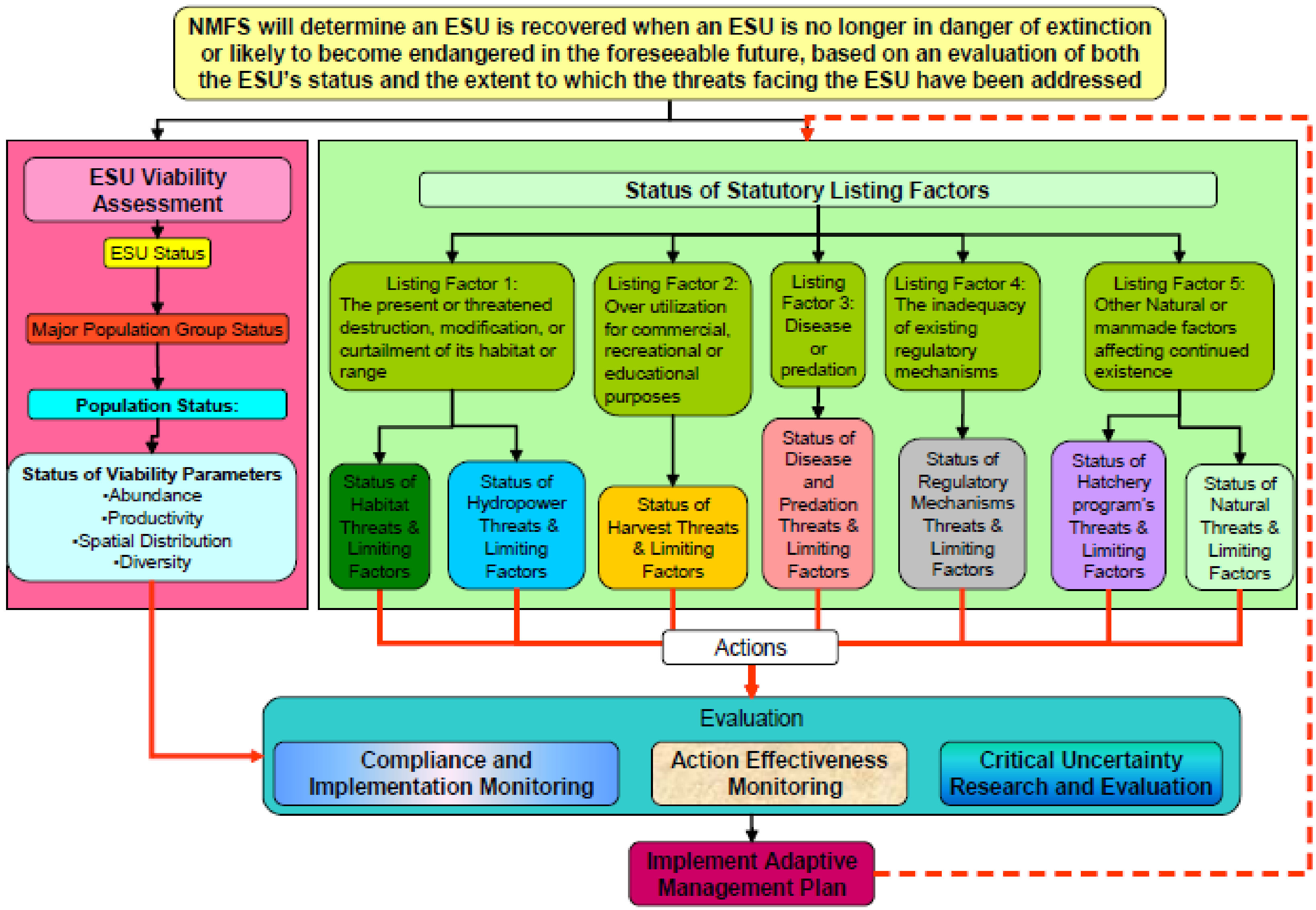


Figure 5-1. NMFS listing status decision framework. Figure taken from NMFS (2007).

Given the amount of data to be collected at LCM stations, they may serve as the focal point for evaluating the status of SONCC coho salmon populations and restoration efforts, as well as encouraging further research. LCM stations in close proximity to the ocean can be used to determine marine survival. Large rivers may not be appropriate or feasible locations for LCM stations if all coho salmon adults cannot be counted, smolt trapping efficiencies are low, or flows are too high or unsafe for operation. Alternatively, an LMC station could be established on a tributary of a large river. LCM stations are likely to be located opportunistically and at existing counting stations within each stratum. Adams et al. (2011) describes LCM stations. One LCM, located in a core population, is needed for each diversity stratum in the SONCC coho salmon ESU.

Initial Phase

During the initial phase, the number of coho salmon spawners and juveniles should be estimated or counted each year at each LCM (as described in Adams et al. 2011 and Stevens 2002). Juvenile occupancy surveys should be carried out in all independent populations without an LCM (with the exception of non-core 2 populations). Occupancy surveys will alternate with periods of 3 years on, three years off, to determine the percent of the area occupied by juveniles. Occupancy surveys allow tracking of the spatial distribution of fish at the population scale, which could be used as a surrogate for population abundance and productivity if direct monitoring of population abundance and productivity is prohibitively expensive. Joseph et al. (2006) evaluated the probability of detection between occupancy versus abundance monitoring for detecting trends under financial constraints. Their simulations suggest abundance monitoring is most effective when the target species is abundant; otherwise occupancy was best. Furthermore, they suggest when surveyors target a species that is cryptic or occurs in low-densities, leading to low observation probability, occupancy surveys should be considered over abundance surveys when financial resources are limited (Joseph et al. 2006).

Table 5-1. Sampling strategy for the initial phase of recovery monitoring.

Population Type	Monitoring Goal	Purpose	Potential Method(s)
Core with Life Cycle Monitoring (LCM) Station	Estimate annual number of wild/natural spawners	Determine population status	Total counts, mark/recapture, or spawner surveys[1] conducted in a spatially balanced probabilistic sampling design. Sampling would be limited to those areas accessible to coho salmon and would occur each year in each population.
	Estimate annual smolt abundance	Assess freshwater productivity	LCM stations in one core population per diversity stratum.
	Estimate annual marine survival	Assess influence of marine survival on coastal population's abundance	Divide smolt data by spawner abundance data, or determine PIT tag recovery ratios at each coastal[2] LCM station. If necessary, use recaptures of hatchery fish.
	Estimate migration timing, age structure, size, and behavior	Determine degree of population diversity	In LCMs, utilize data from weir counts, spawner surveys, and outmigrant traps.
	Estimate natural/hatchery ratio on spawning grounds	Determine degree of hatchery influence on spawners to assess overall genetic diversity	Weir counts, spawner surveys
Independent (except Non-Core 2) without LCM	Estimate juvenile occupancy	Track the population abundance, productivity, and spatial distribution (using juvenile presence as a surrogate)	Juvenile occupancy surveys (% area occupied) of three consecutive year classes every other generation
Dependent and Non-Core 2 Independent	None	None	None

[1] Calibrated by annual spawner: redd ratios from nearest LCM station in that diversity stratum (Gallagher et al. 2010a).
[2] Only coastal LCM stations would be used to estimate annual marine survival. Fish migrating from the ocean to inland LCM stations must migrate through miles of river before they reach the inland LCM stations, and the effect of this migration through inland areas would confound estimates of marine survival.

Intermediate Phase

During the intermediate phase of monitoring, the number of coho salmon spawners in each core population should be estimated each year. Spawner abundance in non-core 1 populations should also be tracked over time to detect trends and progress toward spawner abundance targets. Estimates of adult abundance can be very expensive because they often involve repeated, frequent surveys of the same area, or continual operation of counting weirs or stations. To reduce expense, the status of non-core independent populations may be monitored using redd counts, DIDSON units, or adult abundance surveys (Table 5-2) during every other generation for all 3 year classes (e.g., an interval of three consecutive years of monitoring followed by a break the next three years). Occupancy surveys will document the percent of the accessible area in each population that is occupied, and the trend in this indicator will reveal whether the spatial structure is improving. Spawner abundance surveys or redd counts are needed to detect when coho salmon spawner abundance approaches the numeric criteria, triggering the delisting phase. These surveys yield more detailed information than occupancy surveys. Redd counts provide reliable indices of spawner abundance during the intermediate phase. At low abundance, Gallagher et al. (2010a) found that coho salmon redd counts in Mendocino County, CA tributaries, when converted to spawner numbers using spawner to redd ratios, were statistically and operationally similar to live-fish capture-recapture estimates, cost effective, and less intrusive. In addition, Gallagher et al. (2010b) found that redd counts were not statistically different between the 10 percent random sampling design and total redd counts. The adult escapements estimated from the 10 percent GRTS (Generalized Random Tessellation Stratified) sampling were not statistically different than intensively surveyed methods (Gallagher et al. 2010b).

Table 5-2. Sampling strategy for the intermediate phase of recovery monitoring.

Population Type	Monitoring Goal	Purpose	Potential Method(s)
Core	Estimate annual number of wild/natural spawners in each population	Determine population status	Total counts, mark/recapture, or spawner surveys[1]
	Estimate annual natural/hatchery ratio on spawning grounds	Determine degree of hatchery influence on spawner population to assess overall genetic diversity	Hatchery data; weir counts, spawner surveys
Core with LCM	Estimate annual number of wild/natural spawners	Determine population status	Total counts, mark/recapture, redd counts, or spawner surveys[1]
	Estimate annual smolt abundance	Assess freshwater productivity	Life cycle monitoring (LCM) stations in one core population per diversity stratum.
	Estimate annual marine survival	Assess influence of marine survival on coastal population's abundance	Divide smolt with spawner abundance data, or PIT tag recovery ratios at each coastal LCM station. If necessary, use recaptures of hatchery fish.
	Estimate annual migration timing, age structure, size, and behavior	Determine degree of population diversity	In LCMs, utilize data from weir counts, spawner surveys, and outmigrant traps.
	Estimate annual natural/hatchery ratio on spawning grounds	Determine degree of hatchery influence on spawner population to assess overall genetic diversity	Hatchery data; weir counts, spawner surveys
Non-Core 1	Estimate annual juvenile occupancy	Track the population abundance, productivity, and spatial distribution (using juvenile presence as a surrogate)	Juvenile occupancy surveys (% area occupied) and density of three consecutive year classes every other generation
Dependent and Non-Core 2	None	None	None

[1] Calibrated by annual spawner: redd ratios from nearest LCM station in that diversity stratum (Gallagher et al. 2010a).

Delisting Phase

During the delisting phase, spawner, juvenile occupancy, and life history diversity surveys should be carried out in core and non-core 1 populations each year (Table 5-3). All monitoring begun in the initial phase should continue. This intensive sampling is necessary to demonstrate that spawner abundance, spatial distribution, productivity, and diversity meet delisting criteria. If data obtained during the delisting phase indicate that SONCC coho salmon have declined and are no longer near (e.g., within 90 percent of the delisting criteria for spawner abundance) the delisting criteria, monitoring would revert back to the initial or intermediate phase until data indicate that spawner abundance of core populations are approaching delisting criteria again.

Table 5-3. Monitoring population status and trends for the delisting phase.

Population Type	Monitoring Goal	Purpose	Potential Method(s)
Core and Non-Core 1	Estimate annual number of wild/natural spawners	Determine number spawners relative to spawner targets	Total counts, mark/recapture, or spawner surveys[1]
	Estimate annual juvenile occupancy	Track the population abundance, productivity, and spatial distribution (using juvenile presence as a surrogate)	Juvenile occupancy surveys (% area occupied) and density of three consecutive year classes every other generation
Core with LCM	Estimate annual number of wild/natural spawners	Determine number spawners relative to spawner targets	Total counts, mark/recapture, or spawner surveys[1]
	Estimate annual smolt abundance	Assess population productivity, and use smolt numbers to determine marine survival rate	Use smolt numbers from coastal LCMs to determine marine survival rate
	Estimate annual marine survival	Assess influence of marine survival on abundance of coastal population	Divide smolt with spawner abundance data, or PIT tag recovery ratios at each coastal LCM station. If necessary, use recaptures of hatchery fish. Extrapolate findings to other core populations within each coastal diversity stratum.
	Estimate annual migration timing, age structure, size, and behavior	Determine degree of population diversity	In LCMs, utilize data from weir counts, spawner surveys, and outmigrant traps.
	Estimate wild/hatchery ratio used in hatchery breeding and on spawning grounds	Determine degree of hatchery influence on spawners as way to determine overall genetic diversity	Hatchery data: weir counts, spawner surveys
Dependent and Non-Core 2	Estimate juvenile occupancy	Track the population abundance, productivity, and spatial distribution (using juvenile presence as a surrogate)	Juvenile occupancy surveys (% area occupied) and density of three consecutive year classes every other generation, in a spatially balanced random sampling design.

Post-delisting Phase

After SONCC coho salmon are delisted, post-delisting monitoring of SONCC coho salmon should continue with the same intensity as the delisting phase for another 12 years to assess whether SONCC coho salmon can continue to be viable without the protection of the Endangered Species Act. The results of the 12 years of post-delisting monitoring will guide decisions on the monitoring intensity for future years.

Table 5-4. Monitoring actions for each population in the coastal diversity strata.

Coastal Diversity Strata	Population (Location)	Initial Phase	Intermediate Phase	De-Listing Phase	Post De-Listing Phase
N. Coastal	Chetco River[C, LCM]	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D
	Winchuck River[NC1]	J	J	A	A
	Elk River[C, LCM]	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D
	Lower Rogue[NC1]	J	J	A	A
	Dependent Populations			J	J
C. Coastal	Lower Klamath[C, LCM]	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D
	Redwood Creek[C, LCM]	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D
	Mad River[NC1]	J	J	A	A
	Smith River[C, LCM]	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D
	Little River[NC1]	J	J	A	A
	Dependent Populations			J	J
S. Coastal	Humboldt Bay Tributaries[C, LCM]	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D
	Lower Eel/Van Duzen[C, LCM]	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D
	Mattole River[NC1]	J	J	A	A
	Bear River[NC2]			J	J
	Dependent Populations			J	J

A = Estimate adult abundance
J = Estimate juvenile occupancy (at non-LCM sites)
S = Estimate smolt abundance (at selected LCM sites)
M = Estimate marine survival (at selected LCM sites)
D = Track life history and genetic diversity (at selected LCM sites)

C = Core
LCM = Candidate for life cycle monitoring (LCM) station
NC1 = Non-Core 1
NC2 = Non-Core 2

Table 5-5. Monitoring actions for each population in the interior diversity strata.

Interior Diversity Strata	Population	Initial Phase	Intermediate Phase	De-Listing Phase	Post De-Listing Phase
Interior Rogue	Illinois River[C, LCM]	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D
	Upper Rogue River[C, LCM]	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D
	Middle Rogue/Applegate[NC1]	J	J	A	A
Interior Klamath	Upper Klamath River[C, LCM]	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D
	Shasta River[C, LCM]	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D
	Scott River[C, LCM]	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D
	Salmon River[NC1]	J	J	A	A
	Middle Klamath River[NC1]	J	J	A	A
Interior Trinity	South Fork Trinity River[NC1]	J	J	A	A
	Upper Trinity River[C, LCM]	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D
	Lower Trinity River[C, LCM]	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D
Interior Eel	South Fork Eel River[C, LCM]	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D
	Middle Mainstem Eel[C, LCM]	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D
	Mainstem Eel River[C, LCM]	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D	A, J, S, M, D
	Upper Mainstem Eel River[NC2]			J	J
	Middle Fork Eel River[NC2]			J	J

A = Estimate adult abundance
J = Estimate juvenile occupancy (at non-LCM sites)
S = Estimate smolt abundance (at selected LCM sites)
M = Estimate marine survival (at selected LCM sites)
D = Track life history and genetic diversity (at selected LCM sites)

C = Core
LCM = Candidate for life cycle monitoring (LCM) station
NC1 = Non-Core 1
NC2 = Non-Core 2

5.1.2 Limiting Factor (Stress) and Threat Monitoring

In order to achieve recovery and delisting, the limiting factors (stresses) and threats faced by coho salmon populations in the ESU must be sufficiently abated to facilitate the long term sustainability of the coho salmon. The objectives for limiting factors (stresses) and threats abatement are as follows: (1) the limiting factors (stresses) currently affecting SONCC coho salmon have been sufficiently abated in target areas and (2) the threats identified at the time of listing, as well as any new threats, have been sufficiently removed or abated in target areas. Target areas are those areas which will produce the numbers of adults or juvenile occupancy needed to meet biological recovery criteria for each population. Target areas have not yet been determined. These areas will be identified for each watershed after the comprehensive habitat survey in each watershed occurs. Monitoring can gauge progress toward meeting the stress and threat objectives. Table 5-6 describes monitoring to assess the status of limiting factors (stresses) and threats. Monitoring needs for limiting factors (stresses) and threats are described for each population in Table 5-7 and Table 5-8.

Annual, as opposed to less frequent, monitoring is recommended for those limiting factors (stresses) for which resultant habitat conditions are expected to change rapidly, or for which direct coho salmon mortality is possible. Indicators for barriers (due to sediment, dry areas, or temperature), altered hydrologic function, adverse fishery-related effects, increased disease, predation, and competition, and adverse hatchery-related effects should be monitored annually for populations that rated high or very high for these limiting factors (stresses) and threats (Table 5-6). For other limiting factors (stresses), an initial, comprehensive field-based habitat survey should be carried out for all populations (except ephemeral) as soon as possible (Table 5-6). The purpose of these surveys is to describe the current habitat conditions in each population area. The surveys should be followed by monitoring of indicators related to those limiting factors (stresses) ranked high or very high for each population. For core and non-core 1 populations, such indicators should be monitored every 10 years beginning after the initial habitat survey (Table 5-6). For non-core 2 and dependent populations, such indicators should be monitored every 15 years beginning after the initial habitat survey (Table 5-6). Monitoring needs for limiting factors (stresses) are described for each population in Table 5-7 (for coastal diversity strata) and Table 5-8 (for interior diversity strata).

Table 5-6. Monitoring for limiting factor (stress) assessment, with associated listing factors.

Listing Factor	Limiting Factor (Stress)	Monitoring
A: The present or threatened destruction, modification, or curtailment of the species' habitat or range	Lack of Floodplain and Channel Structure Altered Sediment Supply Impaired Water Quality Degraded Riparian Forest Condition Impaired Estuarine Function[3]	<u>Core and Non-Core 1 Independent populations</u>: The first habitat monitoring should be comprehensive and occur as soon as possible in both freshwater and estuarine (if applicable) habitat. After the first habitat monitoring is complete[2], habitat indicators for the applicable limiting factors (stresses)[1] should be monitored every 10 years. <u>Dependent and Non-core 2 Independent populations)</u>: The first habitat monitoring should be comprehensive and occur as soon as possible in both freshwater and estuarine (if applicable) habitat. After the first habitat monitoring is complete[2], habitat indicators for the applicable limiting factors (stresses)[1] should be monitored every 15 years.
	Barriers (due to sediment, dry areas, or high temperature)	Annually monitor the extent of barriers due to sediment or seasonally dry areas in independent populations where such barriers are identified as a *high* or *very high* stress.
	Altered Hydrologic Function	Annually monitor the hydrograph, where appropriate, in independent populations where altered hydrologic function is identified as a *high* or *very high* stress.
B: Overutilization for commercial, recreational, scientific, or educational purposes	Adverse Fishery-Related Effects	Annually estimate the commercial and recreational ocean fisheries bycatch and mortality rate for wild SONCC coho salmon. Annually estimate the in-river bycatch and tribal harvest for all rivers and streams in the SONCC domain.

Listing Factor	Limiting Factor (Stress)	Monitoring
C: Disease or predation	Increased Disease/Predation/Competition	Annually estimate the infection and mortality rate of juvenile coho salmon from pathogens, such as *Ceratomyxa shasta*, in independent populations where diseases are identified as a *high* or *very high* limiting factor (stress).
C: Disease or predation	Increased Disease/Predation/Competition	Annually estimate the density of non-native predators, such as the Sacramento pikeminnow in the Eel River basin, in independent populations where predation is identified as a *high* or *very high* limiting factor (stress).
D: The inadequacy of existing regulatory mechanisms	Adverse Hatchery-Related Effects	Annually determine the percent of hatchery origin spawners (PHOS) in independent populations where hatchery effects are a *high* or *very high* limiting factor (stress).
E: Other natural or manmade factors affecting the species' continued existence	Climate Change	Refer to monitoring associated with Impaired Hydrologic Function and Water Quality.
[1] A list of habitat indicators is presented in Chapter 4. [2] The first habitat monitoring should be comprehensive and occur as soon as possible, while subsequent monitoring (e.g., every 10-15 years) should use a spatially balanced probabilistic sampling design. [3] NMFS has no recommendation regarding the habitat parameters to be measured in estuaries. A recovery action to identify the appropriate estuarine parameters is included for each population where such monitoring is needed.		

Table 5-7. Limiting factor (stress) monitoring actions for each population in the coastal diversity strata.

	Northern Coastal Basins					Central Coastal Basins						Southern Coastal Basins				
Monitoring Action: Track indicators related to:	Chetco River **C**	Winchuck **NC1**	Elk River **C**	Lower Rogue **NC1**	Dependent Populations	Lower Klamath **C**	Redwood Creek **C**	Mad River **NC1**	Smith River **C**	Little River **NC1**	Dependent Populations	Humboldt Bay Tributaries **C**	Lower Eel/Van Duzen **C**	Mattole River **NC1**	Bear River **NC2**	Dependent Populations
Spawning, rearing, and migration	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Lack of Floodplain and Channel Structure	3	3	3	3	4	3	3	3	3	3	4	3	3	3	4	
Degraded Riparian Forest Conditions	3	3	3	3	4	3	3	3		3	4	3	3	3	4	
Altered Sediment Supply		3		3	4	3	3	3		3	4	3	3	3	4	4
Impaired Water Quality	3	3	3	3	4		3	3	3		4	3	3	3	4	
Impaired Hydrologic Function	2	2	2		4	2								2		
Impaired Estuarine Function	3			3	4	3	3	3	3		4	3	3	3	4	
Adverse Fishery-Related Effects				2		2										
Adverse Hatchery-Related Effects																
Disease/Predation/Competition													2			
Barriers									3		4	3				

[1] Conduct initial comprehensive habitat survey.
[2] Monitor every year.
[3] Monitor applicable habitat indicators every ten years, to begin after initial comprehensive habitat survey completed.
[4] Monitor applicable habitat indicators every fifteen years, to begin after initial comprehensive habitat survey completed.

C = core population
NC1 = non-core 1 population
NC2 = non-core 2 population

Table 5-8. Limiting factor (stress) monitoring actions for each population in the interior diversity strata.

	Interior Rogue			**Interior Klamath**					**Interior Trinity**			**Interior Eel**				
Monitoring Action: Track indicators related to:	Illinois River **C**	Upper Rogue **C**	Middle Rogue/ Applegate **NC1**	Upper Klamath **C**	Shasta River **C**	Scott River **C**	Salmon River **NC1**	Middle Klamath **NC1**	South Fork Trinity **NC1**	Upper Trinity **C**	Lower Trinity **C**	South Fork Eel River **C**	Middle Mainstem Eel **C**	Mainstem Eel **C**	Upper Mainstem Eel **NC2**	Middle Fork Eel **NC2**
Spawning, rearing, and migration	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Lack of Floodplain and Channel Structure	3	3	3	3	3	3		3	3	3	3	3	3	3	3	
Degraded Riparian Forest Conditions	3	3	3	3	3	3	3		3			3	3	3	3	3
Altered Sediment Supply	3	3		3		3		3	3		3	3	3	3	3	3
Impaired Water Quality	3	3	3	3	3	3	3	3	3			3	3		3	
Impaired Hydrologic Function	2	2	2	2	2	2		2	2	2	2	2	2		2	
Impaired Estuarine Function	3	3	3	3	3	3		3								
Adverse Fishery-Related Effects																
Adverse Hatchery Related Effects				2	2				2	2	2					
Disease/ predation/ competition				2	2			2		2		2	2	2	2	2
Barriers	3	3		3				3		3		3			3	

[1] Conduct initial comprehensive habitat survey.
[2] Monitor applicable habitat indicators every year.
[3] Monitor applicable habitat indicators every ten years, to begin after initial comprehensive habitat survey completed.
[4] Monitor applicable habitat indicators every fifteen years, to begin after initial comprehensive habitat survey completed.

C = core population
NC1 = non-core 1 population
NC2 = non-core 2 population

Threat monitoring is described in Table 5-9. NMFS will describe the status and trends of limiting factors (stresses) related to particular threats, along with other identified information, as part of the status review to be completed every five years.

Table 5-9. Monitoring for threats, with associated listing factors.

Listing Factor	Threat	Monitoring
A: The present or threatened destruction, modification, or curtailment of the species' habitat or range	Roads	Evaluate the status and trend of related limiting factors (stresses)[1]. Describe status and trends of road treatments and road density[1].
	Timber harvest	Evaluate the status and trend of related limiting factors (stresses)[1].
	Dams/Diversion Road-Stream Crossing Barriers	Describe status and trends of identified fish passage barriers[1]
	High Intensity Fire	Describe trends in occurrence of high-intensity fire as well as trends in change of related limiting factors (stresses)[1].
	Agricultural Practices	Evaluate the status and trend of related limiting factors (stresses)[1].
	Channelization/Diking	Evaluate the status and trend of related limiting factors (stresses)[1]. Describe new channelization/diking and changes to existing channelization/diking.
	Urban/Residential/Industrial Development	Evaluate the status and trend of related limiting factors (stresses)[1]. Describe new development and changes to existing development.
	Mining/Gravel Extraction	Evaluate the status and trend of related limiting factors (stresses)[1]. Describe any new mining or gravel extraction.
B: Over-utilization for commercial, recreational, scientific or educational purposes	Fishing and Collecting	Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon. Annually estimate the in-river bycatch and tribal harvest for all rivers and streams in SONCC domain.
D: The inadequacy of existing	Hatcheries	Evaluate the status and trend of related limiting factors (stresses)[1]. Describe status of HGMP development and implementation.

Listing Factor	Threat	Monitoring
regulatory mechanisms	Invasive Non-Native Alien Species	Evaluate the status and trend of abundance and occurrence of invasive, non-predatory species that may adversely affect SONCC coho salmon.
E: Other natural or manmade factors affecting the species' continued existence	Climate Change	Evaluate the status and trend of related limiting factors (stresses)[1].
[1] Consult population profiles to determine related limiting factors (stresses) for each population.		

5.2 Adaptive Management

Adaptive management is the process of improving management policies and practices as conditions change. Information is rarely complete and sometimes incorrect. What is known is research, examined and tested, knowledge is extended, and management is adjusted. Adaptive management requires care and consideration both before monitoring (by employing sampling designs that adequately informs decision making) and after monitoring (by using results to improve future conservation efforts). New scientific research may provide information that may warrant adjustments to the recovery plan or implementation.

New scientific research may be a source for adjustment. In addition, adaptive management for this recovery plan relies on additional, proactive elements that track limiting factors of SONCC coho salmon and assess the effectiveness of restoration actions. Ideally, adaptive management guides the implementation of salmon recovery activities through repeated adjustments in strategies and actions, as information from monitoring and evaluation become available. Strategies and actions needed for recovery can evolve as uncertainties in the effectiveness of actions are reduced through monitoring and evaluation. Adaptive management plays a critical role in NMFS' listing status decision framework (Figure 5-1).

5.2.1 Research needs

Research is a foundation of adaptive management. Research can augment existing data and reduce uncertainty related to precision, bias, and assumptions. Additionally, research can reduce uncertainty associated with evaluating population status and trend in future assessments, and will help elucidate what changes in actions or implementation may be needed via the adaptive management framework. Critical uncertainty research verifies the basic assumptions behind effectiveness monitoring and models, prioritization of limiting factors and threats, or any other topic for which assumptions have been made, which if untrue, would significantly alter the actions identified for implementation by the recovery Plan. There are several areas of critical uncertainty research which should be investigated to facilitate SONCC coho salmon recovery. Research needs include:

- Develop techniques to estimate adult abundance in remote areas.
- Evaluate the potential to restore extirpated populations.
- Research supplemental or alternative means to develop population targets.
- Determine best parameters to measure for monitoring estuarine habitat.
- Research supplemental means to delineate populations.
- Determine whether the low-risk threshold abundance target for core populations could be decreased if other VSP parameters are well-estimated.

Specific research needs for particular populations are described in the population profiles and associated recovery actions (Chapters 7 through 45).

5.2.2 Limiting Factors Modeling

Modeling limiting factors may provide insight into what elements of the habitat, or which life stages of coho salmon, are acting as roadblocks to recovery. Models can validate assumptions on which recovery actions are most essential to achieve recovery as well as identify factors which may have been overlooked. As recovery actions are implemented, limiting factors may change. Periodic use of and updates to the limiting factors models that are validated with habitat surveys, may help identify changes in limiting factors to help recovery practitioners to redirect their efforts where they are most needed.

A quantitative limiting factors life cycle model is designed to integrate information about the ecology of the salmon life cycle, the factors that may limit the survival of key life stages and incorporate human activities such as landscape management, habitat rehabilitation, and exploitation. Results of the model can be used to identify additional or reprioritize recovery actions to achieve SONCC coho salmon recovery.

Typically these models associate fish abundance (density) and survival with each habitat type at important life stages. Both carrying capacity and density-independent survival are affected by habitat quantity and quality. Limiting habitat analyses at the basin-level are conducted using this life-stage specific approach. Two potential approaches are simplified limiting factor models and dynamic life cycle models. Both approaches are based on the salmon life cycle, and assess current and historical habitat conditions in a basin to estimate how habitat changes may have altered salmon abundance or survival at different life stages. However, the approaches differ in two main respects. First, each approach emphasizes different parameters driving stage-to-stage survivorship. Simplified limiting factors models focus on changes in capacity at each freshwater life stage and treat density-independent stage-to-stage survival as constants. The dynamic life cycle model incorporates both capacity and survival through the use of stage to stage stock-recruitment relationships and estimates population abundance, or other VSP parameters via iterative simulations.

Such modeling efforts have implications for identifying habitats that may limit recovery of populations. They can provide a transparent framework to: (1) relate habitat to capacity and survival; (2) estimate stage specific abundance from a basin's intrinsic potential; (3) apply knowledge of the current state of the habitat to stage specific capacity, survival and abundance; (4) identify model assumptions and parameters that can dramatically alter predictions of population responses to habitat changes; (5) indicate which life stages may be most sensitive to habitat change regardless of the assumptions about density dependence and therefore shift the focus of restoration efforts; and (6) identify parameter and model uncertainties that substantially alter conclusions about which habitats limit recovery. Such analyses motivate critical research to identify and characterize poorly understood habitats, their effects on salmon abundance and survival, and the extent to which they have been modified.

An example of a simplified limiting factors model for coho salmon in Oregon coastal streams is the Habitat Limiting Factors Model (Nickelson 1998; HLFM v7). This model relies upon habitat typing information to determine total area of the various habitat types. The analyst then multiplies the area of each habitat by habitat-specific coho salmon density to estimate potential abundance. This process is done for each life stage/season using life history-specific density values.

An example of a life cycle model is RIPPLE developed by Stillwater Sciences and UC Berkley (Dietrich and Ligon 2009). RIPPLE couples geomorphic information with biological and aquatic habitat data. RIPPLE uses three sub-models: (1) a physical model that uses GIS-derived values of drainage area and channel slope to predict hydraulic geometry, bed particle size, and channel confinement; (2) a habitat model which uses the output from the physical model to define the quantity of habitat types or capacity of the channel network for different life stages; and (3) a generalized stock production model that defines the relationship between the abundance at one life stage to the abundance at the successive life stages using familiar functions such as Ricker, Beverton-Holt, and hockey stick formulations. The parameters controlling the properties of this stage-to-stage relationship can be derived from critical research, or literature. This portion of the model operates on small portions or "arcs" of the stream network, allowing fish to redistribute seasonally. Analysts are expected to ask questions like "what is the expected population response to increasing the capacity or productivity (survival) of habitat in 'X' portion of the stream?" Additionally, the analyst could compare the abundance of fish at any given stage to the intrinsic potential of the basin and the current status of the habitat within the basin.

5.2.3 Assessing Restoration Actions

The restoration of physical habitat is one of the fundamental strategies used to achieve recovery. Therefore, the effectiveness of certain habitat restoration activities in achieving the desired habitat improvements should be identified, as well as the change or response in coho salmon populations. Three types of monitoring can be employed to evaluate restoration actions: implementation, effectiveness, and validation. Each type serves a unique purpose.

Implementation Monitoring

Implementation monitoring is designed to assess whether restoration projects are carried out as planned (MacDonald et al. 1991), according to the intended purpose and design.

Effectiveness Monitoring

Effectiveness monitoring is used to determine whether restoration actions result in the expected physical effect. For instance, effectiveness monitoring could be used to assess the short-term structural integrity (e.g., instream structure anchoring) and physical objectives (e.g., scouring due to instream structure placement) of implemented restoration actions. Much of this can be done through on-site observations. Effectiveness monitoring of restoration actions has two parts: (1) pre-treatment site characterization for establishing the conditions prior to restoration and (2) post-treatment monitoring to determine if the restoration is having the intended effects.

Validation Monitoring

Validation monitoring is designed to assess whether an anticipated biological response actually occurred. Validation monitoring can range from measuring short-term response (1 to 3 years) of coho salmon to restoration actions implemented at the project level (e.g., successful passage through a former barrier). In addition, validation monitoring may evaluate the long term response of coho salmon populations to the cumulative basin restoration.

Implementation monitoring should occur in conjunction with restoration actions, while effectiveness and validation monitoring will be necessary for certain restoration actions. Many effectiveness or validation monitoring efforts should be undertaken in the same area where intense biological sampling occurs, and could result in an intensively monitored watershed (IMW). Careful planning and implementation of restoration activities within the same areas as LCMs will allow for these analyses to be conducted with little additional costs for status or biological information.

An accurate evaluation of the effectiveness of a restoration action requires a clear statement of the desired effect of the project on the environment. Restoration objectives should be expressed as quantifiable changes in environmental conditions. For example, if installation of an in-stream structure is intended to improve rearing habitat, the desired changes could be expressed in terms of pool frequency, in-stream cover, or some other measurable environmental characteristic. The objectives should be stated as desired outcomes (e.g., 50 percent of reach length in pools). If objectives are vague, it will be difficult to focus the monitoring (Harris et. al 2005).

Detecting a biological response to restoration actions may be difficult, or impossible to discern from other influences. Validation monitoring may be confounded by other potentially limiting factors or variables that are not addressed by the restoration action. Similarly, single project restoration actions may not have enough impact to see a measurable response at the basin scale (MacDonald et al. 1991). Therefore, validation monitoring may be best for restoration actions that result in a quick response to the quality of instream salmonid habitat, such as instream habitat and fish passage improvement projects. Validation monitoring of other restoration actions should occur as part of an IMW. IMWs are used to evaluate assumptions about what should be done to improve habitat and resulting fish response. IMWs also allow evaluation of critical uncertainties for the limiting factors models. Monitoring efforts conducted in IMW may find that using the Before-After-Control-Impact (BACI) approach (Stewart-Oaten et al. 1986) will provide the most useful information to evaluate biological and physical response to restoration activities. BACI study designs are often used to determine if a restoration action had the intended effect. The spatial and temporal scale of both the treatment and response must be carefully considered for this type of design to be informative. For example, a large road decommissioning project may not reduce sediment delivery for a number of years after project implementation. Road decommissioning may have a short term negative effect on sediment delivery. The spatial scale might be considered a reach, stream, or basin while the temporal scale of response might be 10 years or more.

5.2.4 Hypothesis Testing

Ultimately, monitoring should evaluate whether populations or habitat conditions are trending in the right direction, in addition to whether they have met established criteria. Interim hypotheses can be used to assess progress towards meeting recovery criteria, and NMFS identified three such hypotheses (Table 5-10). For example, a hypothesis could seek to answer whether water temperature is cooling in a watershed. Using appropriate time scales are important in testing hypotheses and reaching conclusions based on results. For example, it may require several years, if not decades, before significant changes in many variables would be realized or detected.

Table 5-10. Example hypotheses for assessing population status and limiting factors (stresses) and threats abatement.

Viable Salmonid Population Parameter (Hypothesis 1)	Abundance	Coho salmon adult abundance in population X is increasing.
	Spatial Structure	Coho salmon spatial structure in population X is increasing.
	Productivity	Coho salmon productivity in population X is increasing.
	Diversity	Coho salmon diversity (life history and genetic) in population X is not decreasing.
Stressors (Hypothesis 2)	Habitat indicator condition	The trend in habitat indicator condition is positive (e.g., water temperature is getting cooler).
Threats (Hypothesis 2)	Threat severity	Threat severity is not increasing (e.g., the number of miles of untreated roads per square mile of a basin is not increasing).

Interim hypotheses allow evaluation of the effectiveness of implemented recovery actions. Although the abundance of adult coho salmon is not expected to quickly approach the recovery objectives, monitoring the trends in both fish abundance and the status of the threats and limiting factors (stresses) affecting SONCC coho salmon is important. If recovery efforts do not increase abundance or abate threats, adjustments can be made to the recovery plan and resources can be redirected. Alternatively, adjustments can be made to the restoration action or the perceived limiting factors and life stages.

Having a process in place before recovery efforts are underway will allow adjustments to recovery actions to achieve better results. Figure 5-2 and Figure 5-3 show the decision tree which may be used to determine how well the recovery strategy is functioning in terms of the VSP parameters, limiting factors, limiting life stages, and threat abatement. If the hypothesis testing results indicate that certain selected core populations are not having positive VSP responses, then the selection of core populations may need to be re-visited.

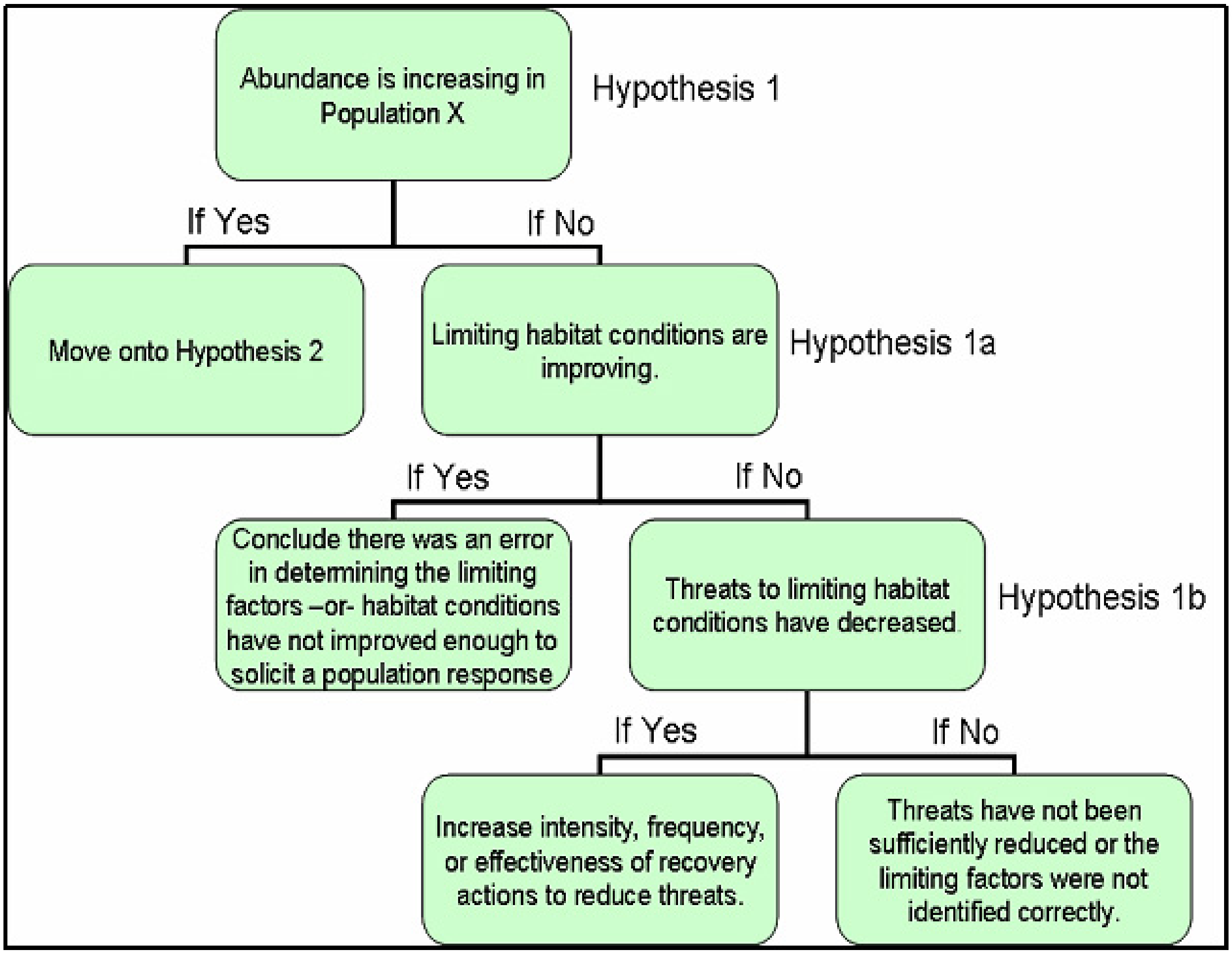


Figure 5-2. Decision tree for the adaptive management process to test hypotheses associated with limiting factors (stresses) and threats.

5.2.5 Database Management

Data on the VSP parameters, limiting factors (stresses) and threats, restoration actions, and other pertinent monitoring and adaptive management elements are expected to be collected into a single, electronic database that will be readily accessible. This database may be created to mimic an existing database. Standards for data collection methods and calculations (for example, population estimates) should be developed with resource agencies and tribes to ensure data quality and consistency.

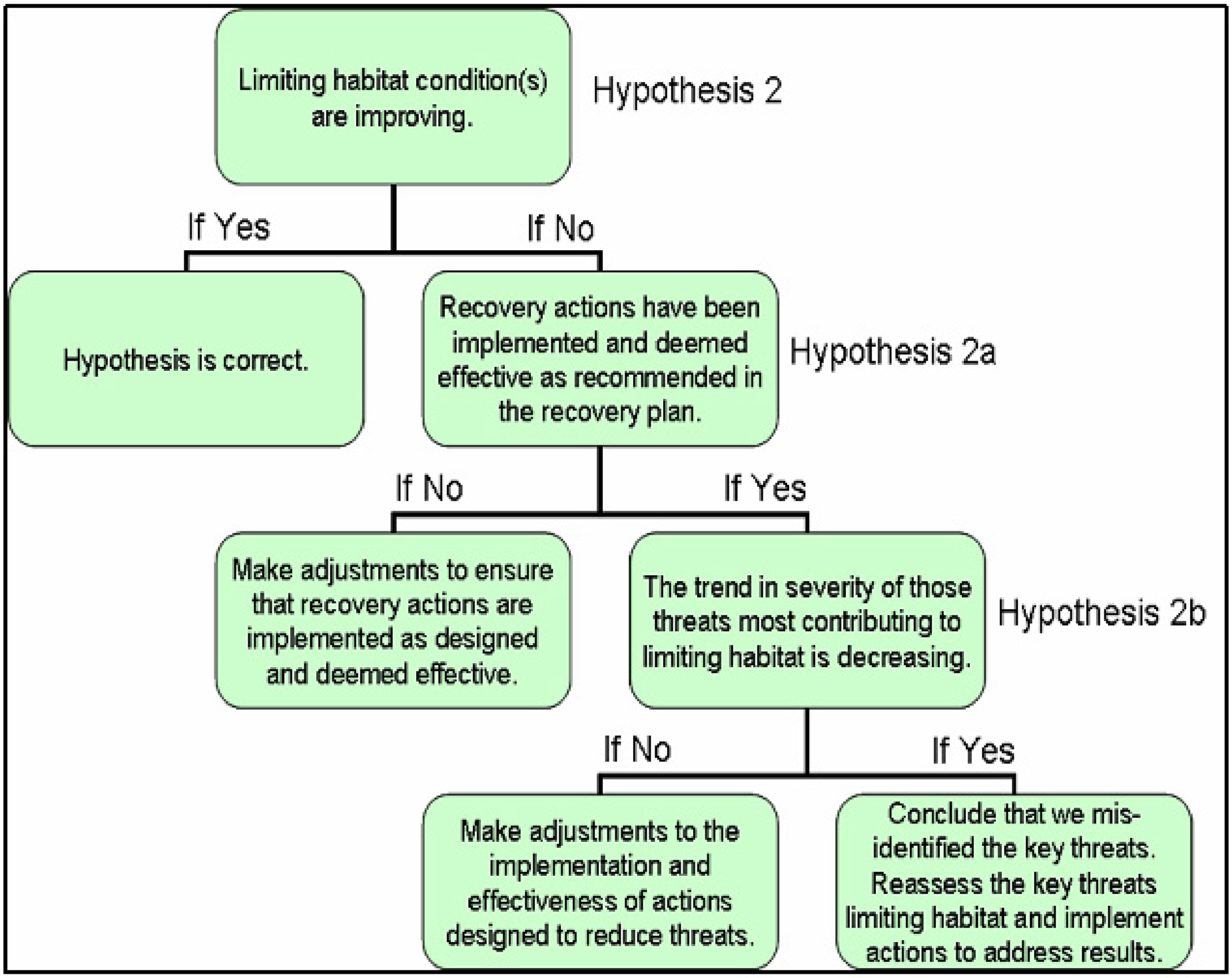


Figure 5-3. Decision tree for the adaptive management process to test hypotheses associated with limiting factors (stresses) and threats.

5.3 Future of the Recovery Plan

This plan was developed based on the information available in 2011. When appropriate, the plan may change to reflect new information as it becomes available. The modeling of limiting factors, monitoring of restoration actions, testing of interim hypotheses, and completion of scientific research are examples of sources of new information which could prompt adjustments to the recovery plan. Adaptive management requires that NMFS be prepared and willing to revise current approaches when new information indicates a revision is necessary.

Status reviews of SONCC coho salmon will occur every five years. Following these status reviews, the recovery plan will be reviewed to determine whether updates would be beneficial.

Status reviews of SONCC coho salmon will occur every five years. Following these status reviews, the recovery plan will be reviewed to determine whether the plan should be updated or revised. Plan updates or revisions may also occur at any time. Details of the plan update and revision process are provided in Section 6.5.

6. Implementation Program

6.1 Conservation Community

The recovery plan is a roadmap to recovery. Voluntary communication, coordination, and collaboration among a wide variety of entities, which could also be called conservation partners. A conservation partner is anyone who has an interest in the recovery of the species. Conservation partners are essential to the implementation of the recovery plan. Conservation partners may be individuals, groups, government or non-government organizations, industry, or tribes who have an interest in the recovery of SONCC coho salmon. Recovery plans are not regulatory documents, and no entity is required by the ESA to implement them. Plans that benefit coho salmon are developed and implemented by many entities. This recovery plan identifies, prioritizes, and ranks recovery actions. NMFS anticipates that conservation partners will choose to participate in implementation of the plan to advance their missions as part of funding and contractual agreements, and as a result of outreach. In fact, there are many examples of recovery actions already underway.

6.2 Recovery Program

6.2.1 ESU Recovery Program

Many recovery actions, and their respective priority, are identified for each population. These actions, combined with criteria previously described, collectively comprise the ESU Recovery Program. Recovery action themes are described below. The seven diversity strata in the SONCC Coho Salmon ESU share stresses and threats which must be resolved for SONCC coho salmon to recover. Recovery actions are designed to both address acute issues, and restore processes which create and maintain coho salmon habitat. Recovery actions should focus on areas where coho salmon currently persist and on unoccupied areas of suitable habitat, to maximize the chance of preserving existing coho salmon. The best available information on coho salmon distribution is described in Chapters 7 through 45.

Flow

Stream flow quantity, quality, and timing are insufficient across much of the ESU. Insufficient flows contribute to problems with water quality in many populations. Instream flow criteria should be established. Flows should be restored, through actions such as reducing the number of diversions, encouraging water conservation, streamlining water leasing and instream dedication processes, and improving timber, grazing, and irrigation practices. The current timing and volume of flow should be assessed in the Eel, Klamath, Trinity, and Rogue Rivers, and dams and diversions should be operated so that the timing and volume of flow better approximates pre-disturbance conditions.

Floodplain and Channel Structure

Floodplain and channel structure is insufficient in every population. Habitat should be reconnected and restored. Large wood or other structure should be added to streams, or recruitment promoted. Off-channel ponds, wetlands, and side channels should be restored or connected to the channel, possibly by reintroducing beavers. Levees and dikes should be removed, set back, or reconfigured and the natural channel form and floodplain connectivity re-established. To reduce fine sediment delivery to streams, roads should be upgraded, maintained, or decommissioned, slopes stabilized, and logging and grazing practices improved. Mature forests should be established along streams to increase the potential for large woody debris by improving timber harvest practices, planting conifers, releasing conifers from competition with hardwoods, and establishing a healthy fire regime.

Estuaries

In coastal basins, estuaries have been disconnected from their floodplains by major highways or levees, drained or filled, or converted to freshwater. Restoration of the hydrologic function of estuaries is necessary to provide tidal habitat used by rearing juvenile coho salmon. The tidal exchange of water should be increased by setting back or removing levees and improving or removing tide gates. Tidal channels, wetlands, sloughs, and the estuary should be connected. Channelized reaches should be restored. Remaining estuarine habitat should be protected from development, dredging, or filling.

Dams

In the Klamath and Trinity rivers, dams block access to large amounts of habitat needed to produce coho salmon. Four dams should be removed from the Upper Klamath River: Iron Gate, Copco 1, Copco 2, and JC Boyle. On the Trinity River, removal of Lewiston Dam should be considered. If habitat above dams becomes accessible, it should be restored.

Hatcheries

The ecological and genetic impacts of fish produced by the Trinity River Hatchery and Iron Gate Hatchery should be reduced. Hatchery genetic management plans should be developed for every hatchery in the ESU.

Some populations of coho salmon are so small that they suffer from effects of low population size which increase the possibility of population extirpation. Enhancement programs such as captive broodstock, rescue rearing, or conservation hatcheries should be considered and, if appropriate, employed to support coho salmon populations in the Mainstem Eel River, Middle Mainstem Eel River, Mattole River, and Shasta River.

Disease and Non-Native Species

A plan to disrupt the life cycle of the C. Shasta parasite should be developed and implemented in the Upper Klamath River. In the Interior Rogue and Interior Klamath strata, a plan to reduce the number of warm-water, non-native fish should be developed and implemented. In the Interior Trinity stratum, brown trout should be eradicated. Throughout the Eel River, Sacramento pikeminnow abundance should be substantially reduced.

Fishing

Fisheries should be managed consistent with recovery of the SONCC coho salmon ESU.

6.2.2 Implementation Schedule

The last table of Chapters 7 through 45 lists the population-specific recovery actions that make up the SONCC coho salmon Recovery Program, including the recovery action number, recovery action step number, objective, recovery action, action step, area, priority, and key limiting factor status. Appendix F lists the recovery action step number, potential lead agency and estimated cost for each action. Together, the tables in Chapters 7 through 45 and Appendix F make up the implementation schedule.

Recovery Action Tables in Population Profiles

The fields in the recovery action tables found in each population profile provides a unique identifier for each recovery action, information about which limiting factor (stress) each action is meant to address, the purpose of the action, the particular action to be completed and the steps needed to complete it, the location where the action should be completed, the priority assigned to each action, and whether the action addresses a key limiting factor.

Recovery Action Number

A unique recovery action number is assigned to every recovery action) to facilitate reference to the recovery action. For example, in the recovery action number SONCC-HBT.2.2, "SONCC" refers to the ESU, "HBT" refers to the population, the first "2" is the strategy ID number (see Table 6-1), and the second "2",refers to the recovery action.

Recovery Action Step Number

The recovery action step number is a unique identifier assigned to each step of a particular recovery action to facilitate reference to a particular recovery action step number. It consists of the Recovery Action Number, with an additional number which refers to the sequential order of the action step (i.e., 1, 2, 3, or 4). For example, in SONCC-HBT.2.2.1, the "1" refers to the action step, in this case the first in a sequence of steps.

Strategy

The strategy is the primary stress the recovery action is designed to address (e.g., the strategy "Sediment" is meant to address the stress "Altered sediment supply"). Table 6-1 shows the stategy ID number, the strategy, and the limiting factor (stress) addressed by that strategy. Note that a recovery action may address more than one stress, and therefore more than one strategy. However, only one strategy is associated with each recovery action in the implementation schedule.

Table 6-1. Limiting factor (stress) addressed by each strategy.

Strategy ID*	Strategy	Limiting Factor (Stress) Addressed
1	Estuary	Impaired Estuarine Function
2	Floodplain and Channel Structure	Lack of Floodplain and Channel Structure

Strategy ID*	Strategy	Limiting Factor (Stress) Addressed
3	Hydrology	Impaired Hydrologic Function
5	Passage	Barriers
7	Riparian	Degraded Riparian Forest Conditions
8	Sediment	Altered Sediment Supply
10	Water Quality	Impaired Water Quality
14	Disease/Predation/Competition	Disease/Predation/Competition
16	Fishing/Collecting	Adverse Fishery-Related Effects
17	Hatcheries	Adverse Hatchery-Related Effects
26	Low Population Dynamics	Not applicable
27	Monitor	Not applicable
*gaps in strategy ID numbers reflect categories not used for SONCC plan but used for other recovery plans in California.		

Objective

The objective describes the purpose of the recovery action: To increase, reduce, or maintain particular characteristics of the stress (e.g., reduce delivery of sediment to streams).

Recovery Action

Action to be completed (e.g., reduce road-stream hydrologic connection).

Action Step

Steps to accomplish action (e.g., assess and prioritize road-stream connection, and identify appropriate treatments to meet objective; decommission roads, guided by assessment).

Area

Location where action should be completed (e.g., all tributaries of the alluvial coastal plain downstream of Rock Creek, Indian Creek, and Bagley Creek, especially the Butler Creek watershed).

Priority

Each recovery action has been assigned a recovery task priority number, which is explained in Section 6.2.3.

Key LF

Some recovery actions address key limiting factors (Key LF), which are those limiting factors (stresses) that have the greatest impact on current population viability. Key LFs are explained in

Section 6.2.3. If a recovery action addresses a Key LF, this field will read “Yes”. If not, it will read “No”.

Appendix F

Recovery Action Step Number

Unique recovery action step identifier. Recovery Action Number, with an additional number which refers to the sequential order of the action step (e.g., 1, 2, 3, or 4). E.g., recovery action number SONCC-HBT.2.2, recovery action step number SONCC-HBT.2.2.1 refers to first recovery action step of that recovery action number). Provided so reader can cross reference information about a particular recovery action between the tables in the profiles and Appendix F.

Potential Lead

The “Potential Lead” is the entity most likely to carry out a recovery action based on its authority, expertise, or other factors. Identification of a candidate “Potential Lead” does not require the identified party to implement an action or to secure funding for such, nor does it preclude any other party from implementing the action or obtaining funds to do so.

5 Year Cost

The 5 year cost is the estimated cost to carry out action in years 1 to 5. The method used to estimate cost is described in Section 6.2.4 and Appendix D.

10 Year Cost

The 10 year cost is the estimated cost to carry out action in years 6 to 10. The method used to estimate cost is described in Section 6.2.4 and Appendix D.

15 Year Cost

The 15 years cost is the estimated cost to carry out action in years 11 to 15. The method used to estimate cost is described in Section 6.2.4 and Appendix D.

20 Year Cost

The 20 year cost is the estimated cost to carry out action for years 16 to 20. The method used to estimate cost is described in Section 6.2.4 and Appendix D.

25 Year Cost

The 25 year cost is the estimated cost to carry out action for years 21 to 25. The method used to estimate cost is described in Section 6.2.4 and Appendix D.

26+ Year Cost

The 26+ year cost is the estimated cost to carry out action for years 26 and after. The method used to estimate cost is described in Section 6.2.4 and Appendix D.

Total Cost

The total cost is the estimated cost to carry out action over all years. The method used to estimate cost is described in Section 6.2.4 and Appendix D.

6.2.3 Guidance for Understanding the Priority and Importance of Recovery Actions

When choosing recovery actions to implement, conservation partners should consider the priority and importance rankings.

Priority rankings

Each recovery action has been assigned a recovery task priority number, based on the criteria described in NMFS' listing and recovery priority guidelines (NMFS 1990) and an added category (BR), meaning the priority is not applicable to the action but the action would address "broad sense" recovery goals (Chapter 4). The recovery action task priority definitions are designed to call out those actions that are necessary to prevent extinction of the ESU or prevent a significant negative impact to the ESU short of extinction. In addition, the priority definitions allow differentiation between those actions which are necessary to provide for full recovery of the ESU versus those which would contribute to broad-sense recovery goals but which are not necessary to provide for ESA recovery of the ESU.

Table 6-2. Recovery action task priority definitions.

Priority	Type of Task
1	Actions that must be taken to prevent extinction [of the ESU] or to identify those actions necessary to prevent extinction [of the ESU].
2	Actions that must be taken to prevent a significant decline1 in population numbers, habitat quality2 or in some other significant negative impact short of extinction [of the ESU].
3	All other actions necessary to provide for full recovery of the species/ESU.
BR	Actions which are not necessary to provide for ESA recovery of the ESU, but which would contribute to broad-sense recovery (BR) goals.

[1] NMFS SWR defined "actions that must be taken to prevent a significant decline" as those that: prevent loss of one or more year classes; prevent abundance from falling below the depensation threshold; prevent take of coho salmon; prevent loss of a critical life history requirement (e.g., summer rearing habitat, migratory habitat); reduce a limiting stress; reduce a critically important threat; or prevent the loss of occupied habitat.

[2] Significant declines [in habitat quality]' is defined as the elimination of habitat to the point where thepopulation area does not support all life stages.

None of the recovery actions described in this plan is assigned a Priority 1. This is consistent with NMFS guidance: "It should be noted that even the highest priority tasks within a plan are not given a Priority 1 ranking unless they are actions necessary to prevent a species from becoming extinct or to identify those actions necessary to prevent extinction. Therefore, some plans will not have any Priority 1 tasks (NMFS 1990)."

The recovery task prioritization system is part of a larger system used by NMFS to prioritize recovery actions across ESUs and DPSs so that "…the most critical activities for each listed species can be identified and evaluated against other species recovery actions. This system recognizes the need to work toward the recovery of all listed species (NMFS 1990)." NMFS guidelines state "…these priority systems are guidelines and should not be interpreted as inflexible frameworks for making final decisions on funding or on performance of tasks. They will be given considerable weight by the agency in making decisions; however, the agency will also evaluate the cost-effectiveness of funding and tasks and take advantage of opportunities. For example, the agency may be able to conduct a relatively low priority item in conjunction with an ongoing activity at little cost." To provide NMFS and other conservation partners with other considerations when choosing which recovery actions to implement, the "Importance Ranking" was developed.

Importance Rankings

Several factors are combined in the importance ranking: The priority of the action, whether the action addresses a key limiting factor, and whether the population is at high risk of extinction.

Priority

The extent to which an action prevents extinction or a significant decline is described by the priority system as described above, which is used to assign a priority 1, 2, 3, or BR to every action.

Key Limiting Factor

This plan uses the terms "limiting factor" and "stress" interchangeably. Key limiting factors (Key LF) are those limiting factors that have the greatest impact on current population viability.

Population Size Relative to Depensation Threshold

Some populations are at high risk of extirpation because they are below the depensation threshold. Conservation partners should consider the current biological status of a population, specifically whether it is extirpated and whether it is above or below the depensation threshold, when funding and implementing recovery actions. The current status of each population is described in Chapters 7 through 45, and more recent information available after the recovery plan is finalized could also be used. Populations that are not extirpated but are below the depensation threshold are at high risk of extinction and in more need of recovery actions to restore the population and its habitat than populations that are above the depensation threshold. The Importance Ranking of a recovery action considers the extinction risk of the benefiting population, whether the action would best address a Key LF, and the priority of the action.

Importance Ranking

Actions of Primary Importance (API):

Priority 1 (see column N in Implementation schedule).

OR

Priority 2 or 3

AND

Would benefit a population with a current number of spawners greater than zero but less than or equal to the depensation threshold

AND

Would address one or more key limiting factors.

Actions of Secondary Importance (ASI):

Priority 2 or 3

AND

Would benefit a population with a current number of spawners greater than the depensation threshold

AND

Would address one or more key limiting factors.

Actions of Tertiary Importance (ATI):

Priority 2 or 3

AND

Would benefit a population with a current number of spawners greater than zero but less than the depensation threshold (see population profile, Chapters 7 through 45, for more current information)

AND

Would not address a key limiting factor.

Action of Quaternary Importance (AQI):

Priority 2 or 3

AND

Would benefit a population with any number of spawners, including zero.

6.2.4 Cost

Cost is estimated for all recovery actions (Appendix F). The method used to calculate cost is described in Appendix D, and the cost of actions rated priority 1, 2, or 3 is explained in Appendix F. No cost was estimated for actions rated priority BR. Cost is estimated in accordance with the year the action would occur relative to when implementation of this plan begins (year 1). Costs are broken into five-year increments (i.e., 1-5, 6-10, 11-15, 16-20, and 21-25) except for the last category, 26+, which includes cost after year 25. The calculation of cost estimates does not imply funding availability. The cost of SONCC coho salmon recovery actions is presented by population and diversity stratum in Table 6-3.

Table 6-3. Summary of estimated cost of recovery actions for each population and diversity stratum.

Stratum	Population	Population Type	Cost for Recovery Actions
Southern Coastal	Mattole River	Independent; Non-Core 1	$70,266,865
	Bear River	Potentially Independent, Non-Core 2	$28,194,418
	Lower Eel/Van Duzen rivers	Independent; Core	$473,195,149
	Humboldt Bay Tributaries	Independent; Core	$81,400,408
	Guthrie Creek	Dependent	$572,315
Stratum Total			*$653,629,156*
Interior Eel	Mainstem Eel River	Potentially Independent, Core	$107,892,354
	Middle Mainstem Eel River	Potentially Independent, Core	$140,433,116
	Upper Mainstem Eel River	Potentially Independent, Non-Core 2	$4,467,086
	South Fork Eel River	Independent, Core	$227,863,612
	Middle Fork Eel River	Independent, Non-Core 2	$4,904,220
Stratum Total			*$485,560,388*
Central Coast	Smith River	Independent, Core	$170,120,783
	Lower Klamath River	Independent, Core	$138,708,796
	Redwood Creek	Independent, Core	$204,662,734
	Maple Creek/Big Lagoon	Potentially Independent, Non-Core 2	$43,454,963

Stratum	Population	Population Type	Cost for Recovery Actions
	Little River	Potentially Independent, Non-Core 1	$57,554,367
Central Coast	Mad River	Independent, Non-Core 1	$190,767,970
	Elk Creek	Dependent	$622,458
	Wilson Creek	Dependent	$5,612,644
	Strawberry Creek	Dependent	$3,384,031
	Norton/Widow White creeks	Dependent	$3,305,607
Stratum Total			*$818,194,354*
Trinity	Upper Trinity River	Independent, Core	$20,124,422
	Lower Trinity River	Independent, Core	$78,326,272
	South Fork Trinity River	Independent, Non-Core 1	$141,759,766
Stratum Total			*$240,210,460*
Interior Klamath	Upper Klamath River	Independent, Core	$616,240,058
	Middle Klamath River	Potentially Independent, Non–Core 1	$12,342,284
	Salmon River	Potentially Independent, Non-Core 1	$4,775,533
	Shasta River	Independent, Core	$98,029,971
	Scott River	Independent, Core	$91,380,973
Stratum Total			*$822,768,819*
Interior Rogue	Illinois River	Independent, Core	$196,828,698
	Middle Rogue/Applegate rivers	Independent, Non-Core 1	$35,266,447
	Upper Rogue River	Independent, Core	$224,069,681
Stratum Total			*$456,164,826*
Northern Coastal	Elk River	Independent, Core	$26,525,230
	Lower Rogue River	Potentially Independent, Non-Core 1	$60,721,512
	Chetco River	Independent, Core	$14,910,879
	Winchuck River	Potentially Independent, Non-Core 1	$6,812,091
	Hubbard Creek	Ephemeral	$0
	Euchre Creek	Ephemeral	$0
	Brush Creek	Dependent	$1,443,992
	Mussel Creek	Dependent	$1,394,745
	Hunter Creek	Dependent	$1,938,760
	Pistol River	Dependent	$4,445,434
Stratum Total			*$118,192,644*

Stratum	Population	Population Type	Cost for Recovery Actions
ESU Total			**$3,594,720,645**

6.3 Review of Recovery Progress

NMFS will regularly review the recovery actions accomplished and actions still in need of implementation, in order to track implementation status and identify any additional recovery needs. NMFS is required to review the status of listed species at least once every five years (ESA Section 4(c)2(A)). As part of each status review, NMFS will compare the status of the ESU, stresses, and threats to the delisting criteria. All available monitoring data will be used to determine the status of the ESU, describe progress made toward delisting, and identify any needed changes to the recovery program.

6.4 Changing the Recovery Plan

The recovery plan may be changed at any time. There are three types of plan modifications: update, revision, and addendum.

6.4.1 Update

An update to a recovery plan involves relatively minor changes. An update may identify specific actions that have been initiated since the plan was completed, as well as changes in species status or background information that do not alter the overall direction of the recovery effort. An update cannot suffice if substantive changes are made in the recovery criteria or if any changes in the recovery strategy, criteria, or recovery actions indicate a shift in the overall direction of recovery. In this case, a revision would be required.

6.4.2 Addendum

An addendum can be added to a plan after a recovery plan has been finalized. Types of addenda can range from implementation strategies or participation plans, to minor information updates. Addenda that represent significant additions to the recovery plan should undergo public review and comment before being attached to the recovery plan. An example of a significant addendum is one that adds a species to a plan.

6.4.3 Revision

A revision is a substantial rewrite of at least a portion of a recovery plan and is usually required if major changes are required in the recovery strategy, objectives, criteria, or actions. A revision may be required when new threats to the species are identified, when research identifies new life history traits or threats that have significant recovery ramifications, or when the current plan is not achieving its objectives. The planning process for revising a recovery plan is the same as for original plan development.

6.4.4 Notification, Review, and Approval of Plan Modifications

Updates to recovery plans and minor addenda represent minor changes and can be approved at the field office or at the Regional Administrator level. Updates do not require formal public comment. Contributors, stakeholders, and the Headquarters offices will be sent a copy of the changes to the plan and the changes will be posted on regional and national NMFS websites.

Because plan revisions represent a significant change to the recovery plan, they go through the same review and clearance procedures as a draft and final recovery plan including a public comment period announced in the Federal Register. If plan revisions or major addenda are planned, NMFS will publish a Federal Register Notice of Intent at the outset of the process. This Notice will solicit data, provide information about public review and comment, and state the purpose of the revision. Because plan revisions represent a significant change to the recovery plan, they go through the same review and clearance procedures as a draft and final recovery plan including a public comment period announced in the Federal Register.

6.5 Implementation Database

NMFS plans to track funding and implementation of SONCC coho salmon recovery actions using an implementation database. Conservation partners will be able to update the recovery action database on the internet, and generate reports on action parameters.

Volume I Literature Cited

Ackerman, N.K. and S. Cramer. 2006. Simulating Fall Redistribution and Overwinter Survival of Klamath River Coho – Review Draft. Technical Memorandum #2 of 8. Klamath Coho Integrated Modeling Framework Technical Memorandum Series. Submitted to the Bureau of Reclamation Klamath Basin Area Office on November 22, 2006.

Ackerman, N.K., B. Pyper, S. Cramer, and I. Courter. 2006. Estimation of Returns of Naturally Produced Coho to the Klamath River – Review Draft Technical Memorandum #1 of 8 Klamath Coho Integrated Modeling Framework Technical Memorandum Series.

Adams, P.B., L.B. Boydstun, S.P. Gallagher, M.K. Lacy, T. McDonald, and K.E. Shaffer. 2011. California coastal salmonid population monitoring: Strategy, design, and methods. Fish Bulletin 180. State of California, The Natural Resources Agency, Department of Fish and Game. 80 p.

Agrawal, A., R. Schick, E. Bjorkstedt, R.G. Szerlong, M. Goslin, B. Spence, T. Williams, and K. Burnett. 2005. Predicting the potential for historical coho, Chinook and steelhead habitat in northern California. U. S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-379.

Allee, W.C. 1938. The Social Life of Animals. Heinemann, London.

Allendorf, F.W., D. Bayles, D.L. Bottom, K.P. Currens, C.A. Frissell, D. Hankin, J.A. Lichatowich, W. Nehlsen, P.C. Trotter, and T.H. Williams. 1997. Prioritizing Pacific salmon stocks for conservation. Conservation Biology 11:140-152.

Araki, H., W.R. Ardren, E. Olsen, B. Cooper, and M.S. Blouin. 2007a. Reproductive success of captive-bred steelhead trout in the wild: evaluation of three hatchery programs in the Hood River. Conserv. Biol. **21**: 181–190. doi:10.1111/j.1523-1739. 2006.00564.x. PMID:17298524.

Araki, H., B. Cooper, and M.S. Blouin. 2007b. Genetic effects of captive breeding cause a rapid, cumulative fitness decline in the wild. Science (Washington, D.C.), 318: 100–103. doi:10.1126/ science.1145621. PMID:17916734.

Araki, H., Berejikian, B. A., Ford, M. J. and Blouin, M. S. 2008. Fitness of hatchery-reared salmonids in the wild. Evolutionary Applications, 1: 342–355. doi: 10.1111/j.1752-4571.2008.00026.x

Armentrout, S., H. Brown, S. Chappell, M. Everett-Brown, J. Fites, J. Forbes, M. McFarland, J. Riley, K. Roby, A. Villalovos, R. Walden, D. Watts, and M.R. Williams. 1998. Watershed Analysis for Mill, Deer, and Antelope Creeks. U.S. Department of Agriculture. Lassen National Forest. Almanor Ranger District. Chester, CA. 299 pp.

Au, D.W.K. 1972. Population dynamics of the coho salmon and its response to logging in three coastal streams. Doctoral dissertation. Oregon State University, Corvallis.

Barnett, T. P., D. W. Pierce, K. M. AchutaRao, P. J. Gleckler, B. D. Santer, J. M. Gregory, and W. M. Washington. 2005. Penetration of human-induced warming into the world's oceans. Science 309:284-287.

Barrowman, N.J., R.A. Myers, R. Hilborn, D.G. Kehler, and C.A. Field. 2003. The variability among populations of coho salmon in the maximum reproductive rate and depensation. Ecological Applications 13(3): 784-793.

Bartholow, J.M. 2005. Recent water temperature trends in the Lower Klamath River, CA. N. American Journal of Fisheries Management. 25:152-162.

Bartholomew J.L. 2008. *Ceratomyxa shasta* 2007 Study summary, Oregon State University Final Report to Bureau of Reclamation http://www.fws.gov/arcata/fisheries/projectupdates.html

Bartholomew, J. L., Atkinson, S. D. and Hallett, S. L. 2006. Involvement of *Manayunkia speciosa* (Annelida: Polychaeta: Sabellidae) in the life cycle of *Parvicapsula minibicornis*, a myxozoan parasite of Pacific salmon. *Journal of Parasitology*. 92:742-748

Bartholomew, J.L., H.V. Lorz, S.A. Sollid and D.G. Stevens. 2003. Susceptibility of juvenile and yearling bull trout to *Myxobolus cerebralis*, and effects of sustained parasite challenges. Journal of Aquatic Animal Health.15:248-255.

Bartley, D.M., B. Bentley, P.G. Olin, and G.A.E. Gall. 1992. Population genetic structure of coho salmon (*Oncor- hynchus kisutch*).Calif. Fish. Game 78:88–104.

Bash, J., C. Berman, and S. Bolton. 2001. Effects of turbidity and suspended solids on salmonids. Center for Streamside Studies, University of Washington. 74 pages.

Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, Eds., 2008: Climate Change and Water. Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva, 210 pp.

Battin, T.J., W.T. Sloan, S. Kjelleberg, H. Daims, I.M. Head, T. Curtis *et al*. 2007. Microbial landscapes: new paths to biofilm research. Nat Rev Microbiol 5: 76–81

Beacham, T.D. 1982. Fecundity of coho salmon (*Oncorhynchus kisutch*) and chum salmon (*O. keta*) in the northeast Pacific Ocean. Can. J. Zool. 60:1463- 1469.

Beamish, R.J., C. Neville, and A.J. Cass. 1997a. Production of Fraser River sockeye salmon (Oncorhynchus nerku) in relation to decadal-scale changes in the climate and the ocean.Canadian Journal of Fisheries and Aquatic Sciences, 54: 543-554.

Beamish R.J., C. Mahnken, and C.M. Neville. 1997b. Hatchery and wild production of Pacific salmon in relation to large-scale, natural shifts in the productivity of the marine environment. ICES J Mar Sci 54:1200–1215.

Beamish R.J., D.J. Noakes, G.A. McFarlane, L. Klyashtorin, V.V. Ivanov, and V. Kurashov. 1999. The regime concept and natural trends in the production of Pacific salmon. Canadian Journal of Fisheries and Aquatic Sciences 56:516-526

Beamish, R. J., D. J. Noakes, G. A. McFarlane, W. Pinnix, R. Sweeting, and J. King. 2000. Trends in coho marine survival in relation to the regime concept. Fisheries Oceanography 9:114-119.

Beamish, R.J. and C. Mahnken. 2001. A critical size and period hypothesis to explain natural regulation of salmon abundance and the linkage to climate and climate change, *Progress in Oceanography* 49 pp. 423–437.

Beechie, T.J., E.A. Steel, P. Roni, and E. Quimby (editors). 2003. Ecosystem recovery planning for listed salmon: an integrated assessment approach for salmon habitat. U.S. Department of Commerce, NOAA Technical memorandum. NMFS-NWFSC-58. 183p.

Bell, E. and W.G. Duffy. 2007. Previously undocumented two-year freshwater residency of juvenile coho salmon in Prairie Creek, California. Transactions of the American Fisheries Society 136: 966-970.

Bellows, B.C. 2003. Managed Grazing in Riparian Areas. Appropriate technology Transfer for Rural Areas (ATTRA). 28 Pp

Belsky, A. J., A. Matzke, and S. Uselman. 1999. Survey of livestock influences on stream and riparian ecosystems in the western United States. Journal of Soil and Water Conservation 54(1): 419-431.

Benson, K. 2010. Personal communication. Biologist. Redwood National and State Parks.

Berejikian, B. A. 1995. The effects of hatchery and wild ancestry and experience on the relative ability of steelhead trout fry (Oncorhynchus mykiss) to avoid a benthic predator. Canadian Journal of Fisheries and Aquatic Sciences 52: 2476-2482.

Berejikian, B.A., Mathews, S.B., and Quinn, T.P. 1996. The Effects of hatchery and wild ancestry on the development of agonistic behavior in steelhead trout fry (*Oncorhynchus mykiss*). Can. J. Fish. Aquat. Sci. **53**: 2004–2014.

Berg, L. 1982. The effect of exposure to short-term pulses of suspended sediment on the behavior of juvenile salmonids. P. 177-196 in G.F. Hartman et al. [eds.] Proceedings of the Carnation Creek workshop: a ten-year review. Department of Fisheries and Oceans, Pacific Biological Station, Nanaimo, Canada.

Berg, L. and T.G. Northcote. 1985. Changes in territorial, gill- flaring, and feeding behaviour in juvenile coho salmon (Oncohynchus kisutch) following short-term pulses of suspended sediment. Canadian Journal of Fisheries and Aquatic Sciences 42: 1410-1417.

Bilton, H.T., R.B. Morley, A.S. Colburn, and J. Van Tyne. 1984. The influence of time and size and release of juvenile coho salmon (Oncorhynchus kisutch) on returns at maturity and results from releases from Quinsam River hatchery, B,C,, in 1980. Can. Technical Report of Fisheries and Aquatic Sci.1306:1-98.

Birtwell, I.K. 1999. The effects of sediment on fish and their habitat. Canadian Stock Assessment Secretariat Research Document 99/139,West Vancouver, British Columbia.

Bisson, P.A. and R.E. Bilby. 1982. Avoidance of suspended sediment by juvenile coho salmon. North American Journal of Fisheries Management 4: 371-374.

Bisson, P.A., Reeves, G.H., Bilby, R.E., Naiman, R.J. 1997. Watershed management and Pacific salmon: desired future conditions. In: Stouder, D.J., Bisson, P.A., Naiman, R.J. (Eds.), Pacific Salmon and their Ecosystems: Status and Future Options. Chapman & Hall, New York, pp. 447– 474.

Bjornn, T.C. and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. In: Meehan, W.R. Influences of forest and rangeland management of salmonid fishes and their habitats. Bethesda, MD: American Fisheries Society: 83-138.

Blanchard, T. 2002. Draft 2002 technical report AQU 16: Summary of information available to assess potential aquatic species interactions in the Lewis River Basin. PacifiCorp/Cowlitz PUD LewisRiver Hydroelectric Projects. FERC Project Nos. 935, 2071, 2111, and 2213.

Blanchet S., G. Loot, L. Bernatchez, and J.J. Dodson. 2007. The disruption of dominance hierarchies by a non-native species: an individual based analysis. Oecologia 152:569–581

Bliesner, A., D. Halligan, M. Miles, and K. Sullivan. 2006. Bear River watershed analysis. Fish habitat assessment. Appendix E. HCP Signatory Review Team Draft. June 21.106p.

Booth, D.B and C.R. Jackson. 1997. Urbanization of Aquatic Systems--Degradation Thresholds, Stormwater Detention, and the Limits of Mitigation. Journal of the Amer. Water Res. Assoc. Vol. 22, No. 5. 20 p.

Booth, D.B., B. Visitacion and A.C. Steinemann. 2006. Damages and Costs of Stormwater Runoff in the Puget Sound Region. Project sponsored by the Puget Sound Action Team and the WA Governor's Office. The Water Center, Department of Civil and Environmental Engineering, University of Washington, Seattle, WA. 42 p.

Botkin, D.B., K. Cummins, T. Dunne, H. Regier, M. J. Sobel, and L. M. Talbot. 1995. Status and Future of Anadromous Fish of Western Oregon and Northern California: Findings and Options, Center for the Study of the Environment, Santa Barbara, CA.

Bottom, D.L., T.E. Nickelson, and Johnson, S.L. 1986. Research and development of Oregon's coastal salmon stocks. Oregon Department of Fish and Wildlife, Fishery Research Project NA-85-ABD-00111. Annual Progress Report, Portland, OR.

Bowen, J.L., and I. Valiela. 2001. The ecological effects of urbanization of coastal watersheds: Historical increases in nitrogen loads and eutrophication of Waquoit Bay estuaries. *Can. J. Fish Aquat. Sci.* 58:1489-1500.

Boydstun, L.B. and T. McDonald (Editors). 2005. Actions plan for monitoring California's coastal salmonids. Report for NOAA Fisheries Santa Cruz Laboratory, Contract number WASC-3-1295. 68 pp plus appendices.

Bradford, M. J. 1995. Comparative review of Pacific salmon survival rates. Canadian Journal of Fisheries and Aquatic Sciences 52:1327-1338.

Briggs, J. C. 1953. The behavior and reproduction of salmonid fishes in a coastal stream. Fish Bulletin 94. California Department of Fish and Game.

Brodeur, R.D., J.P. Fisher, D.J. Teel, R.L. Emmett, E. Casillas, and T.W. Miller. 2004. Juvenile salmonid distribution, growth, condition, origin, and environmental and species associations in the Northern California Current. Fisheries Bulletin 102: 25-46.

Brown, J.S. 1999. Vigilance, patch use and habitat selection: Foraging under predation risk. Evol. Ecol. Res. 1:49-71.

Brown, A.V., M.M. Lyttle, and K.B. Brown. 1998. Impacts of Gravel Mining on Gravel Bed Streams. Trans. of the Amer. Fish. Soc. 127:6, 981-996.

Brown, L.R. and P.B. Moyle. 1991. Eel River survey: final report. Report to Calif. Dept. of Fish and Game, Contract: F-46-R-2.

Brown, L.R., and P.B. Moyle. 1994. Distribution, ecology, and status of the fishes of the San Joaquin River drainage, California. Calif. Fish Game, 79: 96-1 14.

Brown, L. R., P. B. Moyle, and R. M. Yoshiyama. 1994. Historical Decline and Current Status of Coho Salmon in California. North American Journal of Fisheries Management 14(2):237-261.

Brown, R.F. and B.R. Mate. 1983. Abundance, movements and feeding habits of harbor seals *(Phoca vitulina)* at Netarts and Tillamook bays, Oregon. *NOAA Fishery Bulletin* 81(2): 291–301.

Buffington JM, Lisle TE, Woodsmith RD, Hilton S. 2002. Controls on the size and occurrence of pools in coarse‐grained forest rivers. River Research and Applications 18:507-531.

Bugert R.M. and T.C. Bjornn. 1991. Habitat Use by Steelhead and Coho Salmon and Their Responses to Predators and Cover in Laboratory Streams, Trans. Amer. Fish. Soc. 120: 486-493.

Burnett, K., G. Reeves, D. Miller, S. Clarke, K. Christiansen, and K. Vance-Borland. 2003. A first step toward broad-scale identification of freshwater protected areas for Pacific salmon and trout in Oregon, USA. Pages 144-154 in J. P. Beumer, A. Grant, and D. C. Smith, editors. Aquatic protected areas: what works best and how do we know? Proceedings of the World Congress on Aquatic Protected Areas, Cairns, Australia, August 2002.

CalFish. 2009. California Fish Passage Assessment Database (CFPAD). State-wide inventory of known and potential barriers to fish passage. Accessed 9/30/2009 from:http://www.calfish.org/ProgramsandProjects/FishPassageAssessment/tabid/97/Default.aspxNMFS-NWFSC-27, 261 p

California Advisory Committee on Salmon and Steelhead Trout. 1988. Restoring the balance. 1988 Annual Report. A report to the Legislature and the Department of Fish and Game. 84 pp.

California Department of Fish and Game (CDFG). 1994. Petition to the Board of Forestry to list coho salmon (*Oncorhynchus kisutch*) as a sensitive species. Redding, CA. 109p.

California Department of Fish and Game (CDFG). 1997. A Biological Needs Assessment for Anadromous Fish in the Shasta River Siskiyou County, California. Northern California-North Coast Region. Redding, CA. 29p.

California Department of Fish and Game (CDFG). 2002a. Status review of California coho salmon north of San Francisco. Report to the California Fish and Game Commission. Candidate Species Status Review Report 2002-3.

California Department of Fish and Game (CDFG). 2002b. Department of Fish and Game Annual Report: Shasta and Shasta River Juvenile Salmonid Outmigration Study, 2003. Northern California, North Coast Region.

California Department of Fish and Game (CDFG). 2003. September 2002 Klamath River Fish Kill: Preliminary analysis of contributing factors [700 Kb] At KRIS Web site.

California Department of Fish and Game (CDFG). 2004. Recovery strategy for California coho salmon. Report to the California Fish and Game Commission. 594pp. Copies/CD available upon request from California Department of Fish and Game, Native Anadromous Fish and Watershed Branch, 1419 9th Street, Sacramento, CA 95814, or on-line: http:www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

California Department of Fish and Game (CDFG). 2011. Freshwater Sport Fishing Regulations. Effective March 1, 2011 through February 29, 2012. 75 p.

California Department of Fish and Game (CDFG) and National Marine Fisheries Service (NMFS). 2001. Joint Hatchery Review Committee final report on anadromous salmonid fish hatcheries in California. 93 p.

California Division of Water Rights (CDWR). 1999. *A Guide to Water Transfers*. State of California.

California Division of Water Rights (CDWR). 2001. *A Guide to California Water Right Appropriations*. State of California.

California Environmental Protection Agency (CEPA). 2011. State Water Resources Control Board, Division of Water Rights, Website. http://www.waterboards.ca.gov/waterrights/

California State Lands Commission (CSLC). 1993. California's rivers-A public trust report. Second Edition. CSLC, Sacramento, California.

Campton, D. E. 1995. Genetic effects of hatchery fish on wild populations of Pacific salmon and steelhead: What do we really know? Pp. 337–353 in H. L. Schramm Jr. and R. G. Piper (Eds.), American Fisheries Society, Bethesda, MD.

Cannata, S., R. Henly, J. Erler, J. Falls, D. McGuire and J. Sunahara. 2006. Redwood Creek watershed assessment report. Coastal Watershed Planning and Assessment Program and North Coast Watershed Assessment Program. California Resources Agency and California Environmental Protection Agency, Sacramento, California.

Carrasco, K. 2000. Coho pre-spawn mortalities in a flooded reed canarygrass habitat. Reed Canarygrass Working Group Conference, Washington State Department of Transportation, USDA Natural Resources Conservation Service, and Society for Ecological Restoration – Northwest Chapter, March 15, 2000, Olympia, Washington.

Carter, K. 2005. The effects of dissolved oxygen on steelhead trout, coho salmon, and Chinook salmon biology and function by life stage. Prepared as staff to the California Regional Water Quality Control Board, North Coast Region.

Caughley, G. 1994. Directions in conservation biology. Journal of Animal Ecology 63(2): 215-244.

Cederholm, C.J., L.M. Reid, and E.O. Salo. 1981. Cumulative effects of logging road sediment on salmonid populations of the Clearwater River, Jefferson County, Washington. Pages 38-74 in Proceedings of Conference on Salmon Spawning Gravel: A Renewable Resource in the Pacific Northwest? Report 19. Wash. State University, Water Research Center, Pullman, WA.

Cederholm, C.J., R.E. Bilby, P.A. Bisson, T.W. Bumstead, B.R. Fransen, W.J. Scarlett and J.W. Ward. 1997. Response of Juvenile Coho Salmon and Steelhead to Placement of Large

Woody Debris in a Coastal Washington Stream. North American Journal of Fisheries Management. 17:947-963.

Chamberlin, T.W., R.D. Harr, F.H. Everest. 1991. Timber harvesting, silviculture, and watershed processes. In: W.R. Meehan (ed.), "Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats." American Fisheries Society, Special Publication Number 19. Bethesda, Maryland.

Chapman, D. W. 1962. Aggressive behavior in juvenile coho salmon as a cause of emigration. Journal of the Fisheries Research Board of Canada 19: 1047-1080.

Chapman, D. W., and E. Knudsen. 1980. Channelization and livestock impacts on salmonid habitat and biomass in western Washington. Transactions of the American Fisheries Society 109:357-363.

Chapman, D. W., J. F. Corliss, R. W. Phillips, and R. L. Demory. 1961. Summary report, Alsea watershed study. Oregon State University, Agriculture Experimental Station, Miscellaneous Paper 110, Corvallis.

Chesney, W. R., C.C. Adams, W. B. Crombie, H. D. Langendorf, S.A. Stenhouse and K. M. Kirkby. 2009. Shasta River Juvenile Coho Habitat & Migration Study. Report prepared for U. S. Bureau of Reclamation, Klamath Area Office. Funded by U.S. Bureau of Reclamation, National Oceanic and Atmospheric Administration and California Department of Fish and Game. California Department of Fish and Game, Yreka, California. Accessed 12/13/2011 from: http://www.klamathriver.org/Documents/CDFG-Juvenile-Coho-2009.pdf

Chesney, D. and M. Knechtle. 2010. Shasta River Chinook and coho salmon observations in 2009-2010. California Department of Fish and Game. Siskiyou County, California.

Chesney, D. and M. Knechtle. 2011a. Recovery of fall-run Chinook and coho salmon at Iron Gate Hatchery, September 24, 2010 to December 15, 2010. California Department of Fish and Game, Klamath River Project, Yreka, CA. 20 p.

Chesney, D. and M. Knechtle. 2011b. Shasta River Chinook and coho salmon observations in 2010-2011, Siskiyou County, CA. California Department of Fish and Game, Klamath River Project, Yreka, CA. 30 p.

Chilcote, M.W. 1999. Conservation status of Lower Columbia River coho salmon. Oregon Department of Fish and Wildlife Information Report Number 99-3. 45 p.

Chilcote, M.W. 2003. Relationship between natural productivity and the frequency of wild fish in mixed spawning populations of wild and hatchery steelhead (*Oncorhynchus mykiss*). Canadian Journal of Fisheries and Aquatic Sciences 60:1057-1067. 2001–2003.

Chilcote, M.W., K.W. Goodson, and M.R. Falcy. 2010. Reduced recruitment performance in natural populations of anadromous salmonids associated with hatchery-reared fish. Can. J. Fish. Aquat. Sci. 68: 511-522.

Clark, C.W. (1985) Bioeconomic Modelling and Fisheries Management. John Wiley & Sons, New York, NY.

Cohen, R. 1997. Fact Sheets: Functions and Values of Riparian Areas. Massachusetts Department of Fisheries, Wildlife and Environmental Law Enforcement. www.state.ma.us/dfwele/river/rivfstoc.htm coldocs/2003/09/Landscape_Practicitioners_Handbook_July03_-

Cole, J. 2000. Coastal sea surface temperature and coho salmon production off the north-west United States. Fish. Oceanogr. 9: 1–16.

Cone, J., and S. Ridlington, editors. 1996. *The Northwest Salmon Crisis: A Documented History*. Oregon State University Press, Corvallis, Oregon, 374 pp.

Cordone, A.J. and D.W. Kelley. 1961. The influences of inorganic sediment on the aquatic life of streams. Reprint from California Fish and Game. Vol. 47, No. 2. California Department of Fish and Game, Inland Fisheries Branch. Sacramento, CA. 41 pp.

Cornwell, T.J., Bottom, D.L., and Jones, K.K. 2001. Rearing of juvenile salmon in recovering wetlands of the Salmon River Estuary. Information Reports 2001-05. Oregon Department of Fish and Wildlife, Portland, Oregon.

Cover, M.R., C.C. May, W.E. Dietrich, and V.H. Resh. 2008. Quantitative linkages among sediment supply, streambed fine sediment, and benthic macroinvertebrates in northern California streams. Journal of the North American Benthological Society 27, 135–149.

Crawford, B.A. and S. Rumsey. 2011. Guidance for monitoring recovery of salmon and steelhead listed under the federal Endangered Species Act (Idaho, Oregon, and Washington). Northwest Region, NOAA Fisheries Service. 125 p.

Crisp T.M., E.D. Clegg, R.L. Cooper, W.P. Wood, D.G. Anderson, and K.P. Baetcke. 1998. Environmental endocrine disruption: an effect assessment and analysis. Environ Health Perspect. 1998;106:11–56.

Crone, R. A., and C. E. Bond. 1976. Life history of coho salmon, *Oncorhynchus kisutch*, in Sashin Creek, southeastern Alaska. *U.S. Fisheries Bulletin* 74:897-923.

Dawley, E. M., R. D. Ledgerwood, T. H. Blahm, C. W. Sims, J. T. Durkin, R. A. Kirn, A. E. Rankis, G. E. Monan, and F. J. Ossiander. 1986. Migrational characteristics, biological observations, and relative survival of juvenile salmonids entering the Columbia River estuary, 1966-1983. Final Report to Bonneville Power Administration, 256 p. Available Bonneville Power Administration, P.O. Box 351, Portland, OR 97208

Davis, G. E., J. Foster, C. E. Warren, and P. Doudoroff. 1963. The influence of oxygen concentration on the swimming performance of juvenile Pacific salmon at various temperatures. Transactions of the American Fisheries Society 92: 111-124.

DeWald, L., and M. A. Wilzbach. 1992. Interactions between native brook trout and hatchery brown trout: effects on habitat use, feeding, and growth. Transactions of the American Fisheries Society 121(3):287-296.

Dietrich, W. E., and F. K. Ligon. 2009. RIPPLE: a digital terrain-based model for linking salmon population dynamics to channel networks. Prepared by UC Berkeley and Stillwater Sciences, Berkeley, California.

Driscoll, J. 2009. Miners Blast back at Karuk Tribe. Times Standard Newspaper. March 4, 2009.

Dunham, J. B. M. K. Young, R. E. Gresswell, B. E. Riemana. 2003. The effect of wildland fire on aquatic ecosystems in the western USA. Forest Ecology and Management 178: 183-196.

Dutra, B.L. and S.A. Thomas. 1999. 1998-99 Chinook and coho spawning report. Lower Trinity Ranger District, Six Rivers National Forest, Willow Creek, California. April 1999. Online at: http://www.krisweb.com/biblio/trinity_usdafs_dutraetal_1999.pdf

Dwire, K.A. and J.B. Kauffman. 2003. Fire and riparian ecosystems in landscapes of the western USA. Forest Ecology and Management 178: 61-74.

Eames, M., T. Quinn, K. Reidinger, and D. Haring. 1981. Northern Puget Sound 1976 adult coho and chum tagging studies. Wash. Dep. Fish. Tech. Rep. 64, 136 p

Elder, D., B. Olson, A. Olson, J. Villeponteaux, and P. Brucker. 2002. Salmon River Subbasin Restoration Strategy: Steps to Recovery and Conservation of Aquatic Resources. Report prepared for the Klamath River Basin Fisheries Restoration Task Force and U.S. Fish and Wildlife Service, Yreka, California. 53 pp.

Elliott, J.M. 1981. Some aspects of thermal stress on freshwater teleosts. Pages 209-245 *In* A. D. Pickering editor, Stress and Fish. Academic Press, London.

Engen, S., R. Lande, and B. E. Saether. 2003. Demographic stochasticity and Allee effects in populations with two sexes. Ecology 84: 2378-2386.

Ewers, R. M. and R. K. Didham. 2005. Confounding factors in the detection of species response to habitat fragmentation. Biological Reviews 81: 117-142.

Fagan, W. F. and E. E. Holmes. 2006. Quantifying the extinction vortex. Ecology Letters 9: 51-60.

Federal Energy Regulatory Commission (FERC). 2007. Final Environmental Impact Statement for Relicensing of the Klamath Hydroelectric Project No. 2082-027. November 16.

Five Counties Salmonid Conservation Program. 2010. Water Quality and Stream Habitat protection manuals for County Road Maintenance in Northwestern California Watersheds. Prepared for the Five Counties Salmon Conservation Program Available at: http://www.5counties.org/docs.htm

Flagg, T.A., B.A. Berejikia, J.E. Colt, W.W. Dickhoff, L.W. Harrell, et al., eds. 2000. Ecological and behavioral impacts of artificial production strategies on the abundance of wild salmon populations—a review of prac- tices in the Pacific Northwest. NOAA Tech. Memo. NMFS-NWFSC-4, Northwest Fish. Sci. Cent., Seattle, WA

Flaherty, C.M. and Dodson, S.I. 2005. Effects of pharmaceuticals on Daphnia survival, growth, and reproduction: Chemosphere, v. 61, p. 200-207.

Fleming, I. A. 1994. Captive breeding and the conservation of wild salmon populations. Conservation Biology 8:886–888.

Fleming I.A., and M.R. Gross. 1989. Evolution of adult female life history and morphology in a Pacific Salmon (Coho: Oncorhynchus kisutch). Evolution. 43: 141–157.

Fleming, I. A., and M. R. Gross. 1990. Latitudinal clines: a trade-off between egg number and size in Pacific salmon. Ecology 71: 1-11.

Fleming, I.A. and Gross, M.R. 1994. Breeding competition in a Pacific salmon (Coho: Oncorhynchus kisutch): Measures of natural and sexual selection. Evolution 48: 637-657.

Fleming, I. A., and Petersson, E. 2001. The ability of released, hatchery salmonids to breed and contribute to the natural productivity of wild populations. Nordic Journal of Freshwater Research, 75: 71e98.

Fleming, I. A., B. Jonsson, M. R. Gross, and A. Lamberg. 1996. An experimental study of the reproductive behavior and success of farmed and wild Atlantic Salmon (Salmo salar). Journal of Applied Ecology 33:893-905.

Foott, S. 1995. Preliminary results of Spring 1995 Klamath R. chinook smolt study (95-FP-01), Iron Gate Hatchery June release group. U.S. Fish and Wildlife Service California-Nevada Fish Health Center, Anderson, CA. 6 p. (67 Kb)

Foott, J.S, G. Stutzer, R. Fogerty, H.C. Hansel, S.D. Juhnke, and J.W. Beeman. 2010. Pilot study to access the role of *Ceratomyxa shasta* infection in mortality of fall-run Chinook smolts migration through the lower Klamath River in 2008. US Fish and Wildlife Service-US Geological Survey Technical report, US Fish and Wildlife Service, CA-NV Fish Health Center, Anderson, CA.

Ford, M. J. 2002. Applications of selective neutrality tests to molecular ecology. Molecular Ecology, 11:1245-1262.

Forest Ecosystem Management Assessment Team (FEMAT). 1993. Forest Ecosystem Management: an ecological, economic and social assessment. Report of the Forest Ecosystem Management Assessment Team. 1993-793-071. U.S. Govt. Printing Office.

Foster, S.C., C.H. Stein, and K.K. Jones. 2001. A guide to interpreting stream survey reports. Oregon Department of Fish and Wildlife, Aquatic Inventories Project, Portland, OR. 55 p.

Fowler, C. W. and Baker, J. D. 1991. A review of animal population dynamics at extremely reduced population levels. – Rept. Int. Whaling Comm. 41: 545–554.

Frankham, R. 2005. Genetics and Extinction. Biological Conservation 126: 131–140.

Fraser, F. J., E. A. Perry, and D. T. Lightly. 1983. Big Qualicum River salmon development project. Volume 1: a biological assessment 1959-1972. Canadian Technical Report of Fisheries and Aquatic Sciences 1189. Department of Fisheries and Oceans, Fisheries Research Branch, Pacific Biological Station, Nanaimo, British Columbia.

Fresh, K.L. 1997. The role of competition and predation in the decline of Pacific salmon and steelhead. In Pacific salmon and their ecosystems: status and future options. Edited by D.J. Stouder, P.A. Bisson, and R.J. Naiman. Chapman Hall, New York. pp. 245–275.

Fried, J.S, M.S. Torn, and E. Mills. 2004. The impact of climate change on wildfire severity: A regional forecast for Northern California. Climate Change 64:169–191

Frissell, C.A. 1992. Cumulative effects of land use on salmonid habitat on southwest Oregon streams. Ph.D. thesis, Oregon State University, Corvalis, OR.

Galbraith, H.; Jones, R.; Park, R.; Clough, J.; Herrod-Julius, S.; Harrington, B.; Page, G. 2005. Global climate change and sea level rise: potential losses of intertidal habitat for shorebirds. In: Ralph, C. John; Rich, Terrell D., editors 2005. Bird Conservation Implementation and Integration in the Americas: Proceedings of the Third International Partners in Flight Conference. 2002 March 20-24; Asilomar, California, Volume 2 Gen. Tech. Rep. PSW-GTR-191. Albany, CA: U.S. Dept. of Agriculture, Forest Service, Pacific Southwest Research Station: p. 1119-1122.

Gallagher, S.P., P.B. Adams, D.W. Wright, and B.W. Collins. 2010a. Performance of spawner survey techniques at low abundance levels. N. Am. J. Fish. Manage. 30: 1086-1097

Gallagher, S.P., D.W. Wright, B.W. Collins, and P.B. Adams. 2010b. A Regional Approach for Monitoring Salmonid Status and Trends: Results from a Pilot Study in Coastal Mendocino County, California. North American Journal of Fisheries Management. 30, 1075-1085.

Gilbert, C.H. 1912. Age at maturity of the Pacific coast salmon of the genus *Oncorhynchus*. Fish Bull., U.S. 32:3-22.

Godfrey, H. 1965. Coho salmon in offshore waters, p. 1-39. *In*: Salmon of the North Pacific Ocean. Part IX. Coho, chinook and masu salmon in offshore waters. International North Pacific Fisheries Commission Bulletin 16.

Gleick, P. H., 1987. The Development and Testing of a Water Balance Model for Climate Impact Assessment: Modeling the Sacramento Basin. Water Resources Research 23:1049-1061.

Goldman, C.R. and A.J. Horne. 1983. Limnology. McGraw-Hill, Inc. New York. 464 pp.

Goley, D. and A. Gemmer. 2000. Pinniped/salmonid interactions on the Smith, Mad and Eel rivers in northern California between 31 August and 15 December 1999. Unpublished report, Humboldt State University Marine Mammal Education and Research Program, Arcata, California.

Good, T.P., R.S. Waples, and P. Adams (editors). 2005. Updated status of federally listed ESUs of West Coast salmon and steelhead. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-66, 598 p.

Grant, W.S. (Ed.) 1997. Genetic effects of straying of non-native hatchery fish into natural populations: Proceedings of the workshop. U.S. Dept. of Commerce, NOAA Tech. Memo., NMFS-NWFSC-30, 130 p.

Grant, G.E., 2010. Effects of forest practices on peak flows and consequent channel response: a state-of-science report for western Oregon and Washington. DIANE Publishing.

Graybill, M.R. 1981. Haul-out patterns and diet of harbor seals, *Phoca vitulina,* in Coos County, Oregon. M.S. thesis. University of Oregon.

Greig, S.M., D.A. Sear, and P.A. Carling. 2005. The impact of fine sediment accumulation on the survival of incubating salmon progeny: Implications for sediment management. Science of The Total Environment 344, 241-258.

Green Diamond Resource Company (GDRC). 2006. Aquatic habitat conservation plan and candidate conservation agreement with assurances. Final. Volume 1-2 plus appendices. Prepared for National Marine Fisheries Service and U.S. Fish and Wildlife Service, October 2006. 568 p.

Green Diamond Resource Company (GDRC). 2009. Unpublished data obtained from Darold Perry. Large Woody Debris, Temperature, and Out Migrant Trapping Survey Data.

Gresswell, R.E. 1999. Fire and Aquatic Ecosystems in Forested Biomes of North America Trans. of the Amer. Fish. Soc. 128(2): 193-221.

Griffith, J. S., Jr. 1972. Comparative behavior and habitat utilization of brook trout (Salvelinus fontinalis) and cutthroat trout (Salmo clarki) in small streams in northern Idaho. Journal of the Fisheries Research Board of Canada 29:265-273.

Griffith, J.S., and D.A. Andrews. 1981. Effects of a small suction dredge on fishes and aquatic invertebrates in Idaho streams. North American Journal of Fisheries Management 1:21-28.

Guillen, G. 2003. Klamath River fish die-off, September 2002: Report on estimate of mortality. Report number AFWO-01-03 . U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office. Arcata, CA. 35 pp.

Gustafson, R.G., R.S. Waples, J.M. Myers, L.A. Weitkamp, G.J. Bryant, O.W. Johnson, and J.J. Hard. 2007. Pacific salmon extinctions: quantifying lost and remaining diversity. *Conservation Biology* 21(4):1009-1020.

Gwynne, B. 1993. North Investigation of Water Quality Conditions in the Shasta River, Siskiyou County. Interim Report. NCRWQCB, Santa Rosa, CA.

Hanson, L.C. 1993. The foraging ecology of harbor seals, *Phoca vitulina*, and California sea lions, *Zalophus californianus*, at the mouth of the Russian River, California. Master’s thesis, Sonoma State University, California.

Hard, J.J., B.A. Berejikian, E.P. Tezak, S.L. Schroder, C.M. Knudsen, and L.T. Parker. 2000. Evidence for morphometric differentiation of wild an captively reared adult coho salmon: a geometric analysis. Environ. Biol. Fishes, 58: 61–73.

Hare, S.R. and R.C. Francis. 1995. Climate change and salmon production in the northeast Pacific Ocean. In: R.J. Beamish, Editor, *Climate Change and Northern Fish Populations* (1995), pp. 357–372 Canadian Special Publication of Fisheries and Aquatic Sciences, 121.

Harris, R.R., C.M. Olson, S.D. Kocher, J.M. Gerstein, W. Stockard and W.E. Weaver. 2005. Procedures for Monitoring the Implementation and Effectiveness of Fisheries Habitat Restoration Projects. Center for Forestry, University of California, Berkeley. 24pp.

Hartman, G.F., B.C. Anderson, and J.C. Scrivener. 1982. Seaward movement of coho salmon (*Oncorhynchus kisutch*) fry in Carnation Creek, an unstable coastal stream in British Columbia. Canadian Journal of Fisheries and Aquatic Sciences 39:588–597.

Hartman, G.F. 1965. The role of behavior in the ecology and interaction of underyearling coho salmon (Oncorhynchus kisutch) and Steelhead trout (Salmo gairdneri). J. Fish Res. Board Can 22:1035-1081.

Harvey, B.C. and T.E. Lisle. 1999. Scour of Chinook Salmon Redds on Suction Dredge Tailings. North American Journal of Fisheries Management 19:613-617.

Hatchery Scientific Review Group (HSRG)–Lars Mobrand (chair), John Barr, Lee Blankenship, Don Campton, Trevor Evelyn, Tom Flagg, Conrad Mahnken, Robert Piper, Paul Seidel, Lisa Seeb and Bill Smoker. 2004. *Hatchery Reform: Principles and Recommendations of the HSRG*. Long Live the Kings, 1305 Fourth Avenue, Suite 810, Seattle, WA 98101 (available from www.hatcheryreform.org).

Hearn, W. E. 1987. Interspecific competition and habitat segregation among stream dwelling trout and salmon: A review. Fisheries 12:24–31.

Hemmer, H. 1990. Domestication: The decline of environmental appreciation. Cambridge University Press, Cambridge, MA.

Herrmann, R.B., Warren, C.E., Doudoroff, P., 1962. Influence of oxygen concentration on the growth of juvenile coho salmon. Transactions of the American Fisheries Society 91, 155–167.

Hindar, K., N. Ryman, and F. Utter. 1991. Genetic effects of cultured fish on natural fish populations. Canadian Journal of Fisheries and Aquatic Sciences 48:945–957.

Hjort, R.C., and C.B. Schreck. 1982. Phenotypic differences among stocks of hatchery and wild coho salmon, *Oncorhynchus kisutch*, in Oregon, Washington, and California. Fish. Bull., U.S. 80:105-119.

Hobday A.J. and G.W. Boehlert. 2001. The role of coastal ocean variation in spatial and temporal patterns in survival and size of coho salmon (*Oncorhynchus kisutch*), *Canadian Journal of Fisheries and Aquatic Sciences* **58** (10) (2001), pp. 2021–2036.

Holt, R.A., J.E. Sanders, J.L. Zim, J.L. Fryer, and K.S. Pilcher. 1975. Relation of water temperature to Flexibacter columnaris infection in steel head trout (Salmo gairdneri), coho (Oncorhynchus kisutch), and chinook *(Q.* tshawytscha) salmon. J. Fish. Res. Board Can. 32:1553-1559.

Holtby, L.B., and J.C. Scrivener. 1989. Observed and simulated effects of climatic variability, clear-cut logging, and fishing on the numbers of chum salmon (*Oncorhynchus keta*) and coho salmon (*O. kisutch*) returning to Carnation Creek, British Columbia. In C. D. Levings, L. B. Holtby, and M. A. Henderson (editors), Proceedings of the national workshop on effects of habitat alteration on salmonid stocks, p. 62-81. Can. Spec. Publ. Fish. Aquat. Sci. 105.

Hood, W.G. 2005. "Sea Level Rise in the Skagit Delta." *Skagit River Tidings*. Skagit Watershed Council,Mount Vernon, Washington.

Hoopa Valley Tribe Environmental Protection Agency (HVTEPA). 2008. Water Quality Control Plan Hoopa Valley Indian Reservation. Approved September 11, 2002, Amendments Approved February 14, 2008. Hoopa Tribal EPA. Hoopa, CA. 285p.

Hopelain, J.S. 2001. Lower Klamath River angler creel census with emphasis on upstream migrating fall chinook salmon, coho salmon, and steelhead trout during July through October, 1983 through 1987.

Humboldt Redwoods Company (HRC). 2009. Aquatic Conditions Annual Report 2009. 11p.

ICF/ Jones & Stokes. 2010. Hatchery and Stocking Program Environmental Impact Report/Environmental Impact Statement. Final. January.(ICF J&S 00264.08) (SCH #2008082025). Sacramento, CA. Prepared for the California Department of Fish and Game and U.S. Fish and Wildlife Service, Sacramento, CA. Available at: http://www.dfg.ca.gov/news/pubnotice/hatchery/

Independent Multidisciplinary Science Team (IMST). 2002. Recovery of Wild Salmonids in Western Oregon Lowlands. Technical Report 2002-01. July 15, 2002. Oregon Watershed Enhancement Board Office. Salem, Oregon. Available on the Internet at: http://www.fsl.orst.edu/imst/reports/2002-01.doc

Independent Scientific Advisory Board (ISAB). 2002. Hatchery surpluses in the Pacific Northwest. Fisheries 27(12): 16-27.

Intergovernmental Panel on Climate Change (IPCC). 2007. The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Iwata, M. and Komatsu, S. 1984. Importance of estuarine residence for adaptation of chum salmon (*Oncorhynchus keta*) fry to seawater. Canadian Journal of Fisheries and Aquatic Sciences 41(5): 744-749.

Jacobs, S.E. 1988. Oregon coastal salmon spawning surveys, 1985. Oreg. Dep. Fish Wildl., Fish Div., 56 p. (Available from Oregon Department of Fish and Wildlife, P.O. Box 59, Portland, OR 97207.)

Jahn, J. 2010. Personal communication. Fisheries Biologist. National Marine Fisheries Service. Santa Rosa, CA.

Jameson, R.J. and K.W. Kenyon. 1977. Prey of sea lions in the Rogue River, Oregon. *Journal of Mammalogy* 58(4): 672.

Jenkins, T. M. 1969. Social structure, position choice and microdistribution of two trout species (Salmo trutta and Salmo gairdneri) resident in mountain streams. Animal Behavior Monographs 1(2):57–123.

Johnson, C. 2010. Personal communication. Biologist. National Marine Fisheries Service. La Jolla, CA.

Johnson, S.L. 1988. The effects of the 1983 El Niño on Oregon's coho (*Oncorhynchus kisutch*) and chinook (*O. tshawytscha*) salmon. Fish. Res. 6:105-123.

Johnson, S.L., M.F. Solazzi, and J.D. Rogers. 1993. Development and evaluation of techniques to rehabilitate Oregon's wild salmonids. Oreg. Dep. Fish Wildl. Fish Research Proj. F-125-R-5, Annual Rep, 12 p. (Available from Oregon Department of Fish and Wildlife, P. O. Box 59, Portland, OR 97207.)

Johnstone, J.A. and T.E. Dawson. 2010. Climatic context and ecological implications of summer fog decline in the coast redwood region. *Proceedings of the National Academy of Sciences*. 107(10): 4533-4538.

Jong, W.H. and T. Mills. 1992. Anadromous salmonid escapement studies, South Fork Trinity River, 1984 through 1990. Klamath-Trinity Program, Inland Fisheries Division. Unpublished Administrative Report No. 92-XX. 26 p.

Jong, B., L. Preston, and M. Gilroy. 2008. Status of coho salmon (Oncorhynchus kisutch) in California as measured by changes in temporal and spatial historic occurrence Part I: California coastal watersheds north of Punta Gorda. Draft for NMFS. Northern Region Fisheries Program for Fisheries Restoration Grant Program. California Department of Fish and Game. Sacramento, California. September 2.

Jonsson, B. 1997. A review of ecological and behavioural interac- tions between cultured and wild Atlantic salmon. ICES Journal of Marine Science, 54: 1031-1039.

Jordahl, D.M., and Benson, A. 1987. Effect of low pH on survival of brook trout embryos and yolk-sac larvae in West Virginia streams. Trans. Am. Fish. Soc. **116**: 807– 816.

Joseph, L.N., S.A. Field, C. Wilcox, and H.P. Possingham. 2006. Presence-absence versus abundance data for monitoring threatened species. Conservation biology 20(6):1679-1687.

Kahler, T.H., P. Roni, and T.P. Quinn. 2001. Summer movement and growth of juvenile anadromous salmonids in small western Washington streams. Canadian Journal of Fisheries and Aquatic Sciences 58:1947–1956.

Karuk Tribe of California. 2002. Water Quality Control Plan. Karuk Tribe Department of Natural Resources, Orleans, CA. 36 p. (1.2 Mb)

Kaufmann, P.R., Larsen, D.P., Faustini, J.M., 2009. Bed Stability and Sedimentation Associated With Human Disturbances in Pacific Northwest Streams1. JAWRA Journal of the American Water Resources Association 45, 434-459.

Kelsey, H.M. 1980. A sediment budget and an analysis of geomorphic process in the Van Duzen River basin, north coastal California, 1941-1975: Geological Society of America Bulletin, v. 91, no. 41, pt. 2, p. 1119-1216.

Kendall, B.E. and G.A. Fox. 2003. Unstructured individual variation and demographic stochasticity. Conservation biology 17. 1170-1172.

Keppeler, E., Lewis, J., Lisle, T., 2003. Effects of forest management on streamflow, sediment yield, and erosion, Caspar Creek Experimental Watersheds. The First Interagency Conference on Research in the Watersheds, Benson, AZ. USDA Forest Service, Pacific Southwest Research Station, Arcata, CA.

Kier Associates and National Marine Fisheries Service (NMFS). 2008. Updated guide to the reference values used in the Southern Oregon/Northern California coho salmon recovery conservation action planning (CAP) workbooks. July. Arcata, CA.

Kinnison, M.T., M.J. Unwin, A.P. Hendry, and T.P. Quinn. 2001. Migratory costs and the evolution of egg size and number in introduced and indigenous salmon populations.Evolution 55:1656-1667.

Kiparsky M, and Gleick P.H. 2003. Climate change and California water resources: a survey and summary of the literature. Pacific Institute for Studies in Development, Environment, and Security, Oakland, California. California Energy Commission. Report 500-04-073, Sacramento, CA

Klein, R.D. 1979. Urbanization and stream water quality impairment. *Water Resources Bulletin* 15: 948-963.

Klein, R.D., W.J. Trush, M. Buffleben, 2008. Watershed condition, turbidity, and implications for anadromous salmonids in north coastal California streams. Report to North Coast Regional Water Quality Control Board, Santa Rosa, CA.

Knechtle, M. and D. Chesney. 2011. 2010 Scott River Salmon Studies – Final Report. California Department of Fish and Game Northern Region, Klamath River Project, Yreka, California. 21 p.

Knighton, A.D. 1991. Channel bed adjustment along mine-affected rivers of northeast Tasmania. *Geomorphology* **4**, 205–19.

Knowles, N., M. D. Dettinger, and D. R. Cayan, 2006: Trends in snowfall versus rainfall in the western United States. *J. Clim*., 4545–4559.

Koenings, J.P., H.J. Geiger, and J.J. Hasbrouck. 1993. Smolt-to-adult survival patterns of sockeye salmon (*Oncorhynchus nerka*): Effects of smolt length and geographic latitude when entering the sea. Canadian Journal of Fisheries and Aquatic Sciences 50:600-611.

Kohane, M. J. & Parsons, P. A. 1988. Domestication. Evolutionary change under stress. Evolutionary Biology 23, 31–48.

Kondolf, G.M. 1997. Hungry water: Effects of dams and gravel mining on river channels. *Environmental Management* 21(4):533-551.

Kondolf, G.M. 2000. Assessing Salmonid Spawning Gravel Quality. Trans. Am. Fish. Soc. 129:262-281.

Kondolf, G.M., and M.G. Wolman. 1993. The sizes of salmonid spawning gravels. Water Resources Research 29:2275-2285.

Kondolf, G.M., and M.L. Swanson. 1993. Channel adjustments to reservoir construction and instream gravel mining, Stony Creek, California. Environmental Geology and Water Science 21:256-269.

Koski, K.V. 1966. The survival of coho salmon (Oncorhynchus kisutch) from egg deposition to emergence in three Oregon coastal streams. Master's thesis, Oregon State University. 98 pp.

Koski, K V. 2009. Estuarine rearing by age-0 coho salmon: life-history strategy for resilience. Ecology and Society 14(1): 2. [online] URL: http://www.ecologyandsociety.org/vol14/iss1/art2/.

Koslow, J.A., A. Hobday and G. Boehlert. 2002. Climate variability and marine survival of coho salmon (Oncorhynchus kisutch) off the coast of California, Oregon and Washington, USA. Fisheries Oceanography 11: 65-77.

Kostow, K.E. 2004. Differences in juvenile phenotypes and survival between hatchery stocks and a natural population provide evidence for modified selection due to captive breeding. Canadian Journal of Fisheries and Aquatic Sciences 61:577–589.

Kostow K.E. 2009. Factors that contribute to the ecological risks of salmon and steelhead hatchery programs and some mitigating strategies. Rev. Fish Biol. Fish., 19(1): 9-31.

Kostow, K.E. and S.J. Zhou. 2006. The effect of an introduced summer steelhead hatchery stock on the productivity of a wild winter steelhead population. Trans. Am. Fish. Soc. 135:825-841.

Kostow, K.E, Marshall AR, Phelps S.R. 2003. Naturally spawning hatchery steelhead contribute to smolt production but experience low reproductive success. Trans Am Fish Soc 132:780–790.

Kukulka, T., D.A. Jay. 2003. Impacts of Columbia River discharge on water surface elevation and salmonid habitat I. A non-stationary fluvial tide model, J. Geophys. Res., 108(C9), 10.1029/2002JC001382

Kundzewicz, Z.W., L.J. Mata, N.W. Arnell, P. Döll, P. Kabat, B. Jiménez, K.A. Miller, T. Oki, Z. Sen and I.A. Shiklomanov, 2007: Freshwater resources and their management. Climate

Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 173-210.

Kruzic, L. 2011. Fishery Biologist. National Marine Fisheries Service. Salmon Recovery Division. Roseburg, Oregon.

Labelle, M. 1992. Straying patterns of coho salmon (*Oncorhynchus kisutch*) stocks from southeast Vancouver Island, British Columbia. Can. J. Fish. Aquat. Sci. 49:1843-1855.

Laetz, C.A., D.H. Baldwin, T.K. Collier, V. Herbert, J.D. Stark and N. L. Scholz. 2009. The Synergistic Toxicity of Pesticide Mixtures: Implications for Risk Assessment and the Conservation of Endangered Pacific Salmon. Environmental Health Perspectives, Volume 117, No. 3 | March 2009, 348-353.

Lande, R. 1993. Risks of population extinction from demographic and environmental stochasticity and random catastrophes. American Naturalist. 142:911-927.

Landgridge, R. 2002. Changing legal regimes and the allocation of water between two California Rivers. Natural Resources Journal 42: 283-330.

Landsberg, J.H., 2002. The effects of harmful algal blooms on aquatic organisms. Reviews of Fisheries Science 10, 113–390.

Langridge, R. 2002. Changing legal regimes and the allocation of water between two northern California rivers. Natural Resources Journal 42 (2):283–330.

Lanigan, S.H., S.N. Gordon, P. Eldred, M. Isley, S. Wilcox, C. Moyer, and H.Andersen. 2011. Northwest Forest Plan – the first 15 years (1994-2008): status and trend of watershed condition. Gen. Tech. Rep. PNW-GTR-XXX. Portland, OR:U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Larkin, P.A. 1977. Pacific salmon. Pages 156-186 in J. A. Gulland, editor. Fish population dynamics.

Lathrop R.C., S.R. Carpenter, J.C. Panuska, P.A. Soranno, and CF.A. Stow. 1998. Phosphorus Loading Reductions Needed to Control Blue-green Algal Blooms in Lake Mendota. Canadian Journal of Fisheries and Aquatic Sciences 55:1169-1178.

Lawson, P.W. 1993. Cycles in ocean productivity, trends in habitat quality, and the restoration of salmon runs in Oregon. Fisheries 18(8):6-10.

Learn, S. 2011. Gold miner Cliff Tracy agrees to stop mining on Galice Creek in southwest Oregon. The Oregonian, Friday, June 24, 2011. 1 p.

Leidy, R.A., and G.R. Leidy. 1984. Life stage periodicities of anadromous salmonids in the Klamath River Basin, northwestern California. U.S. Fish and Wildlife Service, Sacramento, California, 38 p. (Available U.S. Fish and Wildlife Service, Division of Ecological Services, Sacramento Field Office, 2800 Cottage Way, Rm. 1803, Sacramento, CA 95825.)

Leopold, L.B. 1968, Hydrology for Urban Land Planning A Guidebook on the Hydrologic Effects of Urban Land Use, U.S. Geological Survey Circular 554, 18p.

Lettenmaier, D. P. and T. Y. Gan. 1990. "Hydrologic Sensitivities of the Sacramento-San Joaquin River Basin, California, to Global Warming," Water Resources Research. 26(1): 69-86.

Levin P.S, R.W. Zabel, and J.G. Williams. 2001. The road to extinction is paved with good intentions: negative asso- ciation of fish hatcheries with threatened salmon. Proc R Soc Lond 268:1153–1158.

Levin, P.S. and N. Tolimieri. 2001. Differences in the impacts of dams on the dynamics of salmon populations Journal: Animal Conservation Volume: 4 Issue: 4 Pages: 291-299

Liermann, M. and R. Hilborn. 2001. Depensation: evidence, models, and implications. Fish and Fisheries 2: 33-58.

Ligon, F.K., W.E. Dietrich and W.J. Trush. 1995. Ecological Effects of dams. Page 183 of 183-192 Bioscience 1995

Ligon, F.K., A. Rich, G. Rynearson, D. Thornburgh, and W. Trush. 1999. Report of the Scientific Review Panel on California Forest Practice Rules and Salmonid Habitat. Prepared for the Resources Agency of California and the National Marine Fisheries Service; Sacramento, CA.

Lindley, S.T., R.S. Schick, E. Mora, P.B. Adams, J.J. Anderson, S. Greene, C. Hanson, B. May, D. McEwan, R.B. MacFarlane, C. Swanson, and J.G. Williams. 2007. Framework for assessing viability of threatened and endangered Chinook salmon and steelhead in the Sacramento-San Joaquin Basin. San Francisco Estuary and Watershed Science 5: Article 4.

Lisle, T.E. 1982. Effects of aggradation and degradation on riffle-pool morphology in natural gravel channels, northwestern California. Water Resources Research 18(6):1643-1651.

Lisle, T.E. 1989. Sediment transport and resulting deposition in spawning gravels, North Coast California. Water Resource Research 25: 1303-1319.

Lister, D.B., L.M. Thorson, and I. Wallace. 1981. Chinook and coho salmon escapements and coded-wire tag returns to the Cowichan-Koksilah river system, 1976-1979. Can. Manuscript Rep. Fish. Aquat. Sci. 1608, 168 p.

Loeffel, R.E., and H.O. Wendler. 1968. Review of the Pacific coast chinook and coho salmon resources with special emphasis on the troll fishery. Prepared by the U.S. working group of the Informal Committee on Chinook and Coho, 107 p. (Available from Oregon Department of Fish and Wildlife, P.O. Box 59, Portland, OR 97207.)

Logerwell, E.A., Mantua, N.J., Lawson, P.W., Francis, R.C., and Agostini, V.N. 2003. Tracking environmental processes in the coastal zone for understanding and predicting Oregon coho (Oncorhynchus kisutch) marine survival. Fish. Oceanogr. 12: 554–568.

Lorenz, J.M., and J.H. Eiler. 1989. Spawning Habitat and Redd Characteristics of Sockeye Salmon in the Glacial Taku River, British Columbia and Alaska. Transactions of the American Fisheries Society 118:495-502.

Luers, A.L., P.C. Frumhoff, K. Hayhoe, M.D. Mastrandrea. 2007. How to avoid dangerous climate change: a target for U.S. emissions reductions. Union of Concerned Scientists (UCS), Cambridge, MA

Macdonald, J.S., C.D. Levings, C.D. McAllister, U.H.M. Fagerlund, and J.R. McBride. 1988. A field experiment to test the importance of estuaries for chinook salmon (*Oncorhynchus tshawytscha*) survival: Short-term results. Canadian Journal of Fisheries and Aquatic Sciences 45(8): 1366-1377.

MacDonald, L., A.W. Smart, and R.C. Wissmar. 1991. Monitoring guidelines to evaluate effects for forestry activities on streams in the Pacific Northwest and Alaska. U.S. Environmental Protection Agency, Region 10, NPS Section, WD-139, Seattle, Washington.

MacFarlane, R.B., S. Hayes, and B. Wells. 2008. Coho and Chinook Salmon Decline in California during the Spawning Seasons of 2007/'08. Unpublished memo.

Madej, M.A., Sutherland, D.G., Lisle, T.E., Pryor, B., 2009. Channel responses to varying sediment input: A flume experiment modeled after Redwood Creek, California. Geomorphology 103, 507–519.

Mantua, N., S. Hare, Y. Zhang, J. Wallace, and R. Francis. 1997. A Pacific interdecadal climate oscillation with impacts on salmon production, Bull. Am. Meteorol. Soc., 78, 1069–1079.

Marine, K.R. and J.J. Cech Jr. 2004. Effects of High Water Temperature on Growth, Smoltification, and Predator Avoidance in juvenile Sacramento River Chinook Salmon. N. Amer. J. Fish. Man. 24:198-210

Martin, A. 2009. Personal Communication. Fisheries Biologist, Yurok Tribal Fisheries Program.

Mason, J.C., and D.W. Chapman. 1965. Siqnificance of early emergence, environmental rearing capacity, and behavioral ecology of juvenile coho salmon in stream channels. J. Fish. Res. Board Can. 22(1): 172-190.
Mathews, S.B., and R. Buckley. 1976. Marine mortality of Puget Sound coho salmon (Oncorhynchus kisutch). Journal of the Fisheries Research Board of Canada 33:1677-1684.

Matthews, G.M., D.L. Park, S. Achord, and T.E. Ruehle. 1986. Static seawater challenge test to measure relative stress levels in spring Chinook salmon smolts. Transactions of the American Fisheries Society 115:236-244.

Maule, A.G., C.B. Schreck, C.S. Bradford, and B.A. Barton. 1988. Physiological effects of collecting and transporting emigrating juvenile chinook salmon past dams on the Columbia River. Transactions of the American Fisheries Society 117:245-261.

May, C.W., E.B. Welch, R.R. Horner, J.R. Karr, and B.W. Mar. 1997. Quality Indices for Urbanization Effects in Puget Sound Lowland Streams. Washington Department of Ecology, Olympia, WA.

May, R.M. 1973. Stability in randomly fluctuating versus deterministic environments. American Naturalist 107: 621-650.

McCullough, D. 1999. A Review and Synthesis of Effects of Alterations to the Water Temperature Regime on Freshwater Life Stages of Salmonids, with Special Reference to Chinook Salmon. Columbia Intertribal Fisheries Commission, Portland, OR. Prepared for the U.S. Environmental Protection Agency Region 10. Published as EPA 910-R-99-010.

McElhany P., T. Backman, C. Busack, S. Heppell, S. Kolmes, A. Maule, J. Myers, D. Rawding, D. Shively, A. Steel, C. Steward, and T. Whitesel. 2003. Interim report on viability criteria for Willamette and Lower Columbia Basin Pacific salmonids. Willamette/Lower Columbia Technical Recovery Team report, 31 March 2003. NOAA Fisheries, Seattle, Washington. Available at: www.nwfsc.noaa.gov/trt/wlc_viabrpt/complete.pdf.

McElhany, P., M. Ruckelshaus, M. Ford, T. Wainwright, and E. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-42, 158p.

McGinnity,P., P. Prodohl, A. Ferguson, R. Hynes, N. O'Maoi-le´idigh, N. Baker, D. Cotter, B. O'Hea, D. Cooke, G. Rogan, J. Taggart, and T. Cross. 2003. Fitness reduction and potential extinction of wild populations of Atlantic salmon, Salmo salar, as result of interactions with escaped farmed salmon. Proceedings of the Royal Society of London Series B, 270: 2443-2450.

McGurk, M.D. 1996. Allometry of marine mortality of Pacific Salmon. Fish Bulletin 94:77-88

McHugh P. and P. Budy. 2006. Experimental effects of nonnative brown trout (Salmo trutta) on the individ- ual- and population-level performance of native Bonneville cutthroat trout (Oncorhynchus clarkii utah). Trans Am Fish Soc 135:1441–1455

McIntosh, B.A., J.R. Sedell, J.E. Smith, R.C. Wissmar, S.E. Clarke, G.H. Reeves, and L.A. Brown. 1994. Management History of Eastside Ecosystems: Change in Fish Habitat Over 50 Years, 1935 to 1992. 1994. Forest Service, U.S. Department of Agriculture.

Mclean, J.E., P. Bentzen, and T.P. Quinn. 2003. Differential reproductive success of Sympatric, naturally spawning hatchery and wild steelhead trout (*Oncorhynchus mykiss*) through the adult stage. Can. J. Fish. Aquat. Sci. 60(4): 433–440. doi:10.1139/f03-040.

McLeod, R.F. and C.F. Howard. 2010. January 7, 2010 Mill Creek Fisheries Monitoring Program Final Report. Mill Creek Fisheries Monitoring Program Funded by California Department of Fish and Game Fisheries Restoration Grants Program. Grantee Agreement No. P0610530.

McMichael, G.A., C.S. Sharpe, and T.N. Pearson. 1997. Effects of residual hatchery-reared steelhead on growth of wild rainbow trout and spring chinook salmon. Trans. Am. Fish. Soc. 126, 230–239.

Meengs, C.C. and R.T. Lackey. 2005. Estimating the size of historical Oregon salmon runs. Reviews in Fisheries Science 13:51-66.

Melbourne, B.A. and A. Hastings. 2008. Extinction risk depends strongly on factors contributing to stochasticiy. Nature 454: 100-103.

Menzie C., A.M. Burke, D. Grasso, M. Harnois, B. Magee, D. McDonald, C. Montgomery, A. Nichols, J. Piquatello, B. Price, and R. Price. 2000. An Approach for Incorporating Information on Chemical Availability in Soils into Risk Assessment and Risk-Corrective Action. Prepared by the New England Environmentally Acceptable Endpoints Workgroup. Human and Ecological Risk Assessment. Vol. 6 (3) p. 479 - 510.

Merrell, T.R., Jr., and K.V. Koski. 1978. Habitat values of coastal wetlands for pacific coast salmonids. Pages 256–266 *in* P. E. Greeson, and J. R. Clark, editors. Wetland functions and values: the state of our understanding: proceedings of the national symposium on wetlands. American Water Resources Association, Minneapolis, Maryland.

Miller, B. and S. Sadro. 2003. Residence Time and Seasonal Movements of Juvenile Coho Salmon in the Ecotone and Lower Estuary of Winchester Creek, South Slough, Oregon. Transactions of the American Fisheries Society 132:546–559.

Miller, B., K. Nordholm, and R.J. Constable, Jr. 2008. West Fork Smith River Salmonid Life Cycle Monitoring Project, Draft Report 2007-2008, Oregon Department of Fish and Wildlife, Western Oregon Research and Monitoring Program.

Minshall, G.W. 2003. Responses of stream benthic macroinvertebrates to fire. Forest Ecology and Management 178:155-161.

Mobrand, L., J. Barr, D. Campton, T. Evelyn, T. Flagg, C. Mahnken, L. Seeb, P. Seidel, and W. S moker. 2005 . Hatchery Reform in Washington State: Principles and Emerging Issues. Fisheries, 30(6):11-23.

Montgomery DR, Collins BD, Buffington JM, Abbe TB. 2003. Geomorphic effects of wood in rivers. In: Gregory, Stan V.; Boyer, Kathryn L.; Gurnell, Angela M., eds. The ecology and management of wood in world rivers. American Fisheries Society Symposium 37: 21-47.

Montgomery, D.R., Schmidt, K.M., Greenberg, H.M., Dietrich, W.E., 2000. Forest clearing and regional landsliding. Geology 28, 311.

Moring, J.R., and R.L. Lantz. 1975. The Alsea watershed study: effects of logging on the aquatic resources of three headwater streams of the Alsea River, Oregon. Part I—Biological studies. Fishery Research Report 9. Oregon Department of Fish and Wildlife, Portland, Oregon.

Moseley, M., R.D. Harmel, R. Blackwell, and T. Bidwell. 1998. Grazing and riparian area management. p. 47-53. In: M.S. Cooper (ed.) Riparian Area Management Handbook. Oklahoma Cooperative Extension Service, Division of Agricultural Services and Natural Resources, Oklahoma State University and the Oklahoma Conservation Commission. www.okstate.edu/OSU_Ag/e-952.pdf [PDF/3.3M]

Mote, P.W. and 18 co-authors. 1999. Impacts of climate variability and change: Pacific Northwest. A report of the Pacific Northwest Regional Assessment Group for the U.S. Global Change Research Program. JISAO/SMA Climate Impacts Group, University of Washington, Seattle.

Moyle, P.B. 2002. Inland fishes of California. Revised and expanded. University of California Press, Berkely, CA.

Moyle, P.B., J.A. Israel, and S.E. Purdy. 2008. Salmon, steelhead, and trout in California: status of an emblematic fauna. University of California, Davis. Available: www. caltrout.org/SOS-Californias-Native-Fish-Crisis-Final-Report.pdf.

Mundy, P.R. 1997. The role of harvest management in the future of Pacific salmon populations: shaping human behavior to enable the persistence of salmon. In: Stouder, Deanna J., Peter A. Bisson, and Robert J. Naiman, editors. *Pacific Salmon and Their Ecosystems: Status and Future Options*. Chapman and Hall, Inc., New York, NY, p. 315-329.

Murphy, G.I. 1952. An analysis of silver salmon counts at Benbow Dam, South Fork Eel River California. Calif Fish Game 38:105-112.

Murphy, M.L. 1995. Forestry impacts on freshwater habitat of anadromous salmonids in the Pacific Northwest and Alaska-requirements for protection and restoration. U.S.

Deparment of Commerce (NOAA) Coastal Ocean Program. Decision Analysis Series No. 7.

Murphy, M.L., J.F. Thedinga, K.V. Koski, and G.B. Grette. 1984. A stream ecosystem in an old-growth forest in southeastern Alaska. Part V: seasonal changes in habitat utilization by juvenile salmonids. Pages 89–98 in W.R. Meehan, T.R. Merrell, Jr., and T.A. Hanley, editors. Symposium proceedings on fish and wildlife relationships in old-growth forests. American Institute of Fisheries Research Biologists, Auke Bay, Alaska.

Murray,C.A., and C.D. Ziebell. 1984. Acclimation of rainbow trout to high pH to prevent stocking mortality in summer. Prog. Fish-Cult. 46:176-179.

Murray, C.B., T.D. Beacham, and J.D. McPhail. 1990. Influence of parental stock and incubation on the early development of coho salmon (*Oncorhynchus kisutch*) in British Columbia. Can. J. Zool. 68:347-358.

Nakamoto, R.J. 1998. Effects of timber harvest on aquatic vertebrates and habitat in the North Fork Caspar Creek. Pages 87-96 in R.R. Ziemer (technical coordinator). Proceedings of the Conference on Coastal Watersheds: the Caspar Creek Story, 6 May 1998, Ukiah, California. General Technical Report PSW GTR-168. Pacific Southwest Research Station, Forest Service, US Department of Agriculture, Albany, California.

Naman, S.W. 2008. Predation by hatchery steelhead on natural salmon fry in the Upper Trinity River, California. M.S. Thesis, Humboldt State University, December 2008. 74 pp. Available online at: http://hdl.handle.net/2148/449.

Narver, D.W. 1978. Ecology of juvenile coho salmon: can we use present knowledge for stream enhancement? Pages 38-42 in B. G. Shephard and R. M. J. Grinetz (eds.). Proc. 1977 Northeast Pacific chinook and coho salmon workshop. Dept. Fish. Environ., Vancouver. Canada Fish. Marine Servo Tech. Rep. 759.

NMFS. 1990. Endangered and threatened species; listing and recovery priority guidelines. Notice. Federal Register, Volume 55, No. 115. Friday, June 15, 1990. 3 p.

National Marine Fisheries Service (NMFS). 1996. Coastal Salmon Conservation: Working Guidance for Comprehensive Salmon Restoration Initiatives on the Pacific Coast. September 1996. 5pp.

National Marine Fisheries Service (NMFS). 1997. Endangered Species Act - Section 7 Consultation, Biological Opinion and Conference Opinion on Continued Implementation of Land and Resource Management Plans (USFS) and Land Use Planning Documents (BLM): USDA Forest Service: Klamath, Mendocino, Shasta-Trinity, and Six Rivers National Forests; USDI Bureau of Land Management: Arcata, Clear Lake, and Redding Resource Areas. National Marine Fisheries Service (NMFS), Southwest Region, Long Beach, California. June 20.

National Marine Fisheries Service (NMFS). 1998. Factors Contributing to the Decline of Chinook Salmon: An Addendum to the 1996 West Coast Steelhead Factors for Decline Report. Northwest Region, Protected Resources Division. Portland, Oregon. 74 p.

National Marine Fisheries Service (NMFS). 1999. Supplemental Biological Opinion and Incidental Take Statement: The Pacific Coast Salmon Plan and Amendment 13 to the Plan. 51 p.

National Marine Fisheries Service (NMFS). 2001. Status review update for coho salmon (Oncorhynchus kisutch) from the Central California Coast and the California Portion of the Southern Oregon/Northern California Coast Evolutionarily Significant Units. Southwest Fisheries Science Center, Santa Cruz, California. April 12. 43 p.

National Marine Fisheries Service (NMFS). 2003. Updated July 2000 4(d) Rule Implementation Binder for Threatened Salmon and Steelhead on the West Coast. 103 p.

National Marine Fisheries Service (NMFS). 2004. Interim Endangered and Threatened Species Recovery Planning Guidance Version 1.3. National Marine Fisheries Service, Silver Spring, Maryland. October.

National Marine Fisheries Service (NMFS). 2006. Historical Population Structure of Coho Salmon in the Sothern Oregon / Northern California Coasts Evolutionarily Significant Unit. NOAA-TM-NMFS-SWFSC-390.

National Marine Fisheries Service (NMFS). 2007a. Magnuson-Stevens Reauthorization Act Klamath River Coho Salmon Recovery Plan. Prepared by Rogers, F. R., I. V. Lagomarsino and J. A. Simondet for the National Marine Fisheries Service, Long Beach, CA. 48 pp.

National Marine Fisheries Service (NMFS). 2007b. Adaptive Management for ESA-Listed Salmon and Steelhead Recovery: Decision Framework and Monitoring Guidance. NOAA’s National Marine Fisheries Service Northwest Region and Northwest Fisheries Science Center. 66 p.

National Marine Fisheries Service (NMFS). 2008a. Biennial Report to Congress on the Recovery Program for Threatened and Endangered Species. October 1, 2006 – September 30, 2008. National Marine Fisheries Service. Silver Spring, Maryland. 184 p.

National Marine Fisheries Service (NMFS). 2008b. Environmental Protection Agency Registration of Pesticides Containing Chlorpyrifos, Diazinon, and Malathion. National Marine Fisheries Service Endangered Species Act Section 7 Consultation Biological Opinion. NMFS, Silver Springs Md. 478 p.

National Marine Fisheries Service (NMFS). 2009. Fisheries of the United States – 2008. Silver Spring, MD: U.S. Department of Commerce, National Marine Fisheries Service, Office of Science and Technology, Fisheries Statistics Division. 103pp.

National Marine Fisheries Service (NMFS). 2010. Interim Endangered and Threatened Species Recovery Planning Guidance Version 1.3 National Marine Fisheries Service1315 East-West Hwy. Silver Spring, MD 20910.

National Marine Fisheries Service (NMFS). 2011. Southern Oregon/Northern California Coast Recovery Domain 5-Year Review: Summary and Evaluation of Southern Oregon/Northern California Coast Coho Salmon ESU. National Marine Fisheries Service Southwest region. Long Beach, California. 59 p.

National Marine Fisheries Service (NMFS) and California Department of Fish and Game (CDFG). 2001. Joint Hatchery Review Committee Final report on Anadromous Salmonid Fish Hatcheries in California. December 3, 2001

National Research Council (NRC). 2004. Endangered and threatened fishes in the Klamath River basin: causes of decline and strategies for recovery. Committee on Endangered and Threatened Fishes in the Klamath River Basin, Board of Environmental Toxicology, Division on Earth and Life Studies, Washington D.C. 398 p.

National Wildlife Federation (NWF). 2007. Sea Level Rise and Coastal Habitats in the Pacific Northwest: An analysis for the Puget Sound, Southwestern Washington, and Northwestern Oregon. 106 pp.

Nawa, R.K. and C.A. Frissell. 1993. Measuring scour and fill of gravel streambeds with scour chains and sliding-bead monitors. North American Journal of Fisheries Management 13(3):634-639.

Neave, F. 1949. Game fish populations on the Cowichan River. Fisheries Research Board of Canada Bulletin 84.

Nehlsen. W., J. Williams, and J. Lichatowich. 1991. Pacific Salmon at the Crossroads: Stocks at Risk from California, Oregon, Idaho, and Washington. Fisheries 16(2): 4–21.

Newcombe, C.P. and J.O.T. Jensen. 1996. Channel Suspended Sediment and Fisheries: A Synthesis for Quantitative Assessment of Risk and Impact. North American Journal of Fisheries Management 16: 693-727.

Newcombe, C.P. and D.D. MacDonald. 1991. Effects of Suspended Sediments on Aquatic Ecosystems. North American Journal of Fisheries Management. 11: 72-82.

Nichols, K. and J.S. Foott. 2005. Health Monitoring of Juvenile Klamath River Chinook Salmon, FY 2004 Investigational Report. USFWS California-Nevada Fish Health Center, Red Bluff, CA. (77 Kb)

Nichols K, K. True, R. Fogerty, and L. Ratcliff. 2008. Klamath River juvenile salmonid health monitoring, April-August 2007. FY 2007 Investigational report. US Fish and Wildlife Service, CA-NV Fish Health Center

Nichols, K. M., Young, W. P., Danzmann, R. G., Robison, B. D., Rexroad, C., Noakes, M., Phillips, R. B., Bentzen, P., Spies, I., Knudsen, K., Allendorf, F. W., Cunningham, B. M., Brunelli, J., Zhang, H., Ristow, S., Drew, R., Brown, K. H., Wheeler, P. A. and Thorgaard, G. H. 2003. A consolidated linkage map for rainbow trout (*Oncorhynchus mykiss*). Animal Genetics, 34: 102–115. doi: 10.1046/j.1365-2052.2003.00957.x

Nickelson, T.E. 1998. A Habitat-Based Assessment of Coho Salmon Production Potential and Spawner Escapement Needs for Oregon Coastal Streams. Oregon Department. Fish and Wildlife, Information Report, 98-4, Salem

Nickelson, T. 2003. The influence of hatchery coho salmon (Oncorhynchus kisutch) on the productivity of wild coho salmon populations in Oregon coastal basins. Can J Fish Aquat Sci 60:1050–1056

Nickelson, T.E., and P.W. Lawson. 1998. Population viability of coho salmon, *Oncorhynchus kisutch*, in Oregon coastal basins: application of a habitat-based life cycle model. Canadian Journal of Fisheries and Aquatic Sciences 55:2383-2392.

Nickelson, T.E., J.W. Nicholas, A.M. McGie, R.B. Lindsay, D.L. Bottom, R.J. Kaiser, and S.E. Jacobs. 1992. Status of anadromous salmonids in Oregon coastal basins. Oreg. Dep. Fish. Wildl., Res. Develop. Sect. and Ocean Salmon Manage., 83 p. (Available from Oregon Department of Fish and Wildlife, P. O. Box 59, Portland, OR 97207.)

Nimick DA, Gammons CH, Parker SR. 2011. Diel biogeochemical processes and their effect on the aqueous chemistry of streams: A review. Chemical Geology 283:3–17.

North Coast Regional Water Quality Control Board (NCRWQCB). 2001. Water Quality Control Plan for the North Coast Region. Staff report adopted by the North Coast Regional Water Quality Control Board on June 28, 2001. Santa Rosa, CA. 124 p. Appendix.

North Coast Regional Water Quality Control Board (NCRWQCB). 2009. Water Quality Control Plan for the North Coast Region. Staff report adopted by the North Coast Regional Water Quality Control Board in January 2009. Santa Rosa, CA. 124 p.

Northcote, T.G. and D.Y. Atagi. 1997. Pacific salmon abundance trends in the Fraser River watershed compared with other British Columbia systems. In: Pacific salmon and their ecosystems. D. J. Strouder, P.A Bisson, R. J. Naiman editors. Chapman and Hall. New York, New York.

Opperman, J.J., Lohse, K.A., Brooks, C., Kelly, N.M., Merenlender, A.M., 2005. Influence of land use on fine sediment in salmonid spawning gravels within the Russian River Basin, California. Canadian Journal of Fisheries and Aquatic Sciences 62, 2740–2751.

Oregon Department of Environmental Quality (ODEQ). 2000. Oregon Nonpoint Source Control Program Plan, 2000 Update. ODEQ, Portland, Oregon. 190 p.

Oregon Department of Fish and Wildlife (ODFW). 1998. Hatchery Genetic Management Plan for Cole Rivers Hatchery. 49 p.

Oregon Department of Fish and Wildlife (ODFW). 2003a. Fish Hatchery Management Policy. May 9, 2003. 20 p.

Oregon Department of Fish and Wildlife. 2003b. Native Fish Conservation Policy, 635-007-0502 through 0509. November 8, 2002; revised September 12, 2003.

Oregon Department of Fish and Wildlife (ODFW). 2005a. Oregon Native Fish Status Report. Volume II. Assessment Methods and Population Results. Salem, Oregon.

Oregon Department of Fish and Wildlife (ODFW). 2005b. The Importance of Beaver (Castor Canadensis) to Coho Habitat and Trend in Beaver Abundance in the Oregon Coast Coho ESU. ODFW, Portland, OR. 11 p.

Oregon Department of Fish and Wildlife (ODFW). 2008. Oregon fish passage barriers database. State-wide inventory of known barriers to fish passage. Accessed online on 12/1/2008 at http://nrimp.dfw.state.or.us/OregonPlan/default.aspx?p=134&XMLname=44.xml

Oregon Department of Fish and Wildlife (ODFW). 2009. Cole Rivers Hatchery Operation Plan. 32 p. ODFW. 2011a. Estimates of the run size of Rogue basin adult coho salmon past Huntley park, 1980-2010. Accessed 9/27/11 from site: http://oregonstate.edu/dept/ODFW/spawn/pdf_files/coho/RogueCoho.pdf

Oregon Department of Fish and Wildlife (ODFW). 2011a. 2011 Oregon Sport Fishing Regulations. 108 p.

Oregon Department of Fish and Wildlife (ODFW). 2011b. Estimates of the run size of Rogue basin adult coho salmon past Huntley Park, 1980-2010. Accessed 9/27/11 from site: http://oregonstate.edu/dept/ODFW/spawn/pdf%20files/coho/RogueCoho.pdf

Oregon Division of State Lands. 1999. Placer mining in the State of Oregon. A Guide To Recreational And Small-Scale Placer Mining In Oregon's Waterways: What You Should Know Before You Begin. 21 pages.

Oregon Department of Transportation (ODOT). 1999. Routine Road Maintenance: Water Quality and Habitat Guide Best Management Practices. Salem, OR. July. 51 p.

Oregon Water Resources Department (OWRD). 2009. Water Rights in Oregon, An Introduction to Oregon's Water Laws. Centennial Edition. September 2009. 48 Pages

Pacific Fishery Management Council (PFMC). 1999. Review of the 1998 ocean salmon fisheries. Chapter 3 – Inside Coho salmon fisheries and spawning escapements. Pacific

Fishery Management Council, Portland, Oregon. *Available from* Pacific Fishery Management Council, 2130 SW Fifth Ave., Suite 224, Portland, OR 97201.

Pacific Fishery Management Council (PFMC). 2001. *Review of 2000 Ocean Salmon Fisheries.* (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384.

Pacific Fishery Management Council (PFMC). 2002. *Review of 2001 Ocean Salmon Fisheries.* (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384.

Pacific Fishery Management Council (PFMC). 2003. *Review of 2002 Ocean Salmon Fisheries.* (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384.

Pacific Fishery Management Council(PFMC). 2004. *Review of 2003 Ocean Salmon Fisheries.* (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384.

Pacific Fishery Management Council (PFMC). 2005. *Review of 2004 Ocean Salmon Fisheries.* (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384.

Pacific Fishery Management Council (PFMC). 2006. *Review of 2005 Ocean Salmon Fisheries.* (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384.

Pacific Fishery Management Council (PFMC). 2007. *Review of 2006 Ocean Salmon Fisheries.* (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384.

Pacific Fishery Management Council (PFMC). 2008. *Review of 2007 Ocean Salmon Fisheries.* (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384.

Pacific Fishery Management Council (PFMC). 2009. *Review of 2008 Ocean Salmon Fisheries.* (Document prepared for the Council and its advisory entities.) Pacific Fishery

Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384

Pacific Fishery Management Council (PFMC). 2010. *Review of 2009 Ocean Salmon Fisheries.* (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384.

Pacific Fishery Management Council (PFMC). 2011. www.pcouncil.org. Accessed 4/27/11.

Pacific Lumber Company (PALCO). 1999. Habitat Conservation Plan for the Properties of The Pacific Lumber Company, Scotia Pacific Holding Company, and Salmon Creek Corporation February 1999 Revision. 166 pages

Pearcy, W.G. 1992. Ocean ecology of North Pacific salmonids. Seattle, WA, Washington Sea Grant Program, University of Washington Press.

Pearse D.E., C.J. Donohoe, J.C. Garza. 2007. Population genetics of steelhead (*Oncorhynchus mykiss*) in the Klamath River. Environmental Biology of Fishes 80, 377-387.

Peterman, R.M. 1982. Non-linear relation between smolts and adults in Babine Lake sockeye populations and implications for other salmon populations. Can. J. Fish. Aquat. Sci. 39:904-913.

Peterson, N.P. 1982. Immigration of juvenile coho salmon (Oncorhynchus kisutch) into riverine ponds. Can. J. Fish. Aquat. Sci. 39:1308-1310.

Petersson, E., and T. Järvi. 1993. Differences in reproductive traits between sea-ranched and wild sea-trout (Salmo trutta) originating from a common stock. Nordic Journal of Freshwater Research 68:91–97.

Pfeffer, W.T., J.T. Harper, and S. O'Neel. 2008. Kinematic Constraints on Glacier Contributions to 21st- Century Sea Level Rise. Science AAAS. W.T. Science 321. Available at: http://www.sciencemag.org/content/321/5894/1340.full

Platts, W.S., R.J. Torquemada, M.L. Mchenry, and C.K. Graham. 1989. Changes in salmon spawning and rearing habitat from increased delivery of fine sediment to the South-Fork Salmon River, Idaho. Transactions of the American Fisheries Society 118:274–283.

Pollock MM, Pess GR, Beechie TJ, Montgomery DR. 2004. The importance of beaver ponds to coho salmon production in the Stillaguamish River basin, Washington, USA. North American Journal of Fisheries Management 24:749–760.

Polos, J. (Yurok Tribal Fisheries Program). 1994. Memo to Greg Bryant (NMFS), 5/7/94.

Preusch, M. 2009. Feds cracking down on illegal mining on Oregon's public lands. The Oregonian, Tuesday, December 2, 2009. 1 p.

Price, E. O. 1984. Behavioral aspects of animal domestication. Quarterly Review of Biology 59(1):1– 32.

Quartz Valley Indian Reservation. 2009. Water Quality Monitoring and Assessment Report 2008. By Crystal Bowman, Environmental Director, QVIR, Fort Jones, CA. 65 p.

Quinn, T.P. 1993. A review of homing and straying of wild and hatchery-produced salmon. Fisheries Research 18:29-44.

Quinn, T.P. 2005. The behavior and ecology of Pacific salmon and trout. UBC Press, Vancouver.

Quinn, T.P. and N.P. Peterson. 1996. The influence of habitat complexity and fish size on over-winter survival and growth of individually marked juvenile coho salmon (*Oncorhynchus kisutch*) in Big Beef Creek, Washington. Can. J. Fish Aqu. Sci. 53: 1555-1564.

Ransom, B.O. 2007. Extended freshwater rearing of juvenile Coho salmon (Oncorhynchus kisutch) in Northern California streams. Masters Thesis – Humboldt State Universtiy, Arcata, CA.

Raymond,H.L. 1979. Effects of Dams and Impoundments on Migrations of Juvenile Chinook Salmon and Steelhead from the Snake River, 1966 to 1975. Transactions of the American Fisheries Society 1979; 108: 505-529 doi: 10.1577/1548 8659(1979)108<505:EODAIO>2.0.CO;2

Reeves, G.H., F.H. Everest and J.R. Sedell. 1993 . Diversity of Juvenile Anadromous Salmonid Assemblages in Coastal Oregon Basins with Different Levels of Timber Harvest. Transactions of the American Fisheries Society. Vol 122, No. 3. May 1993.

Reeves, G.H., P.A. Bisson, and J.M Dambacher. 1998. Fish communities. Pages 200–234 in R. J. Naiman, R. E. Bilby, and S. Kantor editors. River ecology and management: lessons from the Pacific coastal ecosystem. Springer, New York.

Reeves GH, Everest FH, Nickelson TE. 1989. Identification of physical habitats limiting the production of coho salmon in western Oregon and Washington. US Forest Service General Technical Report PNW 245.

Reid, L.M., Dewey, N.J., Lisle, T.E., Hilton, S., 2010. The incidence and role of gullies after logging in a coastal redwood forest. Geomorphology 117, 155–169.

Reinhardt, U. 2001. Selection for surface feeding in farmed and sea - ranched Masu salmon juveniles. Transactions of the American Fisheries Society 130:155–158.

Reisenbichler, R.R. and McIntyre, J.D. 1977 Genetic differences in growth and survival of juvenile hatchery and wild steelhead trout, Salmo gairdneri. Can. J. Fish. Res. Board 34, 123–128.

Reisenbichler, R.R. and S.P. Rubin. 1999. Genetic changes from artificial propagation of Pacific salmon affect the productivity and viability of supplemented populations. ICES J. Mar. Sci. 56:459–466.

Resighini Rancheria Environmental Department. 2006. Draft Revised Tribal Water Quality Ordinance of the Resighini Rancheria. Prepared with assistance from Kier Associates, Arcata, CA. Resighini Rancheria, Klamath, CA. (212 Kb)

Richter, A. and S.A. Kolmes. 2003. Maximum Temperature: Upper Optimal Temperature Limits for Salmonids in the Willamette and Lower Columbia Rivers. Appendix L of Interim Report on viability criteria for Williamette and Lower Columbia Basin Pacific salmonids.

Ricker, S. 2002. Annual report; Bear River juvenile salmonid emigration run-size estimates, 2000-2001. Project 2a4. California Department of Fish and Game, Northern California - North Coast Region. Steelhead Research and Monitoring Program . Arcata, CA January.

Ricker, S.J. and C.W. Anderson. 2011. Freshwater Creek Salmonid Life Cycle Monitoring Station. Annual Report. California Department of Fish and Game, Anadromous Fisheries Resource Assessment and Monitoring Program, Arcata, CA.

Ricks, C.L. 1995. Effects of channelization on sediment distribution and aquatic habitat at the mouth of Redwood Creek, northwestern California. Pages Q1-Q17, in: Nolan, K.M., H.M. Kelsey, and D.C. Marron, eds., Geomorphic processes and aquatic habitat in the Redwood Creek basin, northwestern California . U.S. Geological Survey Professional Paper 1454. Washington, DC. 21 pp.

Riverbend Sciences. 2011. Beaver Mapper. Online map of beaver distribution in California and Oregon. Riverbend Sciences, Eureka, California. Available online at http://www.riverbendsci.com/projects/beavers Accessed 12/6/2011.

Roberts, R.G., Church, M. 1986. The sediment budget in severely disturbed watersheds, Queen Charlotte Ranges, British Columbia. Can. J. For. Res. 16, 1092–1106.

Rodgers, J.D., R.D. Ewing, and J.D. Hall. 1987. Physiological changes during seaward migration of wild juvenile coho salmon (*Oncorhynchus kisutch*). Canadian Journal of Fisheries and Aquatic Sciences 44:452–457.

Rodgers, J.D., S.L. Johnson, T.E. Nickelson, and M.F. Solazzi. 1993. The seasonal use of natural and constructed habitat by juvenile coho salmon (*Oncorhynchus kisutch*) and preliminary results from two habitat improvement projects on smolt production in Oregon coastal streams. *In* L. Berg and P.W. Delaney (editors), Proceedings of the Coho Workshop, Nanaimo, B.C., May 26-28, 1992, p. 344-351. (Available from Department of

Fisheries and Oceans, Habitat Management Sector, Policy and Information Unit, 327-555 West Hastings Street, Vancouver, BC V6B 5G3.)

Rodgers, J.D., K.K. Jones, A.G. Talabere, C.H. Stein, and E.H. Gilbert. 2005. Oregon coast coho habitat assessment, 1998-2003. OPSW-ODFW-2005-5, Oregon Department of Fish and Wildlife, Salem.

Roering, J.J., Schmidt, K.M., Stock, J.D., Dietrich, W.E., Montgomery, D.R., 2003. Shallow landsliding, root reinforcement, and the spatial distribution of trees in the Oregon Coast Range. Canadian Geotechnical Journal 40, 237–253.

Roffe, T.J. and B.R. Mate. 1984. Abundance and feeding habits of pinnipeds in the Rogue River, Oregon. Journal of Wildlife Management 48(4): 1262–1274.

Roos, M. 2003. The Effects of Global Climate Change on California Water Resources. Contractors Report, Public Interest Energy Research, California Energy Commission, P500-03-025 (April), Sacramento, California.

Roughgarden, J.A. 1975. A simple model for population dynamics in stochastic environments. American Naturalist 109: 713-736. 1975.

Ruzzante D. E. 1994. Domestication effects on aggressive and schooling behavior in fish. Aquaculture 120:1–24.

Ryall, P.E., and C.D. Levings. 1987. Juvenile salmon utilization of rejuvenated tidal channels in the Squamish Estuary, British Columbia. Canadian Manuscript Report of Fisheries and Aquatic Sciences 1904:1–23.

Ryding, K.E., and Skalski, J.R. 1999. Multivariate regression relationships between ocean conditions and early marine survival of coho salmon (*Oncorhynchus kisutch*). Can. J. Fish. Aquat. Sci. 56: 2374–2384.

Salmon and Steelhead Hatchery Assessment Group (SSHAG). 2003. Hatchery broodstock summaries and assessments for chum, coho, and Chinook salmon and steelhead stocks within the Evolutionarily Significant Units listed under the Endangered Species Act. NOAA Fisheries Northwest Fisheries Science Center and NOAA Fisheries Southwest Fisheries Science Center. 325 p.

Salo, E., and W.H. Bayliff. 1958. Artificial and natural production of silver salmon, *Oncorhynchus kisutch,* at Minter Creek, Washington. Wash. Dep. Fish. Res. Bull. 4, 76 p.

Sandahl, J.F., D.H. Baldwin, J.J. Jenkins & N.L. Scholz. 2007. A sensory system at the interface between urban stormwater runoff and salmon survival. Environmental Science & Technology 41:2998-3004.

Sandercock, F.K. 1991. Life history of coho salmon (*Oncorhynchus kisutch*). Pp. 397-445 *In* C. Groot and L. Margolis (Eds.). 1991. Pacific salmon life histories. University of British Columbia Press, Vancouver, B. C.

Scheffer, T.H., and C.C. Sperry. 1931. Food habits of the Pacific harbor seal, *Phoca vitulina richardsi. Journal of Mammalogy* 12(3): 214–226.

Schlosser, I.J. 1987. The role of predation in age- and size-related habitat use by stream fishes. *Ecology* **68,** 631–639.

Schmidt, K., Roering, J., Stock, J., Dietrich, W., Montgomery, D., Schaub, T., 2001. The variability of root cohesion as an influence on shallow landslide susceptibility in the Oregon Coast Range. Canadian Geotechnical Journal 38, 995–1024.

Scholz, Nathaniel L., N.K. Truelove, B.L. French, B.A. Berejikian, T.P. Quinn, E. Casillas, and T.K. Collier. 2000. Diazinon disrupts antipredator and homing behaviors in chinook salmon (*Ocorhynchus tshawytscha*). *Canadian Journal of Fisheries and Aquatic Sciences*.

Scrivener, J.C. and Andersen, B.C. 1982. Logging impacts and some mechanisms which determine the size of spring and summer populations of coho salmon fry in Carnation Creek. *In* Proceedings of the Carnation Creek Workshop: a ten year review. *Edited by* G. F. Hartman. Pacific Biological Station, Nanaimo, BC, Canada. pp. 257-272.

Scrivener, J.C., and B.C. Andersen. 1984. Logging impacts and some mechanisms that determine the size of spring and summer populations of coho salmon fry (*Oncorhynchus kisutch*) in Carnation Creek, British Columbia. Can. J. Fish. Aquat. Sci. 41:1097-1105.

Shaffer, M.L. 1981. Minimum population sizes for species conservation. BioScience 31:131-134.

Shapovalov, L. and A.C. Taft. 1954. The life histories of the steelhead rainbow trout (Salmo uairdneri clairdneri) and Fish and Game Bulletin 98. 275 pp. silver salmon (Oncorhvnchus kisutch). California Department of Game Bulletin 98. 275 pp.

Sharr, S., C. Melcher, T. Nickelson, P. Lawson, R. Kope, and J. Coon. 2000. 2000 review of amendment 13 to the Pacific Coast salmon plan. Exhibit B.3.b. OCN workgroup report. Pacific Fisheries Management Council, Portland, OR.

Shaver, E., J. Maxted, G. Curtis and D. Carter. 1995. "Watershed Protection Using an Integrated Approach." In Stormwater NPDES Related Monitoring Needs. Engineering Foundation. American Society of Civil Engineers. Crested Butte, CO. August 7-12, 1994.

Sibert, J.T., Brown, T.J., Healey, M.C., Kask, B.A., and Naiman, R.J. 1977. Detritus-based food webs: Exploitation by juvenile chum salmon (*Oncorhynchus keta*). Science 196: 649-650.

Sidle, R.C., A.J. Pearce and C.L. O'Loughlin. 1985. Hillslope stability and land use. Water Resources Monograph Series, Volume 11. American Geophysical Union, Washington, D.C.

Silloway S. 2010. Fish Surveys Related to the Proposed Del Norte Highway 101 Klamath Grade Raise Project Contract No. 03A1317 Task Order 48. Accessed online 12/13/2011: http://www.yuroktribe.org/departments/fisheries/documents/YTFP2010KlamathGradeRaisebyCaltransFishReportFINAL.pdf

Silver, S., C. Warren, and P. Doudoroff. 1963. Dissolved Oxygen Requirements of Developing Steelhead Trout and Chinook Salmon Embryos at Different Water Velocities. Transactions of the American Fisheries Society 92, 327-343.

Sinnen, W. 2002. Annual Report: Trinity River Basin Salmon and Steelhead Monitoring Project, 2001– 2002 Season. Task 3: Survival and spawner escapements made by Coho salmon produced at the Trinity River Hatchery. (Available from California Department of Fish and Game, Northern California Coast District, 5341 Ericson Way, Arcata, CA 95521.)

Skeesick, D.G. 1970. The fall immigration of juvenile coho salmon into a small tributary. Fish Commission of Oregon, Research Division Research Report 2, Subject: Coho data collected during harvest monitoring activities on Yurok Indian Reservation, CA.

Snyder, J.O. 1931. Salmon of the Klamath River, California. Div. of Fish and Game of Calif., Fish Bulletin No. 34.

Sommer, T.R, W.C. Harrell and M.L. Nobriga. 2005. Habitat use and stranding risk of juvenile Chinook salmon on a seasonal floodplain. North America Journal of Fisheries Management 25:1493-1504

Sorenson, P. W., J. R. Cardwell, T. Essington, and D. E. Weigel. 1995. Reproductive interactions between sympatric brook and brown trout in a small Minnesota stream. Canadian Journal of Fisheries and Aquatic Sciences 52:1958–1965.

Spence, B.C., E.P. Bjorkstedt, J.C. Garza, J.J. Smith, D.G. Hankin, D. Fuller, W.E. Jones, R.Macedo, T.H. Williams, and E. Mora. 2008. A framework for assessing the viability of threatened and endangerd salmon and steelhead in the North-Central California Coast recovery domain. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-423. 173 p.

Spence, B.C., G.A. Lomnicky, R.M. Hughes and R. P. Novitzki. 1996. An Ecosystem Approach to Salmonid Conservation. Funded jointly by the U.S. EPA, U.S. Fish and Wildlife Service and National Marine Fisheries Service. TR-4501-96-6057. Man Tech Environmental Research Services Corp., Corvallis, OR.

Spencer, C.N., K.O. Gabel, and F.R. Hauer. 2003. Wildfire effects on stream food webs and nutrient dynamics in Glacier National Park, USA. Forest Ecology and Management 178: 141-153.

State of Oregon, J.W. Nichols, principal writer. 1997. The Oregon Plan (Oregon Coastal Salmon Restoration Initiative). Oregon Governor's Office. Salem, OR. 134 p.

Stevens, D.L. Jr. 2002. Sampling design and statistical analysis methods for the integrated biological and physical monitoring of Oregon streams. OPSW-ODFW-2002-07, Department of Statistics, Oregon State University, Corvallis.

Steward, C.R. and T.C. Bjornn. 1990. Supplementation of salmon and steelhead stocks with hatchery fish: a synthesis of published literature. Idaho Cooperative Fisheries and Wildlife Research Unit, Univ. of Idaho, Moscow, ID, Tech. Report 901.

Stewart-Oaten, A., W.W. Murdoch, and K.R. Parker. 1986. Environmental impact assessment: "pseudoreplication" in time? Ecology 67:929-940.

Stocking, R.W. and J.L. Bartholomew. 2004. Assessing links between water quality, river health and Ceratomyxosis of salmonids in the Klamath River system. Department of Microbiology, Oregon State University, Corvallis, OR. 5 p. (81 Kb)

Sumner, F.H. 1953. Migrations of salmonids in Sand Creek, Oregon. Trans. Am. Fish. Soc. 82:139-149.

Sumpter, J.P. and A.C. Johnson. 2005. Lessons from endocrine disruption and their application to other issues concerning trace organics in the aquatic environment. Environ Sci Technol 39, 4321-4332.

Suttle, K.B, Power, M.E., Levine, J.M., McNeely, C. 2004. How Fine Sediment in Riverbeds Impairs Growth and Survival of Juvenile Salmonids. Ecological Applications, 14(4), 969–974, pp. 973.

Swain, D.P., and L.B. Holtby. 1989. Differences in morphology and behavior between juvenile coho salmon (*Oncorhynchus kisutch*) rearing in a lake and in its tributary stream. Can. J. Fish. Aquat. Sci. 46:1406-1414.

Sweeting, R.M., Beamish, R.J., Noakes, D.J., and Neville, C.M. 2003. Replacement of wild coho salmon by hatchery-reared coho salmon in the Strait of Georgia over the past three decades. N. Am. J. Fish. Manage. 23:492-502

Sweka, J.A., and K.J. Hartman. 2001. Influence of turbidity on brook trout reactive distance and foraging success. Transactions of the American Fisheries Society 130:138– 146.

Taylor, E.B., and J.D. McPhail. 1985. Variation in body morphology among British Columbia populations of coho salmon, *Oncorhynchus kisutch*. Can. J. Fish. Aquat. Sci. 42:2020-2028.

The Nature Conservancy (TNC). 2003. Landscape-scale conservation: a practitioner's guide. Available online http://conserveonline.org/workspaces/cbdgateway/cap/resources/4/2/Landscape_Practicitioners_Handbook_July03_PR.pdf

The Nature Conservancy. 2006. Pool and wood summaries for Siskiyou mountain streams by stream size. Illinois Valley Conservation Action Plan. 6 p.

Thomas, C.D. 1990. What do real population dynamics tell us about minimum viable population sizes. Conservation Biology 4 (3): 324–327.

Thomas, C.D. 1994. Extinction, colonization, and metapopulations: environmental tracking by rare species. Conservation Biology 8:373-378.

Thompson, K. G., R. B. Nehring, D. C. Bowden, and T. Wygant. 1999. Field exposure of seven species or subspecies of salmonids to Myxobolus cerebralis in the Colorado River, Middle Park, Colorado. Journal of Aquatic Animal Health 11:312–329.

Treuren, R.V., R Bijlsma, W. Van Delden, and N.J. Ouborgi. 1991. The significance of genetic erosion in the process of extinction. I. Genetic differentiation in Salvia pratensis and Scabiosa columbaria in relation to population size. Heredity 66: 181-189.

Tripp, D., and P. McCart. 1983. Effects of different coho stocking strategies on coho and cutthroat trout production in isolated headwater streams. Canadian Technical Report of Fisheries and Aquatic Sciences 1212: 176 pp.

True, K. 2011. 2011 Klamath River Salmonid Health Monitoring. Memorandum dated September 28, 2011, to Nick Hetrick, Arcatat Fish and Wildlife Office. U.S. Fish and Wildlife Service. 7 p.

Tschaplinski, P.J. 1988. The use of estuaries as rearing habitats by juvenile coho salmon. In T.W. Chamberlain (ed.), *Proceedings of a workshop: Applying 15 years of Carnation Creek results.* (pp. 123-142). Nanaimo, BC: British Columbia Ministry of Environment, Lands, and Parks.

Unwin M. J. 1997. Fry-to-adult survival of natural and hatchery-produced chinook salmon (Oncorhynchus tshawytscha) from a common origin. Canadian Journal of Fisheries and Aquatic Sciences 54: 1246-1254.

U.S. Department of Agriculture - Forest Service (USDA-FS) and U.S. Department of Interior - Bureau of Land Management (USDI-BLM). 1994. Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern sported owl; standards and guidelines for management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl. April.

U.S. Environmental Protection Agency (EPA). 1999. South Fork Eel River Total Maximum Daily Loads for Sediment and Temperature. Region IX.

U.S. Fish and Wildlife Service (USFWS). 2003. Klamath River Fish Die Off September 2002 – Caustitive Factors of Mortality.Report Number AFWO-F-02-03. 128 p.

U.S. Fish and Wildlife Service (USFWS) and Hoopa Valley Tribe (HVT). 1999. Trinity River Flow Evaluation Final Report. Report to the Secretary, U.S. Department of the Interior. Washington, D.C. Available at: http://www.fws.gov/arcata/fisheries/reportsDisplay.html. Accessed October 2008.

U.S. Global Change Research Program (USGCRP). 2002. Strategic Plan for the Climate Change Science Program Review draft, November 2002. 177p.

Van Doornik, D.M., D.J. Teel, D.R. Kuligowski, C.A. Morgan, and E. Casillas. 2007. Genetic analyses provide insight into the early ocean stock distribution and survival of juvenile coho salmon off the coasts of Washington and Oregon. North American Journal of Fisheries Management 27: 220-237.

Van Kirk, R.W., and S.W. Naman. 2008. Relative effects of climate and water use on base-flow trends in the lower Klamath Basin. Journal of the American Water Resources Association 44:1035–1052.

Wagener, S.M. and J.D. Laperriere. 1985. Effects of Placer Mining on the Invertebrate Communities of Interior Alaska Streams *Freshwater Invertebrate Biology*. Vol. 4, No. 4 (Nov., 1985), pp. 208-214

Wagner, E.J., Jeppsen, T., Arndt, R., Routledge, M.D. & Bradwisch, Q. 1997. Effects of rearing desity upon cutthroat trout hematology, hatchery performance, fin erosion and general health and condition. The Progressive Fish-Culturist, 59, 173-187.

Wainwright, T.C., M.W. Chilcote, P.W. Lawson, T.E. Nickelson, C.W. Huntington, J.S. Mills, K.M.S. Moore, G.H. Reeves, H.A. Stout, and L.A. Weitkamp. 2008. Biological Recovery Criteria for the Oregon Coast Coho Salmon Evolutionarily Significant Unit. U.S. Department of Commerce. NOAA Technical Memorandum NMFS-NWFSC-91, 199 p.

Walters, C.J., R. Hilborn, R.M. Peterman, and M.J. Staley. 1978. Model for examining early ocean limitation of Pacific salmon production. Journal of the Fisheries Research Board of Canada 35:1303-1315.

Wang, L. and R. White. 1994. Competition between brown trout and hatchery greenback cutthroat trout of largely-wild parentage. North American Journal of Fisheries Management 14:475-487

Waples, R. 1991. Pacific salmon, *Oncorhynus* spp., and the definition of "species" under the Endangered Species Act. Mar. Fish. Rev. 53:11-22.

Waters, T.F. 1983. Replacement of brook trout by brown trout over 15 years in a Minnesota stream: production and abundance. Transactions of the American Fisheries Society 112:137-146.

Warren, J.W. 1991. Diseases of hatchery fish, 6th edition. U.S. Fish and Wildlife Service, Pacific Region, Portland, Oregon.

Washington Department of Fisheries (WDF). 1951. Lower Columbia River Fisheries Development Program: Planning reports for Grays River area, Elokomin area, Abernathy area, Cowlitz area, Kalama River area, Lewis River area, Washougal River area, Wind River area, Little White Salmon area, Big White Salmon area, and Klickitat River area. Preliminary draft, unnumbered. (Available from Washington Department of Fish and Wildlife, 600 Capitol Way N., Olympia, WA 98501-1091.

Washington Department of Fisheries (WDF), Washington Department of Wildlife (WDW), and Western Washington Treaty Indian Tribes (WWTIT). 1993. 1992 Washington State salmon and steelhead stock inventory (SASSI). Wash. Dep. Fish Wildl., Olympia, 212 p. plus three Appendices: Appendix One--Hood Canal and Strait of Juan de Fuca (December 1994, 424 p.), North Puget Sound (June 1994, 418 p.), and South Puget Sound (September 1994, 371 p.) Volumes; Appendix Two--Coastal stocks (August 1994, 587 p.); and Appendix Three--Columbia River stocks (June 1993, 580 p.). (Available Washington Department of Fish and Wildlife, 600 Capitol Way N., Olympia, WA 98501-1091.)

Washington State Department of Agriculture (WSDA). 2010. The Endangered Species Act and the impacts to Pesticide Registration and Use. 21p.

Weaver, W. and D. Hagans. 1996. Sediment treatments and road restoration: protecting and restoring watersheds from sediment-related impacts. pages 105-134 in The Pacific Rivers Council, Inc. 1996 Healing the watershed: a guide to the restoration of watersheds and native fish in the West.

Weitkamp, L.. and K. Neely. 2002. Coho salmon (*Oncorhynchus kisutch*) ocean migration patterns: insight from marine coded-wire tag recoveries, *Canadian Journal of Fisheries and Aquatic Sciences* **59** (7) (2002), pp. 1100–1115.

Weitkamp, L.A., T.C. Wainwright, G.J. Bryant, G.B. Milner, D.J. Teel, R.G. Kope, and R.S. Waples. 1995. Status review of coho salmon from Washington, Oregon, and California. U.S. Department of Commerce. NOAA Technical Memorandum NMFS-NWFSC-24, Northwest Fisheries Science Center, Seattle, Washington. 258 p.

Wells, B.K., C.B. Grimes, J.C. Field and C.S. Reiss. 2006. Covariation between the average lengths of mature coho (*Oncorhynchus kisutch*) and Chinook salmon (*O. tshawytscha*) and the ocean environment, *Fisheries Oceanography* **15** (2006), pp. 67–79.

Welsch, D.J. 1991. Riparian Forest Buffers; Function and design for protection and enhancement of water resources. USDA publication NA-PR-07-91 http://www.na.fs.fed.us/spfo/pubs/n_resource/buffer/cover.htm

Welsh, H.H., G.R. Hodgson, M.F. Roche, B.C. Harvey. 2001. Distribution of Juvenile Coho Salmon (Oncorhynchus kisutch) in Relation to Water temperature in Tributaries of a Northern California Watershed: Determining Management Thresholds for an Impaired Cold-water Adapted Fauna. August 2000 North American Journal of Fisheries Management. U.S.D.A. Forest Service, Redwood Sciences.

Wilkie MP, Wood CM. 1996. The adaptations of fish to extremely alkaline environments. Comparative Biochemistry and Physiology Part B: Biochemistry and Molecular Biology 113:665–673.

Williams, D. 2010. Harvest of species listed under the Endangered Species Act. Yurok Tribal Fisheries. March 2010. 9 p.

Williams, T.H., E.P. Bjorkstedt, W.G. Duffy, D. Hillemeier, G. Kautsky, T.E. Lisle, M. McCain, M. Rode, R.G. Szerlong, R.S. Schick, M.N. Goslin, A. Agrawal. 2006. Historical population structure of coho salmon in the Southern Oregon/Northern California Coasts evolutionarily significant unit. NOAA-TM-NMFS-SWFSC-390

Williams, T.H., B. Spence, W. Duffy, D. Hillemeier, G. Kautsky, T. Lisle, M. McCain, T. Nickelson, E. Mora, and T. Pearson. 2008. Framework for assessing viability of threatened coho salmon in the Southern Oregon / Northern California Coasts Evolutionarily Significant Unit. NOAA Technical Memorandum NMFS-SWFSC-432.

Williams, T.H., S.T. Lindley, B.C. Spence, D.A. Boughton. 2011. Draft status review update for Pacific salmon and steelhead under the Endangered Species Act: Southwest. NOAA-TM-NMFS-SWFSC-XXX. December 2010. National Marine Fisheries Service. Southwest Fisheries Science Center. Santa Cruz, CA.

Williamson, K. and D. Hillemeier. 2001. An assessment of pinniped predation upon fall- run Chinook salmon in the Klamath River estuary, California. Yurok Tribal Fisheries Program. 1998.

Wood, J.W. 1979. Diseases of Pacific salmon, their prevention and treatment. Washington Department of Fisheries, Olympia. 82 pp.

Wood J.W. 1987. The genetic demography of the Gainj of Papua New Guinea. 2. Determinants of effective population size. Am Nat 129:165–187.

Yoshiyama, R.M. and P.B. Moyle. 2010. Historical review of Eel River anadromous salmonids, with emphasis on Chinook salmon, coho salmon and steelhead. University of California at Davis. Center for Watershed Sciences working paper; a report commissioned by California Trout. Davis, CA. February 1.

Yurok Tribe Environmental Program (YTEP). 2004 Water Quality Control Plan For the Yurok Indian Reservation. Yurok Tribe Environmental Program, Klamath, CA. 37 p. (708 Kb)

Ziemer, R.R. 1998. Flooding and stormflows. In: Ziemer, R.R., technical coordinator. Proceedings of the conference on coastal watersheds: the Caspar Creek story, 6 May 1998; Ukiah, California. General Tech. Rep. PSW GTR-168. Albany, California: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture; 15-24.

Appendix A: Updated Population Categorization and IP-km

The number of kilometers of habitat with Intrinsic Potential to support rearing coho salmon (IP-km) identified for some populations in Williams et al. (2006) was updated.

Updated IP-km

The amount of IP-km was updated in eleven populations. The old and new IP-km amounts are described in Table A-1. The reason for change is noted in Table A-1 and explained in Section A.2.

Table A - 1- Population-specific changes to IP-km and classification

Diversity Stratum	Population unit	Williams et al. 2008 IP-km with temperature mask	Updated IP-km	Williams et al. 2008 classification	Current classification
Northern Coastal	Elk River	62.64	-	F. Independent	F. Independent
	Mill Creek	7.25	5.16	Dependent	Dependent
	Hubbard Creek	17.94	-	Ephemeral	Ephemeral
	Lower Rogue River	80.88	-	P. Independent	P. Independent
	Chetco River	135.19	-	F. Independent	F. Independent
	Winchuck River	56.5	-	P. Independent	P. Independent
	Brush Creek	5.68	-	Dependent	Dependent
	Mussel Creek	6.06	-	Dependent	Dependent
	Hunter Creek	14.63	-	Dependent	Dependent
	Euchre Creek	32.31	-	Ephemeral	Ephemeral
	Pistol River	30.23	-	Dependent	Dependent
Central Coastal	Smith River	385.71	324.84	F. Independent	F. Independent
	Lower Klamath River	204.69	-	F. Independent	F. Independent
	Redwood Creek	151.02	-	F. Independent	F. Independent
	McDonald Creek	5.44	2.77	Dependent	-
	Maple Creek/Big Lagoon	41.30	-	P. Independent	P. Independent
	Little River	34.20	-	P. Independent	P. Independent
	Mad River	152.87	136.47	F. Independent	F. Independent
	Elk Creek	17.38	-	Dependent	Dependent

Diversity Stratum	Population unit	Williams et al. 2008 IP-km with temperature mask	Updated IP-km	Williams et al. 2008 classification	Current classification
Central Coastal	Wilson Creek	18.80	-	Dependent	Dependent
	Strawberry Creek	5.71	6.95	Dependent	Dependent
	Norton/Widow White Creek	8.54	9.86	Dependent	Dependent
Southern Coastal	Humboldt Bay tributaries	190.91	-	F. Independent	F. Independent
	Low. Eel/Van Duzen rivers	393.52	-	F. Independent	F. Independent
	Bear River	47.84	-	P. Independent	P. Independent
Southern Coastal (continued)	McNutt Gulch	5.90	< 2.0	Dependent	-
	Mattole River	249.79	-	F. Independent	F. Independent
	Guthrie Creek	14.16	13.82	Dependent	Dependent
Interior – Rogue River	Illinois River	589.69	-	F. Independent	F. Independent
	Mid. Rogue/Applegate R.	758.58	683.16	F. Independent	F. Independent
	Upper Rogue River	915.43	-	F. Independent	F. Independent
Interior – Klamath River	Middle Klamath River	113.49	-	P. Independent	P. Independent
	Upper Klamath River	424.71	-	F. Independent	F. Independent
	Salmon River	114.80	-	P. Independent	P. Independent
	Scott River	440.87	-	F. Independent	F. Independent
	Shasta River	531.01	-	F. Independent	F. Independent
Interior – Trinity River	South Fork Trinity River	241.83	-	F. Independent	F. Independent
	Lower Trinity River	112.01	-	P. Independent	P. Independent
	Upper Trinity River	64.33	365	F. Independent	F. Independent
Interior – Eel River	South Fork Eel River	481.11	-	F. Independent	F. Independent
	Mainstem Eel River	143.90	-	P. Independent	P. Independent
	North Fork Eel River	53.87	0.81	P. Independent	-
	Mid. Fork Eel River	77.70	-	P. Independent	P. Independent
	Mid. Mainstem Eel River	255.50	-	F. Independent	F. Independent
	Upper Mainstem Eel River	54.11	-	P. Independent	P. Independent

Rationale for population-specific IP-km amounts and classification changes

Mill Creek

A previously unaccounted for natural barrier at Garrison Lake excludes coho salmon from the watershed. Garrison Lake has a natural historic pattern of connection and disconnection to the ocean by a large sand bar. The watershed has been isolated from the ocean since sand dunes naturally migrated and filled the outlet stream in the mid-1900's (Maguire 2001). Anadromous fish do not currently occur in the Mill Creek watershed (Maguire 2001) and during periods of saltwater intrusion Garrison Lake likely has unsuitable conditions for juvenile rearing. Williams et al. (2006) determined that dependent populations must have at least 5 IP-km. After removing the IP-km in the lake and above it, the Mill Creek population has no IP-km and so does not meet the criterion for dependent populations.

Smith River

Lake Earl and its associated stream network were removed from the Smith River IP calculations because the IP model was not intended for open water habitat. Williams et al. (2006) determined that independent populations must have at least 34 IP-km. After removing the IP habitat that occurs in Lake Earl and its associated stream network, the total amount of IP-km for the Smith River population remains high enough for it to qualify as an independent population.

McDonald Creek

Stone Lagoon was removed from the McDonald Creek IP-km calculations because the IP model was not intended for open water habitat. Williams et al. (2006) determined that dependent populations must have at least 5 IP-km. When the lagoon was accounted for, the amount of IP-km in the McDonald Creek population was reduced and did not meet the critera for a dependent population.

Mad River

IP-km which should have been attributed to Strawberry Creek and Norton/Widow White Creek was attributed to the Mad River. Williams et al. (2006) determined that independent populations must have at least 34 IP-km. When the IP-km for the Mad River was reduced, the total amount of IP-km for the Mad River population remains high enough for it to qualify as an independent population.

Strawberry Creek

IP-km which should have been attributed to Strawberry Creek was attributed to the Mad River. Williams et al. (2006) determined that independent populations must have at least 34 IP-km. When the IP-km for Strawberry Creek was increased, it did not meet this criterion and so remained a dependent population.

Norton/Widow White Creek

IP-km which should have been attributed to Norton/Widow White Creek was attributed to the Mad River. Williams et al. (2006) determined that independent populations must have at least

34 IP-km. When the IP-km for Norton/Widow White Creek was increased, it did not meet this criterion and so remained a dependent population.

Guthrie Creek

The amount of IP-km attributed to Guthrie Creek was too high. Williams et al. (2006) determined that dependent populations must have at least 5 IP-km. When the IP-km for Guthrie Creek was decreased, the total amount of IP-km remained high enough for it to qualify as a dependent population.

Middle Rogue/Applegate Rivers

A previously unaccounted for waterfall occurs 1.7 miles upstream from the Applegate River at Little Applegate Falls. The falls are believed to function as a complete migratory barrier (Maiyo 2011). Williams et al. (2006) determined that independent populations must have at least 34 IP-km. When the IP-km for the Middle Rogue/Applegate Rivers population was reduced, the total amount of IP-km remained high enough for it to qualify as an independent population.

Upper Trinity River

IP-km in the Upper Trinity River population was reduced for two reasons: to account for the gradient of the stream under reservoirs, and because the temperature mask was not appropriate.

The IP model used the surface elevations of the reservoirs as the gradient for those areas of the basin, which artificially inflates the low risk spawner threshold. The historic channel gradient of the Upper Trinity was estimated, and revised IP-km were calculated for the area under the reservoirs. Williams et al. (2006) determined that independent populations must have at least 34 IP-km. After reducing the IP-km as a result of this analysis, the total amount of IP-km for the Upper Trinity River remained high enough for it to qualify as an independent population.

Because the temperature mask is based on air temperature, it does not account for snowmelt and other sources of cold water within the basin, including releases from Lewiston Dam. Numerous streams which are documented to presently support rearing coho salmon rearing occur under the temperature mask. Williams et al. (2006) recognized the potential limitations of the temperature mask approach in the Upper Trinity. The temperature mask was removed from the Upper Trinity River population, which increased the amount of IP-km in the Upper Trinity River population.

North Fork Eel River

A previously unaccounted for natural barrier (Split Rock) excludes coho salmon from most of the watershed. Williams et al. (2006) determined that independent populations must have at least 34 IP-km and dependent populations must have at least 5 IP-km. After removing the IP habitat that occurred above the barrier, the total amount of IP-km for the North Fork Eel River does not meet the criteria for either an independent or a dependent population.

McNutt Gulch

A previously unaccounted for 15-foot waterfall with bedrock canyon walls occurs 1.98 km upstream from the mouth of McNutt Gulch. The waterfall is the natural limit to anadromy (CalFish 2009) and is assumed to be the upstream limit of historic coho occurrence in McNutt Gulch. When this natural barrier was accounted for, the amount of IP-km in the Middle McNutt Gulch population was reduced and did not meet the criterion for a dependent population.

Literature Cited

CalFish. 2009. California Fish Passage Assessment Database (CFPAD). State-wide inventory of known and potential barriers to fish passage. Accessed 9/30/2009 from: http://www.calfish.org/ProgramsandProjects/FishPassageAssessment/tabid/97/Default.aspxNMFS-NWFSC-27, 261 p.

Maguire, M. 2001. Port Orford Watershed Assessment. Performed under contract to the Port Orford Watershed Council with assistance from the South Coast Watershed Council, Gold Beach, OR. 106 p.

Maiyo, S. 2011. Personal communication. Biologist. Rogue-Siskiyou National Forest.

Williams, T. H., E. P. Bjorkstedt, W. G. Duffy, D. Hillemeier, G. Kautsky, T. E. Lisle, M. McCain, M. Rode, R. G. Szerlong, R. S. Schick, M. N. Goslin, A. Agrawal. 2006. Historical population structure of coho salmon in the Southern Oregon/Northern California Coasts evolutionarily significant unit. NOAA-TM-NMFS-SWFSC-390. NMFS, Southwest Fisheries Science Center, Santa Cruz, CA. 85 p.

Appendix B: Stress and Threat Analysis Methodology

B.1. Summary

NMFS used several tools to develop and perform a threat and stress assessment, and to develop methods to score additional threat and stress categories. These tools included The Nature Conservancy's Conservation Action Planning (CAP) process, best professional judgment, climate change models and predictions, and empirical data. NMFS used these tools to ascertain current watershed condition, identify severity and scope of stresses, assess the contribution and irreversibility of identified threats, create additional threat and stress categories, and develop population profiles for each population in the SONCC coho salmon ESU. NMFS used the CAP process as a conceptual framework for the threats assessment. The threats assessment process spanned four years and the methodology evolved over time in response to new information, to incorporate new stresses and threats, and in recognition of the limitations of the initial tools (Table B - 1, Table B - 2).

Underlying the entire threat and stress assessment process was the use of best professional judgment, in consideration of available data. Empirical data were acquired, compiled into a database, summarized, and then entered into an initial set of CAP workbooks. Stress and threat ratings in the CAP workbooks were then revised to include professional judgment for additional stresses and threats. NMFS then utilized best professional judgment to assess the accuracy and reliability of the resulting CAP summary tables, produce a comprehensive stress and threat assessment, and develop individual population profiles that detail the current condition of each population area.

The following sections summarize the components of the stress and threats methodology, including the development of the initial CAP workbooks, revision of the CAP workbooks, creation of GIS maps, refinement of the stress and threat summary tables, and the development of additional stress and threat categories (climate change, estuary/mainstem condition, and fishing/collecting).

Table B - 1. Methods used by NMFS to assess stresses in the SONCC coho salmon ESU.

Stress	Assessment Methods		
	Initial CAP	Revised CAP	Latest Stress Summary Tables
Adverse Fishery-Related Effects	Not included	Not included	Professional judgment
Adverse Hatchery-related Effects	Not included	Professional judgment	Professional judgment
Altered Hydrologic Function	Qualitative indicators	Professional judgment, qualitative indicators	Professional judgment, qualitative indicators
Altered Sediment Supply	Numeric indicators	Numeric indicators, professional judgment	Numeric indicators, professional judgment
Barriers	Numeric indicators	Numeric indicators, professional judgment	Numeric indicators, professional judgment
Degraded Riparian Forest Conditions	Numeric & qualitative indicators	Numeric & qualitative indicators, professional judgment	Numeric & qualitative indicators, professional judgment
Impaired Estuary/ Mainstem Function	Not included	Not included	Professional judgment
Impaired Water Quality	Numeric indicators	Numeric indicators, professional judgment	Numeric indicators, professional judgment
Increased Disease/ Predation/Competition	Not included	Numeric indicators, professional judgment	Numeric indicators, professional judgment
Lack of Floodplain and Channel Structure	Numeric & qualitative indicators	Numeric & qualitative indicators, professional judgment	Numeric & qualitative indicators, professional judgment

Table B - 2. Methods used by NMFS to assess threats in the SONCC coho salmon ESU.

Threat	Assessment Methods		
	Initial CAP	Revised CAP	Latest Threat Summary Tables
Agricultural Practices	GIS analyses	GIS analyses, professional judgment	GIS analyses, professional judgment
Channelization/Diking	GIS analyses	GIS analyses, professional judgment	GIS analyses, professional judgment
Climate Change	Not included	Professional judgment	Computer models, professional judgment
Dams/Diversion	Not included	Professional judgment	Professional judgment
Fishing and Collecting	Not included	Professional judgment	Professional judgment
Hatcheries	Not included	Professional judgment	Professional judgment
High Intensity Fire	Not included	Professional judgment	Professional judgment
Invasive Non-Native/ Alien Spices	Not included	Professional judgment	Professional judgment
Mining/Gravel Extraction	Not included	Professional judgment	Professional judgment
Roads	GIS analyses	GIS analyses, professional judgment	GIS analyses, professional judgment
Road-Stream Crossing Barriers	Not included	Professional judgment	Professional judgment
Timber Harvest	Not included	Professional judgment	Professional judgment
Urban/Residential/ Industrial	GIS analyses	GIS analyses, professional judgment	GIS analyses, professional judgment

B.2. Background Information about the CAP Process

As part of the assessment of the viability and condition of SONCC coho salmon populations and their habitat in the SONCC ESU, NMFS performed a series of conservation planning and assessment exercises based upon the Nature Conservancy's Conservation by Design concept (TNC 2006). This concept utilizes Conservation Action Planning (CAP) tools and workbooks to develop a threat and stress assessment. The CAP process is designed to recognize the shifting nature of knowledge and the challenges that causes, by allowing for a regular, iterative process of successive approximations (TNC 2006). The CAP process provided NMFS with a tool to capture the best understanding of the current situation, and build a set of recovery actions built on that understanding. This understanding included the use of best professional judgment and other tools. NMFS utilized this process to identify conservation targets, assess the current status of the selected targets, identify critical threats and stresses occurring in the landscape, and develop a threat and stress assessment that described current population and environmental conditions across the landscape.

NMFS completed the following planning and assessment activities:

1. Identified conservation targets
2. Assessed the current status of conservation targets
3. Determined potential stresses and threats
4. Compiled available literature, empirical data, and best professional knowledge on the condition of the landscape
5. Rated these stresses and threats across the landscape
6. Developed recovery actions to decrease or eliminate the stresses and threats.

The first step in the process was to identify the conservation targets, which were the life stages of coho salmon in the SONCC coho salmon ESU. Next, NMFS assessed the current status of conservation targets by reviewing all available monitoring data on coho salmon population trends.

NMFS then used the best available information to identify the stresses affecting coho salmon populations and the sources of the stresses, also known as threats. Most stresses are caused by incompatible human uses of land, water and natural resources. Stresses destroy, degrade or impair conservation targets by impacting a key ecological attribute relating to their size, condition or landscape context (TNC 2006). Natural factors such as rainfall and marine productivity (ocean conditions, El Niño) were identified as factors for the decline of SONCC coho salmon (62 FR 24588). NMFS elected to not describe these natural factors as threats, for two reasons. First, SONCC coho salmon evolved to live with natural variation in rainfall and marine productivity, and it was likely a combination of these factors with habitat degradation, fishing, and other human-caused threats that led to their decline. Populations that are fragmented or reduced in size and range are more vulnerable to extinction by natural events (62 FR 24588), and NMFS chose to focus on the causes of population fragmentation and reduced size rather than natural factors. Second, there is little that recovery actions can do to affect change in natural factors such as rainfall or marine productivity. NMFS developed recovery actions to reduce the detrimental effects of the result of that rainfall (e.g., droughts and floods). For example, water resources can be managed to ensure sufficient water remains in waterways when coho salmon need it, and land can be managed to promote bank stability and reduce the likelihood that floods will release large amounts of sediment into coho salmon habitat. Similarly, in years when marine productivity is expected to be poor, fishing effort can be moderated to allow sufficient spawner escapement, as described in the current management of ocean salmon fisheries (Sharr et al. 2000). In short, the recovery plan addresses the causes of population fragmentation and decline that can be improved by human actions. Therefore, stresses are the destruction, degradation or impairment of SONCC coho salmon habitats and ecosystem processes caused directly or indirectly by human sources. A threat is the proximate cause of a stress. The stresses and threats considered are either current stresses or have high potential to occur in the next ten years under current circumstances and management (TNC 2006). The threats and stresses selected for inclusion in the CAP workbooks are the same as those identified at the time of listing. A total of 8 stresses and 11 threats were identified at this time and analyzed using the CAP toolbox (Table B - 1 and Table B - 2). After completing the CAP exercises, three additional categories were created and assessed using the other tools available. More information on these additional threats and stresses are explained later.

After threats and stresses were selected, a large amount of data, literature, and other information were acquired to inform the assessment of stresses and threats. The CAP process uses a simple grading scale was used to assess the current status of key threats and stresses –Very High, High, Medium, Low. This four-part grading scale is based on over 20 years of similar application by natural heritage inventory programs throughout the United States (TNC 2003). It provides a sufficient degree of distinction among the four scores and allows for a reasonable confidence level, while recognizing the current lack of information that would be needed to provide more precise grades (TNC 2003).The final step was to develop a list of recovery actions designed to decrease or eliminate the stresses and threats. These actions were prioritized to address the most important stresses and threats and to focus effort on the coho salmon populations with the most promising prospects for recovery.

B.3. Development of Initial CAP Workbooks Based on Data

The initial set of CAP workbooks were produced using only empirical data only, with the exception of inclusion of pre-existing USFS and ODFW professional judgments.

For the six stresses included in the initial set of CAP workbooks, one or more indicators of aquatic habitat suitability were identified to quantitatively assess that stress. To minimize data gaps, the list of indicators was tailored to match the specific data metrics widely available for populations in the SONCC coho ESU, rather than a comprehensive idealized list. For each indicator, NMFS developed a set of benchmarks for rating habitat suitability for coho salmon on a four-category scale (poor, fair, good, very good) based on the best available scientific literature (Kier Associates and NMFS 2008)(Table B - 3). A few of the indicators are not quantitative, but rather reflect previous professional judgments by USFS and ODFW. In addition, some threats were quantitatively assessed using GIS analyses (Table B - 4).

Table B - 3. Indicators of aquatic habitat suitability for coho salmon, with reference values. Table adapted from Kier Associates and NMFS (2008).

Stress	Indicator	Poor	Fair	Good	Very Good
Altered Hydrologic Function	Flow Restoration Needs (ODFW judgment)	3.5-4	2.5-3.5	1.5-2.5	1-1.5
Altered Hydrologic Function	Water Quantity/Flow Regime (USFS judgment)	Altered	Partially Altered		Unaltered
Altered Sediment Supply	Embeddedness (%)	>45%	30.1-45%	25.1-30%	<=25 %
Altered Sediment Supply	Fines (Dry Sample) (% <1 mm)	>12.6%	11.1-12.6%	8.9-11.1%	<8.9%
Altered Sediment Supply	Fines (Wet Sample) (% <1 mm)	>17%	15-17%	12-15%	<12%
Altered Sediment Supply	Sand (Dry Sample) (% <6.4 mm)	>25.8%	21.5-25.8%	12.9-21.5%	<12.9%
Altered Sediment Supply	Sand (Wet Sample) (% <6.4 mm)	>30%	25-30%	15-25%	<15%
Altered Sediment Supply	Silt/Sand Surface (% riffle area)	>17	15-17	12-15	<12
Altered Sediment Supply	Turbidity (hours/year >25 FNU)	>720	361-720	120-360	<120
Altered Sediment Supply	VStar	>0.25	0.21-0.25	0.15 - 0.21	<0.15
Barriers	Fish Passage (% of Dry Habitat Types)	>5%	1-5%	<1%	0%
Degraded Riparian Forest Conditions	Canopy Cover (% Shade)	<60% shade	60-70% shade	70.1-80% shade	>80% shade
Degraded Riparian Forest Conditions	Canopy Type (% Open + Hardwood)	>40%	30-40%	20-30%	<20%
Degraded Riparian Forest Conditions	Riparian Condition (conifers >36" dbh / 1000ft)	<75	75.0-125	125-200	>200
Degraded Riparian Forest Conditions	Stream Corridor Vegetation (USFS judgment)	Impaired	Functioning At-risk		Properly Functioning
Impaired Water Quality	Aquatic Invertebrates (B-IBI NorCal)	<40	40-60	60.1-80	>80
Impaired Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-2523	>23

Stress	Indicator	Poor	Fair	Good	Very Good
Impaired Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40
Impaired Water Quality	D.O. (COLD) (mg/l 7-DAMin)	<6.0 mg/l	6-6.5 mg/l	6.5-7.0 mg/l	>7.0 mg/L
Impaired Water Quality	D.O. (SPAWN) (mg/l 7-DAMin)	<9 mg/l	9-10 mg/l	10-11 mg/l	>11.0 mg/l
Impaired Water Quality	pH	>8.75	8.5-8.75	8.25-8.5	<8.25
Impaired Water Quality	pH (annual maximum)	>8.75	8.5-8.75	8.25-8.5	<8.25
Impaired Water Quality	Temperature (MWAT) (C)	>17ºC	16-17ºC	15-16ºC	<15ºC
Impaired Water Quality	Temperature (MWMT) (C)	>18.3ºC	17-18.3ºC	16-17ºC	<16ºC
Lack of Floodplain and Channel Structure	D50 (median particle size) (mm)	<38 or >128	38-50 or 110-128	50-60 or 95-110	60-95 mm
Lack of Floodplain and Channel Structure	Floodplain Connectivity (USFS judgment)	Impaired	Functioning At-risk		Properly Functioning
Lack of Floodplain and Channel Structure	Pool Depth (Ave. in Feet)	<2 Ft	2-3 ft	3-3.3 ft	> 3.3 ft.
Lack of Floodplain and Channel Structure	Pool Frequency (% by Area)	<10%	10-20%	20-35%	>35%
Lack of Floodplain and Channel Structure	Pool Frequency (% by Length)	<35%	35-40%	40-50%	>50
Lack of Floodplain and Channel Structure	Wood Frequency ODFW (key pieces/100m)	>1	1-2	2-3	>3
Lack of Floodplain and Channel Structure	Wood Frequency USFS: streams <20 ft. wide	>35 pieces/mi	35-53	54-84	<85
Lack of Floodplain and Channel Structure	Wood Frequency USFS: streams >30 ft. wide	>16 pieces/mi	16-33	33-60	<60
Lack of Floodplain and Channel Structure	Wood Frequency USFS: streams 20-30 ft	>25 pieces/mi	26-36	37-64	<65

Table B - 4. Metrics used to assess threats. Table adapted from Kier Associates and NMFS (2008).

Threat	Metric	Low	Medium	High	Very High
Timber Harvest	Harvested area, as percent of watershed	<10%	10-25%	25-35%	>35%
Agricultural Practices	Pasture/hay and cultivated crops, as a percent of watershed	<2%	2-5%	5-10%	>10%
Roads	Road Density (mi/sq mi)	<1.6	1.6-2.5	2.5-3.0	>3.0
Urban/Residential/ Industrial	Total Impervious Area (TIA), as a percent of watershed	<5%	5-10%	10-25%	>25%

Indicator and threat data were acquired, reformatted, and compiled into a Microsoft Access database. Data were tagged with stream name and either spatial coordinates or GIS-linked stream reach codes (LLID), so that summaries for SONCC CAP populations or other spatial units could be produced as needed.

Data were gathered from all available sources including grey literature, peer reviewed literature, data from monitoring and research efforts, and county and state planning efforts. Datasets were generally used only if similar information was widely available across the SONCC coho salmon ESU. Data contributors include the California Department of Fish and Game (CDFG), Oregon Department of Fish and Wildlife (ODFW), U.S. Forest Service (USFS) Region 5 (R5) and Region 6 (R6), California State Water Resources Control Board (SWRCB), Oregon Department of Environmental Quality (ODEQ), California Department of Forestry and Fire Protection (CAL-FIRE), U.S. Environmental Protection Agency (EPA), the Bureau of Reclamation (BOR), the Bureau of Land Management (BLM), the U.S. Fish and Wildlife Service (USFWS), the Yurok Tribe, Karuk Tribe, Hoopa Tribe, U.S. Fish and Wildlife Service (USFWS), Resource Conservation Districts (RCDs), Utah State University's (USU) Bug Lab, Klamath Resource Information System (KRIS), the Conservation Biology Institute (CBI), South Coast and Lower Rogue Watershed Councils, Mattole Restoration Council, Mattole Salmon Group, and other contributors. A complete list of datasets utilized is included in Table B - 8at the end of this profile.

A master CAP workbook template was created. Then a set of custom Python computer programs was used to summarize information from the database to the population level and transfer the summaries into a separate CAP workbook for each population. This methodology ensured that all workbooks used the same criteria and setup, and avoided labor-intensive and error prone manual data entry. This initial set of CAP workbooks for each population was created in June 2007.

B.4. Revised CAP workbooks Incorporating Professional Judgment

Data are lacking for some indicators and threats that are recognized as affecting coho salmon or their habitats. NMFS staff conducted an extensive review of literature for SONCC coho salmon population watersheds to derive values for those factors. Documents included federal agency watershed analyses, TMDL reports, restoration plans and locally driven watershed assessments.

These supplementary values were the incorporated into the Microsoft Access database and a revised set of CAP workbooks was created in November 2008.

B.5. GIS Maps

NMFS also created GIS maps using the instream monitoring and landscape data compiled for each population. These maps are included as an Electronic Appendix H to this recovery plan on the NMFS website in Adobe Acrobat (PDF) format and are designed to be used as electronic documents, not printed. The many layers in the maps can be toggled on/off and users can zoom in to see more detail. There are two PDF maps included for each population. The main set of maps contains the stress and threats data, in addition to base layers such as coho IP and streams, and was completed in May 2010. The second set of maps was completed in December 2009 and includes canopy change over various time periods and tree size. Due to the large number of layers in the maps, full legends could not be included within the individual maps; therefore, a separate legend PDF is provided for each of the two map types. These maps were used to analyze and interpret habitat condition across the landscape. Additionally, boundary maps for each population unit showing land ownership, coho distribution, and IP habitat are included as the first figure in each population profile.

B.6. Creation of Latest Stress and Threat Summary Tables

The CAP workbooks produced summary tables that display the ranking for identified threats and stresses, the severity of the impact on each life stage (egg, juvenile, smolt, adult), and an overall ranking. One summary table for threats and one summary table for stresses are provided for each independent and dependent population (e.g., Table B - 5 and Table B - 6).

Once the summary tables were developed, NMFS used best professional judgment to further analyze and assess the severity of the identified threats and stresses as shown in the CAP table. Best professional judgment was employed to verify the CAP results, override results known to be erroneous, or include information where no current data are available. While empirical data are the preferred information with which to conduct population area condition assessments, develop indicator criteria, and evaluate threats and stresses in an area, these data are not always available or may be too old for current uses. This was the case in many of the areas in the SONCC ESU. When this is the case, professional judgment is applied to improve the strength and accuracy of the threat and stress assessment.

Table B - 5. Example of summary table for identified stresses. Note: table contains ranks for stress Impaired Estuary/Mainstem Function that was not included in the CAP workbooks.

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

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

Table B - 6. Example of summary table for identified threats. Note: table contains ranks for the threats Fishing and Collecting and Climate Change that were not included in the CAP workbooks.

	Threats	Egg	Fry	Juvenile	Smolt	Adult	Overall Threat Rank
1	Channelization/Diking	Low	Very High	Very High	High	Medium	Very High
2	Hatcheries	High	High	High	High	High	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

After the summary tables were developed, NMFS used best professional judgment to further assess the severity of the identified threats and stresses. Best professional judgment was employed to verify the CAP results, override results known to be erroneous, or include information where no current data are available. While empirical data are the preferred information with which to conduct population area condition assessments, develop indicator criteria, and evaluate threats and stresses in an area, these data are not always available or may be too old for current uses. This was the case in many of the areas in the SONCC ESU. In such cases, NMFS used professional judgment to improve the accuracy of the threat and stress assessment.

Additional Threat and Stress Categories

NMFS also used best professional judgment to develop additional threat and stress categories that are currently impacting the SONCC coho salmon ESU. Some were not identified at the time of listing, but are considered to be affecting SONCC coho salmon populations currently. These categories were developed for Climate Change, Impaired Estuary and Mainstem Function, fishing-related stress and threat ("Adverse Hatchery-Related Effects" and "Fishing and

Collecting"), and hatchery-related stress and threat ("Adverse Fishery-Related Effects" and "Fishing and Collecting"). Since no empirical data are available for these categories, NMFS utilized additional tools to perform the threat and stress assessment and ranking. NMFS utilized professional judgment when ranking and assessing the severity for each life stage for the Estuary and Mainstem Condition category. For Climate Change, NMFS utilized climate change models and predictors that assessed future changes in a variety of environmental conditions. See below for environmental variables selected for the Climate Change category.

Climate Change

Climate change has the potential to dramatically alter the recovery landscape and must be considered in assessing current and future conditions. The impacts that are most likely to affect SONCC coho salmon populations include increasing temperatures, changes in quantity and quality of snowpack, changes in precipitation, and rising sea level. NMFS assessed the climate change threat for each individual population using current conditions along with modeled future conditions based on projections for future greenhouse gas emissions. Current climate was derived from PRISM (Parameter-elevation Regressions on Independent Slopes Model) an analytical tool that uses point data, a digital elevation model, and other spatial data sets to generate gridded estimates of monthly, yearly, and event-based climatic parameters, such as precipitation, temperature, and dew point. Future climate data were derived from climate projections produced using a statistical downscaling method (Vertenstein et al. 2004). These projections were derived from the Community Climate System Model (CCSM-3) (Vertenstein et al.. 2004). We chose the A2 emission pathways, which uses one of the highest rates of greenhouse gas (GHG) emission predictions and the GFDL model, which has a relatively high sensitivity to emissions compared to other IPCC global climate models (California Environmental Protection Agency (CEPA) 2006). Since recent trends in GHG emission are thought to be well above those used in any of the IPCC (2007) models, it is likely that even the “high emission” scenario may underestimate actual emission in the future (Raupach et al. 2007). We chose the time period of 2030 to 2050 to reflect expected short-term changes in climate. For this recovery plan, ten years is the time period assumed for other stresses and threats in the stress and threats assessment. NMFS expects that effects of climate change may take longer to manifest than effects of other stresses, and so chose a longer time period in which to detect its effects.

To develop threat rankings for the climate change threat NMFS analyzed the assigned risks to populations from the various climate change indices and overlaid known life history requirements. Like other threats, the final threat level was based on application of NMFS professional judgment in consideration of available data.

Current Minimum and Maximum Temperature

An assessment of current summer and winter temperatures provided insight into the vulnerability of populations to climate change. Those populations at or near the current thresholds for coho salmon are likely to have a greater threat from climate change based on the increases in temperature occurring. Current temperature regimes were assessed using PRISM data (PRISM Climate Group 2011) averaged for the time period from 1971 to 2000 which was the time period available through the PRISM Climate Group. The months of January and July were chosen for this analysis to represent winter and summer conditions.

Current Precipitation

Current summer and winter precipitation provided a baseline condition on which to assess future changes in climate. Low precipitation in the summer and high winter precipitation are factors which can increase the threat from climate change based on predicted and ongoing changes in climate (IPCC 2007) and on the environmental requirements of SONCC coho salmon during those time periods. Current precipitation regimes were assessed using PRISM data (PRISM Climate Group 2011) averaged for the time period from 1971 to 2000. The months of January and July were chosen for this analysis to represent winter and summer conditions. The average precipitation does not indicate the rates or types of precipitation, which is another climate factor which can influence coho salmon growth and survival.

Current snowpack

Changes in temperature and precipitation will ultimately affect the snowpack in Southern Oregon and Northern California. Areas that currently have little snowpack will likely have less in the future given the modeled changes in temperature and precipitation for the area (Gleick and Chalecki 1999, Lettenmeier and Gan 1990). Snowpack-driven systems are highly vulnerable to climate change and identification of these sensitive populations helps inform our assessment of the climate change threat. Information about current snowpack was derived from NRCS SNOTEL and Snow Course snow water equivalents for the month of January (NRCS 2011). These data are represented as a percentage of normal and averaged between 1971 and 2000. High risk was assigned to populations that currently have a low snowpack and are snowpack dependent.

Modeled Future Temperature Change

Regional forecasts of temperature changes related to climate change were derived from the statistical downscaling method and Community Climate System Model (CCSM-3) (Vertenstein et al. 2004). The months of January and July are used to represent changes in the summer and winter in terms of mean daily temperature (Figure B - 1 and Figure B – 2). A high risk is assigned to populations where temperatures are already high and future increases in summer temperature are expected. High risk is also assigned to snowpack-dependent populations where increases in winter temperature are expected to decrease snowpack levels.

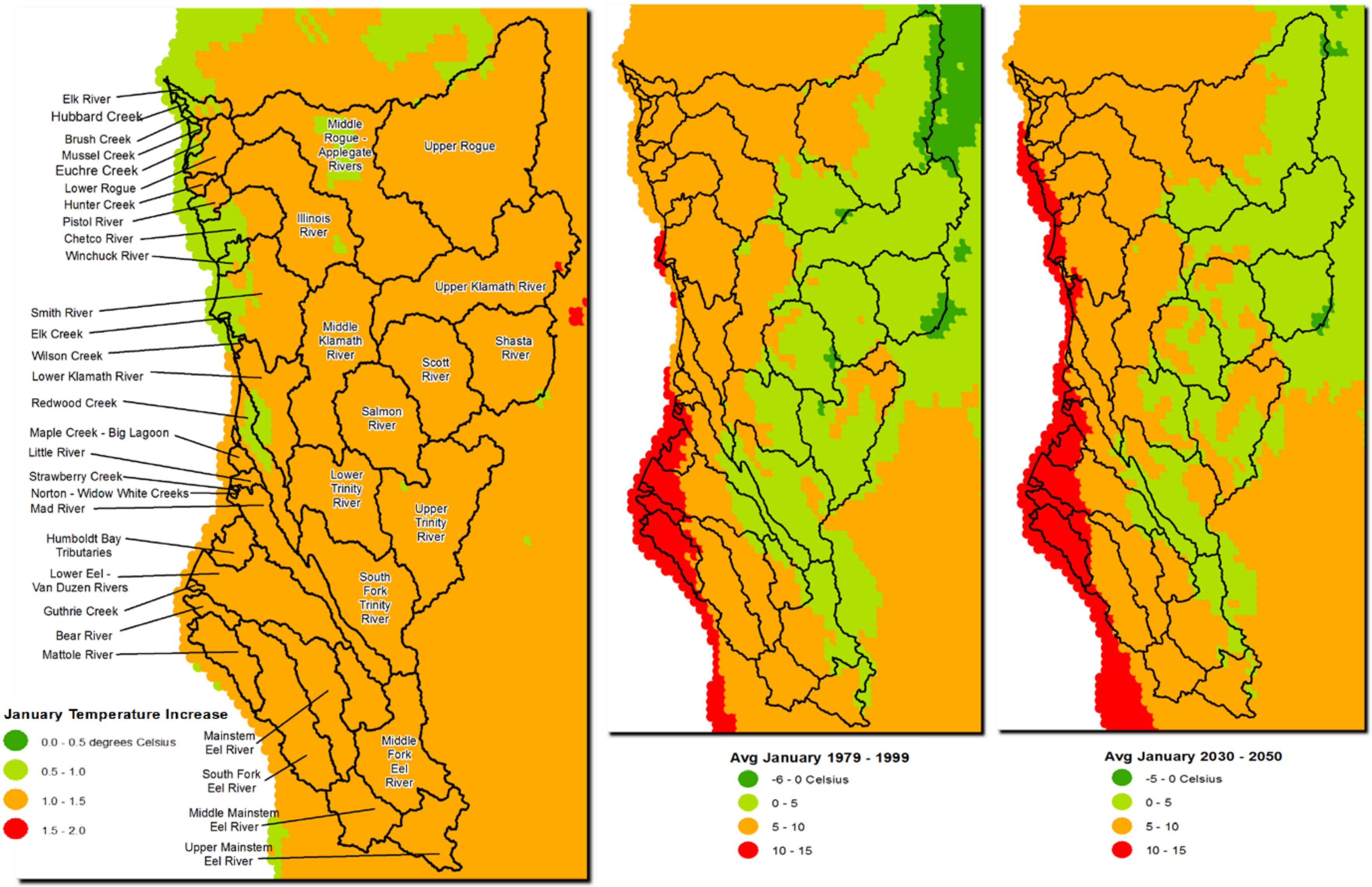


Figure B - 1. Modeled average January temperatures for the years 1979 to 1999 (middle panel) and 2030 to 2050 (right panel), and the difference between the two time periods (left panel). Datasets generated by the Community Climate System Model (CCSM) model for the IPCC 4th Assessment Report, and were downloaded from http://www.gisclimatechange.org/. The 1979-1999 data are from the 20th Century Experiment and the 2030-2050 data are from emissions scenario A2. Boundaries of the coho salmon populations in the SONCC coho salmon ESU are also shown.

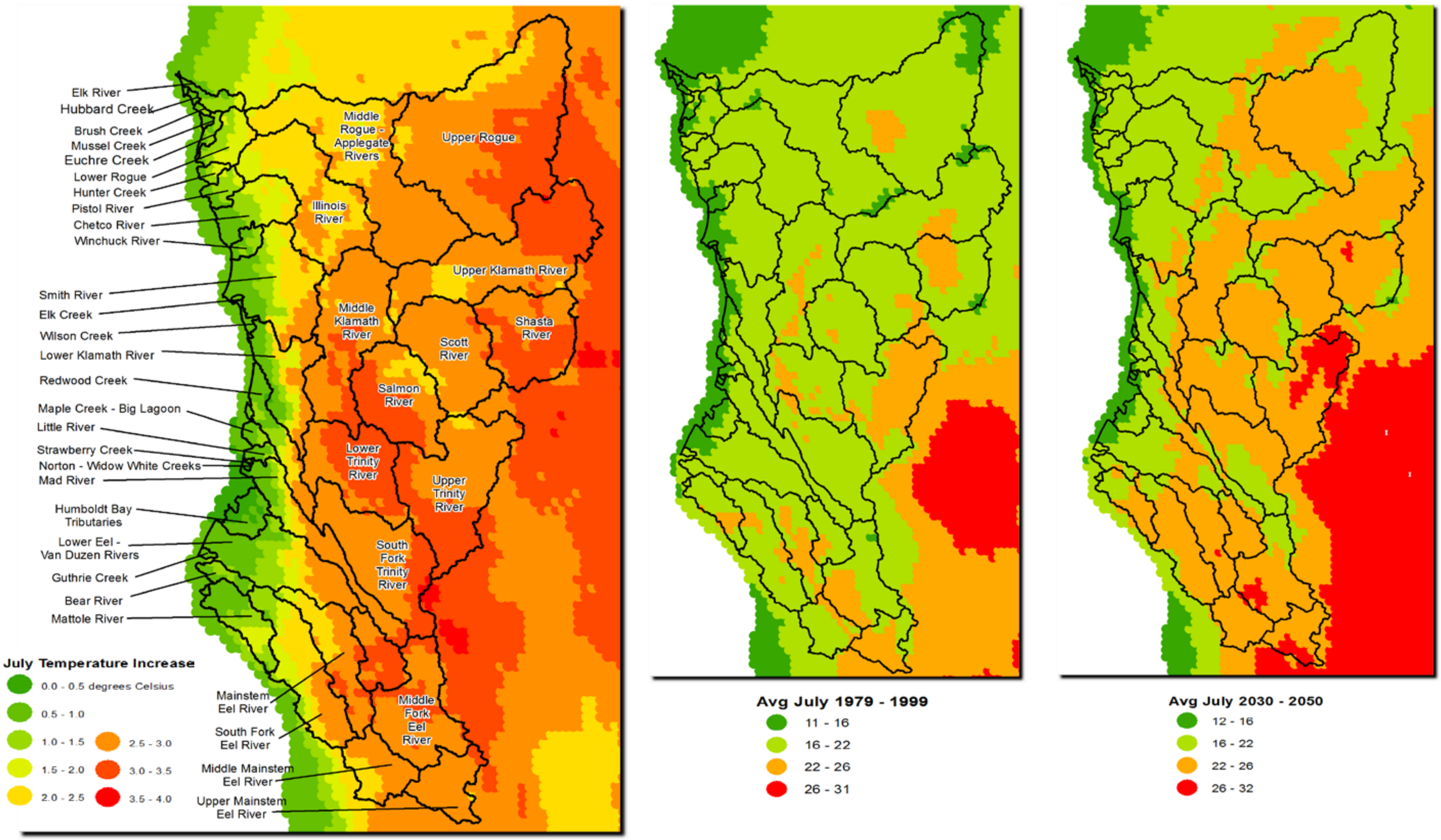


Figure B - 2. Modeled average July temperatures for the years 1979 to 1999 (middle panel) and 2030 to 2050 (right panel), and the difference between the two time periods (left panel). Datasets generated by the Community Climate System Model (CCSM) model for the IPCC 4th Assessment Report, and were downloaded from http://www.gisclimatechange.org/. The 1979-1999 data are from the 20th Century Experiment and the 2030-2050 data are from emissions scenario A2. Boundaries of the coho salmon populations in the SONCC coho salmon ESU are also shown.

Modeled Future Precipitation Change

Regional forecasts of precipitation changes related to climate change are derived from projections of temperature produced using a statistical downscaling method (Vertenstein et al. 2004). These projections are derived from the same A2 emission pathway and the Community Climate System Model (CCSM-3) (Vertenstein et al. 2004). The same time period is used to create model output. We used the general trends of the predicted changes in precipitation (i.e., increasing, decreasing, or stable) instead of the exact predicted values. High risk is assigned to populations where precipitation was already low and the expected trend was for decreasing precipitation over the next 20 years.

Modeled Sea Level Rise

Sea level rise has the potential to have a dramatic impact on salmon habitat in some SONCC coho salmon populations. To assess this aspect of climate change we use a coastal vulnerability index (CVI) provided by the U.S. Geological Survey (Thieler and Hammar-Klose 2000). This classification is based upon the variables geomorphology, regional coastal slope, tide range, wave height, relative sea-level rise, and shoreline erosion and accretion rates. The combination of these variables and the association of these variables to each other furnish a broad overview of regions where physical changes are likely to occur due to sea-level rise (Figure B - 3).

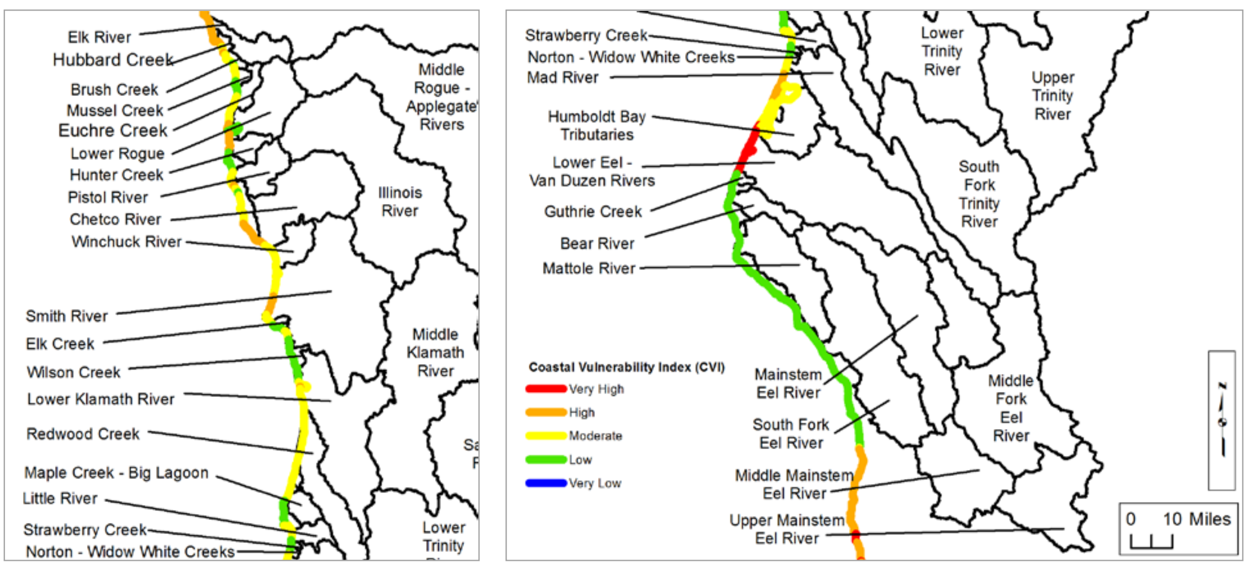


Figure B-3. Coastal Vulnerability Index (CVI) (Thieler and Hammer-Klose 2000) and boundaries of coho salmon population in the northern (left panel) and southern (right panel) portions of the SONCC coho salmon ESU.

Impaired Estuary and Mainstem Function

Due to the lack of numeric data that covered the entire ESU, no numeric values or categories were used to develop rankings for this stress. Instead, professional judgment was used based on a series of information about the current state of estuarine or mainstem habitat and environmental conditions. Important considerations included the extent of development in the estuarine floodplain; known or presumed former extent of estuary habitat, availability of diverse and well-connected off-channel, pond, and wetland estuary and mainstem habitat; water quality; presence of dams and other obstacles to migration; and extent of diking and ditching in the estuary. Life stage specific factors were also considered to contribute to this stress level. For fry, the stress level was elevated if there was a known fry migrant life history or the occurrence of fry migrants in the populations. For juveniles, the occurrence of estuarine life history types, accessibility issues (such as barriers block access to tributary rearing habitat), the extent and quality of rearing habitat, and water quality issues were all used in developing stress rankings. Smolts were considered to be impacted by this stress if there were predation issues in the mainstem or estuary, poor migratory conditions (such as exposure to stressful water quality conditions, parasites, or diseases) that could reduce survival and growth, a lack of refugia or holding habitat in the mainstem and/or estuary, and ocean accessibility issues (such as a seasonal berm). The adult life stage was ranked based on the accessibility of the watershed, poor migratory conditions in the estuary and/or mainstem which could reduce survival, and the availability of holding habitat in the estuary.

Adverse Fishery-Related Effects (stress) and Fishing and Collecting (threat)

The percent of observed adults of hatchery origin is used as an indicator of relative genetic risk to a coho salmon population. Use of less than 5 percent as the threshold for low risk is consistent with the approach described in Williams et al. (2008). Williams et al. (2008) does not provide guidance regarding degree of risk above 5 percent. The status review for Oregon salmon and steelhead populations in the Willamette and Lower Columbia basins (McElhany et al. 2007) describes categories of genetic risk from hatcheries with break points at 10 percent and 30 percent, and this convention was adopted. Ecological effects of hatcheries are accounted for in the Medium stress and threat rank, which is assigned if there is a salmonid hatchery in the basin.

Table B - 7. Criteria for ranking fishing- and collecting-related stress (Adverse Fishing- and Collection-Related Effects) and threat (Fishing and Collecting).

Rank	Definition
Low	Less than 5 percent of observed adults are of hatchery origin.
Medium	Greater than or equal to 5 percent and less than or equal to 10 percent of observed adults are of hatchery origin OR there is a salmonid hatchery in the basin.
High	Greater than 10 percent and less than 30 percent of observed adults are of hatchery origin.
Very High	Greater than or equal to 30 percent of observed adults are of hatchery origin.

B.7. Limiting Factor Analysis

A limiting factor refers to any condition that is required by a species which becomes insufficient or absent in a habitat. When particular needs are not met individuals of the population start to die off or fertility becomes inhibited. Some common examples of limiting factors are food, water, predation or lack thereof, water, shelter, gases (i.e., oxygen), and organic chemical compounds. The limiting factor works as a control that prevents unchecked growth in a population or can be one that causes a population to decline and disappear from a habitat. A limiting factors analysis is designed to identify physical limitations to fish production that may be addressed by habitat restoration or enhancement. This approach assumes that when habitat required by a species during a particular season is in short supply, a bottleneck results and this habitat becomes limiting (Reeves et al. 1989). Without information on limiting factors, resources may be allocated with little or no benefit to the species. Key limiting factors were identified as the stresses most limiting particular life stages. NMFS utilized the CAP workbooks and summary tables, and best professional judgment, and a narrative was developed to document the results. The results of these exercises were then considered when the recovery team developed both the population level recovery recommendations and the stratum level recovery actions. Recovery actions and recommendations were developed to address all key limiting factors.

B.8. Datasets Utilized in the Stress and Threat Analysis

Table B - 8. Data type, state, year, and reference for data to inform GIS maps, CAP workbooks, and resultant summary tables. Datasets were generally used only if similar information was widely available across the SONCC coho salmon ESU.

Data Type	State/year	Reference
Amount of Impervious Surfaces	California/ Oregon	Homer, C. C. Huang, L. Yang, B. Wylie and M. Coan. 2004. Development of a 2001 National Landcover Database for the United States. Photogrammetric Engineering and Remote Sensing, Vol. 70, No. 7, pp 829-840
Agricultural Practices	California/ Oregon	Homer, C. C. Huang, L. Yang, B. Wylie and M. Coan. 2004. Development of a 2001 National Landcover Database for the United States. Photogrammetric Engineering and Remote Sensing, Vol. 70, No. 7, pp 829-840
Road Density	California - inland areas	LEGACY-The Landscape Connection Long Range Strategy: Creating a Biodiversity Conservation Network. Released April 29, 1999 By Curtice Jacoby, Noel Soucy, Daniel Boiano, Steven Day, Shayne Green, KayDee Simon, Keith Slauson, and Chris Trudel Produced by LEGACY – The Landscape Connection
	California - coastal areas	CAL FIRE Forest Practices GIS for coastal areas.
Road Density	Oregon	Southwest Oregon Province (SWOP). 1998. Unpublished data released on a CD of GIS Data.
Timber Harvest	California	CAL FIREForest Practices GIS - only harvest on non-public lands and harvest not conducted as part of Non-Industrial Timber Management Plans.

Data Type	State/year	Reference
	Oregon	Bredensteiner, K., K. Palacios, and J. Strittholt. 2003. Assessment of Aquatic Habitat Monitoring Data in the Rogue River Basin and Southern Oregon Coastal Streams. Performed under grant from David and Lucille Packard Foundation by the Conservation Biology Institute, Corvallis, OR. 42 p. Chapter 1-5. Chapter 6. Chapter 7. Chapter 8 + Appendices.
Barriers	California - Mendocino, Humboldt, Del Norte, Trinity, and Siskiyou County	Five Counties Salmonid Conservation Program. 2008. Five Counties Salmonid Conservation Program (5C) Final Report. Contract P0510327. CA Department of Fish and Game, Fisheries Restoration Grant Program March 2007 – July 2008
	California	California Department of Fish and Game Fish Passage Assessment Database -
	Oregon	Oregon Department of Fish and Wildlife Fish Passage Barriers database -
Coho Distribution	California	Shape files from California Department of Fish and Game Calfish database -
	Oregon	Oregon Department of Fish and Wildlife (ODFW). 2010. Oregon Fish Habitat Distribution. Electronic map dataset published 3/9/2010 (http://nrimp.dfw.state.or.us/nrimp/default.aspx?pn=fishdistdata). Oregon Dept. of Fish and Wildlife, Salem, Oregon.
SONCC coho salmon intrinsic potential	California and Oregon	Williams, T. H. and others. 2008. Framework for Assessing Viability of Threatened Coho Salmon in the Southern Oregon/Northern California Evolutionary Significant Unit. Southwest Fisheries Science Center. Santa Cruz, CA.
Coho brood year information	California	California_Coho_Status_Review_Brood_Year_Investigation.shp, version 11/3/2009, received 11/2/2009 from CDFG. Supplemental information: Atlas_Hydro_SONCC.shp, version 10/22/2009, received 11/3/2009 from CDFG.
	California	California Department of Fish and Game (CDFG). 2002a. North Coast California Coho Salmon Investigation (NCCCSI) .
Change Scene and tree size data	California only	Tree size data downloaded from: http://www.reo.gov/monitoring/reports/10yr-report/map-data/index.shtml

Data Type	State/year	Reference
	California and Oregon	Methods for tree size and change scene data: Moeur, M., T.A. Spies, M. Hemstrom, J.R. Martin, J. Alegria, J. Browning, J. Cissel, W.B. Cohen, T.E.Demeo, S. Healey, and R. Warbington. 2005. Northwest Forest Plan- the first 10 years (1994 to 2003): status and trend of late-successional and old-growth forest. Gen. Tech. Rep. PNW-GTR-646. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 142 p.
Aquatic Invertebrates (B-IBI NorCal)	2000	Rehn, A.C. and P.R. Ode. 2005. Draft Development of a Benthic Index of Biotic Integrity (B-IBI) for Wadeable Streams in Northern Coastal California and its Application to Regional 305(b) Assessment. CDFG Aquatic Bioassessment Laboratory, Rancho Cordova, CA. 24 p.
Aquatic Invertebrates (EPT)	1980 -1998	PL [Pacific Lumber Company]. 1998. Sustained yield/Habitat Conservation Plan for the properties of The Pacific Lumber Company, Scotia Pacific Holding Company, and Salmon Creek Corporation. Public Review Draft.
	California	Salmon River Restoration Council (SRRC). 1994. Unpublished data of macroinvertebrate samples for the year 1994 in tributaries of the Salmon River: Salmon River Macroinvertebrate Reconnaissance Study. Data included in the "Aquatic Inverts: EPT Richness Index Three Salmon River Tribs Fall 1994" topic of the Klamath Resource Information System. Salmon River Restoration Council, Somes Bar, CA.
Aquatic Invertebrates (Rich)	1980-1996	PL [Pacific Lumber Company]. 1998. Sustained yield/Habitat Conservation Plan for the properties of The Pacific Lumber Company, Scotia Pacific Holding Company, and Salmon Creek Corporation. Public Review Draft.
Canopy Cover (% Shade)	1991	California Department of Fish and Game (CDFG). 2007. Unpublished data from a database of stream habitat surveys in Northwestern California for the years 1991-2003, acquired from Ron Rogers in 2007. California Department of Fish and Game, Sacramento, CA.
	1994	California Department of Fish and Game (CDFG). 2009. Unpublished data from a database of stream habitat surveys in Northwestern California for the years 1994-2008, acquired from Karen Wilson in 2009. California Department of Fish and Game, Sacramento, CA.
Canopy Cover (% Shade)	2002-2003	Mattole Salmon Group (MSG). 2003. Final Report: Mattole Basin Channel Monitoring 2002-2003. Petrolia, CA.

Data Type	State/year	Reference
	2005	Mattole Restoration Council (MRC). 2008. Unpublished spreadsheet of stream habitat information for the Mattole River for the years 2005-2007, acquired from Nathan Queener on 5/15/2008. Mattole Restoration Council, Petrolia, CA.
Canopy Type (% Open + Hardwood)	1991-2003	California Department of Fish and Game (CDFG). 2007. Unpublished data from a database of stream habitat surveys in Northwestern California for the years 1991-2003, acquired from Ron Rogers in 2007. California Department of Fish and Game, Sacramento, CA.
Canopy Type (% Open + Hardwood)	1994-2008	California Department of Fish and Game (CDFG). 2009. Unpublished data from a database of stream habitat surveys in Northwestern California for the years 1994-2008, acquired from Karen Wilson in 2009. California Department of Fish and Game, Sacramento, CA.
D.O. (COLD) (mg/l 7-DAMin)	1995	U.S. Fish and Wildlife Service. 1995. Unpublished Klamath River water quality data for the year 1995. Data are included in the "Temperature: Salmonid Stress Klamath River at Blue Creek 1995" topic of the Klamath Resource Information System (KRIS) Klamath-Trinity. U.S. Fish and Wildlife Service, Arcata, CA.
D.O. (COLD) (mg/l 7-DAMin)	1994-2003	Asarian, E. and J. Kann. 2006. Klamath River Nitrogen Loading and Retention Dynamics, 1996-2004 (Appendix C: updated version of Klamath TMDL water quality database). Kier Associates Final Technical Report to the Yurok Tribe Environmental Program, Klamath, California. 56pp + appendices.
D50 (mm)	1998 -200	Dresser, A. T., C. Cook, and M. Smith. 2001. Long Term Trend Monitoring Program for the South Fork Trinity River watershed. Data are included in the "Sediment: Median Particle Size (3) - Hyampom (1998, 2000)" topic of the Klamath Resource Information System (KRIS) Klamath-Trinity
D50 (mm)	1992	Knopp, C. 1993. Testing indices of cold water fish habitat. Final report for development of techniques for measuring beneficial use protection and inclusion into the North Coast Region's Basin Plan by Amendment of the.....Activities, September 18, 1990. Data are included in the " Sediment: V* by NCRWQCB, 1992" topic of the Klamath Resource Information System (KRIS) Mattole. North Coast Regional Water Quality Control Board in cooperation with California Department of Forestry. 57 pp.
D50 (mm)	2001-2003	Mattole Salmon Group (MSG). 2003. Final Report: Mattole Basin Channel Monitoring 2002-2003. Petrolia, CA.

Data Type	State/year	Reference
D50 (mm)	1979-1995	Redwood National and State Parks. 2002. Unpublished particle size distribution data for Redwood Creek at locations of gaging stations from 1979 to 1995. Data included in the "Sediment: D50 from Cross-Sections at Redwood Creek at Gauging Stations" topic of the Klamath Resource Information System (KRIS) Redwood. Redwood National and State Parks, Orick, CA.
D50 (mm)	2000-2008	Aquatic and Riparian Effectiveness Monitoring Program (AREMP). 2009. Unpublished database of aquatic habitat monitoring and temperature data for Northern California and Southern Oregon for the years 2000-2008, collected as part of the Northwest Forest PlanInteragency Regional Monitoring Program, acquired from Mark Isley on 12/4/2009. United States Forest Service, Corvallis, OR.
Embeddedness (%)	2002-2003	Mattole Salmon Group (MSG). 2003. Final Report: Mattole Basin Channel Monitoring 2002-2003. Petrolia, CA.
Embeddedness (%)	1991-2003	California Department of Fish and Game (CDFG). 2007. Unpublished data from a database of stream habitat surveys in Northwestern California for the years 1991-2003, acquired from Ron Rogers in 2007. California Department of Fish and Game, Sacramento, CA.
Embeddedness (%)	1994-2008	California Department of Fish and Game (CDFG). 2009. Unpublished data from a database of stream habitat surveys in Northwestern California for the years 1994-2008, acquired from Karen Wilson in 2009. California Department of Fish and Game, Sacramento, CA.
Embeddedness (%)	2005-2007	Mattole Restoration Council (MRC). 2008. Unpublished spreadsheet of stream habitat information for the Mattole River for the years 2005-2007, acquired from Nathan Queener on 5/15/2008. Mattole Restoration Council, Petrolia, CA.
Fines (Dry Sample) (% <1 mm)	2002	Trinity County Resource Conservation District (TCRCD). 2003. South Fork Trinity River Water Quality Monitoring Project - Agreement No. P0010340 Final Report. Data included in the "Sediment: SF Trinity - Cumulative Percent Fines <0.85 mm, GMA 2002" topic of the Klamath Resource Information System (KRIS) Klamath-Trinity .Prepared for California Department of Fish and Game by TCRCD, with assistance from Graham Matthews. Weaverville, CA. 77 pp.

Data Type	State/year	Reference
Fines (Dry Sample) (% <1 mm)	1983-1995	North Coast Regional Water Quality Control Board. 2002. Unpublished fine sediment data for the Redwood Creek Basin for the years 1983-1995. Data included in the "Sediment: Percent Fines <1mm at Redwood Creek Mainstem Sites" topic of the Klamath Resource Information System (KRIS) Redwood. North Coast Regional Water Quality Control Board, Santa Rosa, CA.
Fines (Wet Sample) (% <1 mm)	1967-1996	PL [Pacific Lumber Company]. 1998. Sustained yield/Habitat Conservation Plan for the properties of The Pacific Lumber Company, Scotia Pacific Holding Company, and Salmon Creek Corporation. Public Review Draft. Salmon Creek, 1994" topic of the Klamath Resource Information System (KRIS) Humboldt Bay. Arcata CA. 81 pp. without appendices.
Fines (Wet Sample) (% <1 mm)	1967-1996	Barnard, K. 1992. Physical and Chemical Conditions in Coho Salmon (Oncorhynchus kisutch) Spawning Habitat in Freshwater Creek, Northern California. Masters Thesis. Humboldt State University. Some data included in the " Sediment: Fines <0.85mm
Fines (Wet Sample) (% <1 mm)	1992	Hoopa Valley Tribe Fisheries Department. 1997. Pine Creek Sediment Monitoring Project. Grey literature report submitted to USFWS Yreka, in fulfillment of a Klamath Task Force funded evaluation report of restoration in Pine Creek. Some data included in the "Sediment: Pine Creek Coho Expected Emergence, 1992-1993" topic of the Klamath Resource Information System (KRIS) Klamath Trinity Hoopa Valley Tribe Fisheries Department, Hoopa, CA.
Fines (Wet Sample) (% <1 mm)	1990	Preston, L. 2002. Unpublished data of wet sieve McNeil samples from Lost Man Creek and seven mainstem Mattole sites in 1990 by Larry Preston. Data included in the "Sediment: Fines <4.7 mm Mattole South Subbasin, 1990" topic of the Klamath Resource Information System (KRIS) Mattole. California Department of Fish and Game, Eureka, CA.
Fines (Wet Sample) (% <1 mm)	1974	North Coast Regional Water Quality Control Board. 2002. Unpublished fine sediment data for the Redwood Creek Basin for the years 1983-1995. Data included in the "Sediment: Percent Fines <1mm at Redwood Creek Mainstem Sites" topic of the Klamath Resource Information System (KRIS) Redwood North Coast Regional Water Quality Control Board, Santa Rosa, CA.
Fish Passage (% of Dry Habitat Types)	1991-2003	California Department of Fish and Game (CDFG). 2007. Unpublished data from a database of stream habitat surveys in Northwestern California for the years 1991-2003, acquired from Ron Rogers in 2007. California Department of Fish and Game, Sacramento, CA.

Data Type	State/year	Reference
Fish Passage (% of Dry Habitat Types)	1994-2008	California Department of Fish and Game (CDFG). 2009. Unpublished data from a database of stream habitat surveys in Northwestern California for the years 1994-2008, acquired from Karen Wilson in 2009. California Department of Fish and Game, Sacramento, CA.
Floodplain Connectivity (USFS judgment)	2000	U.S. Forest Service. 2000. Rating Watershed Condition: Reconnaissance Level Assessment for the National Forest of the Pacific Southwest Region in California. U.S.D.A. Forest Service, Region 5, San Francisco, CA. 31 p.
Flow Restoration Needs (ODFW judgment)	1998	Oregon Department of Fish and Wildlife (ODFW). 1998. Stream Flow Restoration Priority GIS Data for the Rogue and South Coast Basins. Oregon Department of Fish and Wildlife, Salem, OR.
pH (Annual Maximum)	1995	U.S. Fish and Wildlife Service. 1995. Unpublished Klamath River water quality data for the year 1995. Data are included in the "Temperature: Salmonid Stress Klamath River at Blue Creek 1995" topic of the Klamath Resource Information System (KRIS) Klamath-Trinity U.S. Fish and Wildlife Service, Arcata, CA.
pH (Annual Maximum)	1990-2003	Asarian, E. and J. Kann. 2006. Klamath River Nitrogen Loading and Retention Dynamics, 1996-2004 (Appendix C: updated version of Klamath TMDL water quality database). Kier Associates Final Technical Report to the Yurok Tribe Environmental Program, Klamath, California. 56pp + appendices.
pH (Annual Maximum)	1995-2004	Oregon Department of Environmental Quality (ODEQ). 1997. Unpublished water quality data from the ODEQ Laboratory Analytical Storage and Retrieval (LASAR) database, exported and acquired from Robb Keller, 4/17/2007. Oregon Department of Environmental Quality, Salem, OR.
Pool Depth (Ave. in Feet)	1991-2003	California Department of Fish and Game (CDFG). 2007. Unpublished data from a database of stream habitat surveys in Northwestern California for the years 1991-2003, acquired from Ron Rogers in 2007. California Department of Fish and Game, Sacramento, CA.
Pool Depth (Ave. in Feet)	1994-2008	California Department of Fish and Game (CDFG). 2009. Unpublished data from a database of stream habitat surveys in Northwestern California for the years 1994-2008, acquired from Karen Wilson in 2009. California Department of Fish and Game, Sacramento, CA.
Pool Depth (Ave. in Feet)	2005-2007	Mattole Restoration Council (MRC). 2008. Unpublished spreadsheet of stream habitat information for the Mattole River for the years 2005-2007, acquired from Nathan Queener on 5/15/2008. Mattole Restoration Council, Petrolia, CA.

Data Type	State/year	Reference
Pool Depth (Ave. in Feet)	1990-2003	Oregon Department of Fish and Wildlife (ODFW). 2007. Unpublished geo-referenced stream survey data "Aquatic Inventories Project Habitat and Reach Data", downloaded from ODFW's statewide database. Oregon Department of Fish and Wildlife, Salem, OR.
Pool Depth (Ave. in Feet)	1990-1995	United States Forest Service. 1995. Unpublished geo-referenced stream survey data for the Rogue River-Siskiyou National Forest for the years 1989-1995, acquired from the Conservation Biology Institute (who compiled the data from multiple files). Rogue River-Siskiyou National Forest, Medford, OR.
Pool Depth (Ave. in Feet)	1995-2006	United States Forest Service. 2006. Unpublished geo-referenced stream survey data for the Rogue River-Siskiyou National Forest for the years 1995-2006, acquired from the Rogue River-Siskiyou National Forest. Rogue River-Siskiyou National Forest, Medford, OR.
Pool Depth (Ave. in Feet)	2000-2008	Aquatic and Riparian Effectiveness Monitoring Program (AREMP). 2009. Unpublished database of aquatic habitat monitoring and temperature data for Northern California and Southern Oregon for the years 2000-2008, collected as part of the Northwest Forest Plan Interagency Regional Monitoring Program, acquired from Mark Isley on 12/4/2009. United States Forest Service, Corvallis, OR.
Pool Frequency (% by Area)	1990	Oregon Department of Fish and Wildlife (ODFW). 2007. Unpublished geo-referenced stream survey data "Aquatic Inventories Project Habitat and Reach Data", downloaded from ODFW's statewide database. Oregon Department of Fish and Wildlife, Salem, OR.
Pool Frequency (% by Area)	1990-1195	United States Forest Service. 1995. Unpublished geo-referenced stream survey data for the Rogue River-Siskiyou National Forest for the years 1989-1995, acquired from the Conservation Biology Institute (who compiled the data from multiple files). Rogue River-Siskiyou National Forest, Medford, OR.
Pool Frequency (% by Area)	1995-2006	United States Forest Service. 2006. Unpublished geo-referenced stream survey data for the Rogue River-Siskiyou National Forest for the years 1995-2006, acquired from the Rogue River-Siskiyou National Forest. Rogue River-Siskiyou National Forest, Medford, OR.
Pool Frequency (% by Length)	1991-2003	California Department of Fish and Game (CDFG). 2007. Unpublished data from a database of stream habitat surveys in Northwestern California for the years 1991-2003, acquired from Ron Rogers in 2007. California Department of Fish and Game, Sacramento, CA.

Data Type	State/year	Reference
Pool Frequency (% by Length)	1994-2008	California Department of Fish and Game (CDFG). 2009. Unpublished data from a database of stream habitat surveys in Northwestern California for the years 1994-2008, acquired from Karen Wilson in 2009. California Department of Fish and Game, Sacramento, CA.
Pool Frequency (% by Length)	2005-2007	Mattole Restoration Council (MRC). 2008. Unpublished spreadsheet of stream habitat information for the Mattole River for the years 2005-2007, acquired from Nathan Queener on 5/15/2008. Mattole Restoration Council, Petrolia, CA.
Riparian Condition (conifers >36" dbh / 1000ft)	1990-2003	Oregon Department of Fish and Wildlife (ODFW). 2007. Unpublished geo-referenced stream survey data "Aquatic Inventories Project Habitat and Reach Data", downloaded from ODFW's statewide database. Oregon Department of Fish and Wildlife, Salem, OR.
Sand (Dry Sample) (% <6.4 mm)	2002	Trinity County Resource Conservation District (TCRCD). 2003. South Fork Trinity River Water Quality Monitoring Project - Agreement No. P0010340 Final Report. Data included in the "Sediment: SF Trinity - Cumulative Percent Fines <0.85 mm, GMA 2002" topic of the Klamath Resource Information System (KRIS) Klamath-Trinity (available online at http://krisweb.com/krisklamathtrinity/krisdb/webbuilder/st_c49.htm). Prepared for California Department of Fish and Game by TCRCD, with assistance from Graham Matthews. Weaverville, CA. 77 pp.
Sand (Dry Sample) (% <6.4 mm)	1983-1995	North Coast Regional Water Quality Control Board. 2002. Unpublished fine sediment data for the Redwood Creek Basin for the years 1983-1995. Data included in the "Sediment: Percent Fines <1mm at Redwood Creek Mainstem Sites" topic of the Klamath Resource Information System (KRIS) Redwood. North Coast Regional Water Quality Control Board, Santa Rosa, CA.
Sand (Wet Sample) (% <6.4 mm)	1967-1996	PL [Pacific Lumber Company]. 1998. Sustained yield/Habitat Conservation Plan for the properties of The Pacific Lumber Company, Scotia Pacific Holding Company, and Salmon Creek Corporation. Public Review Draft.
Sand (Wet Sample) (% <6.4 mm)	1967-1996	Barnard, K. 1992. Physical and Chemical Conditions in Coho Salmon (Oncorhynchus kisutch) Spawning Habitat in Freshwater Creek, Northern California. Masters Thesis. Humboldt State University. Some data included in the " Sediment: Fines <0.85mm Salmon Creek, 1994" topic of the Klamath Resource Information System (KRIS) Humboldt Bay. Arcata CA. 81 pp. without appendices.

Data Type	State/year	Reference
Sand (Wet Sample) (% <6.4 mm)	1992	Hoopa Valley Tribe Fisheries Department. 1997. Pine Creek Sediment Monitoring Project. Grey literature report submitted to USFWS Yreka, in fulfillment of a Klamath Task Force funded evaluation report of restoration in Pine Creek. Some data included in the "Sediment: Pine Creek Coho Expected Emergence, 1992-1993" topic of the Klamath Resource Information System (KRIS) Klamath Trinity Hoopa Valley Tribe Fisheries Department, Hoopa, CA.
Sand (Wet Sample) (% <6.4 mm)	1990	Sommarstrom, S., E. Kellogg and J. Kellogg. 1990. Scott River watershed granitic sediment study: Report for Siskiyou Resource Conservation District, 152 p. plus appendices.
Sand (Wet Sample) (% <6.4 mm)	1990	Preston, L. 2002. Unpublished data of wet sieve McNeil samples from Lost Man Creek and seven mainstem Mattole sites in 1990 by Larry Preston. Data included in the "Sediment: Fines <4.7 mm Mattole South Subbasin, 1990" topic of the Klamath Resource Information System (KRIS) Mattole. California Department of Fish and Game, Eureka, CA.
Silt/Sand Surface (% riffle area)	Oregon 1990-2003	Oregon Department of Fish and Wildlife (ODFW). 2007. Unpublished geo-referenced stream survey data "Aquatic Inventories Project Habitat and Reach Data", downloaded from ODFW's statewide database. Oregon Department of Fish and Wildlife, Salem, OR.
Stream Corridor Vegetation (USFS judgment)	2000	U.S. Forest Service. 2000. Rating Watershed Condition: Reconnaissance Level Assessment for the National Forest of the Pacific Southwest Region in California. U.S.D.A. Forest Service, Region 5, San Francisco, CA. 31 p.
Temperature (MWAT) (C)	1995-1996	PL [Pacific Lumber Company]. 1998. Sustained yield/Habitat Conservation Plan for the properties of The Pacific Lumber Company, Scotia Pacific Holding Company, and Salmon Creek Corporation. Public Review Draft.
Temperature (MWAT) (C)	1997-2002	Klamath National Forest. 2003. Unpublished water temperature data for the Middle Klamath River watershed in 1997-2002, compiled by Klamath National Forest's Mark Reichert. Data included in the " Temperature: MWAT at Many Mainstem Klamath Sites by Year 1997-2002 ", "Temperature: MWAT at Many Mainstem Klamath Sites by Year 1997-2002", and "Temperature: MWAT at Many Scott R Sub-basin, by Year 1997-2002" topics of the Klamath Resource Information System (KRIS) Klamath-Trinity
Temperature (MWAT) (C)	2002-2003	Mattole Salmon Group (MSG). 2003. Final Report: Mattole Basin Channel Monitoring 2002 - 2003. Petrolia, CA.

Data Type	State/year	Reference
Temperature (MWAT) (C)	1995-2001	North Coast Regional Water Quality Control Board (NCRWQCB). 2002. Unpublished water temperature data for the Mattole River watershed in 1995-2001. Data included in the "Temperature: MWATs of Mainstem Mattole River (Celsius)" topic of the Klamath Resource Information System (KRIS) Mattole North Coast Regional Water Quality Control Board, Santa Rosa, CA.
Temperature (MWAT) (C)	1974-2001	North Coast Regional Water Quality Control Board (NCRWQCB). 2002. Unpublished water temperature data for the Redwood Creek watershed in 1974-2001. Data included in the "Temperature: MWATs at All Mainstem Redwood Creek Sites (1994-2001)" topic of the Klamath Resource Information System (KRIS) Redwood. North Coast Regional Water Quality Control Board, Santa Rosa, CA.
Temperature (MWAT) (C)	1999-2003	Friedrichsen, G. 2003. Eel River Baseline Temperature Final Report. Performed for the California Department of Fish and Game under Agreement No. P0110546. Humboldt County Resources Conservation District. Eureka, CA. 32 pp.
Temperature (MWAT) (C)	1990-1998	Lewis, T. E., D. W. Lamphear, D. R. McCanne, A. S. Webb, J. P. Krieter, and W. D. Conroy. 2000. Executive Summary: Regional Assessment of Stream Temperatures Across Northern California and Their Relationship to Various Landscape-Level and Site-Specific Attributes. Forest Science Project. Humboldt State University Foundation. Arcata, CA. 14 pp.
Temperature (MWMT) (C)	1994-2008	Green Diamond Resource Company. 2009. Unpublished water temperature data from Green Diamond's northern California land holdings for the years 1994-2008, acquired from David Lamphear. Green Diamond Resource Company, Korbel, CA.
Temperature (MWMT) (C)	1998-2006	Oregon Department of Environmental Quality (ODEQ). 1997. Unpublished water quality data from the ODEQ Laboratory Analytical Storage and Retrieval (LASAR) database, exported and acquired from Robb Keller, 4/17/2007. Oregon Department of Environmental Quality, Salem, OR.
Temperature (MWMT) (C)	1990-1997	Southwest Oregon Province (SWOP). 1998. Unpublished water temperature data released on a CD of GIS Data.
Turbidity (hours >25 FNU)	2001-2007	Kier Associates. 2007. Unpublished turbidity data from multiple data sources within the SONCC coho salmon ESU, derived from various tables in the Klamath Resource Information System (KRIS). Kier Associates, Arcata, CA.

Data Type	State/year	Reference
Turbidity (hours >25 FNU)	2003-2005	Klein, R., W. Trush, M. Buffleben. 2008. Watershed condition, turbidity, and implications for anadromous salmonids in northern coastal California streams. A Report to the California North Coast Regional Water Quality Control Board. Redwood National and State Parks, McBain and Trush, and California Regional Water Quality Control Board North Coast Region: Arcata and Santa Rosa, CA. 89 pp + appendices.
VStar	1992-1999	Halligan, D. and J. P. Fisher. 2001. Appendix F: Freshwater Creek Watershed Analysis - Fisheries Assessment. Review DRAFT. Prepared for Pacific Lumber Company (PALCO). Scotia, CA. 95 pp.
Vstar	1992-2001	Redwood Sciences Lab (RSL). 2001. Unpublished data regarding the proportions of pools filled by fine sediment (Vstar) in several creeks in the Klamath-Trinity watershed measured by Redwood Sciences lab crews in 1992-2001. Data included in the "Sediment: V* Horse Linto Creek 1992-2000" topic of the Klamath Resource Information System (KRIS) Klamath-Trinity. Redwood Sciences Lab, Arcata, CA.
Vstar	1994	Redwood Sciences Lab (RSL). 1994. Unpublished data regarding the proportions of pools filled by fine sediment (Vstar) in several creeks in the Scott watershed measured by Redwood Sciences lab crews in 1994. Data included in the "Sediment: Proportion in Pools (V*) French Creek by Reach 1994" topic of the Klamath Resource Information System (KRIS) Klamath-Trinity. Redwood Sciences Lab, Arcata, CA.
Vstar	1991-1993	Knopp, C. 1993. Testing indices of cold water fish habitat. Final report for development of techniques for measuring beneficial use protection and inclusion into the North Coast Region's Basin Plan by Amendment of the.....Activities, September 18, 1990. Data are included in the " Sediment: V* by NCRWQCB, 1992" topic of the Klamath Resource Information System (KRIS) Mattole North Coast Regional Water Quality Control Board in cooperation with California Department of Forestry. 57 pp.
Vstar	2000	Mattole Salmon Group (MSG). 2001. Unpublished data regarding the proportions of pools filled by fine sediment (Vstar) in the 2000 in the tributaries of the Mattole River. Data included in the "Sediment: V* Averages by Mattole Salmon Group for All Reaches, 2000" topic of the Klamath Resource Information System (KRIS) Mattole. Mattole Salmon Group, Petrolia, CA.

Data Type	State/year	Reference
Vstar	2000-2003	Mattole Salmon Group (MSG). 2003. Final Report: Mattole Basin Channel Monitoring 2002 - 2003. Petrolia, CA.
Vstar	1992-2001	Redwood Sciences Lab (RSL). 2001. Unpublished data regarding the proportions of pools filled by fine sediment (Vstar) in the 1991-2001 for Little Lost Man Cr, Bridge Creek and the Mainstem of Redwood Creek at Emerald Cr. Data included in the " Sediment: V* From Little Lost Man Creek, 1992-2001" topic of the Klamath Resource Information System (KRIS) Redwood. Redwood Sciences Lab, Arcata, CA.
Water Quantity/ Flow Regime (USFS judgment)	2000	U.S. Forest Service. 2000. Rating Watershed Condition: Reconnaissance Level Assessment for the National Forest of the Pacific Southwest Region in California. U.S.D.A. Forest Service, Region 5, San Francisco, CA. 31 p.
Wood Frequency ODFW (key pieces/mile)	1990-2003	Oregon Department of Fish and Wildlife (ODFW). 2007. Unpublished geo-referenced stream survey data "Aquatic Inventories Project Habitat and Reach Data", downloaded from ODFW's statewide database. Oregon Department of Fish and Wildlife, Salem, OR. Available at:
Wood Frequency USFS (score by stream width)	1990-1995	United States Forest Service. 1995. Unpublished geo-referenced stream survey data for the Rogue River-Siskiyou National Forest for the years 1989-1995, acquired from the Conservation Biology Institute (who compiled the data from multiple files). Rogue River-Siskiyou National Forest, Medford, OR.
Wood Frequency USFS (score by stream width)	1995-2006	United States Forest Service. 2006. Unpublished geo-referenced stream survey data for the Rogue River-Siskiyou National Forest for the years 1995-2006, acquired from the Rogue River-Siskiyou National Forest. Rogue River-Siskiyou National Forest, Medford, OR.

Literature Cited

California Environmental Protection Agency (CEPA). 2006. Climate Action Team Report to Governor Schwarzenegger and the Legislature. March 2006. 110 p.

Lettenmaier, D.P. and T.Y. Gan. 1990. Hydrologic sensitivities of the Sacramento-San Joaquin River Basin, California, to global warming. Water Resources Research 26(1): 69-86.

Intergovernmental Panel on Climate Change (IPCC). 2007. Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A.(eds.)]. IPCC, Geneva, Switzerland, 104 pp. Accessed 12/6/2011 at: http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf.

Gleick, P.H. and E.L. Chalecki. 1999. The impacts of climate changes for water resources of the Colorado and Sacramento-San Joaquin River basins. Journal of the American Water Resources Association 35(6): 1429-1441.

Kier Associates and National Marine Fisheries Service (NMFS). 2008. Updated guide to the reference values used in the Southern Oregon/Northern California coho salmon recovery conservation action planning (CAP) workbooks. July. Arcata, CA.

McElhany, P., M. Chilcote, J. Myers, and R. Beamesderfer. 2007. Viability status of Oregon salmon and steelhead populations in the Willamette and Lower Columbia Basins. National Marine Fisheries Service and Oregon Department of Fish and Wildlife. 414 p.

Natural Resources Conservation Service (NRCS). 2011. SNOTEL Data & Products. National Water and Climate Center. Accessed 12/6/11 at http://www.wcc.nrcs.usda.gov/snow/. 2 p.

PRISM Climate Group. 2011. Latest PRISM data- September 2011. Oregon State University. Accessed 10/24/11 at http://prism.oregonstate.edu.

Raupach MR, Marland G, Ciais P, Le Quéré C, Canadell JG, Klepper G, Field CB. 2007. Global and regional drivers of accelerating CO2 emissions. Proceedings of the National Academy of Sciences 104:10288 -10293.

Reeves GH, Everest FH, Nickelson TE. 1989. Identification of physical habitats limiting the production of coho salmon in western Oregon and Washington. US Forest Service General Technical Report PNW 245.

Sharr, S., C. Melcher, T. Nickelson, P. Lawson, R. Kope, and J. Coon. 2000. 2000 review of amendment 13 to the Pacific Coast salmon plan. Exhibit B.3.b. OCN workgroup report. Pacific Fisheries Management Council, Portland, OR.

The Nature Conservancy (TNC). 2003. Landscape-scale conservation: a practitioner's guide. Accessed 12/6/11 at: http://conserveonline.org/workspaces/cbdgateway/cap/resources/4/2/Landscape_Practicitioners_Handbook_July03_PR.pdf

The Nature Conservancy (TNC). 2006. Conservation by Design, A Strategic Framework for Mission Success. TNC, Arlington, Virginia. 20p. Accessed 12/6/2011 at: http://www.nature.org/ourscience/conservationbydesign/cbd.pdf.

Thieler, E.R. and E.S. Hammar-Klose. 2000. Modeled temperatures 1979-1999 and 2030-2050, and coastal vulnerability index (CVI) for the U.S. Pacific coast. Data presented in map produced by Kier Associates for NMFS Southwest Region-Arcata, December 2, 2009.

Vertenstein, M., T. Craig, T. Henderson, S. Murphy, G.R. Carr Jr., and N. Norton. 2004. CCSM3.0 User's Guide. Community Climate System Model, Natonal Center for Atmospheric Research, Boulder, CO. 70 p.

Appendix C. Method Used to Select Core Populations

NOAA's National Marine Fisheries Service (NMFS) considers the role each population is expected to play in a recovered Evolutionarily Significant Unit (ESU) to determine population abundance and juvenile occupancy targets for all the populations in the SONCC coho salmon ESU. Independent populations are evaluated using a modified Bradbury et al. (1995) framework. This evaluation produces a set of biological and habitat scores for each independent population which informs development of demographic targets for each independent population. NMFS' objective is to develop scientifically sound demographic targets that reflect each population's capacity for coho salmon production and potential for meeting demographic and threat abatement recovery criteria. Professional judgment is relied upon to rate biological integrity parameters.

Demographic population targets

NMFS identifies five population categories and the method to establish demographic targets for each (Table C - 1). The rationale for NMFS' choice of category type and associated demographic targets is described in Exhibits 1 to 7.

Table C - 1. Population type (as determined by Williams et al. 2006), category, demographic target, and life stage used to measure progress toward target.

<table>
<tr><th>Type</th><th>Category</th><th>Demographic Target</th><th>Life Stage</th></tr>
<tr><td>Dependent or Independent</td><td>Extirpated</td><td>No requirement for spawner abundance, juvenile occupancy, or habitat</td><td>None</td></tr>
<tr><td>Dependent</td><td>Dependent</td><td rowspan="2">Juvenile occupancy
(20 percent of habitat occupied in years following spawning of brood years with high marine survival)</td><td rowspan="2">Juvenile</td></tr>
<tr><td rowspan="3">Independent</td><td>Non-Core 2</td></tr>
<tr><td>Non-Core 1</td><td>Moderate risk threshold (depensation threshold multiplied by four)</td><td rowspan="2">Spawner</td></tr>
<tr><td>Core</td><td>≥ Low risk threshold</td></tr>
</table>

Extirpated Populations

Some populations in the SONCC coho salmon ESU may be extirpated. To determine whether each extirpated population should have any recovery targets, NMFS considers several questions related to absence and potential.

Evidence of coho absence

Have there been surveys that document the absence of coho salmon? How extensive have they been? How recently were they completed? Is there documented past presence or absence of coho salmon? How much uncertainty surrounds the information?

Prospects of coho salmon use

Are there characteristics of the watershed which suggest it will likely not support coho salmon in the future? For example, is there a barrier blocking most of the habitat, which is expected to remain in place? What is the current condition of accessible habitat? What are the prospects for improvement of accessible habitat? What are the prospects for threat abatement?

Connectivity

Would designation as an extirpated population create a gap of more than 30 km between population river mouths along the coastline? If so, a target of juvenile occupancy is minimally required.

Dependent populations

All populations identified as dependent by Williams et al. (2006), are assigned the juvenile occupancy demographic target. If NMFS determines a dependent population is extirpated, it has no juvenile occupancy requirement.

Independent populations

To determine the appropriate target for each independent population, NMFS considers the current condition of the population and its habitat, as well as the role that population is expected to play in a recovered ESU (i.e., core, non-core).

Method used to score characteristics of independent populations

NMFS developed a framework to describe characteristics of each independent population, starting with a model provided by Bradbury et al. (1995). This model uses three groupings of criteria for ranking watersheds for Pacific salmon restoration prioritization: 1) biological and ecological resources (Biological Importance); 2) watershed integrity and salmonid extinction risk (Integrity and Risk); and 3) potential for restoration (Optimism and Potential). Some of the ranking criteria proposed under these categories are also used in the NMFS method, and NMFS developed additional criteria. Scores given to each criterion are based on information in the profiles and professional judgment. Other factors are considered. Although these factors do not change scores, they may influence the final choice of population category and demographic targets for independent populations. These other factors (e.g., economic, social or political) pertain to the potential success of restoration, and are described in Exhibits 1 through 7.

Biological Importance

Scores for Biological Importance are based on the concept of viable salmonid populations (VSP) (McElhany et al. 2000), and are used to describe the current status of the population – population size, productivity, spatial structure, and diversity. Almost all populations are information limited, so perceived differences between populations in population size, productivity, spatial structure, and diversity could be due to a lack of data rather than true, physical or biological differences. These limitations are described in Exhibits 1 to 7.

Population Size and Productivity

Coho salmon typically follow a three year life cycle, producing three cohorts. NMFS' rating of the current population size and productivity of populations is based on the number of cohorts present, the consistency of runs, and trends over time. The number of individuals (population size) and growth rate (productivity) of a population are interrelated risk factors that affect population viability over time. Small populations are subject to numerous risks due to low abundance, whereas large populations are more resilient to the same risks. Productivity refers to production over the entire life cycle. The trends in abundance reflect the long-term population growth rate (McElhany et al. 2000).

The following metrics, described in Table C - 2 through Table C - 7, are especially important because a coho salmon population that drops to extremely low levels of abundance and productivity represent greater challenges for restoration and recovery. Scores are determined based on the following guidance.

Population Size

Table C - 2. Metric used to assess population size parameter.

Score	Description
0	No coho salmon are produced by any cohort, AND any adults are likely strays.
1	Number of spawners is consistently (multiple generations) < 50 percent of the depensation threshold.
2	Number of spawners is consistently (multiple generations) ≥ 50 percent of the depensation threshold.
3	Number of spawners is consistently (multiple generations) > the depensation threshold.

Population Productivity

Table C - 3. Metric used to assess population productivity parameter.

Score	Description
0	No coho salmon are produced in any cohort, AND any adults are likely strays.
1	At least one naturally-spawned cohort is absent, or about to be absent, AND the other cohorts is not consistently present (at least six consecutive years) or show decreasing trends in abundance.
2	Three cohorts are consistently present (at least six consecutive years) AND all cohorts show decreasing trends in abundance.
3	Three cohorts are consistently present (at least six consecutive years) AND at least one cohort shows no change in trend in abundance, or an increasing trend in abundance.

Spatial structure and diversity

NMFS expects that populations that are well distributed have a diverse array of life history traits and maintain greater genetic diversity. NMFS expects such populations will be more resilient and have higher potential for recovery to the low risk spawner threshold than populations with diminished spatial structure and diversity.

Spatial Structure

The spatial structure of a population depends on habitat quality and spatial configuration, and the dynamics and dispersal characteristics of individuals in the population (McElhany et al. 2000). The spatial structure rating is based on the current spatial extent of the population compared with the potential juvenile habitat, as described by a model of intrinsic habitat potential (IP).

Table C - 4. Metric used to assess spatial structure parameter.

Score	Description
0	No coho salmon are present from any cohort, and any adults are likely strays.
1	Coho salmon occur in 0-25 percent of the IP habitat outside the temperature mask*.
2	Coho salmon occur in ≥25 but ≤50 percent of the IP habitat outside the temperature mask*.
3	Coho salmon occur in >50 percent of IP habitat outside the temperature mask*.
*The temperature mask (Williams et al. 2006) was applied to the IP model results to exclude areas with high air temperatures from calculation of required spawner density.	

Diversity

This parameter was made up of 50 percent Life History Diversity and 50 percent Genetic Diversity. Genetic Diversity included two equally-weighted elements: Hatchery Influence and Population Size.

Life History Diversity

Within and among populations, coho salmon exhibit diverse life history traits which have the potential to enhance growth and survival of individuals in a spatially and temporally variable environment. Because populations are made up of individuals, maintaining diverse life history traits (1) allows for individuals to utilize a wide range of habitats; (2) protects species against short term spatial and temporal changes in habitat; and (3) increases the likelihood that some individuals will survive and reproduce. The diversity of life history traits expressed by individuals, and the availability of a diversity of habitats, spreads any risk to population viability over space and time (Weitkamp et al 1995, Spence et al. 1996, McElhany et al. 2000).

Life history traits are phenotypic and genotypic characteristics which provide the potential for individuals to utilize multiple habitats in order to enhance growth and survival. These traits include: adult age, size, fecundity, run and spawning timing, and spawning behavior; egg size and developmental rate; juvenile physiology and behavior; smolt size, age, and outmigration timing; disease resistance; and ocean distribution patterns (Weitkamp et al 1995, Spence et al. 1996, McElhany et al 2000).

Adult coho salmon typically begin their freshwater spawning migration in the late summer and fall, spawn by mid-winter, and then die. Juveniles typically feed and rear within the streams of their natal watershed for a year before migrating to the ocean in the spring. Coho salmon typically spend 2 growing seasons in the ocean before returning to their natal stream to spawn as 3 year-olds.

Table C - 5. Metrics used to assess life history diversity parameter.

Score	Description
0.5	Diverse habitat types are not present, so potential for expression of atypical life history traits is not apparent, AND there is no evidence of expression of atypical life history traits.
1	Diverse habitat types are present, suggesting potential for expression of atypical life history traits, AND there is no evidence of expression of atypical life history traits.
1.5	Diverse habitat types are present, suggesting potential for expression of atypical life history traits, AND there is evidence of expression of atypical life history traits.

Hatchery Influence

Table C - 6. Metrics used to assess hatchery influence parameter.

Score	Description
0.25	The proportion of hatchery strays in the spawning population is high (Proportion of Natural Influence [PNI] <0.3) in >50 percent of years, and these strays support the population.
0.5	The proportion of hatchery strays in the spawning population is moderate (PNI >0.5) in >50 percent of years, and these strays do not support the population .
0.75	The proportion of hatchery strays in the spawning population is low or zero (PNI >0.7) in >50 percent of years, and these strays do not support the population.

Population size

Small populations tend to have less genetic diversity than large ones. The depensation threshold is used to define a small population. The score for population size as it relates to genetic diversity can be calculated by multiplying the population's score for population size (calculated using the table in Section 1.3.1.1.1.1) by 0.25.

Table C - 7. Metrics used to assess population size parameter.

Score	Description
0	No coho salmon are produced by any cohort, AND any adults are likely strays.
1	Number of spawners is consistently (multiple generations) < 50 percent of depensation threshold.
2	Number of spawners is consistently (multiple generations) 51 percent to 100 percent of depensation threshold.
3	Number of spawners is consistently (multiple generations) greater than depensation threshold.

Habitat Integrity and Risks

The Habitat Integrity and Risks parameter describes the relative habitat integrity (lack of human-caused disturbance; Bradbury et al. 1995) and relative risk to current biological and ecological resources (Bradbury et al. 1995) in each population. The following metrics were chosen to assess Habitat Integrity and Risks because they were related to the parameter, and because numeric data describing them were readily available.

Road Density

This metric is the average density of roads in the population area. It is based on the rationale that areas with high road densities are more prone to unnatural levels of disturbance and relatively high rates of chronic sedimentation, while areas with lower road densities have a higher integrity and less risk. Scores were based on a frequency distribution of road density data from the populations in the ESU divided into roughly equal thirds and scored as 3 for the lowest third (road density 1.6-2.5), 2 for the middle third (2.6-3.0), and 1 for the highest third (3.24-12.59).

Number of Stresses Ranked High or Very High

This metric is the total number of high or very high stresses indicated in the stress summary tables from population profiles. It is based on the rationale that numerous high-level stresses are an indication of a lower ecological integrity and higher degree of risks. Scores were based on a frequency distribution of the number stresses for each population in the ESU divided into roughly equal thirds and scored as 3 for the lowest third (0-3), 2 for the middle third (4-6), and 1 for the highest third (7-9).

Slope

This metric is the total area of the watershed with a percentage of slope ≥ 55 percent based on GIS analysis of 30-meter digital elevation model. It is based on the rationale that populations within a stratum with more high-gradient area are more likely to experience large-scale disturbance (e.g., mass-wasting), whereas areas with a less high-gradient habitat are likely to experience these disturbances on a smaller scale within the landscape. Scores were based on a frequency distribution of proportion watershed with slope ≥ 55 percent for each population divided into roughly equal thirds and scored as 3 for the lowest third (proportion 0.04-0.09), 2 for the middle third (0.11-0.24), and 1 for the highest third (0.26-0.51).

Forest Integrity

This metric is based on the percentage of large trees (>30” or >20” depending on location) and change scene detection (percent harvested, percent change due to other impacts). Both are GIS-based and determined from LandSat imagery. This metric was chosen based on the rationale that areas that have a higher degree of mature forest and/or have been less impacted by timber harvest have a higher resiliency and more ecological integrity. Large tree scores were based on a frequency distribution of data from the ESU divided into roughly equal thirds and scored as 0.5 for the lowest third, 1 for the middle third, and 1.5 for the highest third. Harvest scores were based on a frequency distribution of data from the ESU divided into roughly equal thirds and scored as 1.5 for the lowest third, 1 for the middle third, and 0.5 for the highest third. These two scores were then combined for the overall score.

Optimism and Potential

The Optimism and Potential parameter describes the relative degree of optimism that freshwater or estuarine ecosystems can be protected or restored and the potential increase to populations if protection and restoration are effective (Bradbury et al. 1995). The following metrics were chosen to assess Optimism and Potential because they are related to the parameter, and numeric data is readily available.

Public Land

This metric is the percent of land within the population that is in public ownership. Populations within a stratum with more public land are assumed to benefit from higher standards of management and greater ease of implementation of recovery measures. Individual scores were based on a frequency distribution of data from the ESU divided into roughly equal thirds and scored as 1 for the lowest third, 2 for the middle third, and 3 for the highest third.

California State Recovery Priority

The California Department of Fish and Game (CDFG) Coho Recovery Strategy (CDFG 2004) used a prioritization model to predict restoration and management potential based on the existing population status, risks, and watershed condition. This metric, which is based on the CDFG scores of restoration and management potential, indicate which areas the state of California believes have the greatest likelihood for successful coho recovery. A similar metric is not available for Oregon populations. Scores were based on a frequency distribution of scores for each population in the ESU divided into roughly equal thirds and scored as 1 for the lowest third (score 1.0-1.5), 2 for the middle third (2.0-3.2), and 3 for the highest third (3.3-5.0).

Number of Threats Ranked High or Very High

This metric is the total number of high or very high threats as shown in the threat summary tables from population profiles. It is based on the rationale that numerous high-level threats means there likely is a lower ecological integrity, higher degree of risk, and a reduced potential for success. Scores were based on a frequency distribution of the number of high/very high stresses for each population in the ESU and were divided into roughly equal thirds and scored as 1 for the lowest third (7-8), 2 for the middle third (4-6), and 3 for the highest third (1-3).

Number of Other Listed Anadromous Salmonid Species

This metric is the number of other NMFS-listed anadromous species that occur within the population area. It is based on the rationale that a population with more listed species is more likely to be a focus for restoration and so attract restoration dollars than a population with less listed species. Scores were based on a frequency distribution of number species for each population in the ESU divided into roughly equal thirds and scored as 1 for the lowest third, 2 for the middle third, and 3 for the highest third.

Number of Other Non-Listed Anadromous Salmonid Species

This metric is the number of non-listed anadromous salmonid species that occupy the population area. It is based on the rationale that populations with other anadromous salmonid species maintain some of the habitat features that are critical for supporting coho salmon populations. Scores were based on a frequency distribution of number salmonid species for each population in the ESU divided into roughly equal thirds and scored as 1 for the lowest third (0-2 species), 2 for the middle third (3-4), and 3 for the highest third (5-6).

Using Ratings to Choose Core Populations

NMFS considers the population ratings to inform the choice of core population. Consistent with Bradbury et al. (1995), NMFS places most importance on the Biological Importance (BI) score. Independent populations with the highest BI scores may be chosen as core populations based on the BI scores alone. The BI scores, and other BI-related considerations, play a strong role in the decision because they are very relevant to how quickly a population can improve from its current state. Populations with the highest BI scores are likely in the best condition and are expected to recover more quickly than populations with lower BI scores. The scores for the other two categories are considered if the BI scores do not support a clear choice.

Using Ratings to Determine Targets for Non-Core Populations

There are a range of possible targets for non-core populations, and reasons why a particular target may be chosen. NMFS considers two factors when setting these targets. 1. What are the prospects for recovery in a particular population? NMFS uses the scores described in Section 1.3.2 to answer this question. 2. Given what was learned for factor 1, what role does each population need to play in a recovered ESU? Is the population more or less important as a source to recolonize areas? The rationale for selection of particular targets for each population is explained in the appropriate Exhibit (1 through 7).

Non-Core 2

The target for populations in this category is 20 percent of habitat occupied in years following spawning of brood years with high marine survival. NMFS chooses this target if the chance of recovery of a coho salmon population in a basin is very low, but it is feasible that some habitat could be restored to support all life stages of coho salmon. If strays were to arrive, the basin would be able to support all life stages, and juveniles may be observed in some years. A population with this target would not be relied upon to provide a source of colonists for other populations.

Non-Core 1

The target for populations in this category the moderate risk threshold, which is the depensation threshold multiplied by four. NMFS chooses this target if the population is likely to ultimately produce considerably more than the depensation threshold, but less than the low risk threshold.

Core

The target for populations in this category is the low risk threshold. NMFS chooses this target for a population after considering its current condition, its geographic location in the ESU, its low risk threshold compared to the number of spawners needed for the entire stratum, and other factors. The rationale for selection of particular core populations is explained in the appropriate Exhibit (1 through 7).

Literature Cited

Bradbury, B., W. Nehlsen, T.E. Nickelson, K.M.S. Moore, R.M. Huges, D. Heller, J. Nicholas, D.L.

Bottom, W.E. Weaver, R.L. Beschta. 1995. Handbook for prioritizing watershed protection and restoration to aid recovery of native salmon. 56 p.

California Department of Fish and Game (CDFG). 2004. Recovery strategy for California coho salmon. Report to the California Fish and Game Commission. 594pp. Copies/CD available upon request from California Department of Fish and Game, Native Anadromous Fish and Watershed Branch, 1419 9th Street, Sacramento, CA 95814, or on-line: http:www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

McElhany, P., M. Ruckelshaus, M. Ford, T. Wainwright, and E. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-42, 158p.

Spence, B.C., G.A. Lomnicky, R.M. Hughes and R. P. Novitzki. 1996. An Ecosystem Approach to Salmonid Conservation. Funded jointly by the U.S. EPA, U.S. Fish and Wildlife Service and National Marine Fisheries Service. TR-4501-96-6057. Man Tech Environmental Research Services Corp., Corvallis, OR.

Weitkamp, L.A., T.C. Wainwright, G.J. Bryant, G.B. Milner, D.J. Teel, R.G. Kope, and R.S. Waples. 1995. Status review of coho salmon from Washington, Oregon, and California. U.S. Department of Commerce. NOAA Technical Memorandum NMFS-NWFSC-24, Northwest Fisheries Science Center, Seattle, Washington. 258 p.

Williams, T.H., E.P. Bjorkstedt, W.G. Duffy, D. Hillemeier, G. Kautsky, T.E. Lisle, M. McCain, M. Rode, R.G. Szerlong, R.S. Schick, M.N. Goslin, A. Agrawal. 2006. Historical population structure of coho salmon in the Southern Oregon/Northern California Coasts evolutionarily significant unit. NOAA-TM-NMFS-SWFSC-390.

Exhibit 1.

Northern Coastal Stratum Population Targets

Application of the method used to select population type (i.e., core, non-core 1, non-core 2, extirpated) and identification of appropriate population adult spawner abundance or juvenile occupancy targets resulted in the following Biological Importance (BI), Integrity and Risks (IR), and Optimism and Potential (OP) Scores; discussion of other related considerations such as cost; and conclusion. Unless otherwise noted, results are based on information presented in Interior Eel River Stratum population profiles.

(a) Biological Importance (BI) Score

Biological Importance Score							
				Diversity			
Population	Abundance	Productivity	Spatial	Life History	Hatchery	Depensation	Total
Chetco River	2	3	2	1	0.75	0.25	9
Elk River	2	2	2	1	0.75	0.25	8
Lower Rogue River	2	2	1	1	0.5	0.75	7.25
Winchuck River	1	1	1	1	0.75	0.25	5

Available data indicate the Winchuck River population abundance is currently well below the depensation threshold, while the Elk River, Chetco River, and Lower Rogue River populations have at least one year class that is likely above the depensation threshold. Coho salmon in the Chetco River and Elk River populations are believed to occupy a higher percentage of the IP habitat in their basins, while the Lower Rogue River population is believed to be constrained to a few tributaries.

The extent of life history diversity is rated the same for all populations due to similar coastal and estuary condition. Hatchery influence is of low concern in the Chetco River, Elk River, and Winchuck populations. However, stray coho salmon from the Cole Rivers hatchery are known to occasionally spawn in the Lower Rogue River. The Lower Rogue River population supports more coho salmon than the others, so it is less affected by depensatory effects.

(b) Integrity and Risks (IR) Scores

Integrity and Risks Score					
Population	Road	Stress	Slope	Forest	Total
Chetco River	3	2	1	3	9
Elk River	3	2	1	3	9
Lower Rogue River	1	2	2	2	7
Winchuck River	3	2	1	2	8

Road density is higher in the Lower Rogue River than in the other populations. There were no scored differences in the number of high or very high stresses across populations. The Lower Rogue River has a lower incidence of steep slopes compared to the other populations. Populations with more high-gradient areas may be more vulnerable to large-scale disturbance than areas with less high-gradient areas. The forest integrity of the Chetco and Elk Rivers was rated higher than that of the other population area, suggesting more mature forest and more resiliency and ecological integrity in the Chetco River and Elk River populations.

(c) Optimism and Potential (OP) Scores

Optimism and Potential						
Population	Federal Land	CDFG	Listed Species	Species	Threat	Total
Chetco River	3	0	0	2	2	7
Elk River	3	0	0	2	3	8
Lower Rogue River	2	0	0	3	2	7
Winchuck River	3	0	0	2	3	8

The proportion of publicly–owned land is greater in the Chetco River, Elk River, and Winchuck River populations than in the Lower Rogue River population. Populations with more public land are assumed to benefit from higher standards of management and greater ease of implementation of recovery measures. There are more salmonid species in the Lower Rogue River than in the other populations. A population with more salmonid species may maintain more of the habitat features critical for supporting coho salmon populations than a population with less salmonid species. There are less highly-ranked threats in the Elk River and Winchuck River than the other populations, possibly indicating greater ecological integrity and a greater potential for success in restoring coho salmon.

The Elk River has great potential for recovery due to an ongoing public effort to protect and restore salmon habitat, as well as the management of a large portion of the watershed as Wilderness or a Late Successional Reserve. All population areas possess suitable private land which could contribute toward restoration if state, federal, or private funding was available.

d) Other Considerations

Cost

Preliminary results indicate the total cost of recovery actions needed in each population is as follows:

Elk River – $7 million
Lower Rogue River - $58 million
Chetco River - $14 million
Winchuck River - $5 million

Recognize that the cost estimate for recovery actions identified for the Winchuck River and Lower Rogue River do not include recovery actions necessary for a core population; and the Elk River and Chetco River costs may include recovery actions not necessary for a non-core 1 population.

Preliminary cost estimates reveal the cost of recovery actions identified for the Lower Rogue River population is much higher than the cost for the other populations. This result is due to extensive road treatment and decommissioning actions, as well as estuarine restoration, in the Lower Rogue River. Although the Lower Rogue River is not proposed as a core population, the estuarine restoration actions there are needed by other populations in the Rogue basin. If the Chetco River was not selected as a core population, then the remaining three populations would have to be selected in order to meet the stratum 50% abundance threshold. This scenario would result in a more costly scenario.

(e) Score Summary

Population	BI	IR	OP	Total	Low Risk Spawner Threshold
Chetco River	9	9	7	25	4,500
Elk River	8	9	8	25	2,400
Lower Rogue River	7.25	7	7	21.25	3,000
Winchuck River	5	8	8	21	2,200
Number spawners needed to meet stratum requirement (50% of total)					6,050

(f) Conclusion

Population	Type	Target
Chetco River	Core	4,500
Elk River	Core	2,400
Lower Rogue River	Non-Core 1	324
Winchuck River	Non-Core 1	228
		Total Core : 6,900 Spawners

The Chetco River and Elk River populations are the best choices for core populations in this stratum primarily because the coho salmon populations found there are in the best condition. In addition, their IR scores are the highest, indicating greater watershed integrity. The core population targets would result in a low risk of extinction. The Lower Rogue River and Winchuck River targets would result in a moderate risk of extinction.

Exhibit 2

Interior Rogue Stratum Population Targets

Application of the method used to select population type (i.e., core, non-core 1, non-core 2, extirpated) and identification of appropriate population adult spawner abundance or juvenile occupancy targets resulted in the following Biological Importance (BI), Integrity and Risks (IR), and Optimism and Potential (OP) Scores; discussion of other related considerations such as cost; and conclusion. Unless otherwise noted, results are based on information presented in Interior Eel River Stratum population profiles.

(a) Biological Importance (BI) Score

Biological Importance Score							
				Diversity			
Population	Abundance	Productivity	Spatial	Life History	Hatchery	Depensation	Total
Upper Rogue River	3	2	2	1	0.5	0.5	9
Middle Rogue/Applegate	3	2	1	1	0.75	0.5	8.25
Illinois River	3	2	2	1	0.75	0.5	9.25

The number of adults in each population is consistently greater than the depensation threshold, and all populations have three cohorts consistently present. The Illinois and Upper Rogue have more adult coho salmon than the Middle Rogue/Applegate River.

Juvenile coho salmon are better distributed in the Upper Rogue River and Illinois River population areas than in the Middle Rogue/Applegate population areas (between 25 and 50 percent of IP occupied, compared to 0 to 25 percent occupied). Juvenile density is higher in the Upper Rogue River and Illinois River populations than in the Middle Rogue/Applegate River.

Diversity measures are the same across all populations, except hatchery influence is greater in the Upper Rogue River than in the other two populations.

(b) Integrity and Risks (IR) Scores

Integrity and Risks Score					
Population	Road	Stress	Slope	Forest	Total
Upper Rogue River	1	2	3	3	9
Middle Rogue/Applegate	1	2	1	2	6
Illinois River	2	2	1	2	7

The road density is lower in the Illinois River than in the other two populations. There were no scored differences in the number of high or very high stresses in the three populations. The Upper Rogue River has a lower incidence of steep slopes than seen in the other two populations. Populations with more high-gradient areas may be more vulnerable to large-scale disturbance than areas with less high-gradient areas. The forest integrity of the Upper Rogue River was rated higher than that of the Middle Rogue/Applegate and Illinois Rivers, indicating there is more mature forest and so more resiliency and ecological integrity in the Upper Rogue River.

The natural hydrograph of the Illinois River is still in place and functional, not affected by dams as are the Upper Rogue (William L. Jess Dam) and Middle Rogue/Applegate Rivers (William L. Jess and Applegate Dams).

(c) Optimism and Potential (OP) Scores

Optimism and Potential Score						
Population	Public Land	CDFG	Listed Species	Species	Threat	Total
Upper Rogue River	2	0	0	3	1	6
Middle Rogue/Applegate	3	0	0	2	2	7
Illinois River	3	0	0	3	2	8

The proportion of publicly–owned land is greater in the Middle Rogue/Applegate River and Illinois Rivers than in the Upper Rogue River. Populations with more public land may benefit from higher standards of management and greater ease of implementation of recovery measures. More public land is owned by the U.S. Forest Service than BLM in the Illinois River basin. The U.S. Forest Service currently manages land under the Northwest Forest Plan, while BLM in the Rogue basin manages under a revised system which is less protective of fish and their habitat. There are fewer salmonid species in the Middle Rogue Applegate River than in the other two populations. A population with more salmonid species may maintain more of the habitat features critical for supporting coho salmon populations than a population with less salmonid species. The threat rating for the Upper Rogue River was less than for the other two populations, possibly indicating greater ecological integrity and a greater potential for success in restoring coho salmon.

Recent removal of mainstem dams on the Upper Rogue has restored passage to much of the basin. Much of the Middle Rogue River is too steep for coho salmon, and many of the lower gradient areas are highly impacted and do not present a great opportunity for restoration. The Applegate is less impacted, but has less recovery potential than the Illinois River. All population areas possess suitable private land which could contribute toward restoration if state, federal, or private funding was available.

d) Other Considerations

Cost

Preliminary results indicate the total cost of recovery actions needed in each population is as follows:

Illinois River – $173 million
Upper Rogue River - $224 million
Middle Rogue/Applegate River - $5 million

Recognize that the cost estimate for recovery actions identified for the Middle Rogue/Applegate River does not include recovery actions necessary for a core population; and the Illinois River and Upper Rogue River costs may include recovery actions not necessary for a non-core 1 population.

(e) Score Summary

Population	BI	IR	OP	Total	Low Risk Spawner Threshold
Upper Rogue River	9	9	6	24	16,100
Middle Rogue/Applegate	8.25	6	7	21.25	15,200
Illinois River	9.25	7	8	24.25	11,800
Number spawners needed to meet stratum requirement (50% of total)					21,550

(f) Conclusion

Population	Type	Target
Upper Rogue River	Core	16,100
Middle Rogue/Applegate	Non-Core 1	2,700
Illinois River	Core	11,800
		Total Core : 27,900 Spawners

The Upper Rogue River and Illinois River populations are the best choices for core populations in this stratum, primarily because the coho salmon populations found there are in the best condition. In addition, the Upper Rogue has more mature forest and the lowest number of threats compared to the other population areas, and the Illinois has greater recovery potential than the Middle Rogue because it is less urbanized. The core population targets would result in a low risk of extinction. The Middle Rogue/Applegate River target would result in a moderate risk of extinction.

Exhibit 3

Central Coastal Stratum Population Targets

NMFS applied the modified Bradbury et al. (1995) framework to the Central Coastal Stratum to select population type (i.e., core, non-core 1 or 2, extirpated) and to identify the population spawner abundance or juvenile occupancy targets. Application of the framework resulted in the following Biological Importance (BI), Integrity and Risk (IR), and Optimism and Potential (OP) scores. The BI score for this stratum represents the mean of four staff scores, which are largely based upon best professional judgment given the paucity of data within the stratum. Otherwise, results are based on information presented in the Central Coastal Stratum population profiles.

(a) Biological Importance (BI) Scores

Biological Importance							
Population	Abundance Score	Productivity Score	Spatial Score	Life History Score	Genetic Score	Depensation Score	BI Score
Little River	3	3	3	1.13	0.75	0.75	11.63
Lower Klamath R.	2.75	2	2.75	1.5	0.44	0.79	10.13
Mad River	2	2	3	1.5	0.75	.5	9.75
Maple Ck/Big Lagoon	1	1	1	1	0.75	0.25	5
Redwood Creek	2	2	2	1.5	0.75	0.5	8.75
Smith River	1.5	2	3	1	0.75	0.38	8.63

Population abundance is uncertain as surveys are few and results are variable. Data from Redwood Creek are some of the most robust within the stratum, with data sets spanning 12 years. However, the most robust data on spawner abundance is from Prairie Creek, a tributary to Redwood Creek. Data indicate that spawner escapement in Prairie Creek is highly variable between years, ranging from 680 spawners in 2002 to a low of 28 adults in 2010. Within the five-year period from 2007 to 2011, three of five years the spawner estimates for Prairie Creek exceeded the depensation threshold of 151 spawners calculated for Redwood Creek watershed, although during one of those years the estimate was very close to depensation. Prairie Creek is a stronghold for coho salmon in Redwood Creek, whereas very little production is documented elsewhere in the watershed. In contrast, data are limited for the Little River, Mad River, Smith River, and Maple Creek. Based upon the team's best professional judgment, Little River likely produces equal to or greater than the depensation threshold (34), whereas population abundance in the Mad and Smith rivers, are likely below depensation (153 and 325, respectively). Finally, the team debated whether the data from the Lower Klamath was reliable. While the data suggest that the Lower Klamath is likely above the depensation threshold, staff members were concerned that the use of juvenile data may poorly reflect abundance and distribution of the population due to the presences of juveniles from upper basin populations (non-natal rearing).

(b) Integrity and Risks (IR) Scores

Integrity and Risks					
Population	Roads Score	Stress Score	Slope Score	Forest Score	IR Score
Little River	1	3	3	2	9
Lower Klamath River	1	2	2	2	7
Mad River	1	2	2	2	7
Maple Ck/Big Lagoon	1	3	3	1	8
Redwood Creek	1	2	3	3	9
Smith River	1	2	1	2	6

Road density is of concern throughout the stratum, and as such, each basin scored a one for road density. Populations differ, however, according to the remainder of the metrics that make up the Integrity and Risk score. The larger of the basins in this stratum, the Lower Klamath, Smith, and Mad rivers, and Redwood Creek scored as a two for high-level stresses. The Smith River scored low in the slope metric due to the proportion of the basin contained in high gradient reaches; however, the metric oversimplifies the relationship between slope and the risk of mass wasting. While the Smith River may have a higher proportion of steep slopes than other watersheds within the stratum, the underlying geology is inherently different between the Smith River and the other basins within the stratum. The Smith River basin contains more competent rocks (primarily Josephine Ophiolite sequence) and produces courser grain landslides that tend to be less detrimental to fish and their habitat, and can contribute to the formation and maintenance of spawning habitat. In contrast, other basins within the stratum consist primarily of sedimentary rocks, which produce finer grain landslides that can several damage salmonid habitat. Consequently, NMFS considered the final IR scores for each population in concert with relative strength of each metric in arriving at the final recommendation for the core populations for the stratum.

(c) Optimism and Potential (OP) Scores

Optimism and Potential						
Population	Land Score	CDFG Score	Listed Species Score	Species Score	Threat Score	OP Score
Little River	1	3	2	2	3	11
Lower Klamath River	2	3	1	3	2	11
Mad River	2	3	3	3	3	14
Maple Ck/Big Lagoon	1	3	0	2	3	9
Redwood Creek	2	3	3	3	2	13
Smith River	3	3	1	3	3	13

The three highest scoring populations for Optimism and Potential (OP) are the Mad River, Smith River, and Redwood Creek. The number of listed anadromous fish species influences this score with the Mad River and Redwood Creek occurring within the range of all listed anadromous fish within the stratum. That is, although Pacific eulachon are listed within the Central Coastal stratum, they are generally relegated to larger watersheds such as the Lower Klamath, Smith, and Mad rivers. In contrast, the Northern California steelhead DPS and the Central Coast Chinook salmon ESU are limited to watersheds south of the Klamath River. Thus, the Mad River and Redwood Creek contain the highest number of listed anadromous fish species. The final OP score for the Smith River also reflects the fact that this basin has the highest proportion of lands within public ownership.

(d) Other Considerations

Climate change

The anticipated effect of future climate change influenced the final core populations selected for this stratum. NMFS expects that projected temperature increases and changes in precipitation patterns from climate change models would have a relatively smaller effect on coho salmon and their habitat in the Smith River basin than other watersheds within the stratum. Because the headwaters of the Smith River originate on US Forest Service land, which is managed to protect water quality and quantity, and water quantity and water temperatures are not currently limiting coho salmon in the Smith River, the Smith River population may be more buffered from the effects of climate change. NMFS expects that climate change would not decrease the availability of suitable habitat for coho salmon in the Smith River, or if suitable habitat were to decline due to climate changes, then we would expect such declines to be less severe than the declines that would occur in neighboring basins.

Cost

Preliminary results indicate the total cost of recovery actions needed in each population of this stratum is as follows:

Smith River—$169 million
Lower Klamath River—$148 million
Redwood Creek—$248 million
Mad River—$191 million

The cost estimate for recovery actions identified in the Mad River may include actions that are not necessary for a non-core population.

(e) Summary

Population	BI Score	IR Score	OP Score	Total Score	Low Risk Spawner Threshold
Little River	11.63	9	11	31.6	1,600
Lower Klamath River	10.13	7	11	28.1	5,900
Mad River	9.75	7	14	30.8	4,900
Maple Ck/Big Lagoon	5	8	9	22.0	1,600
Redwood Creek	8.75	9	13	30.8	4,900
Smith River	8.63	6	13	27.6	6,500
Number spawners needed to meet stratum requirement (50% of total)					12,600

NMFS staff members were not confident in the scoring methodology or the output from applying the methodology given the paucity of data, and thus spent considerable time deliberating the merits of choosing the populations with the highest scores. According to above BI scores the Little River, Lower Klamath, and Mad River are the top three highest scoring populations. However, the combined low risk spawner threshold for these three populations equals 12,200 spawners; 400 adult coho salmon less than the 50% stratum target. After several meetings to deliberate the core population configuration for the Central Coast stratum, the team arrived at the following recommendation by majority vote for core populations: **Lower Klamath River, Redwood Creek and Smith River.** Rationale for recommendation:

Lower Klamath River –CORE

- Abundance may be above depensation threshold
- Estuarine habitat is considered some of the highest quality in the stratum
- Supports upstream populations in the Interior Klamath Stratum and the Interior Trinity Stratum, five of which are core populations
- Currently coho salmon are widely distributed

Smith River – CORE

- Northern expression within stratum, key basin for seeding dependent populations nearby and maintaining metapopulation structure with populations in most northern extent of SONCC coho salmon range (northern coastal stratum)
- Unique geology (Siskiyou bioregion)
- Cold water tributaries originate in Siskiyou Mountains; within stratum considered basin most resilient to climate change; water temperatures likely least impacted within stratum
- Hydrology considered less impacted than other basins within stratum; no large hydroelectric dams, headwaters contained within wilderness or other public land
- Steep geology, possibly more springs than other basin
- Currently coho salmon are widely distributed

Redwood Creek –CORE

- Abundance near or above depensation

- Only basin in stratum with documented 2 year freshwater rearing of juveniles
- Lower watershed managed by Redwood National and State Parks, which has goals that include recovering listed species
- Currently coho salmon are suspected to have a limited distribution

Mad River –Non-Core

- Neighboring basin to south coastal stratum; would assist in seeding and maintaining metapopulation dynamics
- Optimism increasing; increasing interest in disperse parties for restoring/making improvements; most urban of basins within stratum
- Currently coho salmon are widely distributed

Little River –Non-Core

- Abundance may be above depensation threshold; however, population considered too small to contribute substantially to the 50% target for stratum viability
- Presently considered “potentially independent” population; genetic studies needed to determine if supports a unique population or clusters with neighboring basin
- Majority of watershed in Green Diamond ownership and covered by HCP; fate of population highly dependent upon Green Diamond management practices.
- Estuarine habitat degraded by grazing practices
- High spawner requirement likely difficult to meet

Maple Creek/Big Lagoon –Non-Core

- Population too dependent on breaching of the spit
- Abundance considered less than depensation
- Estuarine habitat is considered some of the highest quality in the stratum
- Population too small to contribute to stratum viability target

(f) Conclusion

Population	Category	Target
Little River	Non-Core 1	136
Lower Klamath River	**Core**	**5900**
Mad River	Non-Core 1	612
Maple Ck/Big Lagoon	Non-Core 2	Juvenile occupancy
Redwood Creek	**Core**	**4900**
Smith River	**Core**	**6500**
		Total Core : **17,300 spawners**

The Lower Klamath River, Redwood Creek, and Smith River are considered the best candidates to serve as the core populations in this stratum because these populations represent the populations that the NMFS has the most optimism will persist as strongholds in the face of climate change. With the exception of Redwood Creek, these basins also currently contain the widest in-basin distribution of coho salmon, which suggests that these basins are more resilient to stochastic events and within basin re-seeding can occur. Although the distribution of coho salmon within Redwood Creek is limited, Redwood Creek, in particular Prairie Creek, is an important stronghold within the stratum at present and is expected to persist due to the protections afforded the watershed by Redwood National and State Parks. Similarly, the Smith River contains a considerable amount of protected habitat because much of the watershed is contained within US Forest Service lands and the Redwood National and State Parks.

Literature Cited

Bradbury, B., W. Nehlsen, T.E. Nickelson, K.M.S. Moore, R.M. Huges, D. Heller, J. Nicholas, D.L.Bottom, W.E. Weaver, R.L. Beschta. 1995. Handbook for prioritizing watershed protection and restoration to aid recovery of native salmon. 56 p.

Exhibit 4

Interior Klamath Population Targets

Application of the method used to select population type (i.e., core 1, core 2, non-core, extirpated) and identification of appropriate population adult spawner abundance or juvenile occupancy targets resulted in the following Biological Importance (BI), Integrity and Risks (IR), and Optimism and Potential (OP) Scores; summary of findings; discussion of other related considerations such as cost; and conclusion. Unless otherwise noted, results are based on information presented in Interior Klamath Stratum population profiles.

(a) Biological Importance (BI) Score

Population	Abundance Score	Productivity Score	Spatial Score	Life History Score	Genetic Score	Depensation Score	BI Score
Mid-Klamath	2	2	3	1	0.75	0.5	9.25
Salmon	1	2	1	0.5	0.75	0.25	5.5
Scott	1	2	3	1	0.5	0.25	7.75
Shasta	1	1	1	1.5	0.25	0.25	5
Upper Klamath	3	3	1	1	0.25	0.5	8.75

(b) Integrity and Risks (IR) Scores

Population	Roads Score	Stress Score	Slope Score	Forest Score	IR Score
Mid-Klamath	3	1	1	3	8
Salmon	3	3	1	3	10
Scott	2	2	2	3	9
Shasta	3	2	3	3	11
Upper Klamath	2	1	2	3	8

(c) Optimism and Potential (OP) Scores

Population	Land Score	CDFG Score	Listed Species Score	Species Score	Threat Score	OP Score
Mid-Klamath	3	2	0	3	3	11
Salmon	3	2	0	3	3	11
Scott	2	3	0	2	1	8
Shasta	2	3	0	2	2	9
Upper Klamath	2	3	0	2		9

(d) Summary of Population Profile Findings

Scott River Population

- High natural production in recent history (2004) .
- Current distribution of coho salmon in the Scott River is widespread
- Exhibits a wide variety of habitats and life histories
- Limiting factors that currently limit production are well understood.
- Potential for high production given the high IP, and large runs of Chinook.
- One strong brood year.
- Strong monitoring program exists

Shasta River Population

- Low numbers of abundance contrast with high value of Integrity and Optimism.
- High production of Chinook salmon currently exists, indicating production value for coho could exist if limiting factors are addressed.
- Diversify of habitat features (e.g., spring flow dominated hydrology) and life history traits contribute to the overall adaptability and resiliency of the stratum to combat future climate effects and catastrophic events.
- Stressors are well understood, as are the identification of effective restoration priorities.
- Location allows for strays to support other populations.
- Recent success in acquiring more than 6,000 acres within the Big Springs Complex increases optimism for long term recovery.
- Large quantity of high IP habitat
- Strong monitoring program exists

Upper Klamath Population

- Optimism guarded high given the KHSA/KBRA
- Population comprised of a series of small streams, some intermittent.
- High quality habitat above Iron Gate Dam will be made available upon fish passage. Cold water tributaries will provide refugia from climate effects.
- Selection as core allows for full extent and range of occupied habitat to be restored, enhancing the spatial structure of the ESU.
- Location allows for strays to support other populations.
- Moderate monitoring program exists (Bogus Creek, Iron Gate Hatchery)

Middle Klamath Population

- Population may be above depensation threshold.
- Provides non-natal rearing habitat and migratory habitat
- Comprised of a series of low production tributaries with generally monotypic habitat features.
- Formation of low gradient coho habitat systems is constrained by the geology of the Klamath Mountain geomorphic province (particularly the northern range). Deep soils, steep slopes, high precipitation and sediment yields are natural factors controlling the geomorphology within the Middle Klamath population unit. This geomorphology naturally confines coho distribution and abundance.

- Habitat condition is currently good relative to Shasta and Scott.
- High amount of public land ownership
- Concern that recovery actions will not result in population response to the degree necessary to meet the low risk threshold.
- Poor monitoring program exists.

Salmon River Population

- Geology is rocky and does not provide a lot of IP habitat
- Carrying capacity of the sub-basin is likely lower than other populations in stratum

e) Other Considerations

Co-manager comments

Co-manager comments included recommendations to (1) re-consider the Shasta population as a core population and replace the selection with the Middle Klamath population; and (2) re-evaluate depensation threshold targets for non-core populations.

We did not find compelling evidence to re-configure the original recommendation to select Upper Klamath, Shasta River, and Scott River as core populations for the Klamath Interior stratum. The decision to select the Shasta population is based on the factors described above in (d) including: a clear understanding of limiting factors and restoration priorities, a high potential for production value, a diversity of life history strategies and habitat features, and a long term data and strong monitoring program. No new information was discovered that warranted changing the selections of the Scott and Upper Klamath populations as core.

Revised IP

We are aware of impassable barriers in the Shasta River Basin. IP values were re-calculated and habitat above Dwinnell Reservoir and Greenhorn Dam (Yreka Creek) was removed from the Shasta IP calculation. The resulting adult spawner target (8,778 fish) to achieve a low risk threshold is approximately 2,000 fish less than the original target.

Cost

Preliminary results indicate the total cost of recovery actions needed in each population is as follows:

Upper Klamath	$614,708,410
Shasta River	$90,786,729
Scott River	$52,325,005

f) Score Summary

Population	BI Score	IR Score	OP Score	Total Score	Low Risk Spawner Threshold	Core Spawners Needed
Mid-Klamath	9.25	8	11	28.25	3,900	
Salmon	5.5	10	11	26.5	4,000	
Scott	7.75	9	8	24.75	8,800	8,800
Shasta	5	11	9	25	8,778	8,778
Upper Klamath	8.75	8	9	25.75	8,500	8,500
				Total abundance	33,978	26,078
				50% total stratum N_a	16,989	

(f) Conclusion

Population	Type	Target
Scott	Core	8,800
Shasta	Core	8,778
Upper Klamath	Core	8,500
Middle Klamath	Non-Core 1	450
Salmon	Non-Core 1	460
		Total : 26,988 Spawners

Three core populations, the Upper Klamath, Shasta River, and Scott River populations are proposed to be chosen in this diversity stratum. This combination would allow for the largest amount of IP habitat, spatial diversity, greatest production potential, most appropriate habitat, and unique life history traits to be restored and will achieve the goal of 50% stratum abundance. Non-core population targets represent a four-fold increase in abundance over depensation thresholds.

Exhibit 5

Interior Trinity River Population Targets

Application of the method used to select population type (i.e., core, non-core 1, non-core 2, extirpated) and identification of appropriate population adult spawner abundance or juvenile occupancy targets resulted in the following Biological Importance (BI), Integrity and Risks (IR), and Optimism and Potential (OP) scores; discussion of other related considerations such as cost; and conclusion. Unless otherwise noted, results are based on information presented in the Interior Trinity River Stratum population profiles.

(a) Biological Importance (BI) Scores

	Biological Importance						
Population	Abundance Score	Productivity Score	Spatial Score	Life History Score	Genetic Score	Depensation Score	BI Score
Lower Trinity River	3	3	3	1	0.25	0.5	10.75
South Fork Trinity River	2	2	1	0.5	0.25	0.25	6
Upper Trinity River	3	3	1	1.5	0.25	0.75	9.5

The two highest scoring populations for Biological Importance (BI) are the Lower Trinity and the Upper Trinity. Of great concern across the stratum is the high proportion of hatchery fish within the Trinity watershed. This concern is greatest for the Upper Trinity population where hatchery fish dominate the run (typically, greater than 85% with some years as high as 97% hatchery fish comprising the run [see 2000, table 1-2 Upper Trinity River population profile]). Population abundance is uncertain for all three populations because surveys are few throughout the basin, although estimates are most robust for Upper Trinity population due to the survey efforts at the Willow Creek weir. Based on this effort, it appears that in some years naturally spawning coho salmon to the Upper Trinity River may exceed the low risk spawner threshold. In contrast, best available information suggests that the South Fork Trinity River and the Lower Trinity River are not likely to meeting the population’s depensation thresholds.

(b) Integrity and Risks (IR) Scores

Integrity and Risks					
Population	Roads Score	Stress Score	Slope Score	Forest Score	IR Score
Lower Trinity River	3	2	1	2	8
South Fork Trinity River	1	2	2	2	7
Upper Trinity River	3	2	1	3	9

(c) Optimism and Potential (OP) Scores

Optimism and Potential						
Population	Land Score	CDFG Score	Listed Species Score	Species Score	Threat Score	OP Score
Lower Trinity River	3	2	0	3	2	10
South Fork Trinity River	3	2	0	3	3	11
Upper Trinity River	3	2	0	2	2	9

(d) Other Considerations

Cost

Preliminary results indicate the total cost of recovery actions needed in each population of this stratum is as follows:

Lower Trinity River—$75 million
South Fork Trinity River—$127 million
Upper Trinity River—$15 million

The cost estimate for recovery actions identified in the South Fork Trinity River may include actions that are not necessary for a non-core population. In contrast, more actions may be necessary to ensure that the Upper Trinity River population meets the low risk spawner threshold, and as such the cost estimate provided here may significantly underestimate the cost of actions necessary to achieve recovery.

(e) Summary

Population	BI Score	IR Score	OP Score	Total Score	Low Risk Spawner Threshold
Lower Trinity River	10.75	8	10	28.75	3,900
South Fork Trinity River	6	7	11	24	6,400
Upper Trinity River	9.5	9	9	27.5	7,300
Number spawners needed to meet stratum requirement (50% of total)					8,800

(f) Conclusion

Population	Category	Target
Lower Trinity River	Core	3,900
South Fork Trinity River	Non-core 1	1,000
Upper Trinity River	Core	7,300
		Total Core : 11,200 Spawners

The Lower Trinity and Upper Trinity River populations are considered the best candidates to serve as the core populations in this stratum for several reasons. Chief among these is a concern that the IP model grossly overestimates the production potential of the South Fork, given the severe degradation that has occurred within the basin as a result of historic flooding. In addition, only a small portion of the tributaries in the South Fork is likely to support coho salmon or their reintroduction. In comparison, the Lower Trinity and Upper Trinity have nearly three times the number of tributaries that could support coho salmon (See also CDFG 2004). Moreover, according to the Trinity River Flow Evaluation document (USFWS and HVT 1999) about 80 percent of the best coho salmon habitat within the basin historically occurred upstream of the dams. It is a widely shared opinion that the South Fork probably never was a particularly important basin for coho salmon production within the Trinity/Klamath watershed.

Reference:

California Department of Fish and Game (CDFG). 2004. Recovery strategy for California coho salmon. Report to the California Fish and Game Commission. 594pp. Copies/CD available upon request from California Department of Fish and Game, Native Anadromous Fish and Watershed Branch, 1419 9th Street, Sacramento, CA 95814, or on-line: http:www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

U.S. Fish and Wildlife Service (USFWS) and Hoopa Valley Tribe (HVT). 1999. Trinity River Flow Evaluation Final Report. Report to the Secretary, U.S. Department of the Interior. Washington, D.C. Available at: http://www.fws.gov/arcata/fisheries/reportsDisplay.html. Accessed October 2008.

Exhibit 6

Southern Coastal Stratum Population Targets

Application of the method used to select population type (i.e., core, non-core 1, non-core 2, extirpated) and identification of appropriate population adult spawner abundance or juvenile occupancy targets resulted in the following Biological Importance (BI), Integrity and Risks (IR), and Optimism and Potential (OP) Scores; discussion of other related considerations such as cost; and conclusion. Unless otherwise noted, results are based on information presented in Interior Eel River Stratum population profiles.

(a) Biological Importance (BI) Score

Biological Importance Score							
				Diversity			
Population	Abundance	Productivity	Spatial	Life History	Hatchery	Depensation	Total
Bear River	0	0	0	0.5	.75	0	1.25
Humboldt Bay Tributaries	3	2	3	1.5	.75	.75	11
Lower Eel / Van Duzen	2	2	1	1.5	.75	.50	7.75
Mattole River	1	2	1	1	.75	.25	6

Population abundance is uncertain as surveys are few and the results are variable. The Bear River population has a conspicuous absence of coho salmon. Surveyed streams in the Humboldt Bay population indicate regular adult abundance greater than depensation (191), while the adult abundance is likely below depensation in the Lower Eel / Van Duzen (394) and Mattole (250) populations. All populations show evidence of decline in all three cohorts, except for Bear River which has no evidence of coho salmon being present.

Coho salmon are found well-distributed throughout the Humboldt Bay tributaries and estuary. However, they are found in less than a quarter of IP habitat in the Mattole River and Lower Eel / Van Duzen River populations – likely as a result of degraded or inaccessible habitat or lack of survey effort. In 2008, coho salmon adult spawners were found in just one Mattole River tributary.

Diversity across the stratum can be influenced by many factors, including life history strategies, hatcheries, and abundance proximity to depensation. The amount of environmental diversity in an area can indicate the degree of potential diversity that same area can support. Life history strategies are greater in Humboldt Bay and Lower Eel / Van Duzen River populations where greater environmental and habitat variability exists. Humboldt Bay Tributaries include life history strategies that take advantage of relatively stable temperature and estuarine and bay habitat. The Lower Eel / Van Duzen River population likely possess many of the same life history strategies as found in Humboldt Bay, plus strategies that succeed in warmer and dryer conditions farther inland.

(b) Integrity and Risks (IR) Scores

Integrity and Risks Score					
Population	Road	Stress	Slope	Forest	Total
Bear River	1	2	2	2	7
Humboldt Bay Tributaries	1	1	3	1	6
Lower Eel / Van Duzen	1	1	2	2	6
Mattole River	2	1	1	2	6

Water in the mainstem Eel River is closely regulated in accordance with provisions identified in NMFS' biological opinion addressing the Potter Valley Project diversion, including opportunity to augment flow by 2,000 acre-feet. Water diversion in all other streams is largely unregulated or uncontrolled.

Humboldt Bay Tributaries and Lower Eel / Van Duzen populations are comprised of much low-grade slope areas, often associated with a delta or valley. Road densities on low-grade slopes likely produce less erosion and sedimentation than those on steep slopes or inherently unstable geologic material.

Principle stresses in the Lower Eel / Van Duzen population are altered sediment supply and impaired estuary function, compared to the Mattole River population where they are impaired water quality and altered hydrologic function. Cooling and increasing the volume of water in the Mattole River population is challenging, and severely influences survival. Decreasing sediment and improving estuary function in the Lower Eel / Van Duzen population appears feasible.

Much of the forest in the Humboldt Bay Tributaries has been harvested. However, several decades have passed since most harvest activity, resulting in mid-mature forests which provide more suitable habitat elements than less mature forest. A large portion of the Humboldt Bay Tributaries population area is managed under a federal aquatic habitat conservation plan or by federal agencies with salmonid conservation goals. Other forested areas in the Humboldt Bay Tributaries, and other populations, are primarily regulated by the California Forest Practice Rules.

(c) Optimism and Potential (OP) Scores

Optimism and Potential Score						
Population	Federal Land	CDFG	Listed Species	Species	Threat	Total
Bear River	1	2	1	1	3	8
Humboldt Bay Tributaries	1	3	3	2	2	11
Lower Eel / Van Duzen	2	3	3	2	1	11
Mattole River	2	3	3	2	2	12

There is high non-government organization (NGO) interest in salmon recovery in all populations, except Bear River. The Humboldt Bay population is located in the heart of Humboldt County's hub, near Arcata and Eureka, California. Generating interest and support for restoring habitats in highly visible locals such as the Humboldt Bay and Lower Eel / Van Duzen River population areas is generally much easier than rural sites. However, some rural locations, such as in the Mattole River population, have created a culture centered on salmon restoration and conservation.

Moderate amounts of federal land managed with salmon conservation goals in the Lower Eel / Van Duzen and Mattole River populations provide enhanced opportunity for restoration opportunities. All population areas possess suitable private land which can contribute toward restoration through development, or implementation, of a federal habitat conservation plan, or eligible for receipt of federal or state grant funding.

The number of threat categories that rank high or very high is a function of threat opportunity. The Lower Eel / Van Duzen scores low due to a larger array of different environs and thus human activity. For instance, the Lower Eel / Van Duzen may have more opportunity for agricultural threat because a large portion of the area is conducive to farming. Compare it to the Mattole River population area where little traditional farming opportunities exist. Threat opportunity may be linked to the size of the population area – potentially explaining why the Lower Eel / Van Duzen received a low threat score.

In addition, the larger population areas with the greatest amount of IP habitat may equate to more opportunity for active and passive restoration.

d) Other Considerations

Cost

Preliminary results indicate the total cost of recovery actions needed in each population is as follows: Bear River - $29 million
Humboldt Bay Tributaries - $81 million
Lower Eel / Van Duzen - $21 million
Mattole River - $70 million

Recognize that the cost estimate for recovery actions identified for Lower Eel / Van Duzen River population does not include recovery actions necessary for a core population; and the Mattole River population may include recovery actions not necessary for a non-core 1 population. Cost calculation method and assumptions likely resulted in a gross estimate, lending the greatest utility to relative comparisons between like population types. Refer to chapter 6 additional information about cost.

Preliminary cost estimates reveal the cost of recovery actions identified for Lower Eel / Van Duzen population is much less than the cost for Mattole River population. This result is due to the fact that many recovery actions identified for the Mattole River population may not be necessary; and additional recovery actions are needed for the Lower Eel / Van Duzen River population. Cost estimates are often based on the size of a watershed, or length of IP, making costs to produce nearly equal number of spawners disproportionately large for small population areas, and vice versa.

(e) Score Summary

Population	BI	IR	OP	Total	Low Risk Spawner Threshold
Bear River	0	7	8	15	1900
Humboldt Bay Tributaries	11	6	10	27	5700
Lower Eel / Van Duzen	7.75	7	11	25.75	7900
Mattole River	6	6	12	24	6500
Number spawners needed to meet stratum requirement (50% of total)					11000

(f) Conclusion

Population	Type	Target
Bear River	Non-Core 2	Juvenile occupancy
Humboldt Bay Tributaries	Core	5700
Lower Eel / Van Duzen	Core	7900
Mattole River	Non-Core 1	1000
		Total Core : 13600 Spawners

Humboldt Bay Tributaries and Lower Eel / Van Duzen populations are the best candidates to efficiently serve as core populations in this stratum because they have the total highest BI scores, and their collective adult spawner abundance target exceeds the minimum stratum requirement. IR scores are nearly equal for all populations.

Targets for Humboldt Bay Tributaries and Lower Eel / Van Duzen populations reflect the adult spawner abundance required for a low risk of extinction. The Mattole River population spawner abundance target is a product of depensation times four, serving as a non-core 1 role. The Bear River population target is juvenile occupancy, serving as a non-core 2 role.

Exhibit 7

Interior Eel River Stratum Population Targets

Application of the method used to select population type (i.e., core, non-core 1, non-core 2, extirpated) and identification of appropriate population adult spawner abundance or juvenile occupancy targets resulted in the following Biological Importance (BI), Integrity and Risks (IR), and Optimism and Potential (OP) Scores; discussion of other related considerations such as cost; and conclusion. Unless otherwise noted, results are based on information presented in Interior Eel River Stratum population profiles.

(a) Biological Importance (BI) Score

Biological Importance Score							
				Diversity			
Population	Abundance	Productivity	Spatial	Life History	Hatchery	Depensation	Total
Mainstem Eel River	1	1	1	1	0.75	0.25	5
Middle Mainstem Eel River	1	1	1	1	0.75	0.25	5
Upper Mainstem Eel River	0	0	0	1	0.75	0	1.75
Middle Fork Eel River	0	0	0	1	0.75	0	0.75
South Fork Eel River	3	3	2	1	0.75	0.75	10.5

Population abundance is uncertain as surveys are few and the results are variable. Surveys of the Upper Mainstem Eel River and Middle Fork Eel River sub-basins suggest that they do not support coho salmon consistently. The South Fork Eel River population abundance is likely above depensation (i.e., 481) in some years. All populations show evidence of decline in all three cohorts, particularly for the Upper Mainstem Eel and Middle Fork Eel populations, which may have lost all three year classes.

Coho salmon distribution is largely un-documented in the populations within this stratum and rated as very limited in all areas except the South Fork Eel River population. In the South Fork Eel River, coho salmon occur in 25 to 50 percent of Intrinsic Potential (IP) habitat, primarily in the western tributaries such as Hollow Tree Creek. In the western tributaries of the South Fork Eel River population, coho salmon are well distributed and occupy the majority (>90%) of IP habitat.

Diversity across the stratum is influenced by many factors, including life history strategies and abundance which is often below the depensation threshold. The rating for life history diversity assigned to all populations indicates they contain diverse habitat types which could support atypical life history strategies. Most populations in this stratum could be considered “long run” given the distance adult fish must migrate to their natal spawning grounds from the ocean, which constitutes a unique life history strategy. All populations rated the same for hatchery influence, with a presumed low proportion of hatchery strays in the spawning populations. All populations except the South Fork Eel River received a low score for depensation, because the number of spawners is likely significantly less than the depensation threshold.

(b) Integrity and Risks (IR) Scores

	Integrity and Risks Score				
Population	Road	Stress	Slope	Forest	Total
Mainstem Eel River	1	3	2	2	8
Middle Mainstem Eel River	1	2	2	3	8
Upper Mainstem Eel River	2	2	2	3	9
Middle Fork Eel River	2	3	2	2	9
South Fork Eel River	1	2	2	2	7

Water in the mainstem Eel River is closely regulated in accordance with provisions identified in NMFS’ biological opinion addressing the Potter Valley Project diversion, including opportunity to augment flow which may assist in reducing issues with water quality during periods of extremely low flows or muted spring flow. Water diversion in all other streams is largely unregulated or uncontrolled.

The Upper Mainstem Eel River and Middle Fork Eel River high IP lay mostly under the temperature mask, indicating water temperature within these populations are likely inhospitably warm.

Road density in the Upper Mainstem Eel River and Middle Fork Eel River is higher than in the other populations. Principle stresses in most populations are sediment, degraded riparian condition, and floodplain and channel structure. The Upper Mainstem Eel River principal stresses, in contrast, are barriers obstructing passage and impaired water quality. These stresses in these populations may be more difficult to resolve than those in the other populations. All populations are comprised of primarily low gradient stream reaches, often associated with a delta or valley. Forest integrity in the Middle Mainstem Eel River and Upper Mainstem Eel River populations was rated lower than that of the other populations due to reduced tree size and density, and species composition.

(c) Optimism and Potential (OP) Scores

Optimism and Potential Score						
Population	Federal Land	CDFG	Listed Species	Species	Threat	Total
Mainstem Eel River	1	2	2	2	2	9
Middle Mainstem Eel River	2	3	1	2	2	10
Upper Mainstem Eel River	3	1	2	1	2	9
Middle Fork Eel River	2	1	3	2	3	11
South Fork Eel River	1	3	3	2	1	10

There is a high level of interest in the South Fork Eel River population area, and hosts the most abundant and stable spawning cohorts in the stratum. One of the most significant tributaries, Hollow Tree Creek, has consistent presence of all three cohorts of coho salmon. Out-migrant trapping efforts indicate that Hollow Tree Creek can produce more than 35,000 smolts per season. There is a draft federal aquatic Habitat Conservation Plan (HCP) throughout most of the Hollow Tree Creek watershed. The HCP, when finalized, would reduce sediment and improve habitat complexity in the near future. Several long-standing and well-supported non-government organizations, as well as state, federal and tribal entities regularly express interest in conserving salmon and aquatic habitat within the Eel River basin.

The Eel River estuary is located within the Lower Eel/Van Duzen population area (downstream of the Interior Eel River stratum) and has great potential for restoration because the estuary remains functional and there is high opportunity for increasing the size and availability of the floodplain and off channel habitats. The Eel River estuary likely serves as essential non-natal juvenile rearing habitat, which is a key limiting factor (stress) for all populations in this stratum. All population areas possess suitable private land which can contribute toward restoration through development, or implementation, of a federal HCP. Much of the private land is eligible for receipt of federal or state grant funding.

(d) Other Considerations

Cost

Preliminary results indicate the total cost of recovery actions needed in each population is as follows: Mainstem Eel River - $105 million
Middle Mainstem Eel River - $144 million
Upper Mainstem Eel River - $6 million
Middle Fork Eel River - $5 million
South Fork Eel River - $229 million

Recognize that the cost estimate for recovery actions identified for non core populations do not include recovery actions that may be necessary were they made core populations. If the Upper Mainstem Eel River or Middle Fork Eel River populations were chosen as a core population, the cost would likely be much greater because more recovery actions may be necessary to meet higher targets. Cost calculation method and assumptions likely resulted in a gross estimate, lending the greatest utility to relative comparisons between like population types. Refer to chapter 6 additional information about cost.

(e) Score Summary

Population	BI	IR	OP	Total	Low Risk Spawner Threshold
Mainstem Eel River	5	8	9	22	4,800
Middle Mainstem Eel River	5	8	10	23	6,400
Upper Mainstem Eel River	4	9	9	22	2,100
Middle Fork Eel River	1	9	11	21	2,900
South Fork Eel River	10.5	7	10	27.5	9,600
Number spawners needed to meet stratum requirement (50% of total)					12,900

(f) Conclusion

Population	Type	Target
Mainstem Eel River	Core	4,800 spawners
Middle Mainstem Eel River	Core	6,400 spawners
Upper Mainstem Eel River	Non-Core 2	Juvenile occupancy
Middle Fork Eel River	Non-Core 2	Juvenile occupancy
South Fork Eel River	Core	9,600 spawners
		Total Core : 20,800 Spawners

The Mainstem Eel River, Middle Mainstem Eel River, and South Fork Eel River populations are the best candidates to efficiently serve as core populations in this stratum because they have the total highest BI scores, and their collective adult spawner abundance target exceeds the minimum stratum requirement. Equally important, the other two populations – Upper Mainstem Eel River and Middle Fork Eel River – have inherently extremely low potential to produce coho salmon and several anthropogenic-derived challenges.

Targets for the Mainstem Eel River, Middle Mainstem Eel River, and South Fork Eel River populations reflect the adult spawner abundance required for core populations. Targets for core populations were set to achieve a low risk of extinction.

The target for the Upper Mainstem Eel River and Middle Fork Eel River populations is juvenile occupancy, which is the target for a non-core 2 population. The Middle Fork Eel River population may be functionally extinct as there have been no documented occurrences of coho salmon for many decades. Given the lack of coho salmon in the Middle Fork Eel River, the most reasonable target to accommodate recovery would be the juvenile occupancy target established for non-core 2 populations.

Over a period of several decades, the Upper Mainstem Eel River population has had very few observations of coho salmon at the fish counting station at Van Arsdale. However, returns of coho salmon at Van Arsdale in the 2010/2011 spawning season were the best since 1948. Although these recent observations appear promising, the Upper Mainstem Eel River population remains unoccupied during almost all years on record. Furthermore, all of the IP habitat which is not covered by the temperature mask is located upstream of the Scott Dam. When IP habitats upstream of the dam or under the temperature mask are removed, it leaves this population with only 0.5 km of IP habitat (which is not enough lineal habitat to be considered as a population). Given the extremely episodic nature of coho salmon observations in the Upper Mainstem Eel River population, the non-core 2 population target for juvenile occupancy is the most reasonable target.

Appendix D. Recovery Action Cost Methodology

To determine recovery action costs for the SONCC coho salmon ESU, a systematic and consistent methodology is applied. In general, cost estimates are derived from previous, similar projects or tasks (Tables D-2 to D-51). Each recovery action cost estimate is limited to the monetary expenditure required to physically perform the task, and therefore does not include secondary costs (e.g., administrative, overhead) or economic costs or benefits (e.g., fishing, tourism, lost opportunity) that may result from action implementation. Recovery actions costs presented in five year intervals out to 25 years (i.e., 0-5, 5-10, 15-20, 20-25), with one value estimated for costs beyond 25 years (i.e., 26+ years). Cost estimates are not calculated for those actions determined not essential for recovery (“NA” priority).

Factors such as project scale and location are accounted for when possible, and costs are calculated accordingly. For example, county and population-specific data is used to inform the cost of actions that occur in those particular areas. Additionally, the costs of past projects used to inform recovery action cost estimates are adjusted for inflation. The scale of a recovery action is often unknown. In these cases an assumption is made regarding the amount or extent of work needed to achieve the recovery objective. For example, if the amount of roads in need of decommissioning in a given population is unknown, the assumption is to reduce the amount of roads to a level equal to a “medium” threat. Table D-18 indicates the cost to decommission one mile of road in the Humboldt Bay watershed is $20,938. If 85 miles of road need to be decommissioned, the estimated cost is $1,779,730 ($20,938 multiplied by 85 miles).

Some recovery actions involve policy changes, coordination, or other activities that rely primarily on staff time. For these types of actions, the cost is calculated by multiplying the annual salary (Table D-2) of the occupation most likely to complete the task by the amount of time anticipated to complete the task. For example, an action to educate stakeholders regarding water conservation practices may require six months of a professional biologist’s time. Table D-2 indicates a professional biologist’s time costs $68,030 a year. In this case, the estimated cost is $34,015 ($68,030 multiplied by 0.5 years).

Recovery action costs are calculated for each action-step level and calculated in spreadsheets containing population specific data (e.g., watershed acreage, amount of IP habitat, road density) and recovery action type cost information. A sample spreadsheet outlining the process for calculating recovery action costs can be found in Table D - 1.

Table D - 1. Sample of the cost estimation spreadsheet.

Number of miles is unknown; use blanket assumption

Number of miles is unknown; use blanket assumption

Data from "Road Inventory" worksheet ($635/mi)

Data from "Population Statistics" worksheet (878 total road miles in the Mattole watershed)

Action Step	Explanation	Factor 1	Factor 2	Cost (years 1-5)
Assess and prioritize road-stream connection, and identify appropriate treatment to meet objective	Road inventory in Mattole * 878 miles total roads in watershed	635	878	$557,530
Decommission roads, guided by assessment	Road decom. in California * 286 miles (to obtain 2mi/mi² density)	93,279	286	$26,677,794
Upgrade roads, guided by assessment	Road upgrade in Mattole * 149 miles (25% of remaining roads after decom)	32,857	149	$4,895,693
Maintain roads, guided by assessment	Gravel road maintenance * 594 (# of road miles remaining after decom)	2,389	594	$1,419,066

Table D-2. Information used to estimate cost of staff time.

Staff Time			
Occupation	**Hourly Wage (seasonals)**	**Annual Wage (FTE)**	**Source**
Biologist	33	68,030	Bureau of Labor Statistics 2009
Biologist Technician	20	40,900	
Fish and Game Warden	27	56,030	
Police/Sheriff Patrol Officers	25	52,810	
Forest Fire Inspectors/ Prevention	18	36,400	
Forest and Conservation Workers	13	26,110	
Urban and Regional Planners	30	62,400	
Physical Scientists (all others)	44	91,850	
Engineers (all others)	43	89,080	
Hydrologist	36	73,540	

Table D-3. Information used to estimate cost of lining a ditch.

Ditch Lining		
Type of Liner	**$/ft**	**Source**
Plain Concrete	21	NMFS 2008, pg. 46
Flexible Membrane	15	
Galvanized Steel	21	

Table D-4. Information used to estimate cost of irrigation pipe.

Piping		
Type	**$/ft***	**Source**
Aluminum Pipeline	16	NMFS 2008, pg. 47

*When number of feet of pipe is unknown, assume 1% of privately owned land is in agriculture (population stats worksheet). Assume 50% of those acres are irrigated and 1 ft per acre of land will be piped.

Table D-5. Information used to estimate cost of headgates.

Install Headgates		
Size of Headgate	**$/Diversion**	**Source**
<3 cfs	5,156	NMFS 2008, pg. 47
>3 cfs	10,309	

Table D-6. Information used to estimate cost of storm drain retrofits.

Storm Drain Retrofit		
Action	**$/filter or program**	**Source**
Catch Basin/Filter Installation	98	Kosciusko County 2002
Annual Maintenance Program	6,452	

Table D-7. Information used to estimate cost of stream flow gate installation and maintenance.

Stream Flow Gage Installation & Maintenance		
Action	**$/gage or year**	**Source**
Installation of State/Private Gage	26,136	Rhode Island DEM-WRB 2004
Installation of USGS Gage	29,545	
Annual Maintenance of State/Private Gage	7,955	
Annual Maintenance of USGS Gage	3,409	

Table D-8. Information used to estimate cost of tidegate restoration.

Tidegate Restoration		
Activity	**$/Tidegate**	**Source**
Replace Tidegate	120,114	NMFS 2008, pg. 20
Retrofit Tidegate	28,571	

Table D-9. Information used to estimate cost of tailwater management.

Tailwater Management		
Area Covered by System (acres)	**Cost ($)**	**Source**
1-50	10,309	NMFS 2008, pg. 45
51-100	20,618	
101-200	30,928	
201-300	41,237	
301-400	61,856	
401-500	82,474	

Table D-10. Information used to estimate cost of installing, compliance, or monitoring of a forbearance program.

Forbearance Program		
Part of Program	**$/landowner, $/year**	**Source**
Avg. cost for installation & agreements	70,000	Tasha McKee Sanctuary Forest, pers. comm. 2010
Avg. cost for compliance & flow monitoring	500	

Table D-11. Information used to estimate cost of installing or maintaining engineered beaver ponds.

Engineered Beaver Ponds		
Activity Type	**$/pond, $/year**	**Source***
Installation of Pond	15,000	Tasha McKee Sanctuary Forest, pers. comm. 2010
Maintenance of Ponds	25,000	

*Recommends 10 years of maintenance following installation.

Table D-12. Information used to estimate cost of fish passage improvement.

Fish Passage Improvement ($/Project)					
Stream Crossing	**Land Use**				**Source**
Tributary	**Forest**	**Agriculture**	**Suburban**	**Urban**	CDFG 2004, pg I-16
Total Barrier	63,636	159,090	318,181	556,818	
Partial/Temporal Barrier	31,818	79,545	159,090	278,409	
Stream					
Total Barrier	159,090	381,818	556,818	795,454	
Partial/Temporal Barrier	79,545	190,909	278,409	397,727	

Table D-13. Information used to estimate cost of dam removal.

Dam Removal		
Size of Dam	**$; $/ft**	**Source**
one cost estimate for <15ft dam	568,181	CDFG 2004, pg I.11
>15 ft high -cost/ft	17,045	
one estimate - unknown height; complete barrier	1,022,727	
one estimate - unknown height; partial/temporal or unknown barrier	511,363	

Table D-14. Information used to estimate cost of bridge construction.

Bridge Construction		
Bridge Type	**$/sq. ft. of decking**	**Source**
RC Slab	191	California DOT 2008
RC Box Girder	170	
CIP/PS Slab	168	
CIP/PS Box Girder	298	
PC/PS "I" Girder	231	
PC/PS Bulb "T" Girder	239	
Average	216	

Table D-15. Information used to estimate cost of arch/box culvert replacement.

Replacing a Culvert w/ a New Type of Structure		
New Type of Crossing	**Avg. Cost ($)**	**Source**
Bridge <40ft	51,546	NMFS 2008, pg 11-15
Bridge >40ft	103,093	
Bottomless/Open Bottom Arch	193,961	
Natural Bottom Pipe Arch	215,776	
Box Culvert	248,352	

Table D-16. Information used to estimate cost of road construction.

Road Construction (for relocation purposes)		
Type of Road	**$/mile**	**Source**
Non paved: two directional 12' shared path	175,000	DOT 2010
Undivided 2 lane rural road w/ 5' paved shoulders	1,713,000	

Table D-17. Information used to estimate cost of road upgrade.

Road Upgrade		
Location	**$/mi***	**Source**
California	18,104	NMFS 2008, pg. 43-44
Mendocino County	34,278	
Siskiyou County	50,119	
Klamath River	29,186	
Salmon River	41,453	
Smith River	53,068	
Eel River	32,658	
Mattole River	32,857	
SONCC	14,535	
Russian River	95,275	
Garcia River	32,528	

*If number of miles unknown, assume 25% of road miles remaining in watershed after decommissioning to the level of 2 mi/mi².

Table D-18. Information used to estimate cost of road decommissioning.

Road Decommissioning		
Location	**$/mi***	**Source**
California	93,279	NMFS 2008, pg. 42
Humboldt Bay	20,938	
Klamath	33,801	
Mendocino	34,884	
Trinity	61,525	
Salmon River	48,242	
Van Duzen River	89,149	
SONCC	141,395	

*If number of miles unknown, reduce watershed road density to 2 mi/mi^2.

Table D-19. Information used to estimate cost of road maintenance.

Average Road Maintenance Cost		
Type*	**$/mi***	**Source**
Gravel Roads	2,389	Jahren et al. 2005
Bituminous Roads	2,639	

*If type and number of miles is unknown, assume 'gravel roads' and total number of miles of road in the watershed after decommissioning to a level of 2mi/mi^2.

Table D-20. Information used to estimate cost of installing a fish ladder.

New Fish Ladder		
Size of Waterway	**$/Ladder**	**Source**
Large Waterway	1,022,727	NMFS 2008, pg 9
Small Waterway	568,181	

Table D-21. Information used to estimate cost of gate installation.

Average Cost of Gate and Installation		
Gate	**$/gate**	**Source**
Aluminum Gate (5ft tall, 10ft wide) + installation	880	www.profenceworks.com (site accessed March 4, 2011)

Table D-22. Information used to estimate cost of culvert replacement.

Culvert Replacement ($/Culvert)					
Size of Waterway	Road Type				Source
	Forest Road	Minor 2 Lane	Major 2 Lane	Hwy 4+ Lane	
Small (0-10')	31,976	87,209	174,419	319,767	NMFS 2008, pg. 10
Medium (10-20')	87,209	220,930	319,767	436,047	
Large (20-30')	133,721	267,442	406,977	813,953	

*if number and type of barriers is unknown, assume 1 barrier per 5 miles of high IP miles and type is 'small' and 'forest road'.

Table D-23. Information used to estimate cost of tributary and floodplain reconnection.

Floodplain and Tributary Reconnection ($/acre)				
Materials	Extent of Earth Moving			Source
	Minimal	Moderate	Substantial	
Minimal	8,721	17,442	40,698	NMFS 2008, pg 26
Moderate	17,442	29,070	58,140	
Substantial	40,698	58,140	81,395	

Table D-24. Information used to estimate cost of side channel reconnection projects.

Side Channel Reconnection ($/acre)				
Extent of Earthmoving	Energy of Waterway			Source
	Low	Medium	High	
Minimal/Near	34,884	63,953	87,209	NMFS 2008, pg 26
Moderate/Avg. Distance	58,140	98,837	174,419	
Substantial/Far	93,023	191,860	290,698	

Table D-25. Information used to estimate cost of supplementing spawning gravel.

Spawning Gravel Supplementation	
$/cubic yard	Source
28	NMFS 2008, pg. 25

Table D-26. Information used to estimate cost of placing large woody debris structures.

LWD Structure Placement	
Avg. $/mi*	Source
547,850	NMFS 2008, pg 23-24

*If length unknown, assume 25% of high IP miles, unless this results in less than 1, then use total IP miles.

Table D-27. Information used to estimate cost of channel restoration.

Channel Restoration		
Type	**$/mi**	**Source**
Large scale reach restoration	4,217,623	NMFS 2008, pg 27

Table D-28. Information used to estimate cost of creating off channel ponds.

Creation of Off Channel Pond	
$/project*	**Source**
102,258	Bob Pagliuco: NOAA RC pers. comm. 2010; averaged from proposed projects: Lower Terwer Creek and Salt Creek

*If number of projects is unknown, assume 1 project/mi. in 25% of total high IP miles, unless this results in less than 1, then use 25% of total IP miles.

Table D-29. Information used to estimate cost of reintroducing beavers.

Beaver Reintroduction	
$/beaver family translocation*	**Source**
10,000	Michael Pollock NMFS, personal communication Feb. 2011

*If numbers are unknown, assume 1 per mi in 5% of high IP miles.

Table D-30. Information used to estimate cost of riparian planting.

Riparian Planting ($/acre)				
Materials/Site Accessibility	**Level of Site Preparation***			**Source**
	Flat/Light Clearing	**Avg. Slope/Avg. Clearing**	**Steep/Heavy Clearing**	
Low Cost	17,442	40,698	93,023	NMFS 2008, pg 32
Medium Cost	26,163	63,954	110,465	
High Cost	46,512	78,488	1,366,279	

*If type of riparian thinning is unknown, assume 'flat/light clearing' and 'low cost'.
*If number of acres is unknown, assume 80 acres per mile will need to be treated in 15% of high IP miles.

Table D-31. Information used to estimate cost of thinning upslope riparian areas.

Upslope Riparian Thinning		
Type	**$/acre***	**Source**
Mechanical	876	NMFS 2008, pg. 64
Hand 15-30% slope 40-60% cover	928	
Hand 30-50% slope 60-90% cover	1,237	
Chemical	155	
Average	799	

*If number of acres is unknown, assume 80 acres/mi will be thinned within 15% of high IP habitat miles.

Table D-32. Information used to estimate cost of bank stabilization.

Bank Stabilization*		
Distance From Road (mi)	**$/ft***	**Source**
0.25-0.5	284	NMFS 2008, pg. 38
0.5-1	313	
1-2	341	
2-3	369	
>3	398	

*If number of feet is unknown, assume 1% of IP miles will be treated.

Table D-33. Information used to estimate cost of wetland restoration.

Wetland Restoration		
Type	**$/acre**	**Source**
Seasonal Wetland (large scale)	11,111	NMFS 2008, pg. 28
Wetland Enhancement (reveg, exotic spp. removal, modest management)	1,235	
Restore Tidal Action to Salt Pond	1,266	
Levee Construction/Repair, Extensive Dredging	34,177	
Highly Engineered, Large Soil Volume, Channel Excavation, Low Berms	70,886	

Table D-34. Information used to estimate cost of livestock management.

Livestock Management		
Fencing Activity	**$/ft**	**Source**
Riparian Fencing - Conventional*	3.09	NMFS 2008, pg. 29
Riparian Fencing and Planting	18.69	
Riparian Fencing w/ Water Relocation	9	

*If number of feet is unknown, assume 5% of high IP miles.

Table D-35. Information used to estimate cost of landslide/gully stabilization.

Landslide/Gully Stabilization	
$/Acre	**Source**
2,609	NMFS, 2008 pg. 44

Table D-36. Information used to estimate cost of estuary restoration.

Estuary Restoration		
Type of Project	**$/acre**	**Source**
Small- Tidegate removal, culvert upgrade; restore tidal salt marsh	6,000	Coastal Resources Management Council 2010
Medium- Automated tidegates, culverts, 500 ft new dikes	67,000	
Large- Automated tidegates, excavation of fill, re-vegetation	20,000	

Table D-37. Information used to estimate cost of setting back or breaching levees.

Levee Setback and Breach		
Type of Project	**$/linear foot*, $/breach****	**Source**
Setback, includes construction of new levee and restoration of wetlands inside levee	31.7	Bob Pagliuco: NOAA RC pers. comm. 2010; from proposed project, McDaniel Slough
Breach	30,000	

*If number of feet is unknown, assume 1% of high IP miles.
**If number of breaches is unknown, assume 1/mile of 1% of high IP miles.

Table D-38. Information used to estimate cost of water development away from streams.

Water Development Away from Streams		
Materials	**$/ft, $**	**Source**
Piping*	0.4	USEPA 1990
Tank**	407	

*If length of piping is unknown, assume 500 ft/project.
**If number of projects (tanks) is unknown, assume 1 per mile in 5% of high IP miles.

Table D-39. Information used to estimate cost of day-lighting a stream section.

Stream Day-lighting	
$/lineal foot*	**Source**
886	Leah Mahan: NOAA RC pers. comm. Dec. 2010; average from projects, Madrona Park Creek and Ravenna Creek

*If number of feet is unknown assume 5,280 (1 mi).

Table D-40. Information used to estimate cost of creating a conservation easement.

Conservation Easement		
Region	**$/acre**	**Source**
Wolverton Gulch, Van Duzen River, Humboldt County, Monterey County, Arroyo Seco River	1,992	NMFS 2008, pg. 55
South Coast, Santa Barbara	65,000	
San Joaquin River	6,867	
Battle Creek	395	
North Fork Consumnes River	1,101	
Mill Creek/Deer Creek	223	
Tuolumne River	6,282	
San Joaquin Delta	3,205	
Mill Creek/Deer Creek - Sac River	5,385	
Sacramento River	1,646	
Lower Tuolumne/San Joaquin	1,646	
CA	534	

Table D-41. Information used to estimate cost of performing a road inventory.

Road Inventories		
Location	**$/mi**	**Source**
Humboldt County	829	NMFS 2008, pg. 61
Eel River	538	
Mattole River	635	
Russian River	936	
Salmon Creek	1068	
Gualala River	837	
Avg. all Inventories	807	

Table D-42. Information used to estimate cost of performing an erosion assessment.

Erosion Assessments		
Location	**$/acre***	**Source**
Humboldt County	9.5	NMFS 2008, pg 61
Del Norte County	11.9	
Average all assessments in CA**	10.7	

*When number of acres unknown, assume 25% of total watershed acres.

**Average does not include figure of $3,157/acre.

Table D-43. Information used to estimate cost of conducting a fuels management program.

Fuel Management Program		
Type of Program*	**$/acre***	**Source**
Prescribed burn: brush/grass	35	USDA Forest Service 2004
Prescribed burn: ponderosa pine	98	
Prescribed burn: mixed conifer	198	
Prescribed burn: Douglas fir	14	
Mechanical Treatment: Low intensity	426	FRFTP 2006
Mechanical Treatment: High Intensity	851	

*If type of program and number of acres is unknown, assume 25% of high IP habitat will treated w/ mechanical thinning and 25% will be treated with burning. Treat IP miles as square miles and convert to acres.

Table D-44. Information used to estimate cost of running a lifecycle monitoring station.

Life Cycle Monitoring Station	
$/Monitoring Station	**Source**
204,000	NMFS 2008

Table D-45. Information used to estimate cost of removing invasive plants.

Removal of Invasive Plant Species		
Species	**$/acre***	**Source**
Arundo	29,762	Neil 2002
Himalayan Blackberry	990	Bennet 2007 (avg)
Purple Loosestrife and Water Chestnut	361	USFWS 2001
Pepperweed and Giant Reed	1,000	Northern California Conservation Center 2010
Average (excluding outlier of Arundo)	784	

*If number of acres is unknown, assume 80 acres per mile will be treated in 5% of high IP miles.

Table D-46. Information used to estimate cost of eradicating pikeminnow.

Pikeminnow Eradication	
$/Fish	**Source**
6.65	NMFS 2008, pg. 67

*Cost averaged from rewards in a bounty program.

Table D-47. Information used to estimate cost of installing fish screens.

Fish Screens		
Size of Tributary	**$/Screen***	**Source**
Large Trib	45,454	NMFS 2008, pg 16
Small Trib	11,364	

*If number and type of screens is unknown, assume 'small trib' and 1 screen per mile in 5% of the high IP miles.

Table D-48. Information used to estimate cost of maintaining fish screens.

Fish Screen Maintenance	
$/Screen/yr	**Source**
1,566	NMFS 2008, pg. 68

Table D-49. Information used to estimate cost of education and outreach programs.

Education and Outreach Programs		
Type	**$/program**	**Source**
General Education and Outreach	76,136	CDFG, 2004 pg I.42
Coho Specific Education	55,682	

Table D-50. Information used to estimate cost of all aspects of running a conservation hatchery.

Conservation Hatchery		
Type of Operation	**$/year**	**Source**
General Operation	120,000	pers. comm. Jeff Jahn 2010; estimate from Monterey County Conservation Hatchery
Robust Monitoring and Evaluation Program to Support Program	250,000	pers. comm. Jeff Jahn 2010; estimate from Russian River monitoring program
Genetic Component (samples, assessments)	50,000	pers. comm. Jeff Jahn 2010; estimate from Russian River genetic program

Table D-51. Information used to estimate cost of converting a production hatchery to a conservation hatchery.

Conversion to Conservation Hatchery		
Extent of Retrofit	**$/type**	**Source**
No retrofit needed, facilities in place	0	pers. comm. Jeff Jahn 2010; estimated based on heavy retrofitting in the Russian River Conservation Hatchery
Light retrofit (a few extra tanks, etc.)	50,000	
Medium retrofit	150,000	
Heavy retrofitting with extensive new infrastructure	500,000	

Literature Cited

Bennet, M. 2007. Managing Himalayan Blackberry in Western Oregon Riparian Areas.

Bureau of Labor Statistics. 2009. Occupational Employment and Wages: 2008.

California Department of Fish and Game (CDFG). 2004. Cost and Socioeconomic Impacts of Implementing the California Coho Salmon Recovery Strategy.

California Department of Transportation (DOT). 2008. Construction Statistics: 2008.

California Department of Transportation (DOT). 2010. Generic Cost per Mile Models. Updated January 19, 2010.

Coastal Resources Management Council. 2010. The Costs of Environmental Restoration Projects. http://www.edc.uri.edu/restoration/html/tech_sci/socio/costs.htm#salt.

Front Range Fuels Treatment Partnership (FRFTP). 2006. Recommendations of the FRFTP Roundtable for Protecting Communities and Restoring Forests.

Jahn, J. 2010. Personal Communication. Fisheries Biologist. National Marine Fisheries Service. Santa Rosa, California.

Jahren, C.T., D. Smith, J. Thorius, M. Rukashaza-Mukome, D. White, and G. Johnson. 2005. Economics of Upgrading and Aggregate Road.

Kosciusko County. 2002. North Webster Storm Drain Engineering Feasibility Study.

Mahan, L. 2010. Personal Communication.Fisheries Biologist. National Marine Fisheries Service. Arcata, California.

McKee, T. 2010. Personal Communication. Co-Executive Director. Sanctuary Forest. Whitethorn, California.

National Marine Fisheries Service (NMFS). 2008. Habitat Restoration Cost References for Salmon Recovery Planning.

Neill, B. 2002. Study of Invasive Non-Native Plants, Primarily Arundo donox, along the Los Angeles River and Tributaries.

Northern California Conservation Center. 2010. Partners for Fish and Wildlife Program in California: Exotic Species Removal. http://www.stateconservation.org/california/?q=r&id=10417

Pagliuco, B. 2010. Personal Communication. Fisheries Biologist. National Marine Fisheries Service. Arcata, California.

Pollock, M. 2011. Personal Communication. Fisheries Biologist. National Marine Fisheries Service. Seattle, Washington.

Pro Fence Works. 2011. www.profenceworks.com. Site accessed March 4, 2011.

Rhode Island Departments of Environmental Management and Water Resources Board (DEM-WRB). 2004. Recommendations for a Stream Gaging Network in Rhode Island. Prepared by the DEM-WRB Streamflow Committee. April 2004.

U.S. Environmental Protection Agency (USEPA). 1990. Cost of Water Development for Grazing Management. Table 2-24.

U.S. Fish and Wildlife Service. 2001. Partners for Fish and Wildlife Program Restoration Costs.

U.S. Forest Service (USFS). 2004. Economic Uses Fact Sheet 8: Prescribed Fire Costs.

Agency Directory

Agency	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R
Applegate Partnership and Watershed Council PO Box 899 Jacksonville, OR 97530 (541) 899-9982 http://www.applegatepartnership.org/	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
California Conservation Corps 1719 24th Street Sacramento, CA 95816 (916) 341-3100 http://www.ccc.ca.gov											✓
California Department of Fish and Game 1416 Ninth Street, 12th Floor Sacramento, CA 95814 (916) 445-0411 http://www.dfg.ca.gov											✓
City of Arcata 736 F Street Arcata, CA 95521 (707) 822-5951 http://www.cityofarcata.org/											
City of Eureka 531 K Street Eureka, CA 95501 (707) 441-4144 http://www.ci.eureka.ca.gov/											

Agency	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs
Applegate Partnership and Watershed Council										
California Conservation Corps	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
California Department of Fish and Game	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
City of Arcata									✓	✓
City of Eureka										✓

Agency	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R
Applegate Partnership and Watershed Council					✓	✓	✓			
California Conservation Corps	✓	✓	✓	✓				✓	✓	✓
California Department of Fish and Game	✓	✓	✓	✓				✓	✓	✓
City of Arcata										
City of Eureka										

Agency	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Applegate Partnership and Watershed Council										
California Conservation Corps	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
California Department of Fish and Game	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
City of Arcata										
City of Eureka										

	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Eel River Watershed Improvement Group (707) 725-4317 http://erwig.org/																						✓															✓	✓	✓	✓	✓
Environmental Protection Agency, Region 9 75 Hawthorne Street San Francisco, CA 94105 (415) 947-8000 http://www.epa.gov/region9/contact-region9.html											✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Five Counties Salmonid Conservation Program PO Box 2571 Weaverville, CA 96093 (530) 623-3967 http://www.5counties.org/											✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
French Creek Watershed Advisory Group http://www.watershed.org/?q=node/236																																✓	✓								
Friends of the Eel River PO Box 2039 Sausalito, CA 94965 www.eelriver.org																						✓															✓	✓	✓	✓	✓
Green Diamond Resource Company PO Box 68 Korbel, CA 95550 (707) 668-4449 http://www.greendiamond.com										✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																			

Hoopa Valley Tribal Fisheries
PO Box 1348
Hoopa, CA 95546
(530) 625-4211
http://www.hoopa-nsn.gov

Humboldt Bay Harbor, Recreation and Conservation District
PO Box 1030
Eureka, CA 95502
(707) 443-0801
http://www.humboldtbay.org/

Humboldt Bay Initiative
2 Commercial Street, Suite 4
Eureka, CA 95501
(707) 443-8369
http://www.westcoastebm.org/Humboldt_Bay_Initiative.html

Humboldt County Resource Conservation District
5630 South Broadway
Eureka, CA 95503
(707) 444-9708
http://www.humboldtrcd.org/

Humboldt Redwood Company
125 Main Street
Scotia, CA 95565
(707) 764-4472
http://www.hrcllc.com/

Partner	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R
Hoopa Valley Tribal Fisheries											
Humboldt Bay Harbor, Recreation and Conservation District											
Humboldt Bay Initiative											
Humboldt County Resource Conservation District											
Humboldt Redwood Company											

Partner	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs
Hoopa Valley Tribal Fisheries			✓							
Humboldt Bay Harbor, Recreation and Conservation District									✓	✓
Humboldt Bay Initiative										✓
Humboldt County Resource Conservation District				✓	✓	✓	✓	✓	✓	✓
Humboldt Redwood Company										✓

Partner	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R
Hoopa Valley Tribal Fisheries										
Humboldt Bay Harbor, Recreation and Conservation District										
Humboldt Bay Initiative										
Humboldt County Resource Conservation District	✓	✓	✓	✓						
Humboldt Redwood Company	✓	✓	✓	✓						

Partner	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Hoopa Valley Tribal Fisheries			✓	✓						
Humboldt Bay Harbor, Recreation and Conservation District										
Humboldt Bay Initiative										
Humboldt County Resource Conservation District						✓	✓		✓	
Humboldt Redwood Company						✓	✓			

	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Illinois Valley Soil and Water Conservation District PO Box 352 Cave Junction, OR 97523 (541) 592-3731 http://www.oregon.gov/ODA/SWCD/																										✓															
Illinois Valley Watershed Council PO Box 352 Cave Junction, OR 97523 (541) 592-3731 http://oregonwatersheds.org/oregoncouncils/illinoisvalley																										✓															
Karuk Tribal Fisheries Department and Restoration Division 64236 Second Avenue Happy Camp, CA 96039 (530) 493-1600 http://www.karuk.us														✓															✓	✓	✓	✓	✓								
Lindsay Creek Watershed Group 904 G Street Eureka, CA 95501 (707) 269-2063 http://www.naturalresourcesservices.org																				✓																					
Lower Rogue Watershed Council http://www.currywatersheds.org						✓																																			

Organization	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Mad River Stakeholders Group 904 G Street Eureka, CA 95501 (707) 269-2063 http://www.naturalresourcesservices.org																				✓																					
Mattole Restoration Council PO Box 160 Petrolia, CA 95558 (707) 629-3514 http://www.mattole.org																									✓																
Mattole Salmon Group PO Box 188 Petrolia, CA 95558 (707) 629-3433 http://www.mattolesalmon.org																									✓																
Mendocino Redwood Company PO Box 996 Ukiah, CA 95482 (707) 463-5110 http://www.mrc.com/Key-Policies-HCP.aspx																																					✓				
Mendocino Resource Conservation District 206 Mason Street, Suite F Ukiah, CA 95482 (707) 462-3664 http://www.mcrcd.org																																					✓		✓	✓	✓

	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Middle Rogue River Watershed Council 543 NE 'E' Street, Suite 201 Grants Pass, OR 97526 (541) 474-6799 http://www.roguebasinwatersheds.org/SectionIndex.asp?SectionID=6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																✓	✓	✓													
Mid-Klamath Watershed Council PO Box 409 Orleans, CA 95556 (530) 627-3202 http://www.mkwc.org														✓															✓	✓	✓	✓	✓								
North Coast Regional Water Quality Control Board 5550 Skylane Blvd, Suite A Santa Rosa, CA 95403 (707) 576-2220 http://www.waterboards.ca.gov/northcoast											✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Northern California Resource Center PO Box 342 Fort Jones, CA 96032 (530) 468-2888 http://www.californiaresourcecenter.org/home.php																																✓									
Oregon Department of Environmental Quality 165 E. 7th Avenue Eugene, OR 97401 (503) 229-5696 http://www.oregon.gov/DEQ/	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																✓	✓	✓		✓											

	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Oregon Department of Fish and Wildlife (503) 947-6000 http://www.dfw.state.or.us/	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																															
Oregon Department of Fish and Wildlife (503) 947-6000 http://www.dfw.state.or.us/																										✓	✓	✓													
Orleans/Somes Bar Fire Safe Council PO Box 766 Somes Bar, CA 95568 (530) 469-3216 http://www.firesafecouncil.org/find/view_council.cfm?c=69														✓															✓	✓	✓	✓	✓								
Pacific Coast Federation of Fishermen's Associations PO Box 29370 San Francisco, CA 94129 (415) 561-5080 http://www.pcffa.org/	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pacific Coast Fish Wildlife and Wetlands Restoration Association PO Box 4574 Arcata, CA 95518 (707) 839-5664 http://www.pcfwwra.org										✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pacific Coast Joint Venture (707) 826-3208 http://www.pcjv.org/california/	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Partner	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Pacificorp 825 NE Multnomah Street Portland, OR 97232 http://www.pacificorp.com/index.html																													✓	✓											
Redwood Community Action Agency 904 G Street Eureka, CA 95501 (707) 269-2001 http://www.rcaa.org/																✓	✓	✓	✓	✓	✓	✓	✓	✓	✓													✓			
Redwood Creek Watershed Group PO Box 4574 Arcata, CA 95518 (707) 839-5664															✓																										
Redwood National and State Park 1111 Second Street Crescent City, CA 95531 (707) 464-1812 http://www.nps.gov/redw/index.htm											✓	✓	✓		✓																										
Rural Human Services 286 M Street Crescent City, CA 95531 (707) 464-7441 http://www.ruralhumanservices.com/											✓	✓																													
Salmon River Fire Safe Council Sawyers Bar, CA 96027 (530) 462-4665 http://www.firesafecouncil.org/find/view_council.cfm?c=58																															✓										

	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Salmon Safe 805 SE 32nd Avenue Portland, OR 97214 (503) 232-3750 http://www.salmonsafe.org/	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔																✔	✔	✔													
Sanctuary Forest PO Box 166 Whitehorn, CA 95589 (707) 986-1087 http://www.sanctuaryforest.org																									✔																
Save-the-Redwoods League 114 Sansome Street, Suite 1200 San Francisco, CA 94104 (415) 362-2352 http://www.savetheredwoods.org/											✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Scott River Fire Safe Councils (530) 468-2888 http://www.firesafecouncil.org/find/index.cfm																																✔									
Scott River Water Trust PO Box 591 Etna, CA 96027 (530) 467-5783 http://www.scottwatertrust.org/																																✔									
Scott River Watershed Council PO Box 355 Etna, CA 96027 (530) 467-5511 http://www.scottriver.org/																																✔									

	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Shasta Valley Coordinated Resources Management and Planning 450 Main Street Etna, CA 96027 (530) 467-3975 http://www.siskiyourcd.org/																																	✓								
Shasta Valley Resource Conservation District 215 Executive Court, Suite A Yreka, CA 96097 (530) 842-6121 http://www.svrcd.org/																																	✓								
Siskiyou Field Institute / Deer Creek Center PO Box 207 Selma, OR 97538 (541) 597-8530 http://www.thesfi.org/index.asp																										✓															
Siskiyou Land Conservancy PO Box 4209 Arcata, CA 95518 (707) 498-4900 http://siskiyouland.wordpress.com/											✓	✓																													
Siskiyou Resource Conservation District 450 Main Street Etna, CA 96027 (530) 467-3975 http://www.siskiyourcd.org/																													✓	✓											

Organization	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Smith River Advisory Council 586 G Street Crescent City, CA 95531 (707) 464-4711 http://www.coastal.ca.gov/publiced/directory/resdirectory/s_orgs/smithriveradvisory.html											✓	✓																													
Smith River Alliance PO Box 2129 Crescent City, CA 95531 (916) 715-9898 www.smithriveralliance.org											✓	✓																													
South Coast Watersheds Council PO Box 1614 Gold Beach, OR 97444 (541) 247-2755 http://oregonwatersheds.org/oregoncouncils/southcoast	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																															
South Fork Trinity River Coordinated Resource Management Plan Committee PO Box 1 Hyampom, CA 96046 (530) 623-6004 http://www.tcrcd.net/sfcrmp.htm																																		✓	✓	✓					
Southern Oregon Land Conservancy 84 Fourth Street Ashland, OR 97520 (541) 482-3069 http://www.landconserve.org/	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																✓	✓	✓													
The Nature Conservancy (703) 841-5300 www.tnc.org	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Partner	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R
The Salmon River Restoration Council PO Box 1089 Sawyers Bar, CA 96027 (530) 462-4665 http://www.srrc.org/	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Trinity County Resource Conservation District PO Box 1450 Weaverville, CA 96093 (530) 623-6004 http://www.tcrcd.net	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Trinity River Restoration Program PO Box 1300 Weaverville, CA 96093 (530) 623-1800 www.trrp.net	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
U.S. Bureau of Land Management, Arcata Office 1695 Heindon Road Arcata, CA 95521 (707) 825-2301 http://www.blm.gov/ca/st/en/fo/arcata.html	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
U.S. Bureau of Land Management, Coos Bay Office 1300 Airport Lane North Bend, OR 97459 (503) 808-6002 http://www.blm.gov/or/districts/coosbay/index.php	☐	☐	☐	☐	☐	☐	☐	☐	✔	☐	☐

Partner	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs
The Salmon River Restoration Council	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Trinity County Resource Conservation District	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Trinity River Restoration Program	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
U.S. Bureau of Land Management, Arcata Office	☐	☐	☐	✔	☐	☐	☐	☐	☐	✔
U.S. Bureau of Land Management, Coos Bay Office	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Partner	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R
The Salmon River Restoration Council	☐	☐	☐	☐	☐	☐	☐	✔	✔	✔
Trinity County Resource Conservation District	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Trinity River Restoration Program	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
U.S. Bureau of Land Management, Arcata Office	✔	✔	✔	✔	☐	☐	☐	☐	☐	☐
U.S. Bureau of Land Management, Coos Bay Office	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Partner	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
The Salmon River Restoration Council	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Trinity County Resource Conservation District	☐	☐	✔	✔	✔	☐	☐	☐	☐	☐
Trinity River Restoration Program	☐	☐	✔	✔	✔	☐	☐	☐	☐	☐
U.S. Bureau of Land Management, Arcata Office	☐	☐	☐	☐	☐	✔	☐	☐	☐	☐
U.S. Bureau of Land Management, Coos Bay Office	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Partner	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R
U.S. Bureau of Land Management, Medford Office 3040 Biddle Road Medford, OR 97504 (503) 808-6002 http://www.blm.gov/or/	✓			✓		✓		✓			
U.S. Fish and Wildlife Service, Humboldt Bay National Wildlife Refuge 1020 Ranch Road Loleta, CA 95551 (707) 733-5406 http://www.fws.gov/humboldtbay/											
U.S. Forest Service, Klamath National Forest 1312 Fairlane Road Yreka, CA 96097 (530) 842-6131 http://www.fs.fed.us/r5/klamath/											
U.S. Forest Service, Mendocino National Forest 825 N. Humboldt Ave. Willows, CA 95988 (530) 934-3316 http://www.fs.usda.gov/main/mendocino/home											
U.S. Forest Service, Orleans District 1711 South Main Street Yreka, CA 96097 (530) 842-6131 http://www.fs.fed.us/r5/klamath/											

Partner	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs
U.S. Bureau of Land Management, Medford Office										
U.S. Fish and Wildlife Service, Humboldt Bay National Wildlife Refuge										✓
U.S. Forest Service, Klamath National Forest										
U.S. Forest Service, Mendocino National Forest										
U.S. Forest Service, Orleans District			✓							

Partner	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R
U.S. Bureau of Land Management, Medford Office					✓	✓	✓			
U.S. Fish and Wildlife Service, Humboldt Bay National Wildlife Refuge										
U.S. Forest Service, Klamath National Forest								✓	✓	✓
U.S. Forest Service, Mendocino National Forest										
U.S. Forest Service, Orleans District								✓	✓	✓

Partner	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
U.S. Bureau of Land Management, Medford Office										
U.S. Fish and Wildlife Service, Humboldt Bay National Wildlife Refuge										
U.S. Forest Service, Klamath National Forest	✓	✓								
U.S. Forest Service, Mendocino National Forest						✓	✓	✓	✓	✓
U.S. Forest Service, Orleans District										

	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
U.S. Forest Service, Rogue River-Siskiyou National Forest 3040 Biddle Road Medford, OR 97504 (541) 618-2200 http://www.fs.fed.us/r6/rogue-siskiyou/						✓	✓	✓	✓	✓																															
U.S. Forest Service, Shasta-Trinity National Forest 3644 Avtech Parkway Redding, CA 96002 (530) 226-2500 http://www.fs.fed.us/r5/shastatrinity/																																✓	✓	✓	✓	✓					
U.S. Forest Service, Six Rivers National Forest 1330 Bayshore Way Eureka, CA 95501 (707) 442-1721 http://www.fs.usda.gov/srnf											✓	✓								✓	✓	✓							✓	✓	✓	✓	✓	✓	✓	✓					
Western Rivers Conservancy 71 SW Oak Street Suite 100 Portland, OR 97204 (503) 241-0151 http://www.westernrivers.org/	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Yurok Tribal Fisheries Program 190 Klamath Blvd Klamath, CA 95548 (707) 482-0439 http://www.yuroktribe.org/departments/fisheries/FisheriesHome.htm														✓															✓	✓	✓	✓	✓	✓	✓	✓					

Agency Directory

Agency	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Applegate Partnership and Watershed Council PO Box 899 Jacksonville, OR 97530 (541) 899-9982 http://www.applegatepartnership.org/	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																✓	✓	✓													
California Conservation Corps 1719 24th Street Sacramento, CA 95816 (916) 341-3100 http://www.ccc.ca.gov											✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
California Department of Fish and Game 1416 Ninth Street, 12th Floor Sacramento, CA 95814 (916) 445-0411 http://www.dfg.ca.gov											✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
City of Arcata 736 F Street Arcata, CA 95521 (707) 822-5951 http://www.cityofarcata.org/																				✓	✓																				
City of Eureka 531 K Street Eureka, CA 95501 (707) 441-4144 http://www.ci.eureka.ca.gov/																					✓																				

Organization	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Eel River Watershed Improvement Group (707) 725-4317 http://erwig.org/																						✓															✓	✓	✓	✓	✓
Environmental Protection Agency, Region 9 75 Hawthorne Street San Francisco, CA 94105 (415) 947-8000 http://www.epa.gov/region9/contact-region9.html											✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Five Counties Salmonid Conservation Program PO Box 2571 Weaverville, CA 96093 (530) 623-3967 http://www.5counties.org/											✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
French Creek Watershed Advisory Group http://www.watershed.org/?q=node/236																																✓	✓								
Friends of the Eel River PO Box 2039 Sausalito, CA 94965 www.eelriver.org																						✓															✓	✓	✓	✓	✓
Green Diamond Resource Company PO Box 68 Korbel, CA 95550 (707) 668-4449 http://www.greendiamond.com										✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																			

Partner	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R
Hoopa Valley Tribal Fisheries PO Box 1348 Hoopa, CA 95546 (530) 625-4211 http://www.hoopa-nsn.gov	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Humboldt Bay Harbor, Recreation and Conservation District PO Box 1030 Eureka, CA 95502 (707) 443-0801 http://www.humboldtbay.org/	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Humboldt Bay Initiative 2 Commercial Street, Suite 4 Eureka, CA 95501 (707) 443-8369 http://www.westcoastebm.org/Humboldt_Bay_Initiative.html	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Humboldt County Resource Conservation District 5630 South Broadway Eureka, CA 95503 (707) 444-9708 http://www.humboldtrcd.org/	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Humboldt Redwood Company 125 Main Street Scotia, CA 95565 (707) 764-4472 http://www.hrcllc.com/	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Partner	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs
Hoopa Valley Tribal Fisheries	☐	☐	✔	☐	☐	☐	☐	☐	☐	☐
Humboldt Bay Harbor, Recreation and Conservation District	☐	☐	☐	☐	☐	☐	☐	☐	✔	✔
Humboldt Bay Initiative	☐	☐	☐	☐	☐	☐	☐	☐	☐	✔
Humboldt County Resource Conservation District	☐	☐	☐	✔	✔	✔	✔	✔	✔	✔
Humboldt Redwood Company	☐	☐	☐	☐	☐	☐	☐	☐	☐	✔

Partner	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R
Hoopa Valley Tribal Fisheries	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Humboldt Bay Harbor, Recreation and Conservation District	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Humboldt Bay Initiative	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Humboldt County Resource Conservation District	✔	✔	✔	✔	☐	☐	☐	☐	☐	☐
Humboldt Redwood Company	✔	✔	✔	✔	☐	☐	☐	☐	☐	☐

Partner	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Hoopa Valley Tribal Fisheries	☐	☐	✔	✔	☐	☐	☐	☐	☐	☐
Humboldt Bay Harbor, Recreation and Conservation District	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Humboldt Bay Initiative	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Humboldt County Resource Conservation District	☐	☐	☐	☐	☐	✔	✔	☐	✔	☐
Humboldt Redwood Company	☐	☐	☐	☐	☐	✔	✔	☐	☐	☐

	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Illinois Valley Soil and Water Conservation District PO Box 352 Cave Junction, OR 97523 (541) 592-3731 http://www.oregon.gov/ODA/SWCD/																										✓															
Illinois Valley Watershed Council PO Box 352 Cave Junction, OR 97523 (541) 592-3731 http://oregonwatersheds.org/oregoncouncils/illinoisvalley																										✓															
Karuk Tribal Fisheries Department and Restoration Division 64236 Second Avenue Happy Camp, CA 96039 (530) 493-1600 http://www.karuk.us														✓															✓	✓	✓	✓	✓								
Lindsay Creek Watershed Group 904 G Street Eureka, CA 95501 (707) 269-2063 http://www.naturalresourcesservices.org																				✓																					
Lower Rogue Watershed Council http://www.currywatersheds.org						✓																																			

	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Mad River Stakeholders Group 904 G Street Eureka, CA 95501 (707) 269-2063 http://www.naturalresourcesservices.org																				✔																					
Mattole Restoration Council PO Box 160 Petrolia, CA 95558 (707) 629-3514 http://www.mattole.org																									✔																
Mattole Salmon Group PO Box 188 Petrolia, CA 95558 (707) 629-3433 http://www.mattolesalmon.org																									✔																
Mendocino Redwood Company PO Box 996 Ukiah, CA 95482 (707) 463-5110 http://www.mrc.com/Key-Policies-HCP.aspx																																					✔				
Mendocino Resource Conservation District 206 Mason Street, Suite F Ukiah, CA 95482 (707) 462-3664 http://www.mcrcd.org																																					✔		✔	✔	✔

Partner	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R
Middle Rogue River Watershed Council 543 NE 'E' Street, Suite 201 Grants Pass, OR 97526 (541) 474-6799 http://www.roguebasinwatersheds.org/SectionIndex.asp?SectionID=6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Mid-Klamath Watershed Council PO Box 409 Orleans, CA 95556 (530) 627-3202 http://www.mkwc.org											
North Coast Regional Water Quality Control Board 5550 Skylane Blvd, Suite A Santa Rosa, CA 95403 (707) 576-2220 http://www.waterboards.ca.gov/northcoast											✓
Northern California Resource Center PO Box 342 Fort Jones, CA 96032 (530) 468-2888 http://www.californiaresourcecenter.org/home.php											
Oregon Department of Environmental Quality 165 E. 7th Avenue Eugene, OR 97401 (503) 229-5696 http://www.oregon.gov/DEQ/	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

Partner	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs
Middle Rogue River Watershed Council										
Mid-Klamath Watershed Council			✓							
North Coast Regional Water Quality Control Board	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Northern California Resource Center										
Oregon Department of Environmental Quality										

Partner	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R
Middle Rogue River Watershed Council					✓	✓	✓			
Mid-Klamath Watershed Council								✓	✓	✓
North Coast Regional Water Quality Control Board	✓	✓	✓	✓				✓	✓	✓
Northern California Resource Center										
Oregon Department of Environmental Quality					✓	✓	✓		✓	

Partner	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Middle Rogue River Watershed Council										
Mid-Klamath Watershed Council	✓	✓								
North Coast Regional Water Quality Control Board	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Northern California Resource Center	✓									
Oregon Department of Environmental Quality										

Partner	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs
Oregon Department of Fish and Wildlife (503) 947-6000 http://www.dfw.state.or.us/	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓											
Oregon Department of Fish and Wildlife (503) 947-6000 http://www.dfw.state.or.us/																					
Orleans/Somes Bar Fire Safe Council PO Box 766 Somes Bar, CA 95568 (530) 469-3216 http://www.firesafecouncil.org/find/view_council.cfm?c=69														✓							
Pacific Coast Federation of Fishermen's Associations PO Box 29370 San Francisco, CA 94129 (415) 561-5080 http://www.pcffa.org/	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pacific Coast Fish Wildlife and Wetlands Restoration Association PO Box 4574 Arcata, CA 95518 (707) 839-5664 http://www.pcfwwra.org										✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pacific Coast Joint Venture (707) 826-3208 http://www.pcjv.org/california/	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Partner	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Oregon Department of Fish and Wildlife																				
Oregon Department of Fish and Wildlife					✓	✓	✓													
Orleans/Somes Bar Fire Safe Council								✓	✓	✓	✓	✓								
Pacific Coast Federation of Fishermen's Associations	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pacific Coast Fish Wildlife and Wetlands Restoration Association	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pacific Coast Joint Venture	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Pacificorps 825 NE Multnomah Street Portland, OR 97232 http://www.pacificorp.com/index.html																													✓	✓											
Redwood Community Action Agency 904 G Street Eureka, CA 95501 (707) 269-2001 http://www.rcaa.org/																✓	✓	✓	✓	✓	✓	✓	✓	✓	✓													✓			
Redwood Creek Watershed Group PO Box 4574 Arcata, CA 95518 (707) 839-5664															✓																										
Redwood National and State Park 1111 Second Street Crescent City, CA 95531 (707) 464-1812 http://www.nps.gov/redw/index.htm											✓	✓	✓		✓																										
Rural Human Services 286 M Street Crescent City, CA 95531 (707) 464-7441 http://www.ruralhumanservices.com/											✓	✓																													
Salmon River Fire Safe Council Sawyers Bar, CA 96027 (530) 462-4665 http://www.firesafecouncil.org/find/view_council.cfm?c=58																															✓										

Organization	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Salmon Safe 805 SE 32nd Avenue Portland, OR 97214 (503) 232-3750 http://www.salmonsafe.org/	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔																✔	✔	✔													
Sanctuary Forest PO Box 166 Whitehorn, CA 95589 (707) 986-1087 http://www.sanctuaryforest.org																									✔																
Save-the-Redwoods League 114 Sansome Street, Suite 1200 San Francisco, CA 94104 (415) 362-2352 http://www.savetheredwoods.org/											✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Scott River Fire Safe Councils (530) 468-2888 http://www.firesafecouncil.org/find/index.cfm																																✔									
Scott River Water Trust PO Box 591 Etna, CA 96027 (530) 467-5783 http://www.scottwatertrust.org/																																✔									
Scott River Watershed Council PO Box 355 Etna, CA 96027 (530) 467-5511 http://www.scottriver.org/																																✔									

Partner	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R
Shasta Valley Coordinated Resources Management and Planning 450 Main Street Etna, CA 96027 (530) 467-3975 http://www.siskiyourcd.org/	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Shasta Valley Resource Conservation District 215 Executive Court, Suite A Yreka, CA 96097 (530) 842-6121 http://www.svrcd.org/	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Siskiyou Field Institute / Deer Creek Center PO Box 207 Selma, OR 97538 (541) 597-8530 http://www.thesfi.org/index.asp	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Siskiyou Land Conservancy PO Box 4209 Arcata, CA 95518 (707) 498-4900 http://siskiyouland.wordpress.com/	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑
Siskiyou Resource Conservation District 450 Main Street Etna, CA 96027 (530) 467-3975 http://www.siskiyourcd.org/	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Partner	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs
Shasta Valley Coordinated Resources Management and Planning	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Shasta Valley Resource Conservation District	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Siskiyou Field Institute / Deer Creek Center	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Siskiyou Land Conservancy	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐
Siskiyou Resource Conservation District	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Partner	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R
Shasta Valley Coordinated Resources Management and Planning	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Shasta Valley Resource Conservation District	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Siskiyou Field Institute / Deer Creek Center	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐
Siskiyou Land Conservancy	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Siskiyou Resource Conservation District	☐	☐	☐	☐	☐	☐	☐	☑	☑	☐

Partner	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Shasta Valley Coordinated Resources Management and Planning	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐
Shasta Valley Resource Conservation District	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐
Siskiyou Field Institute / Deer Creek Center	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Siskiyou Land Conservancy	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Siskiyou Resource Conservation District	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Organization	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R
Smith River Advisory Council 586 G Street Crescent City, CA 95531 (707) 464-4711 http://www.coastal.ca.gov/publiced/directory/resdirectory/s_orgs/smithriveradvisory.html											✓
Smith River Alliance PO Box 2129 Crescent City, CA 95531 (916) 715-9898 www.smithriveralliance.org											✓
South Coast Watersheds Council PO Box 1614 Gold Beach, OR 97444 (541) 247-2755 http://oregonwatersheds.org/oregoncouncils/southcoast	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
South Fork Trinity River Coordinated Resource Management Plan Committee PO Box 1 Hyampom, CA 96046 (530) 623-6004 http://www.tcrcd.net/sfcrmp.htm											
Southern Oregon Land Conservancy 84 Fourth Street Ashland, OR 97520 (541) 482-3069 http://www.landconserve.org/	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
The Nature Conservancy (703) 841-5300 www.tnc.org	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Organization	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs
Smith River Advisory Council	✓									
Smith River Alliance	✓									
South Coast Watersheds Council										
South Fork Trinity River Coordinated Resource Management Plan Committee										
Southern Oregon Land Conservancy										
The Nature Conservancy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Organization	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R
Smith River Advisory Council										
Smith River Alliance										
South Coast Watersheds Council										
South Fork Trinity River Coordinated Resource Management Plan Committee										
Southern Oregon Land Conservancy					✓	✓	✓			
The Nature Conservancy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Organization	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Smith River Advisory Council										
Smith River Alliance										
South Coast Watersheds Council										
South Fork Trinity River Coordinated Resource Management Plan Committee			✓	✓	✓					
Southern Oregon Land Conservancy										
The Nature Conservancy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Partner	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
The Salmon River Restoration Council PO Box 1089 Sawyers Bar, CA 96027 (530) 462-4665 http://www.srrc.org/																													✓	✓	✓										
Trinity County Resource Conservation District PO Box 1450 Weaverville, CA 96093 (530) 623-6004 http://www.tcrcd.net																																		✓	✓	✓					
Trinity River Restoration Program PO Box 1300 Weaverville, CA 96093 (530) 623-1800 www.trrp.net																																		✓	✓	✓					
U.S. Bureau of Land Management, Arcata Office 1695 Heindon Road Arcata, CA 95521 (707) 825-2301 http://www.blm.gov/ca/st/en/fo/arcata.html															✓						✓	✓	✓	✓	✓												✓				
U.S. Bureau of Land Management, Coos Bay Office 1300 Airport Lane North Bend, OR 97459 (503) 808-6002 http://www.blm.gov/or/districts/coosbay/index.php									✓																																

Partner	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R
U.S. Bureau of Land Management, Medford Office 3040 Biddle Road Medford, OR 97504 (503) 808-6002 http://www.blm.gov/or/	✓			✓		✓		✓			
U.S. Fish and Wildlife Service, Humboldt Bay National Wildlife Refuge 1020 Ranch Road Loleta, CA 95551 (707) 733-5406 http://www.fws.gov/humboldtbay/											
U.S. Forest Service, Klamath National Forest 1312 Fairlane Road Yreka, CA 96097 (530) 842-6131 http://www.fs.fed.us/r5/klamath/											
U.S. Forest Service, Mendocino National Forest 825 N. Humboldt Ave. Willows, CA 95988 (530) 934-3316 http://www.fs.usda.gov/main/mendocino/home											
U.S. Forest Service, Orleans District 1711 South Main Street Yreka, CA 96097 (530) 842-6131 http://www.fs.fed.us/r5/klamath/											

Partner	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs
U.S. Bureau of Land Management, Medford Office										
U.S. Fish and Wildlife Service, Humboldt Bay National Wildlife Refuge										✓
U.S. Forest Service, Klamath National Forest										
U.S. Forest Service, Mendocino National Forest										
U.S. Forest Service, Orleans District			✓							

Partner	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R
U.S. Bureau of Land Management, Medford Office					✓	✓	✓			
U.S. Fish and Wildlife Service, Humboldt Bay National Wildlife Refuge										
U.S. Forest Service, Klamath National Forest								✓	✓	✓
U.S. Forest Service, Mendocino National Forest										
U.S. Forest Service, Orleans District								✓	✓	✓

Partner	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
U.S. Bureau of Land Management, Medford Office										
U.S. Fish and Wildlife Service, Humboldt Bay National Wildlife Refuge										
U.S. Forest Service, Klamath National Forest	✓	✓								
U.S. Forest Service, Mendocino National Forest						✓	✓	✓	✓	✓
U.S. Forest Service, Orleans District										

Partner	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
U.S. Forest Service, Rogue River-Siskiyou National Forest 3040 Biddle Road Medford, OR 97504 (541) 618-2200 http://www.fs.fed.us/r6/rogue-siskiyou/						✓	✓	✓	✓	✓																															
U.S. Forest Service, Shasta-Trinity National Forest 3644 Avtech Parkway Redding, CA 96002 (530) 226-2500 http://www.fs.fed.us/r5/shastatrinity/																																✓	✓	✓	✓	✓					
U.S. Forest Service, Six Rivers National Forest 1330 Bayshore Way Eureka, CA 95501 (707) 442-1721 http://www.fs.usda.gov/srnf											✓	✓								✓	✓	✓							✓	✓	✓	✓	✓	✓	✓	✓					
Western Rivers Conservancy 71 SW Oak Street Suite 100 Portland, OR 97204 (503) 241-0151 http://www.westernrivers.org/	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Yurok Tribal Fisheries Program 190 Klamath Blvd Klamath, CA 95548 (707) 482-0439 http://www.yuroktribe.org/departments/fisheries/FisheriesHome.htm														✓															✓	✓	✓	✓	✓	✓	✓	✓					

Recovery Action Cost Schedule

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
Population: Elk River									
SONCC-ElkR.2.2.5									
	SONCC-ElkR.2.2.5.1	$34,015						$34,015	Private
	SONCC-ElkR.2.2.5.2	$232,126						$232,126	Private
	Action Total:	*$266,141*						*$266,141*	
SONCC-ElkR.2.1.6									
	SONCC-ElkR.2.1.6.1	$34,015						$34,015	USFS
	SONCC-ElkR.2.1.6.2	$1,243,620						$1,243,620	USFS
	Action Total:	*$1,277,635*						*$1,277,635*	
SONCC-ElkR.2.2.29									
	SONCC-ElkR.2.2.29.1	$34,015						$34,015	ODFW
	SONCC-ElkR.2.2.29.2	$10,000						$10,000	ODFW
	Action Total:	*$44,015*						*$44,015*	
SONCC-ElkR.10.2.14									
	SONCC-ElkR.10.2.14.1							$0	Oregon WRD
	Action Total:							*$0*	
SONCC-ElkR.10.2.15									
	SONCC-ElkR.10.2.15.1	$136,060						$136,060	EPA
	Action Total:	*$136,060*						*$136,060*	
SONCC-ElkR.1.4.7									
	SONCC-ElkR.1.4.7.1	$17,077						$17,077	County
	SONCC-ElkR.1.4.7.2	$17,077						$17,077	County
	Action Total:	*$34,154*						*$34,154*	
SONCC-ElkR.1.2.8									
	SONCC-ElkR.1.2.8.1	$34,015						$34,015	ODFW
	SONCC-ElkR.1.2.8.2	$335,000						$335,000	ODFW
	Action Total:	*$369,015*						*$369,015*	
SONCC-ElkR.1.2.28									
	SONCC-ElkR.1.2.28.1	$34,015						$34,015	ODFW
	SONCC-ElkR.1.2.28.2	$34,015						$34,015	ODFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-ElkR.16.1.16									
	SONCC-ElkR.16.1.16.1	$1,744						$1,744	NMFS
	SONCC-ElkR.16.1.16.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-ElkR.16.1.17									
	SONCC-ElkR.16.1.17.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-ElkR.16.1.17.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-ElkR.16.2.18									
	SONCC-ElkR.16.2.18.1	$1,744						$1,744	NMFS
	SONCC-ElkR.16.2.18.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-ElkR.16.2.19									
	SONCC-ElkR.16.2.19.1	$1,744						$1,744	NMFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-ElkR.16.2.19.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-ElkR.3.1.12									
	SONCC-ElkR.3.1.12.1	$34,015						$34,015	Oregon WRD
	SONCC-ElkR.3.1.12.2	$36,770						$36,770	Oregon WRD
	Action Total:	*$70,785*						*$70,785*	
SONCC-ElkR.3.1.13									
	SONCC-ElkR.3.1.13.1	$76,136						$76,136	ODEQ
	Action Total:	*$76,136*						*$76,136*	
SONCC-ElkR.27.1.20									
	SONCC-ElkR.27.1.20.1						$204,500	$204,500	ODFW
	Action Total:						*$204,500*	*$204,500*	
SONCC-ElkR.27.1.21									
	SONCC-ElkR.27.1.21.1						$85,037	$85,037	ODFW
	Action Total:						*$85,037*	*$85,037*	
SONCC-ElkR.27.1.22									
	SONCC-ElkR.27.1.22.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	ODFW
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-ElkR.27.2.23									
	SONCC-ElkR.27.2.23.1	$81,800						$81,800	ODFW
	SONCC-ElkR.27.2.23.2			$40,900		$40,900		$81,800	ODFW
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-ElkR.27.2.24									
	SONCC-ElkR.27.2.24.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-ElkR.27.2.25									
	SONCC-ElkR.27.2.25.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-ElkR.27.2.26									
	SONCC-ElkR.27.2.26.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-ElkR.27.2.27									
	SONCC-ElkR.27.2.27.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-ElkR.27.1.31									
	SONCC-ElkR.27.1.31.1	$122,700	$122,700	$122,700	$122,700	$122,700	$122,700	$736,200	ODFW
	Action Total:	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$736,200*	
SONCC-ElkR.27.2.32									
	SONCC-ElkR.27.2.32.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-ElkR.27.1.33									
	SONCC-ElkR.27.1.33.1	$8,722						$8,722	NMFS
	SONCC-ElkR.27.1.33.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-ElkR.27.2.34									
	SONCC-ElkR.27.2.34.1	$2,721						$2,721	ODFW
	Action Total:	*$2,721*						*$2,721*	
SONCC-ElkR.5.1.11									
	SONCC-ElkR.5.1.11.1	$44,540						$44,540	Watershed Cnsl

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-ElkR.5.1.11.2	$436,045						$436,045	Watershed Cnsl
	Action Total:	*$480,585*						*$480,585*	
SONCC-ElkR.7.1.1									
	SONCC-ElkR.7.1.1.1	$34,015						$34,015	USFS
	SONCC-ElkR.7.1.1.2	$86,931						$86,931	USFS
	SONCC-ElkR.7.1.1.3	$627,912						$627,912	USFS
	Action Total:	*$748,858*						*$748,858*	
SONCC-ElkR.7.1.2									
	SONCC-ElkR.7.1.2.1	$8,503						$8,503	County
	SONCC-ElkR.7.1.2.2	$34,015						$34,015	County
	Action Total:	*$42,518*						*$42,518*	
SONCC-ElkR.7.1.3									
	SONCC-ElkR.7.1.3.1	$34,015						$34,015	FSA
	SONCC-ElkR.7.1.3.2	$34,015						$34,015	FSA
	SONCC-ElkR.7.1.3.3	$219,248						$219,248	FSA
	SONCC-ElkR.7.1.3.4	$7,416						$7,416	FSA
	SONCC-ElkR.7.1.3.5	$607						$607	FSA
	Action Total:	*$295,301*						*$295,301*	
SONCC-ElkR.7.1.4									
	SONCC-ElkR.7.1.4.1	$5,254						$5,254	ODF
	Action Total:	*$5,254*						*$5,254*	
SONCC-ElkR.7.1.30									
	SONCC-ElkR.7.1.30.1	$34,015						$34,015	BLM
	Action Total:	*$34,015*						*$34,015*	
SONCC-ElkR.8.1.9									
	SONCC-ElkR.8.1.9.1	$34,015						$34,015	USFS
	SONCC-ElkR.8.1.9.2	$5,000,000						$5,000,000	USFS
	SONCC-ElkR.8.1.9.3	$2,000,000						$2,000,000	USFS
	SONCC-ElkR.8.1.9.4	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$12,000,000	USFS
	Action Total:	*$9,034,015*	*$2,000,000*	*$2,000,000*	*$2,000,000*	*$2,000,000*	*$2,000,000*	*$19,034,015*	
	Population Total:	***$13,741,103***	***$2,237,158***	***$2,687,058***	***$2,237,158***	***$2,687,058***	***$2,935,695***	***$26,525,230***	

Population: Brush Creek

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-BruC.2.1.1									
	SONCC-BruC.2.1.1.1	$34,015						$34,015	OSP
	SONCC-BruC.2.1.1.2	$350,624						$350,624	OSP
	Action Total:	*$384,639*						*$384,639*	
SONCC-BruC.2.1.2									
	SONCC-BruC.2.1.2.1							$0	ODF
	Action Total:							*$0*	
SONCC-BruC.2.2.3									
	SONCC-BruC.2.2.3.1	$34,015						$34,015	OSP
	SONCC-BruC.2.2.3.2	$10,000						$10,000	OSP
	Action Total:	*$44,015*						*$44,015*	
SONCC-BruC.2.2.9									
	SONCC-BruC.2.2.9.1	$34,015						$34,015	ODFW
	SONCC-BruC.2.2.9.2	$102,258						$102,258	ODFW
	Action Total:	*$136,273*						*$136,273*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-BruC.7.1.6									
	SONCC-BruC.7.1.6.1							$0	OSP
	SONCC-BruC.7.1.6.2							$0	OSP
	SONCC-BruC.7.1.6.3							$0	OSP
	Action Total:							*$0*	
SONCC-BruC.27.2.8									
	SONCC-BruC.27.2.8.1	$81,800						$81,800	ODFW
	SONCC-BruC.27.2.8.2				$40,900			$40,900	ODFW
	Action Total:	*$81,800*			*$40,900*			*$122,700*	
SONCC-BruC.27.1.12									
	SONCC-BruC.27.1.12.1						$122,700	$122,700	ODFW
	Action Total:						*$122,700*	*$122,700*	
SONCC-BruC.27.2.13									
	SONCC-BruC.27.2.13.1	$102,250			$102,250		$102,250	$306,750	ODFW
	Action Total:	*$102,250*			*$102,250*		*$102,250*	*$306,750*	
SONCC-BruC.27.2.14									
	SONCC-BruC.27.2.14.1	$102,250			$102,250		$102,250	$306,750	ODFW
	Action Total:	*$102,250*			*$102,250*		*$102,250*	*$306,750*	
SONCC-BruC.27.1.15									
	SONCC-BruC.27.1.15.1	$8,722						$8,722	NMFS
	SONCC-BruC.27.1.15.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-BruC.27.2.16									
	SONCC-BruC.27.2.16.1	$2,721						$2,721	ODFW
	Action Total:	*$2,721*						*$2,721*	
SONCC-BruC.5.1.7									
	SONCC-BruC.5.1.7.1							$0	OSP
	SONCC-BruC.5.1.7.2							$0	OSP
	Action Total:							*$0*	
SONCC-BruC.8.1.10									
	SONCC-BruC.8.1.10.1							$0	Private
	SONCC-BruC.8.1.10.2							$0	Private
	SONCC-BruC.8.1.10.3							$0	Private
	SONCC-BruC.8.1.10.4							$0	Private
	Action Total:							*$0*	
SONCC-BruC.10.2.5									
	SONCC-BruC.10.2.5.1							$0	Oregon WRD
	Action Total:							*$0*	
SONCC-BruC.10.2.11									
	SONCC-BruC.10.2.11.1							$0	OSP
	Action Total:							*$0*	
	Population Total:	***$871,392***			***$245,400***		***$327,200***	***$1,443,992***	

Population: Mussel Creek

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MusC.2.2.4									
	SONCC-MusC.2.2.4.1	$34,015						$34,015	OSP
	SONCC-MusC.2.2.4.2	$102,258						$102,258	OSP
	Action Total:	*$136,273*						*$136,273*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MusC.2.2.5									
	SONCC-MusC.2.2.5.1	$34,015						$34,015	ODFW
	SONCC-MusC.2.2.5.2	$10,000						$10,000	ODFW
	Action Total:	*$44,015*						*$44,015*	
SONCC-MusC.2.1.6									
	SONCC-MusC.2.1.6.1	$34,015						$34,015	OSP
	SONCC-MusC.2.1.6.2	$258,859						$258,859	OSP
	Action Total:	*$292,874*						*$292,874*	
SONCC-MusC.7.1.1									
	SONCC-MusC.7.1.1.1	$8,503						$8,503	County
	SONCC-MusC.7.1.1.2	$34,015						$34,015	County
	Action Total:	*$42,518*						*$42,518*	
SONCC-MusC.7.1.2									
	SONCC-MusC.7.1.2.1							$0	OSP
	SONCC-MusC.7.1.2.2							$0	OSP
	SONCC-MusC.7.1.2.3							$0	OSP
	Action Total:							*$0*	
SONCC-MusC.7.1.3									
	SONCC-MusC.7.1.3.2							$0	ODF
	Action Total:							*$0*	
SONCC-MusC.27.2.10									
	SONCC-MusC.27.2.10.1	$81,800						$81,800	ODFW
	SONCC-MusC.27.2.10.2				$40,900			$40,900	ODFW
	Action Total:	*$81,800*			*$40,900*			*$122,700*	
SONCC-MusC.27.1.12									
	SONCC-MusC.27.1.12.1						$122,700	$122,700	ODFW
	Action Total:						*$122,700*	*$122,700*	
SONCC-MusC.27.2.13									
	SONCC-MusC.27.2.13.1	$102,250			$102,250		$102,250	$306,750	ODFW
	Action Total:	*$102,250*			*$102,250*		*$102,250*	*$306,750*	
SONCC-MusC.27.2.14									
	SONCC-MusC.27.2.14.1	$102,250			$102,250		$102,250	$306,750	ODFW
	Action Total:	*$102,250*			*$102,250*		*$102,250*	*$306,750*	
SONCC-MusC.27.1.15									
	SONCC-MusC.27.1.15.1	$8,722						$8,722	NMFS
	SONCC-MusC.27.1.15.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-MusC.27.2.16									
	SONCC-MusC.27.2.16.1	$2,721						$2,721	ODFW
	Action Total:	*$2,721*						*$2,721*	
SONCC-MusC.5.1.8									
	SONCC-MusC.5.1.8.1							$0	ODFW
	Action Total:							*$0*	
SONCC-MusC.8.1.11									
	SONCC-MusC.8.1.11.1							$0	Private
	SONCC-MusC.8.1.11.2							$0	Private
	SONCC-MusC.8.1.11.3							$0	Private
	SONCC-MusC.8.1.11.4							$0	Private

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:							*$0*	
SONCC-MusC.10.2.7									
	SONCC-MusC.10.2.7.1							$0	Oregon WRD
	Action Total:							*$0*	
	Population Total:	***$822,145***			***$245,400***		***$327,200***	***$1,394,745***	

Population: Lower Rogue

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-LRR.1.1.6									
	SONCC-LRR.1.1.6.1	$34,015						$34,015	ODFW
	SONCC-LRR.1.1.6.2	$174,420						$174,420	ODFW
	Action Total:	*$208,435*						*$208,435*	
SONCC-LRR.1.2.7									
	SONCC-LRR.1.2.7.1	$17,077						$17,077	County
	Action Total:	*$17,077*						*$17,077*	
SONCC-LRR.1.2.8									
	SONCC-LRR.1.2.8.1	$34,015						$34,015	ODFW
	SONCC-LRR.1.2.8.2	$670,000						$670,000	ODFW
	Action Total:	*$704,015*						*$704,015*	
SONCC-LRR.1.2.25									
	SONCC-LRR.1.2.25.1	$34,015						$34,015	ODFW
	SONCC-LRR.1.2.25.2	$34,015						$34,015	ODFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-LRR.2.1.9									
	SONCC-LRR.2.1.9.1	$34,015						$34,015	USFS
	SONCC-LRR.2.1.9.2	$1,679,571						$1,679,571	USFS
	Action Total:	*$1,713,586*						*$1,713,586*	
SONCC-LRR.2.2.10									
	SONCC-LRR.2.2.10.1	$34,015						$34,015	USFS
	SONCC-LRR.2.2.10.2	$20,000						$20,000	USFS
	Action Total:	*$54,015*						*$54,015*	
SONCC-LRR.10.2.26									
	SONCC-LRR.10.2.26.1	$34,015						$34,015	County
	SONCC-LRR.10.2.26.2	$96,692						$96,692	County
	Action Total:	*$130,707*						*$130,707*	
SONCC-LRR.16.1.12									
	SONCC-LRR.16.1.12.1	$1,744						$1,744	NMFS
	SONCC-LRR.16.1.12.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-LRR.16.1.13									
	SONCC-LRR.16.1.13.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-LRR.16.1.13.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-LRR.16.2.14									
	SONCC-LRR.16.2.14.1	$1,744						$1,744	NMFS
	SONCC-LRR.16.2.14.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-LRR.16.2.15									
	SONCC-LRR.16.2.15.1	$1,744						$1,744	NMFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-LRR.16.2.15.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-LRR.27.1.16									
	SONCC-LRR.27.1.16.1						$204,500	$204,500	ODFW
	Action Total:						*$204,500*	*$204,500*	
SONCC-LRR.27.1.17									
	SONCC-LRR.27.1.17.1	$122,700	$122,700	$122,700	$122,700	$122,700	$122,700	$736,200	ODFW
	Action Total:	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$736,200*	
SONCC-LRR.27.1.18									
	SONCC-LRR.27.1.18.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	ODFW
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-LRR.27.2.19									
	SONCC-LRR.27.2.19.1	$81,800						$81,800	ODFW
	SONCC-LRR.27.2.19.2			$40,900		$40,900		$81,800	ODFW
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-LRR.27.2.20									
	SONCC-LRR.27.2.20.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-LRR.27.2.21									
	SONCC-LRR.27.2.21.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-LRR.27.2.22									
	SONCC-LRR.27.2.22.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-LRR.27.2.23									
	SONCC-LRR.27.2.23.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-LRR.27.2.24									
	SONCC-LRR.27.2.24.1	$68,030		$68,030		$68,030	$68,030	$272,120	ODFW
	Action Total:	*$68,030*		*$68,030*		*$68,030*	*$68,030*	*$272,120*	
SONCC-LRR.27.1.28									
	SONCC-LRR.27.1.28.1						$85,037	$85,037	ODFW
	Action Total:						*$85,037*	*$85,037*	
SONCC-LRR.27.2.29									
	SONCC-LRR.27.2.29.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-LRR.27.1.30									
	SONCC-LRR.27.1.30.1	$8,722						$8,722	NMFS
	SONCC-LRR.27.1.30.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-LRR.27.2.31									
	SONCC-LRR.27.2.31.1	$2,721						$2,721	ODFW
	Action Total:	*$2,721*						*$2,721*	
SONCC-LRR.7.1.4									
	SONCC-LRR.7.1.4.1	$5,254						$5,254	ODF
	Action Total:	*$5,254*						*$5,254*	
SONCC-LRR.7.1.5									
	SONCC-LRR.7.1.5.1	$34,015						$34,015	USFS
	SONCC-LRR.7.1.5.2	$117,613						$117,613	USFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-LRR.7.1.5.3	$851,170						$851,170	USFS
	Action Total:	*$1,002,797*						*$1,002,797*	
SONCC-LRR.7.1.27									
	SONCC-LRR.7.1.27.1	$34,015						$34,015	BLM
	Action Total:	*$34,015*						*$34,015*	
SONCC-LRR.8.1.1									
	SONCC-LRR.8.1.1.1	$577,812						$577,812	USFS
	SONCC-LRR.8.1.1.2	$45,246,400						$45,246,400	USFS
	SONCC-LRR.8.1.1.3	$1,442,599						$1,442,599	USFS
	SONCC-LRR.8.1.1.4	$948,433	$948,433	$948,433	$948,433	$948,433	$948,433	$5,690,598	USFS
	Action Total:	*$48,215,244*	*$948,433*	*$948,433*	*$948,433*	*$948,433*	*$948,433*	*$52,957,409*	
SONCC-LRR.8.1.2									
	SONCC-LRR.8.1.2.1	$11,338						$11,338	County
	Action Total:	*$11,338*						*$11,338*	
	Population Total:	***$52,991,130***	***$1,185,591***	***$1,703,521***	***$1,185,591***	***$1,703,521***	***$1,952,158***	***$60,721,512***	

Population: Hunter Creek

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-HunC.2.2.10									
	SONCC-HunC.2.2.10.1	$34,015						$34,015	ODFW
	SONCC-HunC.2.2.10.2	$10,000						$10,000	ODFW
	Action Total:	*$44,015*						*$44,015*	
SONCC-HunC.2.2.11									
	SONCC-HunC.2.2.11.1	$34,015						$34,015	Watershed Cnsl
	SONCC-HunC.2.2.11.2	$102,258						$102,258	Watershed Cnsl
	Action Total:	*$136,273*						*$136,273*	
SONCC-HunC.2.1.13									
	SONCC-HunC.2.1.13.1	$34,015						$34,015	ODFW
	SONCC-HunC.2.1.13.2	$156,137						$156,137	ODFW
	Action Total:	*$190,152*						*$190,152*	
SONCC-HunC.2.2.16									
	SONCC-HunC.2.2.16.1	$89,080						$89,080	Watershed Cnsl
	SONCC-HunC.2.2.16.2	$95,100						$95,100	Watershed Cnsl
	Action Total:	*$184,180*						*$184,180*	
SONCC-HunC.7.1.1									
	SONCC-HunC.7.1.1.1							$0	County
	SONCC-HunC.7.1.1.2							$0	County
	Action Total:							*$0*	
SONCC-HunC.7.1.2									
	SONCC-HunC.7.1.2.1							$0	USFS
	SONCC-HunC.7.1.2.2							$0	USFS
	SONCC-HunC.7.1.2.3							$0	USFS
	Action Total:							*$0*	
SONCC-HunC.7.1.3									
	SONCC-HunC.7.1.3.1							$0	USFS
	SONCC-HunC.7.1.3.2							$0	USFS
	Action Total:							*$0*	
SONCC-HunC.7.1.4									
	SONCC-HunC.7.1.4.1							$0	ODF

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:							*$0*	
SONCC-HunC.1.1.15									
	SONCC-HunC.1.1.15.1							$0	ODOT
	SONCC-HunC.1.1.15.2							$0	ODOT
	Action Total:							*$0*	
SONCC-HunC.1.2.17									
	SONCC-HunC.1.2.17.1	$34,015						$34,015	ODFW
	SONCC-HunC.1.2.17.2	$335,000						$335,000	ODFW
	Action Total:	*$369,015*						*$369,015*	
SONCC-HunC.3.1.5									
	SONCC-HunC.3.1.5.1							$0	City
	Action Total:							*$0*	
SONCC-HunC.3.1.6									
	SONCC-HunC.3.1.6.1							$0	Oregon WRD
	Action Total:							*$0*	
SONCC-HunC.27.2.9									
	SONCC-HunC.27.2.9.1	$81,800						$81,800	ODFW
	SONCC-HunC.27.2.9.2				$40,900			$40,900	ODFW
	Action Total:	*$81,800*			*$40,900*			*$122,700*	
SONCC-HunC.27.1.18									
	SONCC-HunC.27.1.18.1						$122,700	$122,700	ODFW
	Action Total:						*$122,700*	*$122,700*	
SONCC-HunC.27.2.19									
	SONCC-HunC.27.2.19.1	$102,250			$102,250		$102,250	$306,750	ODFW
	Action Total:	*$102,250*			*$102,250*		*$102,250*	*$306,750*	
SONCC-HunC.27.2.20									
	SONCC-HunC.27.2.20.1	$102,250			$102,250		$102,250	$306,750	ODFW
	Action Total:	*$102,250*			*$102,250*		*$102,250*	*$306,750*	
SONCC-HunC.27.1.21									
	SONCC-HunC.27.1.21.1	$8,722						$8,722	NMFS
	SONCC-HunC.27.1.21.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-HunC.27.2.22									
	SONCC-HunC.27.2.22.1	$2,721						$2,721	ODFW
	Action Total:	*$2,721*						*$2,721*	
SONCC-HunC.8.1.12									
	SONCC-HunC.8.1.12.1							$0	Private
	SONCC-HunC.8.1.12.2							$0	Private
	SONCC-HunC.8.1.12.3							$0	Private
	SONCC-HunC.8.1.12.4							$0	Private
	Action Total:							*$0*	
SONCC-HunC.10.2.8									
	SONCC-HunC.10.2.8.1	$136,060						$136,060	EPA
	Action Total:	*$136,060*						*$136,060*	
SONCC-HunC.10.2.14									
	SONCC-HunC.10.2.14.1							$0	ODOT
	Action Total:							*$0*	
	Population Total:	***$1,366,160***			***$245,400***		***$327,200***	***$1,938,760***	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
Population: Pistol River									
SONCC-PisR.2.2.6									
	SONCC-PisR.2.2.6.1	$34,015						$34,015	USFS
	SONCC-PisR.2.2.6.2	$111,716						$111,716	USFS
	Action Total:	*$145,731*						*$145,731*	
SONCC-PisR.2.2.7									
	SONCC-PisR.2.2.7.1	$34,015						$34,015	ODFW
	SONCC-PisR.2.2.7.2	$10,000						$10,000	ODFW
	Action Total:	*$44,015*						*$44,015*	
SONCC-PisR.7.1.1									
	SONCC-PisR.7.1.1.1	$34,015						$34,015	ODF
	SONCC-PisR.7.1.1.2	$41,900						$41,900	ODF
	SONCC-PisR.7.1.1.3	$914,648						$914,648	ODF
	Action Total:	*$990,563*						*$990,563*	
SONCC-PisR.7.1.2									
	SONCC-PisR.7.1.2.1							$0	County
	SONCC-PisR.7.1.2.2							$0	County
	Action Total:							*$0*	
SONCC-PisR.7.1.3									
	SONCC-PisR.7.1.3.1							$0	ODF
	Action Total:							*$0*	
SONCC-PisR.8.1.4									
	SONCC-PisR.8.1.4.1	$150,000						$150,000	NGO
	SONCC-PisR.8.1.4.2	$1,000,000						$1,000,000	NGO
	SONCC-PisR.8.1.4.3	$500,000						$500,000	NGO
	SONCC-PisR.8.1.4.4	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$600,000	NGO
	Action Total:	*$1,750,000*	*$100,000*	*$100,000*	*$100,000*	*$100,000*	*$100,000*	*$2,250,000*	
SONCC-PisR.3.1.11									
	SONCC-PisR.3.1.11.1							$0	Oregon WRD
	Action Total:							*$0*	
SONCC-PisR.3.1.12									
	SONCC-PisR.3.1.12.1							$0	NGO
	Action Total:							*$0*	
SONCC-PisR.27.2.13									
	SONCC-PisR.27.2.13.1	$81,800						$81,800	ODFW
	SONCC-PisR.27.2.13.2				$40,900			$40,900	ODFW
	Action Total:	*$81,800*			*$40,900*			*$122,700*	
SONCC-PisR.27.1.14									
	SONCC-PisR.27.1.14.1						$122,700	$122,700	ODFW
	Action Total:						*$122,700*	*$122,700*	
SONCC-PisR.27.2.15									
	SONCC-PisR.27.2.15.1	$102,250			$102,250		$102,250	$306,750	ODFW
	Action Total:	*$102,250*			*$102,250*		*$102,250*	*$306,750*	
SONCC-PisR.27.2.16									
	SONCC-PisR.27.2.16.1	$102,250			$102,250		$102,250	$306,750	ODFW
	Action Total:	*$102,250*			*$102,250*		*$102,250*	*$306,750*	
SONCC-PisR.27.1.17									
	SONCC-PisR.27.1.17.1	$8,722						$8,722	NMFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-PisR.27.1.17.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-PisR.27.2.18									
	SONCC-PisR.27.2.18.1	$2,721						$2,721	ODFW
	Action Total:	*$2,721*						*$2,721*	
SONCC-PisR.5.1.10									
	SONCC-PisR.5.1.10.1							$0	USFS
	Action Total:							*$0*	
SONCC-PisR.10.2.8									
	SONCC-PisR.10.2.8.1							$0	Oregon WRD
	Action Total:							*$0*	
SONCC-PisR.10.2.9									
	SONCC-PisR.10.2.9.1	$136,060						$136,060	EPA
	Action Total:	*$136,060*						*$136,060*	
	Population Total:	***$3,372,834***	***$100,000***	***$100,000***	***$345,400***	***$100,000***	***$427,200***	***$4,445,434***	
Population: Chetco River									
SONCC-CheR.1.1.1									
	SONCC-CheR.1.1.1.1	$34,015						$34,015	USFS
	SONCC-CheR.1.1.1.2	$61,363						$61,363	USFS
	SONCC-CheR.1.1.1.3	$446,515						$446,515	USFS
	Action Total:	*$541,893*						*$541,893*	
SONCC-CheR.1.4.7									
	SONCC-CheR.1.4.7.1	$17,077						$17,077	County
	SONCC-CheR.1.4.7.2	$17,077						$17,077	County
	Action Total:	*$34,154*						*$34,154*	
SONCC-CheR.1.3.8									
	SONCC-CheR.1.3.8.1	$44,540						$44,540	ODFW
	SONCC-CheR.1.3.8.2	$20,098						$20,098	ODFW
	Action Total:	*$64,638*						*$64,638*	
SONCC-CheR.1.2.9									
	SONCC-CheR.1.2.9.1	$34,015						$34,015	ODFW
	SONCC-CheR.1.2.9.2	$335,000						$335,000	ODFW
	Action Total:	*$369,015*						*$369,015*	
SONCC-CheR.1.2.10									
	SONCC-CheR.1.2.10.1	$73,540						$73,540	Watershed Cnsl
	SONCC-CheR.1.2.10.2	$17,077						$17,077	Watershed Cnsl
	Action Total:	*$90,617*						*$90,617*	
SONCC-CheR.1.2.31									
	SONCC-CheR.1.2.31.1	$34,015						$34,015	ODFW
	SONCC-CheR.1.2.31.2	$34,015						$34,015	ODFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-CheR.2.2.5									
	SONCC-CheR.2.2.5.1	$34,015						$34,015	USFS
	SONCC-CheR.2.2.5.2	$163,613						$163,613	USFS
	Action Total:	*$197,628*						*$197,628*	
SONCC-CheR.2.1.6									
	SONCC-CheR.2.1.6.1	$34,015						$34,015	USFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-CheR.2.1.6.2	$876,560						$876,560	USFS
	Action Total:	*$910,575*						*$910,575*	
SONCC-CheR.2.2.32									
	SONCC-CheR.2.2.32.1	$34,015						$34,015	ODFW
	SONCC-CheR.2.2.32.2	$10,000						$10,000	ODFW
	Action Total:	*$44,015*						*$44,015*	
SONCC-CheR.3.1.11									
	SONCC-CheR.3.1.11.1	$34,015						$34,015	Oregon WRD
	SONCC-CheR.3.1.11.2	$36,770						$36,770	Oregon WRD
	SONCC-CheR.3.1.11.3	$76,136						$76,136	Oregon WRD
	Action Total:	*$146,921*						*$146,921*	
SONCC-CheR.7.1.2									
	SONCC-CheR.7.1.2.1							$0	USFS
	Action Total:							*$0*	
SONCC-CheR.7.1.3									
	SONCC-CheR.7.1.3.1	$8,503						$8,503	County
	SONCC-CheR.7.1.3.2	$34,015						$34,015	County
	Action Total:	*$42,518*						*$42,518*	
SONCC-CheR.7.1.4									
	SONCC-CheR.7.1.4.1	$5,254						$5,254	ODF
	Action Total:	*$5,254*						*$5,254*	
SONCC-CheR.7.1.33									
	SONCC-CheR.7.1.33.1	$34,015						$34,015	BLM
	Action Total:	*$34,015*						*$34,015*	
SONCC-CheR.10.2.15									
	SONCC-CheR.10.2.15.1							$0	Oregon WRD
	Action Total:							*$0*	
SONCC-CheR.10.2.16									
	SONCC-CheR.10.2.16.1	$136,060						$136,060	EPA
	Action Total:	*$136,060*						*$136,060*	
SONCC-CheR.16.1.17									
	SONCC-CheR.16.1.17.1	$1,744						$1,744	NMFS
	SONCC-CheR.16.1.17.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-CheR.16.1.18									
	SONCC-CheR.16.1.18.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-CheR.16.1.18.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-CheR.16.2.19									
	SONCC-CheR.16.2.19.1	$1,744						$1,744	NMFS
	SONCC-CheR.16.2.19.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-CheR.16.2.20									
	SONCC-CheR.16.2.20.1	$1,744						$1,744	NMFS
	SONCC-CheR.16.2.20.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-CheR.27.1.21									
	SONCC-CheR.27.1.21.1	$204,500	$204,500	$204,500	$204,500	$204,500	$204,500	$1,227,000	ODFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$1,227,000*	
SONCC-CheR.27.1.22									
	SONCC-CheR.27.1.22.1	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$6,120,000	ODFW
	Action Total:	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$6,120,000*	
SONCC-CheR.27.1.23									
	SONCC-CheR.27.1.23.1						$85,037	$85,037	ODFW
	Action Total:						*$85,037*	*$85,037*	
SONCC-CheR.27.1.24									
	SONCC-CheR.27.1.24.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	ODFW
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-CheR.27.2.25									
	SONCC-CheR.27.2.25.1	$81,800						$81,800	ODFW
	SONCC-CheR.27.2.25.2			$40,900		$40,900		$81,800	ODFW
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-CheR.27.2.26									
	SONCC-CheR.27.2.26.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-CheR.27.2.27									
	SONCC-CheR.27.2.27.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-CheR.27.2.28									
	SONCC-CheR.27.2.28.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-CheR.27.2.29									
	SONCC-CheR.27.2.29.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-CheR.27.2.30									
	SONCC-CheR.27.2.30.1	$68,030		$68,030		$68,030	$68,030	$272,120	ODFW
	Action Total:	*$68,030*		*$68,030*		*$68,030*	*$68,030*	*$272,120*	
SONCC-CheR.27.2.34									
	SONCC-CheR.27.2.34.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-CheR.27.2.35									
	SONCC-CheR.27.2.35.1	$68,030		$68,030		$68,030	$68,030	$272,120	ODFW
	Action Total:	*$68,030*		*$68,030*		*$68,030*	*$68,030*	*$272,120*	
SONCC-CheR.27.1.38									
	SONCC-CheR.27.1.38.1	$8,722						$8,722	NMFS
	SONCC-CheR.27.1.38.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-CheR.27.1.39									
	SONCC-CheR.27.1.39.1	$34,015						$34,015	ODFW
	Action Total:	*$34,015*						*$34,015*	
SONCC-CheR.27.2.40									
	SONCC-CheR.27.2.40.1	$2,721						$2,721	ODFW
	Action Total:	*$2,721*						*$2,721*	
SONCC-CheR.5.1.12									
	SONCC-CheR.5.1.12.1	$34,015						$34,015	County
	SONCC-CheR.5.1.12.2	$654,068						$654,068	County
	Action Total:	*$688,083*						*$688,083*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-CheR.5.1.37									
	SONCC-CheR.5.1.37.1	$34,015						$34,015	BLM
	SONCC-CheR.5.1.37.2	$654,068						$654,068	BLM
	Action Total:	*$688,083*						*$688,083*	
SONCC-CheR.7.1.36									
	SONCC-CheR.7.1.36.1	$34,015						$34,015	Private
	SONCC-CheR.7.1.36.2	$30,818						$30,818	Private
	SONCC-CheR.7.1.36.3	$223,263						$223,263	Private
	Action Total:	*$288,096*						*$288,096*	
SONCC-CheR.8.1.13									
	SONCC-CheR.8.1.13.1							$0	USFS
	SONCC-CheR.8.1.13.2							$0	USFS
	SONCC-CheR.8.1.13.3							$0	USFS
	SONCC-CheR.8.1.13.4							$0	USFS
	Action Total:							*$0*	
	Population Total:	***$6,380,057***	***$1,338,958***	***$1,924,918***	***$1,338,958***	***$1,924,918***	***$1,969,055***	***$14,876,864***	

Population: Winchuck River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-WinR.2.2.5									
	SONCC-WinR.2.2.5.1	$34,015						$34,015	USFS
	SONCC-WinR.2.2.5.2	$139,071						$139,071	USFS
	Action Total:	*$173,086*						*$173,086*	
SONCC-WinR.2.2.6									
	SONCC-WinR.2.2.6.1	$34,015						$34,015	ODFW
	SONCC-WinR.2.2.6.2	$10,000						$10,000	ODFW
	Action Total:	*$44,015*						*$44,015*	
SONCC-WinR.2.1.7									
	SONCC-WinR.2.1.7.1	$34,015						$34,015	USFS
	SONCC-WinR.2.1.7.2	$745,076						$745,076	USFS
	Action Total:	*$779,091*						*$779,091*	
SONCC-WinR.2.1.31									
	SONCC-WinR.2.1.31.1	$34,015						$34,015	ODFW
	SONCC-WinR.2.1.31.2	$750,555						$750,555	ODFW
	Action Total:	*$784,570*						*$784,570*	
SONCC-WinR.10.2.15									
	SONCC-WinR.10.2.15.1							$0	Oregon WRD
	Action Total:							*$0*	
SONCC-WinR.10.2.16									
	SONCC-WinR.10.2.16.1	$136,060						$136,060	EPA
	Action Total:	*$136,060*						*$136,060*	
SONCC-WinR.1.2.30									
	SONCC-WinR.1.2.30.1	$34,015						$34,015	ODFW
	SONCC-WinR.1.2.30.2	$34,015						$34,015	ODFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-WinR.16.1.17									
	SONCC-WinR.16.1.17.1	$1,744						$1,744	NMFS
	SONCC-WinR.16.1.17.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-WinR.16.1.18									
	SONCC-WinR.16.1.18.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-WinR.16.1.18.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-WinR.16.2.19									
	SONCC-WinR.16.2.19.1	$1,744						$1,744	NMFS
	SONCC-WinR.16.2.19.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-WinR.16.2.20									
	SONCC-WinR.16.2.20.1	$1,744						$1,744	NMFS
	SONCC-WinR.16.2.20.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-WinR.3.1.8									
	SONCC-WinR.3.1.8.1	$34,015						$34,015	Oregon WRD
	SONCC-WinR.3.1.8.2	$26,136						$26,136	Oregon WRD
	SONCC-WinR.3.1.8.3	$17,045	$17,045	$17,045	$17,045	$17,045	$17,045	$102,270	Oregon WRD
	SONCC-WinR.3.1.8.4	$36,770						$36,770	Oregon WRD
	Action Total:	*$113,966*	*$17,045*	*$17,045*	*$17,045*	*$17,045*	*$17,045*	*$199,191*	
SONCC-WinR.3.1.9									
	SONCC-WinR.3.1.9.1	$76,136						$76,136	Oregon WRD
	Action Total:	*$76,136*						*$76,136*	
SONCC-WinR.3.1.10									
	SONCC-WinR.3.1.10.1							$0	Oregon WRD
	Action Total:							*$0*	
SONCC-WinR.27.1.21									
	SONCC-WinR.27.1.21.1						$204,500	$204,500	ODFW
	Action Total:						*$204,500*	*$204,500*	
SONCC-WinR.27.1.22									
	SONCC-WinR.27.1.22.1	$122,700	$122,700	$122,700	$122,700	$122,700	$122,700	$736,200	ODFW
	Action Total:	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$736,200*	
SONCC-WinR.27.1.23									
	SONCC-WinR.27.1.23.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	ODFW
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-WinR.27.2.24									
	SONCC-WinR.27.2.24.1	$81,800						$81,800	ODFW
	SONCC-WinR.27.2.24.2			$40,900		$40,900		$81,800	ODFW
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-WinR.27.2.25									
	SONCC-WinR.27.2.25.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-WinR.27.2.26									
	SONCC-WinR.27.2.26.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-WinR.27.2.27									
	SONCC-WinR.27.2.27.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-WinR.27.2.28									
	SONCC-WinR.27.2.28.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-WinR.27.2.29									
	SONCC-WinR.27.2.29.1	$68,030		$68,030		$68,030	$68,030	$272,120	ODFW
	Action Total:	*$68,030*		*$68,030*		*$68,030*	*$68,030*	*$272,120*	
SONCC-WinR.27.1.33									
	SONCC-WinR.27.1.33.1						$85,037	$85,037	ODFW
	Action Total:						*$85,037*	*$85,037*	
SONCC-WinR.27.2.34									
	SONCC-WinR.27.2.34.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-WinR.27.1.35									
	SONCC-WinR.27.1.35.1	$8,722						$8,722	NMFS
	SONCC-WinR.27.1.35.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-WinR.27.1.36									
	SONCC-WinR.27.1.36.1	$68,030						$68,030	ODFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-WinR.5.1.11									
	SONCC-WinR.5.1.11.1	$44,540						$44,540	ODFW
	SONCC-WinR.5.1.11.2	$79,545						$79,545	ODFW
	Action Total:	*$124,085*						*$124,085*	
SONCC-WinR.5.1.12									
	SONCC-WinR.5.1.12.1							$0	Watershed Cnsl
	SONCC-WinR.5.1.12.2							$0	Watershed Cnsl
	Action Total:							*$0*	
SONCC-WinR.7.1.1									
	SONCC-WinR.7.1.1.1	$8,503						$8,503	County
	SONCC-WinR.7.1.1.2	$34,015						$34,015	County
	Action Total:	*$42,518*						*$42,518*	
SONCC-WinR.7.1.2									
	SONCC-WinR.7.1.2.1	$5,254						$5,254	ODF
	Action Total:	*$5,254*						*$5,254*	
SONCC-WinR.7.1.3									
	SONCC-WinR.7.1.3.1	$34,015						$34,015	USFS
	SONCC-WinR.7.1.3.2	$52,414						$52,414	USFS
	SONCC-WinR.7.1.3.3	$376,747						$376,747	USFS
	Action Total:	*$463,177*						*$463,177*	
SONCC-WinR.7.1.4									
	SONCC-WinR.7.1.4.1							$0	FSA
	SONCC-WinR.7.1.4.2							$0	FSA
	SONCC-WinR.7.1.4.3							$0	FSA
	SONCC-WinR.7.1.4.4							$0	FSA
	SONCC-WinR.7.1.4.5							$0	FSA
	Action Total:							*$0*	
SONCC-WinR.7.1.32									
	SONCC-WinR.7.1.32.1	$34,015						$34,015	BLM
	Action Total:	*$34,015*						*$34,015*	
SONCC-WinR.8.1.13									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-WinR.8.1.13.1							$0	USFS
	SONCC-WinR.8.1.13.2							$0	USFS
	SONCC-WinR.8.1.13.3							$0	USFS
	SONCC-WinR.8.1.13.4							$0	USFS
	Action Total:							*$0*	
	Population Total:	***$3,735,928***	***$254,203***	***$772,133***	***$254,203***	***$772,133***	***$1,020,770***	***$6,809,370***	
Population: Smith River									
SONCC-SmiR.1.3.12									
	SONCC-SmiR.1.3.12.1	$36,770						$36,770	CDFG
	SONCC-SmiR.1.3.12.2	$600,000						$600,000	CDFG
	Action Total:	*$636,770*						*$636,770*	
SONCC-SmiR.1.2.13									
	SONCC-SmiR.1.2.13.1							$0	NRCS/RCD
	SONCC-SmiR.1.2.13.2							$0	NRCS/RCD
	Action Total:							*$0*	
SONCC-SmiR.1.2.32									
	SONCC-SmiR.1.2.32.1	$34,015						$34,015	CDFG
	SONCC-SmiR.1.2.32.2	$34,015						$34,015	CDFG
	Action Total:	*$68,030*						*$68,030*	
SONCC-SmiR.2.1.1									
	SONCC-SmiR.2.1.1.1	$34,015						$34,015	CDFG
	SONCC-SmiR.2.1.1.2	$10,957,000						$10,957,000	CDFG
	Action Total:	*$10,991,015*						*$10,991,015*	
SONCC-SmiR.2.2.2									
	SONCC-SmiR.2.2.2.1	$34,015						$34,015	CDFG
	SONCC-SmiR.2.2.2.2	$290,700						$290,700	CDFG
	Action Total:	*$324,715*						*$324,715*	
SONCC-SmiR.2.2.3									
	SONCC-SmiR.2.2.3.1	$34,015						$34,015	CDFG
	SONCC-SmiR.2.2.3.2	$2,045,160						$2,045,160	CDFG
	Action Total:	*$2,079,175*						*$2,079,175*	
SONCC-SmiR.2.2.4									
	SONCC-SmiR.2.2.4.1	$34,015						$34,015	CDFG
	SONCC-SmiR.2.2.4.2	$40,000						$40,000	CDFG
	Action Total:	*$74,015*						*$74,015*	
SONCC-SmiR.2.2.5									
	SONCC-SmiR.2.2.5.1	$89,080						$89,080	CDFG
	SONCC-SmiR.2.2.5.2	$133,647						$133,647	CDFG
	Action Total:	*$222,727*						*$222,727*	
SONCC-SmiR.10.2.9									
	SONCC-SmiR.10.2.9.1	$34,015						$34,015	NGO
	SONCC-SmiR.10.2.9.2	$34,015						$34,015	NGO
	Action Total:	*$68,030*						*$68,030*	
SONCC-SmiR.10.2.10									
	SONCC-SmiR.10.2.10.1	$76,136						$76,136	NGO
	Action Total:	*$76,136*						*$76,136*	
SONCC-SmiR.10.2.11									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-SmiR.10.2.11.1							$0	CWQCB
	SONCC-SmiR.10.2.11.2							$0	CWQCB
	Action Total:							*$0*	
SONCC-SmiR.16.1.21									
	SONCC-SmiR.16.1.21.1	$1,744						$1,744	NMFS
	SONCC-SmiR.16.1.21.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-SmiR.16.1.22									
	SONCC-SmiR.16.1.22.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-SmiR.16.1.22.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-SmiR.16.2.23									
	SONCC-SmiR.16.2.23.1	$1,744						$1,744	NMFS
	SONCC-SmiR.16.2.23.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-SmiR.16.2.24									
	SONCC-SmiR.16.2.24.1	$1,744						$1,744	NMFS
	SONCC-SmiR.16.2.24.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-SmiR.17.2.20									
	SONCC-SmiR.17.2.20.1							$0	CDFG
	SONCC-SmiR.17.2.20.2							$0	CDFG
	Action Total:							*$0*	
SONCC-SmiR.3.1.17									
	SONCC-SmiR.3.1.17.1							$0	CWQCB
	SONCC-SmiR.3.1.17.2							$0	CWQCB
	Action Total:							*$0*	
SONCC-SmiR.3.1.18									
	SONCC-SmiR.3.1.18.1							$0	CDFG
	SONCC-SmiR.3.1.18.2							$0	CDFG
	Action Total:							*$0*	
SONCC-SmiR.3.1.19									
	SONCC-SmiR.3.1.19.1	$34,015						$34,015	CDFG
	SONCC-SmiR.3.1.19.2	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$180,000	CDFG
	Action Total:	*$64,015*	*$30,000*	*$30,000*	*$30,000*	*$30,000*	*$30,000*	*$214,015*	
SONCC-SmiR.27.1.25									
	SONCC-SmiR.27.1.25.1						$204,500	$204,500	CDFG
	Action Total:						*$204,500*	*$204,500*	
SONCC-SmiR.27.1.26									
	SONCC-SmiR.27.1.26.1	$122,700	$122,700	$122,700	$122,700	$122,700	$122,700	$736,200	CDFG
	Action Total:	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$736,200*	
SONCC-SmiR.27.1.27									
	SONCC-SmiR.27.1.27.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-SmiR.27.2.28									
	SONCC-SmiR.27.2.28.1	$81,800						$81,800	CDFG
	SONCC-SmiR.27.2.28.2			$40,900		$40,900		$81,800	CDFG
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-SmiR.27.2.29									
	SONCC-SmiR.27.2.29.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-SmiR.27.2.30									
	SONCC-SmiR.27.2.30.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-SmiR.27.2.31									
	SONCC-SmiR.27.2.31.1	$68,030		$68,030		$68,030	$68,030	$272,120	CDFG
	Action Total:	*$68,030*		*$68,030*		*$68,030*	*$68,030*	*$272,120*	
SONCC-SmiR.27.1.33									
	SONCC-SmiR.27.1.33.1						$85,037	$85,037	CDFG
	Action Total:						*$85,037*	*$85,037*	
SONCC-SmiR.27.2.34									
	SONCC-SmiR.27.2.34.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-SmiR.27.1.35									
	SONCC-SmiR.27.1.35.1	$8,722						$8,722	NMFS
	SONCC-SmiR.27.1.35.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-SmiR.27.2.36									
	SONCC-SmiR.27.2.36.1	$2,721						$2,721	CDFG
	Action Total:	*$2,721*						*$2,721*	
SONCC-SmiR.5.1.14									
	SONCC-SmiR.5.1.14.1	$44,540						$44,540	USFS
	SONCC-SmiR.5.1.14.2	$959,299						$959,299	USFS
	Action Total:	*$1,003,839*						*$1,003,839*	
SONCC-SmiR.7.1.6									
	SONCC-SmiR.7.1.6.1	$34,015						$34,015	USFS
	SONCC-SmiR.7.1.6.2	$767,040						$767,040	USFS
	SONCC-SmiR.7.1.6.3	$5,581,440						$5,581,440	USFS
	Action Total:	*$6,382,495*						*$6,382,495*	
SONCC-SmiR.7.1.7									
	SONCC-SmiR.7.1.7.1	$34,015						$34,015	NRCS/RCD
	SONCC-SmiR.7.1.7.2	$34,015						$34,015	NRCS/RCD
	SONCC-SmiR.7.1.7.3	$1,926,940						$1,926,940	NRCS/RCD
	SONCC-SmiR.7.1.7.4	$65,137						$65,137	NRCS/RCD
	SONCC-SmiR.7.1.7.5	$2,428						$2,428	NRCS/RCD
	Action Total:	*$2,062,535*						*$2,062,535*	
SONCC-SmiR.7.1.8									
	SONCC-SmiR.7.1.8.1	$100,000						$100,000	CDFG
	Action Total:	*$100,000*						*$100,000*	
SONCC-SmiR.8.1.15									
	SONCC-SmiR.8.1.15.1	$2,085,288						$2,085,288	USFS
	SONCC-SmiR.8.1.15.2	$98,875,740						$98,875,740	USFS
	SONCC-SmiR.8.1.15.3	$20,218,908						$20,218,908	USFS
	SONCC-SmiR.8.1.15.4	$3,640,836	$3,640,836	$3,640,836	$3,640,836	$3,640,836	$3,640,836	$21,845,016	USFS
	Action Total:	*$124,820,772*	*$3,640,836*	*$3,640,836*	*$3,640,836*	*$3,640,836*	*$3,640,836*	*$143,024,952*	
SONCC-SmiR.8.1.16									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-SmiR.8.1.16.1							$0	USFS
	SONCC-SmiR.8.1.16.2							$0	USFS
	Action Total:							*$0*	
	Population Total:	***$149,596,386***	***$3,805,744***	***$4,221,424***	***$3,805,744***	***$4,221,424***	***$4,470,061***	***$170,120,783***	

Population: Elk Creek

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-ElkC.7.1.14									
	SONCC-ElkC.7.1.14.1							$0	NRCS/RCD
	SONCC-ElkC.7.1.14.2							$0	NRCS/RCD
	SONCC-ElkC.7.1.14.3							$0	NRCS/RCD
	SONCC-ElkC.7.1.14.4							$0	NRCS/RCD
	SONCC-ElkC.7.1.14.5							$0	NRCS/RCD
	Action Total:							*$0*	
SONCC-ElkC.7.1.15									
	SONCC-ElkC.7.1.15.1							$0	City
	Action Total:							*$0*	
SONCC-ElkC.7.1.16									
	SONCC-ElkC.7.1.16.1							$0	City
	SONCC-ElkC.7.1.16.2							$0	City
	Action Total:							*$0*	
SONCC-ElkC.7.1.17									
	SONCC-ElkC.7.1.17.1							$0	County
	SONCC-ElkC.7.1.17.2							$0	County
	Action Total:							*$0*	
SONCC-ElkC.1.2.10									
	SONCC-ElkC.1.2.10.1							$0	CDFG
	SONCC-ElkC.1.2.10.2							$0	CDFG
	Action Total:							*$0*	
SONCC-ElkC.2.1.1									
	SONCC-ElkC.2.1.1.1							$0	CDFG
	SONCC-ElkC.2.1.1.2							$0	CDFG
	SONCC-ElkC.2.1.1.3							$0	CDFG
	Action Total:							*$0*	
SONCC-ElkC.2.2.2									
	SONCC-ElkC.2.2.2.1	$34,015						$34,015	CDFG
	SONCC-ElkC.2.2.2.2	$10,000						$10,000	CDFG
	Action Total:	*$44,015*						*$44,015*	
SONCC-ElkC.2.2.3									
	SONCC-ElkC.2.2.3.1							$0	CDFG
	SONCC-ElkC.2.2.3.2							$0	CDFG
	Action Total:							*$0*	
SONCC-ElkC.3.1.4									
	SONCC-ElkC.3.1.4.1							$0	CDFG
	SONCC-ElkC.3.1.4.2							$0	CDFG
	Action Total:							*$0*	
SONCC-ElkC.3.1.5									
	SONCC-ElkC.3.1.5.1							$0	NGO
	Action Total:							*$0*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-ElkC.3.1.6									
	SONCC-ElkC.3.1.6.1							$0	CDFG
	Action Total:							*$0*	
SONCC-ElkC.3.1.7									
	SONCC-ElkC.3.1.7.1	$6,128						$6,128	DWR
	Action Total:	*$6,128*						*$6,128*	
SONCC-ElkC.3.1.8									
	SONCC-ElkC.3.1.8.1							$0	CWQCB
	Action Total:							*$0*	
SONCC-ElkC.3.2.9									
	SONCC-ElkC.3.2.9.1							$0	County
	SONCC-ElkC.3.2.9.2							$0	County
	Action Total:							*$0*	
SONCC-ElkC.27.2.22									
	SONCC-ElkC.27.2.22.1	$81,800						$81,800	CDFG
	SONCC-ElkC.27.2.22.2				$40,900			$40,900	CDFG
	Action Total:	*$81,800*			*$40,900*			*$122,700*	
SONCC-ElkC.27.1.23									
	SONCC-ElkC.27.1.23.1						$122,700	$122,700	CDFG
	Action Total:						*$122,700*	*$122,700*	
SONCC-ElkC.27.2.24									
	SONCC-ElkC.27.2.24.1	$102,250			$102,250		$102,250	$306,750	CDFG
	Action Total:	*$102,250*			*$102,250*		*$102,250*	*$306,750*	
SONCC-ElkC.27.1.25									
	SONCC-ElkC.27.1.25.1	$8,722						$8,722	NMFS
	SONCC-ElkC.27.1.25.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-ElkC.27.2.26									
	SONCC-ElkC.27.2.26.1	$2,721						$2,721	CDFG
	Action Total:	*$2,721*						*$2,721*	
SONCC-ElkC.5.1.20									
	SONCC-ElkC.5.1.20.1							$0	County
	SONCC-ElkC.5.1.20.2							$0	County
	Action Total:							*$0*	
SONCC-ElkC.5.1.21									
	SONCC-ElkC.5.1.21.1							$0	County
	Action Total:							*$0*	
SONCC-ElkC.8.1.11									
	SONCC-ElkC.8.1.11.1							$0	CDFG
	Action Total:							*$0*	
SONCC-ElkC.8.1.12									
	SONCC-ElkC.8.1.12.1							$0	County
	SONCC-ElkC.8.1.12.2							$0	County
	SONCC-ElkC.8.1.12.3							$0	County
	SONCC-ElkC.8.1.12.4							$0	County
	Action Total:							*$0*	
SONCC-ElkC.10.2.18									
	SONCC-ElkC.10.2.18.1							$0	CWQCB

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-ElkC.10.2.18.2							$0	CWQCB
	Action Total:							*$0*	
SONCC-ElkC.10.2.19									
	SONCC-ElkC.10.2.19.1							$0	CWQCB
	Action Total:							*$0*	
	Population Total:	***$254,358***			***$143,150***		***$224,950***	***$622,458***	
Population: Wilson Creek									
SONCC-WilC.2.1.1									
	SONCC-WilC.2.1.1.1	$34,015						$34,015	NGO
	SONCC-WilC.2.1.1.2	$873,820						$873,820	NGO
	Action Total:	*$907,835*						*$907,835*	
SONCC-WilC.2.2.10									
	SONCC-WilC.2.2.10.1	$34,015						$34,015	CDFG
	SONCC-WilC.2.2.10.2	$10,000						$10,000	CDFG
	Action Total:	*$44,015*						*$44,015*	
SONCC-WilC.2.2.11									
	SONCC-WilC.2.2.11.1	$34,015						$34,015	NGO
	SONCC-WilC.2.2.11.2	$163,101						$163,101	NGO
	Action Total:	*$197,116*						*$197,116*	
SONCC-WilC.7.1.2									
	SONCC-WilC.7.1.2.1							$0	Private
	SONCC-WilC.7.1.2.2							$0	Private
	SONCC-WilC.7.1.2.3							$0	Private
	Action Total:							*$0*	
SONCC-WilC.7.1.3									
	SONCC-WilC.7.1.3.1							$0	Private
	Action Total:							*$0*	
SONCC-WilC.27.2.8									
	SONCC-WilC.27.2.8.1	$81,800						$81,800	CDFG
	SONCC-WilC.27.2.8.2				$40,900			$40,900	CDFG
	Action Total:	*$81,800*			*$40,900*			*$122,700*	
SONCC-WilC.27.1.9									
	SONCC-WilC.27.1.9.1							$0	CSP
	SONCC-WilC.27.1.9.2							$0	Private
	Action Total:							*$0*	
SONCC-WilC.27.1.12									
	SONCC-WilC.27.1.12.1						$122,700	$122,700	CDFG
	Action Total:						*$122,700*	*$122,700*	
SONCC-WilC.27.1.13									
	SONCC-WilC.27.1.13.1	$8,722						$8,722	NMFS
	SONCC-WilC.27.1.13.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-WilC.27.2.14									
	SONCC-WilC.27.2.14.1	$2,721						$2,721	ODFW
	Action Total:	*$2,721*						*$2,721*	
SONCC-WilC.5.1.4									
	SONCC-WilC.5.1.4.1							$0	CDFG

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-WilC.5.1.4.2							$0	CDFG
	Action Total:							*$0*	
SONCC-WilC.5.1.5									
	SONCC-WilC.5.1.5.1							$0	Private
	Action Total:							*$0*	
SONCC-WilC.8.1.6									
	SONCC-WilC.8.1.6.1							$0	Private
	SONCC-WilC.8.1.6.2							$0	Private
	Action Total:							*$0*	
SONCC-WilC.8.1.7									
	SONCC-WilC.8.1.7.1	$4,198,113						$4,198,113	CDFG
	Action Total:	*$4,198,113*						*$4,198,113*	
	Population Total:	***$5,449,044***			***$40,900***		***$122,700***	***$5,612,644***	

Population: Lower Klamath River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-LKR.2.1.1									
	SONCC-LKR.2.1.1.1	$34,015						$34,015	BIA/Tribe
	SONCC-LKR.2.1.1.2	$4,930,650						$4,930,650	BIA/Tribe
	Action Total:	*$4,964,665*						*$4,964,665*	
SONCC-LKR.2.2.2									
	SONCC-LKR.2.2.2.1	$34,015						$34,015	BIA/Tribe
	SONCC-LKR.2.2.2.2	$920,322						$920,322	BIA/Tribe
	Action Total:	*$954,337*						*$954,337*	
SONCC-LKR.2.2.3									
	SONCC-LKR.2.2.3.1	$80,000						$80,000	BIA/Tribe
	Action Total:	*$80,000*						*$80,000*	
SONCC-LKR.2.2.4									
	SONCC-LKR.2.2.4.1	$34,015						$34,015	BIA/Tribe
	SONCC-LKR.2.2.4.2	$406,980						$406,980	BIA/Tribe
	SONCC-LKR.2.2.4.3	$235,224						$235,224	BIA/Tribe
	Action Total:	*$676,219*						*$676,219*	
SONCC-LKR.2.2.6									
	SONCC-LKR.2.2.6.1	$34,015						$34,015	CDFG
	SONCC-LKR.2.2.6.2	$10,000						$10,000	CDFG
	Action Total:	*$44,015*						*$44,015*	
SONCC-LKR.2.2.7									
	SONCC-LKR.2.2.7.1							$0	CDFG
	Action Total:							*$0*	
SONCC-LKR.2.2.8									
	SONCC-LKR.2.2.8.1	$89,080						$89,080	BIA/Tribe
	SONCC-LKR.2.2.8.2	$636,029						$636,029	BIA/Tribe
	Action Total:	*$725,109*						*$725,109*	
SONCC-LKR.8.1.9									
	SONCC-LKR.8.1.9.1	$253,816						$253,816	BIA/Tribe
	Action Total:	*$253,816*						*$253,816*	
SONCC-LKR.8.1.10									
	SONCC-LKR.8.1.10.1	$73,540						$73,540	BIA/Tribe
	SONCC-LKR.8.1.10.2	$20,033,709						$20,033,709	BIA/Tribe
	Action Total:	*$20,107,249*						*$20,107,249*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-LKR.8.1.11									
	SONCC-LKR.8.1.11.1	$2,558,294						$2,558,294	BIA/Tribe
	SONCC-LKR.8.1.11.2	$71,049,702						$71,049,702	BIA/Tribe
	SONCC-LKR.8.1.11.3	$7,179,756						$7,179,756	BIA/Tribe
	SONCC-LKR.8.1.11.4	$2,353,165	$2,353,165	$2,353,165	$2,353,165	$2,353,165	$2,353,165	$14,118,990	BIA/Tribe
	Action Total:	*$83,140,917*	*$2,353,165*	*$2,353,165*	*$2,353,165*	*$2,353,165*	*$2,353,165*	*$94,906,742*	
SONCC-LKR.8.1.12									
	SONCC-LKR.8.1.12.1	$2,267						$2,267	County
	Action Total:	*$2,267*						*$2,267*	
SONCC-LKR.8.1.13									
	SONCC-LKR.8.1.13.1	$34,015						$34,015	NRCS/RCD
	SONCC-LKR.8.1.13.2	$542,440						$542,440	NRCS/RCD
	Action Total:	*$576,455*						*$576,455*	
SONCC-LKR.1.2.39									
	SONCC-LKR.1.2.39.1	$34,015						$34,015	CDFG
	SONCC-LKR.1.2.39.2	$34,015						$34,015	CDFG
	Action Total:	*$68,030*						*$68,030*	
SONCC-LKR.16.1.25									
	SONCC-LKR.16.1.25.1	$1,744						$1,744	NMFS
	SONCC-LKR.16.1.25.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-LKR.16.1.26									
	SONCC-LKR.16.1.26.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-LKR.16.1.26.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-LKR.16.2.27									
	SONCC-LKR.16.2.27.1	$1,744						$1,744	NMFS
	SONCC-LKR.16.2.27.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-LKR.16.2.28									
	SONCC-LKR.16.2.28.1	$1,744						$1,744	NMFS
	SONCC-LKR.16.2.28.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-LKR.3.1.19									
	SONCC-LKR.3.1.19.1	$36,770						$36,770	CDFG
	SONCC-LKR.3.1.19.2	$34,015						$34,015	CWQCB
	Action Total:	*$70,785*						*$70,785*	
SONCC-LKR.3.1.20									
	SONCC-LKR.3.1.20.1	$76,136						$76,136	NGO
	Action Total:	*$76,136*						*$76,136*	
SONCC-LKR.3.1.21									
	SONCC-LKR.3.1.21.1	$34,015						$34,015	CDFG
	Action Total:	*$34,015*						*$34,015*	
SONCC-LKR.3.1.22									
	SONCC-LKR.3.1.22.1	$6,128						$6,128	DWR
	Action Total:	*$6,128*						*$6,128*	
SONCC-LKR.3.1.23									
	SONCC-LKR.3.1.23.1	$5,218						$5,218	CWQCB

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$5,218*						*$5,218*	
SONCC-LKR.27.1.29									
	SONCC-LKR.27.1.29.1	$204,500	$204,500	$204,500	$204,500	$204,500	$204,500	$1,227,000	CDFG
	Action Total:	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$1,227,000*	
SONCC-LKR.27.1.30									
	SONCC-LKR.27.1.30.1	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$6,120,000	CDFG
	Action Total:	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$6,120,000*	
SONCC-LKR.27.1.31									
	SONCC-LKR.27.1.31.1						$85,037	$85,037	CDFG
	Action Total:						*$85,037*	*$85,037*	
SONCC-LKR.27.1.32									
	SONCC-LKR.27.1.32.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG
	SONCC-LKR.27.1.32.2	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG
	Action Total:	*$17,440*	*$17,440*	*$17,440*	*$17,440*	*$17,440*	*$17,440*	*$104,640*	
SONCC-LKR.27.2.33									
	SONCC-LKR.27.2.33.1	$81,800						$81,800	CDFG
	SONCC-LKR.27.2.33.2			$40,900		$40,900		$81,800	CDFG
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-LKR.27.2.34									
	SONCC-LKR.27.2.34.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-LKR.27.2.35									
	SONCC-LKR.27.2.35.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-LKR.27.2.36									
	SONCC-LKR.27.2.36.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-LKR.27.2.37									
	SONCC-LKR.27.2.37.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFG
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-LKR.27.2.38									
	SONCC-LKR.27.2.38.1	$68,030		$68,030		$68,030	$68,030	$272,120	CDFG
	Action Total:	*$68,030*		*$68,030*		*$68,030*	*$68,030*	*$272,120*	
SONCC-LKR.27.2.41									
	SONCC-LKR.27.2.41.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-LKR.27.1.42									
	SONCC-LKR.27.1.42.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFG
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-LKR.27.1.43									
	SONCC-LKR.27.1.43.1	$8,722						$8,722	NMFS
	SONCC-LKR.27.1.43.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-LKR.27.2.44									
	SONCC-LKR.27.2.44.1	$2,721						$2,721	CDFG
	Action Total:	*$2,721*						*$2,721*	
SONCC-LKR.5.1.40									
	SONCC-LKR.5.1.40.1	$34,015						$34,015	CDFG
	SONCC-LKR.5.1.40.2	$318,180						$318,180	CDFG

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$352,195*						*$352,195*	
SONCC-LKR.7.1.14									
	SONCC-LKR.7.1.14.1	$34,015						$34,015	BIA/Tribe
	SONCC-LKR.7.1.14.2	$347,086						$347,086	BIA/Tribe
	SONCC-LKR.7.1.14.3	$2,525,602						$2,525,602	BIA/Tribe
	Action Total:	*$2,906,702*						*$2,906,702*	
SONCC-LKR.7.1.15									
	SONCC-LKR.7.1.15.1	$34,015						$34,015	NRCS/RCD
	SONCC-LKR.7.1.15.2	$34,015						$34,015	NRCS/RCD
	SONCC-LKR.7.1.15.3	$873,300						$873,300	NRCS/RCD
	SONCC-LKR.7.1.15.4	$29,531						$29,531	NRCS/RCD
	SONCC-LKR.7.1.15.5	$1,214						$1,214	NRCS/RCD
	Action Total:	*$972,075*						*$972,075*	
SONCC-LKR.7.1.16									
	SONCC-LKR.7.1.16.1	$34,015						$34,015	BIA/Tribe
	Action Total:	*$34,015*						*$34,015*	
SONCC-LKR.7.1.17									
	SONCC-LKR.7.1.17.1							$0	BIA/Tribe
	SONCC-LKR.7.1.17.2							$0	BIA/Tribe
	SONCC-LKR.7.1.17.3							$0	BIA/Tribe
	Action Total:							*$0*	
SONCC-LKR.7.1.18									
	SONCC-LKR.7.1.18.1	$5,669						$5,669	CDF
	Action Total:	*$5,669*						*$5,669*	
	Population Total:	***$118,095,404***	***$3,803,093***	***$4,321,023***	***$3,803,093***	***$4,321,023***	***$4,365,160***	***$138,708,796***	
Population: Redwood Creek									
SONCC-RedC.1.2.5									
	SONCC-RedC.1.2.5.1	$1,000,000						$1,000,000	County
	SONCC-RedC.1.2.5.2	$89,080						$89,080	County
	SONCC-RedC.1.2.5.3	$468,653						$468,653	County
	Action Total:	*$1,557,733*						*$1,557,733*	
SONCC-RedC.1.2.32									
	SONCC-RedC.1.2.32.1	$34,015						$34,015	CDFG
	SONCC-RedC.1.2.32.2	$34,015						$34,015	CDFG
	Action Total:	*$68,030*						*$68,030*	
SONCC-RedC.2.2.1									
	SONCC-RedC.2.2.1.1	$89,080						$89,080	County
	SONCC-RedC.2.2.1.2	$669,504						$669,504	County
	Action Total:	*$758,584*						*$758,584*	
SONCC-RedC.2.2.2									
	SONCC-RedC.2.2.2.1	$1,972,260						$1,972,260	County
	SONCC-RedC.2.2.2.2	$5,023,296						$5,023,296	County
	Action Total:	*$6,995,556*						*$6,995,556*	
SONCC-RedC.2.1.3									
	SONCC-RedC.2.1.3.1	$36,770						$36,770	USACE
	Action Total:	*$36,770*						*$36,770*	
SONCC-RedC.2.1.4									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-RedC.2.1.4.1	$34,015						$34,015	NPS
	SONCC-RedC.2.1.4.2	$4,821,080						$4,821,080	NPS
	Action Total:	*$4,855,095*						*$4,855,095*	
SONCC-RedC.16.1.19									
	SONCC-RedC.16.1.19.1	$1,744						$1,744	NMFS
	SONCC-RedC.16.1.19.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-RedC.16.1.20									
	SONCC-RedC.16.1.20.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-RedC.16.1.20.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-RedC.16.2.21									
	SONCC-RedC.16.2.21.1	$1,744						$1,744	NMFS
	SONCC-RedC.16.2.21.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-RedC.16.2.22									
	SONCC-RedC.16.2.22.1	$1,744						$1,744	NMFS
	SONCC-RedC.16.2.22.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-RedC.27.1.23									
	SONCC-RedC.27.1.23.1						$204,500	$204,500	CDFG
	Action Total:						*$204,500*	*$204,500*	
SONCC-RedC.27.1.24									
	SONCC-RedC.27.1.24.1						$85,037	$85,037	CDFG
	Action Total:						*$85,037*	*$85,037*	
SONCC-RedC.27.1.25									
	SONCC-RedC.27.1.25.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-RedC.27.2.26									
	SONCC-RedC.27.2.26.1	$81,800						$81,800	CDFG
	SONCC-RedC.27.2.26.2			$40,900		$40,900		$81,800	CDFG
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-RedC.27.2.27									
	SONCC-RedC.27.2.27.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-RedC.27.2.28									
	SONCC-RedC.27.2.28.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-RedC.27.2.29									
	SONCC-RedC.27.2.29.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-RedC.27.2.30									
	SONCC-RedC.27.2.30.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-RedC.27.2.31									
	SONCC-RedC.27.2.31.1	$68,030		$68,030		$68,030	$68,030	$272,120	CDFG
	Action Total:	*$68,030*		*$68,030*		*$68,030*	*$68,030*	*$272,120*	
SONCC-RedC.27.1.33									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-RedC.27.1.33.1	$122,700	$122,700	$122,700	$122,700	$122,700	$122,700	$736,200	CDFG
	Action Total:	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$736,200*	
SONCC-RedC.27.1.34									
	SONCC-RedC.27.1.34.1	$8,722						$8,722	NMFS
	SONCC-RedC.27.1.34.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-RedC.27.2.35									
	SONCC-RedC.27.2.35.1	$2,721						$2,721	CDFG
	Action Total:	*$2,721*						*$2,721*	
SONCC-RedC.5.1.10									
	SONCC-RedC.5.1.10.1	$44,540						$44,540	NPS
	SONCC-RedC.5.1.10.2	$436,045						$436,045	NPS
	Action Total:	*$480,585*						*$480,585*	
SONCC-RedC.5.1.11									
	SONCC-RedC.5.1.11.1	$188,080						$188,080	NPS
	Action Total:	*$188,080*						*$188,080*	
SONCC-RedC.7.1.6									
	SONCC-RedC.7.1.6.1	$34,015						$34,015	NPS
	SONCC-RedC.7.1.6.2	$338,776						$338,776	NPS
	SONCC-RedC.7.1.6.3	$2,455,834						$2,455,834	NPS
	Action Total:	*$2,828,625*						*$2,828,625*	
SONCC-RedC.7.1.7									
	SONCC-RedC.7.1.7.1	$8,503						$8,503	County
	SONCC-RedC.7.1.7.2	$34,015						$34,015	County
	Action Total:	*$42,518*						*$42,518*	
SONCC-RedC.7.1.8									
	SONCC-RedC.7.1.8.1	$34,015						$34,015	NRCS/RCD
	SONCC-RedC.7.1.8.2	$34,015						$34,015	NRCS/RCD
	SONCC-RedC.7.1.8.3	$850,296						$850,296	NRCS/RCD
	SONCC-RedC.7.1.8.4	$28,715						$28,715	NRCS/RCD
	SONCC-RedC.7.1.8.5	$1,214						$1,214	NRCS/RCD
	Action Total:	*$948,255*						*$948,255*	
SONCC-RedC.7.1.9									
	SONCC-RedC.7.1.9.1	$5,669						$5,669	CDF
	Action Total:	*$5,669*						*$5,669*	
SONCC-RedC.8.1.12									
	SONCC-RedC.8.1.12.1	$18,200						$18,200	NPS
	SONCC-RedC.8.1.12.2	$3,518,112						$3,518,112	NPS
	Action Total:	*$3,536,312*						*$3,536,312*	
SONCC-RedC.8.1.13									
	SONCC-RedC.8.1.13.1	$68,030						$68,030	NPS
	Action Total:	*$68,030*						*$68,030*	
SONCC-RedC.8.1.14									
	SONCC-RedC.8.1.14.1	$34,015						$34,015	CDF
	Action Total:	*$34,015*						*$34,015*	
SONCC-RedC.8.1.15									
	SONCC-RedC.8.1.15.1	$1,961,414						$1,961,414	NPS
	SONCC-RedC.8.1.15.2	$166,036,620						$166,036,620	NPS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-RedC.8.1.15.3	$2,643,184						$2,643,184	NPS
	SONCC-RedC.8.1.15.4	$1,402,343	$1,402,343	$1,402,343	$1,402,343	$1,402,343	$1,402,343	$8,414,058	NPS
	Action Total:	*$172,043,561*	*$1,402,343*	*$1,402,343*	*$1,402,343*	*$1,402,343*	*$1,402,343*	*$179,055,276*	
SONCC-RedC.8.1.16									
	SONCC-RedC.8.1.16.1	$2,267						$2,267	County
	Action Total:	*$2,267*						*$2,267*	
	Population Total:	***$195,174,052***	***$1,537,251***	***$2,055,181***	***$1,537,251***	***$2,055,181***	***$2,303,818***	***$204,662,734***	
Population: Maple Creek									
SONCC-MapC.2.1.1									
	SONCC-MapC.2.1.1.1	$34,015						$34,015	Private
	SONCC-MapC.2.1.1.2	$2,081,830						$2,081,830	Private
	Action Total:	*$2,115,845*						*$2,115,845*	
SONCC-MapC.2.2.2									
	SONCC-MapC.2.2.2.1	$34,015						$34,015	Private
	SONCC-MapC.2.2.2.2	$388,580						$388,580	Private
	Action Total:	*$422,595*						*$422,595*	
SONCC-MapC.8.1.4									
	SONCC-MapC.8.1.4.1	$376,366						$376,366	Private
	SONCC-MapC.8.1.4.2	$33,580,440						$33,580,440	Private
	SONCC-MapC.8.1.4.3	$425,444						$425,444	Private
	SONCC-MapC.8.1.4.4	$224,566	$224,566	$224,566	$224,566	$224,566	$224,566	$1,347,396	Private
	Action Total:	*$34,606,816*	*$224,566*	*$224,566*	*$224,566*	*$224,566*	*$224,566*	*$35,729,646*	
SONCC-MapC.8.1.5									
	SONCC-MapC.8.1.5.1	$2,267						$2,267	County
	Action Total:	*$2,267*						*$2,267*	
SONCC-MapC.14.2.8									
	SONCC-MapC.14.2.8.1	$34,015						$34,015	CDFG
	SONCC-MapC.14.2.8.2	$19,950						$19,950	CDFG
	Action Total:	*$53,965*						*$53,965*	
SONCC-MapC.14.3.9									
	SONCC-MapC.14.3.9.1	$34,015						$34,015	CDFG
	SONCC-MapC.14.3.9.2	$15,736	$15,736	$15,736	$15,736	$15,736	$15,736	$94,416	CDFG
	Action Total:	*$49,751*	*$15,736*	*$15,736*	*$15,736*	*$15,736*	*$15,736*	*$128,431*	
SONCC-MapC.1.3.6									
	SONCC-MapC.1.3.6.1	$44,540						$44,540	Caltrans
	SONCC-MapC.1.3.6.2	$1,556,400						$1,556,400	Caltrans
	Action Total:	*$1,600,940*						*$1,600,940*	
SONCC-MapC.1.3.7									
	SONCC-MapC.1.3.7.1	$44,540						$44,540	Private
	SONCC-MapC.1.3.7.2	$568,181						$568,181	Private
	Action Total:	*$612,721*						*$612,721*	
SONCC-MapC.1.2.21									
	SONCC-MapC.1.2.21.1	$34,015						$34,015	CDFG
	SONCC-MapC.1.2.21.2	$34,015						$34,015	CDFG
	Action Total:	*$68,030*						*$68,030*	
SONCC-MapC.16.1.10									
	SONCC-MapC.16.1.10.1	$1,744						$1,744	NMFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MapC.16.1.10.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-MapC.16.1.11									
	SONCC-MapC.16.1.11.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-MapC.16.1.11.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-MapC.16.2.12									
	SONCC-MapC.16.2.12.1	$1,744						$1,744	NMFS
	SONCC-MapC.16.2.12.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-MapC.16.2.13									
	SONCC-MapC.16.2.13.1	$1,744						$1,744	NMFS
	SONCC-MapC.16.2.13.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-MapC.27.1.15									
	SONCC-MapC.27.1.15.1						$122,700	$122,700	CDFG
	Action Total:						*$122,700*	*$122,700*	
SONCC-MapC.27.1.16									
	SONCC-MapC.27.1.16.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-MapC.27.2.17									
	SONCC-MapC.27.2.17.1	$81,800						$81,800	CDFG
	SONCC-MapC.27.2.17.2			$40,900		$40,900		$81,800	CDFG
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-MapC.27.2.18									
	SONCC-MapC.27.2.18.1	$102,250			$102,250	$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*			*$102,250*	*$102,250*	*$102,250*	*$409,000*	
SONCC-MapC.27.2.19									
	SONCC-MapC.27.2.19.1	$102,250			$102,250	$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*			*$102,250*	*$102,250*	*$102,250*	*$409,000*	
SONCC-MapC.27.2.20									
	SONCC-MapC.27.2.20.1	$68,030		$68,030	$68,030		$68,030	$272,120	CDFG
	Action Total:	*$68,030*		*$68,030*	*$68,030*		*$68,030*	*$272,120*	
SONCC-MapC.27.1.22									
	SONCC-MapC.27.1.22.1	$8,722						$8,722	NMFS
	SONCC-MapC.27.1.22.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-MapC.27.2.23									
	SONCC-MapC.27.2.23.1	$2,721						$2,721	CDFG
	Action Total:	*$2,721*						*$2,721*	
SONCC-MapC.7.1.3									
	SONCC-MapC.7.1.3.1	$34,015						$34,015	Private
	SONCC-MapC.7.1.3.2	$145,738						$145,738	Private
	SONCC-MapC.7.1.3.3	$1,060,474						$1,060,474	Private
	Action Total:	*$1,240,226*						*$1,240,226*	
	Population Total:	***$41,170,323***	***$252,510***	***$361,440***	***$525,040***	***$497,910***	***$647,740***	***$43,454,963***	

Population: Little River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-LitR.2.1.2									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-LitR.2.1.2.1	$34,015						$34,015	Private
	SONCC-LitR.2.1.2.2	$1,335,384						$1,335,384	Private
	Action Total:	*$1,369,399*						*$1,369,399*	
SONCC-LitR.2.2.3									
	SONCC-LitR.2.2.3.1	$89,080						$89,080	CDFG
	SONCC-LitR.2.2.3.2	$357,360						$357,360	CDFG
	Action Total:	*$446,440*						*$446,440*	
SONCC-LitR.8.1.1									
	SONCC-LitR.8.1.1.1	$790,866						$790,866	Private
	SONCC-LitR.8.1.1.2	$48,598,359						$48,598,359	Private
	SONCC-LitR.8.1.1.3	$1,959,758						$1,959,758	Private
	SONCC-LitR.8.1.1.4	$1,034,437						$1,034,437	Private
	Action Total:	*$52,383,420*						*$52,383,420*	
SONCC-LitR.1.2.4									
	SONCC-LitR.1.2.4.1	$34,015						$34,015	CDFG
	SONCC-LitR.1.2.4.2	$420,000						$420,000	CDFG
	Action Total:	*$454,015*						*$454,015*	
SONCC-LitR.1.4.5									
	SONCC-LitR.1.4.5.1							$0	CSP
	Action Total:							*$0*	
SONCC-LitR.1.2.20									
	SONCC-LitR.1.2.20.1	$34,015						$34,015	CDFG
	SONCC-LitR.1.2.20.2	$34,015						$34,015	CDFG
	Action Total:	*$68,030*						*$68,030*	
SONCC-LitR.16.1.9									
	SONCC-LitR.16.1.9.1	$1,744						$1,744	NMFS
	SONCC-LitR.16.1.9.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-LitR.16.1.10									
	SONCC-LitR.16.1.10.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-LitR.16.1.10.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-LitR.16.2.11									
	SONCC-LitR.16.2.11.1	$1,744						$1,744	NMFS
	SONCC-LitR.16.2.11.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-LitR.16.2.12									
	SONCC-LitR.16.2.12.1	$1,744						$1,744	NMFS
	SONCC-LitR.16.2.12.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-LitR.27.1.13									
	SONCC-LitR.27.1.13.1						$204,500	$204,500	CDFG
	Action Total:						*$204,500*	*$204,500*	
SONCC-LitR.27.1.14									
	SONCC-LitR.27.1.14.1	$122,700	$122,700	$122,700	$122,700	$122,700	$122,700	$736,200	CDFG
	Action Total:	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$736,200*	
SONCC-LitR.27.1.15									
	SONCC-LitR.27.1.15.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-LitR.27.2.16									
	SONCC-LitR.27.2.16.1	$81,800						$81,800	CDFG
	SONCC-LitR.27.2.16.2			$40,900		$40,900		$81,800	CDFG
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-LitR.27.2.17									
	SONCC-LitR.27.2.17.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-LitR.27.2.18									
	SONCC-LitR.27.2.18.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-LitR.27.2.19									
	SONCC-LitR.27.2.19.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-LitR.27.2.22									
	SONCC-LitR.27.2.22.1	$68,030		$68,030		$68,030	$68,030	$272,120	CDFG
	Action Total:	*$68,030*		*$68,030*		*$68,030*	*$68,030*	*$272,120*	
SONCC-LitR.27.1.23									
	SONCC-LitR.27.1.23.1	$8,722						$8,722	NMFS
	SONCC-LitR.27.1.23.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-LitR.27.2.24									
	SONCC-LitR.27.2.24.1	$2,721						$2,721	CDFG
	Action Total:	*$2,721*						*$2,721*	
SONCC-LitR.5.1.8									
	SONCC-LitR.5.1.8.1							$0	NRCS/RCD
	SONCC-LitR.5.1.8.2							$0	NRCS/RCD
	Action Total:							*$0*	
SONCC-LitR.7.1.6									
	SONCC-LitR.7.1.6.1							$0	Private
	SONCC-LitR.7.1.6.2							$0	Private
	SONCC-LitR.7.1.6.3							$0	Private
	Action Total:							*$0*	
SONCC-LitR.7.1.7									
	SONCC-LitR.7.1.7.1	$34,015						$34,015	NRCS/RCD
	SONCC-LitR.7.1.7.2	$34,015						$34,015	NRCS/RCD
	SONCC-LitR.7.1.7.3	$20,000						$20,000	NRCS/RCD
	SONCC-LitR.7.1.7.4	$32,736						$32,736	NRCS/RCD
	SONCC-LitR.7.1.7.5	$5,000						$5,000	NRCS/RCD
	Action Total:	*$125,766*						*$125,766*	
	Population Total:	***$55,469,187***	***$134,908***	***$550,588***	***$134,908***	***$550,588***	***$714,188***	***$57,554,367***	

Population: Strawberry Creek

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-StrC.5.1.1									
	SONCC-StrC.5.1.1.1	$34,015						$34,015	County
	SONCC-StrC.5.1.1.2	$883,720						$883,720	County
	SONCC-StrC.5.1.1.3	$813,953						$813,953	CalTrans
	Action Total:	*$1,731,688*						*$1,731,688*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-StrC.1.4.7									
	SONCC-StrC.1.4.7.1							$0	County
	Action Total:							*$0*	
SONCC-StrC.1.2.8									
	SONCC-StrC.1.2.8.1	$34,015						$34,015	County
	SONCC-StrC.1.2.8.2	$290,070						$290,070	County
	Action Total:	*$324,085*						*$324,085*	
SONCC-StrC.1.2.9									
	SONCC-StrC.1.2.9.1							$0	CCC
	Action Total:							*$0*	
SONCC-StrC.2.2.2									
	SONCC-StrC.2.2.2.1	$34,015						$34,015	NGO
	SONCC-StrC.2.2.2.2	$639,033						$639,033	NGO
	Action Total:	*$673,048*						*$673,048*	
SONCC-StrC.2.1.13									
	SONCC-StrC.2.1.13.1	$34,015						$34,015	CDFG
	SONCC-StrC.2.1.13.2	$353,363						$353,363	CDFG
	Action Total:	*$387,378*						*$387,378*	
SONCC-StrC.2.2.14									
	SONCC-StrC.2.2.14.1							$0	CDFG
	SONCC-StrC.2.2.14.2							$0	CDFG
	SONCC-StrC.2.2.14.3							$0	CDFG
	Action Total:							*$0*	
SONCC-StrC.27.2.11									
	SONCC-StrC.27.2.11.1	$81,800						$81,800	CDFG
	SONCC-StrC.27.2.11.2				$40,900			$40,900	CDFG
	Action Total:	*$81,800*			*$40,900*			*$122,700*	
SONCC-StrC.27.1.15									
	SONCC-StrC.27.1.15.1						$122,700	$122,700	CDFG
	Action Total:						*$122,700*	*$122,700*	
SONCC-StrC.27.1.16									
	SONCC-StrC.27.1.16.1	$8,722						$8,722	NMFS
	SONCC-StrC.27.1.16.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-StrC.27.2.17									
	SONCC-StrC.27.2.17.1	$2,721						$2,721	CDFG
	Action Total:	*$2,721*						*$2,721*	
SONCC-StrC.7.1.5									
	SONCC-StrC.7.1.5.1							$0	NRCS/RCD
	SONCC-StrC.7.1.5.2							$0	NRCS/RCD
	SONCC-StrC.7.1.5.3							$0	NRCS/RCD
	SONCC-StrC.7.1.5.4							$0	NRCS/RCD
	SONCC-StrC.7.1.5.5							$0	NRCS/RCD
	Action Total:							*$0*	
SONCC-StrC.7.1.6									
	SONCC-StrC.7.1.6.1							$0	County
	SONCC-StrC.7.1.6.2							$0	County
	Action Total:							*$0*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-StrC.8.1.10									
	SONCC-StrC.8.1.10.1	$2,267						$2,267	County
	Action Total:	*$2,267*						*$2,267*	
SONCC-StrC.10.2.3									
	SONCC-StrC.10.2.3.1							$0	County
	SONCC-StrC.10.2.3.2							$0	County
	Action Total:							*$0*	
SONCC-StrC.10.2.4									
	SONCC-StrC.10.2.4.1							$0	County
	Action Total:							*$0*	
SONCC-StrC.10.2.12									
	SONCC-StrC.10.2.12.1							$0	County
	Action Total:							*$0*	
	Population Total:	***$3,220,431***			***$40,900***		***$122,700***	***$3,384,031***	

Population: Norton/Widow White Creek

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-NWWC.2.1.7									
	SONCC-NWWC.2.1.7.1	$34,015						$34,015	CDFG
	SONCC-NWWC.2.1.7.2	$524,566						$524,566	CDFG
	Action Total:	*$558,581*						*$558,581*	
SONCC-NWWC.2.2.8									
	SONCC-NWWC.2.2.8.1	$34,015						$34,015	NGO
	SONCC-NWWC.2.2.8.2	$102,258						$102,258	NGO
	Action Total:	*$136,273*						*$136,273*	
SONCC-NWWC.2.2.9									
	SONCC-NWWC.2.2.9.1							$0	CDFG
	SONCC-NWWC.2.2.9.2							$0	CDFG
	SONCC-NWWC.2.2.9.3							$0	CDFG
	Action Total:							*$0*	
SONCC-NWWC.7.1.1									
	SONCC-NWWC.7.1.1.1							$0	County
	SONCC-NWWC.7.1.1.2							$0	County
	Action Total:							*$0*	
SONCC-NWWC.7.1.2									
	SONCC-NWWC.7.1.2.1							$0	County
	SONCC-NWWC.7.1.2.2							$0	County
	SONCC-NWWC.7.1.2.3							$0	County
	Action Total:							*$0*	
SONCC-NWWC.27.2.6									
	SONCC-NWWC.27.2.6.1	$81,800						$81,800	CDFG
	SONCC-NWWC.27.2.6.2				$40,900			$40,900	CDFG
	Action Total:	*$81,800*			*$40,900*			*$122,700*	
SONCC-NWWC.27.1.10									
	SONCC-NWWC.27.1.10.1						$122,700	$122,700	CDFG
	Action Total:						*$122,700*	*$122,700*	
SONCC-NWWC.27.2.11									
	SONCC-NWWC.27.2.11.1	$102,250			$102,250		$102,250	$306,750	CDFG
	Action Total:	*$102,250*			*$102,250*		*$102,250*	*$306,750*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-NWWC.27.2.12									
	SONCC-NWWC.27.2.12.1	$102,250			$102,250		$102,250	$306,750	CDFG
	Action Total:	*$102,250*			*$102,250*		*$102,250*	*$306,750*	
SONCC-NWWC.27.1.13									
	SONCC-NWWC.27.1.13.1	$8,722						$8,722	NMFS
	SONCC-NWWC.27.1.13.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-NWWC.27.2.14									
	SONCC-NWWC.27.2.14.1	$2,721						$2,721	CDFG
	Action Total:	*$2,721*						*$2,721*	
SONCC-NWWC.5.1.3									
	SONCC-NWWC.5.1.3.1	$34,015						$34,015	County
	SONCC-NWWC.5.1.3.2	$813,953						$813,953	Caltrans
	SONCC-NWWC.5.1.3.3	$883,720						$883,720	County
	Action Total:	*$1,731,688*						*$1,731,688*	
SONCC-NWWC.10.2.4									
	SONCC-NWWC.10.2.4.1							$0	NGO
	Action Total:							*$0*	
SONCC-NWWC.10.2.5									
	SONCC-NWWC.10.2.5.1							$0	NGO
	Action Total:							*$0*	
	Population Total:	***$2,733,007***			***$245,400***		***$327,200***	***$3,305,607***	

Population: Mad River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MadR.2.1.1									
	SONCC-MadR.2.1.1.1	$34,015						$34,015	CDFG
	SONCC-MadR.2.1.1.2	$6,902,910						$6,902,910	CDFG
	Action Total:	*$6,936,925*						*$6,936,925*	
SONCC-MadR.2.2.2									
	SONCC-MadR.2.2.2.1	$34,015						$34,015	CDFG
	SONCC-MadR.2.2.2.2	$1,329,354						$1,329,354	CDFG
	Action Total:	*$1,363,369*						*$1,363,369*	
SONCC-MadR.2.2.3									
	SONCC-MadR.2.2.3.1	$34,015						$34,015	NMFS
	SONCC-MadR.2.2.3.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MadR.10.2.20									
	SONCC-MadR.10.2.20.1	$136,060						$136,060	EPA
	Action Total:	*$136,060*						*$136,060*	
SONCC-MadR.1.1.4									
	SONCC-MadR.1.1.4.1	$34,015						$34,015	CDFG
	SONCC-MadR.1.1.4.2	$593,022						$593,022	CDFG
	Action Total:	*$627,037*						*$627,037*	
SONCC-MadR.1.2.36									
	SONCC-MadR.1.2.36.1	$34,015						$34,015	CDFG
	SONCC-MadR.1.2.36.2	$34,015						$34,015	CDFG
	Action Total:	*$68,030*						*$68,030*	
SONCC-MadR.16.1.21									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MadR.16.1.21.1	$1,744						$1,744	NMFS
	SONCC-MadR.16.1.21.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-MadR.16.1.22									
	SONCC-MadR.16.1.22.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-MadR.16.1.22.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-MadR.16.2.23									
	SONCC-MadR.16.2.23.1	$1,744						$1,744	NMFS
	SONCC-MadR.16.2.23.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-MadR.16.2.24									
	SONCC-MadR.16.2.24.1	$1,744						$1,744	NMFS
	SONCC-MadR.16.2.24.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-MadR.17.3.11									
	SONCC-MadR.17.3.11.1	$34,015						$34,015	CDFG
	Action Total:	*$34,015*						*$34,015*	
SONCC-MadR.17.2.12									
	SONCC-MadR.17.2.12.1	$68,030						$68,030	CDFG
	Action Total:	*$68,030*						*$68,030*	
SONCC-MadR.3.1.18									
	SONCC-MadR.3.1.18.1	$34,015						$34,015	NMFS
	SONCC-MadR.3.1.18.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MadR.3.1.19									
	SONCC-MadR.3.1.19.1	$34,015						$34,015	CDFG
	SONCC-MadR.3.1.19.2	$34,015						$34,015	CDFG
	Action Total:	*$68,030*						*$68,030*	
SONCC-MadR.27.1.25									
	SONCC-MadR.27.1.25.1						$204,500	$204,500	CDFG
	Action Total:						*$204,500*	*$204,500*	
SONCC-MadR.27.1.26									
	SONCC-MadR.27.1.26.1						$85,037	$85,037	CDFG
	Action Total:						*$85,037*	*$85,037*	
SONCC-MadR.27.1.27									
	SONCC-MadR.27.1.27.1	$6,803	$6,803	$6,803	$6,803	$6,803	$6,803	$40,818	CDFG
	Action Total:	*$6,803*	*$6,803*	*$6,803*	*$6,803*	*$6,803*	*$6,803*	*$40,818*	
SONCC-MadR.27.1.28									
	SONCC-MadR.27.1.28.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-MadR.27.1.29									
	SONCC-MadR.27.1.29.1	$42,518	$42,518	$42,518	$42,518	$42,518	$42,518	$255,108	CDFG
	Action Total:	*$42,518*	*$42,518*	*$42,518*	*$42,518*	*$42,518*	*$42,518*	*$255,108*	
SONCC-MadR.27.2.30									
	SONCC-MadR.27.2.30.1	$81,800						$81,800	CDFG
	SONCC-MadR.27.2.30.2			$40,900		$40,900		$81,800	CDFG
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MadR.27.2.31									
	SONCC-MadR.27.2.31.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-MadR.27.2.32									
	SONCC-MadR.27.2.32.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-MadR.27.2.33									
	SONCC-MadR.27.2.33.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-MadR.27.2.34									
	SONCC-MadR.27.2.34.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-MadR.27.2.35									
	SONCC-MadR.27.2.35.1	$68,030		$68,030		$68,030	$68,030	$272,120	CDFG
	Action Total:	*$68,030*		*$68,030*		*$68,030*	*$68,030*	*$272,120*	
SONCC-MadR.27.1.38									
	SONCC-MadR.27.1.38.1	$122,700	$122,700	$122,700	$122,700	$122,700	$122,700	$736,200	CDFG
	Action Total:	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$736,200*	
SONCC-MadR.27.1.39									
	SONCC-MadR.27.1.39.1	$8,722						$8,722	NMFS
	SONCC-MadR.27.1.39.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-MadR.27.2.40									
	SONCC-MadR.27.2.40.1	$2,721						$2,721	CDFG
	Action Total:	*$2,721*						*$2,721*	
SONCC-MadR.5.1.9									
	SONCC-MadR.5.1.9.1	$34,015						$34,015	BIA/Tribe
	SONCC-MadR.5.1.9.2	$290,700						$290,700	BIA/Tribe
	Action Total:	*$324,715*						*$324,715*	
SONCC-MadR.5.1.10									
	SONCC-MadR.5.1.10.1	$44,540						$44,540	Caltrans
	SONCC-MadR.5.1.10.2	$436,045						$436,045	Caltrans
	Action Total:	*$480,585*						*$480,585*	
SONCC-MadR.5.1.37									
	SONCC-MadR.5.1.37.1	$125,280						$125,280	CDFG
	Action Total:	*$125,280*						*$125,280*	
SONCC-MadR.7.1.5									
	SONCC-MadR.7.1.5.1	$34,015						$34,015	Private
	SONCC-MadR.7.1.5.2	$485,792						$485,792	Private
	SONCC-MadR.7.1.5.3	$3,530,261						$3,530,261	Private
	SONCC-MadR.7.1.5.4	$158,614						$158,614	Private
	SONCC-MadR.7.1.5.5							$0	USFS
	Action Total:	*$4,208,682*						*$4,208,682*	
SONCC-MadR.7.1.6									
	SONCC-MadR.7.1.6.1	$17,077						$17,077	CDFG
	Action Total:	*$17,077*						*$17,077*	
SONCC-MadR.7.1.7									
	SONCC-MadR.7.1.7.1	$34,015						$34,015	NRCS/RCD

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MadR.7.1.7.2	$34,015						$34,015	NRCS/RCD
	SONCC-MadR.7.1.7.3	$749,760						$749,760	NRCS/RCD
	SONCC-MadR.7.1.7.4	$41,276						$41,276	NRCS/RCD
	SONCC-MadR.7.1.7.5	$1,821						$1,821	NRCS/RCD
	Action Total:	*$860,887*						*$860,887*	
SONCC-MadR.7.1.8									
	SONCC-MadR.7.1.8.1	$5,669						$5,669	CDF
	SONCC-MadR.7.1.8.2	$34,015	$34,015	$34,015	$34,015	$34,015	$34,015	$204,090	CDF
	Action Total:	*$39,684*	*$34,015*	*$34,015*	*$34,015*	*$34,015*	*$34,015*	*$209,759*	
SONCC-MadR.8.1.13									
	SONCC-MadR.8.1.13.1	$750,177						$750,177	Private
	Action Total:	*$750,177*						*$750,177*	
SONCC-MadR.8.1.14									
	SONCC-MadR.8.1.14.1	$18,200						$18,200	CDF
	SONCC-MadR.8.1.14.2	$5,060,016						$5,060,016	CDF
	Action Total:	*$5,078,216*						*$5,078,216*	
SONCC-MadR.8.1.15									
	SONCC-MadR.8.1.15.1	$2,107,318						$2,107,318	Private
	SONCC-MadR.8.1.15.2	$145,048,845						$145,048,845	Private
	SONCC-MadR.8.1.15.3	$4,471,688						$4,471,688	Private
	SONCC-MadR.8.1.15.4	$2,357,943	$2,357,943	$2,357,943	$2,357,943	$2,357,943	$2,357,943	$14,147,658	Private
	Action Total:	*$153,985,794*	*$2,357,943*	*$2,357,943*	*$2,357,943*	*$2,357,943*	*$2,357,943*	*$165,775,509*	
SONCC-MadR.8.1.16									
	SONCC-MadR.8.1.16.1	$2,267						$2,267	County
	Action Total:	*$2,267*						*$2,267*	
	Population Total:	***$176,084,608***	***$2,576,187***	***$3,094,117***	***$2,576,187***	***$3,094,117***	***$3,342,754***	***$190,767,970***	

Population: Humboldt Bay Tributaries

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-HBT.1.3.4									
	SONCC-HBT.1.3.4.2	$1,201,140						$1,201,140	CDFG
	Action Total:	*$1,201,140*						*$1,201,140*	
SONCC-HBT.1.1.5									
	SONCC-HBT.1.1.5.1	$89,080						$89,080	CDFG
	SONCC-HBT.1.1.5.2	$275,041						$275,041	CDFG
	Action Total:	*$364,121*						*$364,121*	
SONCC-HBT.1.2.40									
	SONCC-HBT.1.2.40.1	$34,015						$34,015	CDFG
	SONCC-HBT.1.2.40.2	$34,015						$34,015	CDFG
	Action Total:	*$68,030*						*$68,030*	
SONCC-HBT.2.1.1									
	SONCC-HBT.2.1.1.1	$34,015						$34,015	CDFG
	SONCC-HBT.2.1.1.2	$10,025,655						$10,025,655	CDFG
	Action Total:	*$10,059,670*						*$10,059,670*	
SONCC-HBT.2.2.2									
	SONCC-HBT.2.2.2.1	$34,015						$34,015	CDFG
	SONCC-HBT.2.2.2.2	$1,871,321						$1,871,321	CDFG
	Action Total:	*$1,905,336*						*$1,905,336*	
SONCC-HBT.2.2.3									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-HBT.2.2.3.1	$34,015						$34,015	City
	SONCC-HBT.2.2.3.2	$4,680,350						$4,680,350	City
	Action Total:	*$4,714,365*						*$4,714,365*	
SONCC-HBT.8.1.11									
	SONCC-HBT.8.1.11.1	$34,015						$34,015	NRCS/RCD
	SONCC-HBT.8.1.11.2	$34,015						$34,015	NRCS/RCD
	SONCC-HBT.8.1.11.3	$1,184,564						$1,184,564	NRCS/RCD
	SONCC-HBT.8.1.11.4	$59,714						$59,714	NRCS/RCD
	SONCC-HBT.8.1.11.5	$2,428						$2,428	NRCS/RCD
	Action Total:	*$1,314,736*						*$1,314,736*	
SONCC-HBT.8.1.12									
	SONCC-HBT.8.1.12.1	$239,153						$239,153	CDFG
	SONCC-HBT.8.1.12.2	$1,766,480						$1,766,480	CDFG
	Action Total:	*$2,005,633*						*$2,005,633*	
SONCC-HBT.8.1.13									
	SONCC-HBT.8.1.13.1	$1,642,249						$1,642,249	Private
	SONCC-HBT.8.1.13.2	$34,882,708						$34,882,708	Private
	SONCC-HBT.8.1.13.3	$1,425,690						$1,425,690	Private
	SONCC-HBT.8.1.13.4	$752,535	$752,535	$752,535	$752,535	$752,535	$752,535	$4,515,210	Private
	Action Total:	*$38,703,182*	*$752,535*	*$752,535*	*$752,535*	*$752,535*	*$752,535*	*$42,465,857*	
SONCC-HBT.8.1.14									
	SONCC-HBT.8.1.14.1	$2,267						$2,267	County
	Action Total:	*$2,267*						*$2,267*	
SONCC-HBT.16.1.24									
	SONCC-HBT.16.1.24.1	$1,744						$1,744	NMFS
	SONCC-HBT.16.1.24.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-HBT.16.1.25									
	SONCC-HBT.16.1.25.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-HBT.16.1.25.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-HBT.16.2.26									
	SONCC-HBT.16.2.26.1	$1,744						$1,744	NMFS
	SONCC-HBT.16.2.26.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-HBT.16.2.27									
	SONCC-HBT.16.2.27.1	$1,744						$1,744	NMFS
	SONCC-HBT.16.2.27.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-HBT.3.1.19									
	SONCC-HBT.3.1.19.1	$76,136						$76,136	CDFG
	Action Total:	*$76,136*						*$76,136*	
SONCC-HBT.3.1.20									
	SONCC-HBT.3.1.20.1							$0	CDFG
	Action Total:							*$0*	
SONCC-HBT.3.1.21									
	SONCC-HBT.3.1.21.1							$0	CDFG

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-HBT.3.1.21.2							$0	CDFG
	Action Total:							*$0*	
SONCC-HBT.3.2.22									
	SONCC-HBT.3.2.22.1	$34,015						$34,015	County
	Action Total:	*$34,015*						*$34,015*	
SONCC-HBT.3.2.23									
	SONCC-HBT.3.2.23.2	$34,015						$34,015	County
	Action Total:	*$34,015*						*$34,015*	
SONCC-HBT.27.2.28									
	SONCC-HBT.27.2.28.1							$0	CDFG
	Action Total:							*$0*	
SONCC-HBT.27.2.29									
	SONCC-HBT.27.2.29.1							$0	CDFG
	Action Total:							*$0*	
SONCC-HBT.27.1.30									
	SONCC-HBT.27.1.30.1	$204,500	$204,500	$204,500	$204,500	$204,500	$204,500	$1,227,000	CDFG
	Action Total:	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$1,227,000*	
SONCC-HBT.27.1.31									
	SONCC-HBT.27.1.31.1	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$6,120,000	CDFG
	Action Total:	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$6,120,000*	
SONCC-HBT.27.1.32									
	SONCC-HBT.27.1.32.1						$85,037	$85,037	CDFG
	Action Total:						*$85,037*	*$85,037*	
SONCC-HBT.27.1.33									
	SONCC-HBT.27.1.33.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-HBT.27.2.34									
	SONCC-HBT.27.2.34.1	$81,800						$81,800	CDFG
	SONCC-HBT.27.2.34.2			$40,900		$40,900		$81,800	CDFG
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-HBT.27.2.35									
	SONCC-HBT.27.2.35.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-HBT.27.2.36									
	SONCC-HBT.27.2.36.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-HBT.27.2.37									
	SONCC-HBT.27.2.37.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-HBT.27.2.38									
	SONCC-HBT.27.2.38.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-HBT.27.2.39									
	SONCC-HBT.27.2.39.1	$68,030		$68,030		$68,030	$68,030	$272,120	CDFG
	Action Total:	*$68,030*		*$68,030*		*$68,030*	*$68,030*	*$272,120*	
SONCC-HBT.27.1.41									
	SONCC-HBT.27.1.41.1	$8,722						$8,722	NMFS
	SONCC-HBT.27.1.41.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-HBT.27.2.42									
	SONCC-HBT.27.2.42.1	$2,721						$2,721	CDFG
	Action Total:	*$2,721*						*$2,721*	
SONCC-HBT.5.1.10									
	SONCC-HBT.5.1.10.1	$34,015						$34,015	CDFG
	SONCC-HBT.5.1.10.2	$1,308,135						$1,308,135	CDFG
	Action Total:	*$1,342,150*						*$1,342,150*	
SONCC-HBT.7.1.6									
	SONCC-HBT.7.1.6.1	$76,136						$76,136	NGO
	Action Total:	*$76,136*						*$76,136*	
SONCC-HBT.7.1.7									
	SONCC-HBT.7.1.7.1	$8,503						$8,503	County
	SONCC-HBT.7.1.7.2	$34,015						$34,015	County
	Action Total:	*$42,518*						*$42,518*	
SONCC-HBT.7.1.8									
	SONCC-HBT.7.1.8.1	$34,015						$34,015	CDFG
	SONCC-HBT.7.1.8.2	$701,842						$701,842	CDFG
	SONCC-HBT.7.1.8.3	$5,107,018						$5,107,018	CDFG
	Action Total:	*$5,842,874*						*$5,842,874*	
SONCC-HBT.7.1.9									
	SONCC-HBT.7.1.9.1	$5,669						$5,669	CDF
	Action Total:	*$5,669*						*$5,669*	
SONCC-HBT.10.2.16									
	SONCC-HBT.10.2.16.1	$34,015						$34,015	County
	SONCC-HBT.10.2.16.2	$34,015						$34,015	County
	Action Total:	*$68,030*						*$68,030*	
SONCC-HBT.10.2.17									
	SONCC-HBT.10.2.17.1	$34,015						$34,015	City
	Action Total:	*$34,015*						*$34,015*	
SONCC-HBT.10.2.18									
	SONCC-HBT.10.2.18.1	$136,060						$136,060	EPA
	Action Total:	*$136,060*						*$136,060*	
	Population Total:	***$69,856,266***	***$1,989,243***	***$2,507,173***	***$1,989,243***	***$2,507,173***	***$2,551,310***	***$81,400,408***	

Population: Lower Eel and Van Duzen

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-LEVR.1.1.12									
	SONCC-LEVR.1.1.12.1	$34,015						$34,015	CDFG
	SONCC-LEVR.1.1.12.2	$234,021						$234,021	CDFG
	Action Total:	*$268,036*						*$268,036*	
SONCC-LEVR.1.1.13									
	SONCC-LEVR.1.1.13.1	$34,015						$34,015	NMFS
	SONCC-LEVR.1.1.13.2	$1,201,140						$1,201,140	NMFS
	Action Total:	*$1,235,155*						*$1,235,155*	
SONCC-LEVR.1.2.14									
	SONCC-LEVR.1.2.14.1	$34,015						$34,015	CDFG
	SONCC-LEVR.1.2.14.2	$8,700,000						$8,700,000	CDFG
	Action Total:	*$8,734,015*						*$8,734,015*	
SONCC-LEVR.1.2.15									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-LEVR.1.2.15.1	$34,015						$34,015	CDFG
	SONCC-LEVR.1.2.15.2	$8,700,000						$8,700,000	CDFG
	SONCC-LEVR.1.2.15.3	$8,700,000						$8,700,000	CDFG
	Action Total:	*$17,434,015*						*$17,434,015*	
SONCC-LEVR.1.2.16									
	SONCC-LEVR.1.2.16.1	$34,015						$34,015	CDFG
	SONCC-LEVR.1.2.16.2	$8,700,000						$8,700,000	CDFG
	Action Total:	*$8,734,015*						*$8,734,015*	
SONCC-LEVR.1.2.38									
	SONCC-LEVR.1.2.38.1	$34,015						$34,015	CDFG
	SONCC-LEVR.1.2.38.2	$34,015						$34,015	CDFG
	Action Total:	*$68,030*						*$68,030*	
SONCC-LEVR.8.1.5									
	SONCC-LEVR.8.1.5.1	$2,901,972						$2,901,972	CDF
	SONCC-LEVR.8.1.5.2	$367,705,818						$367,705,818	CDF
	SONCC-LEVR.8.1.5.3	$11,854,854						$11,854,854	CDF
	SONCC-LEVR.8.1.5.4	$3,468,828	$3,468,828	$3,468,828	$3,468,828	$3,468,828	$3,468,828	$20,812,968	CDF
	Action Total:	*$385,931,472*	*$3,468,828*	*$3,468,828*	*$3,468,828*	*$3,468,828*	*$3,468,828*	*$403,275,612*	
SONCC-LEVR.8.1.6									
	SONCC-LEVR.8.1.6.1	$2,376						$2,376	County
	Action Total:	*$2,376*						*$2,376*	
SONCC-LEVR.8.1.7									
	SONCC-LEVR.8.1.7.1	$34,015						$34,015	CDF
	Action Total:	*$34,015*						*$34,015*	
SONCC-LEVR.8.1.9									
	SONCC-LEVR.8.1.9.1							$0	NRCS/RCD
	SONCC-LEVR.8.1.9.2							$0	NRCS/RCD
	Action Total:							*$0*	
SONCC-LEVR.8.1.11									
	SONCC-LEVR.8.1.11.1							$0	CDF
	SONCC-LEVR.8.1.11.2							$0	CDF
	Action Total:							*$0*	
SONCC-LEVR.14.2.4									
	SONCC-LEVR.14.2.4.1	$68,030						$68,030	CDFG
	SONCC-LEVR.14.2.4.2	$27,697	$27,697	$27,697	$27,697	$27,697	$27,697	$166,184	CDFG
	Action Total:	*$95,727*	*$27,697*	*$27,697*	*$27,697*	*$27,697*	*$27,697*	*$234,214*	
SONCC-LEVR.16.1.22									
	SONCC-LEVR.16.1.22.1	$1,744						$1,744	NMFS
	SONCC-LEVR.16.1.22.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-LEVR.16.1.23									
	SONCC-LEVR.16.1.23.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-LEVR.16.1.23.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-LEVR.16.2.24									
	SONCC-LEVR.16.2.24.1	$1,744						$1,744	NMFS
	SONCC-LEVR.16.2.24.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-LEVR.16.2.25									
	SONCC-LEVR.16.2.25.1	$1,744						$1,744	NMFS
	SONCC-LEVR.16.2.25.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-LEVR.2.1.17									
	SONCC-LEVR.2.1.17.1	$34,015						$34,015	CDFG
	SONCC-LEVR.2.1.17.2	$16,709,425						$16,709,425	CDFG
	Action Total:	*$16,743,440*						*$16,743,440*	
SONCC-LEVR.2.1.36									
	SONCC-LEVR.2.1.36.1	$34,015						$34,015	CDFG
	SONCC-LEVR.2.1.36.2	$3,107,000						$3,107,000	CDFG
	Action Total:	*$3,141,015*						*$3,141,015*	
SONCC-LEVR.3.1.19									
	SONCC-LEVR.3.1.19.1							$0	CWQCB
	Action Total:							*$0*	
SONCC-LEVR.3.1.20									
	SONCC-LEVR.3.1.20.1							$0	CWQCB
	SONCC-LEVR.3.1.20.2							$0	CWQCB
	Action Total:							*$0*	
SONCC-LEVR.27.1.26									
	SONCC-LEVR.27.1.26.1						$204,500	$204,500	CDFG
	Action Total:						*$204,500*	*$204,500*	
SONCC-LEVR.27.1.27									
	SONCC-LEVR.27.1.27.1	$122,700	$122,700	$122,700	$122,700	$122,700	$122,700	$736,200	CDFG
	Action Total:	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$736,200*	
SONCC-LEVR.27.1.28									
	SONCC-LEVR.27.1.28.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-LEVR.27.1.29									
	SONCC-LEVR.27.1.29.1	$17,042	$17,042	$17,042	$17,042	$17,042	$17,042	$102,252	CDFG
	SONCC-LEVR.27.1.29.2	$4,251	$4,251	$4,251	$4,251	$4,251	$4,251	$25,506	CDFG
	Action Total:	*$21,293*	*$21,293*	*$21,293*	*$21,293*	*$21,293*	*$21,293*	*$127,758*	
SONCC-LEVR.27.2.30									
	SONCC-LEVR.27.2.30.1	$81,800						$81,800	CDFG
	SONCC-LEVR.27.2.30.2	$40,900		$40,900		$40,900		$122,700	CDFG
	Action Total:	*$122,700*		*$40,900*		*$40,900*		*$204,500*	
SONCC-LEVR.27.2.31									
	SONCC-LEVR.27.2.31.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-LEVR.27.2.32									
	SONCC-LEVR.27.2.32.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-LEVR.27.2.33									
	SONCC-LEVR.27.2.33.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-LEVR.27.2.34									
	SONCC-LEVR.27.2.34.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-LEVR.27.2.35									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-LEVR.27.2.35.1	$68,030		$68,030		$68,030	$68,030	$272,120	CDFG
	Action Total:	*$68,030*		*$68,030*		*$68,030*	*$68,030*	*$272,120*	
SONCC-LEVR.27.1.39									
	SONCC-LEVR.27.1.39.1						$85,037	$85,037	CDFG
	Action Total:						*$85,037*	*$85,037*	
SONCC-LEVR.27.1.40									
	SONCC-LEVR.27.1.40.1	$8,722						$8,722	NMFS
	SONCC-LEVR.27.1.40.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-LEVR.27.2.41									
	SONCC-LEVR.27.2.41.1	$2,721						$2,721	CDFG
	Action Total:	*$2,721*						*$2,721*	
SONCC-LEVR.5.1.37									
	SONCC-LEVR.5.1.37.1	$36,770						$36,770	CDFG
	SONCC-LEVR.5.1.37.2	$261,630						$261,630	CDFG
	Action Total:	*$298,400*						*$298,400*	
SONCC-LEVR.7.1.1									
	SONCC-LEVR.7.1.1.1	$8,503						$8,503	County
	SONCC-LEVR.7.1.1.2	$34,015						$34,015	County
	Action Total:	*$42,518*						*$42,518*	
SONCC-LEVR.7.1.2									
	SONCC-LEVR.7.1.2.1	$34,015						$34,015	CDF
	SONCC-LEVR.7.1.2.2	$1,168,458						$1,168,458	CDF
	SONCC-LEVR.7.1.2.3	$8,372,160						$8,372,160	CDF
	Action Total:	*$9,574,633*						*$9,574,633*	
SONCC-LEVR.7.1.3									
	SONCC-LEVR.7.1.3.1	$5,669						$5,669	CDF
	Action Total:	*$5,669*						*$5,669*	
	Population Total:	***$453,129,091***	***$3,652,726***	***$4,170,656***	***$3,652,726***	***$4,170,656***	***$4,419,293***	***$473,195,149***	

Population: Guthrie Creek

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-GutC.8.1.3									
	SONCC-GutC.8.1.3.1							$0	Private
	SONCC-GutC.8.1.3.2							$0	Private
	SONCC-GutC.8.1.3.3							$0	Private
	Action Total:							*$0*	
SONCC-GutC.8.1.4									
	SONCC-GutC.8.1.4.1							$0	Private
	SONCC-GutC.8.1.4.2							$0	Private
	Action Total:							*$0*	
SONCC-GutC.27.2.5									
	SONCC-GutC.27.2.5.1	$81,800						$81,800	CDFG
	SONCC-GutC.27.2.5.2			$40,900				$40,900	CDFG
	Action Total:	*$81,800*		*$40,900*				*$122,700*	
SONCC-GutC.27.1.6									
	SONCC-GutC.27.1.6.1						$122,700	$122,700	ODFW
	Action Total:						*$122,700*	*$122,700*	
SONCC-GutC.27.2.7									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-GutC.27.2.7.1	$102,250			$102,250		$102,250	$306,750	ODFW
	Action Total:	*$102,250*			*$102,250*		*$102,250*	*$306,750*	
SONCC-GutC.27.1.8									
	SONCC-GutC.27.1.8.1	$8,722						$8,722	NMFS
	SONCC-GutC.27.1.8.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-GutC.27.2.9									
	SONCC-GutC.27.2.9.1	$2,721						$2,721	CDFG
	Action Total:	*$2,721*						*$2,721*	
SONCC-GutC.7.1.1									
	SONCC-GutC.7.1.1.1							$0	NRCS/RCD
	SONCC-GutC.7.1.1.2							$0	NRCS/RCD
	SONCC-GutC.7.1.1.3							$0	NRCS/RCD
	SONCC-GutC.7.1.1.4							$0	NRCS/RCD
	SONCC-GutC.7.1.1.5							$0	NRCS/RCD
	Action Total:							*$0*	
SONCC-GutC.7.1.2									
	SONCC-GutC.7.1.2.1							$0	NRCS/RCD
	Action Total:							*$0*	
	Population Total:	***$204,215***		***$40,900***	***$102,250***		***$224,950***	***$572,315***	

Population: Bear River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-BeaR.2.1.1									
	SONCC-BeaR.2.1.1.1	$34,015						$34,015	CDFG
	SONCC-BeaR.2.1.1.2	$1,095,700						$1,095,700	CDFG
	Action Total:	*$1,129,715*						*$1,129,715*	
SONCC-BeaR.7.1.5									
	SONCC-BeaR.7.1.5.1	$34,015						$34,015	NRCS/RCD
	SONCC-BeaR.7.1.5.2	$34,015						$34,015	NRCS/RCD
	SONCC-BeaR.7.1.5.3	$717,384						$717,384	NRCS/RCD
	SONCC-BeaR.7.1.5.4	$6,606						$6,606	NRCS/RCD
	SONCC-BeaR.7.1.5.5	$607						$607	NRCS/RCD
	Action Total:	*$792,627*						*$792,627*	
SONCC-BeaR.7.1.6									
	SONCC-BeaR.7.1.6.1							$0	County
	SONCC-BeaR.7.1.6.2							$0	County
	Action Total:							*$0*	
SONCC-BeaR.7.1.7									
	SONCC-BeaR.7.1.7.1	$5,669						$5,669	CDF
	Action Total:	*$5,669*						*$5,669*	
SONCC-BeaR.16.1.10									
	SONCC-BeaR.16.1.10.1	$1,744						$1,744	NMFS
	SONCC-BeaR.16.1.10.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-BeaR.16.1.11									
	SONCC-BeaR.16.1.11.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-BeaR.16.1.11.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-BeaR.16.2.12									
	SONCC-BeaR.16.2.12.1	$1,744						$1,744	NMFS
	SONCC-BeaR.16.2.12.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-BeaR.16.2.13									
	SONCC-BeaR.16.2.13.1	$1,744						$1,744	NMFS
	SONCC-BeaR.16.2.13.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-BeaR.3.1.8									
	SONCC-BeaR.3.1.8.1							$0	CDFG
	SONCC-BeaR.3.1.8.2							$0	CWQCB
	Action Total:							*$0*	
SONCC-BeaR.3.1.9									
	SONCC-BeaR.3.1.9.1							$0	CWQCB
	SONCC-BeaR.3.1.9.2							$0	CWQCB
	Action Total:							*$0*	
SONCC-BeaR.27.1.15									
	SONCC-BeaR.27.1.15.1						$122,700	$122,700	CDFG
	Action Total:						*$122,700*	*$122,700*	
SONCC-BeaR.27.1.16									
	SONCC-BeaR.27.1.16.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-BeaR.27.2.17									
	SONCC-BeaR.27.2.17.1	$81,800						$81,800	CDFG
	SONCC-BeaR.27.2.17.2			$40,900		$40,900		$81,800	CDFG
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-BeaR.27.2.18									
	SONCC-BeaR.27.2.18.1	$102,250			$102,250		$102,250	$306,750	CDFG
	Action Total:	*$102,250*			*$102,250*		*$102,250*	*$306,750*	
SONCC-BeaR.27.2.19									
	SONCC-BeaR.27.2.19.1	$102,250			$102,250	$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*			*$102,250*	*$102,250*	*$102,250*	*$409,000*	
SONCC-BeaR.27.2.21									
	SONCC-BeaR.27.2.21.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-BeaR.27.2.22									
	SONCC-BeaR.27.2.22.1							$0	CDFG
	Action Total:							*$0*	
SONCC-BeaR.27.1.23									
	SONCC-BeaR.27.1.23.1	$8,722						$8,722	NMFS
	SONCC-BeaR.27.1.23.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-BeaR.27.2.24									
	SONCC-BeaR.27.2.24.1	$2,721						$2,721	CDFG
	Action Total:	*$2,721*						*$2,721*	
SONCC-BeaR.8.1.2									
	SONCC-BeaR.8.1.2.1	$327,455						$327,455	CDFG
	SONCC-BeaR.8.1.2.2	$21,267,612						$21,267,612	CDFG

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-BeaR.8.1.2.3	$760,368						$760,368	CDFG
	SONCC-BeaR.8.1.2.4	$398,963	$398,963	$398,963	$398,963	$398,963	$398,963	$2,393,778	CDFG
	Action Total:	*$22,754,398*	*$398,963*	*$398,963*	*$398,963*	*$398,963*	*$398,963*	*$24,749,213*	
SONCC-BeaR.8.1.3									
	SONCC-BeaR.8.1.3.1	$2,267						$2,267	County
	Action Total:	*$2,267*						*$2,267*	
SONCC-BeaR.8.1.4									
	SONCC-BeaR.8.1.4.1							$0	CCC
	SONCC-BeaR.8.1.4.2							$0	CCC
	Action Total:							*$0*	
	Population Total:	***$25,116,063***	***$411,171***	***$554,321***	***$615,671***	***$656,571***	***$840,621***	***$28,194,418***	

Population: Mattole River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MatR.3.1.2									
	SONCC-MatR.3.1.2.1	$8,503						$8,503	County
	Action Total:	*$8,503*						*$8,503*	
SONCC-MatR.3.1.3									
	SONCC-MatR.3.1.3.1	$36,077						$36,077	County
	Action Total:	*$36,077*						*$36,077*	
SONCC-MatR.3.1.4									
	SONCC-MatR.3.1.4.1	$76,136						$76,136	NGO
	Action Total:	*$76,136*						*$76,136*	
SONCC-MatR.3.1.5									
	SONCC-MatR.3.1.5.1	$350,000	$350,000					$700,000	CDFG
	SONCC-MatR.3.1.5.2	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$15,000	CDFG
	Action Total:	*$352,500*	*$352,500*	*$2,500*	*$2,500*	*$2,500*	*$2,500*	*$715,000*	
SONCC-MatR.3.1.6									
	SONCC-MatR.3.1.6.1	$34,015						$34,015	CWQCB
	Action Total:	*$34,015*						*$34,015*	
SONCC-MatR.3.1.7									
	SONCC-MatR.3.1.7.1	$34,015						$34,015	CDFG
	Action Total:	*$34,015*						*$34,015*	
SONCC-MatR.3.1.8									
	SONCC-MatR.3.1.8.1	$6,128						$6,128	DWR
	Action Total:	*$6,128*						*$6,128*	
SONCC-MatR.3.1.9									
	SONCC-MatR.3.1.9.1	$5,218						$5,218	CWQCB
	Action Total:	*$5,218*						*$5,218*	
SONCC-MatR.3.2.10									
	SONCC-MatR.3.2.10.1	$34,015						$34,015	NGO
	SONCC-MatR.3.2.10.2	$6,000,000						$6,000,000	NGO
	SONCC-MatR.3.2.10.3	$125,000	$125,000					$250,000	NGO
	Action Total:	*$6,159,015*	*$125,000*					*$6,284,015*	
SONCC-MatR.1.2.11									
	SONCC-MatR.1.2.11.1	$34,015	$0	$0	$0	$0	$0	$34,015	BLM
	SONCC-MatR.1.2.11.2	$34,015	$0	$0	$0	$0	$0	$34,015	BLM
	SONCC-MatR.1.2.11.3	$148,000	$0	$0	$0	$0	$0	$148,000	BLM
	Action Total:	*$216,030*	*$0*	*$0*	*$0*	*$0*	*$0*	*$216,030*	
SONCC-MatR.1.2.35									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MatR.1.2.35.1	$34,015						$34,015	CDFG
	SONCC-MatR.1.2.35.2	$34,015						$34,015	CDFG
	Action Total:	*$68,030*						*$68,030*	
SONCC-MatR.16.1.21									
	SONCC-MatR.16.1.21.1	$1,744						$1,744	NMFS
	SONCC-MatR.16.1.21.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-MatR.16.1.22									
	SONCC-MatR.16.1.22.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-MatR.16.1.22.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-MatR.16.2.23									
	SONCC-MatR.16.2.23.1	$1,744						$1,744	NMFS
	SONCC-MatR.16.2.23.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-MatR.16.2.24									
	SONCC-MatR.16.2.24.1	$1,744						$1,744	NMFS
	SONCC-MatR.16.2.24.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-MatR.2.1.12									
	SONCC-MatR.2.1.12.1	$34,015						$34,015	NGO
	SONCC-MatR.2.1.12.2	$5,040,220						$5,040,220	NGO
	Action Total:	*$5,074,235*						*$5,074,235*	
SONCC-MatR.2.2.13									
	SONCC-MatR.2.2.13.1	$34,015						$34,015	NGO
	SONCC-MatR.2.2.13.2	$940,774						$940,774	NGO
	Action Total:	*$974,789*						*$974,789*	
SONCC-MatR.26.1.1									
	SONCC-MatR.26.1.1.1	$68,030						$68,030	CDFG
	SONCC-MatR.26.1.1.2	$500,000						$500,000	CDFG
	SONCC-MatR.26.1.1.3	$600,000	$600,000	$600,000				$1,800,000	CDFG
	SONCC-MatR.26.1.1.4	$1,250,000	$1,250,000	$1,250,000	$1,250,000			$5,000,000	CDFG
	Action Total:	*$2,418,030*	*$1,850,000*	*$1,850,000*	*$1,250,000*			*$7,368,030*	
SONCC-MatR.27.1.25									
	SONCC-MatR.27.1.25.1						$204,500	$204,500	CDFG
	Action Total:						*$204,500*	*$204,500*	
SONCC-MatR.27.1.26									
	SONCC-MatR.27.1.26.1						$85,037	$85,037	CDFG
	Action Total:						*$85,037*	*$85,037*	
SONCC-MatR.27.1.27									
	SONCC-MatR.27.1.27.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-MatR.27.2.28									
	SONCC-MatR.27.2.28.1	$81,800						$81,800	CDFG
	SONCC-MatR.27.2.28.2			$40,900		$40,900		$81,800	CDFG
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-MatR.27.2.29									
	SONCC-MatR.27.2.29.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-MatR.27.2.30									
	SONCC-MatR.27.2.30.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-MatR.27.2.31									
	SONCC-MatR.27.2.31.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-MatR.27.2.32									
	SONCC-MatR.27.2.32.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-MatR.27.2.33									
	SONCC-MatR.27.2.33.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFG
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-MatR.27.2.34									
	SONCC-MatR.27.2.34.1	$68,030		$68,030		$68,030	$68,030	$272,120	CDFG
	Action Total:	*$68,030*		*$68,030*		*$68,030*	*$68,030*	*$272,120*	
SONCC-MatR.27.1.36									
	SONCC-MatR.27.1.36.1	$122,700	$122,700	$122,700	$122,700	$122,700	$122,700	$736,200	CDFG
	Action Total:	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$736,200*	
SONCC-MatR.27.1.37									
	SONCC-MatR.27.1.37.1	$8,722						$8,722	NMFS
	SONCC-MatR.27.1.37.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-MatR.27.2.38									
	SONCC-MatR.27.2.38.1	$2,721						$2,721	CDFG
	Action Total:	*$2,721*						*$2,721*	
SONCC-MatR.5.1.19									
	SONCC-MatR.5.1.19.1	$17,008						$17,008	CDFG
	SONCC-MatR.5.1.19.2	$318,180						$318,180	CDFG
	Action Total:	*$335,188*						*$335,188*	
SONCC-MatR.7.1.14									
	SONCC-MatR.7.1.14.1	$34,015						$34,015	NRCS/RCD
	SONCC-MatR.7.1.14.2	$34,015						$34,015	NRCS/RCD
	SONCC-MatR.7.1.14.3	$889,204						$889,204	NRCS/RCD
	SONCC-MatR.7.1.14.4	$30,060						$30,060	NRCS/RCD
	SONCC-MatR.7.1.14.5	$1,214						$1,214	NRCS/RCD
	Action Total:	*$988,508*						*$988,508*	
SONCC-MatR.7.1.15									
	SONCC-MatR.7.1.15.1	$34,015						$34,015	NGO
	SONCC-MatR.7.1.15.2	$352,838						$352,838	NGO
	SONCC-MatR.7.1.15.3	$2,567,462						$2,567,462	NGO
	Action Total:	*$2,954,316*						*$2,954,316*	
SONCC-MatR.7.1.16									
	SONCC-MatR.7.1.16.1	$5,669						$5,669	CDF
	Action Total:	*$5,669*						*$5,669*	
SONCC-MatR.8.1.17									
	SONCC-MatR.8.1.17.1	$729,520						$729,520	NGO
	SONCC-MatR.8.1.17.2	$26,677,794						$26,677,794	NGO

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MatR.8.1.17.3	$4,895,693						$4,895,693	NGO
	SONCC-MatR.8.1.17.4	$1,419,066	$1,419,066	$1,419,066	$1,419,066	$1,419,066	$1,419,066	$8,514,396	NGO
	Action Total:	*$33,722,073*	*$1,419,066*	*$1,419,066*	*$1,419,066*	*$1,419,066*	*$1,419,066*	*$40,817,403*	
SONCC-MatR.8.1.18									
	SONCC-MatR.8.1.18.1	$450,728						$450,728	NRCS/RCD
	Action Total:	*$450,728*						*$450,728*	
	Population Total:	***$54,745,818***	***$3,983,724***	***$4,026,654***	***$2,908,724***	***$2,176,654***	***$2,425,291***	***$70,266,865***	
Population: Illinois River									
SONCC-IllR.2.2.7									
	SONCC-IllR.2.2.7.1	$34,015						$34,015	NGO
	SONCC-IllR.2.2.7.2	$4,397,094						$4,397,094	NGO
	Action Total:	*$4,431,109*						*$4,431,109*	
SONCC-IllR.2.2.8									
	SONCC-IllR.2.2.8.1	$34,015						$34,015	ODFW
	SONCC-IllR.2.2.8.2	$10,000						$10,000	ODFW
	Action Total:	*$44,015*						*$44,015*	
SONCC-IllR.2.1.9									
	SONCC-IllR.2.1.9.1	$34,015						$34,015	BLM
	Action Total:	*$34,015*						*$34,015*	
SONCC-IllR.2.1.34									
	SONCC-IllR.2.1.34.1	$34,015						$34,015	ODFW
	SONCC-IllR.2.1.34.2	$23,653,424						$23,653,424	ODFW
	Action Total:	*$23,687,439*						*$23,687,439*	
SONCC-IllR.3.1.4									
	SONCC-IllR.3.1.4.1	$36,770						$36,770	Oregon WRD
	SONCC-IllR.3.1.4.2	$73,540						$73,540	Oregon WRD
	Action Total:	*$110,310*						*$110,310*	
SONCC-IllR.3.1.5									
	SONCC-IllR.3.1.5.1	$5,218						$5,218	Oregon WRD
	Action Total:	*$5,218*						*$5,218*	
SONCC-IllR.3.1.6									
	SONCC-IllR.3.1.6.1	$76,136						$76,136	NGO
	Action Total:	*$76,136*						*$76,136*	
SONCC-IllR.5.1.16									
	SONCC-IllR.5.1.16.1	$34,015						$34,015	County
	SONCC-IllR.5.1.16.2	$1,526,158						$1,526,158	County
	Action Total:	*$1,560,173*						*$1,560,173*	
SONCC-IllR.7.1.10									
	SONCC-IllR.7.1.10.1	$8,503						$8,503	County
	SONCC-IllR.7.1.10.2	$34,015						$34,015	County
	Action Total:	*$42,518*						*$42,518*	
SONCC-IllR.7.1.11									
	SONCC-IllR.7.1.11.1	$34,015						$34,015	USFS
	SONCC-IllR.7.1.11.2	$1,655,528						$1,655,528	USFS
	SONCC-IllR.7.1.11.3	$12,000,096						$12,000,096	Private
	Action Total:	*$13,689,639*						*$13,689,639*	
SONCC-IllR.7.1.12									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-IIIR.7.1.12.1	$5,254						$5,254	ODF
	Action Total:	*$5,254*						*$5,254*	
SONCC-IIIR.7.1.31									
	SONCC-IIIR.7.1.31.1							$0	NMFS
	Action Total:							*$0*	
SONCC-IIIR.7.1.33									
	SONCC-IIIR.7.1.33.1	$34,015						$34,015	BLM
	Action Total:	*$34,015*						*$34,015*	
SONCC-IIIR.10.2.13									
	SONCC-IIIR.10.2.13.1	$76,136						$76,136	NRCS/RCD
	Action Total:	*$76,136*						*$76,136*	
SONCC-IIIR.10.1.32									
	SONCC-IIIR.10.1.32.1	$34,015						$34,015	BLM
	SONCC-IIIR.10.1.32.2	$34,015						$34,015	BLM
	Action Total:	*$68,030*						*$68,030*	
SONCC-IIIR.14.2.15									
	SONCC-IIIR.14.2.15.1	$68,030						$68,030	ODFW
	SONCC-IIIR.14.2.15.2	$1,148,522						$1,148,522	ODFW
	Action Total:	*$1,216,552*						*$1,216,552*	
SONCC-IIIR.1.2.35									
	SONCC-IIIR.1.2.35.1							$0	ODFW
	Action Total:							*$0*	
SONCC-IIIR.16.1.17									
	SONCC-IIIR.16.1.17.1	$1,744						$1,744	NMFS
	SONCC-IIIR.16.1.17.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-IIIR.16.1.18									
	SONCC-IIIR.16.1.18.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-IIIR.16.1.18.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-IIIR.16.2.19									
	SONCC-IIIR.16.2.19.1	$1,744						$1,744	NMFS
	SONCC-IIIR.16.2.19.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-IIIR.16.2.20									
	SONCC-IIIR.16.2.20.1	$1,744						$1,744	NMFS
	SONCC-IIIR.16.2.20.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-IIIR.27.1.21									
	SONCC-IIIR.27.1.21.1	$204,500	$204,500	$204,500	$204,500	$204,500	$204,500	$1,227,000	ODFW
	Action Total:	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$1,227,000*	
SONCC-IIIR.27.1.22									
	SONCC-IIIR.27.1.22.1	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$6,120,000	ODFW
	Action Total:	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$6,120,000*	
SONCC-IIIR.27.1.23									
	SONCC-IIIR.27.1.23.1						$85,037	$85,037	ODFW
	Action Total:						*$85,037*	*$85,037*	
SONCC-IIIR.27.1.24									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-IIIR.27.1.24.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	ODFW
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-IIIR.27.2.25									
	SONCC-IIIR.27.2.25.1	$81,800						$81,800	ODFW
	SONCC-IIIR.27.2.25.2			$40,900		$40,900		$81,800	ODFW
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-IIIR.27.2.26									
	SONCC-IIIR.27.2.26.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-IIIR.27.2.27									
	SONCC-IIIR.27.2.27.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-IIIR.27.2.28									
	SONCC-IIIR.27.2.28.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-IIIR.27.2.29									
	SONCC-IIIR.27.2.29.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-IIIR.27.2.30									
	SONCC-IIIR.27.2.30.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-IIIR.27.1.39									
	SONCC-IIIR.27.1.39.1	$8,722						$8,722	NMFS
	SONCC-IIIR.27.1.39.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-IIIR.27.1.40									
	SONCC-IIIR.27.1.40.1	$34,015						$34,015	ODFW
	Action Total:	*$34,015*						*$34,015*	
SONCC-IIIR.5.1.36									
	SONCC-IIIR.5.1.36.1	$34,015						$34,015	BLM
	SONCC-IIIR.5.1.36.2	$1,526,158						$1,526,158	BLM
	Action Total:	*$1,560,173*						*$1,560,173*	
SONCC-IIIR.8.1.1									
	SONCC-IIIR.8.1.1.1	$2,180,514						$2,180,514	Private
	SONCC-IIIR.8.1.1.2	$102,369,980						$102,369,980	Private
	SONCC-IIIR.8.1.1.3	$7,194,825						$7,194,825	Private
	SONCC-IIIR.8.1.1.4	$4,727,831	$4,727,831	$4,727,831	$4,727,831	$4,727,831	$4,727,831	$28,366,986	Private
	Action Total:	*$116,473,150*	*$4,727,831*	*$4,727,831*	*$4,727,831*	*$4,727,831*	*$4,727,831*	*$140,112,305*	
SONCC-IIIR.8.1.2									
	SONCC-IIIR.8.1.2.1	$11,338						$11,338	County
	Action Total:	*$11,338*						*$11,338*	
	Population Total:	***$165,016,901***	***$6,066,789***	***$6,516,689***	***$6,066,789***	***$6,516,689***	***$6,560,826***	***$196,744,683***	

Population: Middle Rogue and Applegate Rivers

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MRAR.2.1.2									
	SONCC-MRAR.2.1.2.1							$0	NGO
	Action Total:							*$0*	
SONCC-MRAR.2.2.10									
	SONCC-MRAR.2.2.10.1	$34,015						$34,015	NRCS/RCD

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MRAR.2.2.10.2	$4,881,797						$4,881,797	NRCS/RCD
	Action Total:	*$4,915,812*						*$4,915,812*	
SONCC-MRAR.2.2.11									
	SONCC-MRAR.2.2.11.1	$34,015						$34,015	ODFW
	SONCC-MRAR.2.2.11.2	$190,000						$190,000	ODFW
	Action Total:	*$224,015*						*$224,015*	
SONCC-MRAR.2.1.12									
	SONCC-MRAR.2.1.12.1							$0	ODFW
	Action Total:							*$0*	
SONCC-MRAR.2.1.13									
	SONCC-MRAR.2.1.13.1	$34,015						$34,015	NGO
	SONCC-MRAR.2.1.13.2	$26,154,359						$26,154,359	NGO
	Action Total:	*$26,188,374*						*$26,188,374*	
SONCC-MRAR.3.1.4									
	SONCC-MRAR.3.1.4.1	$76,136						$76,136	NGO
	Action Total:	*$76,136*						*$76,136*	
SONCC-MRAR.3.1.5									
	SONCC-MRAR.3.1.5.1	$73,540						$73,540	Oregon WRD
	SONCC-MRAR.3.1.5.2	$5,218						$5,218	Oregon WRD
	Action Total:	*$78,758*						*$78,758*	
SONCC-MRAR.3.1.31									
	SONCC-MRAR.3.1.31.1	$68,030						$68,030	USACE
	Action Total:	*$68,030*						*$68,030*	
SONCC-MRAR.5.1.15									
	SONCC-MRAR.5.1.15.1							$0	NGO
	SONCC-MRAR.5.1.15.2							$0	NGO
	Action Total:							*$0*	
SONCC-MRAR.7.1.7									
	SONCC-MRAR.7.1.7.1	$5,254						$5,254	ODF
	Action Total:	*$5,254*						*$5,254*	
SONCC-MRAR.7.1.8									
	SONCC-MRAR.7.1.8.1							$0	USFS
	SONCC-MRAR.7.1.8.2							$0	USFS
	SONCC-MRAR.7.1.8.3							$0	USFS
	Action Total:							*$0*	
SONCC-MRAR.7.1.9									
	SONCC-MRAR.7.1.9.1							$0	County
	SONCC-MRAR.7.1.9.2							$0	County
	Action Total:							*$0*	
SONCC-MRAR.7.1.30									
	SONCC-MRAR.7.1.30.1							$0	NMFS
	Action Total:							*$0*	
SONCC-MRAR.7.1.32									
	SONCC-MRAR.7.1.32.1	$34,015						$34,015	BLM
	Action Total:	*$34,015*						*$34,015*	
SONCC-MRAR.10.2.3									
	SONCC-MRAR.10.2.3.1							$0	County
	Action Total:							*$0*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MRAR.10.2.29									
	SONCC-MRAR.10.2.29.1	$136,060						$136,060	ODEQ
	Action Total:	*$136,060*						*$136,060*	
SONCC-MRAR.14.2.14									
	SONCC-MRAR.14.2.14.1							$0	ODFW
	SONCC-MRAR.14.2.14.2							$0	ODFW
	Action Total:							*$0*	
SONCC-MRAR.1.2.34									
	SONCC-MRAR.1.2.34.1							$0	ODFW
	Action Total:							*$0*	
SONCC-MRAR.16.1.16									
	SONCC-MRAR.16.1.16.1	$1,744						$1,744	NMFS
	SONCC-MRAR.16.1.16.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-MRAR.16.1.17									
	SONCC-MRAR.16.1.17.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-MRAR.16.1.17.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-MRAR.16.2.18									
	SONCC-MRAR.16.2.18.1	$1,744						$1,744	NMFS
	SONCC-MRAR.16.2.18.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-MRAR.16.2.19									
	SONCC-MRAR.16.2.19.1	$1,744						$1,744	NMFS
	SONCC-MRAR.16.2.19.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-MRAR.27.1.20									
	SONCC-MRAR.27.1.20.1						$204,500	$204,500	ODFW
	Action Total:						*$204,500*	*$204,500*	
SONCC-MRAR.27.1.21									
	SONCC-MRAR.27.1.21.1	$122,700	$122,700	$122,700	$122,700	$122,700	$122,700	$736,200	ODFW
	Action Total:	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$736,200*	
SONCC-MRAR.27.1.22									
	SONCC-MRAR.27.1.22.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	ODFW
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-MRAR.27.2.23									
	SONCC-MRAR.27.2.23.1	$81,800						$81,800	ODFW
	SONCC-MRAR.27.2.23.2			$40,900		$40,900		$81,800	ODFW
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-MRAR.27.2.24									
	SONCC-MRAR.27.2.24.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-MRAR.27.2.25									
	SONCC-MRAR.27.2.25.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-MRAR.27.2.26									
	SONCC-MRAR.27.2.26.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-MRAR.27.2.27									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MRAR.27.2.27.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-MRAR.27.2.28									
	SONCC-MRAR.27.2.28.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-MRAR.27.1.33									
	SONCC-MRAR.27.1.33.1						$85,037	$85,037	CDFG
	Action Total:						*$85,037*	*$85,037*	
SONCC-MRAR.27.1.36									
	SONCC-MRAR.27.1.36.1	$8,722						$8,722	NMFS
	SONCC-MRAR.27.1.36.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-MRAR.5.1.35									
	SONCC-MRAR.5.1.35.1							$0	USFS
	SONCC-MRAR.5.1.35.2							$0	USFS
	Action Total:							*$0*	
SONCC-MRAR.8.1.6									
	SONCC-MRAR.8.1.6.1							$0	USFS
	SONCC-MRAR.8.1.6.2							$0	USFS
	SONCC-MRAR.8.1.6.3							$0	USFS
	SONCC-MRAR.8.1.6.4							$0	USFS
	Action Total:							*$0*	
	Population Total:	***$32,482,320***	***$237,158***	***$687,058***	***$237,158***	***$687,058***	***$935,695***	***$35,266,447***	

Population: Upper Rogue River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-URR.2.2.9									
	SONCC-URR.2.2.9.1	$34,015						$34,015	FSA
	SONCC-URR.2.2.9.2	$7,976,124						$7,976,124	FSA
	Action Total:	*$8,010,139*						*$8,010,139*	
SONCC-URR.2.2.10									
	SONCC-URR.2.2.10.1	$34,015						$34,015	ODFW
	SONCC-URR.2.2.10.2	$10,000						$10,000	ODFW
	Action Total:	*$44,015*						*$44,015*	
SONCC-URR.2.1.11									
	SONCC-URR.2.1.11.1	$34,015						$34,015	BLM
	Action Total:	*$34,015*						*$34,015*	
SONCC-URR.3.1.4									
	SONCC-URR.3.1.4.1	$36,770						$36,770	Oregon WRD
	Action Total:	*$36,770*						*$36,770*	
SONCC-URR.3.1.5									
	SONCC-URR.3.1.5.1	$73,540						$73,540	Oregon WRD
	Action Total:	*$73,540*						*$73,540*	
SONCC-URR.3.1.6									
	SONCC-URR.3.1.6.1	$5,218						$5,218	Oregon WRD
	Action Total:	*$5,218*						*$5,218*	
SONCC-URR.3.1.7									
	SONCC-URR.3.1.7.1	$76,136						$76,136	NGO
	Action Total:	*$76,136*						*$76,136*	
SONCC-URR.3.1.8									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-URR.3.1.8.1	$36,770						$36,770	USACE
	SONCC-URR.3.1.8.2	$36,770						$36,770	USACE
	Action Total:	*$73,540*						*$73,540*	
SONCC-URR.5.1.20									
	SONCC-URR.5.1.20.1	$34,015						$34,015	County
	SONCC-URR.5.1.20.2	$2,703,479						$2,703,479	County
	Action Total:	*$2,737,494*						*$2,737,494*	
SONCC-URR.7.1.12									
	SONCC-URR.7.1.12.1	$8,503						$8,503	County
	SONCC-URR.7.1.12.2	$34,015						$34,015	County
	Action Total:	*$42,518*						*$42,518*	
SONCC-URR.7.1.13									
	SONCC-URR.7.1.13.1	$34,015						$34,015	USFS
	SONCC-URR.7.1.13.2	$2,991,456						$2,991,456	USFS
	SONCC-URR.7.1.13.3	$21,628,080						$21,628,080	USFS
	Action Total:	*$24,653,551*						*$24,653,551*	
SONCC-URR.7.1.14									
	SONCC-URR.7.1.14.1	$5,254						$5,254	ODF
	Action Total:	*$5,254*						*$5,254*	
SONCC-URR.7.1.36									
	SONCC-URR.7.1.36.1							$0	NMFS
	Action Total:							*$0*	
SONCC-URR.7.1.37									
	SONCC-URR.7.1.37.1	$34,015						$34,015	BLM
	Action Total:	*$34,015*						*$34,015*	
SONCC-URR.14.2.19									
	SONCC-URR.14.2.19.1	$68,030						$68,030	ODFW
	SONCC-URR.14.2.19.2	$2,068,150						$2,068,150	ODFW
	Action Total:	*$2,136,180*						*$2,136,180*	
SONCC-URR.1.2.39									
	SONCC-URR.1.2.39.1							$0	ODFW
	Action Total:							*$0*	
SONCC-URR.16.1.21									
	SONCC-URR.16.1.21.1	$1,744						$1,744	NMFS
	SONCC-URR.16.1.21.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-URR.16.1.22									
	SONCC-URR.16.1.22.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-URR.16.1.22.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-URR.16.2.23									
	SONCC-URR.16.2.23.1	$1,744						$1,744	NMFS
	SONCC-URR.16.2.23.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-URR.16.2.24									
	SONCC-URR.16.2.24.1	$1,744						$1,744	NMFS
	SONCC-URR.16.2.24.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-URR.27.1.25									
	SONCC-URR.27.1.25.1						$204,500	$204,500	ODFW
	Action Total:						*$204,500*	*$204,500*	
SONCC-URR.27.1.26									
	SONCC-URR.27.1.26.1						$85,037	$85,037	ODFW
	Action Total:						*$85,037*	*$85,037*	
SONCC-URR.27.1.27									
	SONCC-URR.27.1.27.1	$6,803	$6,803	$6,803	$6,803	$6,803	$6,803	$40,818	ODFW
	Action Total:	*$6,803*	*$6,803*	*$6,803*	*$6,803*	*$6,803*	*$6,803*	*$40,818*	
SONCC-URR.27.1.28									
	SONCC-URR.27.1.28.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	ODFW
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-URR.27.1.29									
	SONCC-URR.27.1.29.1	$42,518	$42,518	$42,518	$42,518	$42,518	$42,518	$255,108	ODFW
	Action Total:	*$42,518*	*$42,518*	*$42,518*	*$42,518*	*$42,518*	*$42,518*	*$255,108*	
SONCC-URR.27.2.30									
	SONCC-URR.27.2.30.1	$81,800						$81,800	ODFW
	SONCC-URR.27.2.30.2			$40,900		$40,900		$81,800	ODFW
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-URR.27.2.31									
	SONCC-URR.27.2.31.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-URR.27.2.32									
	SONCC-URR.27.2.32.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-URR.27.2.33									
	SONCC-URR.27.2.33.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-URR.27.2.34									
	SONCC-URR.27.2.34.1	$102,250		$102,250		$102,250	$102,250	$409,000	ODFW
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-URR.27.2.35									
	SONCC-URR.27.2.35.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-URR.27.1.38									
	SONCC-URR.27.1.38.1	$122,700	$122,700	$122,700	$122,700	$122,700	$122,700	$736,200	ODFW
	Action Total:	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$736,200*	
SONCC-URR.27.1.41									
	SONCC-URR.27.1.41.1	$8,722						$8,722	NMFS
	SONCC-URR.27.1.41.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-URR.5.1.40									
	SONCC-URR.5.1.40.1	$34,015						$34,015	USFS
	SONCC-URR.5.1.40.2	$2,703,479						$2,703,479	USFS
	Action Total:	*$2,737,494*						*$2,737,494*	
SONCC-URR.8.1.1									
	SONCC-URR.8.1.1.1	$9,080,364						$9,080,364	Private
	SONCC-URR.8.1.1.2	$141,395,000						$141,395,000	Private
	SONCC-URR.8.1.1.3	$14,535,000						$14,535,000	Private

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-URR.8.1.1.4	$2,389,000	$2,389,000	$2,389,000	$2,389,000	$2,389,000	$2,389,000	$14,334,000	Private
	Action Total:	*$167,399,364*	*$2,389,000*	*$2,389,000*	*$2,389,000*	*$2,389,000*	*$2,389,000*	*$179,344,364*	
SONCC-URR.8.1.2									
	SONCC-URR.8.1.2.1	$11,338						$11,338	County
	Action Total:	*$11,338*						*$11,338*	
SONCC-URR.10.2.15									
	SONCC-URR.10.2.15.1	$76,136						$76,136	County
	Action Total:	*$76,136*						*$76,136*	
SONCC-URR.10.2.16									
	SONCC-URR.10.2.16.1	$34,015						$34,015	County
	Action Total:	*$34,015*						*$34,015*	
SONCC-URR.10.2.17									
	SONCC-URR.10.2.17.1	$34,015						$34,015	County
	SONCC-URR.10.2.17.2	$34,015						$34,015	County
	Action Total:	*$68,030*						*$68,030*	
	Population Total:	***$209,093,949***	***$2,675,479***	***$3,125,379***	***$2,675,479***	***$3,125,379***	***$3,374,016***	***$224,069,681***	

Population: Mid Klamath River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MKR.2.2.1									
	SONCC-MKR.2.2.1.1	$34,015						$34,015	BIA/Tribe
	SONCC-MKR.2.2.1.2	$102,258						$102,258	BIA/Tribe
	Action Total:	*$136,273*						*$136,273*	
SONCC-MKR.2.2.2									
	SONCC-MKR.2.2.2.1	$34,015						$34,015	BIA/Tribe
	SONCC-MKR.2.2.2.2	$10,000						$10,000	BIA/Tribe
	Action Total:	*$44,015*						*$44,015*	
SONCC-MKR.2.2.3									
	SONCC-MKR.2.2.3.1							$0	CDFG
	Action Total:							*$0*	
SONCC-MKR.2.2.4									
	SONCC-MKR.2.2.4.1	$36,770						$36,770	BIA/Tribe
	SONCC-MKR.2.2.4.2	$232,560						$232,560	BIA/Tribe
	Action Total:	*$269,330*						*$269,330*	
SONCC-MKR.2.2.5									
	SONCC-MKR.2.2.5.1	$89,080						$89,080	USFS
	SONCC-MKR.2.2.5.2	$1,800,000						$1,800,000	USFS
	Action Total:	*$1,889,080*						*$1,889,080*	
SONCC-MKR.2.1.6									
	SONCC-MKR.2.1.6.1	$34,015						$34,015	BIA/Tribe
	SONCC-MKR.2.1.6.2	$403,902						$403,902	BIA/Tribe
	Action Total:	*$437,917*						*$437,917*	
SONCC-MKR.8.1.20									
	SONCC-MKR.8.1.20.1							$0	USFS
	SONCC-MKR.8.1.20.2							$0	USFS
	Action Total:							*$0*	
SONCC-MKR.8.1.21									
	SONCC-MKR.8.1.21.1							$0	USFS
	SONCC-MKR.8.1.21.2							$0	USFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MKR.8.1.21.3							$0	USFS
	SONCC-MKR.8.1.21.4							$0	USFS
	Action Total:							*$0*	
SONCC-MKR.10.3.10									
	SONCC-MKR.10.3.10.1	$34,015						$34,015	CDFG
	Action Total:	*$34,015*						*$34,015*	
SONCC-MKR.10.3.11									
	SONCC-MKR.10.3.11.1							$0	CDFG
	Action Total:							*$0*	
SONCC-MKR.10.3.12									
	SONCC-MKR.10.3.12.1	$68,030						$68,030	CDFG
	Action Total:	*$68,030*						*$68,030*	
SONCC-MKR.10.2.13									
	SONCC-MKR.10.2.13.1	$34,015						$34,015	BIA/Tribe
	SONCC-MKR.10.2.13.2	$4,217,623						$4,217,623	BIA/Tribe
	Action Total:	*$4,251,638*						*$4,251,638*	
SONCC-MKR.1.2.43									
	SONCC-MKR.1.2.43.1							$0	BIA/Tribe
	Action Total:							*$0*	
SONCC-MKR.16.1.28									
	SONCC-MKR.16.1.28.1	$1,744						$1,744	NMFS
	SONCC-MKR.16.1.28.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-MKR.16.1.29									
	SONCC-MKR.16.1.29.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-MKR.16.1.29.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-MKR.16.2.30									
	SONCC-MKR.16.2.30.1	$1,744						$1,744	NMFS
	SONCC-MKR.16.2.30.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-MKR.16.2.31									
	SONCC-MKR.16.2.31.1	$1,744						$1,744	NMFS
	SONCC-MKR.16.2.31.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-MKR.3.1.15									
	SONCC-MKR.3.1.15.1	$68,030						$68,030	CDFG
	SONCC-MKR.3.1.15.2	$96,692						$96,692	CDFG
	Action Total:	*$164,722*						*$164,722*	
SONCC-MKR.3.1.16									
	SONCC-MKR.3.1.16.1							$0	NGO
	Action Total:							*$0*	
SONCC-MKR.3.1.17									
	SONCC-MKR.3.1.17.1	$34,015						$34,015	CDFG
	Action Total:	*$34,015*						*$34,015*	
SONCC-MKR.3.1.18									
	SONCC-MKR.3.1.18.1	$6,128						$6,128	DWR
	Action Total:	*$6,128*						*$6,128*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MKR.3.1.19									
	SONCC-MKR.3.1.19.1	$5,218						$5,218	CWQCB
	Action Total:	*$5,218*						*$5,218*	
SONCC-MKR.3.1.42									
	SONCC-MKR.3.1.42.1	$104,554						$104,554	BIA/Tribe
	SONCC-MKR.3.1.42.2	$39,957	$39,957	$39,957	$39,957	$39,957	$39,957	$239,742	BIA/Tribe
	Action Total:	*$144,511*	*$39,957*	*$39,957*	*$39,957*	*$39,957*	*$39,957*	*$344,296*	
SONCC-MKR.27.1.32									
	SONCC-MKR.27.1.32.1	$150,000						$150,000	CDFG
	Action Total:	*$150,000*						*$150,000*	
SONCC-MKR.27.1.33									
	SONCC-MKR.27.1.33.1						$204,500	$204,500	CDFG
	Action Total:						*$204,500*	*$204,500*	
SONCC-MKR.27.1.34									
	SONCC-MKR.27.1.34.1	$122,700	$122,700	$122,700	$122,700	$122,700	$122,700	$736,200	CDFG
	Action Total:	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$736,200*	
SONCC-MKR.27.1.35									
	SONCC-MKR.27.1.35.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-MKR.27.1.36									
	SONCC-MKR.27.1.36.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFG
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-MKR.27.2.37									
	SONCC-MKR.27.2.37.1	$81,800						$81,800	CDFG
	SONCC-MKR.27.2.37.2			$40,900		$40,900		$81,800	CDFG
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-MKR.27.2.38									
	SONCC-MKR.27.2.38.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-MKR.27.2.39									
	SONCC-MKR.27.2.39.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-MKR.27.2.40									
	SONCC-MKR.27.2.40.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-MKR.27.2.41									
	SONCC-MKR.27.2.41.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFG
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-MKR.27.1.44									
	SONCC-MKR.27.1.44.1	$8,722						$8,722	NMFS
	SONCC-MKR.27.1.44.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-MKR.5.1.22									
	SONCC-MKR.5.1.22.1	$36,770						$36,770	BIA/Tribe
	SONCC-MKR.5.1.22.2	$261,630						$261,630	BIA/Tribe
	Action Total:	*$298,400*						*$298,400*	
SONCC-MKR.5.1.23									
	SONCC-MKR.5.1.23.1							$0	BIA/Tribe
	SONCC-MKR.5.1.23.2							$0	BIA/Tribe

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:							*$0*	
SONCC-MKR.5.1.24									
	SONCC-MKR.5.1.24.1	$34,015						$34,015	Caltrans
	SONCC-MKR.5.1.24.2	$318,180						$318,180	Caltrans
	Action Total:	*$352,195*						*$352,195*	
SONCC-MKR.5.1.25									
	SONCC-MKR.5.1.25.1							$0	BIA/Tribe
	SONCC-MKR.5.1.25.2							$0	BIA/Tribe
	Action Total:							*$0*	
SONCC-MKR.5.1.26									
	SONCC-MKR.5.1.26.1							$0	BIA/Tribe
	SONCC-MKR.5.1.26.2							$0	BIA/Tribe
	Action Total:							*$0*	
SONCC-MKR.5.2.27									
	SONCC-MKR.5.2.27.1	$44,540						$44,540	CDFG
	SONCC-MKR.5.2.27.2	$170,460						$170,460	CDFG
	Action Total:	*$215,000*						*$215,000*	
SONCC-MKR.7.1.7									
	SONCC-MKR.7.1.7.1							$0	NRCS/RCD
	SONCC-MKR.7.1.7.2							$0	NRCS/RCD
	SONCC-MKR.7.1.7.3							$0	NRCS/RCD
	SONCC-MKR.7.1.7.4							$0	NRCS/RCD
	SONCC-MKR.7.1.7.5							$0	NRCS/RCD
	Action Total:							*$0*	
SONCC-MKR.7.1.8									
	SONCC-MKR.7.1.8.1							$0	USFS
	SONCC-MKR.7.1.8.2							$0	USFS
	SONCC-MKR.7.1.8.3							$0	USFS
	Action Total:							*$0*	
SONCC-MKR.7.1.9									
	SONCC-MKR.7.1.9.1							$0	USFS
	SONCC-MKR.7.1.9.2							$0	USFS
	SONCC-MKR.7.1.9.3							$0	USFS
	Action Total:							*$0*	
	Population Total:	***$9,256,353***	***$379,365***	***$727,015***	***$379,365***	***$727,015***	***$890,615***	***$12,359,728***	

Population: Upper Klamath River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-UKR.2.2.1									
	SONCC-UKR.2.2.1.1	$89,080						$89,080	CDFG
	SONCC-UKR.2.2.1.2	$217,969						$217,969	CDFG
	Action Total:	*$307,049*						*$307,049*	
SONCC-UKR.2.2.2									
	SONCC-UKR.2.2.2.1	$36,770						$36,770	USFS
	SONCC-UKR.2.2.2.2	$174,420						$174,420	USFS
	Action Total:	*$211,190*						*$211,190*	
SONCC-UKR.2.2.3									
	SONCC-UKR.2.2.3.1	$34,015						$34,015	USFS
	SONCC-UKR.2.2.3.2	$3,333,611						$3,333,611	USFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$3,367,626*						*$3,367,626*	
SONCC-UKR.2.1.4									
	SONCC-UKR.2.1.4.1	$34,015						$34,015	USFS
	SONCC-UKR.2.1.4.2	$17,805,125						$17,805,125	USFS
	Action Total:	*$17,839,140*						*$17,839,140*	
SONCC-UKR.3.1.5									
	SONCC-UKR.3.1.5.1	$73,540						$73,540	BOR
	SONCC-UKR.3.1.5.2	$91,925	$91,925					$183,850	BOR
	Action Total:	*$165,465*	*$91,925*					*$257,390*	
SONCC-UKR.3.1.6									
	SONCC-UKR.3.1.6.1	$68,030						$68,030	NRCS/RCD
	SONCC-UKR.3.1.6.2	$76,136						$76,136	NRCS/RCD
	SONCC-UKR.3.1.6.3	$73,540						$73,540	DWR
	Action Total:	*$217,706*						*$217,706*	
SONCC-UKR.3.1.7									
	SONCC-UKR.3.1.7.1							$0	NGO
	Action Total:							*$0*	
SONCC-UKR.3.1.8									
	SONCC-UKR.3.1.8.1	$34,015						$34,015	CDFG
	Action Total:	*$34,015*						*$34,015*	
SONCC-UKR.3.1.9									
	SONCC-UKR.3.1.9.1	$6,128						$6,128	DWR
	Action Total:	*$6,128*						*$6,128*	
SONCC-UKR.3.2.10									
	SONCC-UKR.3.2.10.1	$5,218						$5,218	CWQCB
	Action Total:	*$5,218*						*$5,218*	
SONCC-UKR.3.2.11									
	SONCC-UKR.3.2.11.1	$34,015						$34,015	CDFG
	SONCC-UKR.3.2.11.2	$130,000						$130,000	CDFG
	Action Total:	*$164,015*						*$164,015*	
SONCC-UKR.3.2.12									
	SONCC-UKR.3.2.12.1							$0	CDFG
	Action Total:							*$0*	
SONCC-UKR.3.1.48									
	SONCC-UKR.3.1.48.1							$0	USFS
	SONCC-UKR.3.1.48.2							$0	USFS
	Action Total:							*$0*	
SONCC-UKR.5.1.19									
	SONCC-UKR.5.1.19.1	$450,000,000						$450,000,000	BOR
	Action Total:	*$450,000,000*						*$450,000,000*	
SONCC-UKR.5.1.20									
	SONCC-UKR.5.1.20.1	$36,770						$36,770	BIA/Tribe
	SONCC-UKR.5.1.20.2	$116,280						$116,280	BIA/Tribe
	Action Total:	*$153,050*						*$153,050*	
SONCC-UKR.5.1.21									
	SONCC-UKR.5.1.21.1	$44,540						$44,540	CDFG
	SONCC-UKR.5.1.21.2	$639,534						$639,534	CDFG
	Action Total:	*$684,074*						*$684,074*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-UKR.5.1.22									
	SONCC-UKR.5.1.22.1							$0	CDFG
	SONCC-UKR.5.1.22.2							$0	CDFG
	SONCC-UKR.5.1.22.3							$0	CDFG
	SONCC-UKR.5.1.22.4							$0	CDFG
	Action Total:							*$0*	
SONCC-UKR.5.1.23									
	SONCC-UKR.5.1.23.1							$0	BIA/Tribe
	SONCC-UKR.5.1.23.2							$0	BIA/Tribe
	Action Total:							*$0*	
SONCC-UKR.5.2.24									
	SONCC-UKR.5.2.24.1	$44,540						$44,540	CDFG
	SONCC-UKR.5.2.24.2	$170,460						$170,460	CDFG
	Action Total:	*$215,000*						*$215,000*	
SONCC-UKR.10.1.16									
	SONCC-UKR.10.1.16.1	$34,015						$34,015	NRCS/RCD
	SONCC-UKR.10.1.16.2	$164,948						$164,948	NRCS/RCD
	Action Total:	*$198,963*						*$198,963*	
SONCC-UKR.14.1.25									
	SONCC-UKR.14.1.25.1	$68,030						$68,030	NMFS
	SONCC-UKR.14.1.25.2	$68,030						$68,030	NMFS
	Action Total:	*$136,060*						*$136,060*	
SONCC-UKR.14.1.26									
	SONCC-UKR.14.1.26.1	$68,030						$68,030	CDFG
	SONCC-UKR.14.1.26.2	$68,030						$68,030	CDFG
	Action Total:	*$136,060*						*$136,060*	
SONCC-UKR.1.2.49									
	SONCC-UKR.1.2.49.1							$0	CDFG
	Action Total:							*$0*	
SONCC-UKR.16.1.30									
	SONCC-UKR.16.1.30.1	$1,744						$1,744	NMFS
	SONCC-UKR.16.1.30.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-UKR.16.1.31									
	SONCC-UKR.16.1.31.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-UKR.16.1.31.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-UKR.16.2.32									
	SONCC-UKR.16.2.32.1	$1,744						$1,744	NMFS
	SONCC-UKR.16.2.32.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-UKR.16.2.33									
	SONCC-UKR.16.2.33.1	$1,744						$1,744	NMFS
	SONCC-UKR.16.2.33.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-UKR.17.2.18									
	SONCC-UKR.17.2.18.2	$68,030						$68,030	CDFG
	Action Total:	*$68,030*						*$68,030*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-UKR.27.1.34									
	SONCC-UKR.27.1.34.1	$150,000						$150,000	CDFG
	Action Total:	*$150,000*						*$150,000*	
SONCC-UKR.27.1.35									
	SONCC-UKR.27.1.35.1	$204,500	$204,500	$204,500	$204,500	$204,500	$204,500	$1,227,000	CDFG
	Action Total:	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$1,227,000*	
SONCC-UKR.27.1.36									
	SONCC-UKR.27.1.36.1	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$6,120,000	CDFG
	Action Total:	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$6,120,000*	
SONCC-UKR.27.1.37									
	SONCC-UKR.27.1.37.1						$85,037	$85,037	CDFG
	Action Total:						*$85,037*	*$85,037*	
SONCC-UKR.27.1.38									
	SONCC-UKR.27.1.38.1	$6,803	$6,803	$6,803	$6,803	$6,803	$6,803	$40,818	CDFG
	Action Total:	*$6,803*	*$6,803*	*$6,803*	*$6,803*	*$6,803*	*$6,803*	*$40,818*	
SONCC-UKR.27.1.39									
	SONCC-UKR.27.1.39.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-UKR.27.1.40									
	SONCC-UKR.27.1.40.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFG
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-UKR.27.1.41									
	SONCC-UKR.27.1.41.1	$42,518	$42,518	$42,518	$42,518	$42,518	$42,518	$255,108	CDFG
	Action Total:	*$42,518*	*$42,518*	*$42,518*	*$42,518*	*$42,518*	*$42,518*	*$255,108*	
SONCC-UKR.27.2.42									
	SONCC-UKR.27.2.42.1	$81,800						$81,800	CDFG
	SONCC-UKR.27.2.42.2			$40,900		$40,900		$81,800	CDFG
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-UKR.27.2.43									
	SONCC-UKR.27.2.43.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-UKR.27.2.44									
	SONCC-UKR.27.2.44.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-UKR.27.2.45									
	SONCC-UKR.27.2.45.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-UKR.27.2.46									
	SONCC-UKR.27.2.46.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-UKR.27.2.47									
	SONCC-UKR.27.2.47.1	$102,250	$102,250	$102,250	$102,250	$102,250		$511,250	CDFG
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*		*$511,250*	
SONCC-UKR.27.1.50									
	SONCC-UKR.27.1.50.1	$8,722						$8,722	NMFS
	SONCC-UKR.27.1.50.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-UKR.7.1.13									
	SONCC-UKR.7.1.13.1	$34,015						$34,015	NRCS/RCD

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-UKR.7.1.13.2	$34,015						$34,015	NRCS/RCD
	SONCC-UKR.7.1.13.3	$3,142,744						$3,142,744	NRCS/RCD
	SONCC-UKR.7.1.13.4	$106,237						$106,237	NRCS/RCD
	SONCC-UKR.7.1.13.5	$4,249						$4,249	NRCS/RCD
	Action Total:	*$3,321,260*						*$3,321,260*	
SONCC-UKR.7.1.14									
	SONCC-UKR.7.1.14.1							$0	USFS
	SONCC-UKR.7.1.14.2							$0	USFS
	SONCC-UKR.7.1.14.3							$0	USFS
	Action Total:							*$0*	
SONCC-UKR.7.1.15									
	SONCC-UKR.7.1.15.1							$0	USFS
	SONCC-UKR.7.1.15.2							$0	USFS
	Action Total:							*$0*	
SONCC-UKR.8.2.27									
	SONCC-UKR.8.2.27.1	$36,770						$36,770	BIA/Tribe
	SONCC-UKR.8.2.27.2	$336,000	$336,000	$336,000	$336,000	$336,000	$336,000	$2,016,000	BIA/Tribe
	Action Total:	*$372,770*	*$336,000*	*$336,000*	*$336,000*	*$336,000*	*$336,000*	*$2,052,770*	
SONCC-UKR.8.1.28									
	SONCC-UKR.8.1.28.1	$3,298,209						$3,298,209	USFS
	SONCC-UKR.8.1.28.2	$43,468,086						$43,468,086	USFS
	SONCC-UKR.8.1.28.3	$20,444,793						$20,444,793	USFS
	SONCC-UKR.8.1.28.4	$6,693,978	$6,693,978	$6,693,978	$6,693,978	$6,693,978	$6,693,978	$40,163,868	USFS
	Action Total:	*$73,905,066*	*$6,693,978*	*$6,693,978*	*$6,693,978*	*$6,693,978*	*$6,693,978*	*$107,374,956*	
SONCC-UKR.8.1.29									
	SONCC-UKR.8.1.29.1	$476,278						$476,278	USFS
	SONCC-UKR.8.1.29.2	$18,110,610						$18,110,610	USFS
	Action Total:	*$18,586,888*						*$18,586,888*	
	Population Total:	***$572,254,011***	***$8,612,432***	***$8,970,407***	***$8,520,507***	***$8,970,407***	***$8,912,294***	***$616,240,058***	

Population: Salmon River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-SalR.2.1.7									
	SONCC-SalR.2.1.7.1	$34,015						$34,015	USFS
	SONCC-SalR.2.1.7.2	$191,748						$191,748	USFS
	Action Total:	*$225,763*						*$225,763*	
SONCC-SalR.2.1.8									
	SONCC-SalR.2.1.8.1	$34,015						$34,015	USFS
	SONCC-SalR.2.1.8.2	$102,258						$102,258	USFS
	Action Total:	*$136,273*						*$136,273*	
SONCC-SalR.7.1.1									
	SONCC-SalR.7.1.1.1	$34,015						$34,015	USFS
	SONCC-SalR.7.1.1.2	$13,423						$13,423	USFS
	SONCC-SalR.7.1.1.3	$97,675						$97,675	USFS
	SONCC-SalR.7.1.1.4	$4,389						$4,389	USFS
	Action Total:	*$149,502*						*$149,502*	
SONCC-SalR.7.1.2									
	SONCC-SalR.7.1.2.1							$0	USFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-SalR.7.1.2.2							$0	USFS
	Action Total:							*$0*	
SONCC-SalR.10.3.5									
	SONCC-SalR.10.3.5.1	$34,015						$34,015	USFS
	SONCC-SalR.10.3.5.2	$76,136						$76,136	USFS
	Action Total:	*$110,151*						*$110,151*	
SONCC-SalR.10.2.6									
	SONCC-SalR.10.2.6.1	$48,346						$48,346	EPA
	SONCC-SalR.10.2.6.2	$34,015						$34,015	EPA
	Action Total:	*$82,361*						*$82,361*	
SONCC-SalR.1.2.20									
	SONCC-SalR.1.2.20.1							$0	BIA/Tribe
	Action Total:							*$0*	
SONCC-SalR.16.1.11									
	SONCC-SalR.16.1.11.1	$1,744						$1,744	NMFS
	SONCC-SalR.16.1.11.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-SalR.16.1.12									
	SONCC-SalR.16.1.12.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-SalR.16.1.12.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-SalR.16.2.13									
	SONCC-SalR.16.2.13.1	$1,744						$1,744	NMFS
	SONCC-SalR.16.2.13.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-SalR.16.2.14									
	SONCC-SalR.16.2.14.1	$1,744						$1,744	NMFS
	SONCC-SalR.16.2.14.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-SalR.3.1.4									
	SONCC-SalR.3.1.4.1	$34,015						$34,015	CDFG
	SONCC-SalR.3.1.4.2	$34,015						$34,015	CWQCB
	Action Total:	*$68,030*						*$68,030*	
SONCC-SalR.27.1.15									
	SONCC-SalR.27.1.15.1						$204,500	$204,500	CDFG
	Action Total:						*$204,500*	*$204,500*	
SONCC-SalR.27.1.16									
	SONCC-SalR.27.1.16.1	$122,700	$122,700	$122,700	$122,700	$122,700	$122,700	$736,200	CDFG
	Action Total:	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$736,200*	
SONCC-SalR.27.1.17									
	SONCC-SalR.27.1.17.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-SalR.27.2.18									
	SONCC-SalR.27.2.18.1	$81,800						$81,800	CDFG
	SONCC-SalR.27.2.18.2				$40,900		$40,900	$81,800	CDFG
	Action Total:	*$81,800*			*$40,900*		*$40,900*	*$163,600*	
SONCC-SalR.27.1.19									
	SONCC-SalR.27.1.19.1						$85,037	$85,037	CDFG

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:						*$85,037*	*$85,037*	
SONCC-SalR.27.2.21									
	SONCC-SalR.27.2.21.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-SalR.27.2.22									
	SONCC-SalR.27.2.22.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-SalR.27.2.23									
	SONCC-SalR.27.2.23.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-SalR.27.1.24									
	SONCC-SalR.27.1.24.1	$8,722						$8,722	NMFS
	SONCC-SalR.27.1.24.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-SalR.5.1.9									
	SONCC-SalR.5.1.9.1	$44,540						$44,540	USFS
	SONCC-SalR.5.1.9.2	$1,395,344						$1,395,344	USFS
	Action Total:	*$1,439,884*						*$1,439,884*	
SONCC-SalR.5.1.10									
	SONCC-SalR.5.1.10.1	$29,070						$29,070	USFS
	SONCC-SalR.5.1.10.2	$17,007						$17,007	USFS
	Action Total:	*$46,077*						*$46,077*	
SONCC-SalR.8.1.3									
	SONCC-SalR.8.1.3.1							$0	USFS
	SONCC-SalR.8.1.3.2							$0	USFS
	SONCC-SalR.8.1.3.3							$0	USFS
	SONCC-SalR.8.1.3.4							$0	USFS
	Action Total:							*$0*	
	Population Total:	***$2,809,406***	***$134,908***	***$441,658***	***$175,808***	***$441,658***	***$772,095***	***$4,775,533***	

Population: Scott River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-ScoR.2.2.20									
	SONCC-ScoR.2.2.20.1	$34,015						$34,015	CDFG
	SONCC-ScoR.2.2.20.2	$5,010,642						$5,010,642	CDFG
	Action Total:	*$5,044,657*						*$5,044,657*	
SONCC-ScoR.2.2.21									
	SONCC-ScoR.2.2.21.1	$34,015						$34,015	NGO
	SONCC-ScoR.2.2.21.2	$8,435,246						$8,435,246	NGO
	Action Total:	*$8,469,261*						*$8,469,261*	
SONCC-ScoR.2.2.22									
	SONCC-ScoR.2.2.22.1	$34,015						$34,015	CDFG
	SONCC-ScoR.2.2.22.2	$100,000						$100,000	CDFG
	Action Total:	*$134,015*						*$134,015*	
SONCC-ScoR.2.2.24									
	SONCC-ScoR.2.2.24.1	$89,080						$89,080	NGO
	SONCC-ScoR.2.2.24.2	$326,859						$326,859	NGO
	Action Total:	*$415,939*						*$415,939*	
SONCC-ScoR.2.1.25									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-ScoR.2.1.25.1	$34,015						$34,015	NGO
	SONCC-ScoR.2.1.25.2	$26,735,080						$26,735,080	NGO
	Action Total:	*$26,769,095*						*$26,769,095*	
SONCC-ScoR.3.1.1									
	SONCC-ScoR.3.1.1.1	$36,770						$36,770	DWR
	SONCC-ScoR.3.1.1.2	$36,770						$36,770	DWR
	SONCC-ScoR.3.1.1.3	$36,770						$36,770	DWR
	Action Total:	*$110,310*						*$110,310*	
SONCC-ScoR.3.1.2									
	SONCC-ScoR.3.1.2.1	$130,680						$130,680	Watermaster Dst
	SONCC-ScoR.3.1.2.2	$198,875						$198,875	Watermaster Dst
	SONCC-ScoR.3.1.2.3	$25,780						$25,780	Watermaster Dst
	Action Total:	*$355,335*						*$355,335*	
SONCC-ScoR.3.1.3									
	SONCC-ScoR.3.1.3.1	$367,700						$367,700	Watermaster Dst
	SONCC-ScoR.3.1.3.2	$36,770						$36,770	Watermaster Dst
	Action Total:	*$404,470*						*$404,470*	
SONCC-ScoR.3.1.4									
	SONCC-ScoR.3.1.4.1	$73,540						$73,540	NRCS/RCD
	SONCC-ScoR.3.1.4.2	$34,015						$34,015	NRCS/RCD
	SONCC-ScoR.3.1.4.3	$100,000						$100,000	NRCS/RCD
	SONCC-ScoR.3.1.4.4	$34,015						$34,015	NRCS/RCD
	Action Total:	*$241,570*						*$241,570*	
SONCC-ScoR.3.1.5									
	SONCC-ScoR.3.1.5.1							$0	NRCS/RCD
	SONCC-ScoR.3.1.5.2							$0	Watermaster Dst
	SONCC-ScoR.3.1.5.3							$0	NRCS/RCD
	Action Total:							*$0*	
SONCC-ScoR.3.1.6									
	SONCC-ScoR.3.1.6.1	$76,136						$76,136	Water Trust
	Action Total:	*$76,136*						*$76,136*	
SONCC-ScoR.3.1.7									
	SONCC-ScoR.3.1.7.1	$34,015						$34,015	CDFG
	Action Total:	*$34,015*						*$34,015*	
SONCC-ScoR.3.1.8									
	SONCC-ScoR.3.1.8.1	$6,128						$6,128	DWR
	Action Total:	*$6,128*						*$6,128*	
SONCC-ScoR.3.1.9									
	SONCC-ScoR.3.1.9.1	$5,218						$5,218	CWQCB
	Action Total:	*$5,218*						*$5,218*	
SONCC-ScoR.3.2.10									
	SONCC-ScoR.3.2.10.1	$34,015						$34,015	NRCS/RCD
	SONCC-ScoR.3.2.10.2	$2,925,000						$2,925,000	NRCS/RCD
	SONCC-ScoR.3.2.10.3	$125,000	$125,000					$250,000	NRCS/RCD
	Action Total:	*$3,084,015*	*$125,000*					*$3,209,015*	
SONCC-ScoR.3.1.42									
	SONCC-ScoR.3.1.42.1	$36,770						$36,770	Watermaster Dst

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-ScoR.3.1.42.2	$36,770						$36,770	Watermaster Dst
	Action Total:	*$73,540*						*$73,540*	
SONCC-ScoR.7.1.18									
	SONCC-ScoR.7.1.18.1							$0	NRCS/RCD
	SONCC-ScoR.7.1.18.2							$0	NRCS/RCD
	SONCC-ScoR.7.1.18.3							$0	NRCS/RCD
	SONCC-ScoR.7.1.18.4							$0	NRCS/RCD
	SONCC-ScoR.7.1.18.5							$0	NRCS/RCD
	Action Total:							*$0*	
SONCC-ScoR.7.1.19									
	SONCC-ScoR.7.1.19.1	$5,669						$5,669	CDF
	Action Total:	*$5,669*						*$5,669*	
SONCC-ScoR.7.1.43									
	SONCC-ScoR.7.1.43.1	$18,200						$18,200	USFS
	SONCC-ScoR.7.1.43.2	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$1,200,000	USFS
	Action Total:	*$218,200*	*$200,000*	*$200,000*	*$200,000*	*$200,000*	*$200,000*	*$1,218,200*	
SONCC-ScoR.10.1.14									
	SONCC-ScoR.10.1.14.1	$36,770						$36,770	NRCS/RCD
	Action Total:	*$36,770*						*$36,770*	
SONCC-ScoR.10.1.15									
	SONCC-ScoR.10.1.15.1	$36,770						$36,770	CDFG
	SONCC-ScoR.10.1.15.2	$36,770	$36,770	$36,770	$36,770	$36,770	$36,770	$220,620	CDFG
	Action Total:	*$73,540*	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$257,390*	
SONCC-ScoR.10.1.16									
	SONCC-ScoR.10.1.16.1	$34,015						$34,015	NRCS/RCD
	SONCC-ScoR.10.1.16.2	$247,422						$247,422	NRCS/RCD
	Action Total:	*$281,437*						*$281,437*	
SONCC-ScoR.10.2.17									
	SONCC-ScoR.10.2.17.1	$36,770	$36,770	$36,770	$36,770	$36,770	$36,770	$220,620	EPA
	Action Total:	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$220,620*	
SONCC-ScoR.1.2.46									
	SONCC-ScoR.1.2.46.1							$0	BIA/Tribe
	Action Total:							*$0*	
SONCC-ScoR.16.1.28									
	SONCC-ScoR.16.1.28.1	$1,744						$1,744	NMFS
	SONCC-ScoR.16.1.28.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-ScoR.16.1.29									
	SONCC-ScoR.16.1.29.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-ScoR.16.1.29.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-ScoR.16.2.30									
	SONCC-ScoR.16.2.30.1	$1,744						$1,744	NMFS
	SONCC-ScoR.16.2.30.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-ScoR.16.2.31									
	SONCC-ScoR.16.2.31.1	$1,744						$1,744	NMFS
	SONCC-ScoR.16.2.31.2	$1,744						$1,744	NMFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$3,488*						*$3,488*	
SONCC-ScoR.27.1.32									
	SONCC-ScoR.27.1.32.1							$0	CDFG
	SONCC-ScoR.27.1.32.2							$0	CDFG
	Action Total:							*$0*	
SONCC-ScoR.27.1.33									
	SONCC-ScoR.27.1.33.1						$204,500	$204,500	CDFG
	Action Total:						*$204,500*	*$204,500*	
SONCC-ScoR.27.1.34									
	SONCC-ScoR.27.1.34.1						$85,037	$85,037	CDFG
	SONCC-ScoR.27.1.34.2	$150,000						$150,000	CDFG
	Action Total:	*$150,000*					*$85,037*	*$235,037*	
SONCC-ScoR.27.1.35									
	SONCC-ScoR.27.1.35.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-ScoR.27.2.36									
	SONCC-ScoR.27.2.36.1	$81,800						$81,800	CDFG
	SONCC-ScoR.27.2.36.2			$40,900		$40,900		$81,800	CDFG
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-ScoR.27.2.37									
	SONCC-ScoR.27.2.37.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-ScoR.27.2.38									
	SONCC-ScoR.27.2.38.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-ScoR.27.2.39									
	SONCC-ScoR.27.2.39.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-ScoR.27.2.40									
	SONCC-ScoR.27.2.40.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-ScoR.27.2.41									
	SONCC-ScoR.27.2.41.1	$102,250	$102,250	$102,250	$102,250	$102,250		$511,250	CDFG
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*		*$511,250*	
SONCC-ScoR.27.1.45									
	SONCC-ScoR.27.1.45.1	$122,700	$122,700	$122,700	$122,700	$122,700	$122,700	$736,200	CDFG
	Action Total:	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$736,200*	
SONCC-ScoR.27.1.47									
	SONCC-ScoR.27.1.47.1	$8,722						$8,722	NMFS
	SONCC-ScoR.27.1.47.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-ScoR.5.1.11									
	SONCC-ScoR.5.1.11.1							$0	NGO
	SONCC-ScoR.5.1.11.2							$0	NGO
	Action Total:							*$0*	
SONCC-ScoR.5.1.12									
	SONCC-ScoR.5.1.12.1	$44,540						$44,540	NGO
	SONCC-ScoR.5.1.12.2	$238,635						$238,635	NGO
	Action Total:	*$283,175*						*$283,175*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-ScoR.5.1.13									
	SONCC-ScoR.5.1.13.1	$36,770						$36,770	NGO
	SONCC-ScoR.5.1.13.2	$397,725						$397,725	NGO
	Action Total:	*$434,495*						*$434,495*	
SONCC-ScoR.8.2.26									
	SONCC-ScoR.8.2.26.1	$36,770						$36,770	NGO
	SONCC-ScoR.8.2.26.2	$420,000	$420,000	$420,000	$420,000	$420,000	$420,000	$2,520,000	NGO
	Action Total:	*$456,770*	*$420,000*	*$420,000*	*$420,000*	*$420,000*	*$420,000*	*$2,556,770*	
SONCC-ScoR.8.1.44									
	SONCC-ScoR.8.1.44.1	$150,000						$150,000	Private
	SONCC-ScoR.8.1.44.2	$20,000,000						$20,000,000	Private
	SONCC-ScoR.8.1.44.3	$5,000,000						$5,000,000	Private
	SONCC-ScoR.8.1.44.4	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$12,000,000	Private
	Action Total:	*$27,150,000*	*$2,000,000*	*$2,000,000*	*$2,000,000*	*$2,000,000*	*$2,000,000*	*$37,150,000*	
	Population Total:	***$75,106,396***	***$3,055,698***	***$3,380,598***	***$2,930,698***	***$3,380,598***	***$3,526,985***	***$91,380,973***	

Population: Shasta River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-ShaR.3.1.1									
	SONCC-ShaR.3.1.1.1	$36,770						$36,770	Watermaster Dst
	SONCC-ShaR.3.1.1.2	$36,770						$36,770	Watermaster Dst
	SONCC-ShaR.3.1.1.3	$36,770						$36,770	Watermaster Dst
	SONCC-ShaR.3.1.1.4	$36,770						$36,770	Watermaster Dst
	SONCC-ShaR.3.1.1.5	$36,770						$36,770	Watermaster Dst
	Action Total:	*$183,850*						*$183,850*	
SONCC-ShaR.3.1.2									
	SONCC-ShaR.3.1.2.1	$130,680						$130,680	Watermaster Dst
	SONCC-ShaR.3.1.2.2	$198,875						$198,875	Watermaster Dst
	SONCC-ShaR.3.1.2.3	$25,780						$25,780	Watermaster Dst
	Action Total:	*$355,335*						*$355,335*	
SONCC-ShaR.3.1.3									
	SONCC-ShaR.3.1.3.1							$0	Watermaster Dst
	SONCC-ShaR.3.1.3.2							$0	Watermaster Dst
	Action Total:							*$0*	
SONCC-ShaR.3.1.4									
	SONCC-ShaR.3.1.4.1	$45,454						$45,454	CDFG
	SONCC-ShaR.3.1.4.2	$34,015						$34,015	CDFG
	SONCC-ShaR.3.1.4.3	$190,909						$190,909	CDFG
	Action Total:	*$270,378*						*$270,378*	
SONCC-ShaR.3.1.5									
	SONCC-ShaR.3.1.5.1	$73,540						$73,540	NRCS/RCD
	SONCC-ShaR.3.1.5.2	$45,925						$45,925	NRCS/RCD
	SONCC-ShaR.3.1.5.3	$196,000						$196,000	NRCS/RCD
	SONCC-ShaR.3.1.5.4	$36,770						$36,770	NRCS/RCD
	Action Total:	*$352,235*						*$352,235*	
SONCC-ShaR.3.1.6									
	SONCC-ShaR.3.1.6.1	$36,770						$36,770	Watermaster Dst
	SONCC-ShaR.3.1.6.2	$183,750						$183,750	Watermaster Dst

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-ShaR.3.1.6.3	$36,770						$36,770	Watermaster Dst
	Action Total:	*$257,290*						*$257,290*	
SONCC-ShaR.3.1.7									
	SONCC-ShaR.3.1.7.1	$73,540						$73,540	NRCS/RCD
	SONCC-ShaR.3.1.7.2	$48,346						$48,346	NRCS/RCD
	SONCC-ShaR.3.1.7.3	$36,770						$36,770	Water Trust
	Action Total:	*$158,656*						*$158,656*	
SONCC-ShaR.3.1.8									
	SONCC-ShaR.3.1.8.1	$76,136						$76,136	NGO
	Action Total:	*$76,136*						*$76,136*	
SONCC-ShaR.3.1.9									
	SONCC-ShaR.3.1.9.1	$34,015						$34,015	CDFG
	Action Total:	*$34,015*						*$34,015*	
SONCC-ShaR.3.1.10									
	SONCC-ShaR.3.1.10.1	$6,128						$6,128	DWR
	Action Total:	*$6,128*						*$6,128*	
SONCC-ShaR.3.1.11									
	SONCC-ShaR.3.1.11.1	$5,218						$5,218	CWQCB
	Action Total:	*$5,218*						*$5,218*	
SONCC-ShaR.10.1.16									
	SONCC-ShaR.10.1.16.1	$36,077						$36,077	Private
	SONCC-ShaR.10.1.16.2	$34,015						$34,015	Private
	Action Total:	*$70,092*						*$70,092*	
SONCC-ShaR.10.1.17									
	SONCC-ShaR.10.1.17.1	$34,015						$34,015	Private
	SONCC-ShaR.10.1.17.2	$36,770						$36,770	Private
	Action Total:	*$70,785*						*$70,785*	
SONCC-ShaR.10.1.18									
	SONCC-ShaR.10.1.18.1	$34,015						$34,015	CDFG
	SONCC-ShaR.10.1.18.2	$36,770						$36,770	CDFG
	SONCC-ShaR.10.1.18.3	$34,015						$34,015	CDFG
	Action Total:	*$104,800*						*$104,800*	
SONCC-ShaR.10.1.19									
	SONCC-ShaR.10.1.19.1	$73,540						$73,540	Water District
	Action Total:	*$73,540*						*$73,540*	
SONCC-ShaR.10.1.20									
	SONCC-ShaR.10.1.20.1	$36,770						$36,770	NRCS/RCD
	SONCC-ShaR.10.1.20.2	$329,896						$329,896	NRCS/RCD
	Action Total:	*$366,666*						*$366,666*	
SONCC-ShaR.10.2.21									
	SONCC-ShaR.10.2.21.1	$36,770	$36,770	$36,770	$36,770	$36,770	$36,770	$220,620	EPA
	Action Total:	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$220,620*	
SONCC-ShaR.1.2.48									
	SONCC-ShaR.1.2.48.1							$0	BIA/Tribe
	Action Total:							*$0*	
SONCC-ShaR.16.1.33									
	SONCC-ShaR.16.1.33.1	$1,744						$1,744	NMFS
	SONCC-ShaR.16.1.33.2	$1,744						$1,744	NMFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$3,488*						*$3,488*	
SONCC-ShaR.16.1.34									
	SONCC-ShaR.16.1.34.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-ShaR.16.1.34.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-ShaR.16.2.35									
	SONCC-ShaR.16.2.35.1	$1,744						$1,744	NMFS
	SONCC-ShaR.16.2.35.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-ShaR.16.2.36									
	SONCC-ShaR.16.2.36.1	$1,744						$1,744	NMFS
	SONCC-ShaR.16.2.36.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-ShaR.2.2.27									
	SONCC-ShaR.2.2.27.1	$34,015						$34,015	NGO
	SONCC-ShaR.2.2.27.2	$5,930,964						$5,930,964	NGO
	Action Total:	*$5,964,979*						*$5,964,979*	
SONCC-ShaR.2.2.28									
	SONCC-ShaR.2.2.28.1	$34,015						$34,015	NGO
	SONCC-ShaR.2.2.28.2	$9,700,533						$9,700,533	NGO
	Action Total:	*$9,734,548*						*$9,734,548*	
SONCC-ShaR.2.2.46									
	SONCC-ShaR.2.2.46.1	$34,015						$34,015	CDFG
	SONCC-ShaR.2.2.46.2	$100,000						$100,000	CDFG
	Action Total:	*$134,015*						*$134,015*	
SONCC-ShaR.26.1.25									
	SONCC-ShaR.26.1.25.1	$68,030						$68,030	CDFG
	SONCC-ShaR.26.1.25.2	$500,000						$500,000	CDFG
	SONCC-ShaR.26.1.25.3	$600,000	$600,000	$600,000				$1,800,000	CDFG
	SONCC-ShaR.26.1.25.4	$1,250,000	$1,250,000	$1,250,000	$1,250,000			$5,000,000	CDFG
	Action Total:	*$2,418,030*	*$1,850,000*	*$1,850,000*	*$1,250,000*			*$7,368,030*	
SONCC-ShaR.26.1.26									
	SONCC-ShaR.26.1.26.1	$34,015						$34,015	NMFS
	SONCC-ShaR.26.1.26.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-ShaR.27.1.37									
	SONCC-ShaR.27.1.37.1						$204,500	$204,500	CDFG
	Action Total:						*$204,500*	*$204,500*	
SONCC-ShaR.27.1.38									
	SONCC-ShaR.27.1.38.1						$85,037	$85,037	CDFG
	SONCC-ShaR.27.1.38.2						$68,030	$68,030	CDFG
	Action Total:						*$153,067*	*$153,067*	
SONCC-ShaR.27.1.39									
	SONCC-ShaR.27.1.39.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-ShaR.27.2.40									
	SONCC-ShaR.27.2.40.1	$81,800						$81,800	CDFG
	SONCC-ShaR.27.2.40.2			$40,900		$40,900		$81,800	CDFG

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-ShaR.27.2.41									
	SONCC-ShaR.27.2.41.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-ShaR.27.2.42									
	SONCC-ShaR.27.2.42.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-ShaR.27.2.43									
	SONCC-ShaR.27.2.43.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-ShaR.27.2.44									
	SONCC-ShaR.27.2.44.1	$102,250	$102,250	$102,250	$102,250	$102,250		$511,250	CDFG
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*		*$511,250*	
SONCC-ShaR.27.1.47									
	SONCC-ShaR.27.1.47.1	$122,700	$122,700	$122,700	$122,700	$122,700	$122,700	$736,200	CDFG
	Action Total:	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$736,200*	
SONCC-ShaR.27.1.49									
	SONCC-ShaR.27.1.49.1	$8,722						$8,722	NMFS
	SONCC-ShaR.27.1.49.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-ShaR.5.1.13									
	SONCC-ShaR.5.1.13.1	$36,770						$36,770	NGO
	SONCC-ShaR.5.1.13.2	$116,280						$116,280	NGO
	Action Total:	*$153,050*						*$153,050*	
SONCC-ShaR.5.1.14									
	SONCC-ShaR.5.1.14.1	$44,540						$44,540	CDFG
	SONCC-ShaR.5.1.14.2	$381,818						$381,818	CDFG
	Action Total:	*$426,358*						*$426,358*	
SONCC-ShaR.5.1.15									
	SONCC-ShaR.5.1.15.1	$44,540						$44,540	County
	SONCC-ShaR.5.1.15.2	$5,727,270						$5,727,270	County
	Action Total:	*$5,771,810*						*$5,771,810*	
SONCC-ShaR.7.1.22									
	SONCC-ShaR.7.1.22.1	$34,015						$34,015	NRCS/RCD
	SONCC-ShaR.7.1.22.2	$34,015						$34,015	NRCS/RCD
	SONCC-ShaR.7.1.22.3	$3,482,692						$3,482,692	NRCS/RCD
	SONCC-ShaR.7.1.22.4	$189,470						$189,470	NRCS/RCD
	SONCC-ShaR.7.1.22.5	$7,284						$7,284	NRCS/RCD
	Action Total:	*$3,747,476*						*$3,747,476*	
SONCC-ShaR.7.1.23									
	SONCC-ShaR.7.1.23.1	$34,015						$34,015	Private
	Action Total:	*$34,015*						*$34,015*	
SONCC-ShaR.7.1.24									
	SONCC-ShaR.7.1.24.1	$2,224,416						$2,224,416	Private
	SONCC-ShaR.7.1.24.2	$16,186,176						$16,186,176	Private
	Action Total:	*$18,410,592*						*$18,410,592*	
SONCC-ShaR.7.1.45									
	SONCC-ShaR.7.1.45.1	$18,200						$18,200	Private

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-ShaR.7.1.45.2	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$1,200,000	Private
	Action Total:	*$218,200*	*$200,000*	*$200,000*	*$200,000*	*$200,000*	*$200,000*	*$1,218,200*	
SONCC-ShaR.8.2.29									
	SONCC-ShaR.8.2.29.1	$36,770						$36,770	Water District
	SONCC-ShaR.8.2.29.2	$33,600	$33,600	$33,600	$33,600	$33,600	$33,600	$201,600	Water District
	Action Total:	*$70,370*	*$33,600*	*$33,600*	*$33,600*	*$33,600*	*$33,600*	*$238,370*	
SONCC-ShaR.8.1.30									
	SONCC-ShaR.8.1.30.1	$1,357,402						$1,357,402	NRCS/RCD
	SONCC-ShaR.8.1.30.2	$5,608,148						$5,608,148	NRCS/RCD
	Action Total:	*$6,965,550*						*$6,965,550*	
SONCC-ShaR.8.1.31									
	SONCC-ShaR.8.1.31.1	$1,634,788						$1,634,788	USFS
	SONCC-ShaR.8.1.31.2	$13,047,186						$13,047,186	USFS
	SONCC-ShaR.8.1.31.3	$11,572,249						$11,572,249	USFS
	SONCC-ShaR.8.1.31.4	$3,788,954						$3,788,954	USFS
	Action Total:	*$30,043,177*						*$30,043,177*	
SONCC-ShaR.10.1.12									
	SONCC-ShaR.10.1.12.1	$34,015						$34,015	CWQCB
	SONCC-ShaR.10.1.12.2	$96,692						$96,692	CWQCB
	Action Total:	*$130,707*						*$130,707*	
	Population Total:	***$87,366,416***	***$2,357,528***	***$2,705,178***	***$1,757,528***	***$855,178***	***$1,069,595***	***$96,111,423***	

Population: Lower Trinity River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-LTR.2.2.7									
	SONCC-LTR.2.2.7.1	$34,015						$34,015	CDFG
	SONCC-LTR.2.2.7.2	$2,863,224						$2,863,224	CDFG
	Action Total:	*$2,897,239*						*$2,897,239*	
SONCC-LTR.2.2.8									
	SONCC-LTR.2.2.8.1	$34,015						$34,015	CDFG
	SONCC-LTR.2.2.8.2	$1,790,684						$1,790,684	CDFG
	Action Total:	*$1,824,699*						*$1,824,699*	
SONCC-LTR.2.2.9									
	SONCC-LTR.2.2.9.1	$34,015						$34,015	CDFG
	SONCC-LTR.2.2.9.2	$10,000						$10,000	CDFG
	Action Total:	*$44,015*						*$44,015*	
SONCC-LTR.2.2.10									
	SONCC-LTR.2.2.10.1							$0	CDFG
	Action Total:							*$0*	
SONCC-LTR.2.1.11									
	SONCC-LTR.2.1.11.1	$34,015						$34,015	CDFG
	SONCC-LTR.2.1.11.2	$15,339,800						$15,339,800	CDFG
	Action Total:	*$15,373,815*						*$15,373,815*	
SONCC-LTR.2.2.12									
	SONCC-LTR.2.2.12.1	$89,080						$89,080	NGO
	SONCC-LTR.2.2.12.2	$1,874,738						$1,874,738	NGO
	Action Total:	*$1,963,818*						*$1,963,818*	
SONCC-LTR.3.1.2									
	SONCC-LTR.3.1.2.1	$36,770						$36,770	DWR

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$36,770*						*$36,770*	
SONCC-LTR.3.1.3									
	SONCC-LTR.3.1.3.1							$0	NGO
	Action Total:							*$0*	
SONCC-LTR.3.1.4									
	SONCC-LTR.3.1.4.1	$34,015						$34,015	CDFG
	Action Total:	*$34,015*						*$34,015*	
SONCC-LTR.3.1.5									
	SONCC-LTR.3.1.5.1	$6,128						$6,128	DWR
	Action Total:	*$6,128*						*$6,128*	
SONCC-LTR.3.1.6									
	SONCC-LTR.3.1.6.1	$5,218						$5,218	CWQCB
	Action Total:	*$5,218*						*$5,218*	
SONCC-LTR.3.1.28									
	SONCC-LTR.3.1.28.1	$34,015						$34,015	CDFG
	Action Total:	*$34,015*						*$34,015*	
SONCC-LTR.3.1.29									
	SONCC-LTR.3.1.29.1	$34,015						$34,015	CDFG
	SONCC-LTR.3.1.29.2	$85,037	$85,037	$85,037	$85,037	$85,037	$85,037	$510,222	CDFG
	Action Total:	*$119,052*	*$85,037*	*$85,037*	*$85,037*	*$85,037*	*$85,037*	*$544,237*	
SONCC-LTR.5.1.31									
	SONCC-LTR.5.1.31.1	$159,090						$159,090	BIA/Tribe
	Action Total:	*$159,090*						*$159,090*	
SONCC-LTR.5.1.32									
	SONCC-LTR.5.1.32.1	$34,015						$34,015	USFS
	SONCC-LTR.5.1.32.2	$1,431,810						$1,431,810	USFS
	Action Total:	*$1,465,825*						*$1,465,825*	
SONCC-LTR.14.2.14									
	SONCC-LTR.14.2.14.1	$34,015						$34,015	CDFG
	SONCC-LTR.14.2.14.2	$5,112	$5,112	$5,112	$5,112	$5,112	$5,112	$30,672	CDFG
	Action Total:	*$39,127*	*$5,112*	*$5,112*	*$5,112*	*$5,112*	*$5,112*	*$64,687*	
SONCC-LTR.1.2.33									
	SONCC-LTR.1.2.33.1							$0	BIA/Tribe
	Action Total:							*$0*	
SONCC-LTR.16.1.16									
	SONCC-LTR.16.1.16.1	$1,744						$1,744	NMFS
	SONCC-LTR.16.1.16.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-LTR.16.1.17									
	SONCC-LTR.16.1.17.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-LTR.16.1.17.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-LTR.16.2.18									
	SONCC-LTR.16.2.18.1	$1,744						$1,744	NMFS
	SONCC-LTR.16.2.18.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-LTR.16.2.19									
	SONCC-LTR.16.2.19.1	$1,744						$1,744	NMFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-LTR.16.2.19.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-LTR.27.1.20									
	SONCC-LTR.27.1.20.1	$204,500	$204,500	$204,500	$204,500	$204,500	$204,500	$1,227,000	CDFG
	Action Total:	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$1,227,000*	
SONCC-LTR.27.1.21									
	SONCC-LTR.27.1.21.1	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$6,120,000	CDFG
	Action Total:	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$6,120,000*	
SONCC-LTR.27.1.22									
	SONCC-LTR.27.1.22.1						$85,037	$85,037	CDFG
	Action Total:						*$85,037*	*$85,037*	
SONCC-LTR.27.1.23									
	SONCC-LTR.27.1.23.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG
	SONCC-LTR.27.1.23.2	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG
	Action Total:	*$17,440*	*$17,440*	*$17,440*	*$17,440*	*$17,440*	*$17,440*	*$104,640*	
SONCC-LTR.27.2.24									
	SONCC-LTR.27.2.24.1	$81,800						$81,800	CDFG
	SONCC-LTR.27.2.24.2			$40,900		$40,900		$81,800	CDFG
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-LTR.27.2.25									
	SONCC-LTR.27.2.25.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-LTR.27.2.26									
	SONCC-LTR.27.2.26.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-LTR.27.2.27									
	SONCC-LTR.27.2.27.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFG
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-LTR.27.1.34									
	SONCC-LTR.27.1.34.1	$8,722						$8,722	NMFS
	SONCC-LTR.27.1.34.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-LTR.8.1.13									
	SONCC-LTR.8.1.13.1	$1,487,226						$1,487,226	USFS
	SONCC-LTR.8.1.13.2	$18,642,075						$18,642,075	USFS
	SONCC-LTR.8.1.13.3	$6,752,792						$6,752,792	USFS
	SONCC-LTR.8.1.13.4	$3,561,999	$3,561,999	$3,561,999	$3,561,999	$3,561,999	$0	$17,809,995	USFS
	Action Total:	*$30,444,092*	*$3,561,999*	*$3,561,999*	*$3,561,999*	*$3,561,999*	*$0*	*$44,692,088*	
SONCC-LTR.10.2.30									
	SONCC-LTR.10.2.30.1							$0	CWQCB
	Action Total:							*$0*	
	Population Total:	***$56,108,804***	***$4,999,826***	***$5,245,226***	***$4,999,826***	***$5,245,226***	***$1,727,364***	***$78,326,272***	

Population: Upper Trinity River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-UTR.14.2.22									
	SONCC-UTR.14.2.22.1	$34,015						$34,015	CDFG
	SONCC-UTR.14.2.22.2	$5,112	$5,112	$5,112	$5,112	$5,112	$5,112	$30,672	CDFG
	Action Total:	*$39,127*	*$5,112*	*$5,112*	*$5,112*	*$5,112*	*$5,112*	*$64,687*	
SONCC-UTR.1.2.41									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-UTR.1.2.41.1							$0	BIA/Tribe
	Action Total:							*$0*	
SONCC-UTR.16.1.23									
	SONCC-UTR.16.1.23.1	$1,744						$1,744	NMFS
	SONCC-UTR.16.1.23.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-UTR.16.1.24									
	SONCC-UTR.16.1.24.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-UTR.16.1.24.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-UTR.16.2.25									
	SONCC-UTR.16.2.25.1	$1,744						$1,744	NMFS
	SONCC-UTR.16.2.25.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-UTR.16.2.26									
	SONCC-UTR.16.2.26.1	$1,744						$1,744	NMFS
	SONCC-UTR.16.2.26.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-UTR.2.2.7									
	SONCC-UTR.2.2.7.1	$34,015						$34,015	CDFG
	SONCC-UTR.2.2.7.2	$1,636,128						$1,636,128	CDFG
	Action Total:	*$1,670,143*						*$1,670,143*	
SONCC-UTR.2.2.8									
	SONCC-UTR.2.2.8.1	$34,015						$34,015	CDFG
	SONCC-UTR.2.2.8.2	$10,000						$10,000	CDFG
	SONCC-UTR.2.2.8.3	$34,015						$34,015	CDFG
	Action Total:	*$78,030*						*$78,030*	
SONCC-UTR.2.1.9									
	SONCC-UTR.2.1.9.1	$34,015						$34,015	CDFG
	SONCC-UTR.2.1.9.2	$8,765,600						$8,765,600	CDFG
	Action Total:	*$8,799,615*						*$8,799,615*	
SONCC-UTR.17.2.1									
	SONCC-UTR.17.2.1.1	$68,030						$68,030	CDFG
	SONCC-UTR.17.2.1.2	$68,030						$68,030	CDFG
	Action Total:	*$136,060*						*$136,060*	
SONCC-UTR.17.1.2									
	SONCC-UTR.17.1.2.1	$34,015						$34,015	CDFG
	SONCC-UTR.17.1.2.2	$34,015						$34,015	CDFG
	SONCC-UTR.17.1.2.3	$5,112	$5,112	$5,112	$5,112	$5,112	$5,112	$30,672	CDFG
	SONCC-UTR.17.1.2.4	$34,015						$34,015	CDFG
	Action Total:	*$107,157*	*$5,112*	*$5,112*	*$5,112*	*$5,112*	*$5,112*	*$132,717*	
SONCC-UTR.17.1.3									
	SONCC-UTR.17.1.3.1	$40,900	$40,900	$40,900	$40,900	$40,900	$40,900	$245,400	CDFG
	Action Total:	*$40,900*	*$40,900*	*$40,900*	*$40,900*	*$40,900*	*$40,900*	*$245,400*	
SONCC-UTR.17.1.4									
	SONCC-UTR.17.1.4.1	$17,077						$17,077	CDFG
	Action Total:	*$17,077*						*$17,077*	
SONCC-UTR.17.1.5									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-UTR.17.1.5.1	$34,015						$34,015	CDFG
	Action Total:	*$34,015*						*$34,015*	
SONCC-UTR.17.1.6									
	SONCC-UTR.17.1.6.1	$340,333	$136,333	$136,333	$136,333	$136,333	$136,333	$1,021,998	CDFG
	Action Total:	*$340,333*	*$136,333*	*$136,333*	*$136,333*	*$136,333*	*$136,333*	*$1,021,998*	
SONCC-UTR.3.1.16									
	SONCC-UTR.3.1.16.1	$34,015						$34,015	NMFS
	SONCC-UTR.3.1.16.3	$18,385						$18,385	NMFS
	Action Total:	*$52,400*						*$52,400*	
SONCC-UTR.3.1.17									
	SONCC-UTR.3.1.17.1							$0	NGO
	Action Total:							*$0*	
SONCC-UTR.3.1.18									
	SONCC-UTR.3.1.18.1	$34,015						$34,015	CDFG
	Action Total:	*$34,015*						*$34,015*	
SONCC-UTR.3.1.19									
	SONCC-UTR.3.1.19.1	$6,128						$6,128	DWR
	Action Total:	*$6,128*						*$6,128*	
SONCC-UTR.3.1.20									
	SONCC-UTR.3.1.20.1	$5,218						$5,218	CWQCB
	Action Total:	*$5,218*						*$5,218*	
SONCC-UTR.3.1.21									
	SONCC-UTR.3.1.21.1	$34,015						$34,015	CWQCB
	Action Total:	*$34,015*						*$34,015*	
SONCC-UTR.3.1.36									
	SONCC-UTR.3.1.36.1	$350,000						$350,000	CDFG
	SONCC-UTR.3.1.36.2	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$150,000	CDFG
	Action Total:	*$375,000*	*$25,000*	*$25,000*	*$25,000*	*$25,000*	*$25,000*	*$500,000*	
SONCC-UTR.3.1.37									
	SONCC-UTR.3.1.37.1	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$300,000	City
	Action Total:	*$50,000*	*$50,000*	*$50,000*	*$50,000*	*$50,000*	*$50,000*	*$300,000*	
SONCC-UTR.3.1.38									
	SONCC-UTR.3.1.38.1	$34,015						$34,015	CDFG
	SONCC-UTR.3.1.38.2	$85,037	$85,037	$85,037	$85,037	$85,037	$85,037	$510,222	CDFG
	Action Total:	*$119,052*	*$85,037*	*$85,037*	*$85,037*	*$85,037*	*$85,037*	*$544,237*	
SONCC-UTR.3.1.39									
	SONCC-UTR.3.1.39.1	$34,015						$34,015	CDFG
	Action Total:	*$34,015*						*$34,015*	
SONCC-UTR.27.1.27									
	SONCC-UTR.27.1.27.1						$204,500	$204,500	CDFG
	Action Total:						*$204,500*	*$204,500*	
SONCC-UTR.27.1.28									
	SONCC-UTR.27.1.28.1						$85,037	$85,037	CDFG
	Action Total:						*$85,037*	*$85,037*	
SONCC-UTR.27.1.29									
	SONCC-UTR.27.1.29.1	$6,803	$6,803	$6,803	$6,803	$6,803	$6,803	$40,818	CDFG
	Action Total:	*$6,803*	*$6,803*	*$6,803*	*$6,803*	*$6,803*	*$6,803*	*$40,818*	
SONCC-UTR.27.1.30									
	SONCC-UTR.27.1.30.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-UTR.27.1.31									
	SONCC-UTR.27.1.31.1	$42,518	$42,518	$42,518	$42,518	$42,518	$42,518	$255,108	CDFG
	Action Total:	*$42,518*	*$42,518*	*$42,518*	*$42,518*	*$42,518*	*$42,518*	*$255,108*	
SONCC-UTR.27.2.32									
	SONCC-UTR.27.2.32.1	$81,800						$81,800	CDFG
	SONCC-UTR.27.2.32.2			$40,900		$40,900		$81,800	CDFG
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-UTR.27.2.33									
	SONCC-UTR.27.2.33.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-UTR.27.2.34									
	SONCC-UTR.27.2.34.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFG
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-UTR.27.1.40									
	SONCC-UTR.27.1.40.1	$122,700	$122,700	$122,700	$122,700	$122,700	$122,700	$736,200	CDFG
	Action Total:	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$736,200*	
SONCC-UTR.27.1.42									
	SONCC-UTR.27.1.42.1	$8,722						$8,722	NMFS
	SONCC-UTR.27.1.42.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-UTR.5.1.10									
	SONCC-UTR.5.1.10.1	$44,540						$44,540	CDFG
	SONCC-UTR.5.1.10.2	$523,254						$523,254	CDFG
	Action Total:	*$567,794*						*$567,794*	
SONCC-UTR.5.1.11									
	SONCC-UTR.5.1.11.1	$44,540						$44,540	CDFG
	SONCC-UTR.5.1.11.2	$145,350						$145,350	CDFG
	Action Total:	*$189,890*						*$189,890*	
SONCC-UTR.5.1.35									
	SONCC-UTR.5.1.35.1	$44,540						$44,540	BOR
	SONCC-UTR.5.1.35.2	$1,227,227	$204,500	$204,500	$204,500	$204,500	$204,500	$2,249,727	BOR
	Action Total:	*$1,271,767*	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$2,294,267*	
SONCC-UTR.10.1.13									
	SONCC-UTR.10.1.13.1	$36,770						$36,770	BOR
	SONCC-UTR.10.1.13.2	$45,962	$45,962	$45,962	$45,962	$45,962	$45,962	$275,772	BOR
	Action Total:	*$82,732*	*$45,962*	*$45,962*	*$45,962*	*$45,962*	*$45,962*	*$312,542*	
SONCC-UTR.10.1.14									
	SONCC-UTR.10.1.14.1	$36,770	$36,770	$36,770	$36,770	$36,770	$36,770	$220,620	USFS
	SONCC-UTR.10.1.14.2	$36,770	$36,770	$36,770	$36,770	$36,770	$36,770	$220,620	USFS
	Action Total:	*$73,540*	*$73,540*	*$73,540*	*$73,540*	*$73,540*	*$73,540*	*$441,240*	
	Population Total:	***$14,656,460***	***$957,975***	***$1,101,125***	***$957,975***	***$1,101,125***	***$1,349,762***	***$20,124,422***	

Population: South Fork Trinity River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-SFTR.3.1.1									
	SONCC-SFTR.3.1.1.1	$34,015						$34,015	DWR
	SONCC-SFTR.3.1.1.2	$29,545						$29,545	DWR
	SONCC-SFTR.3.1.1.3	$17,045	$20,454	$20,454	$20,454	$20,454	$20,454	$119,315	DWR

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-SFTR.3.1.1.4	$36,770						$36,770	DWR
	Action Total:	*$117,375*	*$20,454*	*$20,454*	*$20,454*	*$20,454*	*$20,454*	*$219,645*	
SONCC-SFTR.3.1.2									
	SONCC-SFTR.3.1.2.1	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$1,500,000	DWR
	Action Total:	*$250,000*	*$250,000*	*$250,000*	*$250,000*	*$250,000*	*$250,000*	*$1,500,000*	
SONCC-SFTR.3.1.3									
	SONCC-SFTR.3.1.3.1							$0	NGO
	Action Total:							*$0*	
SONCC-SFTR.3.1.4									
	SONCC-SFTR.3.1.4.1	$34,015						$34,015	CDFG
	Action Total:	*$34,015*						*$34,015*	
SONCC-SFTR.3.1.5									
	SONCC-SFTR.3.1.5.1	$6,128						$6,128	DWR
	Action Total:	*$6,128*						*$6,128*	
SONCC-SFTR.3.1.6									
	SONCC-SFTR.3.1.6.1	$5,218						$5,218	CWQCB
	Action Total:	*$5,218*						*$5,218*	
SONCC-SFTR.3.1.7									
	SONCC-SFTR.3.1.7.1	$45,925						$45,925	CDFG
	SONCC-SFTR.3.1.7.2	$3,500,000	$350,000	$350,000	$350,000	$350,000	$350,000	$5,250,000	CDFG
	SONCC-SFTR.3.1.7.3	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$15,000	CDFG
	Action Total:	*$3,548,425*	*$352,500*	*$352,500*	*$352,500*	*$352,500*	*$352,500*	*$5,310,925*	
SONCC-SFTR.3.1.8									
	SONCC-SFTR.3.1.8.1	$34,015						$34,015	CWQCB
	Action Total:	*$34,015*						*$34,015*	
SONCC-SFTR.3.1.9									
	SONCC-SFTR.3.1.9.1	$73,052						$73,052	DWR
	Action Total:	*$73,052*						*$73,052*	
SONCC-SFTR.3.1.10									
	SONCC-SFTR.3.1.10.1	$34,015						$34,015	NRCS/RCD
	SONCC-SFTR.3.1.10.2	$47,712						$47,712	NRCS/RCD
	Action Total:	*$81,727*						*$81,727*	
SONCC-SFTR.3.1.40									
	SONCC-SFTR.3.1.40.1	$34,015						$34,015	CWQCB
	Action Total:	*$34,015*						*$34,015*	
SONCC-SFTR.3.1.41									
	SONCC-SFTR.3.1.41.1	$34,015						$34,015	CDFG
	SONCC-SFTR.3.1.41.2	$85,037	$85,037	$85,037	$85,037	$85,037	$85,037	$510,222	CDFG
	Action Total:	*$119,052*	*$85,037*	*$85,037*	*$85,037*	*$85,037*	*$85,037*	*$544,237*	
SONCC-SFTR.3.1.42									
	SONCC-SFTR.3.1.42.1	$625,520						$625,520	City
	Action Total:	*$625,520*						*$625,520*	
SONCC-SFTR.8.1.16									
	SONCC-SFTR.8.1.16.1	$34,015						$34,015	Private
	Action Total:	*$34,015*						*$34,015*	
SONCC-SFTR.8.1.17									
	SONCC-SFTR.8.1.17.1	$1,415,890						$1,415,890	USFS
	SONCC-SFTR.8.1.17.2	$3,613,616						$3,613,616	USFS
	Action Total:	*$5,029,506*						*$5,029,506*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-SFTR.8.1.18									
	SONCC-SFTR.8.1.18.1	$2,506,067						$2,506,067	USFS
	SONCC-SFTR.8.1.18.2	$71,307,475						$71,307,475	USFS
	SONCC-SFTR.8.1.18.3	$8,436,464						$8,436,464	USFS
	SONCC-SFTR.8.1.18.4	$4,450,707	$4,450,707	$4,450,707	$4,450,707	$4,450,707	$4,450,707	$26,704,242	USFS
	Action Total:	*$86,700,713*	*$4,450,707*	*$4,450,707*	*$4,450,707*	*$4,450,707*	*$4,450,707*	*$108,954,248*	
SONCC-SFTR.8.1.19									
	SONCC-SFTR.8.1.19.1	$34,015						$34,015	NRCS/RCD
	SONCC-SFTR.8.1.19.2	$34,015						$34,015	NRCS/RCD
	SONCC-SFTR.8.1.19.3	$955,660						$955,660	NRCS/RCD
	SONCC-SFTR.8.1.19.4	$16,315						$16,315	NRCS/RCD
	SONCC-SFTR.8.1.19.5	$607						$607	NRCS/RCD
	Action Total:	*$1,040,612*						*$1,040,612*	
SONCC-SFTR.10.1.11									
	SONCC-SFTR.10.1.11.1	$34,015						$34,015	USFS
	SONCC-SFTR.10.1.11.2	$239,700						$239,700	USFS
	SONCC-SFTR.10.1.11.3	$1,744,200						$1,744,200	USFS
	Action Total:	*$2,017,915*						*$2,017,915*	
SONCC-SFTR.10.1.12									
	SONCC-SFTR.10.1.12.1	$36,770	$36,770	$36,770	$36,770	$36,770	$36,770	$220,620	USFS
	SONCC-SFTR.10.1.12.2	$36,770	$36,770	$36,770	$36,770	$36,770	$36,770	$220,620	USFS
	Action Total:	*$73,540*	*$73,540*	*$73,540*	*$73,540*	*$73,540*	*$73,540*	*$441,240*	
SONCC-SFTR.10.3.13									
	SONCC-SFTR.10.3.13.1	$34,015						$34,015	CDFG
	SONCC-SFTR.10.3.13.2	$34,015						$34,015	CDFG
	Action Total:	*$68,030*						*$68,030*	
SONCC-SFTR.10.3.14									
	SONCC-SFTR.10.3.14.1	$34,015						$34,015	CDFG
	Action Total:	*$34,015*						*$34,015*	
SONCC-SFTR.1.2.44									
	SONCC-SFTR.1.2.44.1							$0	BIA/Tribe
	Action Total:							*$0*	
SONCC-SFTR.16.1.27									
	SONCC-SFTR.16.1.27.1	$1,744						$1,744	NMFS
	SONCC-SFTR.16.1.27.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-SFTR.16.1.28									
	SONCC-SFTR.16.1.28.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-SFTR.16.1.28.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-SFTR.16.2.29									
	SONCC-SFTR.16.2.29.1	$1,744						$1,744	NMFS
	SONCC-SFTR.16.2.29.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-SFTR.16.2.30									
	SONCC-SFTR.16.2.30.1	$1,744						$1,744	NMFS
	SONCC-SFTR.16.2.30.2	$1,744						$1,744	NMFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$3,488*						*$3,488*	
SONCC-SFTR.2.2.20									
	SONCC-SFTR.2.2.20.1	$34,015						$34,015	CDFG
	SONCC-SFTR.2.2.20.2	$1,629,481						$1,629,481	CDFG
	Action Total:	*$1,663,496*						*$1,663,496*	
SONCC-SFTR.2.2.21									
	SONCC-SFTR.2.2.21.1							$0	CDFG
	SONCC-SFTR.2.2.21.2							$0	CDFG
	Action Total:							*$0*	
SONCC-SFTR.2.2.22									
	SONCC-SFTR.2.2.22.1							$0	CDFG
	Action Total:							*$0*	
SONCC-SFTR.2.1.23									
	SONCC-SFTR.2.1.23.1	$34,015						$34,015	CDFG
	SONCC-SFTR.2.1.23.2	$8,729,990						$8,729,990	CDFG
	Action Total:	*$8,764,005*						*$8,764,005*	
SONCC-SFTR.2.2.24									
	SONCC-SFTR.2.2.24.1	$34,015						$34,015	CDFG
	SONCC-SFTR.2.2.24.2	$1,670,179						$1,670,179	CDFG
	Action Total:	*$1,704,194*						*$1,704,194*	
SONCC-SFTR.27.1.31									
	SONCC-SFTR.27.1.31.1						$204,500	$204,500	CDFG
	Action Total:						*$204,500*	*$204,500*	
SONCC-SFTR.27.1.32									
	SONCC-SFTR.27.1.32.1	$122,700	$122,700	$122,700	$122,700	$122,700	$122,700	$736,200	CDFG
	Action Total:	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$736,200*	
SONCC-SFTR.27.1.33									
	SONCC-SFTR.27.1.33.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-SFTR.27.2.34									
	SONCC-SFTR.27.2.34.1	$81,800						$81,800	CDFG
	SONCC-SFTR.27.2.34.2			$40,900		$40,900		$81,800	CDFG
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-SFTR.27.2.35									
	SONCC-SFTR.27.2.35.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-SFTR.27.2.36									
	SONCC-SFTR.27.2.36.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-SFTR.27.2.37									
	SONCC-SFTR.27.2.37.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-SFTR.27.2.38									
	SONCC-SFTR.27.2.38.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-SFTR.27.2.39									
	SONCC-SFTR.27.2.39.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFG
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-SFTR.27.1.43									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-SFTR.27.1.43.1						$85,037	$85,037	CDFG
	Action Total:						*$85,037*	*$85,037*	
SONCC-SFTR.27.1.45									
	SONCC-SFTR.27.1.45.1	$8,722						$8,722	NMFS
	SONCC-SFTR.27.1.45.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-SFTR.7.1.25									
	SONCC-SFTR.7.1.25.1							$0	USFS
	SONCC-SFTR.7.1.25.2							$0	USFS
	SONCC-SFTR.7.1.25.3							$0	USFS
	Action Total:							*$0*	
SONCC-SFTR.7.1.26									
	SONCC-SFTR.7.1.26.1							$0	USFS
	SONCC-SFTR.7.1.26.2							$0	USFS
	Action Total:							*$0*	
	Population Total:	***$112,814,449***	***$5,469,396***	***$5,919,296***	***$5,469,396***	***$5,919,296***	***$6,167,933***	***$141,759,766***	

Population: South Fork Eel River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-SFER.2.1.1									
	SONCC-SFER.2.1.1.1	$34,015						$34,015	CDFG
	SONCC-SFER.2.1.1.2	$11,833,560						$11,833,560	CDFG
	Action Total:	*$11,867,575*						*$11,867,575*	
SONCC-SFER.2.2.2									
	SONCC-SFER.2.2.2.1	$73,540						$73,540	CDFG
	SONCC-SFER.2.2.2.2	$174,520						$174,520	CDFG
	Action Total:	*$248,060*						*$248,060*	
SONCC-SFER.2.2.3									
	SONCC-SFER.2.2.3.1	$34,015						$34,015	CDFG
	SONCC-SFER.2.2.3.2	$2,208,773						$2,208,773	CDFG
	Action Total:	*$2,242,788*						*$2,242,788*	
SONCC-SFER.8.1.15									
	SONCC-SFER.8.1.15.1	$1,443,992						$1,443,992	Private
	SONCC-SFER.8.1.15.2	$121,915,653						$121,915,653	Private
	SONCC-SFER.8.1.15.3	$11,267,010						$11,267,010	Private
	SONCC-SFER.8.1.15.4	$3,292,042	$3,292,042	$3,292,042	$3,292,042	$3,292,042	$3,292,042	$19,752,252	Private
	Action Total:	*$137,918,697*	*$3,292,042*	*$3,292,042*	*$3,292,042*	*$3,292,042*	*$3,292,042*	*$154,378,907*	
SONCC-SFER.8.1.16									
	SONCC-SFER.8.1.16.1	$2,640						$2,640	BLM
	Action Total:	*$2,640*						*$2,640*	
SONCC-SFER.8.1.17									
	SONCC-SFER.8.1.17.1	$2,267						$2,267	County
	Action Total:	*$2,267*						*$2,267*	
SONCC-SFER.8.1.18									
	SONCC-SFER.8.1.18.1	$1,047,119						$1,047,119	Private
	SONCC-SFER.8.1.18.2	$7,214,168						$7,214,168	Private
	Action Total:	*$8,261,287*						*$8,261,287*	
SONCC-SFER.14.2.14									
	SONCC-SFER.14.2.14.1	$68,030						$68,030	CDFG

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-SFER.14.2.14.2	$15,996,908						$15,996,908	CDFG
	Action Total:	*$16,064,938*						*$16,064,938*	
SONCC-SFER.1.2.43									
	SONCC-SFER.1.2.43.1							$0	CDFG
	Action Total:							*$0*	
SONCC-SFER.16.1.28									
	SONCC-SFER.16.1.28.1	$1,744						$1,744	NMFS
	SONCC-SFER.16.1.28.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-SFER.16.1.29									
	SONCC-SFER.16.1.29.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-SFER.16.1.29.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-SFER.16.2.30									
	SONCC-SFER.16.2.30.1	$1,744						$1,744	NMFS
	SONCC-SFER.16.2.30.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-SFER.16.2.31									
	SONCC-SFER.16.2.31.1	$1,744						$1,744	NMFS
	SONCC-SFER.16.2.31.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-SFER.3.1.4									
	SONCC-SFER.3.1.4.1	$8,503						$8,503	County
	Action Total:	*$8,503*						*$8,503*	
SONCC-SFER.3.1.5									
	SONCC-SFER.3.1.5.1	$36,077						$36,077	County
	Action Total:	*$36,077*						*$36,077*	
SONCC-SFER.3.1.6									
	SONCC-SFER.3.1.6.1	$34,015						$34,015	CWQCB
	Action Total:	*$34,015*						*$34,015*	
SONCC-SFER.3.1.7									
	SONCC-SFER.3.1.7.1	$350,000						$350,000	CWQCB
	SONCC-SFER.3.1.7.2	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$15,000	CWQCB
	Action Total:	*$352,500*	*$2,500*	*$2,500*	*$2,500*	*$2,500*	*$2,500*	*$365,000*	
SONCC-SFER.3.1.8									
	SONCC-SFER.3.1.8.1							$0	CWQCB
	Action Total:							*$0*	
SONCC-SFER.3.1.9									
	SONCC-SFER.3.1.9.1	$89,080						$89,080	CSP
	SONCC-SFER.3.1.9.2	$568,181						$568,181	CSP
	Action Total:	*$657,261*						*$657,261*	
SONCC-SFER.3.1.10									
	SONCC-SFER.3.1.10.1							$0	NGO
	Action Total:							*$0*	
SONCC-SFER.3.1.11									
	SONCC-SFER.3.1.11.1	$34,015						$34,015	CDFG
	Action Total:	*$34,015*						*$34,015*	
SONCC-SFER.3.1.12									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-SFER.3.1.12.1	$6,128						$6,128	DWR
	Action Total:	*$6,128*						*$6,128*	
SONCC-SFER.3.1.13									
	SONCC-SFER.3.1.13.1	$5,218						$5,218	CWQCB
	Action Total:	*$5,218*						*$5,218*	
SONCC-SFER.27.1.32									
	SONCC-SFER.27.1.32.1	$204,500	$204,500	$204,500	$204,500	$204,500	$204,500	$1,227,000	CDFG
	Action Total:	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$1,227,000*	
SONCC-SFER.27.1.33									
	SONCC-SFER.27.1.33.1	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$6,120,000	CDFG
	Action Total:	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$6,120,000*	
SONCC-SFER.27.1.34									
	SONCC-SFER.27.1.34.1						$85,037	$85,037	CDFG
	Action Total:						*$85,037*	*$85,037*	
SONCC-SFER.27.1.35									
	SONCC-SFER.27.1.35.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-SFER.27.1.36									
	SONCC-SFER.27.1.36.1	$17,042	$17,042	$17,042	$17,042	$17,042	$17,042	$102,252	CDFG
	SONCC-SFER.27.1.36.2	$4,251	$4,251	$4,251	$4,251	$4,251	$4,251	$25,506	CDFG
	Action Total:	*$21,293*	*$21,293*	*$21,293*	*$21,293*	*$21,293*	*$21,293*	*$127,758*	
SONCC-SFER.27.2.37									
	SONCC-SFER.27.2.37.1	$81,800						$81,800	CDFG
	SONCC-SFER.27.2.37.2			$40,900		$40,900		$81,800	CDFG
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-SFER.27.2.38									
	SONCC-SFER.27.2.38.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-SFER.27.2.39									
	SONCC-SFER.27.2.39.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-SFER.27.2.40									
	SONCC-SFER.27.2.40.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-SFER.27.2.41									
	SONCC-SFER.27.2.41.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-SFER.27.2.42									
	SONCC-SFER.27.2.42.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFG
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-SFER.27.1.44									
	SONCC-SFER.27.1.44.1	$8,722						$8,722	NMFS
	SONCC-SFER.27.1.44.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-SFER.5.1.25									
	SONCC-SFER.5.1.25.1	$44,540						$44,540	Caltrans
	SONCC-SFER.5.1.25.2	$1,482,553						$1,482,553	Caltrans
	Action Total:	*$1,527,093*						*$1,527,093*	
SONCC-SFER.7.1.21									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-SFER.7.1.21.1	$34,015						$34,015	CSP
	SONCC-SFER.7.1.21.2	$830,960						$830,960	CSP
	SONCC-SFER.7.1.21.3	$6,027,955						$6,027,955	CSP
	Action Total:	*$6,892,930*						*$6,892,930*	
SONCC-SFER.7.1.22									
	SONCC-SFER.7.1.22.1	$18,200						$18,200	CSP
	SONCC-SFER.7.1.22.2	$14,846,976						$14,846,976	CSP
	Action Total:	*$14,865,176*						*$14,865,176*	
SONCC-SFER.7.1.23									
	SONCC-SFER.7.1.23.1	$34,015						$34,015	County
	Action Total:	*$34,015*						*$34,015*	
SONCC-SFER.7.1.24									
	SONCC-SFER.7.1.24.1	$5,669						$5,669	CDF
	Action Total:	*$5,669*						*$5,669*	
SONCC-SFER.10.2.19									
	SONCC-SFER.10.2.19.1	$250,000						$250,000	County
	Action Total:	*$250,000*						*$250,000*	
	Population Total:	***$203,195,810***	***$4,654,793***	***$5,104,693***	***$4,654,793***	***$5,104,693***	***$5,148,830***	***$227,863,612***	
Population: Mainstem Eel River									
SONCC-MER.2.2.8									
	SONCC-MER.2.2.8.1	$34,015						$34,015	CDFG
	SONCC-MER.2.2.8.2	$214,742						$214,742	CDFG
	Action Total:	*$248,757*						*$248,757*	
SONCC-MER.2.1.9									
	SONCC-MER.2.1.9.1	$34,015						$34,015	CDFG
	SONCC-MER.2.1.9.2	$1,150,485						$1,150,485	CDFG
	Action Total:	*$1,184,500*						*$1,184,500*	
SONCC-MER.8.1.14									
	SONCC-MER.8.1.14.1	$932,354						$932,354	CDFG
	SONCC-MER.8.1.14.2	$64,455,789						$64,455,789	CDFG
	SONCC-MER.8.1.14.3	$8,491,080						$8,491,080	CDFG
	SONCC-MER.8.1.14.4	$2,486,949	$2,486,949	$2,486,949	$2,486,949	$2,486,949	$2,486,949	$14,921,694	CDFG
	Action Total:	*$76,366,172*	*$2,486,949*	*$2,486,949*	*$2,486,949*	*$2,486,949*	*$2,486,949*	*$88,800,917*	
SONCC-MER.8.1.15									
	SONCC-MER.8.1.15.1	$2,267						$2,267	County
	Action Total:	*$2,267*						*$2,267*	
SONCC-MER.8.1.16									
	SONCC-MER.8.1.16.1	$791,531						$791,531	CDF
	SONCC-MER.8.1.16.2	$2,157,832						$2,157,832	CDF
	Action Total:	*$2,949,363*						*$2,949,363*	
SONCC-MER.8.1.17									
	SONCC-MER.8.1.17.1	$34,015						$34,015	CDF
	SONCC-MER.8.1.17.2	$34,015						$34,015	CDF
	Action Total:	*$68,030*						*$68,030*	
SONCC-MER.14.2.2									
	SONCC-MER.14.2.2.1	$68,030						$68,030	CDFG
	SONCC-MER.14.2.2.2	$2,959,250						$2,959,250	CDFG

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$3,027,280*						*$3,027,280*	
SONCC-MER.1.2.31									
	SONCC-MER.1.2.31.1							$0	CDFG
	Action Total:							*$0*	
SONCC-MER.16.1.19									
	SONCC-MER.16.1.19.1	$1,744						$1,744	NMFS
	SONCC-MER.16.1.19.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-MER.16.1.20									
	SONCC-MER.16.1.20.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-MER.16.1.20.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-MER.16.2.21									
	SONCC-MER.16.2.21.1	$1,744						$1,744	NMFS
	SONCC-MER.16.2.21.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-MER.16.2.22									
	SONCC-MER.16.2.22.1	$1,744						$1,744	NMFS
	SONCC-MER.16.2.22.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-MER.3.1.3									
	SONCC-MER.3.1.3.1	$8,503						$8,503	County
	Action Total:	*$8,503*						*$8,503*	
SONCC-MER.3.1.4									
	SONCC-MER.3.1.4.1	$36,077						$36,077	County
	Action Total:	*$36,077*						*$36,077*	
SONCC-MER.3.1.5									
	SONCC-MER.3.1.5.1	$34,015						$34,015	CWQCB
	Action Total:	*$34,015*						*$34,015*	
SONCC-MER.3.1.6									
	SONCC-MER.3.1.6.1	$350,000						$350,000	CWQCB
	SONCC-MER.3.1.6.2	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$15,000	CWQCB
	Action Total:	*$352,500*	*$2,500*	*$2,500*	*$2,500*	*$2,500*	*$2,500*	*$365,000*	
SONCC-MER.3.1.7									
	SONCC-MER.3.1.7.1							$0	CWQCB
	Action Total:							*$0*	
SONCC-MER.26.1.1									
	SONCC-MER.26.1.1.1	$68,030						$68,030	CDFG
	SONCC-MER.26.1.1.2	$500,000						$500,000	CDFG
	SONCC-MER.26.1.1.3	$600,000	$600,000	$600,000				$1,800,000	CDFG
	SONCC-MER.26.1.1.4	$1,250,000	$1,250,000	$1,250,000				$3,750,000	CDFG
	Action Total:	*$2,418,030*	*$1,850,000*	*$1,850,000*				*$6,118,030*	
SONCC-MER.27.1.23									
	SONCC-MER.27.1.23.1						$204,500	$204,500	CDFG
	Action Total:						*$204,500*	*$204,500*	
SONCC-MER.27.1.24									
	SONCC-MER.27.1.24.1						$85,037	$85,037	CDFG
	Action Total:						*$85,037*	*$85,037*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MER.27.1.25									
	SONCC-MER.27.1.25.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-MER.27.1.26									
	SONCC-MER.27.1.26.1	$17,042	$17,042	$17,042	$17,042	$17,042	$17,042	$102,252	CDFG
	SONCC-MER.27.1.26.2	$4,251	$4,251	$4,251	$4,251	$4,251	$4,251	$25,506	CDFG
	Action Total:	*$21,293*	*$21,293*	*$21,293*	*$21,293*	*$21,293*	*$21,293*	*$127,758*	
SONCC-MER.27.2.27									
	SONCC-MER.27.2.27.1	$81,800						$81,800	CDFG
	SONCC-MER.27.2.27.2			$40,900		$40,900		$81,800	CDFG
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-MER.27.2.28									
	SONCC-MER.27.2.28.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-MER.27.2.29									
	SONCC-MER.27.2.29.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-MER.27.1.30									
	SONCC-MER.27.1.30.1	$122,700	$122,700	$122,700	$122,700	$122,700	$122,700	$736,200	CDFG
	Action Total:	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$736,200*	
SONCC-MER.27.1.32									
	SONCC-MER.27.1.32.1	$8,722						$8,722	NMFS
	SONCC-MER.27.1.32.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-MER.5.1.13									
	SONCC-MER.5.1.13.1	$44,540						$44,540	CDFG
	SONCC-MER.5.1.13.2	$1,220,926						$1,220,926	CDFG
	Action Total:	*$1,265,466*						*$1,265,466*	
SONCC-MER.7.1.10									
	SONCC-MER.7.1.10.1	$34,015						$34,015	CDF
	SONCC-MER.7.1.10.2	$79,261						$79,261	CDF
	SONCC-MER.7.1.10.3	$572,098						$572,098	CDF
	Action Total:	*$685,373*						*$685,373*	
SONCC-MER.7.1.11									
	SONCC-MER.7.1.11.1	$18,200						$18,200	CDF
	SONCC-MER.7.1.11.2	$838,656						$838,656	CDF
	Action Total:	*$856,856*						*$856,856*	
SONCC-MER.7.1.12									
	SONCC-MER.7.1.12.1	$5,669						$5,669	CDF
	Action Total:	*$5,669*						*$5,669*	
	Population Total:	***$89,979,267***	***$4,495,650***	***$4,741,050***	***$2,645,650***	***$2,891,050***	***$3,139,687***	***$107,892,354***	

Population: Middle Fork Eel River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MFER.7.1.4									
	SONCC-MFER.7.1.4.1							$0	County
	SONCC-MFER.7.1.4.2							$0	County
	Action Total:							*$0*	
SONCC-MFER.7.1.5									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MFER.7.1.5.1							$0	NRCS/RCD
	SONCC-MFER.7.1.5.2							$0	NRCS/RCD
	SONCC-MFER.7.1.5.3							$0	NRCS/RCD
	SONCC-MFER.7.1.5.4							$0	NRCS/RCD
	SONCC-MFER.7.1.5.5							$0	NRCS/RCD
	Action Total:							*$0*	
SONCC-MFER.8.1.7									
	SONCC-MFER.8.1.7.1							$0	USFS
	SONCC-MFER.8.1.7.2							$0	USFS
	Action Total:							*$0*	
SONCC-MFER.8.1.8									
	SONCC-MFER.8.1.8.1							$0	USFS
	SONCC-MFER.8.1.8.2							$0	USFS
	Action Total:							*$0*	
SONCC-MFER.8.1.9									
	SONCC-MFER.8.1.9.1							$0	USFS
	SONCC-MFER.8.1.9.2							$0	USFS
	SONCC-MFER.8.1.9.3							$0	USFS
	SONCC-MFER.8.1.9.4							$0	USFS
	Action Total:							*$0*	
SONCC-MFER.14.2.1									
	SONCC-MFER.14.2.1.1	$34,015						$34,015	CDFG
	SONCC-MFER.14.2.1.2	$2,583,525						$2,583,525	CDFG
	Action Total:	*$2,617,540*						*$2,617,540*	
SONCC-MFER.1.2.23									
	SONCC-MFER.1.2.23.1							$0	CDFG
	Action Total:							*$0*	
SONCC-MFER.16.1.11									
	SONCC-MFER.16.1.11.1	$1,744						$1,744	NMFS
	SONCC-MFER.16.1.11.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-MFER.16.1.12									
	SONCC-MFER.16.1.12.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-MFER.16.1.12.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-MFER.16.2.13									
	SONCC-MFER.16.2.13.1	$1,744						$1,744	NMFS
	SONCC-MFER.16.2.13.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-MFER.16.2.14									
	SONCC-MFER.16.2.14.1	$1,744						$1,744	NMFS
	SONCC-MFER.16.2.14.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-MFER.2.1.2									
	SONCC-MFER.2.1.2.1							$0	CDFG
	SONCC-MFER.2.1.2.2							$0	CDFG
	Action Total:							*$0*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MFER.2.2.3									
	SONCC-MFER.2.2.3.1							$0	CDFG
	SONCC-MFER.2.2.3.2							$0	CDFG
	Action Total:							*$0*	
SONCC-MFER.2.2.22									
	SONCC-MFER.2.2.22.1	$34,015						$34,015	CDFG
	SONCC-MFER.2.2.22.2	$662,631						$662,631	CDFG
	Action Total:	*$696,646*						*$696,646*	
SONCC-MFER.27.1.15									
	SONCC-MFER.27.1.15.1						$204,500	$204,500	CDFG
	Action Total:						*$204,500*	*$204,500*	
SONCC-MFER.27.1.16									
	SONCC-MFER.27.1.16.1						$122,700	$122,700	CDFG
	Action Total:						*$122,700*	*$122,700*	
SONCC-MFER.27.1.17									
	SONCC-MFER.27.1.17.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG
	SONCC-MFER.27.1.17.2	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG
	Action Total:	*$17,440*	*$17,440*	*$17,440*	*$17,440*	*$17,440*	*$17,440*	*$104,640*	
SONCC-MFER.27.2.18									
	SONCC-MFER.27.2.18.1	$81,800						$81,800	CDFG
	SONCC-MFER.27.2.18.2			$40,900		$40,900		$81,800	CDFG
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-MFER.27.2.19									
	SONCC-MFER.27.2.19.1	$102,250			$102,250	$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*			*$102,250*	*$102,250*	*$102,250*	*$409,000*	
SONCC-MFER.27.2.20									
	SONCC-MFER.27.2.20.1	$102,250			$102,250	$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*			*$102,250*	*$102,250*	*$102,250*	*$409,000*	
SONCC-MFER.27.1.21									
	SONCC-MFER.27.1.21.1	$17,042	$17,042	$17,042	$17,042	$17,042	$17,042	$102,252	CDFG
	SONCC-MFER.27.1.21.2	$4,251	$4,251	$4,251	$4,251	$4,251	$4,251	$25,506	CDFG
	Action Total:	*$21,293*	*$21,293*	*$21,293*	*$21,293*	*$21,293*	*$21,293*	*$127,758*	
SONCC-MFER.27.1.24									
	SONCC-MFER.27.1.24.1	$8,722						$8,722	NMFS
	SONCC-MFER.27.1.24.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
	Population Total:	***$3,670,615***	***$42,221***	***$83,121***	***$246,721***	***$287,621***	***$573,921***	***$4,904,220***	

Population: Middle Mainstem Eel River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MMER.7.1.3									
	SONCC-MMER.7.1.3.1	$34,015						$34,015	NRCS/RCD
	SONCC-MMER.7.1.3.2	$5,860,512						$5,860,512	NRCS/RCD
	Action Total:	*$5,894,527*						*$5,894,527*	
SONCC-MMER.7.1.4									
	SONCC-MMER.7.1.4.1	$17,077						$17,077	CDFG
	Action Total:	*$17,077*						*$17,077*	
SONCC-MMER.7.1.5									
	SONCC-MMER.7.1.5.1	$5,669						$5,669	CDF
	Action Total:	*$5,669*						*$5,669*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MMER.7.1.6									
	SONCC-MMER.7.1.6.1	$18,200						$18,200	CDF
	SONCC-MMER.7.1.6.2	$838,656						$838,656	CDF
	Action Total:	*$856,856*						*$856,856*	
SONCC-MMER.8.1.15									
	SONCC-MMER.8.1.15.1	$831,210						$831,210	CDFG
	SONCC-MMER.8.1.15.2	$79,287,150						$79,287,150	CDFG
	SONCC-MMER.8.1.15.3	$5,682,492						$5,682,492	CDFG
	SONCC-MMER.8.1.15.4	$1,660,355	$1,660,355	$1,660,355	$1,660,355	$1,660,355	$1,660,355	$9,962,130	CDFG
	Action Total:	*$87,461,207*	*$1,660,355*	*$1,660,355*	*$1,660,355*	*$1,660,355*	*$1,660,355*	*$95,762,982*	
SONCC-MMER.8.1.16									
	SONCC-MMER.8.1.16.1	$2,267						$2,267	County
	Action Total:	*$2,267*						*$2,267*	
SONCC-MMER.8.1.17									
	SONCC-MMER.8.1.17.1	$528,086						$528,086	NRCS/RCD
	SONCC-MMER.8.1.17.2	$3,831,160						$3,831,160	NRCS/RCD
	Action Total:	*$4,359,246*						*$4,359,246*	
SONCC-MMER.14.2.9									
	SONCC-MMER.14.2.9.1	$68,030						$68,030	CDFG
	SONCC-MMER.14.2.9.2	$8,495,375						$8,495,375	CDFG
	Action Total:	*$8,563,405*						*$8,563,405*	
SONCC-MMER.1.2.34									
	SONCC-MMER.1.2.34.1							$0	CDFG
	Action Total:							*$0*	
SONCC-MMER.16.1.19									
	SONCC-MMER.16.1.19.1	$1,744						$1,744	NMFS
	SONCC-MMER.16.1.19.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-MMER.16.1.20									
	SONCC-MMER.16.1.20.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-MMER.16.1.20.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-MMER.16.2.21									
	SONCC-MMER.16.2.21.1	$1,744						$1,744	NMFS
	SONCC-MMER.16.2.21.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-MMER.16.2.22									
	SONCC-MMER.16.2.22.1	$1,744						$1,744	NMFS
	SONCC-MMER.16.2.22.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-MMER.2.1.2									
	SONCC-MMER.2.1.2.1	$34,015						$34,015	CDFG
	SONCC-MMER.2.1.2.2	$11,504,850						$11,504,850	CDFG
	Action Total:	*$11,538,865*						*$11,538,865*	
SONCC-MMER.3.1.10									
	SONCC-MMER.3.1.10.1	$34,015						$34,015	DWR
	SONCC-MMER.3.1.10.2	$350,000						$350,000	DWR

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MMER.3.1.10.3	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$15,000	DWR
	Action Total:	*$386,515*	*$2,500*	*$2,500*	*$2,500*	*$2,500*	*$2,500*	*$399,015*	
SONCC-MMER.3.1.11									
	SONCC-MMER.3.1.11.1	$76,136						$76,136	NGO
	Action Total:	*$76,136*						*$76,136*	
SONCC-MMER.3.1.12									
	SONCC-MMER.3.1.12.1	$34,015						$34,015	CDFG
	Action Total:	*$34,015*						*$34,015*	
SONCC-MMER.3.1.13									
	SONCC-MMER.3.1.13.1	$6,128						$6,128	DWR
	Action Total:	*$6,128*						*$6,128*	
SONCC-MMER.3.1.14									
	SONCC-MMER.3.1.14.1	$5,218						$5,218	CWQCB
	Action Total:	*$5,218*						*$5,218*	
SONCC-MMER.26.1.1									
	SONCC-MMER.26.1.1.1	$68,030						$68,030	CDFG
	SONCC-MMER.26.1.1.2	$500,000						$500,000	CDFG
	SONCC-MMER.26.1.1.3	$600,000	$600,000	$600,000				$1,800,000	CDFG
	SONCC-MMER.26.1.1.4	$1,250,000	$1,250,000	$1,250,000	$1,250,000			$5,000,000	CDFG
	Action Total:	*$2,418,030*	*$1,850,000*	*$1,850,000*	*$1,250,000*			*$7,368,030*	
SONCC-MMER.27.1.23									
	SONCC-MMER.27.1.23.1						$204,500	$204,500	CDFG
	Action Total:						*$204,500*	*$204,500*	
SONCC-MMER.27.1.24									
	SONCC-MMER.27.1.24.1						$85,037	$85,037	CDFG
	Action Total:						*$85,037*	*$85,037*	
SONCC-MMER.27.1.25									
	SONCC-MMER.27.1.25.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-MMER.27.1.26									
	SONCC-MMER.27.1.26.1	$17,042	$17,042	$17,042	$17,042	$17,042	$17,042	$102,252	CDFG
	SONCC-MMER.27.1.26.2	$4,251	$4,251	$4,251	$4,251	$4,251	$4,251	$25,506	CDFG
	Action Total:	*$21,293*	*$21,293*	*$21,293*	*$21,293*	*$21,293*	*$21,293*	*$127,758*	
SONCC-MMER.27.2.27									
	SONCC-MMER.27.2.27.1	$81,800						$81,800	CDFG
	SONCC-MMER.27.2.27.2			$40,900		$40,900		$81,800	CDFG
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-MMER.27.2.28									
	SONCC-MMER.27.2.28.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-MMER.27.2.29									
	SONCC-MMER.27.2.29.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-MMER.27.2.30									
	SONCC-MMER.27.2.30.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	
SONCC-MMER.27.2.31									
	SONCC-MMER.27.2.31.1	$102,250		$102,250		$102,250	$102,250	$409,000	CDFG
	Action Total:	*$102,250*		*$102,250*		*$102,250*	*$102,250*	*$409,000*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MMER.27.2.32									
	SONCC-MMER.27.2.32.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFG
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-MMER.27.1.33									
	SONCC-MMER.27.1.33.1	$122,700	$122,700	$122,700	$122,700	$122,700	$122,700	$736,200	CDFG
	Action Total:	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$122,700*	*$736,200*	
SONCC-MMER.27.1.35									
	SONCC-MMER.27.1.35.1	$8,722						$8,722	NMFS
	SONCC-MMER.27.1.35.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-MMER.5.1.7									
	SONCC-MMER.5.1.7.1	$44,540						$44,540	Caltrans
	SONCC-MMER.5.1.7.2	$1,482,553						$1,482,553	Caltrans
	Action Total:	*$1,527,093*						*$1,527,093*	
SONCC-MMER.5.1.8									
	SONCC-MMER.5.1.8.1	$348,836						$348,836	Caltrans
	Action Total:	*$348,836*						*$348,836*	
	Population Total:	***$124,278,249***	***$3,771,306***	***$4,221,206***	***$3,171,306***	***$2,371,206***	***$2,619,843***	***$140,433,116***	

Population: Upper Mainstem Eel River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-UMER.5.2.7									
	SONCC-UMER.5.2.7.1							$0	CDFG
	SONCC-UMER.5.2.7.2							$0	CDFG
	Action Total:							*$0*	
SONCC-UMER.14.2.8									
	SONCC-UMER.14.2.8.1	$34,015						$34,015	CDFG
	SONCC-UMER.14.2.8.2	$1,799,158						$1,799,158	CDFG
	Action Total:	*$1,833,173*						*$1,833,173*	
SONCC-UMER.1.2.29									
	SONCC-UMER.1.2.29.1							$0	CDFG
	Action Total:							*$0*	
SONCC-UMER.16.1.16									
	SONCC-UMER.16.1.16.1	$1,744						$1,744	NMFS
	SONCC-UMER.16.1.16.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-UMER.16.1.17									
	SONCC-UMER.16.1.17.1	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	SONCC-UMER.16.1.17.2	$1,744	$1,744	$1,744	$1,744	$1,744	$1,744	$10,464	NMFS
	Action Total:	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$3,488*	*$20,928*	
SONCC-UMER.16.2.18									
	SONCC-UMER.16.2.18.1	$1,744						$1,744	NMFS
	SONCC-UMER.16.2.18.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-UMER.16.2.19									
	SONCC-UMER.16.2.19.1	$1,744						$1,744	NMFS
	SONCC-UMER.16.2.19.2	$1,744						$1,744	NMFS
	Action Total:	*$3,488*						*$3,488*	
SONCC-UMER.2.1.9									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-UMER.2.1.9.1							$0	USFS
	SONCC-UMER.2.1.9.2							$0	USFS
	Action Total:							*$0*	
SONCC-UMER.2.1.10									
	SONCC-UMER.2.1.10.1							$0	CDFG
	SONCC-UMER.2.1.10.2							$0	CDFG
	Action Total:							*$0*	
SONCC-UMER.3.1.1									
	SONCC-UMER.3.1.1.1	$34,015						$34,015	NMFS
	SONCC-UMER.3.1.1.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-UMER.3.1.2									
	SONCC-UMER.3.1.2.1							$0	NMFS
	SONCC-UMER.3.1.2.2							$0	NMFS
	Action Total:							*$0*	
SONCC-UMER.3.1.3									
	SONCC-UMER.3.1.3.1							$0	CWQCB
	Action Total:							*$0*	
SONCC-UMER.3.1.4									
	SONCC-UMER.3.1.4.1							$0	CDFG
	Action Total:							*$0*	
SONCC-UMER.3.1.5									
	SONCC-UMER.3.1.5.1							$0	NRCS/RCD
	Action Total:							*$0*	
SONCC-UMER.3.1.6									
	SONCC-UMER.3.1.6.1							$0	NRCS/RCD
	Action Total:							*$0*	
SONCC-UMER.27.1.20									
	SONCC-UMER.27.1.20.1						$204,500	$204,500	CDFG
	Action Total:						*$204,500*	*$204,500*	
SONCC-UMER.27.1.21									
	SONCC-UMER.27.1.21.1						$122,700	$122,700	CDFG
	Action Total:						*$122,700*	*$122,700*	
SONCC-UMER.27.1.22									
	SONCC-UMER.27.1.22.1	$8,720	$8,720	$8,720	$8,720	$8,720	$8,720	$52,320	CDFG
	Action Total:	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$8,720*	*$52,320*	
SONCC-UMER.27.1.23									
	SONCC-UMER.27.1.23.1	$17,042	$17,042	$17,042	$17,042	$17,042	$17,042	$102,252	CDFG
	SONCC-UMER.27.1.23.2	$4,251	$4,251	$4,251	$4,251	$4,251	$4,251	$25,506	CDFG
	Action Total:	*$21,293*	*$21,293*	*$21,293*	*$21,293*	*$21,293*	*$21,293*	*$127,758*	
SONCC-UMER.27.2.24									
	SONCC-UMER.27.2.24.1	$81,800						$81,800	CDFG
	SONCC-UMER.27.2.24.2			$40,900		$40,900		$81,800	CDFG
	Action Total:	*$81,800*		*$40,900*		*$40,900*		*$163,600*	
SONCC-UMER.27.2.25									
	SONCC-UMER.27.2.25.1	$102,250			$102,250		$102,250	$306,750	CDFG
	Action Total:	*$102,250*			*$102,250*		*$102,250*	*$306,750*	
SONCC-UMER.27.2.26									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-UMER.27.2.26.1	$102,250			$102,250		$102,250	$306,750	CDFG
	Action Total:	*$102,250*			*$102,250*		*$102,250*	*$306,750*	
SONCC-UMER.27.2.27									
	SONCC-UMER.27.2.27.1	$102,250			$102,250		$102,250	$306,750	CDFG
	Action Total:	*$102,250*			*$102,250*		*$102,250*	*$306,750*	
SONCC-UMER.27.2.28									
	SONCC-UMER.27.2.28.1	$102,250			$102,250		$102,250	$306,750	CDFG
	Action Total:	*$102,250*			*$102,250*		*$102,250*	*$306,750*	
SONCC-UMER.27.2.30									
	SONCC-UMER.27.2.30.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFG
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-UMER.27.1.31									
	SONCC-UMER.27.1.31.1	$8,722						$8,722	NMFS
	SONCC-UMER.27.1.31.2	$8,722						$8,722	NMFS
	Action Total:	*$17,444*						*$17,444*	
SONCC-UMER.7.1.11									
	SONCC-UMER.7.1.11.1							$0	NRCS/RCD
	SONCC-UMER.7.1.11.2							$0	NRCS/RCD
	SONCC-UMER.7.1.11.3							$0	NRCS/RCD
	Action Total:							*$0*	
SONCC-UMER.7.1.12									
	SONCC-UMER.7.1.12.1	$5,669						$5,669	CDF
	Action Total:	*$5,669*						*$5,669*	
SONCC-UMER.7.1.13									
	SONCC-UMER.7.1.13.1							$0	USFS
	SONCC-UMER.7.1.13.2							$0	USFS
	Action Total:							*$0*	
SONCC-UMER.8.1.14									
	SONCC-UMER.8.1.14.1							$0	USFS
	SONCC-UMER.8.1.14.2							$0	USFS
	SONCC-UMER.8.1.14.3							$0	USFS
	SONCC-UMER.8.1.14.4							$0	USFS
	Action Total:							*$0*	
	Population Total:	***$2,561,331***	***$135,751***	***$176,651***	***$544,751***	***$176,651***	***$871,951***	***$4,467,086***	
	ESU Total:	***$3,194,229,740***	***$75,308,742***	***$86,237,457***	***$73,652,447***	***$79,239,777***	***$84,030,626***	***$3,592,698,790***	

Appendix G: Glossary and List of Abbreviations

Abbreviations and Acronyms

The following are is a list of selected acronyms and abbreviations used throughout the plan.

ACOE	-U.S. Army Corps of Engineers
ACS	-Aquatic Conservation Strategy
Af	-Acre Feet
ARWC	-Applegate River Watershed Council
AWQMP	-Aquatic Water Quality Management Plan
BCWC	-Bear Creek Watershed Council
BLM	-Bureau of Land Management
BMPs	-Best Management Practice
BO	-Biological Opinion
BOF	-California Board of Forestry
BOR	-Bureau of Reclamation
BRT	-Biological review teams
CAP	-Conservation Action Planning
CBI	-Center for Biological Integrity
CCC	-California Coastal Conservancy
CCC	-California Conservation Corps
CDF	-California Department of Forestry and Fire Protection
CDFG	-California Department of Fish and Game
CDWR	-California Department of Water Resources
CEQA	-California Environmental Quality Act
CESA	-California Endangered Species Act
CFGC	-California Fish and Game Commission
CFPAD	-California Fish Passage Assessment Database
CFPR	-California Forest Practice Rules
CFR	-Code of Federal Regulations
Ck-	-Creek
CMP	-Coastal Management Plan
COE	-U.S. Army Corps of Engineers
CRMP	-Coordinated Resources Management Planning
CRP	-Conservation Reserve Program
CPUE	-Catch Per Unit Effort
CRT	-California Statewide Coho Salmon Recovery Team
CSLC	-California State Lands Commission
CWA	-Federal - Clean Water Act
DBH	-diameter at breast height
DEQ	-U.S. Department of Environmental Quality
DOI	-U.S. - Department of Interior
DPS	-Distinct Population Segment
DWR	-Department of Water Resources
ECWC	-Euchre Creek Watershed Council
EPA	-U.S. Environmental Protection Agency

EPT	-Ephemoptera, Plecoptera Tricoptera
ERWIG	-Eel River Watershed Improvement Group
ESA	-Federal Endangered Species Act
ESU	-Evolutionarilyy Significant Unit
FEMA	-Federal Emergency Management Agency
FEMAT	-Forest Ecosystem Management Assessment Team
FERC	-Federal Energy Regulatory Commission
FGC	-Fish and Game Code
FIRI	-Farm Irrigation Rating Index Model
FLIR	-Forward-Looking Infrared
FMEP	-Fishery Management and Evaluation Plan
FMP	-Fishery Management Plan
FR	-Federal Register
FWS	-U.S. Fish and Wildlife Service
FMEP	-Fishery Management Evaluation Plan
GDRC	-Green Diamond Resource Company
GIS	-Geographic Information System
GWEB	-Governors Watershed Enhancement Board
HBHRCD	-Humboldt Bay Harbor, Recreation, and Conservation District
HBMWD	-Humboldt Bay Municipal Water District
HBWAC	-Humboldt Bay Watershed Action Council
HCP	-Habitat Conservation Plan
HCRCD	-Humboldt County Resource Conservation District
HCWC	-Hunter Creek Watershed Council
HGMPs	-Hatchery and Genetic Management Plan
HRC	-Humboldt Redwood Company
HSRG	-Hatchery Scientific Review Group
HSA	-Hydrologic Sub Area
HU	-Hydrologic Unit
HUC	-Hydrologic Unit Code
IBI	-Index of Biological Integrity
IGH	-Iron Gate Hatchery
IMST	-Independent Multidisciplinary Science Team
IP	-Intrinsic Potential
IPCC	-International Panel on Climate Change
ISAB	-Independent Scientific Advisory Board
IVWC	-Illinois Valley Watershed Council
KNF	-Klamath National Forest
KRIS	-Klamath River Information System
LRMP	-Land and Resource Management Plan
LRWC	-Lower Rogue Watershed Council
LSR	-Late Successional Reserve
LW	-large wood
LWD	-Large Woody Debris
MKWC	-Middle Klamath Watershed Council
MOU	-Memorandum of Understanding

MRC	-Mendocino Redwood Company
MRWC	-Middle Rogue Watershed Council
MSA	-Magnuson-Stevens Fishery Conservation and Management Act
MWAT	-Mean Weekly Average Temperature
MWMT	-Mean Weekly Mean Temperature
NA	-Not Applicable
NAS	-National Academy of Science
NCIRWMP	-North Coast Integrated Regional Water Management Plan
NCRC	-Northern California Resources Center
NCRWQB	-North Coast Regional Quality Control Board
NCWAP	-North Coast Watershed Assessment Program
NCWQCB	-North Coast Water Quality Control Board
NMFS	-National Marine Fisheries Service
NFP	-Northwest Forest Plan
NOAA	-National Oceanic and Atmospheric Administration
NOI	-Notice of Intent
NRC	-National Research Council
NRCS	-Natural Resources Conservation Service
NRS	-Natural Resources Services
NTU	-Nepheoloemetric Turbidity Unit
NWFP	-Northwest Forest Plan
NWFSC	-Northwest Fisheries Science Center
ODA	-Oregon Department of Agriculture
ODEQ	-Oregon Department of Environmental Quality
ODF	-Oregon Department of Forestry
ODFW	-Oregon Department of Fish and Wildlife
ODOT	-Oregon Department of Transportation
OFPA	-Oregon Forest Practices Act
OFPR	-Oregon Forest Practice Rules
OWEB	-Oregon Watershed Enhancement Board
OWRD	-Oregon Water Rights Division
PALCO	-Pacific Lumber Company
PCFWWRA	-Pacific Coast Fish, Wildlife and Wetlands Restoration Association
PCJV	-Pacific Coast Joint Venture
PCSRF	-Pacific Coastal Salmon Recovery Fund
PDO	-Pacific Decadal Oscillation
PFMC	-Pacific Fisheries Management Council
PRWC	-Pistol River Watershed Council
PWA	-Pacific Watershed Associates
RCAA	-Redwood Community Action Agency
RCD	-Resource Conservation District
RHS	-Rural Human Services
RM	-River mile
RMZ	-Riparian Management Zone
RNSP	-Redwood National and State Parks
RRCC	-Rogue River Coordinating Council

RWQCB	-California - Regional Water Quality Control Board
SCWC	-South Coast Watershed Council
SFP	-Sanctuary Forest Program
SMA	-Streamside Management Area
SMZ	-Streamside Management Zone
SONCC	-Southern Oregon/Northern California Coast Coho
SRA	-Smith River Alliance
SRAC	-Smith River Advisory Council
SRAFAP	-Smith River Anadromous Fish Action Plan
SRCSD	-Smith River Community Services District
SRNF	-Six Rivers National Forest
SRRC	-Salmon River Restoration Council
SSRT	-Shasta-Scott Recovery Team
SVRCD	-Shasta Valley Resource Conservation District
SWFSC	-Southwest Fisheries Science Center
SWRCB	-California - State Water Resources Control Board
TEPA	-Tribal Environmental Protection Agency
TMDL	-Total Maximum Daily Load
TNC	-The Nature Conservancy
TIA	-Total Impervious Area
TRH	-Trinity River Hatchery
TRRP	-Trinity River Restoration Program
TRT	-Technical Recovery Team
USDA	-United States Department of Agriculture
USDI	-United States Department of Interior
USEPA	-United States Environmental Protection Agency
USFS	-United States Forest Service
USFWS	-United States Fish and Wildlife Service
USGS	-United States Geological Survey
VSP	-Viable Salmonid Population
WOPI	-Wells Ocean Productivity Index
WOPR	-Western Oregon Plan Revision
WRWC	-Winchuck River Watershed Council
WWG	-Willits Watershed Group
YOY	-Young of the Year

Glossary

abundance: The number of individuals in a population or subpopulation.

anadromous: Species that migrate as juveniles from freshwater to saltwater and then return as adults to spawn in freshwater (e.g., salmon).

anthropogenic: Of, relating to, or resulting from the influence of human beings on nature (Webster 2001).

artificial propagation: Any assistance provided by man in the reproduction of salmon. This assistance includes, but is not limited to, spawning and rearing in hatcheries, stock transfers, creation of spawning habitat, egg bank programs, captive breeding broodstock programs, and cryopreservation (Hard et al. 1992).

basin: Area of land where surface water converges to a single point, usually the exit of the basin, where the waters join another water body. Examples of basins are the Eel River basin, Rogue River basin, and Klamath-Trinity River basin. The basin is the largest classification unit in a hierarchical drainage system adopted by NMFS for the SONCC coho salmon recovery plan. This hierarchical drainage system is made up of basins (largest scale), sub-basins (intermediate scale), and watersheds (smallest scale). See also *sub-basin* and *watershed*.

biological review team (BRT): The team of scientists from the National Marine Fisheries Service formed to conduct a status review.

broad-sense recovery: Goal of having populations of naturally produced salmon sufficiently abundant, productive, and diverse (in terms of life history and geographic distribution) that the ESU/DPS as a whole (a) will be self-sustaining, and (b) will provide significant ecological, cultural, and economic benefits (ODFW and NMFS 2011). This goal is consistent with ESA delisting, but is designed to achieve a level of performance for the ESUs and constituent population that is far more robust than that needed to remove the ESU from ESA protection (ODFW and NMFS 2011).

captive broodstock program: A form of artificial propagation involving the collection of individuals or gametes from a natural population and rearing of these individuals to maturity in captivity (Hard et al. 1992).

carrying capacity: The maximum population of a species that an area or specific ecosystem can support indefinitely without deterioration of the character and quality of the resource (NOAA 2006).

confluence: A flowing together of two or more streams.

critical habitat: The specific areas within the geographical area occupied by the listed species at the time it is listed in accordance with the provisions of the ESA, on which are found those physical or biological features that are essential to the conservation of the species and which may require special management considerations or protection; and specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of the ESA, upon a determination by the Secretary that such areas are essential for the conservation of the species (ESA of 1973, as amended, 16 U.S.C. §1531 et seq.).

delist: When an ESA-listed species is removed from the list of species protected under the ESA.

delisting criteria: Criteria used to determine whether an ESA-listed species no longer needs the protections of the ESA and may be delisted.

dependent population: Populations that rely upon immigration from surrounding populations to persist. Without these inputs, Dependent Populations would have a lower likelihood of persisting over 100 years (Williams et al. 2006).

depensation: The effect where a decrease in spawning stock leads to reduced survival or production of eggs through either (1) increased predation per egg given constant predator pressure, or (2) the "Allee effect" (the positive relationship between population density and the reproduction and survival of individuals) with reduced likelihood of finding a mate (Liermann and Hilborn 2001).

diversity: All the genetic and phenotypic (life history, behavioral, and morphological) variation within a population (NOAA 2006). Diversity includes diversity of (potential) selective environments, diversity of phenotypes, including life history types, and diversity of genetic variation, both neutral and selected (Wlliams et al. 2006).

diversity stratum: Groups of populations that span the diversity and distribution that currently exists or historically existed within the ESU (Williams et al. 2006). Diversity, broadly defined, was the basis for delineating these groups (Williams et al. 2006).

domestication selection: Natural selection operating on a population during artificial propagation that encourages adaptation to the hatchery environment at the expense of adaptation to the natural environment (Hard et al. 1992).

El Niño: A warming of the ocean surface off the western coast of South America that occurs every 4 to 12 years when upwelling of cold, nutrient-rich water does not occur. It causes die-offs of plankton and fish and affects Pacific jet stream winds, altering storm tracks and creating unusual weather patterns in various parts of the world (NOAA 2006).

ephemeral population: Populations which have a substantial likelihood of going extinct within a 100-year time period in isolation, and do not receive sufficient immigration to affect this likelihood. Habitats that support such populations are expected to be occupied only for relatively short periods of time, and rarely at high densities (Williams et al. 2006).
estuary: A coastal ecological ecosystem that is partially enclosed, receives freshwater input from land, and has a horizontal fresh-salt salinity gradient; the average salinity of estuarine waters is defined as being 30 practical salinity units (PSU) for at least 1 month per year (NOAA 2006).

extant: **N**ot destroyed or lost (Webster 2001).

extinction: In evolutionary biology, the failure of groups of organisms of varying size and inclusiveness (e.g., local geographic or temporally-defined groups to species) to have surviving descendants.

extinction risk: The probability that a given population will become extinct within 100 years. Low probability of extinction is arbitrarily defined for this purpose as 5 percent over 100 years (Williams et al. 2006).

functionally independent population: Populations with a high likelihood of persisting in isolation over a 100-year time scale, which are not substantially altered by exchanges of individuals with other populations (Williams et al. 2006).

hatchery: Salmon hatcheries typically spawn adults in captivity and raise the resulting progeny in fresh water for release into the natural environment. In some cases, fertilized eggs are out-planted (usually in "hatch-boxes"), but it is more common to release fry (young juveniles) or smolts (juveniles that are physiologically prepared to undergo the migration into salt water). The fish are released either at the hatchery (on-station release) or away from the hatchery (off-station release). Releases may also be classified as within basin (occurring within the river basin in which the hatchery is located or the stock originated from) or out-of-basin (occurring in a river basin other than that in which the hatchery is located or the stock originated from). The broodstock of some hatcheries is based on adults that return to the hatchery each year; others rely on fish or eggs from other hatcheries, or capture adults in the wild each year (Hard et al. 1992).

hatchery fish: Fish that have spent some portion of their lives, usually their early lives, in a hatchery.

hatchery-origin fish: See *hatchery fish*.

independent population: A group of fish of the same species that spawns in a particular lake or stream at a particular season and which, to a substantial degree, does not interbreed with fish from any other group spawning in a different place or in the same place at a different season (Williams et al. 2008). Also see "potentially independent population" and "functionally independent population".

Intrinsic Potential: The potential of the landscape to support a population. The Intrisic Potential of a watershed or stream reach, is used to evaluate the likelihood of the area to support fish, and is used when population characteristics are unknown (Williams et al. 2006).

jacks: Male salmon that return from the ocean to spawn one or more years before full-sized adults return. For coho salmon in California, Oregon, Washington, and southern British Columbia, jacks are 2 years old, having spent only 6 months in the ocean, in contrast to adults, which are 3 years old after spending 1½ years in the ocean (NOAA 2006).

large woody debris: Any large piece of woody material that intrudes into a stream channel, whose smallest diameter is greater than 10cm, and whose length is greater than 1 m.

limiting factor: An environmental factor that limits the growth or activities of an organism or that restricts the size of a population or its geographical range.

listed species: Any species of fish, wildlife or plant which has been determined to be endangered or threatened under the ESA.

natural fish: See *wild fish*.

natural-origin fish: See *wild fish*.

phenotype: The observable physical or biochemical characteristics of an organism, as determined by both genetic makeup and environmental influences.

pinniped: Carnivorous aquatic mammals that include the seals, walrus, and similar animals having finlike flippers as organs of locomotion.

population: A group of individuals of the same species that live in the same place at the same time and exhibit some level of reproductive isolation from other such groups. In some contexts, a randomly mating group of individuals that is reproductively isolated from other groups is considered a population. A population may consist of a single isolated run or more than one connected run. Synonymous with *stock* (McElhany et al. 2000).

population size: The number of adults in a population.

potentially independent population: Populations with a high likelihood of persisting in isolation over a 100-year time scale, but which are too strongly influenced by immigration from other populations to exhibit independent dynamics (Williams et al. 2006).

productivity: The population growth rate, measured as the spawner-to-spawner ratio (returns per spawner or recruits per spawner.

recovery: The reestablishment or rehabilitation of a threatened or endangered species to a self-sustaining level in its natural ecosystem (NOAA 2006).

recovery domain: The geographic area for which a Technical Recovery Team is responsible.

recovery plan: Under the ESA, a document identifying actions needed to improve the status of a species or ESU to the point that it no longer requires protection (*Hard et al. 1992*).

recovery supplementation: Short-term artificial propagation designed to reduce the risk of extinction of a small or chaotically fluctuating recovering population in its natural habitat by temporarily increasing population size using recovery hatchery fish, while maintaining available genetic diversity and avoiding genetic change in the natural and hatchery populations.

refugia: An area where special environment circumstances occur, enabling individuals to survive in specific life stages.

riparian area: An area with distinctive soils and vegetation between a stream or other body of water and the adjacent upland. It includes wetlands and those portions of floodplains and valley bottoms that support riparian vegetation (Belsky et al. 1999).

riparian vegetation: Vegetation growing on or near the banks of a stream or other body of water in soils that exhibit some wetness characteristics during some portion of the growing season (Welsch 1991).

self-sustaining population: A population that perpetuates itself without human intervention, without chronic decline, and in its natural ecosystem, at sufficient levels that listing under the California Endangered Species Act (CESA) is not warranted (Hard et al. 1992).

spatial structure: The spatial distribution of individuals in a population.

spawner surveys: Spawner surveys utilize counts of live fish, redds (nests dug by females in which they deposit their eggs) and fish carcasses to estimate spawner abundance and identify habitat being used by spawning fish. Annual surveys can be used to compare the relative magnitude of spawning activity between years.

species: A fundamental category of taxonomic classification, ranking below a genus or subgenus and consisting of related organisms capable of interbreeding.

stochastic: The term is used to describe natural events or processes that are random. Examples include environmental conditions such as rainfall, runoff, and storms, or life-cycle events, such as survival or fecundity rates.

stock: See *population.*

stress: An attribute of the ecology of a conservation target [life stage of coho salmon for this plan] that is impaired directly or indirectly by human activities (TNC 2003). A stress is a degraded condition or "symptom" of a conservation target that results from a threat (TNC 2003).

sub-basin: Area of land draining into a stream or river within a large basin. Examples of sub-basins are the Middle Klamath River, the Upper Mainstem Eel River, the Lower Rogue River, and the South Fork Trinity River. The sub-basin is the intermediate classification in a hierarchical drainage system adopted by NMFS for the SONCC coho salmon recovery plan. This hierarchical drainage system is made up of basins (largest scale), sub-basins (intermediate scale), and watersheds (smallest scale). See also *basin* and *watershed*.

take: To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct to a Federally listed species (ESA of 1973, as amended, 16 U.S.C. §1531 et seq.).

technical recovery team (TRT): The team of scientists from NMFS and other entities formed to develop biological viability criteria for listed Evolutionarily Significant Units (ESUs) that will be considered in setting recovery goals (Williams et al. 2006).

threat: Activities or processes that have caused, are causing, or may cause a stress (TNC 2003).

threatened species: Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range (ESA, as amended, 16 U.S.C. §1531 et seq.).

viability: The likelihood that a population will sustain itself over a 100-year time frame (McElhany et al. 2000).

viable salmonid population: An independent population of any Pacific salmonid (genus *Oncorhynchus*) that has a negligible risk of extinction due to threats for demographic variation (random or directional), local environmental variation, and genetic diversity changes (random or directional) over a 100-year time frame (McElhany et al. 2000).

watershed: Area of land draining into a stream or river within a basin or sub-basin. The watershed is the smallest classification in a hierarchical drainage system adopted by NMFS for the SONCC coho salmon recovery plan. This hierarchical drainage system is made up of basins (largest scale), sub-basins (intermediate scale), and watersheds (smallest scale). See also *basin* and *sub-basin*.

wild fish: Fish that are offspring of parents that spawned in the wild. Wild fish spend their entire lives in the natural environment.

References

Belsky, A.J., A. Matzke, and S. Uselman. 1999. Survey of livestock influences on stream and riparian ecosystems in the western United States. Journal of Soil and Water Conservation 54(1):419-431.

Hard, J.J., R.P. Jones, M.R. Delarm, and R.S. Waples. 1992. Pacific salmon and artificial propagation under the Endangered Species Act. U.S. Dep. Commer., NOAA-TM-NMFS-F/NWFSC-2, 56 pp.

Liermann, M. and R. Hilborn. 2001. Depensation: evidence, models, and implications. Fish and Fisheries 2:33-58.

McElhany, P., M.H. Ruckelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. U.S. Dept. Commer., NOAA-TM-NMFS-NWFSC-42, 156 pp.

The Nature Conservancy (TNC). 2003. Landscape-scale conservation: a practitioner's guide. Available online http://conserveonline.org/workspaces/cbdgateway/cap/resources/4/2/Landscape_Practicitioners_Handbook_July03_PR.pdf

NOAA (National Oceanic and Atmospheric Administration). 2006. NOAA Fisheries Glossary: Revised Addition, June 2006 [online]. NOAA-TM-NMFS-F/SPO-69. Available at: *http://www.st.nmfs.gov/st4/documents/F_Glossary.pdf*

NOAA Fisheries Office of Protected Resources Glossary [online], last accessed on December 8, 2011. Available at: http://www.nmfs.noaa.gov/pr/glossary.htm

Oregon Department of Fish and Wildlife and National Marine Fisheries Service. 2011. Final Upper Williamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead. August 5, 2011. 462 p. plus appendices.

Webster, M. 2001. Merriam-Webster's collegiate dictionary, 10th ed. Merriam-Webster, Incorporated, Springfield, Massachusetts. 1,557 pp.

Welsch, D.J. 1991. Riparian Forest Buffers; Function and design for protection and enhancement of water resources. USDA publication NA-PR-07-91 http://www.na.fs.fed.us/spfo/pubs/n_resource/buffer/cover.htm

Williams, T.H., E.P. Bjorkstedt, W.G. Duffy, D. Hillemeier, G. Kautsky, T.E. Lisle, M. McCain, M. Rode, R.G. Szerlong, R.S. Schick, M.N. Goslin, and A. Agrawal. 2006. Historical population structure of coho salmon in the Southern Oregon/Northern California Coasts Evolutionarily Significant Unit. U.S. Dept. Commer., NOAA-TM-NMFS-SWFSC-390.

Williams, T.H., B. Spence, W. Duffy, D. Hillemeier, G. Kautsky, T. Lisle, M. McCain, T. Nickelson, E. Mora, and T. Pearson. 2008. Framework for assessing viability of threatened coho salmon in the Southern Oregon/Northern California Coast evolutionarily significant unit. U.S. Dept. Commer., NOAA-TM-NMFS-SWFSC-432.

Appendix H: Electronic Maps Used in Threats Assessment

A. Overview

NOAA's National Marine Fisheries Service (NMFS) created GIS (Geographic Information System) maps using the instream monitoring and landscape data compiled for each population. *These maps are included as an Electronic Appendix H to the SONCC coho salmon recovery plan on the NMFS website in Adobe Acrobat (PDF) format and are designed to be used as electronic documents, not printed*. The maps are not included in the printed version of the plan because they are not useful in printed form. The many layers in the maps can be toggled on/off and users can zoom in to see more detail. There are two PDF maps included for each population. The main set of maps contains the stress and threats data, in addition to base layers such as coho IP and streams, and was completed in May 2010. The second set of maps was completed in December 2009 and includes canopy change over various time periods and tree size. Due to the large number of layers in the maps, full legends could not be included within the individual maps; therefore, a separate legend PDF is provided for each of the two map types. These maps were used to analyze and interpret habitat condition across the landscape

B. Inventory of electronic files

This electronic appendix is composed of 92 electronic files in PDF format:

- One introductory guide that explains how to use the stresses and threats PDF maps, and provides a legend for the layers in the stresses and threats map. File name:
    - soncc_pop_maps_legend_and_instructions_2011_12_11.pdf
- 45 PDF maps (one for each population in the SONCC coho ESU) with stress data and threats data. The file name of each map starts with the population name, then ends with "_soncc_cap_indicators_sources.pdf":
    - Bear River_soncc_cap_indicators_sources.pdf
    - Brush Creek_soncc_cap_indicators_sources.pdf
    - Chetco River_soncc_cap_indicators_sources.pdf
    - Elk Creek_soncc_cap_indicators_sources.pdf
    - Elk River_soncc_cap_indicators_sources.pdf
    - Euchre Creek_soncc_cap_indicators_sources.pdf
    - Guthrie Creek_soncc_cap_indicators_sources.pdf
    - Hubbard Creek_soncc_cap_indicators_sources.pdf
    - Humboldt Bay Tributaries_soncc_cap_indicators_source.pdf
    - Hunter Creek_soncc_cap_indicators_sources.pdf
    - Illinois River_soncc_cap_indicators_sources.pdf
    - Little River_soncc_cap_indicators_sources.pdf
    - Lower Eel - Van Duzen Rivers_soncc_cap_indicators_source.pdf
    - Lower Klamath River_soncc_cap_indicators_sources.pdf
    - Lower Rogue_soncc_cap_indicators_sources.pdf
    - Lower Trinity River_soncc_cap_indicators_sources.pdf

  - Mad River_soncc_cap_indicators_sources.pdf
  - Mainstem Eel River_soncc_cap_indicators_sources.pdf
  - Maple Creek - Big Lagoon_soncc_cap_indicators_source.pdf
  - Mattole River_soncc_cap_indicators_sources.pdf
  - McDonald Creek_soncc_cap_indicators_sources.pdf
  - McNutt Gulch_soncc_cap_indicators_sources.pdf
  - Middle Fork Eel River_soncc_cap_indicators_sources.pdf
  - Middle Klamath River_soncc_cap_indicators_sources.pdf
  - Middle Mainstem Eel River_soncc_cap_indicators_sourc.pdf
  - Middle Rogue - Applegate Rivers_soncc_cap_indicators.pdf
  - Mill Creek_soncc_cap_indicators_sources.pdf
  - Mussel Creek_soncc_cap_indicators_sources.pdf
  - North Fork Eel River_soncc_cap_indicators_sources.pdf
  - Norton - Widow White Creek_soncc_cap_indicators_source.pdf
  - Pistol River_soncc_cap_indicators_sources.pdf
  - Redwood Creek_soncc_cap_indicators_sources.pdf
  - Salmon River_soncc_cap_indicators_sources.pdf
  - Scott River_soncc_cap_indicators_sources.pdf
  - Shasta River_soncc_cap_indicators_sources.pdf
  - Smith River_soncc_cap_indicators_sources.pdf
  - South Fork Eel River_soncc_cap_indicators_sources.pdf
  - South Fork Trinity River_soncc_cap_indicators_source.pdf
  - Strawberry Creek_soncc_cap_indicators_sources.pdf
  - Upper Klamath River_soncc_cap_indicators_sources.pdf
  - Upper Mainstem Eel River_soncc_cap_indicators_source.pdf
  - Upper Rogue_soncc_cap_indicators_sources.pdf
  - Upper Trinity River_soncc_cap_indicators_sources.pdf
  - Wilson Creek_soncc_cap_indicators_sources.pdf
  - Winchuck River_soncc_cap_indicators_sources.pdf

- One introductory guide that explains how to use the canopy change and tree size PDF maps, and provides a legend for the layers in the stresses and threats map. File name:

  - change_detect_legend_and_instructions_2011_12_11.pdf

- 45 PDF maps (one for each population in the SONCC coho ESU) of the canopy change and tree size data. The file name of each map starts with the population name, then ends with "_change_detect.pdf":

  - Bear River_change_detect.pdf
  - Brush Creek_change_detect.pdf
  - Chetco River_change_detect.pdf
  - Elk Creek_change_detect.pdf
  - Elk River_change_detect.pdf
  - Euchre Creek_change_detect.pdf
  - Guthrie Creek_change_detect.pdf
  - Hubbard Creek_change_detect.pdf

- Humboldt Bay Tributaries_change_detect.pdf
- Hunter Creek_change_detect.pdf
- Illinois River_change_detect.pdf
- Little River_change_detect.pdf
- Lower Eel - Van Duzen Rivers_change_detect.pdf
- Lower Klamath River_change_detect.pdf
- Lower Rogue_change_detect.pdf
- Lower Trinity River_change_detect.pdf
- Mad River_change_detect.pdf
- Mainstem Eel River_change_detect.pdf
- Maple Creek - Big Lagoon_change_detect.pdf
- Mattole River_change_detect.pdf
- McDonald Creek_change_detect.pdf
- McNutt Gulch_change_detect.pdf
- Middle Fork Eel River_change_detect.pdf
- Middle Klamath River_change_detect.pdf
- Middle Mainstem Eel River_change_detect.pdf
- Middle Rogue - Applegate Rivers_change_detect.pdf
- Mill Creek_change_detect.pdf
- Mussel Creek_change_detect.pdf
- North Fork Eel River_change_detect.pdf
- Norton - Widow White Creek_change_detect.pdf
- Pistol River_change_detect.pdf
- Redwood Creek_change_detect.pdf
- Salmon River_change_detect.pdf
- Scott River_change_detect.pdf
- Shasta River_change_detect.pdf
- Smith River_change_detect.pdf
- South Fork Eel River_change_detect.pdf
- South Fork Trinity River_change_detect.pdf
- Strawberry Creek_change_detect.pdf
- Upper Klamath River_change_detect.pdf
- Upper Mainstem Eel River_change_detect.pdf
- Upper Rogue_change_detect.pdf
- Upper Trinity River_change_detect.pdf
- Wilson Creek_change_detect.pdf
- Winchuck River_change_detect.pdf

C. Example Images Created from the PDF Map Files

Figures H-1 and H-2 below show example images for the Mattole River created from the map files described above.

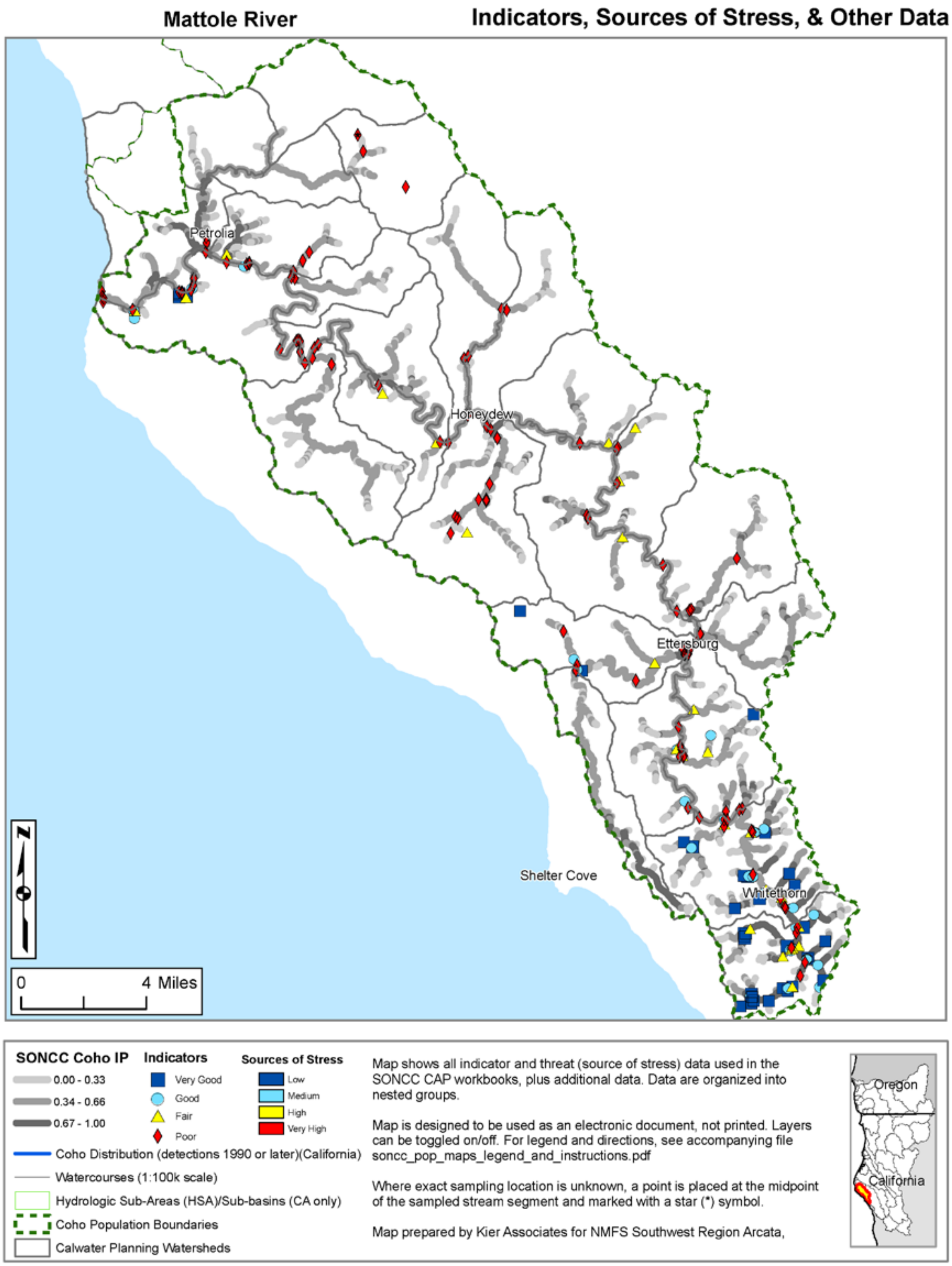


Figure H- 1. Example image from map of Mattole River stress data. Map shows water temperature monitoring stations, modeled Intrinsic Potential (IP) of coho salmon habitat, and boundaries of Calwater Planning Watersheds (all other layers in map are turned off). These are just a few many data layers available in the "Mattole River_soncc_cap_indicators_sources.pdf" map file. Complete legend is available in "soncc_pop_maps_legend_and_instructions_2011_12_11.pdf"

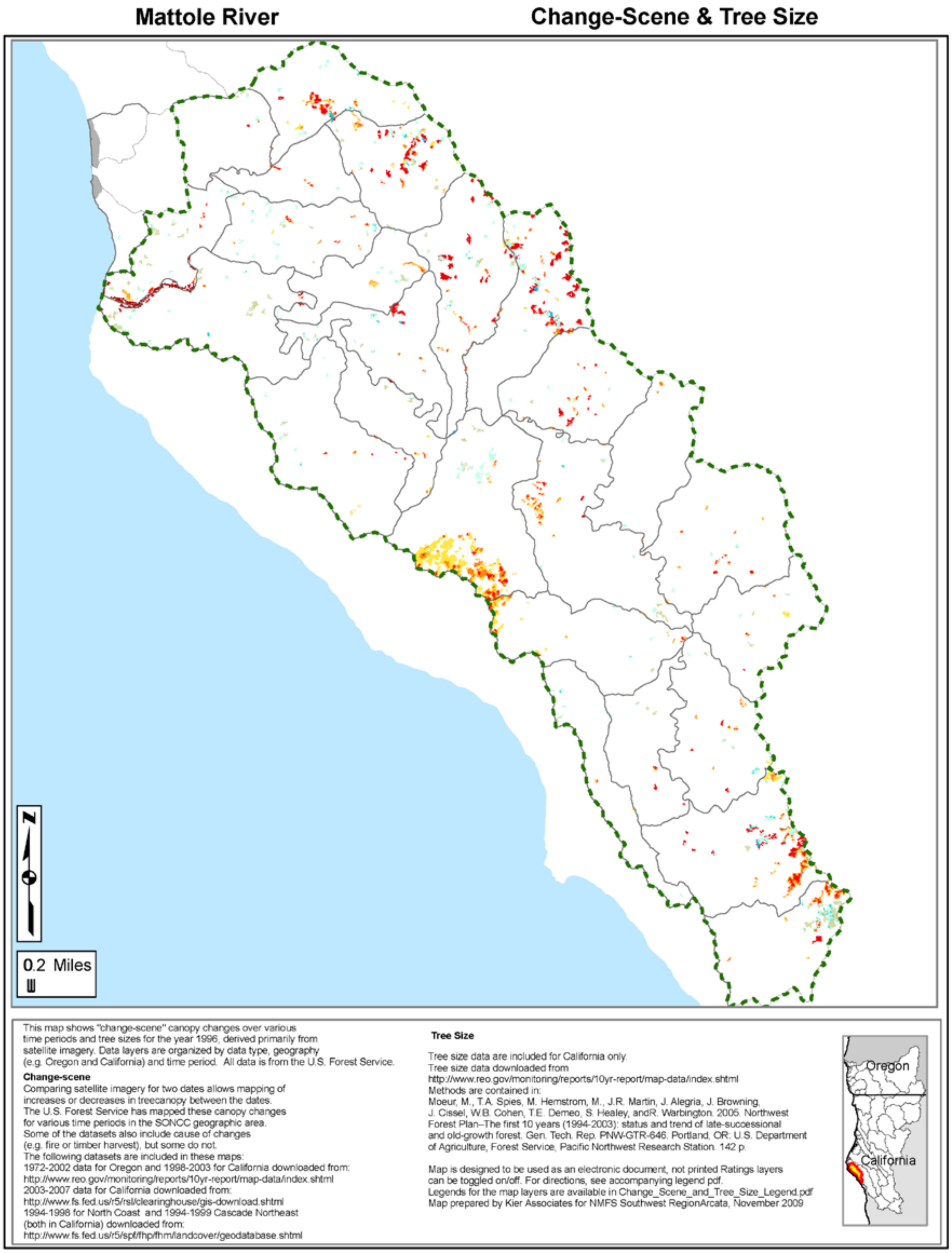


Figure H- 2. Example image from PDF map of Mattole River canopy change and tree size data. Map shows areas where remote sensing detected canopy change in the years 1994 to 2007 and boundaries of Calwater Planning Watersheds (all other layers in map are turned off). These are just a few several data layers available in the “Mattole River_change_detect.pdf” map file. Complete legend is available in “change_detect_legend_and_instructions_2011_12_11.pdf”