Lower Columbia Conservation and Sustainable Fisheries Plan

Lower Columbia Conservation
And
Sustainable Fisheries Plan
For
The Washington Department of Fish and Widlife
In Partnership with
The Lower Columbia Fish Recovery Board

Public Comment Review Draft

Submit comments to the Lower Columbia Fish Recovery Board

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This plan was developed cooperatively between the Lower Columbia Fish Recovery Board and the Washington Department of Fish and Wildlife.

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CHAPTER 1 INTRODUCTION

Fisheries and Hatchery Reform

Operated to mitigate for the impacts hydroelectric dams and habitat losses, Lower Columbia salmon and steelhead hatcheries have helped to sustain commercial, sport and tribal fisheries in the Columbia River and its tributaries and in the Pacific Ocean from California to Alaska. However, past hatchery and harvest practices have also contributed to the decline of natural origin salmon and steelhead populations, many of which are now threatened with extinction.

The Conservation and Sustainable Fisheries (CSF) Plan sets forth a comprehensive plan of action for Lower Columbia hatchery and harvest programs. The goal of this plan is to support efforts to return natural origin lower Columbia salmon and steelhead to healthy, harvestable levels while sustaining important fisheries. It sets forth strategies, actions, and management practices that Washington Department of Fish and Wildlife (WDFW) will use in maintaining and operating its Lower Columbia hatcheries and in managing related fisheries.

Lower Columbia Salmon and Steelhead Hatcheries

Historically salmon were abundant throughout the Columbia River basin with run size estimates exceeding 5-11 million fish annually (CRITFC, 1995). During the latter part of the 1800s salmon canning began and the harvest of Columbia River salmon as a food source increased rapidly. Continued development of the region included forestry, agriculture, mining and other activities. By the mid-1900s salmon abundance began to decline in part due to inadequately regulated harvest, but also due to extensive habitat changes resulting from development of the region.

Construction and operation of hatchery facilities began in the early 1900s and continued throughout the century. In 1938 the Mitchell Act was established for the purpose of conserving anadromous resources of the Columbia River Basin, which included establishment, operation and maintenance of hatchery facilities in Oregon, Washington and Idaho (NOAA Fisheries, 2014). Fish produced at Mitchell Act facilities are intended to partially compensate for fish and habitat losses caused by the construction of dams within the Federal Columbia River Power System (FCRPS).

Additional lower Columbia hatchery facilities have been constructed and are operated with funds provided by Tacoma Power in the Cowlitz Basin and PacifiCorp in the Lewis Basin. These facilities are intended to mitigate for the impact to salmon and steelhead populations resulting from the construction of hydropower facilities on the mainstem Cowlitz and North Fork Lewis Rivers. A key component of these mitigation programs is the reintroduction of salmon and steelhead to upper basin areas that have been blocked to fish passage for over 50 years.

Hatchery programs provide a positive economic benefit for the Columbia Basin, and the region, in terms of personal income from commercial and recreational harvest plus hatchery operations.

Mitchell Act hatchery facilities support over 1,300 full- and part- time jobs that create an estimated $54 million in personal income for rural communities in the region. Mitchell Act[1] supports an extensive network of hatcheries that produces over 50 million fish annually.

In the lower Columbia River, WDFW operates 13 facilities that produce over 30 million salmon and steelhead. Collectively these hatchery programs provide substantial economic benefits and recreational opportunities in Washington and Oregon rural communities including Westport, Tillamook, Astoria, and Cathlamet[2]. Lower Columbia River hatchery programs support sport and commercial fisheries that produce a $29.3 million annual contribution to local personal income and an estimated 1,108 full- and part-time fishery-related jobs throughout the region, excluding hatchery operation related jobs (TCW Economics, 2009).

WDFW-operated hatcheries in the lower Columbia River depend on a variety of funding sources to operate and maintain these facilities (Table 1-1). The vast majority of the funding (91%) for lower Columbia hatchery programs and facilities is provided by Mitchell Act (59%), Tacoma Power (20%) and PacifiCorp (12%). Lower Columbia hatchery production supports fisheries ranging from the interior Columbia River, down to northern California and up to Southeast Alaska. For example, more than 40% of the Chinook salmon catch off the Washington and northern Oregon coasts is reared in Mitchell Act programs and an estimated 25% of coho salmon caught off Washington and 35% caught off Oregon originate in Mitchell Act facilities. Production from other funding sources would contribute to these fisheries at similar rates as Mitchell Act funded programs. Additionally, these programs support salmon and steelhead fisheries in tributaries throughout the lower Columbia River.

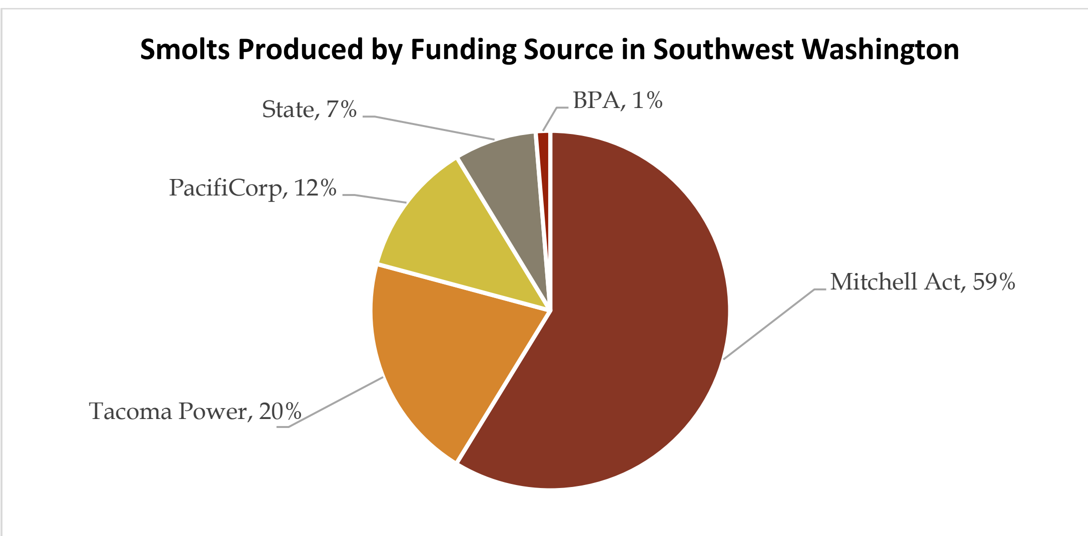


Figure 1-1. Percentage of smolts produced by funding source in southwest Washington.

[1] https://www.fws.gov/laws/lawsdigest/mitchel.html
[2] TCW Economics consulting firm, 2009

Fish hatcheries have been a part of Washington State communities for over 100 years. Not only are they the backbone of artificial production, which provides economic and recreational opportunities, but they also become a part of the fabric that makes up the local communities. WDFW-operated hatcheries, regardless of funding source, provide a wide range of involvement from structured educational outreach programs to visitor centers and kiosks where anyone can simply drop by and visit with staff to see how the fish are raised.

Although providing important social, cultural and economic benefits, hatchery and harvest practices have contributed to the decline of natural origin salmon and steelhead populations. Hatchery fish have reduced the productivity and abundance of natural origin salmon and steelhead populations in the lower Columbia through competition, introduction of disease and the loss of fitness through interbreeding. Decades of intense fishing has dramatically reduced the number of natural origin fish returning to spawning grounds.

These hatchery and harvest impacts coupled with the loss or degradation of critical habitat, hydro-system impacts, and increased predation by birds, marine mammals, and fish have resulted in the listing of nearly all lower Columbia River salmon and steelhead populations as threatened under the federal Endangered Species Act (ESA). Over 70% of the 72 Washington salmon and steelhead populations in the lower Columbia are at a high to very high risk of extinction. Only three of these Washington populations are deemed to be at a low extinction risk (LCFRB 2010).

Efforts to restore these listed fish to healthy, harvestable levels have been underway for over 15 years. Since the mid-1990's harvest impacts on natural origin salmon and steelhead have been reduced substantially and improvements to hatchery practices have been initiated. But additional ongoing efforts are still needed to assist in the recovery of ESA-listed populations while maintaining productive fisheries. The lower Columbia River salmon recovery planning and Hatchery Scientific Review Group (HSRG) processes have provided a regional framework for achieving these needed improvements.

Recovery planning began with the listing of Chinook, chum and steelhead as threatened under the ESA in 1998 and 1999, and in Washington, recovery efforts are guided by the Washington Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan (Washington Recovery Plan) which was completed in 2004 and updated in 2010. The Washington Recovery Plan establishes goals and identifies needed viability improvements for each population. It recognizes that improving population viability will require reductions in habitat, hatchery, harvest and hydro-system impacts that currently limit the productivity of lower Columbia salmon and steelhead populations.

In 2009 the HSRG reviewed Columbia River hatchery programs and provided recommendations regarding improvement to current hatchery and harvest practices that would benefit natural origin populations and support sustainable fishing opportunities. The findings and recommendations resulting from that review are presented in the HSRG's Columbia River Hatchery Reform System-Wide Review (HSRG, 2009a).

Subsequently the Washington Fish and Wildlife Commission (WFWC) adopted a Hatchery and Fishery Reform policy (WDFW, 2009b) to direct hatchery and fishery reform actions by the WDFW. A key tenet of this policy was that all WDFW operated hatcheries would achieve HSRG standards regarding impacts to natural origin populations. WDFW subsequently began a process of evaluating current hatchery and harvest practices in the lower Columbia River for the purpose of identifying reform actions that WDFW could implement to reduce impacts to natural origin populations and maintain sustainable ocean and freshwater fisheries. The results of this evaluation and the overall vision for future of WDFW hatchery programs are captured in the Hatchery Action Implementation Plans (HAIP) – completed in 2009 presented in Appendix 3. This effort grew to become the Conservation and Sustainable Fisheries Plan.

The Conservation and Sustainable Fisheries Plan

The Lower Columbia Fish Recovery Board (LCFRB) and WDFW have utilized guidance and information provided in the Washington Recovery Plan, HSRG reviews and findings, National Marine Fisheries Service (NMFS) Columbia River Basin Hatchery Final Environmental Impact Statement (FEIS) and relevant WFWC policies to develop a CSF Plan that will:

- Support efforts to return natural origin lower Columbia salmon and steelhead to healthy, harvestable levels ; and
- Sustain important fisheries.

The CSF Plan is a critical part of an integrated “All-H” approach to salmon recovery embodied in the Washington Recovery Plan (LCFRB 2010). In an “All-H” recovery approach; habitat, hydropower, hatchery and harvest actions are coordinated and sequenced to:

a. Provide habitat of sufficient quality and quantity to support viable self-sustaining natural fish populations;
b. Ensure sufficient numbers of natural spawners reach the spawning grounds; and
c. Ensure natural spawner populations are sufficiently “fit” or adapted to effectively use available habitat.

Genetically fit naturally spawning fish are better adapted local conditions, thereby being more productive and better able to sustain themselves in the natural environment. Hatchery reforms assist in achieving improved genetic fitness of natural origin populations by ensuring that hatchery fish:

- Have a similar genetic composition to that of natural spawners (integrated hatchery programs) or
- Are sufficiently separated in time and/or space so as not to negatively interact with natural origin populations (segregated hatchery program).

Harvest reforms provide additional assistance by reducing the number of hatchery origin fish reaching the spawning grounds.

Furthermore, the synergistic effects of a coordinated all "H" approach can compound the benefits of habitat restoration, hatchery and harvest reform actions and help to speed recovery efforts. Hatchery reforms can increase the productive capacity of natural origin populations and their ability to effectively use available habitat. Harvest programs can help to ensure a sufficient number of natural origin fish return to spawn. Habitat programs can enhance the quality and quantity of available habitat which in turn determines how many natural origin fish can be produced. The results of the combined actions are compounded to produce a larger natural origin population than would be possible if these same actions were implemented independently (See Figure 1-2).

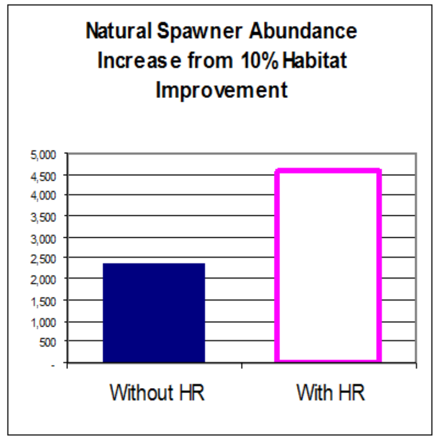


Figure 1-2. Increase in number of spawners with and without hatchery reform when habitat is improves 10%.[3]

The CSF Plan is a living document that consists of three components:

- Implementing hatchery and harvest reform actions;
- Monitoring to evaluate population responses; and
- Adaptive management that adjusts hatchery and harvest programs depending on population responses.

The CSF Plan lays out hatchery and harvest reform objectives and identifies specific measures and actions for each hatchery program operated by WDFW in the lower Columbia. While some of the actions, such as harvest reforms, will benefit all lower Columbia River salmon and steelhead populations, the CSF Plan hatchery reform actions focus on WDFW operated hatcheries and the populations they directly impact. These hatchery programs, and affected natural origin populations, occur in lower Columbia tributaries below Bonneville Dam. The CSF Plan does not address hatchery reforms at hatcheries operated by the State of Oregon or the US Fish and Wildlife Service (USFWS), but it is expected that these programs will also be managed in a manner that supports ESA recovery efforts and sustainable harvest opportunities.

Implementation of the reform actions set forth in this Plan will be guided by an adaptive management approach whereby actions will be implemented, population responses will be measured and adjustments will occur as necessary to achieve goals set forth in the Washington Recovery Plan. The adaptive management process will utilize the population responses to evaluate the effectiveness of actions implemented to date and determine if, and what kind of, adjustments are needed to achieve population goals set forth in the Washington Recovery Plan.

Implementation of this adaptive management process will include improved monitoring programs to collect the data necessary to evaluate the impact of hatchery and harvest programs on natural origin populations. The NMFS Guidance for Monitoring Recovery of Pacific Northwest

[3] HSRG, 2009a

Salmon and Steelhead listed under the Federal Endangered Species Act (2011b) provides the basic framework for such monitoring programs.

The CSF Plan identifies necessary improvements to current monitoring programs and describes how the data collected by these monitoring programs will be used to implement the adaptive management process. Current monitoring programs are limited by funding; therefore, the CSF Plan prioritizes monitoring activities based on importance of the data collected and the population's contribution to recovery.

The CSF Plan will be modified as population responses resulting from hatchery and harvest reform actions become evident. Additional actions may be necessary in the future to ensure that the plans overall objective of returning lower Columbia salmon and steelhead to healthy and harvestable levels is achieved; therefore, the actions presented in this document represent a starting point for implementing hatchery and harvest reform in the lower Columbia River. In some cases actions included in this plan have already been implemented. It will be the responsibility of WDFW to implement, or work with other entities in the region to implement, the actions set forth in this plan. Implementation of these actions will be dependent on adequate funding.

Plan Organization

The CSF Plan is organized into 11 chapters and two supporting appendices. Chapters 2-6 provide background information and context for the CSF Plan. Chapter 7 presents specific hatchery and harvest reform actions to be implemented. Chapters 8-10 discusses the implementation of the CSF Plan, including expected results, monitoring and adaptive management, near-term and long-term actions, and funding. The following provides a more detailed overview of the plans contents:

Chapter 2 Overview of Columbia River Salmon & Steelhead Recovery Planning presents an overview of the recovery planning for the lower Columbia as a whole and Washington Recovery Plan specifically.

Chapter 3 Populations Assessment and Recovery Objectives presents Washington Recovery Plan information regarding population viability assessments and threat evaluations for each species. Also provides information regarding lower Columbia Recovery Scenario, including the identification of individual populations, their priority for recovery and the process of setting threat reduction targets.

Chapter 4 Species Summaries and Recovery Targets presents a description of each species; the status of individual populations and population specific recovery goals and targets.

Chapter 5 Hatchery and Harvest Impacts on Natural Populations presents information regarding impacts of past hatchery and harvest practices on natural origin populations. Also provides information regarding how hatchery programs impact genetic fitness and productivity of natural origin populations. Includes fitness estimates for each population.

Chapter 6 Hatchery and Harvest Reform presents an overview Washington Recovery Plan strategies and measures. Provides information from the Hatchery Scientific Review Group regarding the impact of hatchery programs on natural origin populations, including operational criteria to limit hatchery program impacts on natural origin populations.

Chapter 7 Detail Summary of Hatchery and Harvest Actions presents population specific hatchery and harvest reform actions. Additional information presented for each Washington population includes current and predicted population status and viability metrics; hatchery production and escapement data; and factors limiting population productivity.

Chapter 8 Projected Fitness Improvements presents information regarding the expected improvement in genetic fitness for Washington lower Columbia populations resulting from implementation of the CSF Plan, including fitness estimates prior to and after CSF Plan implementation.

Chapter 9 CSF Plan Implementation provides information on short- and long-term hatchery and harvest reform actions. Discusses short funding sources and implementation needs, including facility investments and improvements implemented to date.

Chapter 10 Monitoring and Adaptive Management presents information regarding monitoring program necessary to fully implement CSF Plan. Includes description of adaptive management process and summary current monitoring programs and needed improvements.

Chapter 11 References includes references and glossary of acronyms.

Appendix 1 outlines the list of Washington Recovery Plan strategies and measures for hatchery and harvest threats.

Appendix 2 outlines WDFW's Six-Year Implementation Work Schedule (IWS) for inclusion in the LCFRB SalmonPORT database. This IWS provides information regarding actions (implementation, ongoing and planned) species and subbasins affected, implementation partners and recovery-related implementation costs.

Appendix 3 presents Hatchery Action Implementation Plans (HAIP) for nine major basins in the Washington lower Columbia region. The HAIPs were completed in June of 2009 to guide hatchery programs. The HAIPs provided the initial foundation for the CSF Plan.

CHAPTER 2 OVERVIEW OF THE LOWER COLUMBIA SALMON & STEELHEAD RECOVERY PLANNING

Four salmon and steelhead species which spawn and rear in the lower Columbia River and its tributaries in Washington and Oregon are listed as threatened under the federal ESA[4]:

- Lower Columbia River Chinook (threatened, 1999—see 64 FR 14308)
- Columbia River Coho (threatened, 2005—see 70 FR 37160)
- Lower Columbia River Steelhead (threatened, 1998--see 63 FR 133347)
- Columbia River Chum (threatened, 1999—see 64 FR 14507)

Listing units are defined as Evolutionarily Significant Units (ESUs) for salmon and Distinct Population Segments (DPSs) for steelhead. Collectively these designations are referred to as the Lower Columbia ESU. See figure 2-1.

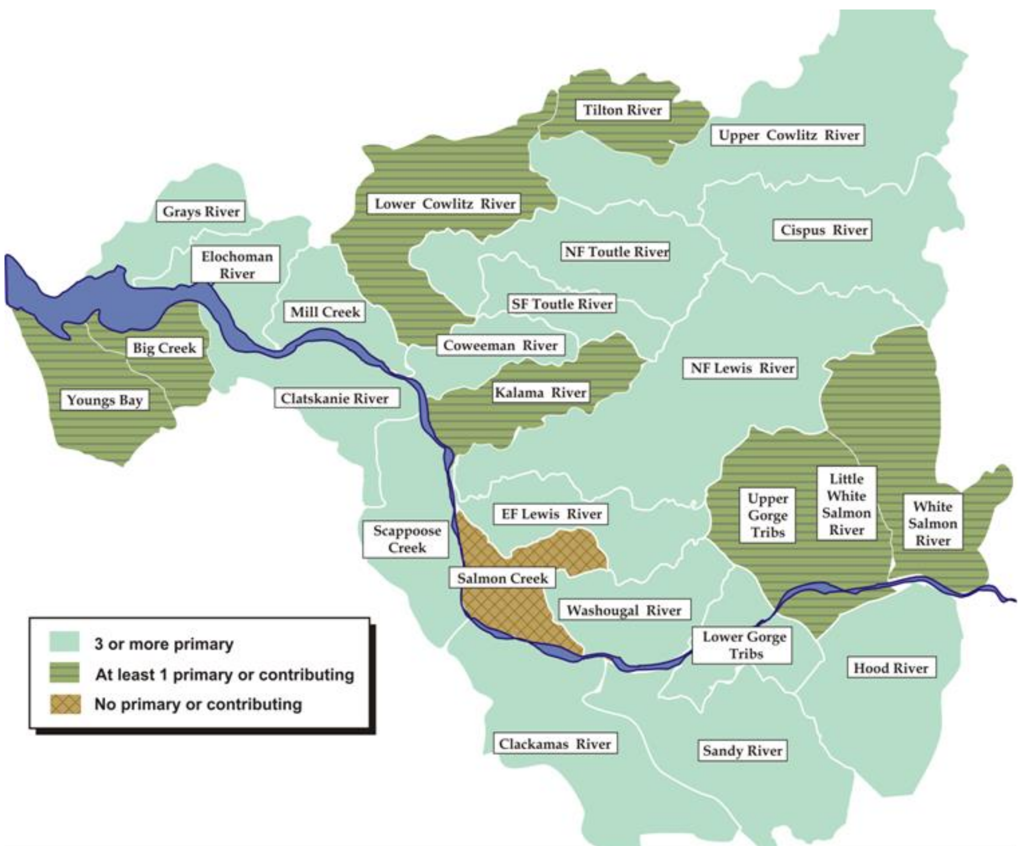


Figure 2-1. The Lower Columbia River Salmon Recover ESU Populations.[5]

Reasons cited by NMFS for these ESA listings include:

[4] NMFS, 2013b
[5] LCFRB, 2010

- habitat loss, alteration and degradation,
- over exploitation in fisheries,
- disease and predation,
- hydropower effects,
- hatchery effects, and
- inadequate regulatory standards.

Within an ESU, independent populations are organized into larger groups, known as strata. Stratum designation is based on the combination of ecological zone and life history strategy (indicated by the time of year when adults return to freshwater to spawn). In the lower Columbia region there are three ecological zones—Coast, Cascade, and Gorge. Two ESUs—Chinook and steelhead—display more than one life history strategy for freshwater rearing, while coho and chum exhibit only one life history strategy. Accordingly there are a total of 16 strata in the Lower Columbia River, as follows:

- Fall Chinook (3 strata) – Coast, Cascade and Gorge
- Spring Chinook (2 strata) – Cascade and Gorge
- Coho (3 strata) – Coast, Cascade and Gorge
- Chum (3 strata) – Coast, Cascade and Gorge
- Winter Steelhead (3 strata) – Coast, Cascade and Gorge
- Summer Steelhead (2 strata) – Cascade and Gorge

The ESU and strata are comprised of multiple demographically independent populations (DIP). The NMFS has defined a DIP as "one or more spawning aggregations that are linked sufficiently by an exchange of spawners such that they share a common demographic fate" (McElhaney et al., 2000). Populations include groups of fish of the same species that spawn in a particular stream, or portion thereof, at a particular time of year and which, to a substantial degree, does not interbreed with fish from any other group spawning in a different place or a different season. The 104 populations in the Lower Columbia ESUs were identified using on a variety of information regarding historical population structure for the lower Columbia. In general, there were six different types of information utilized: (Meyers et al., 2006)

- geography
- migration fidelity,
- genetic attributes,
- life history patterns and morphological characteristic,
- population dynamics, and
- environmental and habitat characteristics

ESA Recovery Planning

The ESA requires the development of a recovery plan for each listed species. The NMFS, often referred to as NOAA Fisheries (NOAA), is the federal agency charged with the responsibility for preparing recovery plans for ESA-listed salmon and steelhead. The ESA requires that these recovery plans contain, at a minimum:

"1. A description of site-specific management actions as may be necessary to achieve the plan's goal for the conservation and survival of the species.
2. Objective, measurable criteria which, when met, would result in a determination… that the species be removed from the list.
3. Estimates of the time required and cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal."[6]

Recovery plans are not regulatory documents. No agency or entity is required by the ESA to implement the actions in the plans unless otherwise legally mandated. Nevertheless, a recovery plan is intended to identify the strategies and actions that, if implemented, are expected to lead to delisting.

Lower Columbia Recovery Plan: Combining the Management Unit Plans and Modules

NOAA adopted its Lower Columbia Recovery Plan for Salmon & Steelhead (Lower Columbia Recovery Plan) in 2013.[7] The plan was developed through a collaborative effort involving federal and state agencies, tribes, local governments, and the public. It is a synthesis or "roll-up" of three locally developed recovery plans, referred to as management unit (MU) plans. Each MU plan covers populations within a distinct geographic segment of the area encompassed by the lower Columbia salmon ESUs and steelhead DPS. The Lower Columbia Recovery Plan also includes two recovery modules addressing regional issues affecting Lower Columbia salmon and steelhead. The three MU plans and two modules are:

Lower Columbia Washington Management Unit or Washington Recovery Plan[8] covers the salmon and steelhead populations originating in the Washington tributaries to the Columbia River from the mouth of the Columbia River upstream to and including the Little White Salmon River. Recovery planning efforts for this portion of the lower Columbia are coordinated by the LCFRB. The board was established by Washington law in 1998 to oversee and coordinate salmon and steelhead recovery efforts in the lower Columbia region of Washington. The LCFRB developed the plan through a collaborative process involving multiple federal and state agencies, local governments, tribal governments, the public, and various organizations, industries, and stakeholders.

White Salmon Management Unit includes the White Salmon River basin in Washington. NMFS completed development of the recovery plan in June 2013.[9]

[6] ESA section 4(f)(1)(B)
[7] NMFS, 2013b
[8] Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan, LCFRB 2010
[9] NMFS, 2013a

Lower Columbia Oregon Management Unit covers lower Columbia salmon and steelhead populations originating in the Oregon tributaries to the Columbia River from the mouth of the Columbia River upstream to and including the Hood River.

Estuary Recovery Plan Module was completed by NMFS in January 2011[10] and is intended to complement all recovery plans in the Columbia River basin. The planning area for this module includes the tidally influenced areas of the Columbia River. This module identifies and prioritizes management actions that, if implemented, would reduce the impacts of limiting factors that impede salmon and steelhead survival during their migration through, and rearing in, the estuary and plume environments.

Columbia River Hydro Module was completed by NMFS in September 2008.[11] This module summarizes the general effects of Columbia River mainstem hydropower projects on all 13 ESA-listed salmon and steelhead species in the Columbia River Basin and identifies limiting factors and threats impacting these populations. The module also includes expected actions, including site-specific management actions, or strategy options to address those threats.

In rolling up the MU plans and recovery modules, the NMFS Lower Columbia Recovery Plan addresses interdependencies and issues of regional scope, and ensures that the entire salmon life cycle and all threats are addressed. The Lower Columbia Recovery Plan also ensures that ESU-level recovery criteria are addressed and that research, monitoring, evaluation, and adaptive management strategies are regionally coordinated.

Washington Lower Columbia Recovery Plan

The vision of the Washington Recovery Plan is to recover lower Columbia salmon and steelhead to:

> "healthy, harvestable levels that will sustain productive sport, commercial, and tribal fisheries, through the restoration and protection of the ecosystems upon which they depend and the implementation of supportive hatchery and fishery practices."

The Plan provides goals, strategies, measures, and actions to reverse the long term declining trends in salmon and steelhead numbers and achieve a trajectory leading to healthy and harvestable levels of naturally produced salmon and steelhead within 25 years. The Plan lays out a framework for monitoring progress and adjusting course as needed to maintain the recovery trajectory.

STRATEGIES AND MEASURES

[10] NMFS, 2011a
[11] NMFS, 2008

The Washington Recovery Plan implements an “All-H” strategy. This strategy addresses the four “H’s” (hatchery, harvest, habitat and hydro), or potentially manageable threats, that limit population productivity and abundance. The plan assesses the extent to which each potentially manageable threat adversely impacts the viability of each lower Columbia salmon and steelhead population. It then sets productivity improvement and impact reduction targets identifying the extent to which each threat must be reduced in order to achieve recovery. This “All-H” strategy assumes that all impact reduction targets for each threat will be met, thereby achieving population specific recovery or viability targets set forth in Washington Recovery Plan.

The Washington Recovery Plan sets forth strategies and measures that guide actions to achieve the threat reduction and productivity improvement targets set forth by the plan. The full list of hatchery and harvest strategies and measures are included in Appendix 1.

RECOVERY PLAN IMPLEMENTATION

The Washington Recovery Plan will be implemented by federal, state, tribal, and local governments with the participation nonprofit organizations, the business community, and the public. Collectively these entities are referred to as recovery partners. The Plan does not obligate any of these partner but does establish specific implementation responsibilities. The plan does identify the partners with the mission, capabilities, responsibilities, authority and jurisdiction needed to implement the various actions identified in the plan. The implementing partners are asked to develop and implement a six-year plan for their recovery actions and to monitor and report their progress.

Success in achieving recovery of the region’s salmon and steelhead is dependent on the effectiveness of the partners in undertaking and sustaining the identified recovery actions. It is incumbent upon each partner to develop and fully implement programs to address its assigned actions. Implementation of recovery programs and actions is not a one-time or short-term initiative. Programs and actions put in place early will have to be sustained, evaluated, adjusted, and augmented over the 25-year recovery period.

The CSF Plan is the proposed plan to address WDFW hatchery and harvest actions identified in the Washington Recovery Plan. It documents that the actions WDFW will take to ensure hatchery and harvest activities meet the goals and targets for the conservation and recovery salmon and steelhead in the lower Columbia River (See Appendix 2). Activities identified in the CSF Plan will require adequate funding levels and actions implemented may not produce the expected population response; therefore, an adaptive management approach will be required in implementing the CSF Plan. The CSF Plan will be updated as new information becomes available or as funding levels dictate. The CSF Plan will be reviewed and updated at least every six years in conjunction with scheduled updates to the Washington Recovery Plan, and at shorter intervals as additional information becomes available or changes in funding occur.

CHAPTER 3 POPULATION ASSESSMENTS AND RECOVERY OBJECTIVES

The Washington Recovery Plan uses a population based systemic all "H" approach to establish recovery goals, strategies, measures, and actions for the 72 Washington salmon and steelhead populations within the Lower Columbia ESU. To accomplish this, the recovery plan:

- Assesses the current status of each population;
- Evaluates the threats affecting each population;
- Lays out a comprehensive recovery scenario addressing all four lower Columbia ESA-listed salmon and steelhead species;
- Sets productivity, abundance and threat reductions targets for each population.

Since the Washington Recovery Plan provides the basis for the hatchery and harvest reform in this chapter provides a brief overview of the Washington Recovery Plan. Specifically, it presents information regarding population viability and threat evaluations and summarizes the plan's comprehensive Recovery Scenario that establishes viability goals for all Washington lower Columbia salmon and steelhead populations. By providing viability goals for each population this scenario establishes a base upon which actions to reduce threat impacts are built.

POPULATION VIABILITY ASSESSMENT

Species and population status are evaluated for viability or extinction risk. Viability is the ability of a population or group of populations to persist over an extended period of time. A viable ESU or population has been defined by NMFS as having a negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over a 100-year time frame. Extinction risk is the inverse of a population's viability. For example, if a population has a high viability, it has a low extinction risk.

The NMFS uses four key population parameters, referred to as Viable Salmonid Parameters (VSP), to evaluate the viability of a population. Theses parameters are abundance, productivity, spatial structure and diversity. The Willamette-Lower Columbia Technical Review Team (TRT) utilized these VSP parameters to develop criteria, for categorizing the viability or risk for a population. This criterion identifies five categories of viability and risk, ranging from very low to very high (Table 3-1).

Table 3-1. Viability and extinction risk categories identified by the Willamette-Lower Columbia Technical Recovery Team.[12]

Scale	Viability		Extinction risk	
	Category	Probability[1]	Category	Probability
0	Very low	<40%	Either extinct or very high	>60%
1	Low	40-74%	High	26-60%
2	Medium	75-94%	Moderate	6-25%
3	High[2]	95-99%	Low[2]	1-5%
4	Very High	>99%	Very low	<1%

[1] 100-year persistence probabilities. [2] Represents a "viable" level.

Additionally, the TRT assigned each viability level with a numerical score to assist in evaluating the species viability at the strata or ESU level (Table 3-1). Individual population scores can be combined to establish a viability score for a given stratum.

THREAT EVALUATION

The Washington Recovery Plan used an ecosystem approach to encompass the wide spectrum of conditions that can affect salmon throughout their life cycle. In order to describe the biological needs of the species throughout this spectrum of conditions the plan utilized a life cycle model to conduct a Population Viability Analysis (PVA). Results of the PVA included the identification of factors that limit the viability of a species or a population. These factors include in-basin and out-of-basin influences as well as human and natural factors.

The Washington Recovery Plan identified threats that describe human activities or other dynamics that affect the limiting factors. The plan specifically focused on potentially-manageable threats in setting a course of action that would improve the viability of lower Columbia salmon and steelhead populations. These manageable threats are primarily the result of human activities and therefore, actions can be implemented to reduce their adverse impacts. The six potentially-manageable threat categories are:

- Estuary Habitat
- Tributary Habitat
- Hydro
- Harvest
- Hatchery
- Ecological interactions such as predation and competition

The Washington Recovery Plan completed life cycle analysis of the various threats to quantify the impact of each threat category on a given species or population. The life cycle analysis captured interactions between the different threats, which is critical to accurately assessing the impact of any given threat and the benefits accrued from reducing the impact of a threat or threats. In some cases the model identified areas where reductions in impacts of multiple

[12] Ibid.

threats would provide compounding benefits over the course of a life cycle. In other situations the model identified situations where gains in one threat may be offset by limitations from another threat.

The result of this modeling work was a comprehensive evaluation of threats that helps ensure equity in balancing the responsibilities and costs of salmon recovery among different partners and stakeholders. Using the results of this evaluation partners and stakeholders developed strategies and measures that would guide actions to mitigate each threat. The completion of the comprehensive evaluation and equitable balancing of costs increased the likelihood that strategies and actions necessary to mitigate for threats would be effectively implemented.

Comprehensive ESU Recovery Scenario

The NMFS developed guidelines for setting recovery goals for the ESU overall and for each stratum. This strategy consists of the five elements described below and makes use of the viability scoring criteria established by the Willamette-Lower Columbia TRT. The LCFRB utilized these guidelines and the scoring criteria to develop a recovery scenario for the Lower Columbia ESU. The TRT criteria provide the technical basis for the recovery scenario. These criteria are based on a series of ESU, strata, and population criteria addressed in five elements, as follows:

Stratified Approach: Every life history and ecological zone stratum that historically existed should have a high probability of persistence.

Viable Populations: Individual populations within a stratum should have persistence probabilities consistent with a high probability of strata persistence. For each stratum, the TRT defined high persistence probability based on the presence of at least two populations with a negligible or low risk of extinction and other populations having persistence probabilities consistent with a high probability of stratum persistence (i.e., the average of all stratum population scores is 2.25 or higher based on the TRT's scoring system presented in Table 3-1).

Representative Populations: Representative populations need to be preserved but not every historical population needs to be restored. Populations selected for high or very high viability should include "core" populations that are highly productive, "legacy" populations that represent historical genetic diversity, and "dispersed" populations that minimize susceptibility to catastrophic events.

Non-Deterioration: No populations should be allowed to deteriorate until the ESU is recovered.

Safety Factors: Higher levels of recovery should be attempted in more populations than identified in the strata viability criteria because not all attempts to recover individual populations will be successful.[13]

A key implication of the TRT's recommendations is that not every population needs to be restored to high levels to recover an ESU. The TRT criteria for a viable ESU allows efforts to be

[13] Ibid.

concentrated in subbasins where multiple species benefits and moderate to high quality habitat provide good prospects for cost effective results. Substantial improvements are not required in some severely degraded subbasins, although criteria require additional protection and restoration efforts to prevent further declines.

The TRT also developed methodology to utilize the population viability scores presented in Table 3-1 to evaluate the viability of a stratum and an ESU. Using this scoring system, a stratum is considered viable when it contains at least two populations that are at a viability $\geq$ 3.0 (high or very high viability) and when the strata-wide average viability for all populations is $\geq$ 2.25 (exceeds medium viability). An ESU is considered viable when all strata are viable.

Using criteria established by NMFS and TRT the LCFRB developed a preferred recovery scenario that set population recovery designations or targets based on the level viability needed to achieve recovery or delisting at the strata and ESU level. The preferred scenario was developed through a collaborative process with stakeholders and *"prioritizes populations for recovery based on biological significance, feasibility of improvements, and equitability in sharing of the recovery burden."*[14] Assumptions were made, in coordination with Oregon, regarding recovery potential for Oregon populations within lower Columbia salmon ESUs and steelhead DPSs to help ensure that the goals and actions in the Washington Recovery plan are consistent with ESU recovery criteria. The population designations described in the Washington Recovery Plan are:

P **"Primary populations** are targeted for restoration to high or very high viability (score = 3-4). These populations are the foundation of salmon recovery. At least two populations per strata must be at high or better viability to meet recommended TRT guidelines for a viable ESU. Primary populations are typically the strongest extant populations and/or those with the best prospects for protection or restoration. These typically include populations at high or medium viability during the listing baseline. In some cases, populations with low or very low baseline viability were also designated as primary populations in order to achieve viable strata and ESU conditions."

C "**Contributing populations** are those for which some improvement will be needed to achieve a stratum-wide average of medium viability (score = 2). Contributing populations might include those of low to medium significance and viability where improvements can be expected to contribute to recovery. Varying levels of improvement are identified for contributing populations. Some contributing populations are targeted for substantial improvements whereas more limited increases are identified for others."

S **"Stabilizing populations** are those that would be maintained at baseline levels. These are typically populations at very low viability (score = 0-1) during the listing baseline. Stabilizing populations might include those where significance is low, feasibility is low, and uncertainty is high. While stabilizing populations are not targeted for significant improvement, substantive recovery actions will typically be required to avoid further degradation."

[14] LCFRB, 2010

Table 3-2 below presents the population designations for salmon and steelhead populations presented in the Washington Recovery Plan.

Table 3-2. Recovery designations for Lower Columbia salmon and steelhead populations in Washington from the Washougal River to the Columbia River mouth.

Lower Columbia Salmon Recovery Scenario[1]

<table>
<tr><th></th><th></th><th colspan="3">Chinook</th><th colspan="2">Chum</th><th colspan="2">Steelhead</th><th rowspan="2">Coho</th></tr>
<tr><th></th><th></th><th>Fall</th><th>Late Fall</th><th>Spr.</th><th>Fall</th><th>Sum.</th><th>Win.</th><th>Sum.</th></tr>
<tr><td rowspan="7">COAST</td><td>Grays/Chinook</td><td>C</td><td>--</td><td>--</td><td>P</td><td>--</td><td>P[3]</td><td>--</td><td>P</td></tr>
<tr><td>Eloch./Skam.</td><td>P</td><td>--</td><td>--</td><td>P</td><td>--</td><td>C[3]</td><td>--</td><td>P</td></tr>
<tr><td>Mill/Aber./Ger.</td><td>P</td><td>--</td><td>--</td><td>P</td><td>--</td><td>P[3]</td><td>--</td><td>C</td></tr>
<tr><td>Youngs Bay (OR)</td><td>S</td><td>--</td><td>--</td><td>S</td><td>--</td><td>P[3]</td><td>--</td><td>S</td></tr>
<tr><td>Big Creek (OR)</td><td>C</td><td>--</td><td>--</td><td>S</td><td>--</td><td>P[3]</td><td>--</td><td>S</td></tr>
<tr><td>Clatskanie (OR)</td><td>P</td><td>--</td><td>--</td><td>P</td><td>--</td><td>P[3]</td><td>--</td><td>P</td></tr>
<tr><td>Scappoose (OR)</td><td>P</td><td>--</td><td>--</td><td>P</td><td>--</td><td>P[3]</td><td>--</td><td>P</td></tr>
<tr><td rowspan="14">CASCADE</td><td>Lower Cowlitz</td><td>C</td><td>--</td><td>--</td><td rowspan="5">C</td><td rowspan="5">C</td><td>C</td><td>--</td><td>P</td></tr>
<tr><td>Coweeman</td><td>P</td><td>--</td><td>--</td><td>P</td><td>--</td><td>P</td></tr>
<tr><td>SF Toutle</td><td rowspan="2">P</td><td>--</td><td rowspan="2">C</td><td>P</td><td>--</td><td>P</td></tr>
<tr><td>NF Toutle</td><td>--</td><td>P</td><td>--</td><td>P</td></tr>
<tr><td>Upper Cowlitz</td><td rowspan="3">S</td><td>--</td><td>P</td><td>P</td><td>--</td><td>P</td></tr>
<tr><td>Cispus</td><td>--</td><td>P</td><td>--</td><td>--</td><td>P</td><td>--</td><td>P</td></tr>
<tr><td>Tilton</td><td>--</td><td>S</td><td>--</td><td>--</td><td>C</td><td>--</td><td>S</td></tr>
<tr><td>Kalama</td><td>C</td><td>--</td><td>C</td><td>C</td><td>--</td><td>P</td><td>P</td><td>C</td></tr>
<tr><td>NF Lewis</td><td rowspan="2">P</td><td>P</td><td>P</td><td rowspan="2">P</td><td>--</td><td>C</td><td>S</td><td>C</td></tr>
<tr><td>EF Lewis</td><td>--</td><td>--</td><td>--</td><td>P</td><td>P</td><td>P</td></tr>
<tr><td>Salmon</td><td>S</td><td>--</td><td>--</td><td>S</td><td>--</td><td>S</td><td>--</td><td>S</td></tr>
<tr><td>Washougal</td><td>P</td><td>--</td><td>--</td><td>P</td><td>--</td><td>C</td><td>P</td><td>C</td></tr>
<tr><td>Sandy (OR)</td><td>C</td><td>P</td><td>P</td><td>P</td><td>--</td><td>P</td><td>--</td><td>P</td></tr>
<tr><td>Clackamas (OR)</td><td>C</td><td>--</td><td>P[2]</td><td>C</td><td>--</td><td>P</td><td>--</td><td>P</td></tr>
<tr><td rowspan="4">GORGE</td><td>Lower Gorge</td><td>C[4]</td><td>--</td><td>--</td><td>P</td><td>--</td><td>P</td><td>--</td><td>P[4]</td></tr>
<tr><td>Upper Gorge</td><td>C</td><td>--</td><td>--</td><td rowspan="3">C</td><td>--</td><td>S[4]</td><td>P</td><td rowspan="2">P</td></tr>
<tr><td>White Salmon</td><td>C</td><td>--</td><td>C</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td>Hood (OR)</td><td>P</td><td>--</td><td>P</td><td>--</td><td>P</td><td>P</td><td>P</td></tr>
</table>

[1] LCFRB 2010, Vol. 1, Chapter 4. [2] Clackamas spring Chinook are part of the Upper Willamette ESU. [3] Winter steelhead of the Coast Strata are not listed under the Federal ESA. [4] Designation for shared population based on WA and OR objectives.

THREAT REDUCTIONS

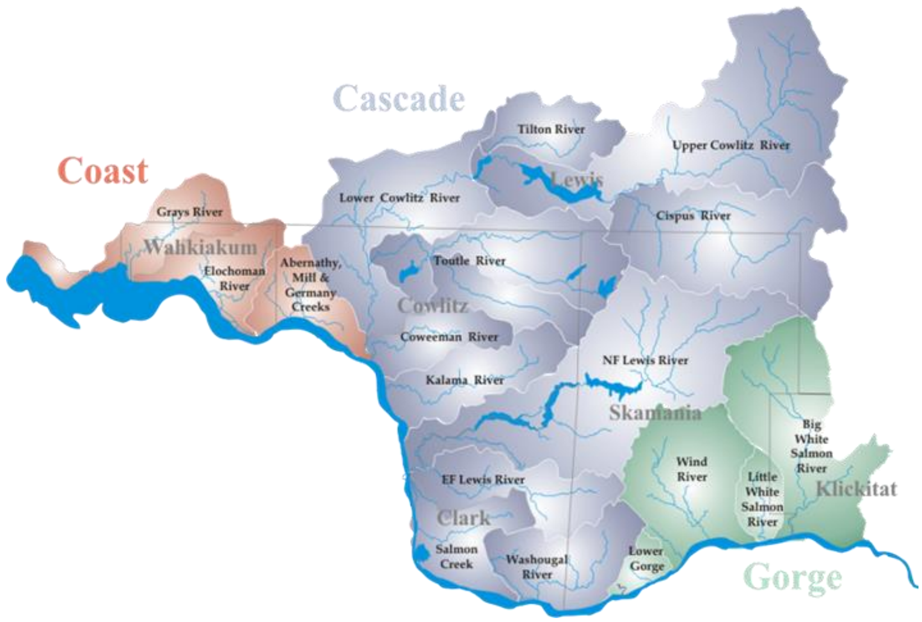
The Lower Columbia Salmon Recovery Scenario presented above establishes a viability objective for each lower Columbia salmon and steelhead population. The life cycle modeling completed as part of the PVA quantifies the impact of each threat on the viability of each population. The Washington Salmon Recovery Plan defined impacts as “the proportional reduction in population productivity due to potentially-manageable threats”. The Washington Recovery Plan used the viability targets from the recovery scenario and the baseline threat impacts from the plan to establish impact reduction targets for each population and each threat.

The Washington Recovery Plan utilizes life cycle modeling to produce productivity estimates, and associated abundance estimates, for each population at baseline conditions and at recovery. The estimates are subsequently used to determine the abundance and productivity improvement necessary to achieve recovery. The change in abundance and productivity from baseline to recovery represents the productivity improvement target necessary to achieve the population viability goal per the Lower Columbia Salmon Recovery Scenario (Table 3-2). Impact reduction targets identify the relative change necessary for each threat to achieve the abundance and productivity improvement targets for each population.

The Washington Recovery Plan strategy for addressing threats included a sharing of the "conservation burden" by identifying impact reductions that are proportional to the significance of that threat and the baseline impact. For instance, if the overall reduction target for a given population is 50% then that target is applied consistently across all six of the potentially manageable threats, which would result in a 50% impact reduction target for each threat. If a given threat had a baseline impact of 60% then its impact reduction target would be 30%. In contrast, if another threat had a baseline impact of 10% then the impact threat reduction target would be 5%.

This strategy results in impact reduction targets providing guidance for the development of substantive actions that will reduce adverse impacts for all six of the potentially manageable threats. These impact reduction targets do not represent absolute objectives per se, but rather identify the general level of effort for each threat that will be necessary to achieve recovery. By sharing the "conservation burden" across all six threats this strategy increases the likelihood for successful implementation of recovery actions and is consistent with the "All-H" recovery strategy used by the Washington Recovery Plan.

CHAPTER 4 SPECIES SUMMARIES AND RECOVERY TARGETS



Chinook (Oncorhyncus tshawytscha)

Species Summary[15]

Lower Columbia fall Chinook spawn in large river mainstem areas, including most tributaries to the lower Columbia. Most lower Columbia fall Chinook are classified as tule stock due to their advanced maturity upon return and early run timing. Lower Columbia Fall (tule) Chinook typically enter freshwater during August through September, with peak spawning occurring in mid-October. Fall Chinook destined for the Lewis and Sandy rivers have later run timing and are classified as a bright stock. Lower Columbia Late Fall (Bright) Chinook enter the Columbia from August to October and spawn from November to January, with peak spawning in mid-November. Juvenile fall Chinook typically rear in freshwater for 1-4 months and make extensive use of the estuary during their migration to the ocean. Juvenile fall Chinook outmigrate to the ocean occur during the late summer or autumn where they rear for 2-5 years.

Lower Columbia spring Chinook historically spawned in the upstream portions of large subbasins, including the Cowlitz and Lewis rivers. Adults have a protracted freshwater spawning migration, entering the lower Columbia from March through June and spawning in August and September. Most juvenile spring Chinook rear freshwater for an entire year prior to making

[15] Species summaries and recovery targets referred to in this chapter are cited from the WA Recovery Plan (LCFRB, 2010) Volume 1, Chapter 6

their smolt outmigration to the ocean during the spring of their second year. Juveniles from some Lower Columbia tributaries do migrate downstream from their natal tributaries into larger river during fall and early winter where they are believed to over-winter before completing their smolt outmigration the next spring. Spring Chinook typically rear in the ocean for 2-5 years.

POPULATION STATUS

Spring, fall (tule), and late fall (bright) runs were included in the Lower Columbia ESU listed as a threatened species under the ESA in 1999.

Fall Chinook: The Willamette-Lower Columbia TRT identified a total of 23 distinct lower Columbia fall Chinook populations, 21 earlier returning tule stocks and two later returning bright stocks. The Washington Recovery Plan utilized life cycle modeling to evaluate the status of all of Washington fall Chinook populations. Modeling results indicate that all Washington tule populations are at high to very high risk of extinction. In contrast the lone Washington bright stock population is at a very low risk of extinction. Figure 4-1 displays current viability and the recovery viability objective or goal for each fall Chinook population.

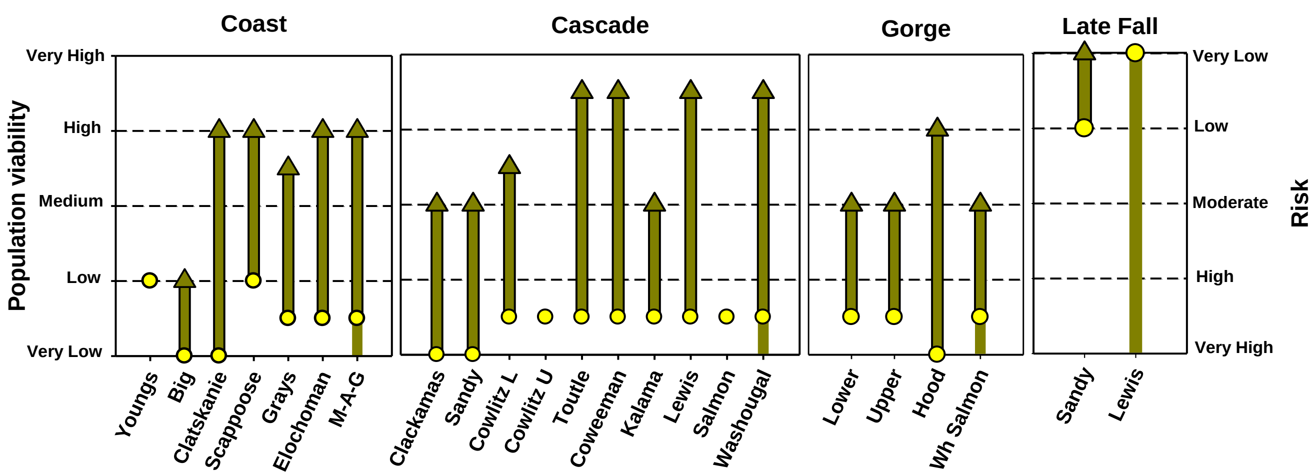


Figure 4-1. Viability objectives for fall Chinook identified in the recovery scenario for Washington and in Oregon's Recovery Plan.

Spring Chinook: The Willamette-Lower Columbia TRT identified a total of nine distinct lower Columbia spring Chinook populations, of which seven are in the Cascade Stratum and two are in the Gorge Stratum. The Washington Recovery Plan utilized life cycle modeling to evaluate the status of all of Washington spring Chinook populations and modeling results indicate that all of the Washington populations are at high to very high risk of extinction. Figure 4-2 displays current viability and the viability objective or goal for each spring Chinook population.

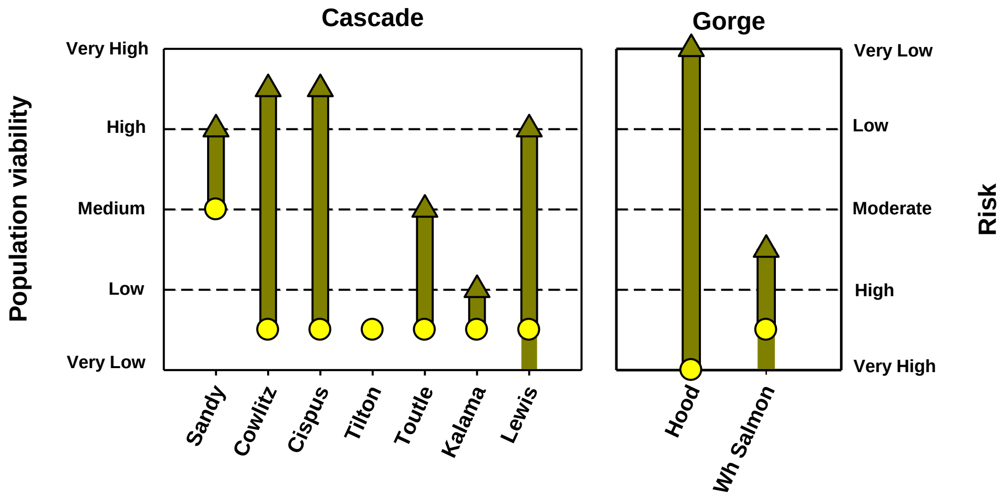


Figure 4-2 Viability objectives for spring Chinook identified in the recovery scenario for Washington and in Oregon's Recovery Plan

THREATS

Fall Chinook: The Washington Recovery Plan estimates that adult abundance of Washington tule populations are 0-25% of their historic production potential and 0-20% of population-specific recovery objectives. As displayed in Figure 4-3 hatchery, harvest and habitat (tributary and estuary), currently have the largest adverse impact on the viability of natural origin fall Chinook.

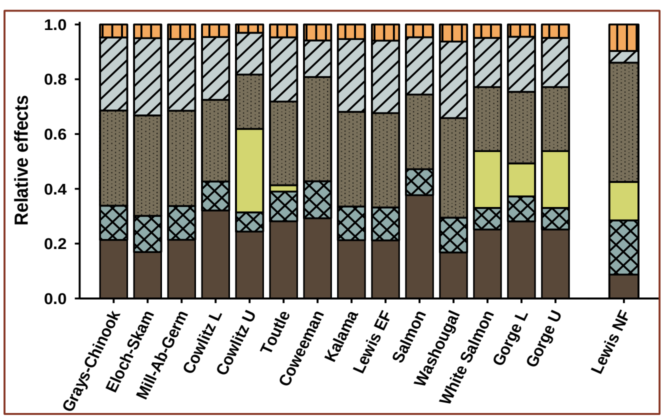


Figure 4-3. Net effect and relative contribution of potentially manageable impact factors on fall Chinook salmon in Washington lower Columbia subbasins.

Tributary
Estuary
Hydro
Harvest
Hatchery
Predation

Lower Columbia fall Chinook are well distributed throughout the region and generally have access to historical habitat; however, available habitat is severely degraded and limits productivity of natural origin populations. Reductions in the quantity and quality of freshwater habitat, primarily due to past and present land use practices, have significantly impacted these populations. Stream habitats have been reduced by 30-70% and freshwater productivity has been reduced by 30-90% for fall (tule) Chinook and 10% for late fall (bright) Chinook, as compared to historic conditions. Additionally, large scale hatchery programs and high harvest rates have significantly reduced abundance and productivity of natural origin populations. Currently, hatchery origin fish typically comprise a large fraction of the natural spawning populations. Restoration of spawning and rearing habitat, in conjunction with reduced impacts from hatchery and harvest programs will be critical to achieving delisting goals for lower Columbia fall Chinook.

Spring Chinook: The Washington Recovery Plan estimates that adult abundance of Washington spring Chinook populations are 0-25% of their historic production potential and 0-20% of population-specific recovery objectives. As displayed in Figure 4-4, hydro and habitat (tributary and estuary), currently have the largest adverse impacts on the viability of natural origin spring Chinook populations.

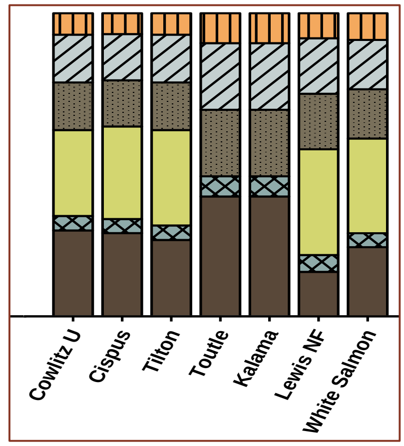
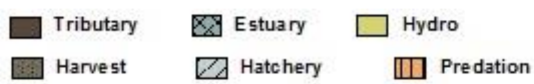


Figure 4-4. Net effect and relative contribution of potentially manageable impact factors on spring Chinook salmon in Washington lower Columbia subbasins.



Distribution of spring Chinook populations in Washington have been severely reduced due to loss of access to core production areas (spawning and rearing habitat) located upstream of dams in the Cowlitz and Lewis basins. Reintroductions were recently initiated and these programs are currently in their infancy. Reductions in the quantity and quality of freshwater spawning and rearing habitat, primarily due to past and present land use practices, have also significantly impacted on these populations. Stream habitats have been reduced by more than 75% and freshwater productivity has been reduced by 40-90%, as compared to historic conditions. Successfully reintroducing spring Chinook to the upper Cowlitz and Lewis basin are the cornerstone for achieving delisting goals for lower Columbia spring Chinook, and successful collection of outmigrating juveniles will be the critical to the success of these programs.

POPULATION VIABILITY GOALS

Fall Chinook: For Washington populations the majority of the tule populations in the Coast (2 of 3) and Cascade (4 of 8) are targeted to achieve high to very high viability levels. All but two of the Washington tule populations in the Coast and Cascade strata will need to achieve at least medium viability level. In the Gorge Stratum expectations are low with all Washington populations needing to achieve medium viability. The lone Washington bright population needs to remain at the very high viability status it is currently attaining.

Based on life cycle modeling, the Washington Recovery Plan established productivity improvement and abundance targets that correspond to the viability objective for each Washington population in the Lower Columbia ESU. These are presented in Table 4-1 below. For tule populations (primary and contributing), targeted productivity improvement necessary to achieve their viability objective ranges from 50% to at least 500%. Abundance targets at delisting range from a low of 500 for the Kalama population to a high of 4,000 for the Toutle population.

Table 4-1. Viability objective and productivity improvement and abundance targets for Washington fall Chinook populations in the Lower Columbia ESU.

		Washington Recovery Plan		
Population	Contribution	Viability Objective	Productivity Target	Abundance Target
<u>Coast Stratum</u>				
Grays/Chinook	Contributing[2]	M+	+500%	1,000
Eloch/Skam [C]	Primary	H	+150%	1,500
Mill/Aber/Germ	Primary[1]	H	+155%	900
<u>Cascade Stratum</u>				
Lower Cowlitz [C]	Contributing	M+	+50%	3,000
Upper Cowlitz	Stabilizing	VL	--	--
Toutle[C]	Primary[1]	H+	+265%	4,000
Coweeman [G]	Primary	H+	+80%	900
Kalama	Contributing[2]	M	+110%	500
Lewis [G]	Primary	H+	+280%	1,500
Salmon	Stabilizing	VL	--	--
Washougal	Primary	H+	+190%	1,200
<u>Cascade Stratum</u>				
Lewis NF (late fall) [C,G]	Primary	VH	0%	7,300
<u>Gorge Stratum</u>				
L. Gorge (WA/OR)	Contributing	M	>500%	1,200
U. Gorge (WA/OR) [C]	Contributing[1]	M	>500%	1,200
White Salmon [C]	Contributing	M	>500%	500

[1] Increase relative to the interim Plan.
[2] Reduction relative to the interim Plan.
[C] Designated as a historical core population by the Technical Recovery Team.
[G] Designated as a historical legacy population by the Technical Recovery Team.

Spring Chinook: Recovery of three Washington populations (Cowlitz, Cispus and Lewis) to at least high viability is critical to recovering this ESU. Additionally, the Toutle and White Salmon populations needs to achieve medium viability and low viability, respectively.

Based on life cycle modeling, the Washington Recovery Plan established productivity improvement and abundance targets that correspond to the viability objective for each Washington population in the Lower Columbia ESU. These are presented in Table 4-2 below. All populations, except for the Toutle, require a productivity improvement of at least 500% to achieve their viability objective. Abundance targets at delisting range from a low of 300 for the Kalama population to a high of 1,800 in the Upper Cowlitz and Cispus populations. The upper Cowlitz and Lewis abundance targets comprise 73% of the combined abundance target (7,000) for the Lower Columbia ESU.

Table 4-2. Viability objective and productivity improvement and abundance targets for Washington spring Chinook populations in the Lower Columbia ESU.

		Washington Recovery Plan		
Population	Contribution	Viability Objective	Productivity Target	Abundance Target
Cascade Stratum				
Upper Cowlitz [C,G]	Primary	H+	>500%	1,800
Cispus [C,G]	Primary	H+	>500%	1,800
Tilton	Stabilizing	VL	0%	--
Toutle	Contributing	M	>500%	1,100
Kalama	Contributing[2]	L	>500%	300
Lewis NF [C]	Primary	H	>500%	1,500
Gorge Stratum				
White Salmon [C]	Contributing	L+	>500%	500

[1] Increase relative to the interim Plan.
[2] Reduction relative to the interim Plan.
[C] Designated as a historical core population by the Technical Recovery Team.
[G] Designated as a historical legacy population by the Technical Recovery Team.

Threat Reduction Targets

As described in Chapter 3 ("Population Threat Evaluation" section), the Washington Recovery Plan utilized a life cycle model to estimate population specific baseline impacts (1998) and impact reduction targets for each threat. Impact reduction targets are calculated by applying the impact reduction to the baseline impacts (see footnote at bottom of Table 4-3 and 4-4).

Fall Chinook: Table 4-3 below presents the baseline impacts, targeted impact reduction, and the resulting impacts when productivity target is achieved for hatchery and harvest threats.

Table 4-3. Baseline and impact reduction targets for hatchery and harvest threats for Washington fall Chinook populations in the Lower Columbia ESU.

	Productivity	Baseline Impacts		Impact	Impacts at Target*	
Population	Target	Hatchery	Fishery	Reduction	Hatchery	Fishery
Coast Stratum						
Grays/Chinook	+500%	0.50	0.65	61%	0.20	0.26
Eloch/Skam	+150%	0.50	0.65	29%	0.35	0.46
Mill/Aber/Germ	+155%	0.49	0.65	28%	0.35	0.47
Cascade Stratum						
Lower Cowlitz	+50%	0.50	0.65	8%	0.46	0.60
Upper Cowlitz	0%	0.50	0.65	0%	0.50	0.65
Toutle	+265%	0.50	0.65	32%	0.34	0.44
Coweeman	+80%	0.23	0.65	18%	0.19	0.53
Kalama	+110%	0.50	0.65	21%	0.39	0.51
Lewis EF	+280%	0.50	0.65	42%	0.29	0.38
Salmon	0%	0.50	0.65	0%	0.50	0.65
Washougal	+190%	0.50	0.65	34%	0.33	0.43

Cascade Stratum						
Lewis NF (late fall)	0%	0.05	0.50	0%	0.05	0.50
Gorge Stratum						
L. Gorge (WA/OR)	>500%	0.50	0.65	50%	0.25	0.33
U. Gorge (WA/OR)	>500%	0.50	0.65	50%	0.25	0.33
White Salmon	>500%	0.50	0.65	50%	0.25	0.33

** Baseline Impacts X (1-Impact Reduction Proportion) = Impacts at Target*
An example calculation using Grays/Chinook Population and Hatchery Impacts 0.50 X 0.39 = 0.20

Spring Chinook: Table 4-4 below presents the baseline impacts, targeted impact reduction, and the resulting impacts when productivity target is achieved for hatchery and harvest threats.

Table 4-4. Baseline and impact reduction targets for Hatchery and Harvest threats for Washington spring Chinook populations in the Lower Columbia ESU.

	Productivity	Baseline Impacts		Impact	Impacts at Target*	
Population	Target	Hatchery	Fishery	Reduction	Hatchery	Fishery
Cascade Stratum						
Upper Cowlitz	>500%	0.50	0.50	50%	0.25	0.25
Cispus	>500%	0.50	0.50	50%	0.25	0.25
Tilton	0%	0.50	0.50	0%	0.50	0.50
Toutle	>500%	0.50	0.50	50%	0.25	0.25
Kalama	>500%	0.50	0.50	50%	0.25	0.25
Lewis NF	>500%	0.50	0.50	50%	0.25	0.25
Gorge Stratum						
White Salmon	>500%	0.50	0.50	50%	0.25	0.25

** Baseline Impacts X (1-Impact Reduction Proportion) = Impacts at Target*
An example calculation using Grays/Chinook Population and Hatchery Impacts 0.50 X 0.39 = 0.20

Coho (Oncorhyncus kitsutch)

Species Summary

Coho return with each fall's rains to spawn in the smaller, lower gradient streams and tributaries throughout the lower Columbia from low elevation valley bottoms to the mountainous headwaters. Natural origin coho return to freshwater from mid-August through December with the majority of spawning occurring during November through January. Hatchery returns include an early stock (Type-S) and a late stock (Type N) that enter tributaries from September through December and October through January, respectively. Juvenile coho spend a full year in freshwater before making their migration to the ocean during April through June. The vast majority of the adult coho rear two years in the ocean before returning on their spawning migration, although a small fraction of the adults will return after rearing in the ocean for a single year.

POPULATION STATUS

Coho were included in the Lower Columbia ESU as a candidate species in 1995 and listed as a threatened species under the ESA in 2005.

The Willamette-Lower Columbia TRT identified a total of 24 distinct lower Columbia coho populations. The Washington Recovery Plan utilized life cycle modeling to evaluate the status of Washington coho populations and modeling results indicate that all Washington populations are currently at high to very high risk of extinction. Figure 4-5 displays current viability and the viability objective or goal for each coho population.

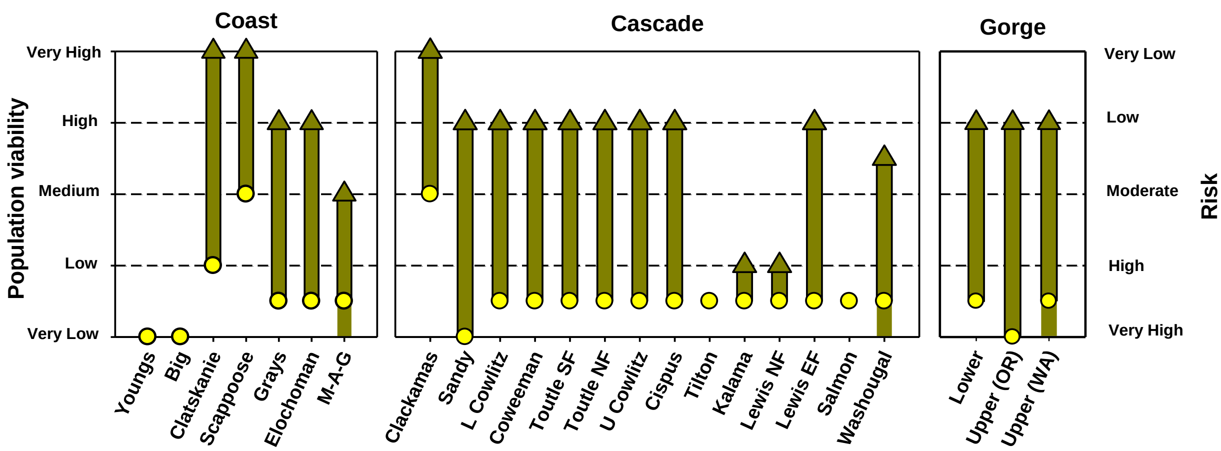


Figure 4-5 Viability objectives for coho identified in the recovery scenario for Washington and in Oregon's Recovery Plan.

THREATS

The Washington Recovery Plan estimates that adult abundance of Washington coho populations are 0-9% of their historic production potential and 2-10% of population-specific recovery objectives. As displayed in Figure 4-6 harvest, hatchery and habitat (tributary and estuary) currently have the largest adverse impacts on the viability of natural origin coho salmon populations. Additionally, hydro has significant impacts to three major populations: Upper Cowlitz, Cispus and North Fork Lewis.

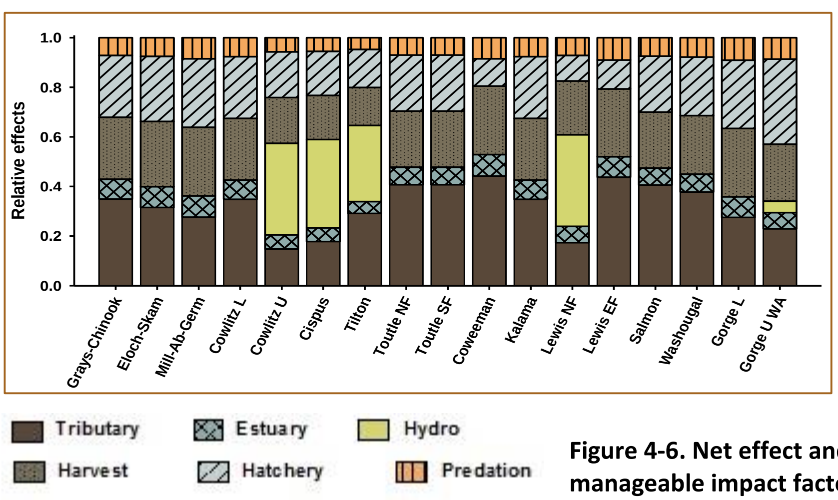


Figure 4-6. Net effect and relative contribution of potentially manageable impact factors on coho salmon in Washington

lower Columbia subbasins.

For the most part lower Columbia coho have access to historical spawning and rearing locations; however, habitat quantity and quality have been significantly degraded in many basins, primarily due to past and present land use practices. Stream habitats have been reduced by 40-95% and freshwater productivity has been reduced by 40-90%, as compared to historic conditions, primarily resulting from current land use activities. Additionally, intense hatchery programs, and associated fisheries, have reduced the genetic fitness and abundance of natural origin coho throughout the basin. Until recently, coho were managed primarily as a hatchery stock, which resulted in lower Columbia coho natural origin populations being harvested at a high rate and heavily influenced by extensive hatchery releases. Currently hatchery origin fish typically comprise a large fraction of the natural spawning populations. Additionally, access has been lost to upstream areas in the Cowlitz and Lewis rivers. Both of these systems historically supported very large, diverse, and productive runs of natural origin coho; and this productive potential remains relatively intact. Restoration of habitat, in conjunction with, reduced impacts from hatchery and harvest will be critical to achieving delisting goals for lower Columbia coho. Reintroduction of natural origin coho to lost habitat will also be important to achieving delisting goals.

POPULATION VIABILITY GOALS

The majority of the Washington coho populations in the Coast (2 of 3) and Cascade (8 of 12) strata are targeted to achieve high viability and all populations in the Gorge Stratum (2) are targeted to achieve high viability level.

Based on life cycle modeling, the Washington Recovery Plan established productivity improvement and abundance targets that correspond to the viability objective for each Washington population in the Lower Columbia ESU. These targets are presented in Table 4-5 below. Targeted productivity improvement necessary to achieve their viability objective ranges from 170% to at least 500% for primary and contributing populations. Abundance targets at delisting range from a low of 500 for the East Fork Lewis and North Fork Lewis populations to a high of 3,700 for the Lower Cowlitz population.

Table 4-5. Viability objective and productivity improvement and abundance targets for Washington coho populations in the Lower Columbia ESU.

Population	Contribution	Washington Recovery Plan		
		Viability Objective	Productivity Target	Abundance Target
Coast Stratum				
Grays/Chinook [L]	Primary	H	+370%	2,400
Eloch/Skam [L]	Primary	H	+170%	2,400
Mill/Ab/Germ [L]	Contributing	M	>500%	1,800
Cascade Stratum				
Lower Cowlitz [L]	Primary	H	+100%	3,700
Upper Cowlitz [E, L]	Primary[1]	H[1]	>500%	2,000

Cispus [E, L]	Primary[1]	H[1]	>500%	2,000
Tilton [E, L]	Stabilizing[2]	VL[2]	0%	--
Toutle SF [E, L]	Primary	H	+180%	1,900
Toutle NF [E, L]	Primary	H	+180%	1,900
Coweeman [L]	Primary	H	+170%	1,200
Kalama [L]	Contributing	L	>500%	500
NF Lewis [E, L]	Contributing	L	+50%	500
EF Lewis [E, L]	Primary	H	>500%	2,000
Salmon [L]	Stabilizing	VL	0%	--
Washougal [L]	Contributing	M+	>500%	1,500
Gorge Stratum				
L Gorge (WA/OR) [L]	Primary	H	+400%	1,900
U Gorge (WA) [L]	Primary[1]	H	+400%	1,900

[1] Increase relative to the interim Plan. [2] Reduction relative to the interim Plan. [E] Early run (Type S) coho stock. [L] Late run (Type N) coho stock. (Core and Legacy populations not designated by the Technical Recovery Team for coho.)

THREAT REDUCTION TARGETS

As described in Chapter 3 ("Population Threat Evaluation" section), the Washington Recovery Plan utilized a life cycle model to estimate populations specific baseline impacts (1998) and impact reduction targets for each threat. Impact reduction targets are calculated by applying the impact reduction to the baseline impacts (see footnote at bottom of Table 4-6). Table 4-6 below presents the baseline impacts, targeted impact reduction, and the resulting impacts when productivity target is achieved for hatchery and harvest threats.

Table 4-6. Baseline and impact reduction targets for Hatchery and Harvest threats for Washington coho populations in the Lower Columbia ESU.

	Productivity	Baseline Impacts		Impact	Impacts at Target*	
Population	Target	Hatchery	Fishery	Reduction	Hatchery	Fishery
Coast Stratum						
Grays/Chinook	+370%	0.50	0.50	43%	0.29	0.29
Eloch/Skam	+170%	0.50	0.50	30%	0.35	0.35
Mill/Ab/Germ	>500%	0.50	0.50	50%	0.25	0.25
Cascade Stratum						
Lower Cowlitz	+100%	0.50	0.50	17%	0.45	0.42
Upper Cowlitz	>500%	0.50	0.50	50%	0.25	0.25
Cispus	>500%	0.50	0.50	50%	0.25	0.25
Tilton	0%	0.50	0.50	0%	0.50	0.50
Toutle NF	+180%	0.50	0.50	12%	0.44	0.44
Toutle SF	+180%	0.50	0.50	12%	0.44	0.44
Coweeman	+170%	0.20	0.50	23%	0.15	0.39
Kalama	>500%	0.50	0.50	20%	0.40	0.40
NF Lewis	+50%	0.24	0.50	6%	0.22	0.47
EF Lewis	>500%	0.21	0.50	50%	0.11	0.25
Salmon	0%	0.50	0.50	0%	0.50	0.50
Washougal	>500%	0.50	0.50	50%	0.25	0.25

Gorge Stratum						
L Gorge	+400%	0.50	0.50	59%	0.20	0.20
U Gorge	+400%	0.75	0.50	39%	0.46	0.31

** Baseline Impacts X (1-Impact Reduction Proportion) = Impacts at Target*
An example calculation using Grays/Chinook Population and Hatchery Impacts 0.50 X 0.39 = 0.20

Steelhead (Oncorhyncus mykiss)

SPECIES SUMMARY

Steelhead, including summer and winter runs have a broad run timing and typically spawn and rear in the steeper boulder-strewn upper reaches of lower Columbia River rivers and streams. Freshwater life history of steelhead is very diverse, with juveniles rearing in freshwater for 1-3 years before making their outmigration to the ocean in the spring. Steelhead rear in the ocean for 1-3 years before returning to freshwater on their adult migration. Unlike salmon, not all steelhead die after spawning and some return to spawn again.

Winter steelhead occur throughout the lower Columbia River while summer steelhead populations are present in the Cascade and Gorge strata, but not the Coast Stratum. Winter steelhead enter freshwater during November through April with the majority of the migration occurring after February. Most winter steelhead enter freshwater in a state of sexual maturity and spawn shortly after entering freshwater. In contrast summer steelhead enter freshwater in a sexually immature condition and require several months in freshwater to reach sexual maturity and spawn. Lower Columbia summer steelhead enter freshwater during May through October with the majority of the return having entered freshwater by early August. Both winter and summer steelhead spawn during the late winter to spring timeframe with summer steelhead primarily spawning in January and February and the majority of the winter steelhead spawning during March through May.

POPULATION STATUS

The Lower Columbia region includes three steelhead DPSs.

- The Southwest Washington DPS includes steelhead from the Grays and Elochoman rivers plus Skamokawa, Mill, Abernathy and Germany creeks
- The Lower Columbia DPS includes steelhead from the Cowlitz, Kalama, Lewis, Washougal and Wind rivers plus Salmon and Hardy creeks
- The Middle Columbia DPS include steelhead from the Little and Big White Salmon rivers

Steelhead populations in the lower Columbia and middle Columbia DPSs were listed as a threatened species under the ESA in 1998, while steelhead populations in the Southwest Washington DPS are not listed under the ESA. The Willamette-Lower Columbia TRT identified a total of 30 distinct lower Columbia steelhead populations, 24 winter populations and six summer populations that fall into these three DPSs.

Winter Steelhead: The Washington Recovery Plan utilized life cycle modeling to evaluate the status of all of Washington winter and summer steelhead populations. Modeling results indicate that most ESA-listed winter steelhead populations are at high to very high risks of extinction while the non-listed populations are all at medium to very low risk of extinction. Figure 4-7 displays current viability and the viability objective or goal for each winter steelhead population.

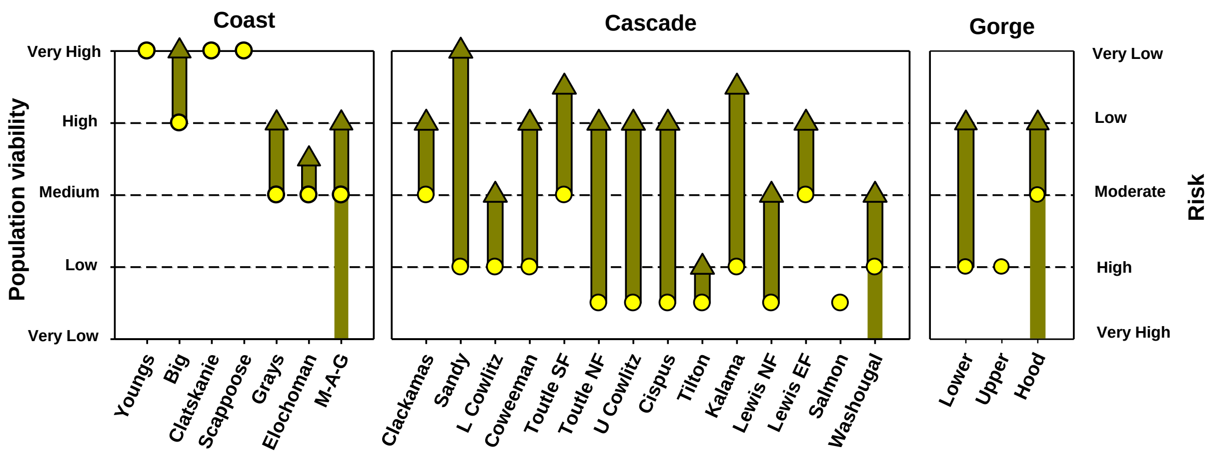


Figure 4-7. Viability objectives for winter steelhead identified in the recovery scenario for Washington and in Oregon's Recovery Plan.

Summer Steelhead: Summer Steelhead populations are only present in the Cascade (4 populations) and Gorge (2 populations) strata, and half of the populations are at very high risk of extinction while the other half of the populations range between moderate to low risk of extinction. Figure 4-8 displays current viability and the viability objective or goal for each summer steelhead population.

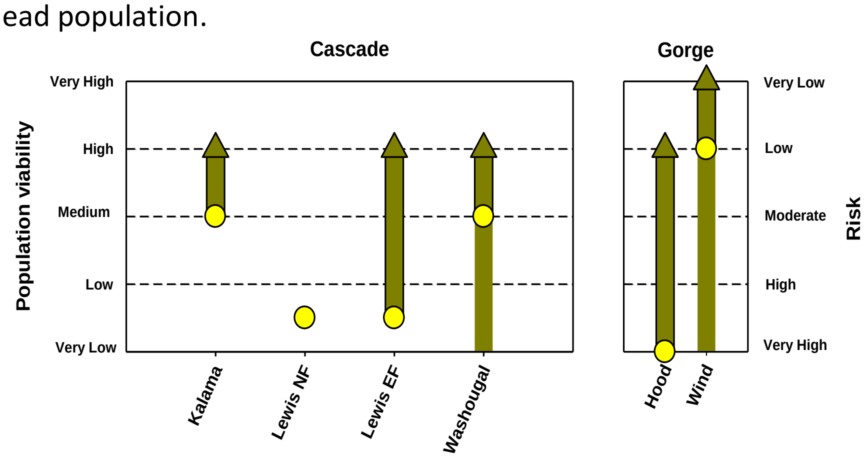
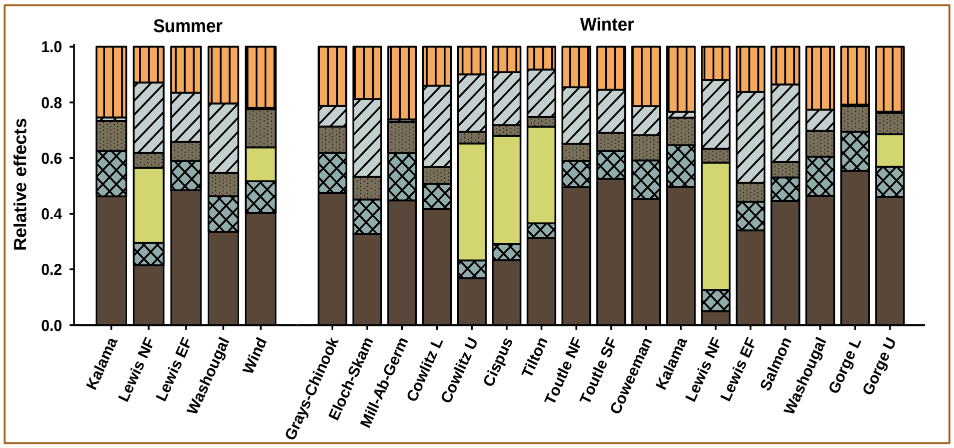


Figure 4-8. Viability objectives for summer steelhead identified in the recovery scenario for Washington and in Oregon's Recovery Plan.

THREATS

The Washington Recovery Plan estimates that adult abundance of Washington steelhead populations are 0-33% of their historic production potential and 10-100% of population-specific recovery objectives. As displayed in Figure 4-9, habitat (tributary and estuary) currently has the largest adverse impact on the viability of natural origin steelhead populations. Additionally, hydro threat significantly impacts four important populations: North Fork Lewis winter and summer steelhead and Upper Cowlitz and Cispus winter steelhead.



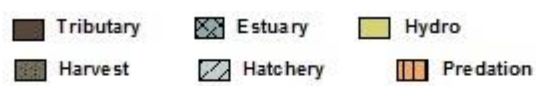


Figure 4-9. Net effect and relative contribution of potentially manageable impact factors on steelhead in Washington lower Columbia subbasins.

Generally, winter and summer steelhead have access to the majority of their historic habit, except for the upper Cowlitz and Lewis basins. Habitat degradation has the largest adverse impact to steelhead productivity and viability with stream habitats being reduced 40-90%, compared to historic conditions. Reduction in quantity and quality of freshwater spawning and rearing habitats, primarily due to past and present land use practices, accounts for a large share of the impact on these populations. Additionally, hydro limits access to key spawning and rearing habitat for winter steelhead in the Cowlitz basin upstream of Mayfield Dam and for winter and summer steelhead in the upper North Fork Lewis basin. Reintroduction programs have just been initiated for winter steelhead in the upper Cowlitz, Cispus and North Fork Lewis subbasins, and success of these reintroduction programs will be important to achieving Washington Recovery Plan goals. Collection of outmigrating juveniles will be crucial to the success of these reintroduction efforts. Hatchery and harvest threats have also reduced productivity and diversity of lower Columbia steelhead populations, but not to the same degree as observed in Chinook and coho. Restoration of habitat, in conjunction with successful reintroduction programs, will be critical to achieving delisting goals. Reintroduction of populations into the upper Cowlitz and Lewis basins and reducing impacts from hatchery and harvest programs will also be important to achieving these goals.

POPULATION VIABILITY GOALS

Winter Steelhead: For Washington populations the majority of the populations in the Coast (2 of 3), Cascade (7 of 12) and Gorge (1 of 2) need to achieve at least high viability level. For the entire ESU all but two Washington populations must achieve at least medium viability.

Based on life cycle modeling, the Washington Recovery Plan established productivity improvement and abundance targets that correspond to the viability objective for each Washington population in the Lower Columbia ESU. These targets are presented in Table 4-7 below. For listed primary and contributing populations in the Cascade and Gorge strata, productivity improvement necessary to achieve their viability objective ranges from 5% to at least 500%. Abundance targets at delisting range from a low of 200 for the Tilton population to a high of 600 for the several populations.

Table 4-7. Viability objective and productivity improvement and abundance targets for Washington winter steelhead populations in the Lower Columbia ESU.

		Washington Recovery Plan		
Population	Contribution	Viability Objective	Productivity Target	Abundance Target
Coast Stratum				
Grays/Chinook	Primary	H	0%[1]	800
Eloch/Skam	Contributing	M+	0%[1]	600
Mill/Ab/Germ	Primary	H	0%[1]	500
Cascade Stratum				
Lower Cowlitz	Contributing	M	+5%	400
Upper Cowlitz [C,G]	Primary	H[1]	>500%	500
Cispus [C,G]	Primary	H[1]	>500%	500
Tilton	Contributing	L	>500%	200
S.F. Toutle	Primary	H+	+35%	600
N.F. Toutle [C]	Primary	H	+125%	600
Coweeman	Primary	H	+25%	500
Kalama	Primary	H+	+45%	600
N.F. Lewis [C]	Contributing	M	>500%	400
E.F. Lewis	Primary	H	+25%	500
Salmon	Stabilizing	VL	0%	--
Washougal	Contributing	M	+15%	350
Gorge Stratum				
L. Gorge (WA/OR)	Primary	H	+45%	300
U. Gorge (WA/OR)	Stabilizing	L	0%	--

[1] *Improvement increments are based on abundance and productivity; however, this population will require improvements in spatial structure or diversity to meet recovery objectives.*
[C] *Designated as a historical core population by the Technical Recovery Team.*
[G] *Designated as a historical legacy population by the Technical Recovery Team.*

Summer Steelhead: All but one of the summer steelhead populations in the Lower Columbia ESU is targeted to achieve at least high viability levels. All four Washington primary populations are expected to achieve high viability status.

Based on life cycle modeling, the Washington Recovery Plan established productivity improvement and abundance targets that correspond to the viability objective for each Washington population in the Lower Columbia ESU. These targets are presented in Table 4-8 below. Currently only the East Fork Lewis and Washougal populations are targeted for an improvement in productivity. Other populations are currently achieving their productivity target. Abundance targets at delisting range from a low of 500 for the several populations to a high of 1,000 for the Wind River population.

Table 4-8. Viability objective and productivity improvement and abundance targets for Washington summer steelhead populations in the Lower Columbia ESU.

		Washington Recovery Plan		
Population	Contribution	Viability Objective	Productivity Target	Abundance Target
Cascade Stratum				
Kalama [C]	Primary	H	0%[1]	500
N.F. Lewis	Stabilizing	VL	0%	--
E.F. Lewis [G]	Primary	H	>500%	500
Washougal [C,G]	Primary	H	+40%	500
Gorge Stratum				
Wind [C]	Primary	VH	0%[1]	1,000

[1] *Improvement increments are based on abundance and productivity; however, this population will require improvements in spatial structure or diversity to meet recovery objectives.*

[C] *Designated as a historical core population by the Technical Recovery Team.*

[G] *Designated as a historical legacy population by the Technical Recovery Team.*

Threat Reduction Targets

As described in Chapter 3 ("Population Threat Evaluation" section), the Washington Recovery Plan utilized a life cycle model to estimate population specific baseline impacts (1998) and threat reduction targets for each threat. Impact reduction targets are calculated by applying the impact reduction to the baseline impacts (see footnote at bottom of Tables 4-9 and 4-10).

Winter Steelhead: Table 4-9 below presents the baseline impacts, targeted impact reduction, and the resulting impacts when productivity target is achieved for hatchery and harvest threats.

Table 4-9. Baseline and impact reduction targets for hatchery and harvest threats for Washington winter steelhead populations in the Lower Columbia ESU.

	Productivity	Baseline Impacts		Impact	Impacts at Target*	
Population	Target	Hatchery	Fishery	Reduction	Hatchery	Fishery
Coast Stratum						
Grays/Chinook	0%	0.08	0.10	0%	0.08	0.10
Eloch/Skam	0%	0.34	0.10	0%	0.34	0.10

Mill/Ab/Germ	0%	0.01	0.10	0%	0.01	0.10
Cascade Stratum						
Lower Cowlitz	+5%	0.49	0.10	1%	0.48	0.10
Upper Cowlitz	>500%	0.49	0.10	50%	0.25	0.05
Cispus	>500%	0.49	0.10	50%	0.25	0.05
Tilton	>500%	0.49	0.10	50%	0.25	0.05
N.F. Toutle	+125%	0.33	0.10	20%	0.26	0.08
S.F. Toutle	+35%	0.24	0.10	7%	0.22	0.09
Coweeman	+25%	0.12	0.10	13%	0.10	0.09
Kalama	+45%	0.02	0.10	25%	0.02	0.07
N.F. Lewis	>500%	0.49	0.10	50%	0.25	0.05
E.F. Lewis	+25%	0.48	0.10	9%	0.44	0.09
Salmon	0%	0.50	0.10	0%	0.50	0.10
Washougal	+15%	0.08	0.10	8%	0.08	0.09
Gorge Stratum						
L. Gorge	+45%	0.01	0.10	20%	0.00	0.08
U. Gorge	0%	0.01	0.10	0%	0.01	0.10

** Baseline Impacts X (1-Impact Reduction Proportion) = Impacts at Target*
An example calculation using Grays/Chinook Population and Hatchery Impacts 0.50 X 0.39 = 0.20

Summer Steelhead: Table 4-10 below presents the baseline impacts, targeted impact reduction, and the resulting impacts when productivity target is achieved for hatchery and harvest threats.

Table 4-10. Baseline and impact reduction targets for hatchery and harvest threats for Washington summer steelhead populations in the Lower Columbia ESU.

	Productivity	Baseline Impacts		Impact	Impacts at Target*	
Population	Target	Hatchery	Fishery	Reduction	Hatchery	Fishery
Cascade Stratum						
Kalama	0%	0.01	0.10	0%	0.01	0.10
N.F. Lewis	0%	0.47	0.10	0%	0.47	0.10
E.F. Lewis	>500%	0.26	0.10	50%	0.13	0.05
Washougal	+40%	0.30	0.10	21%	0.24	0.08
Gorge Stratum						
Wind	0%	0.01	0.17	0%	0.01	0.17

** Baseline Impacts X (1-Impact Reduction Proportion) = Impacts at Target*
An example calculation using Grays/Chinook Population and Hatchery Impacts 0.50 X 0.39 = 0.20

Chum (Oncorhyncus keta)

SPECIES SUMMARY

Chum return to spawn in the lowermost reaches of streams and rivers and prefer low gradient streams with spawning sites in areas of upwelling groundwater. Adult chum primarily return to the Columbia River during the late fall from mid-October through November and spawn from early November to late December. Young chum spend the briefest time of any of the species in freshwater, migrating seaward soon after emerging from the clean spring-fed gravel upon which they depend. Juvenile chum make extensive use of the estuary during their seaward migrations. Chum typically rear in the ocean for 2-5 years before returning to freshwater on their spawning run at an advanced state of maturity.

POPULATION STATUS

Fall and summer chum runs were included in the Lower Columbia ESU listed as a threatened species under the ESA in 1999.

The Willamette-Lower Columbia TRT identified a total of 17 distinct lower Columbia chum populations, of which only two populations are in Gorge stratum. The Washington Recovery Plan utilized life cycle modeling to evaluate the status of all of Washington chum populations and modeling results indicate that all but two of the populations in the ESU are a high to very high risk of extinction. Figure 4-10 displays current viability and the viability objective or goal for each chum population.

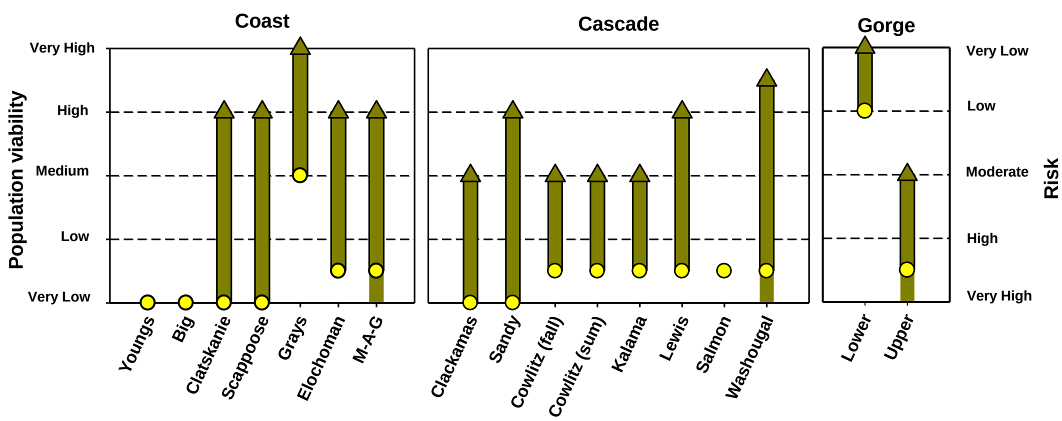


Figure 4-10. Viability objectives for chum identified in the recovery scenario for Washington and in Oregon's Recovery Plan.

THREATS

The Washington Recovery Plan estimates that adult abundance of Washington chum populations are 1-29% of their historic production potential and only 6-30% of population-specific recovery objectives. As displayed in Figure 4-11, the habitat (tributary and estuary) threat has the largest adverse impact on the viability of natural origin chum populations.

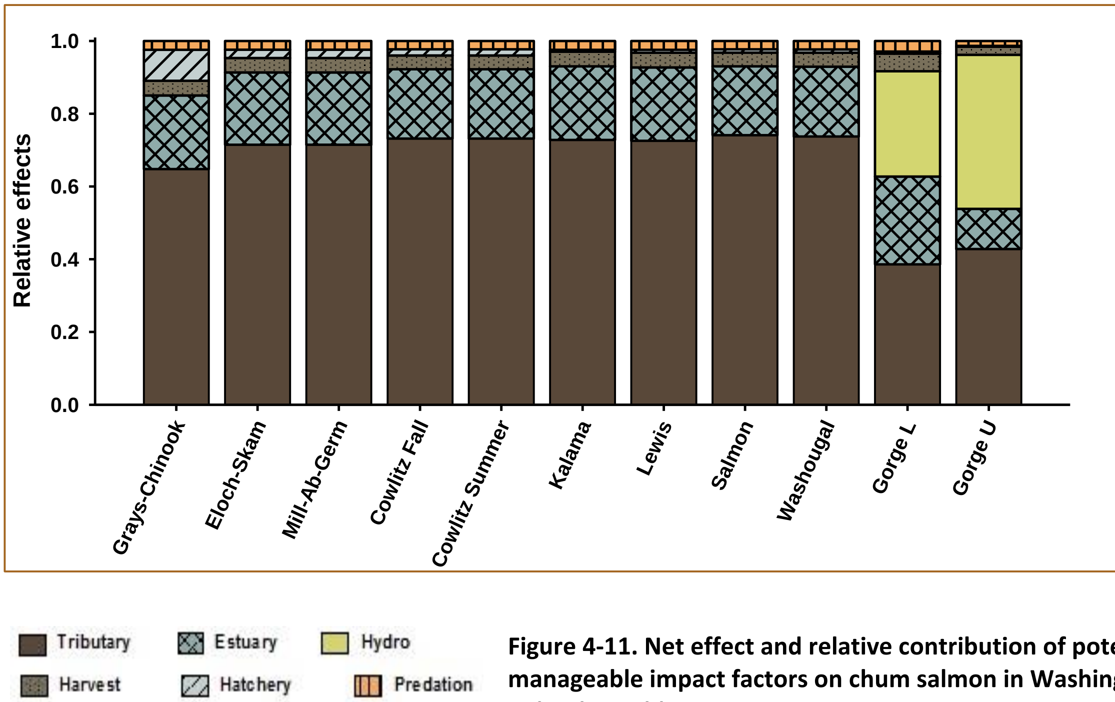


Figure 4-11. Net effect and relative contribution of potentially manageable impact factors on chum salmon in Washington lower Columbia subbasins.

Current chum populations are constrained by limited habitat availability, low abundance numbers, and inundation of productive habitats due to the operation of Bonneville Dam; which results in reduced productivity and diversity resulting from genetic bottlenecks. While chum salmon continue to have access to most historical spawning areas in the lower Columbia, distribution and productivity have been severely reduced due to degradation of habitats, primarily due to past and present land use practices. Steam habitats have been reduced by 75% and freshwater productivity has been reduced by 80-99%, as compared to historic conditions. The majority of the chum production for the lower Columbia currently resides in two limited geographic areas: Grays subbasin and the mainstem Columbia River and small tributaries upstream of I-5 Bridge to Bonneville Dam. Habitat restoration, along with increasing abundance and geographical range natural origin chum will be critical to achieving delisting goals. Successfully implementing the strategy of reintroducing chum to restored habitat will be crucial to achieving these goals.

Population Viability Goals

For Washington populations all but one population is expected to achieve at least medium viability levels. In the Coast Stratum all of the populations need to achieve high to very high viability levels while in the Cascade Stratum two of the six populations need to achieve high viability and three of the six populations need to achieve medium viability.

Based on life cycle modeling, the Washington Recovery Plan established productivity improvement and abundance targets that correspond to the viability objective for each Washington population in the Lower Columbia ESU, which are presented in Table 4-11 below.

All primary and contributing populations, except for the Grays/Chinook and Lower Gorge, require a productivity improvement of at least 500% to achieve their viability objective. Abundance targets at delisting range from a low of 900 for several populations to a high of 2,000 in the Lower Gorge populations.

Table 4-11. Viability objective and productivity improvement and abundance targets for Washington chum populations in the Lower Columbia ESU.

Population	Contribution	Washington Recovery Plan		
		Viability Objective	Productivity Target	Abundance Target
Coast Stratum				
Grays/Chinook [C,G]	Primary	VH	0%[1]	1,600
Eloch/Skam [C]	Primary	H	>500%	1,300
Mill/Ab/Germ	Primary	H	>500%	1,300
Cascade Stratum				
Cowlitz (Fall) [C]	Contributing	M	>500%	900
Cowlitz (Summer) [C]	Contributing	M	>500%	900
Kalama	Contributing	M	>500%	900
Lewis [C]	Primary	H	>500%	1,300
Salmon	Stabilizing	VL	0%	--
Washougal	Primary	H+	>500%	1,300
Gorge Stratum				
L. Gorge (WA/OR) [C,G]	Primary	VH	0%[1]	2,000
U. Gorge (WA/OR)	Contributing	M	>500%	900

[1] Improvement increments are based on abundance and productivity; however, this population will require improvements in spatial structure or diversity to meet recovery objectives.
[C] Designated as a historical core population by the Technical Recovery Team.
[G] Designated as a historical legacy population by the Technical Recovery Team.

Threat Reduction Targets

As described in Chapter 3, the Washington Recovery Plan utilized a life cycle model to estimate population specific baseline impacts (1998) and threat reduction targets each threat. Impact reduction targets are calculated by applying the impact reduction to the baseline impacts (see footnote at bottom of Table 4-12). Table 4-12 below presents the baseline impacts, targeted impact reduction, and the resulting impacts when productivity target is achieved for hatchery and harvest threats.

Table 4-12. Baseline and impact reduction targets for hatchery and harvest threats for Washington chum populations in the Lower Columbia ESU.

	Productivity	Baseline Impacts		Impact	Impacts at Target*	
Population	Target	Hatchery	Fishery	Reduction	Hatchery	Fishery
Coast Stratum						
Grays/Chinook	0%	0.11	0.05	0%	0.11	0.05
Eloch/Skam	>500%	0.03	0.05	50%	0.01	0.03
Mill/Ab/Germ	>500%	0.03	0.05	50%	0.01	0.03
Cascade Stratum						
Cowlitz (Fall)	>500%	0.02	0.05	50%	0.01	0.03
Cowlitz (Summer)	>500%	0.02	0.05	50%	0.01	0.03
Kalama	>500%	0.01	0.05	50%	0.00	0.03
Lewis	>500%	0.01	0.05	50%	0.01	0.03
Salmon	0%	0.01	0.05	0%	0.01	0.05
Washougal	>500%	0.01	0.05	50%	0.01	0.03
Gorge Stratum						
Lower Gorge	0%	0.01	0.05	0%	0.01	0.05
Upper Gorge	>500%	0.01	0.05	50%	0.00	0.03

** Baseline Impacts X (1-Impact Reduction Proportion) = Impacts at Target*
An example calculation using Grays/Chinook Population and Hatchery Impacts 0.50 X 0.39 = 0.20

CHAPTER 5 HATCHERY AND HARVEST IMPACTS ON NATURAL POPULATIONS

Hatchery and Harvest Impacts[16]

Past hatchery programs and associated harvest strategies have adversely affected the productivity and abundance of natural origin fish through reduced escapement levels, competition, introduction of disease and the loss of fitness through interbreeding. The level of impacts from hatchery programs vary depending on nature and extent of interactions between hatchery fish and natural origin populations. Recent information and studies suggest that the most significant effect of hatchery programs on natural origin fish occurs through the reduction of genetic fitness. It is likely that these impacts are at their greatest when hatcheries use broodstock from another basin and the returning adult hatchery fish spawn in natural spawning areas with natural origin fish. Large numbers of juvenile hatchery fish can also overwhelm natural origin fish in competing for habitat and food sources.

While the impacts of hatchery programs on natural origin populations are complex and frequently detrimental to natural origin fish, they can also be beneficial. At low abundances hatchery programs can reduce demographic risk to natural origin populations. For instance, hatchery programs have maintained the native genetic stocks needed for the reintroduction of spring chinook in the upper Cowlitz and Lewis River subbasins. Hatchery programs are also using natural origin broodstock to support chum reintroduction efforts.

Past harvest management strategies have included high harvest rates of hatchery and natural origin fish which resulted in adverse impacts to natural origin populations. As natural origin populations declined, fisheries were reduced. In recent decades, fisheries were modified to consider weak stock management, primarily focused on natural origin populations. Excessive harvest can reduce escapement levels to below demographic thresholds. Extended periods of high harvest can significantly reduce genetic fitness and viability of natural origin populations by reducing numbers of natural origin fish on spawning grounds to levels that produce a genetic bottleneck. Additionally, high harvest rates reduce overall abundance of natural origin populations, which reduces population productivity and viability. Populations subject to excessive or high harvest rates tend to be at greater risk of extinction than populations harvested at moderate or low harvest rates.

Harvest also has the potential to benefit natural origin populations by reducing the number of hatchery origin fish that reach natural spawning areas. Past fish management strategies have used time, area and gear restrictions to focus fisheries on abundant hatchery populations while reducing handle and mortality to natural origin fish More recently, mark-selective fisheries have been utilized to further reduce handle and mortality of natural origin populations. Current

[16] Hatchery and harvest impact referred to in this chapter are cited from the WA Recovery Plan (LCFRB, 2010), Volume 1, Chapter 3

fisheries management strategies have significantly limited impacts to natural origin populations by reducing harvest rates well below the high harvest rates observed during most of the 1900s.

Hatchery and Harvest Threats

The Washington Recovery Plan provides information regarding hatchery and harvest threats for lower Columbia River salmon and steelhead populations, as summarized below:

FALL CHINOOK

Hatchery Threat: Hatchery programs impact natural origin fall Chinook populations primarily through interactions in natural spawning areas and to a lesser extent through competition for rearing habitat. HSRG and others have concluded that a major concern with hatchery programs is the effect hatchery strays have on the long-term fitness of naturally spawning populations. Analysis by HSRG estimated a 23-50% reduction in productivity of tule populations due to natural spawning of less-fit hatchery origin fish. In contrast the historical impacts to the bright population is estimated to be 5% due to lack of interaction between hatchery and natural origin fish. Currently in the lower Columbia, hatchery fish dominate natural tule Chinook escapement in the majority Washington tributaries in the Lower Columbia ESU; therefore, controlling the number, and improving the genetic fitness, of hatchery fish returning to natural spawning areas will be critical to reducing the impact of hatchery programs.

Harvest Threat: Impacts to naturally produced fall Chinook occur primarily through retention in ocean and freshwater fisheries. Ocean harvest occurs primarily in WA/OR/CA coastal and Canadian fisheries for tule populations and Canadian and Alaskan fisheries for bright populations. Currently (2009-2012) ocean fisheries account for nearly three-quarters of the total harvest for both tule and bright populations.[17] Since listing, harvest rates have steadily declined from 65% in 1999 to 37% in 2011. Use of a sliding scale harvest rate that adjusts harvest impact rates to allow higher harvest rates during years of expected larger abundance and lower harvest rates when abundance estimates are smaller was initiated in 2012.

SPRING CHINOOK

Hatchery Threat: Hatchery programs impact natural origin spring Chinook populations primarily through interactions on natural spawning areas and through competition for rearing habitat. Currently in the lower Columbia, accessible natural production areas are very limited and hatchery fish comprise a large fraction of the natural spawning population. HSRG analyses estimated a 50% reduction in productivity of natural origin populations due to the impact of decades of hatchery origin strays. Controlling the number, and improving the genetic fitness, of hatchery fish returning to natural spawning areas will be critical to achieving recovery. Moreover, recovery will also depend on hatchery programs providing spawning stock to initiate reintroduction of spring Chinook to the upper Cowlitz and Lewis rivers.

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[17] Personal communication with Cindy LeFleur, WDFW

Harvest Threat: Impacts to naturally produced spring Chinook from harvest occur primarily through retention in ocean fisheries and non-retention release mortalities in freshwater fisheries. Currently (2008-2011) harvest in mainstem Columbia and its tributaries accounts for only about 15% of the total harvest and ocean (OR/WA/CA) harvest represents about half the catch. Harvest in Canadian and Alaskan fisheries account for about 20% and 10% of the total catch, respectively (Pers. Comm. Cindy LeFleur, WDFW). Historic harvest rates averaged about 50% at the time of listing and were as high as 70% in the 1970's and 1980s. Since ESA listing harvest rates have been reduced to about 25% due to restrictions in ocean fisheries and implementation of mark-selective (only fin-clipped hatchery fish may be retained) fisheries in the lower Columbia River and its tributaries.

COHO

Hatchery Threat: Hatchery programs impact natural origin coho populations primarily through interactions in natural spawning areas and through competition for rearing habitat. Historically, hatchery production levels were very large; releasing over 30 million smolts during the peak production period in the late 1980's. Hatchery production has been significantly reduced over the last three decades with current hatchery releases at about half of the historic peak totals. The HSRG has estimated that productivity of natural coho populations has declined by 20%-50% due to the impact of hatchery fish spawning in natural spawning areas. Continued reductions in adverse impacts from hatchery programs will be a critical piece of achieving the viability targets set forth in the Lower Columbia Recovery Plan.

Harvest Threat: Impacts to naturally produced coho from harvest occur primarily through retention and non-retention release mortalities in ocean and freshwater fisheries. Currently (2008-2012), harvest in mainstem Columbia River and its tributaries accounts for about a third of the harvest and ocean (OR/WA/CA) account for the most of the remaining harvest. Canadian fisheries account for only about 1% of the total harvest (Pers. Comm. Cindy LeFleur, WDFW). Previous harvest rates averaged about 50% at the time of listing and approached or exceeded 80% in the 1970's. Since ESA listing, harvest impacts have been reduced by half or more due to restrictions in ocean and freshwater fisheries plus implementation of mark-selective (only fin-clipped hatchery fish may be retained) fisheries. Use of a sliding scale harvest rate that adjusts harvest impact rates to allow higher harvest rates during years of expected larger abundance and lower harvest rates when abundance estimates are smaller was initiated in 2015.

STEELHEAD

Hatchery Threat: Hatchery programs impact natural origin steelhead populations primarily through interactions in natural spawning areas and competition for rearing habitat. Although impacts are significantly less as compared to salmon hatchery programs, improvements in current hatchery programs will be necessary to achieve Lower Columbia Recovery Plan goals. The HSRG has estimated that productivity of lower Columbia wild steelhead has decreased from 1-47% due to the impact of hatchery fish spawning in natural spawning areas. Reducing impacts from hatchery programs will be important to achieving population viability goals set forth in the Washington Recovery Plan.

Harvest Threat: Impacts to naturally produced steelhead are primarily limited to incidental mortalities in freshwater fisheries in the mainstem Columbia River and tributaries, with the majority of the impacts occurring in tributary fisheries. Ocean harvest impacts are low, typically less than 5% of the total impacts in the fishery threat. Harvest rates at the time of listing were about 10%, which is significantly less than historical levels that regularly exceeded 70%. Mark-selective (only fin-clipped hatchery fish may be retained) sport fisheries for hatchery steelhead were adopted beginning in the 1980's, and have remained a common harvest management tool since.

CHUM

Hatchery Threat: Historically lower Columbia chum have not been heavily impacted by hatchery production. In contrast to other salmon species, large scale hatchery programs were not developed in response to declining abundance levels in the early 1900s. Limited hatchery programs were initiated is some Coast Stratum streams prior to 1990; however, these programs were discontinued due to poor adult returns. Current production is limited to conservation-based programs that are intended to supplement chum populations in the Chinook and Grays rivers plus small Columbia River tributaries upstream of I-5 Bridge. The HSRG has estimated that productivity of natural chum populations exhibited a 1%-11% decline due to impacts associated with hatchery programs; however, this does not take into account the potential positive demographic effects of increasing natural spawning abundance via hatchery supplementation. Use of hatcheries to improve adult abundance, expand geographic range and reduce genetic bottlenecks will be a critical piece of achieving the viability targets set forth in the Lower Columbia Recovery Plan.

Harvest Threat: Currently there is no directed harvest of Columba River chum and only insignificant numbers of chum are handled during Columbia River fisheries targeting other species. Only very limited numbers of chum are caught in ocean fisheries. Historically, chum were heavily exploited in Columbia River late fall commercial fisheries during the early 1900s. More recent fishery management actions have steadily reduced chum harvest by increasing fishery restrictions during lower Columbia late fall commercial seasons. Since 1993, fishery harvest rates on lower Columbia chum have not exceeded 5% and in many years are less than 2%.

Population Fitness and Productivity

As described above past harvest and hatchery practices have had an adverse impact on the abundance and productivity of lower Columbia salmon and steelhead populations. The primary impact of past hatchery and harvest practices has been to significantly alter the genetic fitness fish spawning in the natural environment such that natural origin fish are less effective at using the natural environment for spawning and rearing. Recent studies have documented the impact of excessive hatchery fish in natural spawning areas. The Washington Recovery Plan offers the following information regarding the impacts of hatchery fish on the fitness of natural origin fish:

> Direct estimates of the relative fitness of hatchery and wild spawners are not available for most populations but were inferred in the HSRG analysis from local hatchery program practices based on representative values reported in the scientific literature. Published information on relative fitness of hatchery and wild fish is limited (Berejikian and Ford 2003, TOAST 2004) but generally ranges from under 50% for non-local stocks to 50-90% for local stocks depending on the degree of domestication or selection. Reisenbichler & McIntyre (1977) reported relative survival rates of Deschutes wild and Round Butte hatchery steelhead from egg to migration of 78% for Hatchery:Hatchery pairs, 80% for Hatchery:Wild pairs and 86% for Wild:Wild pairs. Differences are equivalent to a 91% relative fitness of Round Butte hatchery fish which were only a few generations removed from the wild. In the Kalama River, Chilcote et al. (1986) reported a 28% relative fitness of Kalama wild summer and Skamania hatchery summer steelhead based on smolt production. This large reduction in fitness was likely driven by the high degree of domestication in the Skamania hatchery steelhead stock. Even larger differences become apparent where the hatchery stock is substantially different than the wild stock. For instance, a relative fitness of 0% was reported by Kostow et al. (2003) for a Skamania summer steelhead in Clackamas River relative to the native winter run. Finally, Oosterhout & Huntington (2003) assumed a 70% relative fitness for coastal Oregon hatchery and wild coho based on a recommended range of 0.5 to 0.9 by a technical scientific panel.

Genetic fitness of a naturally spawning population is directly linked to the productivity of that population. Based on recent HSRG analyses, the fitness of a population determines the ability of a population to utilize available habitat. For example, if a population with high genetic fitness and a population with low genetic fitness spawn in the same habitat the population with high genetic fitness will produce the most smolts and thereby be more productive. Recently, the HSRG developed metric that can measure genetic fitness at the population scale. The metric can be estimated using the HSRG's "All H Analyzer" (AHA) tool and is described below:

> "In the HSRG Framework, population fitness is defined as the inherent productivity of a population relative to its optimum productivity in the available habitat. In this sense, fitness is a measure of the ability of a population to fully utilize the available habitat, and the population productivity is the product of habitat potential and population fitness. Fitness varies over time based on the genetic legacies of the natural-origin and hatchery-origin spawners. If the composition of hatchery and natural-origin fish on the spawning ground and in the hatchery remain constant over time, fitness reaches equilibrium ("long-term fitness"), which is the fitness value reported in an AHA analysis."[18]

The fitness metrics provides a range of values from 0.5-1.0. A value of 1.0 indicates that the population is fully fit to utilize available habitat. As presented earlier in this chapter, while

[18] HSRG, 2008

hatchery fish are not well adapted to the natural environment, they are still able to utilize habitat to produce smolts and therefore have some minimum level of inherent productivity. Based on information currently available, the HSRG has determined that a hatchery fish spawning in nature is half as productive as a fully fit natural origin fish spawning in that same habitat; therefore, the minimum range of the fitness metric was set at 0.5.

As presented in Chapter 4, the Washington Recovery Plan has established productivity improvement targets for Lower Columbia salmon and steelhead populations. Since fitness is a direct measure of productivity then WDFW can utilize the fitness metric to determine if hatchery and harvest reform actions implemented will be adequate to achieve the productivity improvement targets set forth in the Washington Recovery Plan.

In 2008, in consultation with HSRG, WDFW utilized the AHA tool to conduct modeling analyses of the fitness of Washington lower Columbia salmon and steelhead populations. In conducting this analysis WDFW assumed that hatchery programs, and associated fisheries, were similar to those that were in place in in 1998. By conducting this analysis WDFW was able estimate the baseline fitness (1998) for all Washington lower Columbia salmon and steelhead populations. Tables 5-1 through 5-4 present baseline fitness estimates for Washington lower Columbia natural origin populations impacted by the CSF Plan.

Table 5-1. Baseline fitness estimates for Washington lower Columbia River natural origin Chinook populations.

Chinook Population	Population Designation	Baseline Fitness Estimates		
		Spring	Fall	Late Fall
Grays/Chinook	Fall: Contributing	--	0.50	--
Elochoman/ Skamokawa	Fall: Primary	--	0.50	--
Mill/Abernathy/ Germany	Fall: Primary	--	0.51	--
Cowlitz, Lower *	Fall: Contributing	--	0.50	--
Cowlitz, Upper* includes Cispus & Tilton	Fall: Primary	--	0.50	--
Cowlitz, Upper *	Spring: Primary	0.50		--
Cispus *	Spring: Primary	0.50	--	--
Tilton *	Spring: Stabilizing	0.50	--	--
Toutle, N.F. *	Spring: Contributing Fall: Primary	0.50	0.50	--
Coweeman	Fall: Primary	--	0.62	--
Kalama *	Spring: Contributing Fall: Contributing	0.50	0.50	--
Lewis, N.F.	Fall: Primary	0.50	--	0.95
Lewis, E.F.	Fall: Primary	--	0.50	--
Salmon	Fall: Stabilizing	--	0.50	--
Washougal *	Fall: Primary	--	0.50	--
Gorge, Lower	Fall: Contributing	--	0.50	--
Gorge, Upper	Fall: Contributing	--	0.50	--
White Salmon	Fall: Contributing	--	0.50	--

Significant impact of hatchery fish has reduced fitness of natural spawning fish

* Adult or juvenile hatchery fish of this species released in this basin at time of HSRG Review

Table 5-2. Coho fitness estimates for Washington lower Columbia River natural origin coho populations.

Population	Population Designation	Baseline Fitness Estimates
Grays/Chinook *	Primary	0.5
Elochoman/Skamokawa *	Primary	0.5
Mill/Abernathy/Germany	Contributing	0.79
Cowlitz L *	Primary	0.5
Cowlitz U *	Primary	0.5
Cispus *	Primary	0.5
Tilton *	Stabilizing	0.5
Toutle NF *	Primary	0.5
Toutle SF	Primary	0.5
Coweeman	Primary	0.7
Kalama *	Contributing	0.5
Lewis NF *	Contributing	0.7
Lewis EF	Primary	0.7
Salmon	Stabilizing	0.5
Washougal *	Contributing	0.5
Gorge L	Primary	0.5
Gorge U	Primary	0.25

Table 5-3. Baseline fitness estimates for Washington lower Columbia River natural origin steelhead populations.

Steelhead Population	Population Designation	Baseline Fitness Estimates	
		Summer	Winter
Grays/Chinook *	Primary	--	0.91
Elochoman/Skamokawa *	Contributing	--	0.58
Mill/Abernathy/Germany *	Primary	--	0.99
Cowlitz, Lower *	Contributing	--	0.51
Cowlitz, Upper *	Primary	--	0.51
Cispus *	Primary	--	0.51
Tilton	Contributing	--	0.51
Toutle, N.F. *	Primary	--	0.67
Toutle, S.F. *	Primary	--	0.51
Coweeman *	Primary	--	0.84
Kalama *	Summer: Primary Winter: Primary	0.98	0.97
Lewis, N.F. *	Summer: Stabilizing Winter: Contributing	0.52	0.50
Lewis, E.F. *	Summer: Primary, Winter: Primary	0.50	0.50
Salmon *	Stabilizing	--	0.50
Washougal *	Summer: Primary, Winter: Contributing	0.59	0.89
Gorge, Lower	Primary	--	0.99
Gorge, Upper	Summer: Primary, Winter: Stabilizing	0.99	0.99

Significant impact of hatchery fish has reduced fitness of natural spawning fish

* Adult or juvenile hatchery fish of this species released in this basin at time of HSRG Review

Table 5-4. Baseline fitness estimates for Washington lower Columbia River natural origin chum populations.

Chum Population	Population Designation	Baseline Fitness Estimates
Grays/Chinook *	Primary	0.89
Elochoman/Skamokawa	Primary	0.97
Mill/Abernathy/Germany	Primary	0.97
Cowlitz, Lower	Contributing	0.98
Kalama	Contributing	0.99
Lewis	Primary	0.99
Salmon	Stabilizing	0.99
Washougal	Primary	0.99
Gorge, Lower *	Primary	0.99
Gorge, Upper	Contributing	0.99

* Adult or juvenile hatchery fish of this species released in this basin at time of HSRG Review

CHAPTER 6 HATCHERY AND HARVEST REFORM

Changes to historic hatchery and harvest practices are necessary achieve the Washington Recovery Plan vision of rebuilding lower Columbia salmon and steelhead populations to healthy and harvestable levels. The Washington Recovery Plan has identified a suite of strategies and measures that would assist in reducing impacts of hatchery and harvest management practices. In 2009 the HSRG conducted a full review of Columbia basin hatchery programs and provided recommendations and operational criteria regarding hatchery programs and their impact on natural origin populations. WDFW has utilized the information provided by the Washington Recovery Plan and the HSRG to implement hatchery and harvest reform in the lower Columbia.

This chapter provides a summary of the types of strategies and measures identified in the Washington Recovery Plan and the HSRG recommendations. Additionally, this chapter includes a brief overview of past and present hatchery and harvest management plus a broad-spectrum hatchery and harvest reform actions that could be considered to reduce impacts on natural origin populations (Table 6-1). Details of WDFW's proposed actions for each lower Columbia population are described in Chapter 7.

Washington Recovery Plan Strategies and Measures

The Washington Recovery Plan identifies strategies and measures to address each threat affecting the viability of lower Columbia salmon and steelhead (See Appendix 1). Strategies and measures are fundamentally intended to produce biological results but are also based on economic, political, social, and cultural considerations. Strategies provide broad guidance for addressing threats. Measures "provide specific descriptions of the mechanisms or categories of actions needed to carry out the strategies." [19] The strategies and measures were developed in a series of meetings and workshops involving representatives from implementing agencies, affected parties and the public. The strategies and measures included in the Washington Recovery Plan are based on the current understanding of limiting factors and threats, and therefore provide initial guidance and direction regarding actions partners should take to implement this plan. The Washington Recovery Plan envisions an adaptive management approach in which actions are implemented, evaluated, and adjusted as necessary to achieve impact reduction targets.[20]

For hatchery and harvest threats, the measures are specific to each species, thereby taking into account the population status of each species and addressing current hatchery and harvest practices that are limiting the viability of that species. The types of hatchery and harvest measures that are included in the Washington Recovery Plan are as follows:

[19] LCFRB, 2010
[20] Ibid.

Hatchery

- Reconfigure and reform hatchery programs to achieve Washington Recovery Plan goals and HSRG criteria and standards
- Initiate conservation or supplementation programs to reduce demographic risk or restore extirpated populations
- Utilize hatchery origin fish to reintroduce populations to areas where access is currently blocked (e.g. upper Cowlitz and upper Lewis basins)
- Implement programs using natural origin fish in broodstock or develop local broodstock to benefit local adaption of hatchery origin fish
- Implement rearing and release strategies that minimize interaction between hatchery origin and natural origin smolts
- Establish policies that limit transfer of hatchery fish between basins
- Provide hatchery fish for harvest consistent with other Washington Recovery Plan strategies and measures
- Apply visible mark to all hatchery fish for identification upon their return as adults
- Maximize the removal hatchery origin fish to reduce impact on and interaction with natural origin populations
- Maintain and/or establish wild fish refuges

Harvest

- Set fishery related mortality rate limits based on results of risk assessment analysis
- Evaluate harvest rates in comparison to habitat productivity and capacity
- Develop harvest rate management plans, including sliding scale strategies where fishing opportunity increases or decreases with population abundance
- Manage fisheries to target hatchery origin and healthy natural origin populations
- Manage fisheries to achieve natural origin escapement goals where established
- Manage fisheries to limit harvest and release mortalities to natural origin fish
- Apply a visible mark to all hatchery fish for identification in fisheries
- Manage fisheries to minimize handling of natural origin populations, including selective fisheries where only hatchery fish can be retained
- Investigate fishery methods and strategies that expand implementation of selective fisheries in which only hatchery origin fish are retained
- Improve monitoring of fisheries to estimate handle and mortality of natural origin fish and harvest of hatchery origin fish

Hatchery Scientific Review Group (HSRG) Review (HSRG, 2009a)

The Congressionally-established HSRG reviewed all of the hatchery programs in the Columbia River basin, Puget Sound and the Washington coast. The results of the HSRG review and guiding principles presented in the Columbia River Hatchery Reform System-Wide Report (HSRG, 2009A) offer a foundation for hatchery reform which will help salmon and steelhead hatcheries in the Pacific Northwest in meeting conservation and sustainable harvest goals.

The HSRG outlined three principles for hatchery management:

1) setting clear goals for natural populations and hatchery programs;
2) scientific defensibility of hatchery programs; and
3) monitoring, evaluation to allow for adaptive management.

By applying these principles, the HSRG has demonstrated that the Columbia Basin hatchery system can be managed to achieve recovery goals, while still providing sustainable economic and cultural benefits from salmon and steelhead harvest. To be successful, managers will need to support both hatchery and harvest reforms, and funding entities will need to provide the investments needed for implementation.

The HSRG has developed management tools to support application of these principles, including a scientific framework for artificial propagation of salmon and steelhead; benefit/risk assessments tools; hatchery operational guidelines; and monitoring and evaluation criteria. The primary analytical tool is the "All H Analyzer" (AHA). The AHA tool is a model that includes data regarding habitat conditions, hatchery programs and fisheries impacts. The AHA tool utilizes these inputs to estimate the genetic fitness of the natural origin populations, which allows managers to explore the potential impacts to genetic fitness of natural populations resulting from implementation of alternative hatchery and harvest reform actions based on varying hatchery, harvest, habitat and hydroelectric system constraints.

The HSRG provided recommendations for state, tribal and federal hatchery programs in the Columbia River Basin (2006-2009) that would benefit natural origin populations and maintain sustainable fishing opportunities (HSRG, 2009b). The HSRG's specific recommendations were not presented as the only possible solution, but rather as a clear demonstration that current hatchery programs can be redirected to better meet both conservation and harvest goals.

The HSRG concluded that hatcheries must be managed consistent with basic biological principles and viewed as integral components of the affected ecosystems. The HSRG reached several critical, summary conclusions regarding areas where current hatchery practices need to be reformed. Each of these conclusions must be addressed through policy, management, and research and monitoring. These conclusions are presented in the HSRG's system-wide report and are as follows (HSRG, 2009a):

- "Manage hatchery broodstock to achieve proper genetic integration with, or segregation from, natural populations;
- Promote local adaptation of natural and hatchery populations;
- Minimize adverse ecological interactions between hatchery- and natural-origin fish;
- Minimize effects of hatchery facilities on the ecosystem; and
- Maximize survival of hatchery fish"

Finally, similar to the Lower Columbia Recovery Plan, the HSRG also concluded that hatchery reforms alone will not achieve recovery of natural populations—complementary actions taken by harvest, habitat and hydropower managers are all necessary if long-term conservation goals are to be achieved. The effectiveness of current habitat and future habitat improvements will be greatly increased if combined with hatchery and harvest reforms. A holistic strategy combining reforms and improvements in all of the “H’s” will be necessary to meet the managers’ conservation and harvest goals for salmon and steelhead.

As described in Chapter 5 the hatchery and harvest programs primary impact on the productivity of natural populations occurs through reduced genetic fitness of natural origin populations. The amount of impact that hatchery fish have on genetic fitness is driven by the number of hatchery origin fish, in comparison to natural origin fish, that spawn in natural spawning areas and the genetic composition of the hatchery origin fish.

The genetic composition of hatchery fish is the result of the type of hatchery program that is being conducted: segregated or integrated. A segregated program uses only hatchery origin fish in their broodstock and therefore is genetically dissimilar from the natural origin population. In contrast, an integrated program uses fish from the natural origin population in the hatchery broodstock, which results in the hatchery origin fish sharing more genetic similarities with the natural origin population than do hatchery origin fish from a segregated program.

Estimation of fitness using the AHA model requires significant data inputs and knowledge of the model to provide accurate results for management purposes. While this tool provides valuable information when developing overall strategies for reducing impact of hatchery origin fish on natural origin populations, it is less effective for making annual evaluations of the level of impact a specific hatchery program is having on a population.

The HSRG has developed two additional metrics that are useful in conducting annual program evaluations: Proportion of Hatchery Origin Spawners (pHOS) and Proportion of Natural Origin Spawners (PNI). The pHOS metric is intended for use in evaluating both segregated and integrated hatchery programs while the PNI metric is only used to evaluate integrated programs.

The pHOS metric captures the interaction of hatchery origin and natural origin fish in natural spawning area and is a simple comparison of the number hatchery origin fish spawning in natural spawning areas to the total number of fish spawning in natural spawning areas. The PNI metric is a more complex metric that incorporates the proportion of natural origin fish used in the hatchery broodstock and the proportion of hatchery fish spawning in natural spawning areas. The PNI metric captures the relative influence of the natural and hatchery fish on the genetic composition for a population with higher values indicating that there is an increased similarity in the genetic makeup of hatchery origin and natural origin fish. PNI can be interpreted as a measure of how well the population is adapting to the natural environment.

The HSRG has utilized these two metrics, in combination with population designations from the Washington Recovery Plan, to establish guidance for operation of segregated and integrated hatchery programs, which they have termed “criteria for hatchery influence”. The recommendations presented in the HSRG's system-wide report[21] included the following criteria for hatchery influence on natural populations:

"HSRG criteria for hatchery influence on Primary populations

- The proportion of effective hatchery-origin spawners (pHOS) should be less than 5% of the naturally spawning population, unless the hatchery population is integrated with the natural population.
- For integrated populations, the proportion of natural-origin adults in the broodstock should exceed pHOS by at least a factor of two, corresponding to a PNI (proportionate natural influence) value of 0.67 or greater and pHOS should be less than 0.30.

HSRG criteria for hatchery influence on Contributing populations

- The proportion of effective hatchery-origin spawners (pHOS) should be less than 10% of the naturally spawning population, unless the hatchery population is integrated with the natural population.
- For integrated populations, the proportion of natural-origin adults in the broodstock should exceed pHOS, corresponding to a PNI value of 0.50 or greater and pHOS should be less than 0.30.

HSRG criteria for hatchery influence on Stabilizing populations

- The current operating conditions are considered adequate to meet conservation goals. No criteria were developed for proportion of effective hatchery-origin spawners (pHOS) or PNI."

The HSRG recommendations, guiding principles and biological standards were used in the development of the CSF Plan. Additionally, HSRG recommended solutions regarding how programs could be modified to achieve their criteria for hatchery influence on natural populations. WDFW reviewed and evaluated these solutions in determining the best way to proceed with respect to any given hatchery program. Alternative solutions implemented through the CSF Plan do achieve HSRG's criteria for hatchery influence on natural populations described above.

Hatchery and Harvest Management

The hatchery and harvest threats are uniquely linked. While historic fisheries depended on naturally produced fish, the declines in natural fish abundance during the first half of the 20th century, combined with the implementation of large scale hatchery programs, resulted in the majority of commercial and sport fisheries becoming dependent on hatchery production to maintain sustainable fishing opportunities.

[21] HSRG 2009a

Harvest Management

Harvest of salmon and steelhead in the Columbia River reached their highest levels in the early 1900's, primarily through commercial fisheries. Recreational effort and catch levels increased significantly during the last half of the 20th century, fueled by the shift from historic bank oriented fisheries to boat oriented fisheries. While number of fish harvested decreased from historic levels, impacts to natural origin populations remained high into the last quarter of the 20th century with harvest rates during the 1970's of 65%, 70%and greater than 80% for fall Chinook, spring Chinook and coho, respectively.

Beginning in the 1980's, recognition of reduced abundance resulted in modifications to fishery management strategies in both ocean and freshwater fisheries. A process was established to manage these fisheries to protect weak natural populations in the Columbia River, Puget Sound and along the Oregon, Washington and California coasts. The end of the 20th century brought ESA listings for lower Columbia fall Chinook, coho, chum and steelhead. With these listings came more intense evaluation of how harvest management practices were impacting abundance of natural origin populations, and resulted in declines in harvest rates of lower Columbia salmon and steelhead.

While changes to harvest management strategies, primarily reduced harvest rates, resulted in increased numbers of natural origin fish returning to natural spawning areas, it also resulted more hatchery origin fish returning to those same natural spawning areas. During their review of Columbia River hatchery programs the HSRG identified that sport and commercial fisheries have the potential to benefit natural origin populations by increasing harvest of hatchery origin fish, thereby allowing fewer to escape to natural spawning areas. The HSRG specifically recommended expansion of selective fisheries and development of selective commercial fishing gears and methods to increase the harvest of hatchery fish and reduce handling mortalities for released natural origin fish.[22]

The CSF Plan includes actions intended to increase harvest of hatchery origin fish while reducing or continuing to limit fisheries mortalities to natural origin fish. In recent years, WDFW has adopted mark-selective fisheries, which allow retention of fin-clipped hatchery fish and requires release of unmarked fish, consistent with HSRG recommendations. WDFW will evaluate results of implementing mark-selective fisheries, and other fishery management strategies, to determine the most effective method to increase harvest of hatchery origin fish and limit impacts to natural origin populations. The types of fishery management actions being considered are included in Table 6-1 at the end of this chapter.

Hatchery Management

The first hatchery was constructed and began operation in the late 19th century. Throughout the 20th century additional hatcheries were constructed and put into operation to support

[22] HSRG, 2009a

commercial and sport fishing fisheries. As development of the lower Columbia basin continued throughout the 20th century, natural origin population abundance continued to decline and ocean and freshwater fisheries came to depend on hatchery production to sustain productive fisheries.

Only recently has it been recognized how these hatchery programs have adversely impacted the productivity of natural origin populations. Lower harvest rates in recent decades have resulted in increasing numbers of hatchery origin fish reaching natural spawning areas, which likely resulted in significant declines in genetic fitness and reduced productivity of natural origin salmon and steelhead populations in the lower Columbia.

The HSRG completed a review of lower Columbia hatchery programs and provided recommendations regarding those programs that would reduce the adverse impact of those programs. The most prominent strategies for reducing the impact of hatchery programs included: utilizing natural origin fish in hatchery broodstock, reducing overall program size and limiting number of hatchery origin fish that return to natural spawning areas.

Through the CSF Plan WDFW has evaluated their hatchery programs with respect to impacts on natural origin populations and fisheries. WDFW will utilize a variety of actions to modify current hatchery programs to reduce hatchery impacts on natural origin populations and maintain production to support sustainable fisheries. The types of actions that are being considered are presented in Table 6-1 at the end of this chapter.

Hatchery and Harvest Reform Actions

The CSF Plan has developed hatchery and harvest reform actions that will address many of the measures set forth in the Washington Recovery Plan. The Washington Recovery Plan identifies 155 individual actions to be addressed by WDFW, of which 70 actions address the hatchery and harvest threats. Of these 70 actions, 40 focus on hatchery reform and 30 focus on harvest. Each individual action applies to a single species; therefore, the number of actions varies among species, as follows:

- Fall Chinook: 18 actions, eight for hatchery reform and 10 for harvest
- Spring Chinook: 13 actions, seven for hatchery reform and six for harvest
- Coho: 16 actions, 11 for hatchery reform and five for harvest
- Steelhead: 16 actions, nine for hatchery reform and seven for harvest
- Chum: seven actions, five for hatchery reform and two for harvest

The CSF Plan will address the Washington Recovery Plan actions for hatchery and harvest threats that are within WDFW's authority. In addressing their harvest and hatchery actions WDFW may also address actions in other impact categories, such as ecological interactions and hydro-operations. In some cases WDFW may not have the sole authority to implement a given action and therefore will need to work through other processes to implement this action. For instance the Pacific Fisheries Management Council (PFMC) oversees ocean fisheries; therefore, WDFW will have to work through the PFMC regulation setting process to reduce harvest rates on lower Columbia River natural origin salmon populations. Appendix 2, WDFW's Six-Year IWS, shows how all 70 hatchery and harvest actions called for in the Washington Recovery Plan will be addressed by WDFW.

Table 6-1 identifies the type of hatchery and harvest reform actions that will be implemented through the CSF Plan, and the species they will benefit. Actions listed in Table 6-1 are general actions that apply categorically to a specific species but not necessarily to all populations within that species. These actions will be implemented on a population by population basis depending on the status of the population, the habitat conditions of the subbasin, and existing hatchery programs. For instance, there may not be an existing population in a given basin; therefore, converting the existing hatchery program from segregated to integrated would not be considered for that population. A detailed list of specific actions to be implemented is presented in Chapter 7.

Table 6-1. Potential hatchery and harvest reform actions and the species they impact.

Reform Action	Species				
Hatchery	**FCH**	**SCH**	**Coho**	**SH**	**Chum**
• Mass-mark all hatchery releases for visual identification in fisheries and escapement areas	x	x	x	x	
• Convert from segregated programs to integrated or local brood source	x	x	x	x	
• Shift hatchery production away from basins that are high priority for recovery purposes	x		x	x	
• Reduce or eliminate hatchery releases	x		x	x	
• Manage passage at tributary dams to exclude hatchery fish from natural spawning areas		x	x	x	
• Implement conservation programs to limit demographic risk	x		x	x	x
• Establish weirs to exclude hatchery fish from natural spawning areas consistent with WDFW's Weir Management Plan included in NMFS guidance letter regarding 2011 ocean fisheries	x				
• Investigate potential for using weirs to exclude hatchery fish from spawning areas		x	x	x	
• Provide spawning stock or juveniles for use in supplementation program	x	x	x	x	x
• Develop natural origin brood for use in reintroduction programs		x	x	x	
• Maintain historic genetics in hatcheries for use in reintroduction programs		x	x		
• Establish conservation programs to support existing or reestablish lost populations					X

Reform Action	Species				
Harvest	**FCH**	**SCH**	**Coho**	**SH**	**Chum**
• Implement time, area and gear restrictions to increase protection for specific populations	x	x	x	x	x
• Implement or continue mark-selective commercial fisheries in mainstem Columbia River	x	x	x		
• Implement or continue mark-selective sport fisheries in mainstem Columbia River, including Buoy 10 fishery	x	x	x	x	
• Continue mark-selective sport fisheries in lower Columbia River tributaries	x	x	x	x	
• Adjust sport fishing season and regulations in Columbia River tributaries	x	x	x	x	
• Investigate implementation of alternative fishing gears and methods for lower Columbia commercial fisheries that will allow for implementation of mark-selective fisheries during fall time period	x		x		
• Implement abundance based fishery management structure	x		x		
• Maintain chum retention restrictions to minimize fishery impacts					x

CHAPTER 7 DETAILED SUMMARY OF HATCHERY AND HARVEST ACTIONS

As described in Chapter 6, the Washington Recovery Plan and the HSRG have provided valuable guidance regarding implementation of hatchery and harvest reform in the lower Columbia. The actions presented in this chapter are intended to address Washington Recovery Plan strategies and measures for hatchery and harvest threats. These actions are also expected to result in hatchery programs that will meet the HSRG criteria for hatchery influence on natural origin populations.

WDFW used the HSRG's AHA tool extensively to model different hatchery program options. The model provides information regarding achievement of HSRG criteria and the number of fish available for harvest. Based in part on these model WDFW determined the best hatchery and harvest reform actions to implement for each population to achieve the overarching goals of the CSF plan to rebuild natural origin populations and sustain productive fisheries.

The CSF Plan includes a combination of past and future hatchery and harvest reform actions, and these actions are presented in this chapter. Implementation of hatchery and harvest reform actions began in 2009 concurrent with the development of the CSF plan; therefore, this plan includes some reform actions that have already been implemented and other actions that will occur in the future. This chapter also provides population specific status and hatchery and harvest information for salmon and steelhead populations in the Coast and Cascade strata of the Lower Columbia ESU. The information for each population is provided in five sections:

Population Metrics

- A table containing population metrics to describe population status and future goals.

Hatchery Release And Natural Escapement Data

- Recent hatchery releases and estimated salmon and steelhead returns to natural spawning grounds. For populations where integrated programs are being implemented information regarding broodstock composition will also be presented.

Hatchery and Harvest Factors Impacting Population Fitness

- Information is provided regarding the key hatchery and harvest factors that are adversely impacting natural origin populations and limiting ability to achieve recovery goals.

Potential Reform Actions

- A table presenting hatchery and harvest actions that could potentially benefit natural origin populations.
    - Includes actions that would benefit the natural population. This suite of actions will continually be evaluated as WDFW implements the CSF Plan in order to best achieve impact reduction targets and overall population goal presented here.

CSF Plan Actions

- A summary of hatchery and harvest actions that have been accomplished (since 2009) or are planned to occur in the near future through the implementation of the CSF Plan
  - It is important to remember that there are a variety of strategies that can be used to implement the hatchery and harvest reform actions described in this chapter. In developing the CSF Plan, WDFW evaluated each of the potential actions with respect to their expected benefit to natural origin populations and the feasibility, including both logistics and funding, of implementing a given action. The CSF Plan calls for implementation of a suite of actions that would be most effective in achieving recovery goals set forth in the Washington Recovery Plan.
  - Hatchery and harvest reform actions currently being implemented by WDFW to benefit natural origin populations, and additional actions that were implemented beginning in 2014 are presented here. This list is as summary highlighting the major reform actions WDFW is implementing through the CSF Plan. A full list of hatchery and harvest reform actions is included in Appendix 2.

In reviewing the escapement data presented in this chapter it is important to understand that different data sets are available for the different species. For fall Chinook marking of all hatchery fish and estimating abundance of hatchery and natural origin fish on spawning grounds based on a visual mark (e.g. adipose fin clip) have only recently been implemented. While escapement estimates have been available for several decades, it has only been since 2010 that mass marking has been fully implemented and estimates of pHOS became available. For coho, intensive surveys to provide abundance and hatchery and natural origin fish composition did not begin until 2010. This information is presented in the "Hatchery Release and Natural Escapement Data" section for each population. For steelhead marking of all hatchery fish has been in place since 1986 and monitoring programs estimating natural abundance have been occurring for some time for most populations. The abundance estimates are conducted based on redd count expansions and estimating hatchery and natural origin spawners is difficult. Annual adult returns for the last 10 years are presented in tables at the start of the "Winter and Summer Steelhead Populations" section of this chapter. Chum abundance is extremely low throughout most of the lower Columbia, except for the Grays basin and the mainstem Columbia between I-5 Bridge and Bonneville Dam. There is very little hatchery produced chum in the lower Columbia, so estimating hatchery and natural fish on the spawning grounds is less complicated. Abundance estimates for selected subpopulations of chum are presented in a table at the start of the "Chum Populations" section of this chapter.

The following list of frequently used terms and their definitions are provided below to assist the reader in using the information presented in this chapter.

Baseline: Conditions in 1998 prior to federal ESA listings of lower Columbia Chinook and Chum salmon and steelhead.

Early Stock Coho: A stock of hatchery coho also referred to as Type-S stock, which have a more southerly ocean migration and return to the Columbia River from mid-August through September.

Early Winter Steelhead: A stock of hatchery winter steelhead that returns to Columbia River tributaries during December through February. A non-indigenous stock that was genetically derived from a Puget Sound population (Chambers Creek).

Fitness: In the HSRG framework, population fitness is defined as the inherent productivity of a populations relative to its optimum productivity in the available habitat. In this sense, fitness is a measure of the ability of a populations to fully utilize the available habitat, and population productivity is the product of habitat potential and population fitness (HSRG, 2014).

Fall (Tule) Chinook: A stock of fall Chinook distinguished by their dark skin coloration and advanced state of maturity at time of return to freshwater.

Gene Flow: The rate at which genetic material flows from one population, population component, or group of populations to another (WDFW, 2008).

Harvest Rate: Refers to the percentage of fish of a given population that are retained in fisheries. For Chinook and coho, harvest rate is a surrogate for exploitation rate where fish are harvested in ocean fisheries, as compared to steelhead and chum that have very limited harvest in ocean fisheries.

Hatchery Origin Fish: Fish that were produced in the hatchery environment beginning with egg stage.

Late Fall (Bright) Chinook: A stock of lower Columbia River fall Chinook, commonly referred to as lower river brights, that return to freshwater later at a less mature state than fall (tule) Chinook and have a bright skin coloration.

Late Stock Coho: A stock of hatchery coho also referred to as Type-N stock, which have a more northerly ocean migration and return to the Columbia River at from mid-September through December.

Late Winter Steelhead: A stock of winter steelhead that returns to Columbia tributaries during March through June. A stock that is indigenous to the Columbia River basin. Hatchery stocks are typically genetically derived from the basin that supports the hatchery program.

Minimum Viability Goal: The minimum level that various parameters must achieve for a population to be viable.

Natural Escapement: Number of adults, including jacks, returning to natural spawning areas. Can include both hatchery and natural origin fish.

Natural Origin Fish: Fish that were produced in natural environment beginning with egg stage.

pHOS: Proportion of natural origin spawners made up of hatchery-origin fish (HSRG, 2009a).

PNI: Proportionate Natural Influence. A metric that can be interpreted as a measure of how well the population is adapting to the natural environment (HSRG, 2014).

Population: A group of fish of the same species that spawn in a particular lake or stream (or portion thereof) 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 (Meyers et al, 2006).

Stock: A group of fish within a species that is substantially reproductively isolated from another group of the same species (WDFW, 2008).

Stratum: A larger group of independent populations based on the combination of ecological zone and life history strategy.

TBD: To be determined**.** WDFW to determine harvest rates that will, in concert with other hatchery reform actions, achieve Minimum Viability Goal targets and support fishing opportunities.

Viability: viable independent populations have a negligible risk of extinction (<5%) over a 100-year time frame due to threats from demographic variation, local environmental variation, and genetic diversity changes (McElhaney et al, 2007).

VSP Parameters: Four key population parameters (A-Abundance, P-Productivity, S- Spatial Distribution, and D-Diversity) referred to as Viable Salmonid Population parameters that NMFS uses to evaluate the viability of a salmon or steelhead population.

Fall (Tule) Chinook Populations

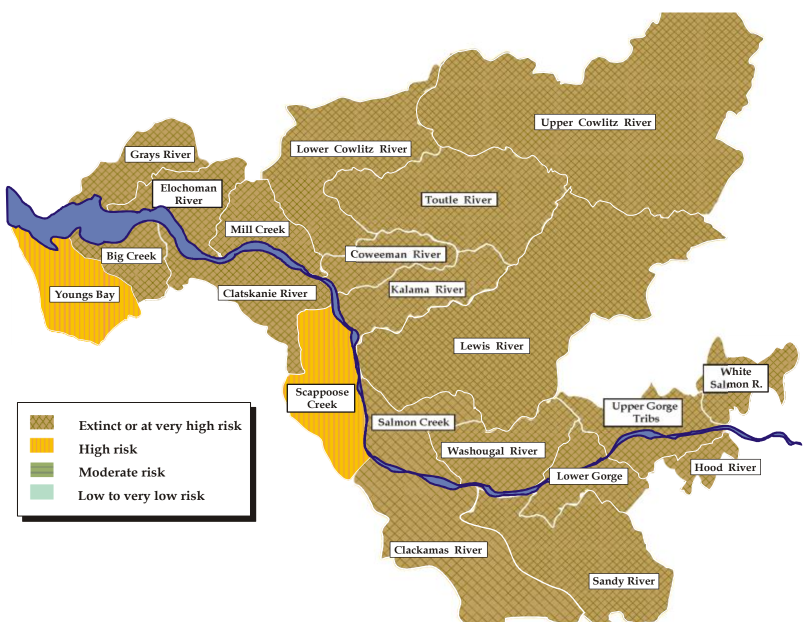


Figure 7-1. Current status of historical demographically-independent lower Columbia River fall (tule) Chinook populations.

Fall (Tule) Chinook Populations and Recovery Plan Designations[23]			
Coast Stratum	***Population Designation***	***Cascade Stratum***	***Population Designation***
Youngs Bay	Stabilizing	Cowlitz (lower)	Contributing
Big Creek	Contributing	Cowlitz (upper)	Stabilizing
Grays/Chinook	Contributing	Toutle	Primary
Elochoman/Skamokawa	Primary	Coweeman	Primary
Mill/Abernathy/Germany	Primary	Kalama	Contributing
Clatskanie	Primary	Lewis	Primary
Scappoose	Primary	Salmon	Stabilizing
		Washougal	Primary
		Clackamas	Contributing
		Sandy	Contributing

Grays/Chinook Fall (Tule) Chinook

ESA Listing Status: Threatened

Population Designation: Contributing

POPULATION METRICS

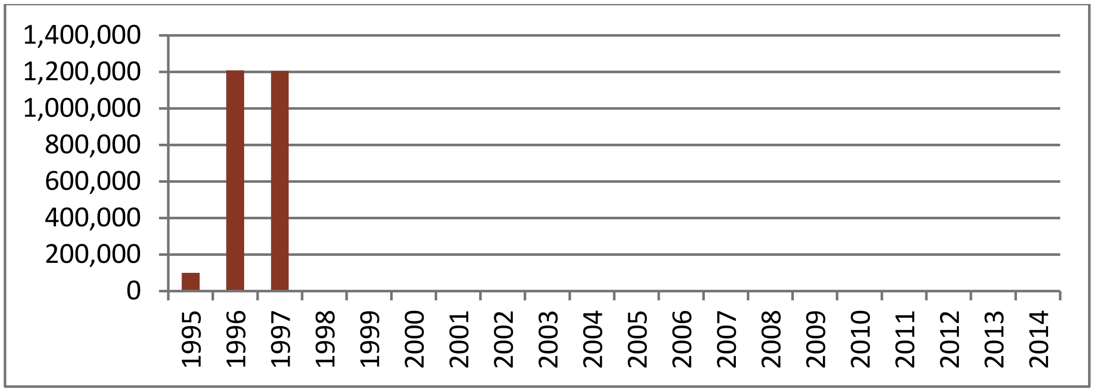
Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	Medium+
Escapement	Natural Origin Fish	800	<50	1,000
Gene Flow (pHOS or PNI)			pHOS 46%	pHOS < 10%
Fitness			0.50	0.66
Harvest Rate	Hatchery Origin Fish		65%	NA
	Natural Origin Fish		65%	26%

HATCHERY RELEASE AND NATURAL ESCAPEMENT DATA

Hatchery Release Data:

- Graph below displays number of fall (tule) Chinook smolts released in Grays basin since 1995
- Historically no releases occurred in Chinook basin

[23] Populations that are shaded are Washington populations that are addressed in this document



Natural Escapement Data:

- Tables below provide number of fall (tule) Chinook returning to natural spawning areas (includes both natural and hatchery origin fish) in Grays basin
- No fall (tule) Chinook spawning ground surveys are conducted in Chinook basin; however, tide gates currently limit access into basin and abundance is thought to be low.

Fall (Tule) Chinook Escapement Estimates for the Grays Basin					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	217	386	208	2,033	711
Percent Hatchery Spawners (pHOS)	40%	83%	83%	91%	74%

Integrated Hatchery Program:

- Data not available because fall (tule) Chinook hatchery program was discontinued in 1998

HATCHERY AND HARVEST FACTORS IMPACTING POPULATION FITNESS

- Fitness of natural origin fish significantly impacted by straying of hatchery fall Chinook and past broodstock sources
- No hatchery fall Chinook program in Grays/Chinook basin, hatchery strays from outside the basin – primarily hatchery fish from Oregon SAFE areas with Rogue River origins
- Based on CWT analyses it is likely that Distinct tule genetics are still present in natural spawning population; however, majority of naturally spawning population resembles SAFE area bright Chinook with Rogue River stock genetics
- Baseline harvest rates exceeded population productivity
- Reduction in genetic diversity within the ESU is likely due to past transfers of eggs and/or fish between watersheds to make up for hatchery shortfall

Potential Reform Actions

Potential Hatchery and Harvest Reform Actions: Grays/Chinook Fall (Tule) Chinook	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Establish Grays Basin as a refuge for wild fall (tule) Chinook	X	X	X	X
2. No hatchery fall (tule) Chinook smolt releases in Grays basin to improve juvenile productivity		X	X	X
3. Establish and annually operate temporary weir in lower Grays River to control hatchery fish on natural spawning grounds	X	X		X
4. Evaluate and determine whether emergency conservation broodstock program is necessary	X	X	X	X
5. Repair hatchery intake to eliminate impacts on juvenile rearing and outmigration	X	X		
6. Eliminate transfers of fish or eggs from other watersheds		X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce aggregate tule harvest rate consistent with PFMC's Abundance-Based Fishery Management Approach	X			X
2. Implement "expanded" river mouth sanctuaries for sport and commercial fisheries to further reduce harvest rates	X			X
3. Implement alternative gear project for lower Columbia River commercial fishery				X
4. Incrementally implement mark-selective fisheries: Ocean Sport, Ocean Troll, Buoy 10 Sport, Mainstem Columbia sport				X
5. Extend mark-selective sport fisheries upstream from upper boundary of Buoy 10 fishing area				X
6. Implement mark-selective fall Chinook sport fishery in Grays River to reduce hatchery fish on natural spawning areas	X	X		X

CSF Plan Actions for Grays/Chinook Fall (Tule) Chinook

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in theWashington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Hatchery program was eliminated in 1997 **(Hatchery Action 1,2,9)**.
- A weir is currently operated in the lower river to remove hatchery strays **(Hatchery Action 3)**. Effectiveness of this weir in meeting overall CSF Plan objectives is being evaluated.
- Evaluation will occur to determine if a conservation level program should be initiated to assist in recovery efforts (**Hatchery Action 4**).
- Harvest rate has been decreased from historical levels where these rates were as high as 60%. A new abundance-based harvest rate matrix was adopted in 2012 consistent with

recommendations in the Washington Recovery Plan. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1).**
  - This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
  - This will result in additional hatchery fish removal from fisheries.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 3)**.
- Mark-selective sport fisheries have occurred in recent years in the ocean and lower Columbia River for selected time frames **(Harvest Action 4,5)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since about 2011 **(Harvest Action 6)**.

Elochoman/Skamokawa Fall (Tule) Chinook

ESA Listing Status: Threatened   Population Designation: Primary

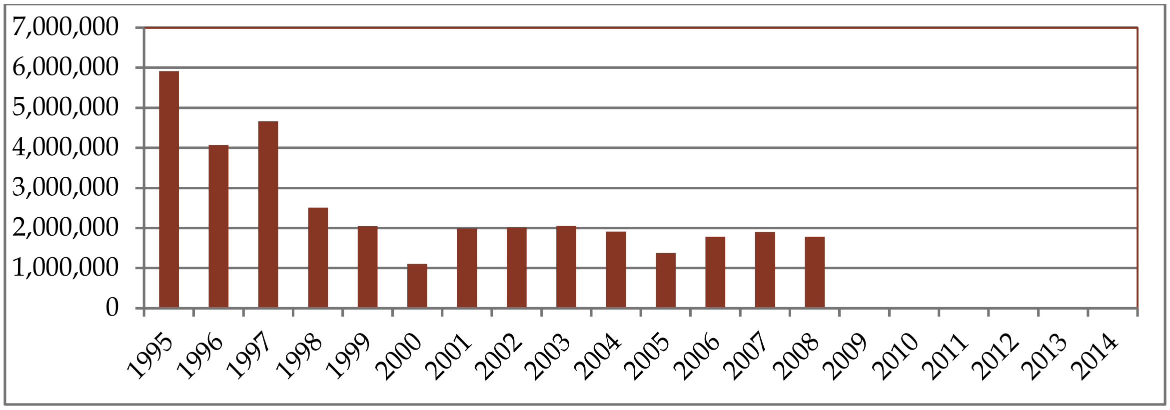
Population Metrics

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	High
Escapement	Natural Origin Fish	3,000	<50	1,500
Gene Flow (pHOS or PNI)			pHOS 61%	pHOS <5%
Fitness			0.50	0.60
Harvest Rate	Hatchery Origin Fish		65%	NA
	Natural Origin Fish		65%	46%

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Graph below displays number of fall (tule) Chinook smolts released in Elochoman basin since 1995
- Historically no releases occurred in Skamokawa basin



Natural Escapement Data:

- Tables below provide number of fall (tule) Chinook returning to natural spawning areas (includes both natural and hatchery origin fish) in Elochoman basin, Skamokawa basin and Elochoman/Skamokawa basin
- Historically no releases occurred in Skamokawa basin

Fall (Tule) Chinook Escapement Estimates for the Elochoman Basin					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	797	635	87	353	468
Percent Hatchery Spawners (pHOS)	86%	95%	60%	64%	76%

Fall (Tule) Chinook Escapement Estimates for the Skamokawa Creek Basin					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	528	490	94	368	370
Percent Hatchery Spawners (pHOS)	94%	94%	90%	61%	85%

Fall (Tule) Chinook Escapement for the Elochoman and Skamokawa basins					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	1,325	1,125	181	721	838
Percent Hatchery Spawners (pHOS)	89%	95%	75%	63%	80%

Integrated Hatchery Program:

- Data not available because fall (tule) Chinook hatchery program was discontinued in 2009

HATCHERY AND HARVEST FACTORS IMPACTING POPULATION FITNESS

- Recent studies regarding large abundance of hatchery fish on spawning ground suggest that fitness of natural origin fish is significantly impacted by historic straying of hatchery fall Chinook and past hatchery program in the basin
- Hatchery from both within (historic, program recently discontinued) and outside the Elochoman/Skamokawa basin – primarily hatchery fall Chinook with lower Columbia River tule genetics

- Reduction in genetic diversity within the ESU is likely due to past transfers of eggs and/or fish between watersheds to make up for hatchery shortfall
- Baseline harvest rates exceeded population productivity

Potential Reform Actions

Potential Hatchery and Harvest Reform Actions: Elochoman/Skamokawa Fall (Tule) Chinook	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Establish Elochoman Basin as a refuge for wild fall (tule) Chinook	X	X	X	X
2. Eliminate hatchery fall (tule) Chinook smolt releases in Elochoman Basin to improve juvenile productivity		X	X	X
3. Annually operate temporary weir in lower Elochoman River to control hatchery fish on natural spawning grounds		X		X
4. Evaluate and determine whether emergency juvenile supplementation program is necessary	X	X	X	X
5. Investigate feasibility of capturing naturally produced juvenille fall Chinook for transport and release into the mainstem Columbia River to reduce predation	X	X		
6. Provide adult passage at hatchery barrier at Elochoman River to improve escapement of wild fish	X	X	X	
7. Improve adult passage at hatchery intake on Beaver Creek to improve escapement of wild fish	X	X	X	
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce aggregate tule harvest rate consistent with PFMC's Abundance-Based Fishery Management Approach	X			X
2. Implement "expanded" river mouth sanctuaries for sport and commercial fisheries to further reduce harvest rates	X			X
3. Implement alternative gear project for lower Columbia River commercial fishery				X
4. Incrementally implement mark-selective fisheries: Ocean Sport, Ocean Troll, Mainstem Columbia sport, Buoy 10 Sport				X
5. Extend mark-selective sport fisheries upstream from upper boundary of Buoy 10 fishing area				X
6. Implement mark-selective fall Chinook sport fishery in Elochoman River to reduce hatchery fish on natural spawning areas	X	X		
7. Transition fall Chinook sport fishery in Elochoman River from mark-selective to no retention as hatchery returns from past hatchery program diminish	X	X		

CSF Plan Actions for Elochoman/Skamokawa Fall (Tule) Chinook

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal

for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- No fall Chinook hatchery program exists currently. Elochoman Hatchery was closed in 2009 (**Hatchery Action 1,2**).
- A weir is operated in the lower river to remove stray hatchery fish **(Hatchery Action 3).** Effectiveness of this weir in meeting overall Plan objectives is being evaluated.
- A conservation level supplementation program is being considered for this system (**Hatchery Action 4).**
- The barrier at the former Elochoman Salmon Hatchery will be removed in 2016 (**Hatchery Action 8).**
- The hatchery intake ladder was modified at Beaver Creek Hatchery to meet NMFS standards for fish passage **(Hatchery Action 9).**
- Harvest rate has been decreased from historical levels where these rates were as high as 60%. A new abundance-based harvest rate matrix was adopted in 2012 consistent with recommendations in the Washington Recovery Plan. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1).**
    - This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
    - This will result in additional hatchery fish removal from fisheries.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 3)**.
    - Mark-selective sport fisheries have occurred in recent years in the ocean and lower Columbia River for selected time frames **(Harvest Action 4,5)**.
    - Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since about 2011 **(Harvest Action 6)**.

Mill/Abernathy/Germany (MAG) Creeks Fall (Tule) Chinook

ESA Listing Status: Threatened Population Designation: Primary

Goals		Historical	Washington Recovery Plan	
			Baseline	**Minimum Viability Goal**
Minimum Viability			Very Low	High
Escapement	Natural Origin Fish	2,500	50	900
Gene Flow (pHOS or PNI)			pHOS 18%	pHOS <5%
Fitness			0.51	0.59
Harvest Rate	Hatchery Origin Fish		65%	NA
	Natural Origin Fish		65%	47%

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Hatchery releases in Abernathy Creek basin were discontinued in 1999
- Historically no releases occurred in Mill Creek or Germany Creek basins

Natural Escapement Data:

- Tables below provide number of fall (tule) Chinook returning to natural spawning areas (includes both natural and hatchery origin fish) in Mill Creek basin, Abernathy Creek basin, Germany Creek Basin and Mill/Abernathy/Germany basin

Fall (Tule) Chinook Escapement Estimates for the Mill Creek Basin					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	1,042	1,182	102	191	629
Percent Hatchery Spawners (pHOS)	95%	95%	83%	75%	87%

Fall (Tule) Chinook Escapement Estimates for the Abernathy Creek Basin					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	540	144	59	262	251
Percent Hatchery Spawners (pHOS)	93%	85%	90%	79%	87%

Fall (Tule) Chinook Escapement Estimates for the Germany Creek Basin					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	1,181	333	19	580	528
Percent Hatchery Spawners (pHOS)	92%	91%	100%	82%	91%

Fall (Tule) Chinook Escapement Estimates for the Mill, Abernathy and Germany Creek Basins					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	2,763	1,659	180	1,033	1,409
Percent Hatchery Spawners (pHOS)	93%	93%	87%	80%	88%

Integrated Hatchery Program:

- Data not available because fall (tule) Chinook hatchery program was discontinued in 1999

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Recent studies regarding large abundance of hatchery fish on spawning ground suggest that fitness of natural origin fish is significantly impacted by historic straying of hatchery fall Chinook and past hatchery program in the basin
- Hatchery strays from outside Mill/Abernathy/Germany basin – primarily hatchery fish fall Chinook with lower Columbia River tule genetics
- Baseline harvest rates exceeded population productivity

CSF Plan Actions for Mill/Abernathy/Germany (MAG) Creeks Fall (Tule) Chinook

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- No hatchery programs currently exist in any of these tributaries **(Hatchery Action 1,2).**
- Harvest rate has been decreased from historical levels where these rates were as high as 60%. A new abundance-based harvest rate matrix was adopted in 2012 consistent with recommendations in the Washington Recovery Plan. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1).**
    - This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
    - This will result in additional hatchery fish removal from fisheries.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 2)**.

- Mark-selective sport fisheries have occurred in recent years in the ocean and lower Columbia River for selected time frames **(Harvest Action 3)**.
- Sport fisheries are closed for Chinook in these tributaries **(Harvest Action 4)**.

Lower Cowlitz Fall (Tule) Chinook

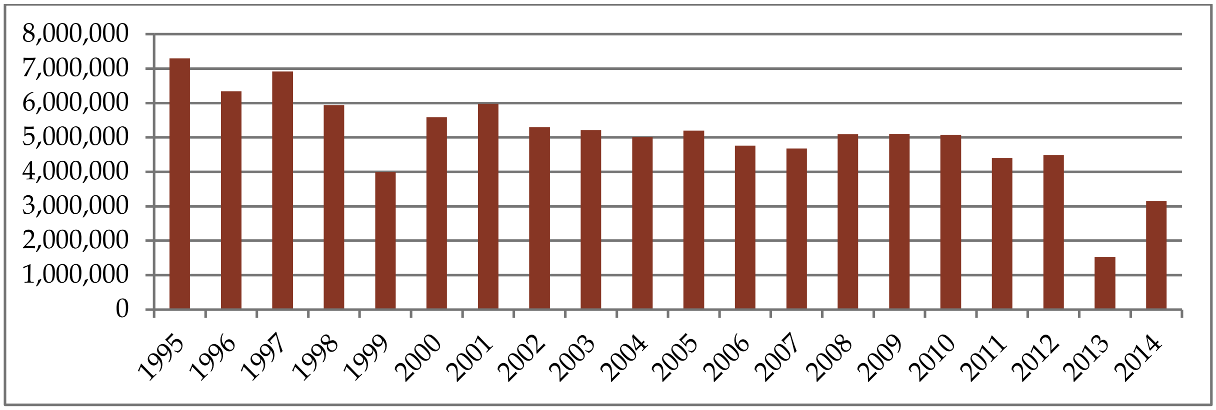
ESA Listing Status: Threatened Population Designation: Contributing

Goals		Historical	Washington Recovery Plan	
			Baseline	**Minimum Viability Goal**
Minimum Viability			Very Low	Medium+
Escapement	Natural Origin Fish	24,000	500	3,000
Gene Flow (pHOS or PNI)			PNI 0.10	PNI >0.50
Fitness			0.50	0.51
Harvest Rate	Hatchery Origin Fish		65%	NA
	Natural Origin Fish		65%	60%

Hatchery Release and Natural Escapement Data

Hatchery Release Data:

- Graph below displays number of fall (tule) Chinook smolts released in Lower Cowlitz basin since 1995



Natural Escapement Data:

- Table below provides escapement estimates for Lower Cowlitz basin

Natural Escapement Data:

- Tables below provide number of fall (tule) Chinook returning to natural spawning areas (includes both natural and hatchery origin fish) in Lower Cowlitz basin

Fall (Tule) Chinook Escapement Estimates for the Lower Cowlitz Basin					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	3,734	3,685	2,725	4,365	3,627
Percent Hatchery Spawners (pHOS)	21%	25%	29%	19%	23%

*Primarily tule stock, but does include some late spawning bright stock

Integrated Hatchery Program:

- Table below provides metrics for integrated fall (tule) Chinook hatchery program in lower Cowlitz basin

Integrated Hatchery Program Metrics for Lower Cowlitz Fall (Tule) Chinook			
Year	**pNOB***	**pHOS****	**PNI*****
2011	NA	0.25	NA
2012	NA	0.29	NA
2013	0.01	0.19	0.04
Average	0.01	0.19	0.05

* Integrated program initiated in 2013 by using natural origin fish from lower Cowliitz River
** Annual pHOS estimated based on actual observations from spawning ground surveys (see escapement estimates above)
** Average (2011-2013) reduced by 20% to account for reduced productivity resulting from hatchery fish spawning in natural spawning locations
*** PNI calcuated using annual estimates for individual year and average estimates for muli-year average

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Recent studies regarding large abundance of hatchery fish on spawning ground suggest that fitness of natural origin fish is significantly impacted by historic straying of hatchery fall Chinook and past hatchery program in the basin

- Hatchery strays from both within and outside Lower Cowlitz basin – primarily hatchery fall Chinook with lower Columbia River tule genetics
- Baseline harvest rates exceeded population productivity

Potential Hatchery and Harvest Reform Actions: Lower Cowlitz Fall (Tule) Chinook	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Manage Cowlitz hatchery broodstock consistent with HSRG standards for a contributing population	X	X	X	X
2. Implement integrated broodstock program	X	X	X	X
3. Implement broodstock collection program in Cowlitz River upstream of confluence with Toutle River to collect natural origin broodstock	X	X		X
4. Manage hatchery production levels in lower Cowlitz River to achieve recovery goals and support ocean and Columbia Basin fisheries through the Fisheries and Hatchery Management Plan update		X		X
5. Limit Cowlitz Salmon Hatchery fall (tule) Chinook smolt releases to meet conservation standards		X		X
6. Annually evaluate program and escapement data and adjust program size to meet HSRG standards as per Fisheries and Hatchery Management Plan Update	X	X	X	X
7. Eliminate transfers of fish or eggs from other watersheds		X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce aggregate tule harvest rate consistent with PFMC's Abundance-Based Fishery Management Approach	X			X
2. Implement alternative gear project for lower Columbia River commercial fishery				X
3. Incrementally implement mark-selective fisheries: Ocean Sport, Ocean Troll, Mainstem Columbia sport, Buoy 10 Sport				X
4. Implement mark-selective fall Chinook sport fishery in lower Cowlitz River to reduce hatchery fish on natural spawning areas	X	X		X

CSF Plan Actions for Lower Cowlitz Fall (Tule) Chinook

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- An integrated hatchery program was initiated in 2013 as a pilot program. The NOR collection increased significantly with the 2014 brood **(Hatchery Actions 1-3).**
- The current program size is 2.4 million segregated and 1.1 million integrated **(Hatchery Action 4,5).** The program size is reviewed annually to ensure consistency with HSRG standards **(Hatchery Action 6).**
- No salmon are transferred from other watersheds **(Hatchery Action 7)**.
- The pHOS estimates should be reduced based on reduction in program size. Current pHOS levels are being measured on the old program size **(Hatchery Action 1,5).**

- The pNOB will be increased beginning in 2014 with increased collections of natural-origin broodstock. The expanded broodstock collection program will begin in 2014 with an expectation of collecting a minimum of 130 adults which would result in a pNOB of 20% per ISIT (In-season Implementation Tool) modeling, and pHOS will be managed to less than 20% **(Hatchery Actions 1-3)**.
    - Accomplished by increased volunteer angler participation in broodstock collection program.
    - "Sight fishing" (snagging) will be conducted by WDFW staff as needed.
    - The number of natural oring broodstock collected will be increased if needed to compensate for higher than modeled pHOS. This will be reviewed on an annual basis through the Annual Project Review Process (APR) as defined in the Cowlitz Fisheries and Hatchery Management Plan (FHMP) **(Hatchery Action 6).**
- Harvest rate has been decreased from historical levels where these rates were as high as 60%. A new abundance-based harvest rate matrix was adopted in 2012 consistent with recommendations in the Washington Recovery Plan. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1).**
    - This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
    - This will result in additional hatchery fish removal from fisheries.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 2)**.
- Mark-selective sport fisheries have occurred in recent years in the ocean and lower Columbia River for selected time frames **(Harvest Action 3)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since about 2011 **(Harvest Action 4)**.
- During the NMFS 5-year status review, staff will discuss with the NMFS and LCFRB, population designations for all fall Chinook populations in the Cowlitz basin and the lower Columbia ESU.
- Increased monitoring of the populations in the lower Cowlitz began in 2014.
    - Includes increased spawning surveys in 2014 and smolt trapping expected to begin in 2015.

Upper Cowlitz Fall (Tule) Chinook[24]

ESA Listing Status: Threatened Population Designation: Stabilizing

Goals	Historical	Washington Recovery Plan	
		Baseline	Minimum Viability Goal
Minimum Viability		Very Low	Very Low

[24] The WA Recovery Plan combined Upper Cowlitz, Cispus and Tilton into a single population

Escapement	Natural Origin Fish	28,000	0	--
Gene Flow (pHOS or PNI) *			TBD	TBD
Fitness			0.50	0.50
Harvest Rate	Hatchery Origin Fish		65%	NA
	Natural Origin Fish		65%	65%

* Gene Flow not intially modeled during development of the Washington Recovery Plan and Recovery Plan Minimum Viability Goal for Gene Flow will depend on reintroduction efforts

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Historically no releases occurred in Tilton, Cowlitz or Cispus basins
- Reintroduction efforts are underway using only adult (hatchery and natural origin) supplementation
- Surplus hatchery adults have been transported and released upstream of Cowlitz Falls Dam since 1997 and in the Tilton Basin since 1996
- Success of reintroduction effort in Upper Cowlitz and Cispus basins to be determined by effectiveness of juvenile fish collection efforts at or near Cowlitz Falls Dam

Natural Escapement Data:

- Tables below provide number of fall (tule) Chinook returning to natural spawning areas (includes both natural and hatchery origin fish) in Upper Cowlitz/Cispus basin, Tilton basin and Upper Cowlitz/ Cispus/Tilton basin

Fall (Tule) Chinook Escapement Estimates for the Upper Cowlitz and Cispus Basins*					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	6,969	7,676	3,372	3,168	5,296
Percent Hatchery Spawners (pHOS)	86%	100%	100%	99.7%	96%

*Estimates based on the number of fish collected at the Cowlitz Salmon Hatchery separator and transported and released upstream of Cowlitz Falls Dam; therfore, does not account for harvest or pre-spawning mortality and is not an estimate of the actual number of spawners in the upper Cowlitz basin

Fall (Tule) Chinook Escapement Estimates fro the Tilton Basin*					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	4,488	6,506	2,771	4,198	4,491
Percent Hatchery Spawners (pHOS)	29%	34%	30%	22%	29%

*Estimates based on the number of fish collected at the Cowlitz Salmon Hatchery separator and transported and released in the Tilton basin; therfore, does not account for harvest or pre-spawning mortality and is not an estimate of the actual number of spawners in the Tilton basin

Fall (Tule) Chinook Escapement Estimates for the Upper Cowlitz, Cispus and Tilton Basins*					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	11,457	14,182	6,143	7,366	9,787
Percent Hatchery Spawners (pHOS)	64%	70%	68%	55%	64%

*Estimates based on the number of fish collected at the Cowlitz Salmon Hatchery separator and released upstream of Cowlitz Fall Dam, Cispus and Tilton basins; therfore, does not account for harvest or pre-spawning mortality and is not an estimate of the actual number of spawners in the upper Cowlitz, Cispus and Tilton basins

Integrated Hatchery Program:

- Data not available because no fall (tule) Chinook hatchery program is currently releasing smolts into Upper Cowlitz/Cispus/Tilton basin

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- No natural population exists due to no downstream juvenile passage at Mossyrock Dam and inundation of spawning and rearing habitat by Mayfield and Mossyrock dams
- Baseline harvest rates exceeded population productivity

Potential Hatchery and Harvest Reform Actions: Upper Cowlitz Fall (Tule)Chinook	**Viable Salmonid Population (VSP) Parameters Addressed**			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Eliminate transfers of fish or eggs from other watersheds		X		X
2. Manage Cowlitz hatchery broodstock consistent with HSRG standards for a contributing population	X	X	X	X
3. Implement reintroduction program above Cowlitz Falls Dam using up to 7,000 lower Cowlitz hatchery origin adults as per the Fisheries and Hatchery Management Plan Update	X	X	X	X
4. Continue to work with Tacoma Power and Cowlitz Fisheries Technical Committee to increase juvenile fish collection at or near Cowlitz Falls Dam	X	X	X	X
5. Implement additional production in Mayfield Lake with the use of net pens to support sustainable fisheries by compensating for reduced production in lower Cowlitz		X		X
6. Maintain releases of hatchery origin adults (up to 1,600) into the Tilton River to provide for local sport fishery as per the Fisheries and Hatchery Management Plan Update		X		X
7. Manage new harvest programs to limit stray rate to lower Cowlitz River consistent with HSRG standards for a contributing population (lower Cowlitz)		X		X
8. Continue to estimate natural origin juvenile out migrating smolts from the Tilton basin for evaluation of smolt to adult survival	X	X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce aggregate tule harvest rate consistent with PFMC's Abundance-Based Fishery Management Approach	X			X
2. Implement alternative gear project for lower Columbia River commercial fishery				X
3. Incrementally implement mark-selective fisheries: ocean Sport, ocean Troll, Mainstem Columbia River sport, Buoy 10 Sport				X
4. Implement mark-selective fall Chinook sport fishery in upper Cowlitz and Tilton Rivers to assist in reestablishing population that is adapted to the upper Cowlitz and Tilton Basins	X	X		X

CSF Plan Actions for Upper Cowlitz Fall (Tule) Chinook

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- No salmon are transferred from other watersheds **(Hatchery Action 1)**.
- Reintroduction efforts are underway using adult supplementation (**Hatchery Action 2).**
- WDFW and LCFRB staff will continue as members or participants in the Cowlitz Fisheries Technical Committee (FTC) and will work towards implementation of the Fisheries and Hatchery Management Plan (FHMP) **(Hatchery Action 3).**
- Design has been completed for a new collector at Cowlitz Falls Dam. Construction of a new collector is expected to be completed in 2017. Testing for an additional collector just downstream of Cowlitz Falls Dam is underway (**Hatchery Action 4).**
- WDFW produced about 2 million smolts in Mayfield net pens beginning with the 2013 brood. This program is expected to continue with the 2014 brood **(Hatchery Action 5).**
- Natural origin fall Chinook are released into the Tilton River for reintroduction with additional hatchery fish released for harvest in the Tilton River **(Hatchery Action 6**).
- Natural origin smolts are collected at Mayfield to estimate smolt outmigrants (**Hatchery Action 8**).
- This reintroduction program will be reevaluated during the upcoming 2016 FHMP review process.
- Harvest rate has been decreased from historical levels where these rates were as high as 60%. A new abundance-based harvest rate matrix was adopted in 2012 consistent with recommendations in the Washington Recovery Plan. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1).**
    - This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
    - This will result in additional hatchery fish removal from fisheries.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 2)**.
- Mark-selective sport fisheries have occurred in recent years in the ocean and lower Columbia River for selected time frames **(Harvest Action 3)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since about 2011 **(Harvest Action 4)**.
- During the NMFS 5-year status review, staff will discuss the population designations for all fall Chinook populations in the Cowlitz basin.
- Increased monitoring of the populations in the lower Cowlitz began in 2014.
    - Includes smolt trapping and increased spawning surveys.

Toutle Fall (Tule) Chinook[25]

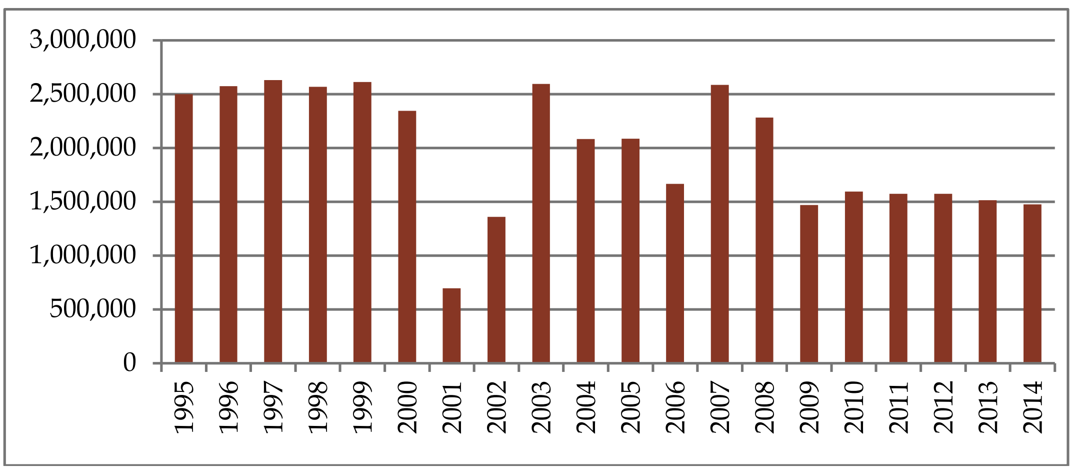
ESA Listing Status: Threatened   Population Designation: Primary

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	High+
Escapement	Natural Origin Fish	11,000	<50	4,000
Gene Flow (pHOS or PNI)			PNI 0.1	PNI >0.67
Fitness			0.50	0.60
Harvest Rate	Hatchery Origin Fish		65%	NA
	Natural Origin Fish		65%	44%

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Graph below displays number of fall (tule) Chinook smolts released in Green River (tributary of the North Fork Toutle River) since 1995
- Historically no releases occurred in South Fork Toutle basin



Natural Escapement Data:

- Tables below provide number of fall (tule) Chinook returning to natural spawning areas (includes both natural and hatchery origin fish) in South Fork Toutle basin, Green River (tributary to North Fork Toutle basin, and Toutle basin
- No fall (tule) Chinook spawning are transported and released upstream of Sediment Retention Structure in the North Fork Toutle basin

Fall (Tule) Chinook Escapement Estimates for the South Fork Toutle Basin					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	412	377	259	597	411
Percent Hatchery Spawners (pHOS)	79%	61%	76%	43%	65%

[25] The WA Recovery Plan combined North Fork Toutle and South Fork Toutle into a single population

Fall (Tule) Chinook Escapement for the Green River Basin					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	1,714	1,199	649	1,686	1,312
Percent Hatchery Spawners (pHOS)	89%	85%	75%	64%	78%

Fall (Tule) Chinook Escapement for the South Fork Toutle and Green River Basins					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	2,216	1,576	908	2,283	1,746
Percent Hatchery Spawners (pHOS)	87%	79%	78%	59%	76%

Integrated Hatchery Program:

- Table below provides metrics for integrated fall (tule) Chinook hatchery program in Toutle basin

Integrated Hatchery Program Metrics for Toutle Fall (Tule) Chinook			
Year	pNOB*	pHOS**	PNI***
2010	0.23	0.87	0.21
2011	0.21	0.79	0.21
2012	0.23	0.76	0.24
2013	0.34	0.58	0.37
Average	0.25	0.60	0.29

* Integrated program initiated in 2010 by using volunteer natural origin fish returning to North Fork Toutle Hatchery
** Annual pHOS estimated based on actual observations from spawning ground surveys (see escapement estimates above)
** Average (2010-2013) reduced by 20% to account for reduced productivity resulting from hatchery fish spawning in natural spawning locations
*** PNI calcuated using annual estimates for individual year and average estimates for muli-year average

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Recent studies regarding large abundance of hatchery fish on spawning ground suggest that fitness of natural origin fish is significantly impacted by historic straying of hatchery fall Chinook and past hatchery program in the basin
- Hatchery strays from both within and from outside Toutle basin – primarily hatchery fall Chinook with lower Columbia River tule genetics
- Reduction in genetic diversity within the ESU is likely due to past transfers of eggs and/or fish between watersheds to make up for hatchery shortfall
- Baseline harvest rates exceeded population productivity

Potential Hatchery and Harvest Reform Actions: Toutle Fall (Tule) Chinook	Viable Salmon Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Manage Toutle hatchery tule broodstock consistent with HSRG standards for a primary population (implement integrated broodstock program)	X	X	X	X
2. Annually operate temporary weir in lower Green River to control hatchery fall Chinook on natural spawning areas and collect natural origin fish for broodstock		X		X
3. Reduce Toutle Hatchery fall (tule) Chinook smolt releases from 2.5 million to 1.4 million (44% reduction)		X		X

	A	P	S	D
4. Eliminate transfers of fish or eggs from other watersheds		X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce aggregate tule harvest rate consistent with PFMC's Abundance-Based Fishery Management Approach	X			X
2. Implement alternative gear project for lower Columbia River commercial fishery				X
3. Incrementally implement mark-selective fisheries: Ocean Sport, Ocean Troll, Mainstem Columbia sport, Buoy 10 Sport				X
4. Implement mark-selective fall Chinook sport fishery in Toutle River to reduce hatchery fish on natural spawning areas	X	X		X

CSF Plan Actions for Toutle Fall (Tule) Chinook

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- This is an integrated program. Natural origin fish are collected for broodstock from the weir (**Hatchery Action 1,2)**.
- All hatchery fall Chinook captured will be removed at weir on the Green River starting in 2014 **(Hatchery Action 2).** Effectiveness of this weir in meeting overall CSF Plan objectives is being evaluated.
- Program size was reduced to 1.4 million in 2009 from a program size of 2.5 million **(Hatchery Action 3).**
- No salmon are transferred from other watersheds **(Hatchery Action 4)**.
- The pHOS in the Green River will be controlled above the weir in 2014 (**Hatchery Action 1)**.
    - Most of the spawning habitat is upstream of the weir.
    - Weir efficiency has ranged from 77-98 % and has been above 95% for 3 of 5 years
    - The weir is assumed to be 95% efficient.
- Natural origin productivity is expected to increase with reduced hatchery program and reduced pHOS beginning in 2018.
- AHA results from 1.4 million integrated program (current size) shows pNOB of 25%, pHOS of 10% and PNI of 72% based on weir efficiency of 95% **(Hatchery Action 1)**.
- Harvest rate has been decreased from historical levels where these rates were as high as 60%. A new abundance-based harvest rate matrix was adopted in 2012 consistent with recommendations in the Washington Recovery Plan. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1).**
    - This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
    - This will result in additional hatchery fish removal from fisheries.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 2)**.

- Mark-selective sport fisheries have occurred in recent years in the ocean and lower Columbia River for selected time frames **(Harvest Action 3)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since about 2011 **(Harvest Action 4)**.

Coweeman Fall (Tule) Chinook

ESA Listing Status: Threatened Population Designation: Primary

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	High+
Escapement	Natural Origin Fish	3,500	100	900
Gene Flow (pHOS or PNI)			pHOS >30%	pHOS <5%
Fitness			0.62	0.67
Harvest Rate	Hatchery Origin Fish		65%	NA
	Natural Origin Fish		65%	53%

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Historically no releases occurred in Coweeman basin

Natural Escapement Data:

- Tables below provide number of fall (tule) Chinook returning to natural spawning areas (includes both natural and hatchery origin fish) in Coweeman basin-

Fall (Tule) Chinook Escapement Estimates for the Coweeman Basin					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	632	563	413	2,036	911
Percent Hatchery Spawners (pHOS)	30%	12%	14%	31%	22%

Integrated Hatchery Program:

- Data not available because no fall (tule) Chinook hatchery program is currently releasing smolts into Coweeman basin

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Recent studies regarding large abundance of hatchery fish on spawning ground suggest that fitness of natural origin fish is significantly impacted by historic straying of hatchery fall Chinook and past hatchery program in the basin
- No hatchery fall Chinook program in basin, hatchery strays from outside Coweeman basin – primarily hatchery fish fall Chinook with lower Columbia River tule genetics
- Baseline harvest rates exceeded population productivity

Potential Hatchery and Harvest Reform Actions: Coweeman Fall (Tule) Chinook	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Establish Coweeman basin as a refuge for wild fall (tule) Chinook	X	X	X	X
2. No hatchery fall (tule) Chinook smolt releases in Coweeman basin to improve juvenile productivity		X	X	X
3. Establish and annually operate temporary weir in Coweeman River to control hatchery fish on natural spawning grounds		X		X
4. Evaluate level of hatchery strays into basin after reduction in hatchery programs from other basins		X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce aggregate tule harvest rate consistent with PFMC's Abundance-Based Fishery Management Approach	X			X
2. Implement alternative gear project for lower Columbia River commercial fishery				X
3. Incrementally implement mark-selective fisheries: Ocean Sport, Ocean Troll, Mainstem Columbia River sport, Buoy 10 Sport				X
4. Fall Chinook sport fishery in Coweeman River closed to protect natural origin fall (tule) Chinook	X	X		X

CSF Plan Actions for Coweeman Fall (Tule) Chinook

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- No hatchery releases occur in this basin **(Hatchery Action 1,2)**.
- A weir is operated on the Coweeman to remove hatchery strays **(Hatchery Action 3, 4).** Effectiveness of this weir in meeting overall Plan objectives is being evaluated.
- Harvest rate has been decreased from historical levels where these rates were as high as 60%. A new abundance-based harvest rate matrix was adopted in 2012 consistent with recommendations in the Washington Recovery Plan. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1).**
    - This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
    - This will result in additional hatchery fish removal from fisheries.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 2)**.
- Mark-selective sport fisheries have occurred in recent years in the ocean and lower Columbia River for selected time frames **(Harvest Action 3)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since about 2011. The Coweeman is closed to Chinook retention **(Harvest Action 4)**.

Fall (Tule) Chinook Escapement Estimates for the Kalama Basin					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	7,061	8,840	8,007	12,061	8,992
Percent Hatchery Spawners (pHOS)	88%	93%	93%	91%	91%

Kalama Fall (Tule) Chinook

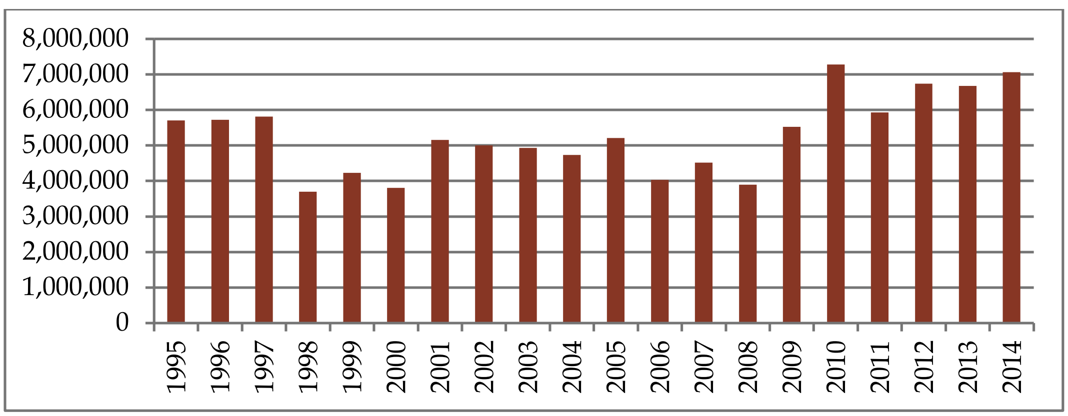
ESA Listing Status: Threatened Population Designation: Contributing

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	Medium
Escapement	Natural Origin Fish	2,700	<50	500
Gene Flow (pHOS or PNI)			PNI 0.10	PNI >0.50
Fitness			0.50	0.555
Harvest Rate	Hatchery Origin Fish		65%	NA
	Natural Origin Fish		65%	51%

HATCHERY RELEASE AND NATURAL ESCAPEMENT DATA

Hatchery Release Data:

- Graph below displays number of fall (tule) Chinook smolts released in Kalama basin since 1995



Natural Escapement Data:

- Tables below provide number of fall (tule) Chinook returning to natural spawning areas (includes both natural and hatchery origin fish) in Kalama basin

Integrated Hatchery Program:

- Table below provides metrics for integrated fall (tule) Chinook hatchery program in Kalama basin

Integrated Hatchery Program Metrics for Kalama Fall (Tule) Chinook			
Year	pNOB*	pHOS**	PNI***
2010	0.04	0.88	0.04
2011	0.14	0.93	0.13
2012	0.05	0.93	0.05
2013	0.16	0.91	0.15
Average	0.10	0.73	0.12

* Integrated program initiated in 2010 using volunteer natural origin fish returning to Modrow Weir (located near Modrow Bridge in the lower Kalama River) and Kalama Falls Hatchery

** Annual pHOS estimated based on actual observations from spawning ground surveys (see escapement estimates above)
** Average (2010-2013) reduced by 20% to account for reduced productivity resulting from hatchery fish spawning in natural spawning locations
*** PNI calcuated using annual estimates for individual year and average estimates for muli-year average

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Recent studies regarding large abundance of hatchery fish on spawning ground suggest that fitness of natural origin fish is significantly impacted by historic straying of hatchery fall Chinook and past hatchery program in the basin
- Hatchery strays from both within and outside Kalama basin – primarily hatchery fish fall Chinook with lower Columbia River tule genetics
- Reduction in genetic diversity within the ESU is likely due to past transfers of eggs and/or fish between watersheds to make up for hatchery shortfall
- Baseline harvest rates exceeded population productivity

Potential Hatchery and Harvest Reform Actions: Kalama Fall (Tule) Chinook	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Manage Kalama hatchery broodstock consistent with HSRG standards for a contributing population				
2. Annually operate temporary weir in lower Kalama River to control hatchery fall Chinook on natural spawning areas and collect natural origin fish for broodstock		X		X
3. Establish new production goal at Kalama Falls and Fallert Creek hatcheries for fall (tule) Chinook between 2.0 (60% reduction) and 7.0 (no change) million juveniles to support sustainable fisheries by compensating for production reductions in other locations				
4. Eliminate transfers of fish or eggs from other watersheds		X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce aggregate tule harvest rate consistent with PFMC's Abundance-Based Fishery Management Approach	X			X
2. Implement alternative gear project for lower Columbia River commercial fishery				X
3. Incrementally implement mark-selective fisheries: Ocean Sport, Ocean Troll, Columbia River mainstem sport, Buoy 10 Sport				X
4. Implement mark-selective fall Chinook sport fishery in Kalama River to reduce hatchery fish on natural spawning areas	X	X		X

CSF Plan Actions for Kalama Fall (Tule) Chinook

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- No salmon are transferred from other watersheds **(Hatchery Action 4)**.
- New weir will be installed in 2015 **(Hatchery Action 2**).
- Hatchery fish will be removed at the weir beginning in 2015 **(Hatchery Action 1, 2).**
    - The majority of the harvest will continue below the weir in the lower river.
- Weir efficiency is projected to be between 80% and 100% in 2015 for fall Chinook adults **(Hatchery Action 1, 2).**
    - Weir spacing will be reduced from 3 inches to 1.5 inches effectively stopping most fish from going upstream.
    - More fish are expected to recruit to the weir because of the expanded size and design and the ability to sort at the weir.
- WDFW staff will work with NMFS and LCFRB to consider that this population designation be changed to stabilizing instead of contributing **(Hatchery Action 1).**
    - Discussions will begin in 2014. NMFS's 5-year status review will begin in 2015.
- If weir is not efficient enough or population designation change is not changed to stabilizing, size of program will be reduced **(Hatchery Action 3)**.
- AHA results show that with a weir efficiency of 80%, program size would be reduced to 3.2 million from the current 7 million program **(Hatchery Action 1, 3).**
- In 2014 all natural origin fish that volunteer to hatchery traps are being collected for broodstock **(Hatchery Action 1)**.
    - Program is being integrated at about 10%.
- An option would be to run a stepping stone program with 900,000 integrated program with 20% pNOB and 20% allowable pHOS and a segregated program of 4.5 million **(Hatchery Action 1).**
    - Preliminary AHA shows pHOS for segregated is 7% and pHOS for integrated is 20%.
- Harvest rate has been decreased from historical levels where these rates were as high as 60%. A new abundance-based harvest rate matrix was adopted in 2012 consistent with recommendations in the Washington Recovery Plan. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1).**
    - This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
    - This will result in additional hatchery fish removal from fisheries.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 2)**.

- Mark-selective sport fisheries have occurred in recent years in the ocean and lower Columbia River for selected time frames **(Harvest Action 3)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since about 2011 **(Harvest Action 4)**.

Lewis River Fall (Tule) Chinook[26]

ESA Listing Status: Threatened Population Designation: Primary

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	High+
Escapement	Natural Origin Fish	2,600	<50	1,500
Gene Flow (pHOS or PNI)			pHOS 41%	pHOS <5%
Fitness			0.50	0.59
Harvest Rate	Hatchery Origin Fish		65%	NA
	Natural Origin Fish		65%	38%

Hatchery Release and Natural Escapement Data

Hatchery Release Data:

- Hatchery releases in North Fork Lewis basin were discontinued in 1986
- Historically no releases occurred in East Fork Lewis basin

Natural Escapement Data:

- Tables below provide number of fall (tule) Chinook returning to natural spawning areas (includes both natural and hatchery origin fish) in East Fork Lewis basin, North Fork Lewis basin and Lewis basin

Fall (Tule) Chinook Escapement in the East Fork Lewis basin					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	426	866	566	1,540	850
Percent Hatchery Spawners (pHOS)	11%	5%	4%	6%	7%

Fall (Tule) Chinook Escapement in the North Fork Lewis Basin					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	1,506	1,084	1,134	4,867	2,148
Percent Hatchery Spawners (pHOS)	40%	42%	43%	18%	36%
Fall (Tule) Chinook Escapement in the North and East Fork Lewis Basins					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	1,932	1,950	1,700	6,407	2,997
Percent Hatchery Spawners (pHOS)	33%	26%	30%	15%	26%

[26] The WA Recovery Plan combined East Fork Lewis and North Fork Lewis into a single population

Integrated Hatchery Program:

- Data not available because no fall (tule) Chinook hatchery program is currently releasing smolts into Lewis basin

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Recent studies regarding large abundance of hatchery fish on spawning ground suggest that fitness of natural origin fish is significantly impacted by historic straying of hatchery fall Chinook and past hatchery program in the basin
- No hatchery fall Chinook program in Lewis basin, hatchery strays from outside the basin - primarily hatchery fall Chinook with lower Columbia River tule genetics
- Baseline harvest rates exceeded population productivity

Potential Hatchery and Harvest Reform Actions: Lewis River Fall (Tule) Chinook	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Establish Lewis basin as a refuge for wild fall Chinook	X	X	X	X
2. No hatchery fall Chinook smolt releases in Lewis basin to improve juvenile productivity		X	X	X
3. Evaluate level of hatchery strays into basin after reduction in hatchery programs from other basins		X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce aggregate tule harvest rate consistent with PFMC's Abundance-Based Fishery Management Approach	X			X
2. Implement alternative gear project for lower Columbia River commercial fishery				X
3. Incrementally implement mark-selective fisheries: Ocean Sport, Ocean Troll, Buoy 10 Sport				X
4. Fall Chinook sport fishery in East Fork Lewis River closed to protect natural origin fall (tule) Chinook	X	X		X

CSF Plan Actions for Lewis Fall (Tule) Chinook

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- No Chinook hatchery programs exist in the Lewis basin **(Hatchery Action 1,2)**.
- Harvest rate has been decreased from historical levels where these rates were as high as 60%. A new abundance-based harvest rate matrix was adopted in 2012 consistent with recommendations in the Washington Recovery Plan. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1).**

    - This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
    - This will result in additional hatchery fish removal from fisheries.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 2)**.
- Mark-selective sport fisheries have occurred in recent years in the ocean and lower Columbia River for selected time frames **(Harvest Action 3)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since about 2011 **(Harvest Action 4)**.

Salmon Creek Fall (Tule) Chinook

ESA Listing Status: Threatened Population Designation: Stabilizing

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	Very Low
Escapement	Natural Origin Fish	NA	<50	--
Gene Flow (pHOS or PNI)			pHOS 50%	pHOS current
Fitness			0.50	0.50
Harvest Rate	Hatchery Origin Fish		65%	NA
	Natural Origin Fish		65%	65%

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Historically no releases occurred in Salmon Creek basin

Natural Escapement Data:

- No fall (tule) Chinook spawning ground surveys are conducted in Salmon Creek basin

Integrated Hatchery Program:

- Data not available because no fall (tule) Chinook hatchery program is currently releasing smolts into Salmon Creek basin

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Recent studies regarding large abundance of hatchery fish on spawning ground suggest that fitness of natural origin fish is significantly impacted by historic straying of hatchery fall Chinook and past hatchery program in the basin

- No hatchery fall Chinook program in Salmon Creek basin, hatchery strays from outside the basin - primarily hatchery fall Chinook with lower Columbia River tule genetics
- Baseline harvest rates exceeded population productivity
- Population currently meeting recovery goals

Potential Hatchery and Harvest Reform Actions: Salmon Creek Fall (Tule) Chinook	**Viable Salmonid Population (VSP) Parameters Addressed**			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Establish Salmon Creek basin as a refuge for wild fall (tule) Chinook	X	X	X	X
2. No hatchery fall (tule) Chinook smolt releases in Salmon Creek basin to improve juvenile productivity		X	X	X
3. Evaluate level of hatchery strays into basin after reduction in hatchery programs from other basins		X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce aggregate tule harvest rate consistent with PFMC's Abundance-Based Fishery Management Approach	X			X
2. Implement alternative gear project for lower Columbia River commercial fishery				X
3. Incrementally implement mark-selective fisheries: Ocean Sport, Ocean Troll, Columbia River sport, Buoy 10 Sport				X
4. Fall Chinook sport fishery in Salmon Creek closed to protect natural origin fall (tule) Chinook	X	X		X

CSF Plan Actions for Salmon Creek Fall (Tule) Chinook

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- No hatchery releases occur in Salmon Creek **(Hatchery Action 1,2)**.
- Harvest rate has been decreased from historical levels where these rates were as high as 60%. A new abundance-based harvest rate matrix was adopted in 2012 consistent with recommendations in the Washington Recovery Plan. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1).**
    - This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
    - This will result in additional hatchery fish removal from fisheries.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 2)**.
- Mark-selective sport fisheries have occurred in recent years in the ocean and lower Columbia River for selected time frames **(Harvest Action 3)**.

- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since about 2011. Salmon Creek is currently closed to fall Chinook retention **(Harvest Action 4)**.

Washougal Fall (Tule) Chinook

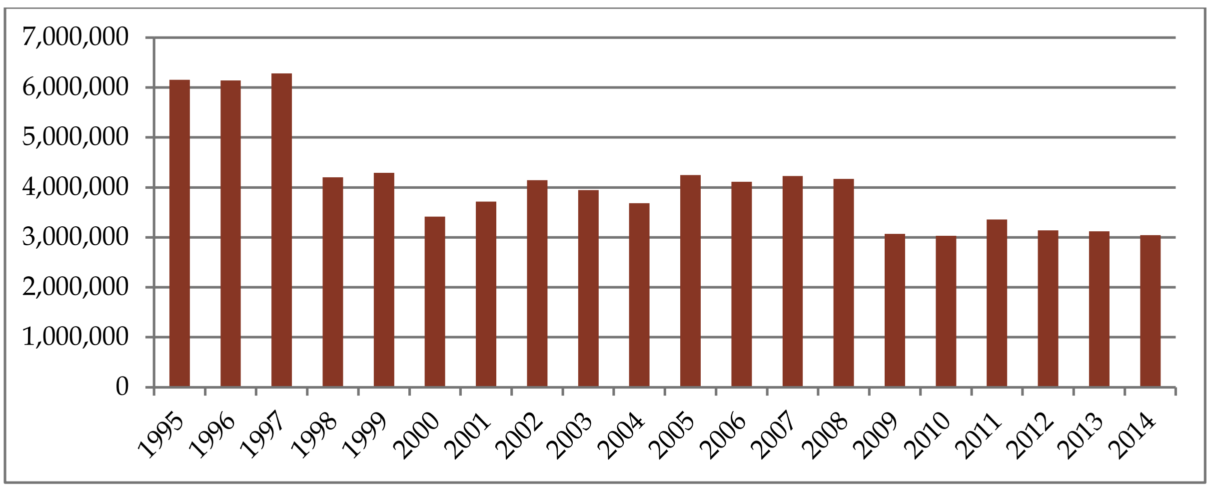
ESA Listing Status: Threatened Population Designation: Primary

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	High +
Escapement	Natural Origin Fish	2,600	60	1,200
Gene Flow (pHOS or PNI)			PNI: >0.67	PNI: >0.67
Fitness			0.50	0.60
Harvest rate	Hatchery Origin Fish		65%	NA
	Natural Origin Fish		65%	43%

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Graph below displays number of fall (tule) Chinook smolts released in Washougal basin since 1995



Natural Escapement Data:

- Tables below provide number of fall (tule) Chinook returning to natural spawning areas (includes both natural and hatchery origin fish) in Washougal basin

Fall (Tule) Chinook Escapement Estimates for the Washougal Basin					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	6,067	4,706	1,913	7,185	4,968
Percent Hatchery Spawners (pHOS)	87%	82%	71%	58%	74%

Integrated Hatchery Program:

- Table below provides metrics for integrated fall (tule) Chinook hatchery program in Washougal basin

Integrated Hatchery Program Metrics for Washougal Fall (Tule) Chinook			
Year	pNOB*	pHOS**	PNI*
2010	NA	0.87	NA
2011	NA	0.82	NA
2012	NA	0.71	NA
2013	NA	0.58	NA
Average	NA	0.60	NA

* Estimates of pNOB and PNI not available because integrated program initiated in 2014
** Annual pHOS estimated based on actual observations from spawning ground surveys (see escapement estimates above)
** Average (2010-2013) reduced by 20% to account for reduced productivity resulting from hatchery fish spawning in natural spawning locations

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Recent studies regarding large abundance of hatchery fish on spawning ground suggest that fitness of natural origin fish is significantly impacted by historic straying of hatchery fall Chinook and past hatchery program in the basin
- Hatchery strays from both within and from outside Washougal basin – primarily hatchery fall Chinook with lower Columbia River tule genetics
- Reduction in genetic diversity within the ESU is likely due to past transfers of eggs and/or fish between watersheds to make up for hatchery shortfall
- Baseline harvest rates exceeded population productivty

Potential Hatchery and Harvest Reform Actions: Washougal Fall (Tule) Chinook	Viable Salmonid Parameters Population (VSP) Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Manage Washougal hatchery broodstock consistent with HSRG standards for a contributing population	X	X	X	X
2. Manage Washougal hatchery broodstock consistent with HSRG standards for a primary population (implement integrated broodstock program)	X	X	X	X
3. Annually operate temporary weir in lower Washougal River to control hatchery fall Chinook on natural spawning areas and collect natural origin fish for broodstock		X		X
4. Reduce Washougal Hatchery fall (tule) Chinook smolt releases into the Washougal River from 4.0 million to 0.9 million (reduction of 77%)		X		X
5. Rear 1 million fall (tule) Chinook for release into Select Area location to support maintain sustainable fisheries and compensate for reductions in production at other locations				
6. Eliminate transfers of fish or eggs from other watersheds		X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce aggregate tule harvest rate consistent with PFMC's Abundance-Based Fishery Management Approach	X			X
2. Implement alternative gear project for lower Columbia River commercial fishery				X

3. Incrementally implement mark-selective fisheries: Ocean Sport, Ocean Troll, Columbia River sport, Buoy 10 Sport				X
4. Implement mark-selective fall Chinook sport fishery in Washougal River to reduce hatchery fish on natural spawning areas	X	X		X

CSF Plan Actions for Washougal Fall (Tule) Chinook

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Total program size is 3 million smolts.
    - Program size of 900,000 integrated and 2.1 million segregated (Hatchery Actions 1,2).
    - Produce 2.1 million for transfer and acclimation in Youngs Bay (Hatchery Action 4).
    - NORs will be collected at the weir for the integrated program **(Hatchery Action 3)**.
- All hatchery fish returning to the weir will be removed starting in 2014 to reduce pHOS **(Hatchery Action 3)**. Effectiveness of this weir in meeting overall CSF Plan objectives is being evaluated.
- Consider new weir location before the fall of 2016 **(Hatchery Action 3)**.
- No salmon are transferred from other watersheds **(Hatchery Action 6)**.
- Consider seine fishery to target Washougal hatchery fish near the mouth of the Washougal River **(Harvest Action 2)**.
- Harvest rate has been decreased from historical levels where these rates were as high as 60%. A new abundance-based harvest rate matrix was adopted in 2012 consistent with recommendations in the Washington Recovery Plan. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1).**
    - This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
    - This will result in additional hatchery fish removal from fisheries.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 2)**.
- Mark-selective sport fisheries have occurred in recent years in the ocean and lower Columbia River for selected time frames **(Harvest Action 3)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since about 2011 **(Harvest Action 4)**.

Late Fall (Bright) Chinook Populations

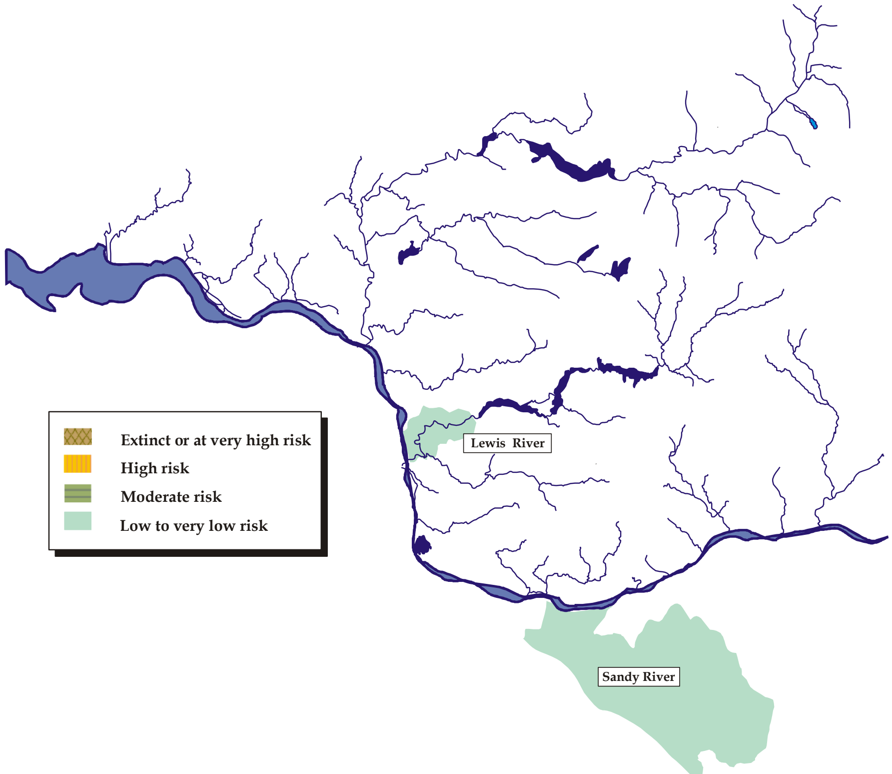


Figure 7-2. Current status of historical demographically-independent lower Columbia River late fall (bright) Chinook populations.

Late Fall (Bright) Chinook Populations and Recovery Plan Designations[27]	
Cascade Stratum	**Population Designation**
North Fork Lewis	Primary
Sandy	Primary

Lewis River Late Fall (Bright) Chinook

ESA Listing Status: Threatened Population Designation: Primary

Goals		Historical	Washington Recovery Plan: Baseline	Washington Recovery Plan: Minimum Viability Goal
Minimum Viability			Very High	Very High
Escapement	Natural Origin Fish	23,000	7,300	7,300
Gene Flow (pHOS or PNI)			pHOS <5%	pHOS <5%
Fitness			0.95	0.95
Harvest Rate	Hatchery Origin Fish		50%	NA
	Natural Origin Fish		50%	50%

[27] Populations that are shaded are Washington populations that are addressed in this document

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Historically no releases (late returning bright stock) occurred in Lewis basin
- Hatchery strays from in-basin and out-of-basin hatchery program may be affecting this population

Natural Escapement Data:

- Tables below provide number of late fall (bright) Chinook returning to natural spawning areas in Lewis basin

Late Bright Fall Chinook Escapement Estimates for the Lewis Basin					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	9,294	8,205	8,143	15,197	10,210
Percent Hatchery Spawners (pHOS)	0%	0%	0%	0%	0%

Integrated Hatchery Program:

- Data not available because no fall Chinook hatchery program is currently releasing smolts into Lewis basin

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- No fall Chinook hatchery program in basin, hatchery strays from outside North Fork Lewis basin, hatchery programs for other species within the basin may be affecting populaion
- Baseline harvest rates may have limited abundance

Potential Hatchery and Harvest Reform Actions: Lewis River Late Fall (Bright) Chinook	**Viable Salmonid Population (VSP) Parameters Addressed**			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Establish North Fork Lewis River as a refuge for wild late fall (bright) Chinook	X	X	X	X
2. No hatchery fall Chinook smolt releases in North Fork Lewis basin to improve juvenile productivity		X	X	X
3. Evaluate level of hatchery strays into basin after reduction in hatchery programs from other basins		X		X
4. Transfer all steelhead to lower river for release to reduce risk of predation	X	X		
5. Review hatchery program production levels for other species through Aquatic Coordinating Committee (ACC) as natural populations are reestablished in the upper North Fork Lewis basin	X	X	X	X
Harvest Actions	**A**	**P**	**S**	**D**
1. Manage harvest rate as mark-selective fisheries are implemented to achieve escapement goals of 5,700 (minimum) and 7,300 (Washington Recovery Plan goal)	X	X		X
2. Implement alternative gear project for lower Columbia River commercial fishery				X

3. Incrementally implement mark-selective fisheries: Ocean Sport, Ocean Troll, Columbia River sport, Buoy 10 Sport				X
4. Implement mark-selective fall Chinook sport fishery in Lewis and North Fork Lewis rivers to reduce hatchery fish on natural spawning areas	X	X		X

CSF Plan Actions for Lewis River Late Fall (Bright) Chinook

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- No hatchery Chinook are released in the basin **(Hatchery Action 1,2)**.
- WDFW and LCFRB participate on the ACC and is a partner in implementing the re-introduction plans for the Lewis basin **(Hatchery Action 5)**.
- Harvest in ocean, Columbia River and Lewis River is managed to meet the escapement goal of 5,700 fish in the North Fork Lewis River **(Harvest Action 1)**.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 2)**.
- Mark-selective sport fisheries have occurred in recent years in the ocean and lower Columbia River for selected time frames **(Harvest Action 3)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since about 2011 **(Harvest Action 4)**.

Spring Chinook Populations

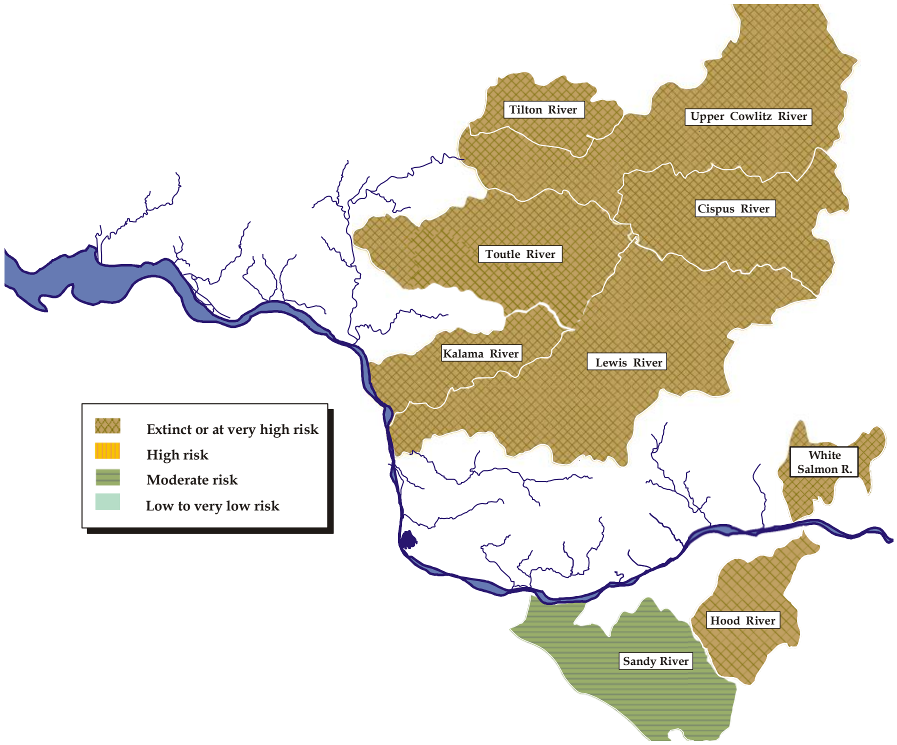


Figure 7-3. Distribution of historical spring Chinook populations among lower Columbia River subbasins (LCFRB, 2010).

Spring Chinook Populations and Recovery Plan Designations[28]	
Cascade Stratum	***Population Designation***
Tilton	Stabilizing
Cowlitz (upper)	Primary
Cispus	Primary
Toutle	Contributing
Kalama	Contributing
Lewis NF	Primary
Sandy	Primary

Tilton Spring Chinook

ESA Listing Status: Threatened Population Designation: Stabilizing

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	Very Low
Escapement	Natural Origin Fish	5,400	<100	NA

[28] Populations that are shaded are Washington populations that are addressed in this document

Gene Flow (pHOS or PNI)			0.50	0.50
Fitness			unknown	TBD
Harvest Rate	Hatchery Origin Fish		50%	NA
	Natural Origin Fish		50%	50%

HATCHERY RELEASE AND NATURAL ESCAPEMENT DATA

Hatchery Release Data:

- Historically no releases (juveniles or adults) occurred in Tilton basin

Natural Escapement Data:

- Escapement estimates are zero annually because all surplus adults are transported and released in the upper Cowlitz and Cispus basins due high priority of reintrodcution efforts in these basins

Integrated Hatchery Program:

- Data not available because no spring Chinook hatchery program is currently releasing smolts into Tilton basin

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- No natural population exist due to blockage of habitat by one dam on the mainstem Cowlitz River
- Baseline harvest rates exceeded population productivity

Potential Hatchery and Harvest Reform Actions: Tilton Spring Chinook	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. None planned, population currently meeting recovery goals				
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce harvest rate on natural origin fish	X	X		X
2. Increase harvest rate on hatchery origin fish		X		X

CSF Plan Actions for Tilton Spring Chinook

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since about 2001 **(Harvest Action 1,2)**.

Upper Cowlitz and Cispus Spring Chinook

<u>ESA Listing Status</u>:
Upper Cowlitz-Threatened
Cispus-Threatened

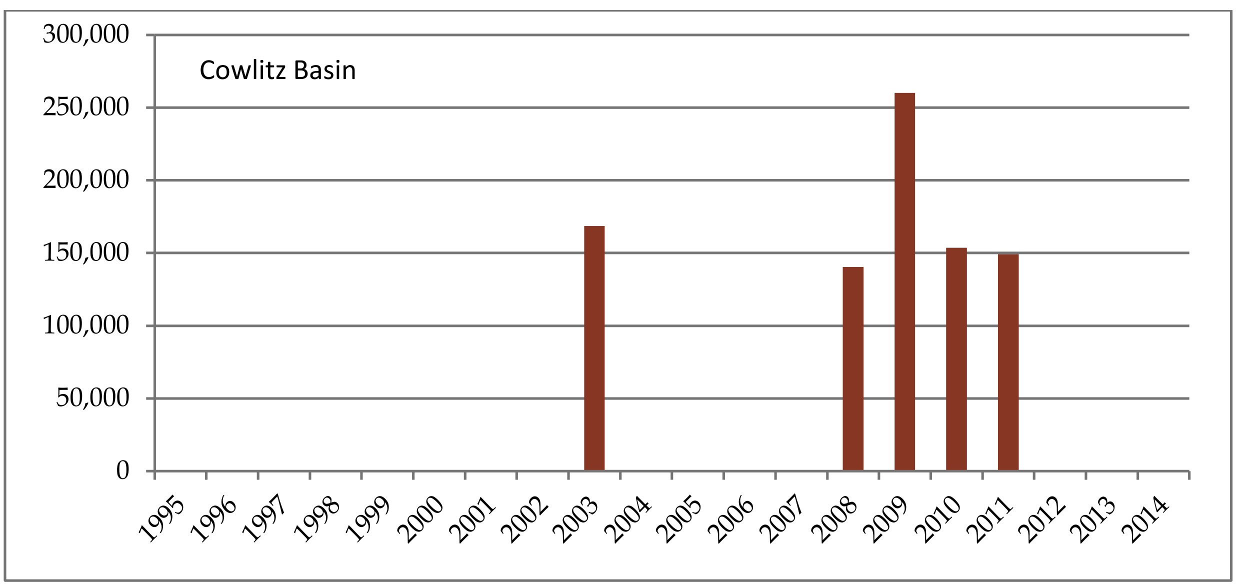
<u>Population Status</u>:
Upper Cowlitz-Primary
Cispus-Primary

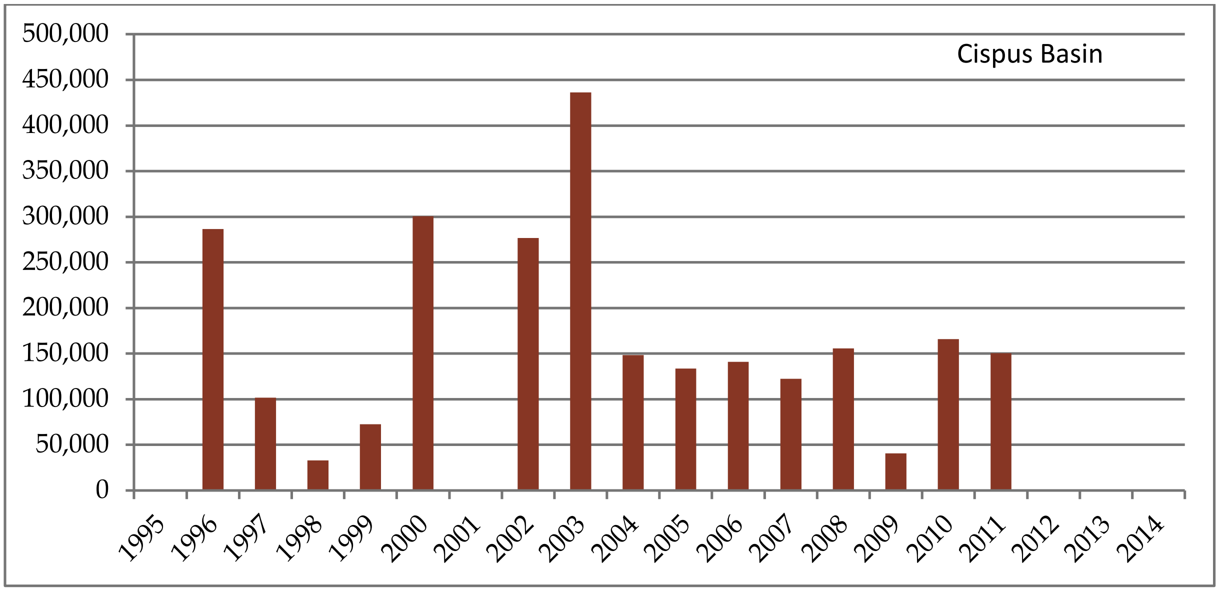
Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low Very Low	High+ High+
Escapement	Natural Origin Fish	22,000 (UC) 7,800 (Cis)	300 300	1,800 1,800
Gene Flow (pHOS or PNI)			PNI 0.0 PNI 0.0	PNI >0.67 PNI>0.67
Fitness			0.50 0.50	0.75 0.75
Harvest Rate	Hatchery Origin Fish		50% 50%	NA NA
	Natural Origin Fish		50% 50%	25% 25%

HATCHERY RELEASE AND NATURAL ESCAPEMENT DATA

Hatchery Release Data:

- Graph below displays number of spring Chinook smolts released in Upper Cowlitz basin since 1995
- Graph below displays number of spring Chinook smolts released in Cispus basin since 1995
- Reintroduction efforts are underway using only adult (hatchery and natural origin) supplementation
- Surplus hatchery adults have been transported and released upstream of Cowlitz Falls Dam since 1997
- Success of reintroduction effort in Upper Cowlitz and Cispus basins to be determined by effectiveness of juvenile fish collection efforts at or near Cowlitz Falls Dam





Natural Escapement Data:

- Tables below provide number of spring Chinook returning to natural spawning areas (includes both natural and hatchery origin fish) in Upper Cowlitz and Cispus basins

Cowlitz River Spring Chinook Transported and Released Upstream of Cowlitz Falls Dam*					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	8,531	2,324	4,806	2,897	4,640
Percent Hatchery Spawners (pHOS)	97%	95%	94%	89%	94%

*Estimates based on the number of fish collected at the Cowlitz Salmon Hatchery separator and transported and released upstream of Cowlitz Falls Dam; therfore, does not account for harvest or pre-spawning mortality and is not an estimate of the actual number of spawners in the upper Cowlitz and Cispus basins

Integrated Hatchery Program:

- Data not available because no spring Chinook hatchery program is currently releasing smolts into Upper Cowlitz and Cispus basins

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- No natural population exist due to blockage of habitat by 3 dams on the mainstem Cowlitz River
- Baseline harvest rates exceeded population productivity

Potential Hatchery and Harvest Reform Actions: Upper Cowlitz and Cispus Spring Chinook	**Viable Salmonid Population (VSP) Parameters Addressed**			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Manage current hatchery program to provide fish for reintroduction efforts and support fisheries through implementation of the Fisheries and Hatchery Management Plan Update	X	X	X	X
2. Release surplus hatchery fish into upper Cowlitz to continue reintroduction effort	X	X	X	X
3. Continue to work to increase juvenile fish collection at Cowlitz Falls Dam and potentially in upper Riffe Lake	X	X		X

4. Manage adult releases to achieve HSRG standards when juvenile fish collection rates reach 60%	X	X	X	X
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce harvest rate while populations rebuilding	X			X
2. Continue mark-selective fishery strategy for Columbia River sport and commercial fisheries				X
3. Maintain mark-selective sport fishery in Cowlitz River		X		X
4. Increase the harvest of hatchery fish		X		X
5. Implement mark-selective sport fishery in upper Cowlitz basin to assist in reestablishing population that is adapted to the upper Cowlitz basin	X	X		X

CSF Plan Actions for Upper Cowlitz and Cispus Spring Chinook

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Manage in-river fisheries to meet the on-station hatchery broodstock goal. Maintaining hatchery broodstock for the Cowlitz River is essential for implementation of recovery actions to ensure the genetic legacy is preserved **(Hatchery Action 1)**.
- The current hatchery program is managed to provide up to 8,000 NOR and HOR spring Chinook to the upper basin when available. All NORs are transported and released upstream of Cowlitz Fall Dam. These efforts are meant to recolonize the upper basin with spring Chinook **(Hatchery Action 1, 2).**
- Design has been completed for a new collector at Cowlitz Falls Dam. Construction of a new collector is expected to be completed in 2017. Testing for an additional collector just downstream of Cowlitz Falls Dam is underway **(Hatchery Action 3)**.
- Once collection efficiency at Cowlitz Falls Dam exceeds 60% on a five-year average, the program will be converted to an integrated program. Only integrated hatchery fish will be put into the upper basin **(Hatchery Action 1,4)**.
- WDFW are active participants in the Cowlitz Fish Technical Committee (FTC) which is involved in implementing the FHMP, with regards to re-introduction efforts in the upper Cowlitz basin **(Hatchery Action 3,4).**
- Mark-selective sport fisheries have occurred since 2001 in the lower Columbia River **(Harvest Action 2, 4)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since 2001 **(Harvest Action 3, 4)**.
- Mark-selective sport fisheries are on-going in the upper Cowlitz basin **(Harvest Action 4,5)**.

Toutle Spring Chinook

- The Lower Columbia Recovery Plan combined North Fork Toutle and South Fork Toutle into a single population

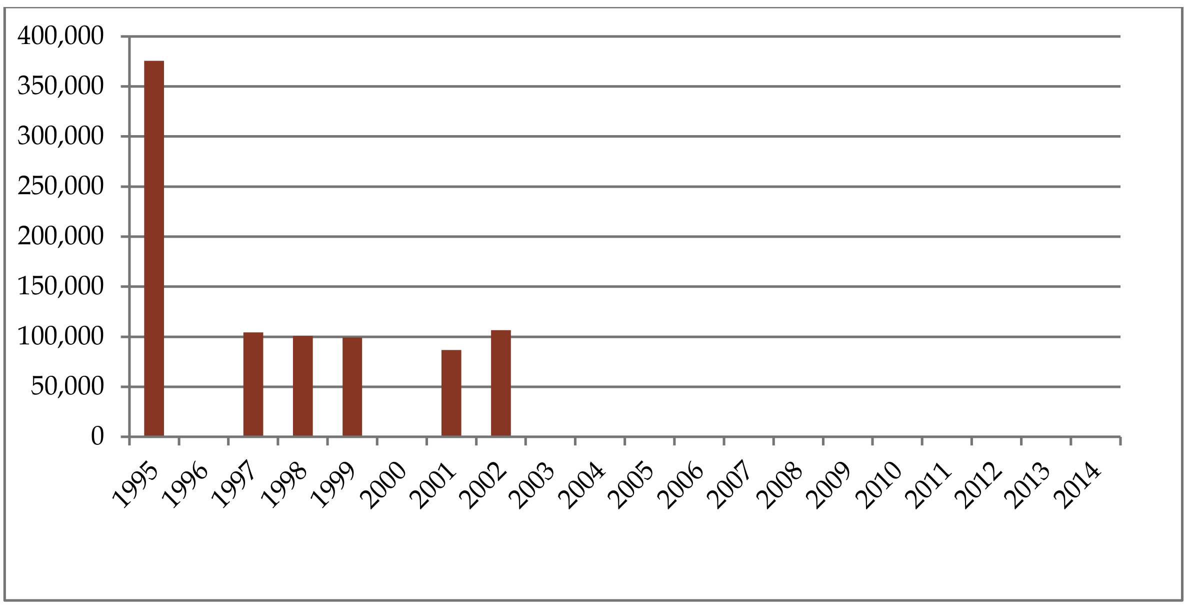
ESA Listing Status: Threatened Population Designation: Contributing

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	Medium
Escapement	Natural Origin Fish	3,100	100	1,100
Gene Flow (pHOS or PNI)			pHOS >20%	pHOS <10%
Fitness			0.50	0.75
Harvest Rate	Hatchery Origin Fish		50%	NA
	Natural Origin Fish		50%	25%

HATCHERY RELEASE AND NATURAL ESCAPEMENT DATA

Hatchery Release Data:

- Graph below displays number of spring Chinook smolts released in Toutle basin since 1995



Natural Escapement Data:

- No spring Chinook spawning ground surveys are conducted in Toutle basin
- No spring Chinook spawning are transported and released upstream of Sediment Retention Structure in the North Fork Toutle basin

Integrated Hatchery Program:

- Data not available because no spring Chinook hatchery program is currently releasing smolts into Toutle basin

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Only sporadic hatchery releases have occurred since the eruption of Mt. St. Helens (1980)
- Current status of population unknown – population is believed to be non-existent at this time
- Baseline harvest rates exceeded population productivity

Potential Hatchery and Harvest Reform Actions: Toutle Spring Chinook	Viable Salmon Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Evaluate need for conservation or reintroduction program	X	X	X	X
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce harvest rate on natural origin spring Chinook	X	X		X
2. Increase harvest rate on hatchery origin spring Chinook		X		X

CSF Plan Actions for Toutle Spring Chinook

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- There are currently no plans to introduce spring Chinook into this system.
- Mark-selective sport fisheries have occurred since 2001 in the lower Columbia River **(Harvest Action 1,2)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since 2001 **(Harvest Action 1,2)**.

Kalama Spring Chinook

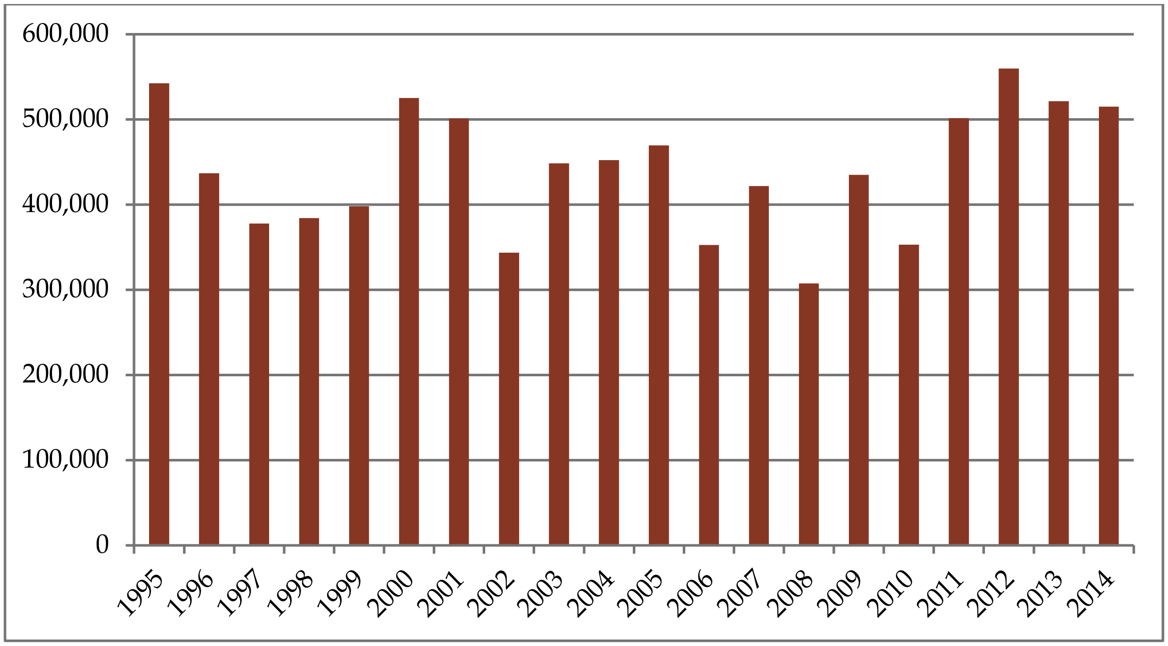
ESA Listing Status: Threatened Population Designation: Contributing

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	Low
Escapement	Natural Origin Fish	4,900	100	300
Gene Flow (pHOS or PNI)			pHOS >50%	pHOS <10%
Fitness			0.50	0.75
Harvest Rate	Hatchery Origin Fish		50%	NA
	Natural Origin Fish		50%	25%

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Graph below displays number of spring Chinook smolts released in Kalama basin downstream of Kalama Falls Hatchery since 1995
- Historically no releases occurred upstream of Kalama Falls Hatchery



Natural Escapement Data:

- Tables below provide number of spring Chinook returning to natural spawning areas (includes both natural and hatchery origin fish) in Kalama basin
- No hatchery spring Chinook are transported and released upstream of Kalama Falls Hatchery

Spring Chinook Escapement Estimates for the Kalama Basin Below Kalama Falls Hatchery					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	0	26	21	155	51
Percent Hatchery Spawners (pHOS)	NA	100%	100%	97%	99%

Spring Chinook Escapement Estimates for the Kalama Basin Above Kalama Falls Hatchery					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	60	171	80	79	98
Percent Hatchery Spawners (pHOS)	0%	0%	0%	0%	0%

Spring Chinook Escapement Estimates for the Entire Kalama Basin					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	60	191	101	234	147
Percent Hatchery Spawners (pHOS)	0%	14%	21%	65%	25%

Integrated Hatchery Program:

- Data not available because spring Chinook program in Kalama basin is being operated as a segregated program

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Hatchery strays from within Kalama basin
- Fitness of fish significantly impacted by historic straying
- Baseline harvest rate exceeded population productivity
- Reduction in genetic diversity within the ESU is likely due to past transfers of eggs and/or fish between watersheds to make up for hatchery shortfall

Potential Hatchery and Harvest Reform Actions: Kalama Spring Chinook	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Manage Kalama Falls hatchery broodstock consistent with HSRG standards for a contributing population (implement segregated broodstock program)	X	X	X	X
2. Establish upper Kalama (above Kalama Falls) as a refuge for wild spring Chinook	X	X	X	X
3. Eliminate transportation of hatchery fish to upper Kalama (above Kalama Falls), except as needed to reduce demographic risks	X	X	X	X
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce harvest rate on natural population	X	X		X
2. Increase the harvest of hatchery fish		X		X
3. Continue mark-selective fishery strategy for Columbia River sport and commercial fisheries				X
4. Maintain mark-selective sport fishery in Kalama River		X		X

CSF Plan Actions for Kalama Spring Chinook

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Manage in-river fisheries to meet the hatchery escapement goal. **(Hatchery Action 1)**.
- This is a segregated program **(Hatchery Action 1**).
- Recovery efforts are focused above Kalama Falls Hatchery **(Hatchery Action 1-3).**
- Only natural origin fish are transported and released upstream Kalama Falls Hatchery **(Hatchery Action 2).**
- Mark-selective sport fisheries are the norm for spring Chinook in the lower Columbia River and tributaries **(Harvest Action 1-4)**.

North Fork Lewis Spring Chinook

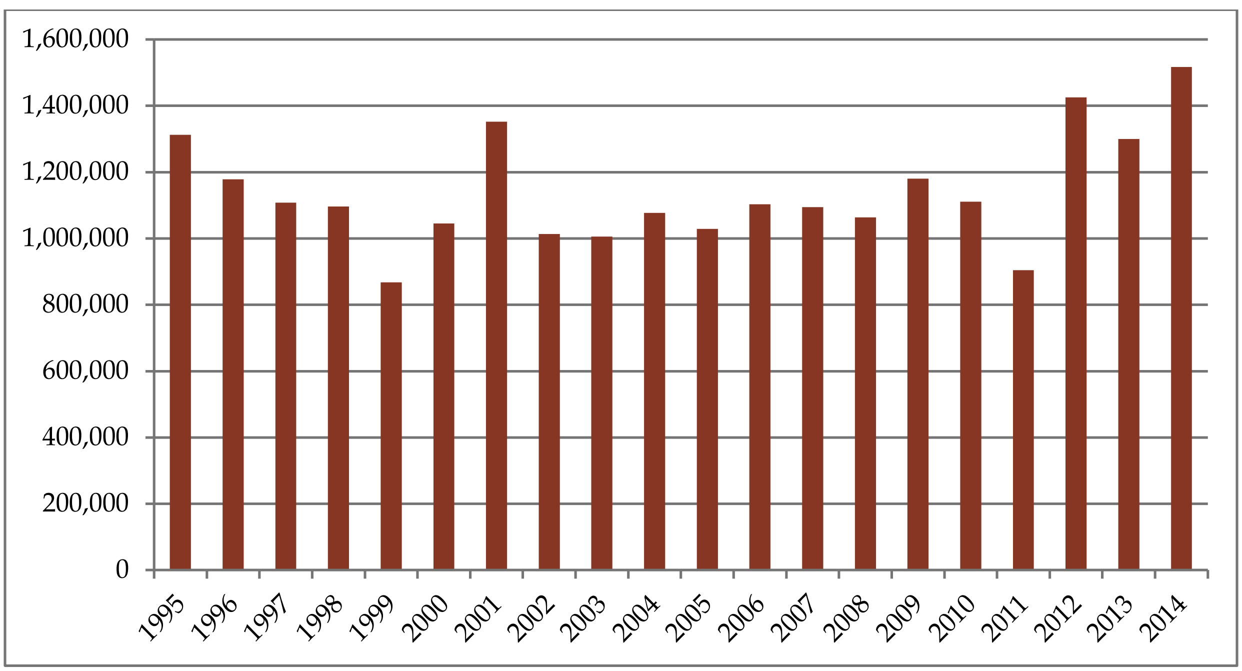
ESA Listing Status: Threatened   Population Designation: Primary

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	High
Escapement	Natural Origin Fish	15,700	300	1,500
Gene Flow (pHOS or PNI)			PNI 0.10	PNI >0.67
Fitness			0.50	0.75
Harvest Rate	Hatchery Origin Fish		50%	NA
	Natural Origin Fish		50%	25%

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Graph below displays number of spring Chinook smolts released in North Fork Lewis basin since 1995
- Reintroduction efforts are underway using only adult (hatchery and natural origin) and supplementation
- Surplus hatchery adults have been transported and released upstream of Swift Dam since 2013
- Success of reintroduction effort in upper Lewis basin to be determined by effectiveness of juvenile fish collection efforts at Swift Dam



Natural Escapement Data:

- Tables below provide number of spring Chinook returning to natural spawning areas (includes both natural and hatchery origin fish) in Lewis basin

Spring Chinook Escapement Estimates for the North Fork Lewis Basin Below Merwin Dam*					
	2010	2011	2012	2013	Average
Total Escapement to Natural Spawning Areas	157	90	190	60	124
Percent Hatchery Spawners (pHOS)	67%	50%	98%	97%	78%

*Reintroduction is focused on the upper basin (above Merwin Dam)

Integrated Hatchery Program:

- Data not available because spring Chinook reintroduction program for upper Lewis basin was initiated in 2013

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Most habitat blocked by 3 dams on the mainstem North Fork Lewis River
- Reintroduction efforts initiated when juvenile fish passage became available December 2012
- Baseline harvest rates exceeded population productivity

Potential Hatchery and Harvest Reform Actions: North Fork Lewis Spring Chinook	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Implement reintroduction of spring Chinook into upper watershed when juvenile collection facilities are available (December 2012)	X	X	X	X
2. Fish passage protocols and reintroduction efforts guided by Aquatic Coordinating Committee	X	X	X	X
3. Maintain current hatchery program to provide fish for reintroduction efforts and support fisheries	X	X	X	X
4. Transfer all steelhead to lower river for release to reduce risk of predation on juvenile spring Chinook	X	X		
5. Review all hatchery program production levels through Aquatic Coordinating Committee as natural populations are reestablished in the upper North Fork Lewis basin	X	X	X	X
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce harvest rate on natural origin spring Chinook	X			X
2. Increase the harvest of hatchery origin spring Chinook		X		X
3. Continue mark-selective fishery strategy for Columbia River sport and commercial fisheries				X
4. Maintain mark-selective sport fishery in North Fork Lewis River		X		X

CSF Plan Actions for North Fork Lewis Spring Chinook

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Manage in-river fisheries to meet the hatchery escapement goal. Maintaining hatchery broodstock for the Lewis River is essential for implementation of recovery actions to ensure the genetic legacy is preserved **(Hatchery Action 3)**.
- The Lewis River Hatchery and Supplementation Plan (H&S Plan) calls for the following actions **(Hatchery Action 1,2,5)**:
    - The reintroduction strategy for spring Chinook will rely on two life stages: smolts and adults. A total of 100,000 smolts and a minimum of 2,000 hatchery adults (when available) will be released above Swift Reservoir to rebuild a natural spawning population. The reintroduction strategy will be conducted as a 15-year program that will continue throughout this period with no trigger points that would discontinue the program prior to its completion.
    - This supplementation program will initially use hatchery origin adults (HORs) for both the smolt and adult supplementation strategies. After adults begin returning from the natural or supplemented releases, hatchery origin fish would only be used in the event that the number of fish produced above Swift are insufficient to meet the desired release numbers.
    - Priority for the use of natural-origin returns will be as follows:
        - For use as broodstock for juvenile supplementation program: Up to 65 adults.
        - Use for adult supplementation into the upper watershed: All NOR's above juvenile supplementation needs (65 adults).
    - Natural origin returns (NOR) will not be incorporated into the broodstock for the existing spring Chinook segregated harvest program for the duration of the re-introduction program. At the completion of the 15 years and evaluation of stock sustainability, a decision will be made whether or not to modify the current segregated harvest program into an integrated program.
- The hatchery escapement goal is a high priority to provide fish for future lower river program and to support reintroduction efforts in the upper basin **(Hatchery Action 3).**
- All hatchery steelhead are released in the lower Lewis River near the mouth of the river **(Hatchery Action 4)**.
- WDFW and LCFRB staff will remain active participants in the Aquatics Coordination Committee (ACC) **(Hatchery Action 5).**
- Mark-selective sport fisheries have occurred since 2001 in the lower Columbia River **(Harvest Action 1-3).**
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since 2001 **(Harvest Action 1,2,4)**.

Coho Populations

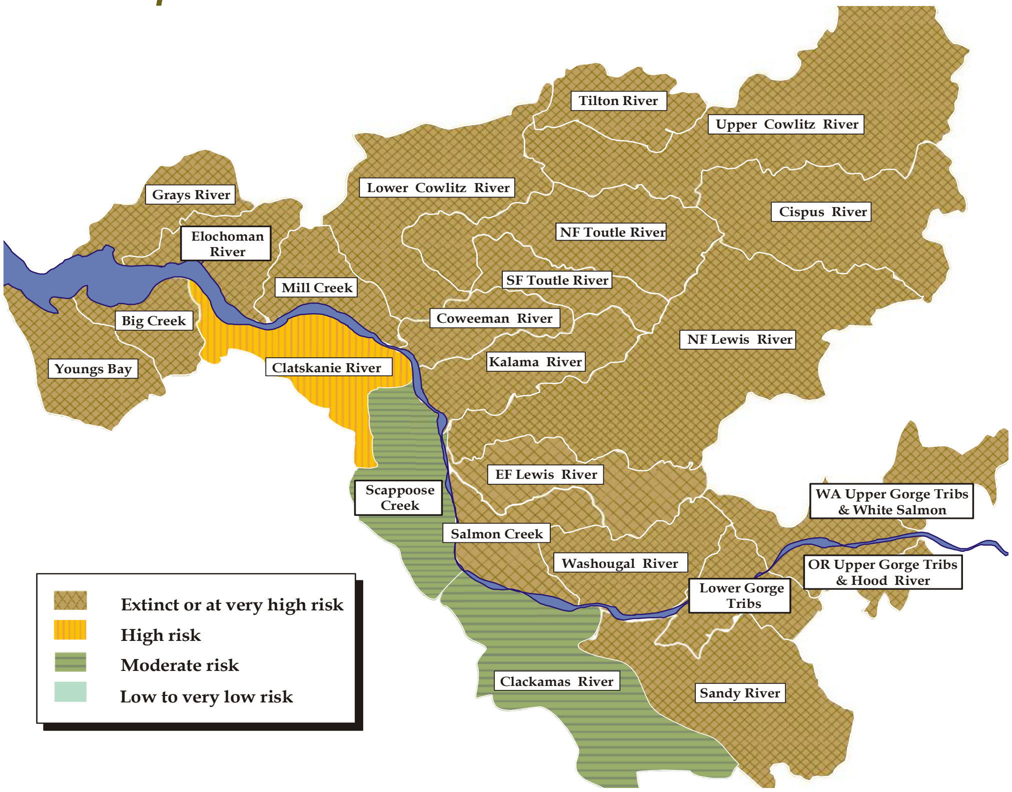


Figure 7-4. Current status of historical demographically-independent lower Columbia River coho populations.

Coho Populations and Recovery Plan Designations[29]			
Coast Stratum	***Population Designation***	***Cascade Stratum***	***Population Designation***
Youngs Bay	Stabilizing	Cowlitz (lower)	Primary
Big Creek	Stabilizing	Tilton	Stabilizing
Grays/Chinook River	Primary	Cowlitz (upper)	Primary
Elochoman/Skamokawa	Primary	Cispus	Primary
Mill/Abernathy/Germany	Contributing	Toutle NF	Primary
Clatskanie	Primary	Toutle SF	Primary
Scappoose	Primary	Coweeman	Primary
		Kalama	Contributing
		Lewis NF	Contributing
		Lewis EF	Primary
		Salmon	Stabilizing
		Washougal	Contributing
		Clackamas	Primary
		Sandy	Primary

[29] Populations that are shaded are Washington populations that are addressed in this document

Grays/Chinook Coho

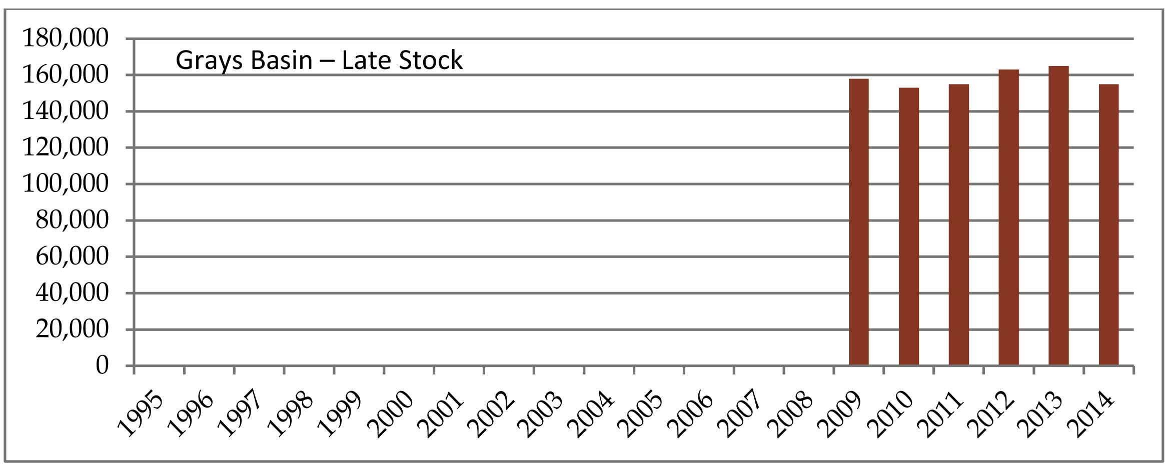
ESA Listing Status: Threatened Population Designation: Primary

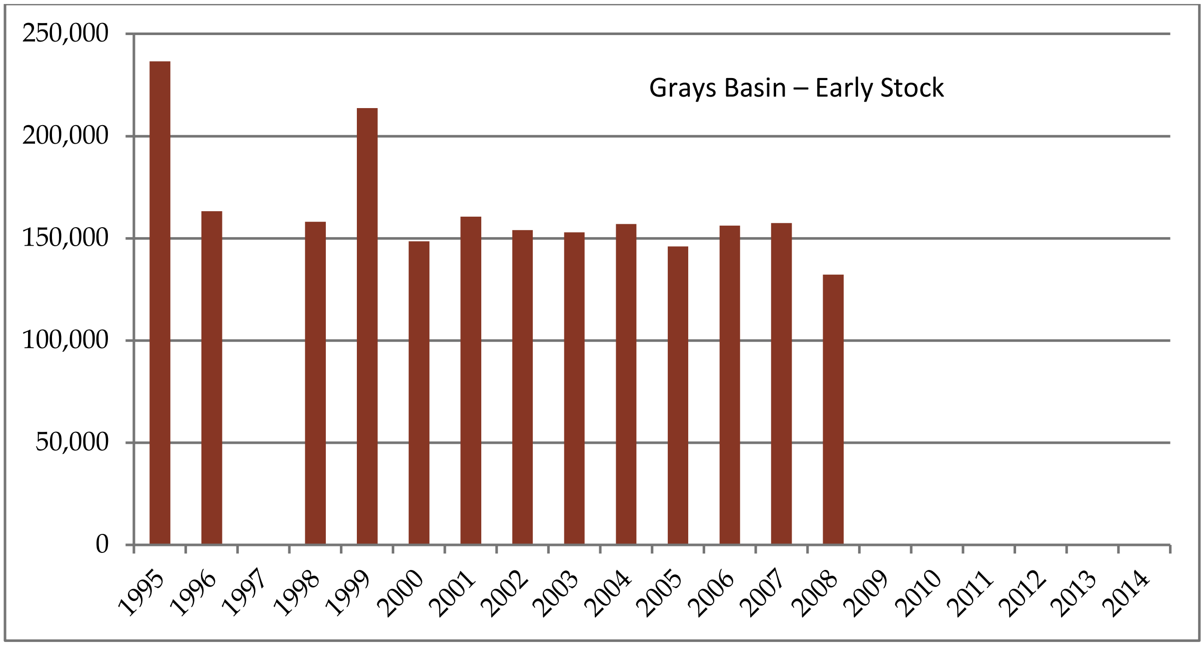
Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	High
Escapement	Natural Origin Fish	3,800	<50	2,400
Gene Flow (pHOS or PNI)			PNI <0.1	PNI >0.67
Fitness			0.50	0.71
Harvest Rate	Hatchery Origin Fish		50%	NA
	Natural Origin Fish		50%	29%

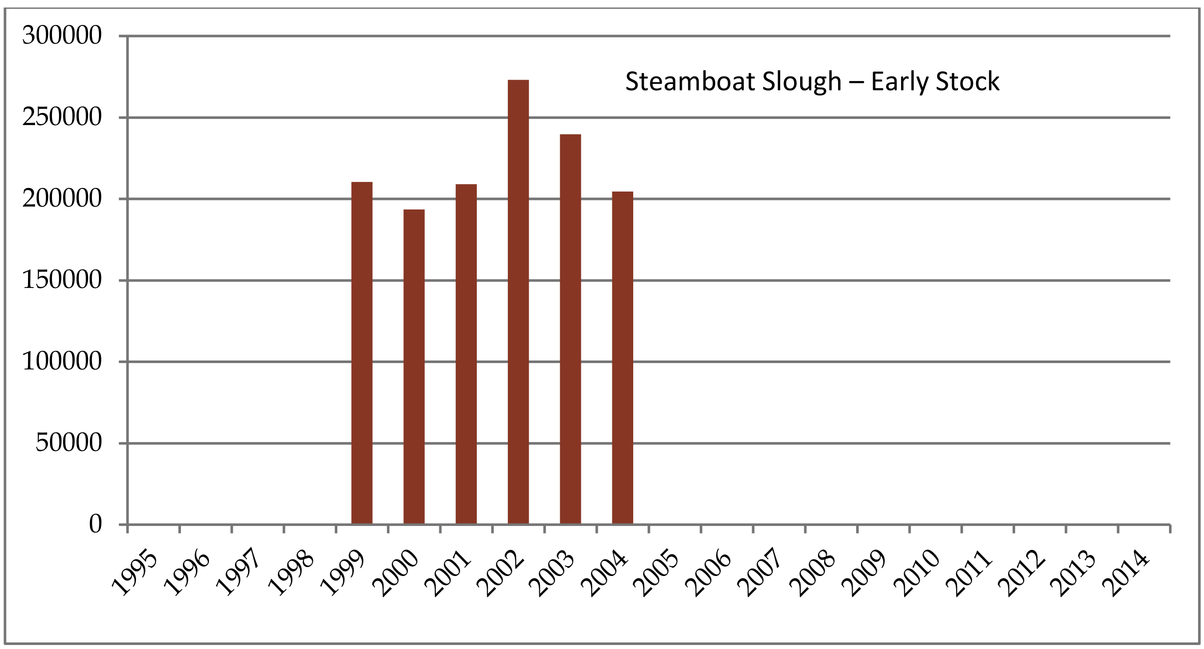
Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Graph below displays number of late stock coho smolts released in Grays basin since 1995
- Graph below displays number of early stock coho smolts released in Grays basin since 1995
- Graph below displays number of early stock coho smolts released in Steamboat Slough since 1995
- No releases occurred in Chinook basin since the late 1990's







Natural Escapement Data:

- Tables below provide number of coho returning to natural spawning areas (includes both natural and hatchery origin fish) in Grays basin
- No coho spawning ground surveys are conducted in Chinook basin

Coho Escapement Estimates for Grays Basin				
	2010	2011	2012	Average
Total Escapement to Natural Spawning Areas	1,968	4,771	1,023	2,587
Percent Hatchery Spawners (pHOS)	81%	97%	22%	57%

Integrated Hatchery Program:

- Table below provides metrics for integrated late stock coho hatchery program in Grays basin

Integrated Hatchery Program Metrics for Grays Late Stock Coho			
Year	**pNOB***	**pHOS****	**PNI*****
2010	0.24	0.81	0.22
2011	0.00	0.97	0.00
2012	0.01	0.22	0.04
2013	0.09	NA	NA
Average	0.08	0.53	0.13

* Integrated program initiated in 2010 by using natural origin fish returning to Grays River Hatchery
** Annual pHOS estimated based on actual observations from spawning ground surveys (see escapement estimates above)
** Average (2010-2012) reduced by 20% to account for reduced productivity resulting from hatchery fish spawning in natural spawning locations
*** PNI calcuated using annual estimates for individual year and average estimates for muli-year average

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Hatchery strays from within the Grays basin – recently shifted from non-native early stock to native late stock
- Fitness of fish significantly impacted by historic straying
- Baseline harvest rate exceeded population productivty
- Reduction in genetic diversity within the ESU is likely due to past transfers of eggs and/or fish between watersheds to make up for hatchery shortfall

Potential Hatchery and Harvest Reform Actions: Grays/Chinook Coho	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Convert from Type S production to Type N production to reestablish historic run timing (integrated program consistent with HSRG standards))	X	X	X	X
2. Minimize hatchery releases (150,000) to establish a conservation hatchery program		X		X
3. Eliminate transfers of fish or eggs between watersheds with integrated programs		X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce harvest rate on natural origin fish	X	X		X
2. Increase the harvest of hatchery fish to control hatchery fish on natural spawning grounds (see next two bullets)				X
3. Continue mark-selective sport fisheries in ocean, Buoy 10 and mainstem Columbia River				X
4. Implement commercial fisheries in the lower Columbia River using alternative fishing gears and methods				X
5. Implement mark-selective sport fishery in Grays River to assist in reestablishing population that is adapted to the Grays basin	X	X		X

CSF Plan Actions for Grays/Chinook Coho

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- The entire broodstock source was converted from out-of-basin early stock source to late stock initially from Elochoman Hatchery **(Hatchery Action 1).**
- The current program is integrated and uses local broodstock returning to Grays River **(Hatchery Action 1).**
- The current program size is 150,000 late stock coho **(Hatchery Action 2).**
- No salmon are transferred from other watersheds **(Hatchery Action 3)**.
- WDFW is working on a plan to move this program to Beaver Creek Hatchery on the Elochoman River **(Hatchery Action 1).**
    - This would require a new river intake at Beaver Creek Hatchery –scheduled for completion in 2015.
    - Requires funding to re-open Beaver Creek to allow for rearing year round.
    - Staff is considering operating the Elochoman weir year round to remove potential strays for this program and other programs that may contribute to unacceptable levels of pHOS.
- AHA modeling results for Grays River late stock coho program of 150,000 smolts released at Beaver Creek shows pNOB of 31%, pHOS of 15% and PNI of 67% assuming a weir efficiency of 80% **(Harvest Action 1,2).** Effectiveness of this weir in meeting overall CSF Plan objectives is being evaluated.
- Harvest rate has been decreased from historical levels where these rates were as high as 95%. Coho ERs averaged 80% in the 1980s and 29% from 1990-2004. In 2005, coho were listed under the ESA and ERs have averaged 15% since the listing. A new abundance-based harvest rate matrix is expected to be adopted in 2015. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1,2).**
    - This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
    - This will result in additional hatchery fish removal from fisheries.
- Mark-selective sport fisheries have occurred for many years in the ocean and lower Columbia River **(Harvest Action 3)**.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 4)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since about 2001 **(Harvest Action 5)**.

Elochoman/Skamokawa Coho

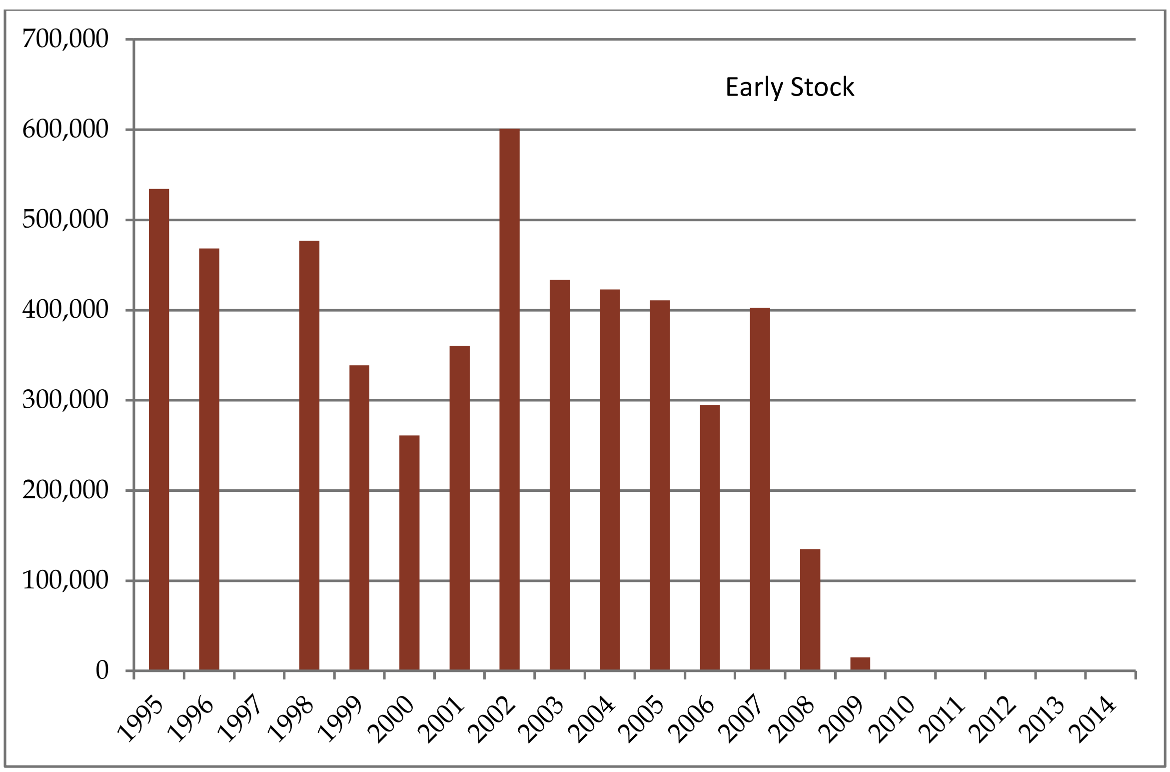
ESA Listing Status: Threatened Population Designation: Primary

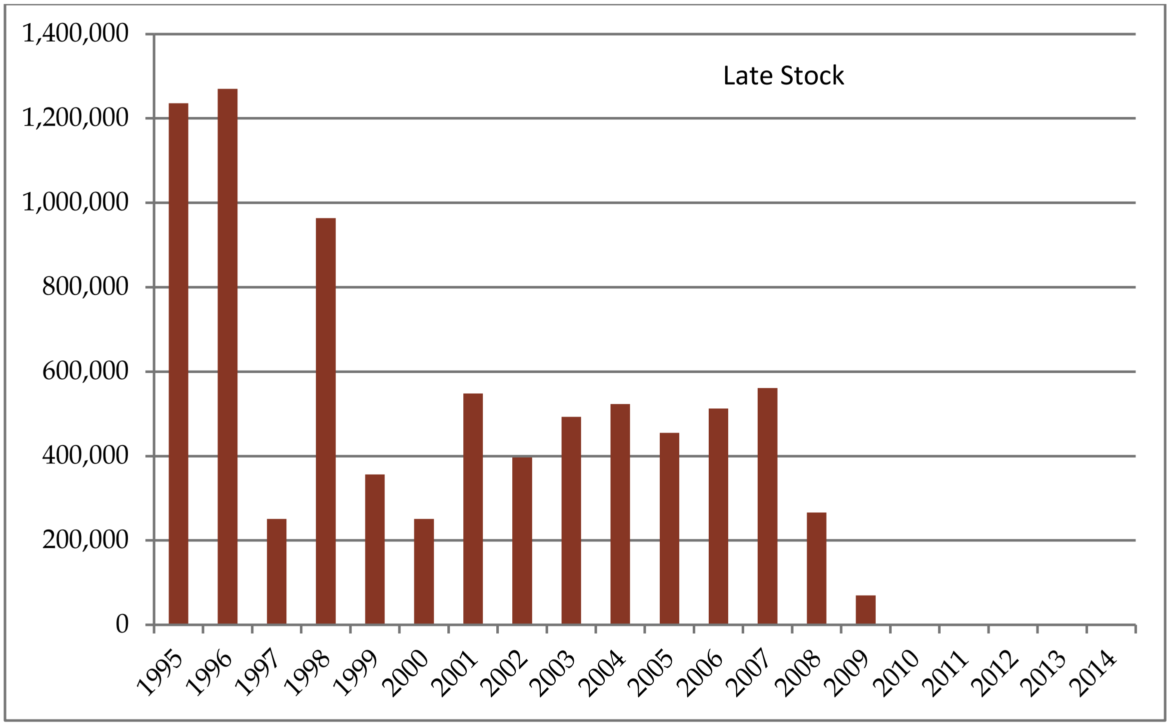
Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	High
Escapement	Natural Origin Fish	6,500	<50	2,400
Gene Flow (pHOS or PNI)			pHOS >50%	pHOS < 5%
Fitness			0.50	0.65
Harvest Rate	Hatchery Origin Fish		50%	NA
	Natural Origin Fish		50%	35%

HATCHERY RELEASE AND NATURAL ESCAPEMENT DATA

Hatchery Release Data:

- Graph below displays number of early stock coho smolts released in Elochoman basin since 1995
- Graph below displays number of late stock coho smolts released in Elochoman basin since 1995
- No releases occurred in Skamokawa basin since the late 1990's





Natural Escapement Data:

- Tables below provide number of coho returning to natural spawning areas (includes both natural and hatchery origin fish) in Elochoman/Skamokawa basin

Coho Escapement Estimates for the Elochoman and Skamokawa Basins				
	2010	2011	2012	Average
Total Escapement to Natural Spawning Areas	3,272	1,946	708	1,975
Percent Hatchery Spawners (pHOS)	73%	57%	29%	53%

Integrated Hatchery Program:

- Data not available because coho hatchery program was discontinued in 1998

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Hatchery strays from within Elochoman basin – recently discontinued coho hatchery program with non-native early stock genetics
- Fitness of fish significantly impacted by historic straying
- Baseline harvest rate exceeded population productivty
- Reduction in genetic diversity within the ESU is likely due to past transfers of eggs and/or fish between watersheds to make up for hatchery shortfall

Potential Hatchery and Harvest Reform Actions: Elochoman/Skamokawa Coho	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Close Elochoman Hatchery and eliminate all releases of hatchery coho in the Elochoman basin	X	X	X	X
2. Establish Elochoman basin as a refuge for wild coho	X	X	X	X
3. Annually operate temporary weir in lower Elochoman River to minimize impact of hatchery strays from early stock program		X		X
4. Investigate operating a temporary weir annually in lower Elochoman River to minimize impact of hatchery strays from late and early stock programs		X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce harvest rate on natural origin fish	X	X		X
2. Increase the harvest of hatchery fish to control hatchery fish on natural spawning grounds (see next two bullets)				X
3. Continue mark-selective sport fisheries in ocean, Buoy 10 and mainstem Columbia River				
4. Implement commercial fisheries in the lower Columbia River using alternative fishing gears and methods				X
5. Implement mark-selective sport fishery in Elochoman River to assist in reestablishing population that is adapted to the Elochoman basin	X	X		X

CSF Plan Actions for Elochoman/Skamokawa Coho

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reducedimpacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Hatchery releases were discontinued and Elochoman Hatchery closed in 2009 **(Hatchery Action 1,2)**.
- A weir is operated in the lower river to remove stray hatchery fish focusing on Chinook, but coho are removed during that time frame **(Hatchery Action 3,4).**
    - Staff is considering operating the Elochoman weir year round to remove potential strays for this program and other programs that may contribute to unacceptable levels of pHOS. Effectiveness of this weir in meeting overall CSF Plan objectives is being evaluated.
- The barrier at the former Elochoman Salmon Hatchery will be removed in 2016.
- The hatchery intake ladder was modified at Beaver Creek Hatchery to meet NMFS standards for fish passage.
- Harvest rate has been decreased from historical levels where these rates were as high as 95%. Coho ERs averaged 80% in the 1980s and 29% from 1990-2004. In 2005, coho were listed under the ESA and ERs have averaged 15% since the listing. A new

abundance-based harvest rate matrix is expected to be adopted in 2015. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1,2).**

  - This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
  - This will result in additional hatchery fish removal from fisheries.

- Mark-selective sport fisheries have occurred for many years in the ocean and lower Columbia River **(Harvest Action 3)**.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 4)**.
- Mark-selective sport fisheries have been in place in lower Columbia River tributaries since about 2001 **(Harvest Action 5)**.

Mill/Abernathy/Germany (MAG) Creeks Coho

ESA Listing Status: Threatened		Population Designation: Contributing

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	Medium
Escapement	Natural Origin Fish	2,800	<50	1,800
Gene Flow (pHOS or PNI)			pHOS <5%	pHOS <10%
Fitness			0.50	0.90
Harvest Rate	Hatchery Origin Fish		50%	NA
	Natural Origin Fish		50%	25%

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- No releases occurred in Mill Creek, Abernathy Creek or Germany Creek basins since the late 1990's

Natural Escapement Data:

- Tables below provide number of coho returning to natural spawning areas (includes both natural and hatchery origin fish) in Mill/Abernathy/Germany basin

Coho Escapement Estimates for Mill, Abernathy and Germany Creeks				
	2010	2011	2012	Average
Total Escapement to Natural Spawning Areas	1,903	1,022	595	1,173
Percent Hatchery Spawners (pHOS)	12%	21%	2%	12%

Integrated Hatchery Program:

- Data not available because no coho hatchery program is currently releasing smolts into Mill/Abernathy/Germany basin

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- No hatchery program within wateshed
- Fitness of fish impacted by historic straying
- Baseline harvest rate exceeded population productivity

Potential Hatchery and Harvest Reform Actions: Mil/Abernathy/Germany (MAG) Creeks Coho	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Establish Mill/Abernathy/Germany basin as a sanctuary for wild coho	X	X	X	X
2. No hatchery coho will be released in Mill, Abernathy or Germany creeks to improve productivity of natural origin population		X	X	X
3. Continue to monitor level of hatchery strays as production is reduced in other watershed, make additional adjustments as needed		X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce harvest rate on natural origin fish	X	X		X
2. Increase the harvest of hatchery fish to control hatchery fish on natural spawning grounds (see next two bullets)				X
3. Continue mark-selective sport fisheries in Buoy 10 and mainstem Columbia River				X
4. Implement commercial fisheries in the lower Columbia River using alternative fishing gears and methods				X
5. Implement mark-selective sport fishery in Mill/Abernathy/Germany rivers to assist in reestablishing population that is adapted to the Mill/Abernathy/Germany Basin	X	X		X

CSF Plan Actions for Mill/Abernathy/Germany (MAG) Creeks Coho

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Hatchery coho are not released in these tributaries **(Hatchery Action 1,2)**.
- Harvest rate has been decreased from historical levels where these rates were as high as 95%. Coho ERs averaged 80% in the 1980s and 29% from 1990-2004. In 2005, coho were listed under the ESA and ERs have averaged 15% since the listing. A new

abundance-based harvest rate matrix is expected to be adopted in 2015. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1,2).**

  - This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
  - This will result in additional hatchery fish removal from fisheries.

- Mark-selective sport fisheries have occurred for many years in the ocean and lower Columbia River **(Harvest Action 3)**.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 4)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since about 2001 **(Harvest Action 5)**.

Lower Cowlitz Coho

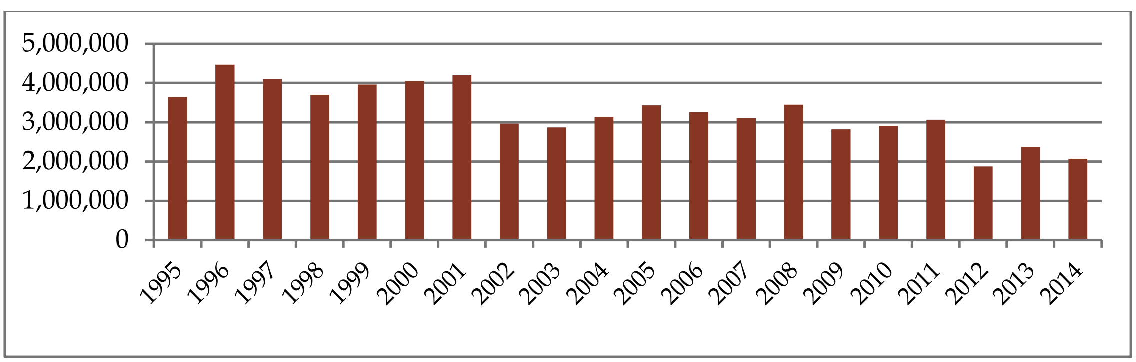
ESA Listing Status: Threatened Population Designation: Primary

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	High
Escapement	Natural Origin Fish	18,000	500	3,700
Gene Flow (pHOS or PNI)			pHOS >50%	pHOS <5%
Fitness			0.50	0.55
Harvest Rate	Hatchery Origin Fish		50%	NA
	Natural Origin Fish		50%	42%

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Graph below displays number of late stock coho smolts released in Lower Cowlitz basin since 1995



Natural Escapement Data:

- Tables below provide number of coho returning to natural spawning areas (includes both natural and hatchery origin fish) in Lower Cowlitz basin

Coho Escapement Estimates for Lower Cowlitz Basin*				
	2010	2011	2012	Average
Total Escapement to Natural Spawning Areas	7,106	3,706	NA	5,406
Percent Hatchery Spawners (pHOS)	15%	8%	NA	12%

***Tributary estimates only – does not include mainstem Cowlitz

Integrated Hatchery Program:

- Table below provides metrics for integrated late coho hatchery program in Lower Cowlitz basin

Segregated Hatchery Program Metrics for Lower Cowlitz Late Stock Coho			
Year	**pNOB***	**pHOS****	**PNI***
2010	NA	0.15	NA
2011	NA	0.08	NA
2012	NA	NA	NA
2013	NA	NA	NA
Average	NA	0.09	NA

* Estimates for pNOB and PNI Not Available (NA) because this is a segregated program
** Annual pHOS estimated based on actual observations from spawning ground surveys (see escapement estimates above)
** Average (2010-2011) reduced by 20% to account for reduced productivity resulting from hatchery fish spawning in natural spawning locations

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Hatchery strays from within Lower Cowlitz basin – hatchery coho with native late stock genetics
- Fitness of fish significantly impacted by historic straying
- Baseline harvest rate exceeded population productivty

Potential Hatchery and Harvest Reform Actions: Lower Cowlitz Coho	**Viable Salmonid Population (VSP) Parameters Addressed**			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Eliminate transfers of fish or eggs from other watersheds		X		X
2. Manage hatchery production program to achieve recovery goals and support Ocean and Columbia Basin fisheries through implementation of the Cowlitz River Fisheries and Hatchery Management Plan Update		X		X
3. Implement segregated coho program consistent with HSRG standards (up to 2.0 million)	X	X	X	X
4. Reduce on-station release from 1,800,000 to 1,200,000 annually	X	X	X	X
5. Annually evaluate program and escapement data and adjust program size to meet HSRG standards as per Fisheries and Hatchery Management Plan Update	X	X	X	X
Harvest Actions	**A**	**P**	**S**	**D**

1. Reduce harvest rate on natural origin fish	X	X		X
2. Increase the harvest of hatchery fish to control hatchery fish on natural spawning grounds (see next two bullets)				X
3. Continue mark-selective sport fisheries in ocean, Buoy 10 and mainstem Columbia River				X
4. Implement commercial fisheries in the lower Columbia River using alternative fishing gears and methods				X
5. Implement mark-selective sport fishery in lower Cowlitz River to assist in reestablishing population that is adapted to the lower Cowlitz basin	X	X		X

CSF Plan Actions for Lower Cowlitz Coho

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- No salmon are transferred from other watersheds **(Hatchery Action 1)**.
- This program is operated as a stepping stone progarm with the current lower river program size of 1.2 million segregated and a 1.0 million integrated upper Cowlitz/Cispus program. Returns from integrated program are transported and released upstream of Cowlitz Falls Dam **(Hatchery Action 2-5).**
- The program size is reviewed annually to ensure consistency with HSRG standards **(Hatchery Action 5)**.
- Hatchery coho will be removed at the lower Cowlitz tributary weirs, beginning in 2015.
- Begin discussions with enhancement groups about eliminating or reducing the Remote Site Incubator (RSI) programs in 2015.
- Harvest rate has been decreased from historical levels where these rates were as high as 95%. Coho ERs averaged 80% in the 1980s and 29% from 1990-2004. In 2005, coho were listed under the ESA and ERs have averaged 15% since the listing. A new abundance-based harvest rate matrix is expected to be adopted in 2015. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1,2)**.
    - This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
    - This will result in additional hatchery fish removal from fisheries.
- Mark-selective sport fisheries have occurred for many years in the ocean and lower Columbia River **(Harvest Action 3)**.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 4)**.

- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since about 2001 (**Harvest Action 5)**.

Tilton Coho

ESA Listing Status: Threatened   Population Designation: Stabilizing

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	Very Low
Escapement	Natural Origin Fish	5,600	<50	unknown
Gene Flow (pHOS or PNI)			pHOS >50%	pHOS current
Fitness			0.50	0.50
Harvest Rate	Hatchery Origin Fish		50%	NA
	Natural Origin Fish		50%	50%

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Reintroduction efforts are underway using only adult (hatchery and natural origin) supplementation
- Surplus hatchery adults have been transported and released in the Tilton Basin since 1996

Natural Escapement Data:

- Tables below provide number of coho returning to natural spawning areas (includes both natural and hatchery origin fish) in Tilton basin

Coho Escapement Estimates for Tilton Basin				
	2010	2011	2012	Average
Total Escapement to Natural Spawning Areas*	3,501	8,090	6,636	6,076
Percent Hatchery Spawners (pHOS)	72%	74%	78%	75%

*Estimates based on the number of fish collected at the Cowlitz Salmon Hatchery separator and transported and released in the Tilton basin; therfore, does not account for harvest or pre-spawning mortality and is not an estimate of the actual number of spawners in the Tilton basin

Integrated Hatchery Program:

- Data not available because no coho hatchery program is currently releasing smolts into Tilton basin

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Population limited 1 dam on the mainstem Cowlitz River, juvenile fish passage survival rate, which is currently under evaluation by Tacoma Power (previous estimate 90% based on passage study conducted in 2003)
- Baseline harvest rates exceeded population productivity

Potential Hatchery and Harvest Reform Actions: Tilton Coho	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Maintain releases of hatchery origin fish from lower Cowlitz segregated program (up to 6,000) in basin to provide for local sport fishery				
2. Annually evaluate number of adults transported and released in the Tilton River to ensure consistency with HSRG standards as per the Fisheries and Hatchery Management Plan Update				X
3. Continue to estimate natural origin juvenile out migrating smolts from the Tilton basin for evaluation of smolt to adult survival	X	X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce harvest rate on natural origin fish	X	X		X
2. Increase the harvest of hatchery fish		X		X
3. Continue mark-selective sport fisheries in ocean, Buoy 10 and mainstem Columbia River				
4. Implement commercial fisheries in the lower Columbia River using alternative fishing gears and methods				X
5. Implement mark-selective sport fishery in lower Cowlitz River to assist in reestablishing population that is adapted to the lower Cowlitz basin	X	X		X

VSP Parameters: A-Abundance, P-Productivity, S-Spatial Distribution, D-Diversity

CSF Plan Actions for Tilton Coho

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Up to 6,000 HOR coho are put into the Tilton River for sport fisheries annually **(Hatchery Action 1)**.
- All NOR adults destined for the Tilton are transported and released in the Tilton River. Tilton NORs are distinguishable by having an intact adipose fin and no CWT **(Hatchery Action 2)**.
- Smolts from the Tilton basin were tagged through 2010, but that program was discontinued when the smolts from the upper Cowlitz/Cispus were tagged beginnning in about 2010 **(Hatchery Action 3).**
- Harvest rate has been decreased from historical levels where these rates were as high as 95%. Coho ERs averaged 80% in the 1980s and 29% from 1990-2004. In 2005, coho were listed under the ESA and ERs have averaged 15% since the listing. A new abundance-based harvest rate matrix is expected to be adopted in 2015. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1,2)**.

- This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
- This will result in additional hatchery fish removal from fisheries.

- Mark-selective sport fisheries have occurred for many years in the ocean and lower Columbia River **(Harvest Action 3)**.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 4)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since about 2001 (**Harvest Action 5)**.

Upper Cowlitz and Cispus Coho

ESA Listing Status:
Upper Cowlitz-Threatened
Cispus-Threatened

Population Status:
Upper Cowlitz-Primary
Cispus-Primary

Goals		Historical	Washington Recovery Plan	
			Baseline	**Minimum Viability Goal**
Minimum Viability			Very Low Very Low	High, High
Escapement	Natural Origin Fish	18,000 (UC) 8,000 (Cis)	<50 <50	2,000 2,000
Gene Flow (pHOS or PNI)			PNI 0.0 PNI 0.0	PNI >0.67 PNI >0.67
Fitness			0.50 0.50	0.75 0.75
Harvest Rate	Hatchery Origin Fish		50% 50%	NA NA
	Natural Origin Fish		50% 50%	25% 25%

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Up to 1,000,000 (average ~ 600,000-700,000) hatchery sub-yearlings released into upstream of Cowlitz Falls Dam during 1995-1999
- Reintroduction efforts are underway using only adult (hatchery and natural origin) supplementation
- Surplus hatchery adults have been transported and released upstream of Cowlitz Falls Dam since 1996
- Success of reintroduction effort in Upper Cowlitz and Cispus basins to be determined by effectiveness of juvenile fish collection efforts at or near Cowlitz Falls Dam

Natural Escapement Data:

- Tables below provide number of coho returning to natural spawning areas (includes both natural and hatchery origin fish) in Upper Cowlitz and Cispus basins

Coho Escapement Estimates to Upper Cowlitz and Cispus Basins				
	2010	2011	2012	Average
Total Escapement to Natural Spawning Areas*	21,746	20,745	6,832	16,441
Percent Hatchery Spawners (pHOS)	87%	62%	75%	75%

*****Estimates based on the number of fish collected at the Cowlitz Salmon Hatchery separator and transported and released upstream of Cowlitz Falls Dam; therfore, does not account for harvest or pre-spawning mortality and is not an estimate of the actual number of spawners in the upper Cowlitz and Cispus basins

Integrated Hatchery Program:

Integrated Hatchery Program Metrics for Upper Cowlitz Late Stock Coho			
Year	**pNOB***	**pHOS****	**PNI*****
2010	1.00	0.87	0.69
2011	1.00	0.62	0.62
2012	1.00	0.75	0.57
2013	0.25	0.99	0.20
Average	0.81	0.65	0.55

- Table below provides metrics for integrated late stock coho hatchery program in Upper Cowlitz basin

* Integrated program initiated in 2007 by using natural origin fish returning to Cowlitz Salmon Hatchery

** Annual pHOS estimated based number of adults transported and released upstream fo Cowlitz Fall Dam (see escapement estimates above)

** Average (2010-2013) reduced by 20% to account for reduced productivity resulting from hatchery fish spawning in natural spawning locations

*** PNI calcuated using annual estimates for individual year and average estimates for muli-year average

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- No natural population existed due to blockage of habitat by 3 dams on the mainstem Cowlitz River
- Baseline harvest rates exceeded population productivity

Potential Hatchery and Harvest Reform Actions: Upper Cowlitz and Cispus Coho	**Viable Salmonid Population (VSP) Parameters Addressed**			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Implement integrated reintroduction program (978,000) for upper Cowlitz basin through implementation of the Cowlitz River Fisheries and Hatchery Management Plan Update	X	X	X	X
2. Transport only adults from integrated program upstream of Cowlitz Falls Dam	X	X		X
3. Continue to work to increase juvenile fish collection at Cowlitz Falls Dam and potentially in upper Riffe Lake	X	X	X	X

	A	P	S	D
4. Manage number of adults transported and released upstream of Cowlitz Falls Dam to achieve HSRG standards when juvenile collection rates (5-yr avg.) achieve 60%	X	X	X	X
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce harvest rate on natural origin fish	X	X		X
2. Increase the harvest of hatchery fish				X
3. Continue mark-selective sport fisheries in ocean, Buoy 10 and mainstem Columbia River				X
4. Implement commercial fisheries in the lower Columbia River using alternative fishing gears and methods				X
5. Implement mark-selective sport fishery in lower Cowlitz River to assist in reestablishing population that is adapted to the lower Cowlitz basin	X	X		X

CSF Plan Actions for Upper Cowlitz and Cispus Coho

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- An integrated program began with 2007 brood. The current program is for 978,000 smolts to be released at Cowlitz Salmon Hatchery. Upon return, up to 25,000 adults are transported and released upstream of Cowlitz Falls Dam **(Hatchery Action 1, 2)**.
    - These fish are distinguishable by having an adipose fin-clip and CWT
- Since 2011, reintroduction efforts have continued using only adult (hatchery and natural origin) supplementation. Success is to be determined by juvenile fish collection efficiency at Cowlitz Falls Dam. Once the collection efficiency at Cowlitz Falls Dam exceeds 60% on a five-year average, the program will move into local adaptation phase. **(Hatchery Action 2)**.
- Design has been completed for a new juvenile collector at Cowlitz Falls Dam. Construction of a new collector is expected to be completed in 2017. Testing for an additional collector just downstream of Cowlitz Falls Dam is underway **(Hatchery Action 3).**
- Harvest rate has been decreased from historical levels where these rates were as high as 95%. Coho ERs averaged 80% in the 1980s and 29% from 1990-2004. In 2005, coho were listed under the ESA and ERs have averaged 15% since the listing. A new abundance-based harvest rate matrix is expected to be adopted in 2015. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1,2)**.
    - This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
    - This will result in additional hatchery fish removal from fisheries.
- Mark-selective sport fisheries have occurred for many years in the ocean and lower Columbia River **(Harvest Action 3)**.

- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 4)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since about 2001 (**Harvest Action 5)**.

North Fork Toutle Coho

ESA Listing Status: Threatened Population Designation: Primary

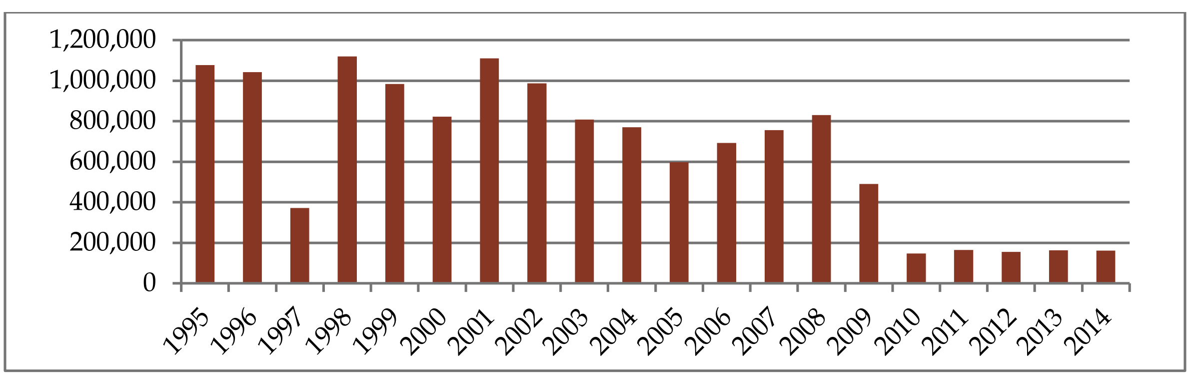
Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	High
Escapement	Natural Origin Fish	27,000 for SF & NF	<50	1,900
Gene Flow (pHOS or PNI)			PNI <0.10	PNI >0.67
Fitness			0.50	0.56
Harvest Rate	Hatchery Origin Fish		50%	NA
	Natural Origin Fish		50%	44%

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Graph below displays number of early stock coho smolts released in Toutle basin since 1995
- Only natural origin adults transported and released upstream of Sediment Retention structure in North Fork Toutle Basin

Coho Escapement Estimates for the Green River Basin (Tributary of North Fork Toutle River)				
Coho Escapement Estimates to North Fork Toutle Basin				
	2010	2011	2012	Average
Total Escapement to Natural Spawning Areas	3,686	526	1,877	2,029
Percent Hatchery Spawners (pHOS)	60%	27%	24%	37%



Natural Escapement Data:

- Tables below provide number of coho returning to natural spawning areas (includes both natural and hatchery origin fish) in Green River (tributary of North Fork Toutle River)

Integrated Hatchery Program:

- Table below provides metrics for integrated early coho hatchery program in North Fork Toutle basin

Integrated Hatchery Program Metrics for South Fork Toutle Early Stock Coho			
Year	**pNOB***	**pHOS****	**PNI*****
2010	0.50	0.60	0.45
2011	1.00	0.27	0.79
2012	1.00	0.24	0.81
2013	1.00	NA	NA
Average	0.88	0.30	0.75

* Integrated program initiated in 2008 by using natural origin fish returing to North Fork Toutle Hatchery

** Annual pHOS estimated based on actual observations from spawning ground surveys (see escapement estimates above)
** Average (2010-2012) reduced by 20% to account for reduced productivity resulting from hatchery fish spawning in natural spawning locations
*** PNI calcuated using annual estimates for individual year and average estimates for muli-year average

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Hatchery strays from within North Fork Toutle basin – hatchery coho with native early stock genetics
- Fitness of fish significantly impacted by historic straying
- Baseline harvest rates exceeded popualtion productivity

Potential Hatchery and Harvest Reform Actions: North Fork Toutle Coho	**Viable Salmonid Population (VSP) Parameters Addressed**			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Reduce hatchery releases from 800,000 to 150,000 (80% reduction)		X		X
2. Implement a conservation hatchery program in the North Fork Toutle River (integrated coho broodstock program) consistent with HSRG standards	X	X	X	X
3. Investigate feasibility of operating weir on lower Green River to minimize impact of hatchery strays	X	X		X
4. Operate fish trap on North Fork Toutle below Sediment Retention Structure to collect and transport natural origin coho to the upper North Fork Toutle basin	X	X	X	X
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce harvest rate on natural origin fish	X	X		X
2. Increase the harvest of hatchery fish to control hatchery fish on natural spawning grounds (see next two bullets)				X
3. Continue mark-selective sport fisheries in ocean, Buoy 10 and mainstem Columbia River				X

4. Implement commercial fisheries in the lower Columbia River using alternative fishing gears and methods				X
5. Implement mark-selective sport fishery in North Fork Toutle River to assist in reestablishing population that is adapted to the North Fork Toutle basin	X	X		X

CSF Plan Actions for North Fork Toutle Coho

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- The current program size was reduced from 800,000 to 150,000 in 2009 **(Hatchery Action 1,2)**.
- This was converted into an integrated program beginning with the 2008 brood **(Hatchery Action 2)**.
- Test operating weir in lower Green River to control hatchery coho on spawning grounds **(Hatchery Action 3)**.
- Trap and haul all natural origin coho collected at the Toutle Fish Collection Facility to upstream of Sediment Retention Structure on the NF Toutle **(Hatchery Action 4)**.
- Harvest rate has been decreased from historical levels where these rates were as high as 95%. Coho ERs averaged 80% in the 1980s and 29% from 1990-2004. In 2005, coho were listed under the ESA and ERs have averaged 15% since the listing. A new abundance-based harvest rate matrix is expected to be adopted in 2015. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1,2)**.
    - This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
    - This will result in additional hatchery fish removal from fisheries.
- Mark-selective sport fisheries have occurred in recent years in the ocean and lower Columbia River for selected time frames **(Harvest Action 3)**.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation) **(Harvest Action 4)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since 2001 **(Harvest Action 5)**.

South Fork Toutle Coho

ESA Listing Status: Threatened   Population Designation: Primary

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	High
Escapement	Natural Origin Fish	27,000 for SF and NF	<50	1,900
Gene Flow (pHOS or PNI)			pHOS >50%	pHOS <5%
Fitness			0.50	0.56
Harvest Rate	Hatchery Origin Fish		50%	NA
	Natural Origin Fish		50%	44%

HATCHERY RELEASE AND NATURAL ESCAPEMENT DATA

Hatchery Release Data:

- No releases occurred in South Fork Toutle basin since the late 1990's

Natural Escapement Data:

- Tables below provide number of coho returning to natural spawning areas (includes both natural and hatchery origin fish) in South Fork Toutle basin

Coho Escapement Estimates for the South Fork Toutle Basin				
	2010	2011	2012	Average
Total Escapement to Natural Spawning Areas	2,118	631	2,409	1,719
Percent Hatchery Spawners (pHOS)	21%	22%	14%	19%

Integrated Hatchery Program:

- Data not available because no coho hatchery program is currently releasing smolts into South Fork Toutle basin

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- No coho hatchery program within South Fork Toutle basin
- Fitness of fish impacted by historic straying from outside South Fork Toutle basin – primarily North Fork Toutle hatchery coho with native early stock genetics
- Baseline harvest rates exceeded popualtion productivity

Potential Hatchery and Harvest Reform Actions: South Fork Toutle Coho	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. No hatchery coho releases in the South Fork Toutle		X	X	X
2. Evaluate level of strays into basin after reduction in hatchery programs from other basins (primarily North Fork Toutle stock)		X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce harvest rate on natural origin fish	X	X		X
2. Increase the harvest of hatchery fish to control hatchery fish on natural spawning grounds (see next two bullets)				X
3. Continue mark-selective sport fisheries in Buoy 10 and mainstem Columbia River				X
4. Implement commercial fisheries in the lower Columbia River using alternative fishing gears and methods				X
5. Implement mark-selective sport fishery in South Fork Toutle River to assist in reestablishing population that is adapted to the South Fork Toutle basin	X	X		X

CSF Plan Actions for South Fork Toutle Coho

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- No hatchery releases occur in the SF Toutle **(Hatchery Action 1)**.
- Harvest rate has been decreased from historical levels where these rates were as high as 95%. Coho ERs averaged 80% in the 1980s and 29% from 1990-2004. In 2005, coho were listed under the ESA and ERs have averaged 15% since the listing. A new abundance-based harvest rate matrix is expected to be adopted in 2015. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1,2)**.
    - This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
    - This will result in additional hatchery fish removal from fisheries.
- Mark-selective sport fisheries have occurred in recent years in the ocean and lower Columbia River for selected time frames **(Harvest Action 3)**.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 4)**.

- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since 2001 **(Harvest Action 5)**.

Coweeman Coho

ESA Listing Status: Threatened Population Designation: Primary

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	High
Escapement	Natural Origin Fish	5,000	<50	1,200
Gene Flow (pHOS or PNI)			pHOS <5%	pHOS < 5%
Fitness			0.74	0.80
Harvest Rate	Hatchery Origin Fish		50%	NA
	Natural Origin Fish		50%	39%

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- No releases occurred in Coweeman basin since the late 1990's

Natural Escapement Data:

- Tables below provide number of coho returning to natural spawning areas (includes both natural and hatchery origin fish) in Coweeman basin

Coho Escapement Estimates for the Coweeman Basin				
	2010	2011	2012	Average
Total Escapement to Natural Spawning Areas	4,006	2,582	3,105	3,231
Percent Hatchery Spawners (pHOS)	10%	6%	5%	7%

Integrated Hatchery Program:

- Data not available because no coho hatchery program is currently releasing smolts into Coweeman basin

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- No hatchery program within Coweeman basin
- Fitness of fish impacted by historic straying from outside Coweeman basin – primarily Cowlitz hatchery coho with native late stock genetics
- Baseline harvest rates exceeded popualtion productivity

Potential Hatchery and Harvest Reform Actions: Coweeman Coho	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Establish Coweeman basin as a refuge for wild coho	X	X	X	X
2. No hatchery coho releases in the Coweeman basin		X	X	X
3. Evaluate level of strays into basin after reduction in hatchery programs from other basins		X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce harvest rate on natural origin fish	X	X		X
2. Increase the harvest of hatchery fish to control hatchery fish on natural spawning grounds (see next two bullets)				X
3. Continue mark-selective sport fisheries in ocean, Buoy 10 and mainstem Columbia River				X
4. Implement commercial fisheries in the lower Columbia River using alternative fishing gears and methods				X
5. Implement mark-selective sport fishery in Coweeman River to assist in reestablishing population that is adapted to the Coweeman basin	X	X		X

CSF Plan Actions for Coweeman Coho

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- No releases of hatchery coho occur in the Coweeman River **(Hatchery Action 1,2)**.
- Harvest rate has been decreased from historical levels where these rates were as high as 95%. Coho ERs averaged 80% in the 1980s and 29% from 1990-2004. In 2005, coho were listed under the ESA and ERs have averaged 15% since the listing. A new abundance-based harvest rate matrix is expected to be adopted in 2015. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1,2)**.
    - This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
    - This will result in additional hatchery fish removal from fisheries.
- Mark-selective sport fisheries have occurred for many years in the ocean and lower Columbia River **(Harvest Action 3)**.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 4)**.

- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since about 2001 (**Harvest Action 5)**.

Kalama Coho

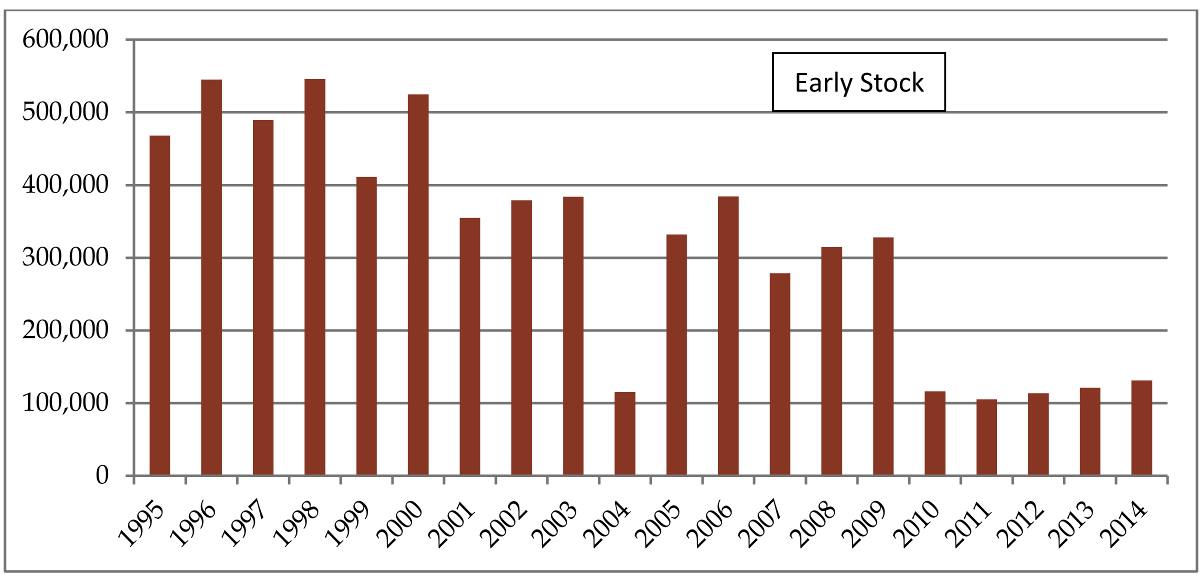
ESA Listing Status: Threatened Population Designation: Contributing

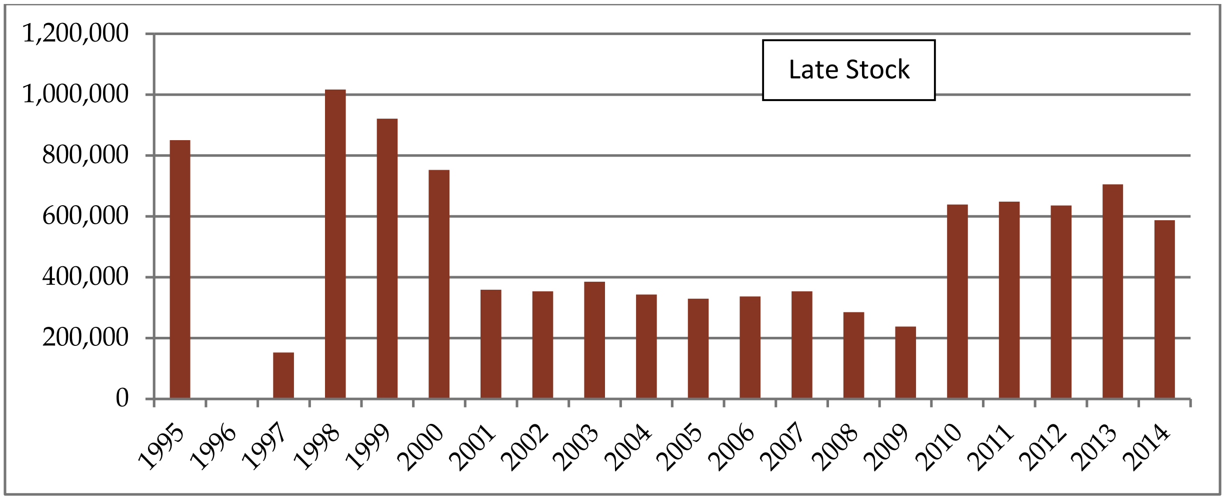
Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	Low
Escapement	Natural Origin Fish	800	<50	500
Gene Flow (pHOS or PNI)			pHOS >50%	pHOS<10% PNI>0.50
Fitness			0.50	0.60
Harvest Rate	Hatchery Origin Fish		50%	NA
	Natural Origin Fish		50%	40%

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Graph below displays number of early stock coho smolts released in Kalama basin since 1995
- Graph below displays number of late stock coho smolts released in Kalama basin since 1995





Natural Escapement Data:

- Tables below provide number of coho returning to natural spawning areas (includes both natural and hatchery origin fish) in Kalama basin

Coho Escapement Escapement Estimates in the Kalama Basin, including both Early and Late Stock Combined				
	2010	2011	2012	Average
Total Escapement to Natural Spawning Areas	521	311	320	384
Percent Hatchery Spawners (pHOS)	99%	NA	79%	89%

Integrated Hatchery Programs:

- Table below provides metrics for integrated early stock coho hatchery program in Kalama basin
- Table below provides metrics for integrated late stock coho hatchery program in Kalama basin

Integrated Hatchery Program Metrics for Kalama Early Stock Coho			
Year	pNOB*	pHOS**	PNI***
2010	0.00	0.99	0
2011	0.00	NA	0
2012	0.26	0.79	0.25
2013	0.26	NA	NA
Average	0.13	0.71	0.15

* Integrated program initiated in 2012 by using natural origin fish returning to Kalama Falls Hatchery
** Annual pHOS estimated based on actual observations from spawning ground surveys (see escapement estimates above)
** Average (2010 and 2012) reduced by 20% to account for reduced productivity resulting from hatchery fish spawning in natural spawning locations
*** PNI calcuated using annual estimates for individual year and average estimates for muli-year average

Integrated Hatchery Program Metrics for Kalama Late Stock Coho			
Year	pNOB*	pHOS**	PNI***
2010	0.21	0.99	0.18
2011	0.40	NA	NA
2012	0.14	0.79	0.15
2013	0.45	NA	NA
Average	0.30	0.71	0.30

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Hatchery strays within Kalama basin – primarily Kalama River hatcheries with native early stock and late stock genetics
- Fitness of fish significantly impacted by historic straying
- Baseline harvest rate exceeded population productivty
- Reduction in genetic diversity within the ESU due to past transfers of eggs and or fish between watersheds to make up for hatchery program short falls

Potential Hatchery and Harvest Reform Actions: Kalama Coho	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Convert majority of Type S production to Type N production (historic run timing)	X	X	X	X
2. Implement an integrated early and late stock coho broodstock program consistent with HSRG guidelines	X	X	X	X
3. Eliminate transfers of fish or eggs between watersheds for integrated programs		X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce harvest rate on natural origin fish	X	X		X
2. Increase the harvest of hatchery fish to control hatchery fish on natural spawning grounds (see next two bullets)				X
3. Continue mark-selective sport fisheries in ocean, Buoy 10 and mainstem Columbia River				X
4. Implement commercial fisheries in the lower Columbia River using alternative fishing gears and methods				X
5. Implement mark-selective sport fishery in Kalama River to assist in reestablishing population that is adapted to the Kalama basin	X	X		X

CSF Plan Actions for Kalama Coho

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- The majority of the early stock coho program was converted to late stock production in 2009 **(Hatchery Action 1)**.
- The early stock coho program was eliminated in 2014 **(Hatchery Action 1)**.
- The late stock coho program was reduced to 300,000 in 2014 from 600,000 **(Hatchery Action 2)**.

- The early stock coho program was integrated beginning in 2012 before it was eliminated in 2014. The late stock program was integrated in 2008 before it was reduced in 2014 **(Hatchery Action 2)**.
  - Challenges have occurred to collect NOR coho for broodstock because NOR abudance is extrememly low.
- No salmon are transferred from other watersheds **(Hatchery Action 3)**.
- Harvest rate has been decreased from historical levels where these rates were as high as 95%. Coho ERs averaged 80% in the 1980s and 29% from 1990-2004. In 2005, coho were listed under the ESA and ERs have averaged 15% since the listing. A new abundance-based harvest rate matrix is expected to be adopted in 2015. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1,2)**.
  - This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
  - This will result in additional hatchery fish removal from fisheries.
- Mark-selective sport fisheries have occurred for many years in the ocean and lower Columbia River **(Harvest Action 3)**.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 4)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since about 2001 (**Harvest Action 5)**.
- WDFW will consult with NMFS and LCFRB to review the population designation for this stock.

North Fork Lewis Coho

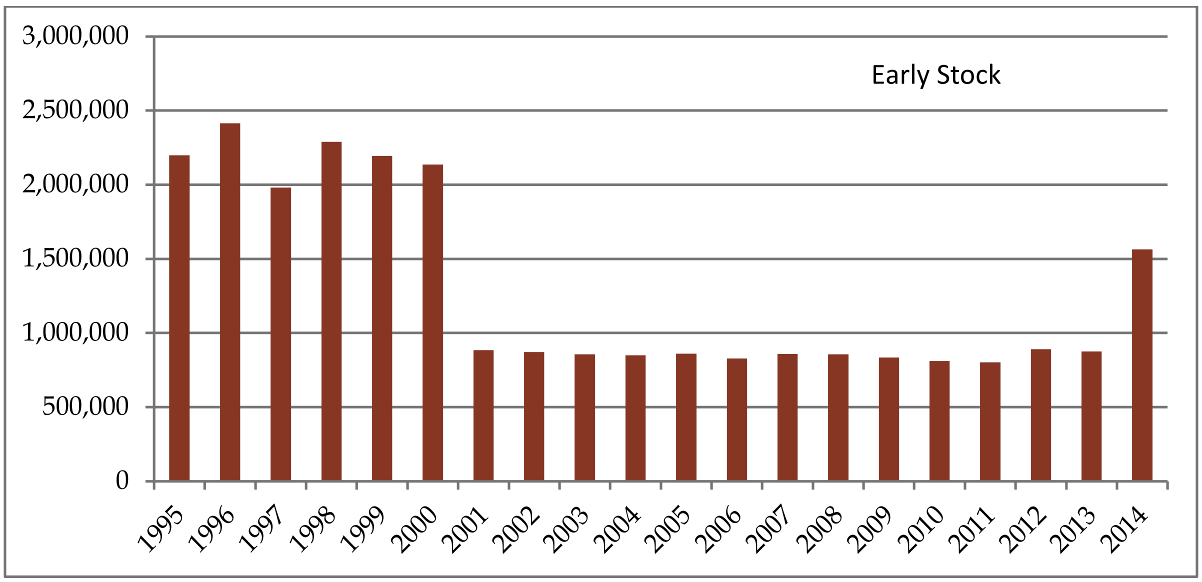
ESA Listing Status: Threatened Population Designation: Contributing

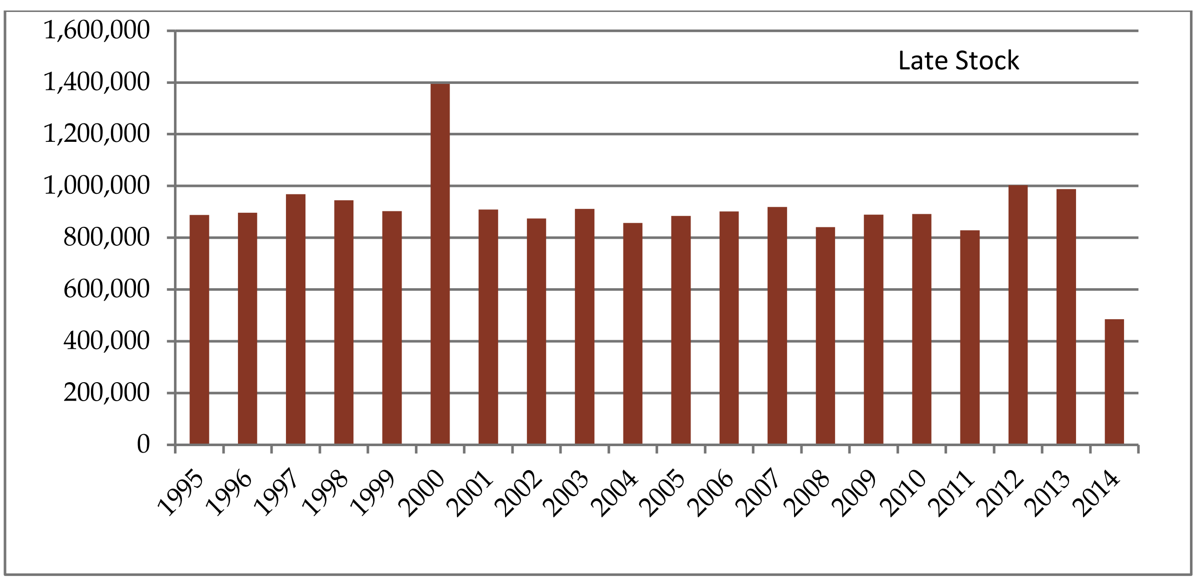
Goals		Historical	Washington Recovery Plan	
			Baseline	**Minimum Viability Goal**
Minimum Viability			Very Low	Low
Escapement	Natural Origin Fish	40,000	200	500
Gene Flow (pHOS or PNI)			Unknown	PNI >0.50
Fitness			0.76	0.78
Harvest Rate	Hatchery Origin Fish		50%	NA
	Natural Origin Fish		50%	47%

HATCHERY RELEASE AND NATURAL ESCAPEMENT DATA

Hatchery Release Data:

- Graph below displays number of early stock coho smolts released in North Fork Lewis basin since 1995
- Graph below displays number of late stock coho smolts released in North Fork Lewis basin since 1995
- Reintroduction efforts in upper North Fork Lewis are underway using only adult (hatchery and natural origin) supplementation
- Surplus hatchery adults have been transported and released upstream of Swift Dam since 2012
- Success of reintroduction effort in Upper North Fork Lewis basin to be determined by effectiveness of juvenile fish collection efforts at Swift Dam





Natural Escapement Data:

- Tables below provide number of coho returning to natural spawning areas (includes both natural and hatchery origin fish) in North Fork Lewis basin downstream of Merwin Dam

Coho Escapement Estimates for the Lower North Fork Lewis				
	2010	2011	2012	Average
Total Escapement to Natural Spawning Areas*	4,338	5,804	2,976	4,377
Percent Hatchery Spawners (pHOS)	6%	56%	13%	25%

* Estimates for tributaries only, does not include mainstem North Fork Lewis

Segregated and Integrated Hatchery Programs:

- Table below provides metrics for segregated early stock coho hatchery program in Lewis basin
- Table below provides metrics for integrated late stock coho hatchery programs

Segregated Hatchery Program Metrics for Lewis Early Stock Coho			
Year	**pNOB***	**pHOS****	**PNI***
2010	NA	0.06	NA
2011	NA	0.56	NA
2012	NA	0.13	NA
2013	NA	NA	NA
Average	NA	0.20	NA

*Estimates of pNOB and PNI Not Available (NA) because currently operated as a segregated program

** Annual pHOS estimated based on actual observations from spawning ground surveys (see escapement estimates above)

** Average (2010-2012) reduced by 20% to account for reduced productivity resulting from hatchery fish spawning in natural spawning locations

Integrated Hatchery Program Metrics for Lewis Late Stock Coho			
Year	**pNOB***	**pHOS****	**PNI*****
2010	NA	0.06	NA
2011	NA	0.56	NA
2012	NA	0.13	NA
2013	NA	NA	NA
Average	NA	0.20	NA

* Integrated program initiated in 2014 by using natural origin returning to Lewis River and Merwin Hatcheries

** Annual pHOS estimated based on actual observations from spawning ground surveys (see escapement estimates above)

** Average (2010-2012) reduced by 20% to account for reduced productivity resulting from hatchery fish spawning in natural spawning locations

*** PNI calcuated using annual estimates for individual year and average estimates for muli-year average

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Hatchery strays within North Fork Lewis basin – primarily North Fork Lewis River hatcheries with non-native early stock and native late stock genetics
- Fitness of fish significantly impacted by historic straying
- All upper river habitat blocked by 3 mainstem dams on the Lewis River
- Reduction in genetic diversity within the ESU is likely due to past transfers of eggs and/or fish between watersheds to make up for hatchery shortfall
- Baseline harvest rate exceeded population productivity

Potential Hatchery and Harvest Reform Actions: Noth Fork Lewis Coho	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Maintain current production levels to support Ocean and Columbia River fisheries				
2. Evaluate feasibility of implementing an integrated program for lower river coho (late stock) consistent with HSRG standards	X	X	X	X
3. Implement an integrated reintroduction program (above Swift Dam using early stock coho	X	X	X	X
4. Eliminate transfers of fish or eggs between watersheds with integrated programs		X		X
5. Reintroduction efforts dependent on fish collection facilities that began operation December 2012	X	X	X	X
6. Review hatchery program production level through Aquatic Coordinating Committee as natural populations are reestablished in the upper North Fork Lewis basin	X	X	X	X
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce harvest rate on natural origin fish	X	X		X
2. Increase the harvest of hatchery fish to control hatchery fish on natural spawning grounds (see next two bullets)				X
3. Continue mark-selective sport fisheries in ocean, Buoy 10 and mainstem Columbia River				X
4. Implement commercial fisheries in the lower Columbia River using alternative fishing gears and methods				X
5. Implement mark-selective sport fishery in North Fork Lewis River to assist in reestablishing population that is adapted to the North Fork Lewis basin	X	X		X
6. Close North Fork Lewis Basin to sport angling for salmon and steelhead until reestablished population has achieved a healthy and harvestable level	X	X		X

CSF Plan Actions for North Fork Lewis Coho

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Maintain Settlement Agreement (SA) Production to support ocean and Comlumbia River fisheries **(Hatchery Action 1)**.
- The current program size is 900,000 early stock and 1.1 million late stock released in the North Lewis River **(Hatchery Action 1).**
- Late stock coho program was converted to an integrated program beginning with 2014 brood **(Hatchery Action 2)**.

- The reintroduction strategy for early stock coho salmon will rely on adult supplementation. Initially, 9,000 early stock Coho adults (when available) will be released above Swift Reservoir to rebuild a natural spawning population. The hatchery stock will be used only in the first generation of the supplementation efforts. Once adults return from upper basin adult releases, the supplementation program will preferentially use these returns for further introduction. Hatchery origin adult coho will only be used if the number of adults produced from above Swift No. 1 Dam is not sufficient to meet the adult supplementation objective of 9,000 adults **(Hatchery Action 3)**.
- At the completion of the 9-year period, adult supplementation with any hatchery origin fish will be evaluated annually to determine if only natural origin returns will be allowed to spawn in the upper watershed. The population will be monitored to determine if reintroduction goals for this species have been reached **(Hatchery Action 3)**.
- Natural origin returns will not be incorporated into the broodstock for the existing lower river early stock coho harvest program for the duration of the re-introduction program. At the completion of the 9 years and evaluation of stock sustainability, a decision will be made whether or not to modify the current segregated harvest program for early stock coho into an Integrated Harvest program **(Hatchery Action 3)**.
- No salmon are transferred from other watersheds **(Hatchery Action 4)**.
- Begin discussions with enhancement groups about eliminating or reducing the RSI programs in 2015.
- WDFW and LCFRB staff will remain active participants in the ACC **(Hatchery Action 6).**
- Harvest rate has been decreased from historical levels where these rates were as high as 95%. Coho ERs averaged 80% in the 1980s and 29% from 1990-2004. In 2005, coho were listed under the ESA and ERs have averaged 15% since the listing. A new abundance-based harvest rate matrix is expected to be adopted in 2015. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1,2)**.
    - This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
    - This will result in additional hatchery fish removal from fisheries.
- Mark-selective sport fisheries have occurred for many years in the ocean and lower Columbia River **(Harvest Action 3)**.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 4)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since about 2001 **(Harvest Action 5).**

East Fork Lewis Coho

ESA Listing Status: Threatened　　　　Population Designation: Primary

Goals		Historical	Washington Recovery Plan Baseline	Washington Recovery Plan Minimum Viability Goal
Minimum Viability			Very Low	High
Escapement	Natural Origin Fish	3,000	<50	2,000
Gene Flow (pHOS or PNI)			unknown	pHOS < 5%
Fitness			0.78	0.89
Harvest Rate	Hatchery Origin Fish		50%	NA
	Natural Origin Fish		50%	25%

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- No releases occurred in East Fork Lewis basin since the late 1990's, excluding releases from Remote Site Incubators

Natural Escapement Data:

- Tables below provide number of coho returning to natural spawning areas (includes both natural and hatchery origin fish) in East Fork Lewis basin

Coho Escapement Estimates for the East Fork Lewis Basin				
	2010	2011	2012	Average
Total Escapement to Natural Spawning Areas	2,022	1,091	4,060	2,391
Percent Hatchery Spawners (pHOS)	32%	6%	9%	16%

Integrated Hatchery Program:

- Data not available because no coho hatchery program is currently releasing smolts into East Fork Lewis basin

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- No hatchery program within East Fork Lewis basin
- Hatchery strays from outside East Fork Lewis basin – primarily from North Fork Lewis River hatcheries with non-native early stock and native late stock genetics
- Fitness of fish impacted by historic straying
- Baseline harvest rate exceeded population productivity

Potential Hatchery and Harvest Reform Actions: East Fork Lewis Coho	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Establish East Fork Lewis basin as a refuge for wild coho	X	X	X	X
2. No hatchery coho will be released in East Fork Lewis River		X	X	X
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce harvest rate on natural origin fish	X	X		X
2. Increase the harvest of hatchery fish to control hatchery fish on natural spawning grounds (see next two bullets)				X
3. Continue mark-selective sport fisheries in ocean, Buoy 10 and mainstem Columbia River				X
4. Implement commercial fisheries in the lower Columbia River using alternative fishing gears and methods				X
5. Implement mark-selective sport fishery in East Fork Lewis River to assist in reestablishing population that is adapted to the East Fork Lewis basin	X	X		X

CSF Plan Actions for East Fork Lewis Coho

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- No coho are released in the EF Lewis River **(Hatchery Action 1,2)**.
- Harvest rate has been decreased from historical levels where these rates were as high as 95%. Coho ERs averaged 80% in the 1980s and 29% from 1990-2004. In 2005, coho were listed under the ESA and ERs have averaged 15% since the listing. A new abundance-based harvest rate matrix is expected to be adopted in 2015. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1,2).**
    - This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
    - This will result in additional hatchery fish removal from fisheries.
- Mark-selective sport fisheries have occurred for many years in the ocean and lower Columbia River **(Harvest Action 3)**.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 4)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since about 2001 **(Harvest Action 5)**.

Salmon Creek Coho

ESA Listing Status: Threatened   Population Designation: Stabilizing

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	Very Low
Escapement	Natural Origin Fish	NA	<50	50
Gene Flow (pHOS or PNI)			pHOS >50%	pHOS current
Fitness			0.50	0.50
Harvest Rate	Hatchery Origin Fish		50%	NA
	Natural Origin Fish		50%	50%

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- No releases occurred in Salmon Creek basin since the late 1990's

Natural Escapement Data:

- Tables below provide number of coho returning to natural spawning areas (includes both natural and hatchery origin fish) in Salmon Creek basin

Coho Escapement Estimates for Salmon Creek Basin				
	2010	2011	2012	Average
Total Escapement to Natural Spawning Areas	NA	1,562	2,434	1,998
Percent Hatchery Spawners (pHOS)	NA	20%	22%	21%

Integrated Hatchery Program:

- Data not available because no coho hatchery program is currently releasing smolts into Salmon Creek basin
- Wild fish rescue program occurring in basin

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Population currently meeting recovery goals

Potential Hatchery and Harvest Reform Actions: Salmon Creek Coho	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. No action required, population currently meeting recovery goals				
Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce harvest rate on natural origin fish	X	X		X

2. Increase the harvest of hatchery fish (to reduce out of basin strays)		X		X
3. Continue mark-selective sport fisheries in ocean, Buoy 10 and mainstem Columbia River				X
4. Implement commercial fisheries in the lower Columbia River using alternative fishing gears and methods				X

CSF Plan Actions for Salmon Creek Coho

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- No coho hatchery smolts are released in Salmon Creek **(Hatchery Action 1)**.
- Begin discussions with enhancement groups about eliminating or reducing the RSI programs in 2015.
- Harvest rate has been decreased from historical levels where these rates were as high as 95%. Coho ERs averaged 80% in the 1980s and 29% from 1990-2004. In 2005, coho were listed under the ESA and ERs have averaged 15% since the listing. A new abundance-based harvest rate matrix is expected to be adopted in 2015. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1,2)**.
    - This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
    - This will result in additional hatchery fish removal from fisheries.
- Mark-selective sport fisheries have occurred for many years in the ocean and lower Columbia River **(Harvest Action 3)**.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 4)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since about 2001 (**Harvest Action 5)**.

Washougal Coho

ESA Listing Status: Threatened Population Designation: Contributing

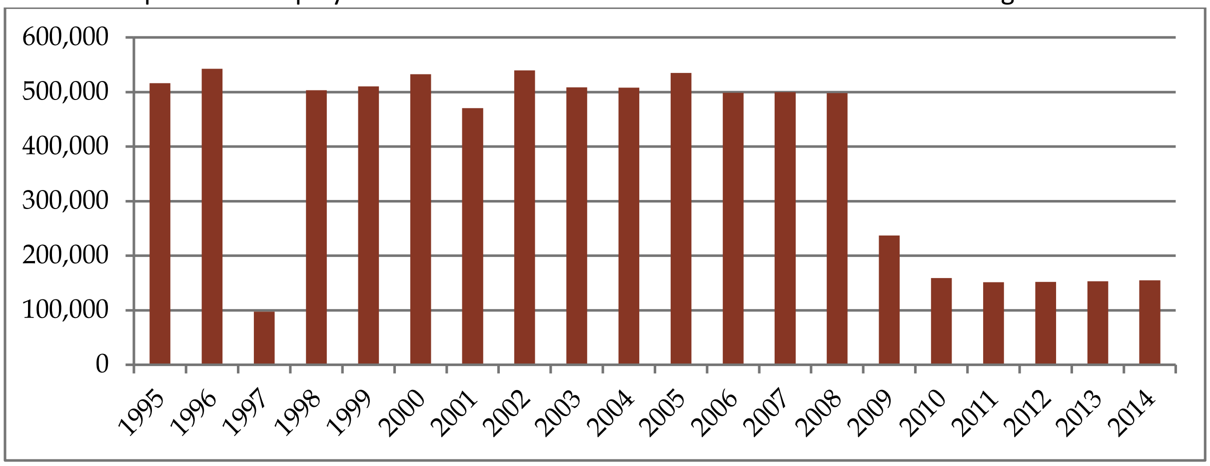
Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	Medium+
Escapement	Natural Origin Fish	3,000	<50	1,500

Gene Flow (pHOS or PNI)			PNI <0.10	PNI >0.50
Fitness			0.50	0.75
Harvest Rate	Hatchery Origin Fish		50%	NA
	Natural Origin Fish		50%	25%

HATCHERY RELEASE AND NATURAL ESCAPEMENT DATA

Hatchery Release Data:

- Graph below displays number of late stock coho smolts released in Washougal basin since 1995



Natural Escapement Data:

- Tables below provide number of coho returning to natural spawning areas (includes both natural and hatchery origin fish) in Washougal basin

Coho Escapement Estimates for the Washougal Basin				
	2010	2011	2012	Average
Total Escapement to Natural Spawning Areas	1,582	609	612	934
Percent Hatchery Spawners (pHOS)	44%	8%	13%	22%

Integrated Hatchery Program:

- Table below provides metrics for integrated late stock coho hatchery program in Washougal basin

Integrated Hatchery Program Metrics for Washougal Late Stock Coho			
Year	**pNOB***	**pHOS****	**PNI*****
2010	0.87	0.44	0.66
2011	0.34	0.08	0.81
2012	0.10	0.13	0.43
2013	0.80	NA	NA
Average	0.53	0.17	0.76

* Integrated program initiated in 2010 by using natural origin fish returning to Washougal Hatchery
** Annual pHOS estimated based on actual observations from spawning ground surveys (see escapement estimates above)
** Average (2010-2012) reduced by 20% to account for reduced productivity resulting from hatchery fish spawning in natural spawning locations
*** PNI calcuated using annual estimates for individual year and average estimates for muli-year average

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Hatchery strays from within Washougal basin and off-station (Klickitat River) – natchery coho with late stock genetics
- Fitness of fish significantly impacted by historic straying
- Baseline harvest rate exceeded population productivity
- Reduction in genetic diversity within the ESU is likely due to past transfers of eggs and/or fish between watersheds to make up for hatchery shortfall

Potential Hatchery and Harvest Reform Actions: Washougal Coho	**Viable Salmonid Population (VSP) Parameters Addressed**			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Reduce on-station release from 500,000 to 150,000 (70% reduction)		X		X
2. Implement an integrated coho program consistent with HSRG standards	X	X	X	X
3. Move 70% of current on-site hatchery releases (350,000) to a Select Area location to support Ocean and Columbia River fisheries		X		X
4. Establish local brood program (1 million) for Klickitat to replace current Washougal stock tribal program (2.5 million)(Washougal to support)	X	X	X	X
5. Eliminate transfers of fish or eggs between watersheds with integrated programs		X		X
6. Mark all fish transferred used in Klickitat off-station plant				X

Harvest Actions	**A**	**P**	**S**	**D**
1. Reduce harvest rate on natural origin fish	X	X		X
2. Increase the harvest of hatchery fish to control hatchery fish on natural spawning grounds (see next two bullets)				X
3. Continue mark-selective sport fisheries in ocean, Buoy 10 and mainstem Columbia River				X
4. Implement commercial fisheries in the lower Columbia River using alternative fishing gears and methods				X
5. Implement mark-selective sport fishery in Washougal River to assist in reestablishing population that is adapted to the Washougal basin	X	X		X

CSF Plan Actions for Washougal Coho

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- On-station release was reduced to 150,000 to meet HSRG standards for a primary population **(Hatchery Action 1,2).**

- 350,000 fish are produced and transferred to Deep River for final acclimation and release **(Hatchery Action 3)**.
- The late stock hatchery coho program is an integrated program. This began with the 2010 brood **(Hatchery Action 2)**.
- Ad clip all fish planted into the Klickitat River (*US v. Oregon* production) **(Hatchery Action 6)**.
- Harvest rate has been decreased from historical levels where these rates were as high as 95%. Coho ERs averaged 80% in the 1980s and 29% from 1990-2004. In 2005, coho were listed under the ESA and ERs have averaged 15% since the listing. A new abundance-based harvest rate matrix is expected to be adopted in 2015. The average ER from this matrix will allow for additional harvest opportunity on large run years **(Harvest Action 1,2)**.
    - This will result in increased protection of natural origin fish from fishery related mortalities in years of low abundance.
    - This will result in additional hatchery fish removal from fisheries.
- Mark-selective sport fisheries have occurred for many years in the ocean and lower Columbia River **(Harvest Action 3)**.
- Alterntive gear studies have been initiated in the Columbia River focused on beach and purse seines, with the goal of implementing increased mark-selective fisheries for salmon. A pilot fishery occurred in 2014 with ten commercial fishers participating. Fisheries in 2015 and beyond are expected to increase in harvest and participation **(Harvest Action 4)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since about 2001 (**Harvest Action 5)**.

Winter and Summer Steelhead Populations

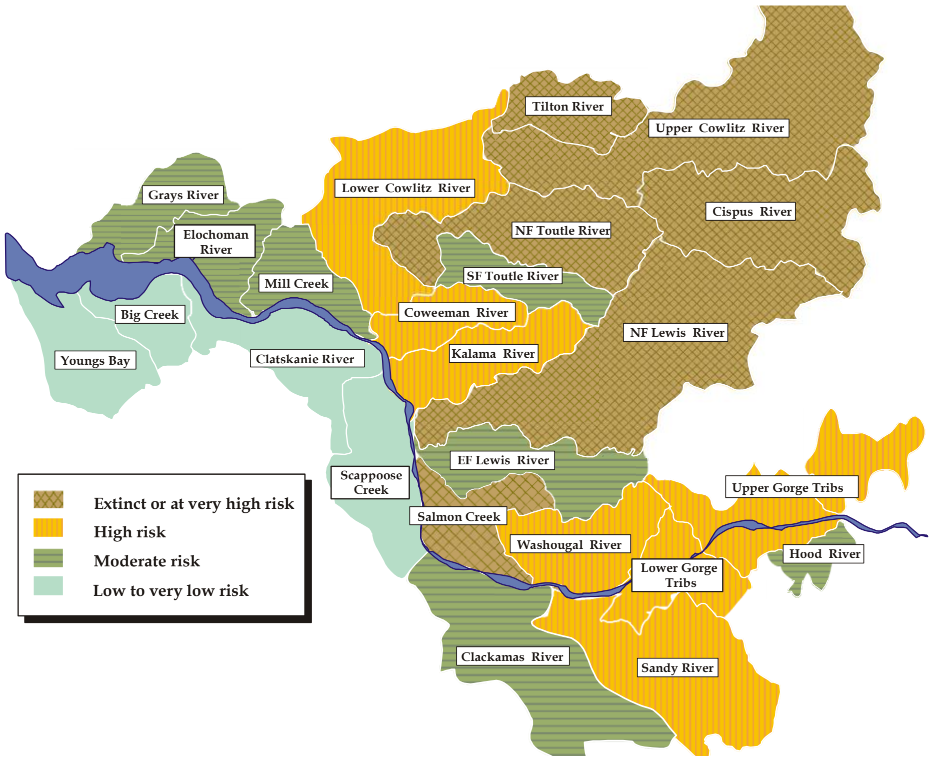


Figure 7-5. Current status of historical demographically-independent lower Columbia River winter steelhead populations.

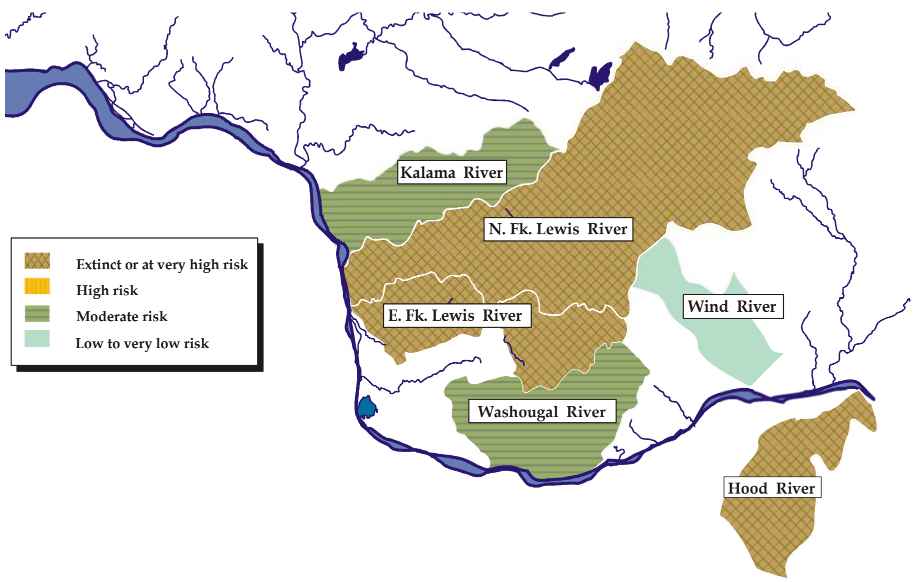


Figure 7-.6. Current status of historical demographically-independent lower Columbia River Summer steelhead

populations.

Steelhead Populations and Recovery Plan Designations[30]			
Coast Stratum – Winter	***Population Designation***	***Cascade Stratum - Winter***	***Population Designation***
Youngs Bay	Primary	Cowlitz (lower)	Contributing
Big Creek	Primary	Tilton	Contributing
Grays/Chinook River	Primary	Cowlitz (upper)	Primary
Elochoman/Skamokawa	Contributing	Cispus	Primary
Mill/Abernathy/Germany	Primary	Toutle NF	Primary
Clatskanie	Primary	Toutle SF	Primary
Scappoose	Primary	Coweeman	Contributing
		Kalama	Primary
Cascade Stratum - Summer	***Population Designation***	Lewis NF	Contributing
		Lewis EF	Primary
Kalama	Primary	Salmon	Contributing
Lewis NF	Stabilizing	Washougal	Contributing
Lewis EF	Primary	Clackamas	Primary
Washougal	Primary	Sandy	Primary

Table 7-1. Wild winter steelhead escapement estimates for select SW Washington DPS populations, current WDFW escapement goals and Washington Recovery Plan Minimum Viability Abundance Goals.

Location	Grays River	Elochoman/ Skamokawa	Mill/Abernathy/ Germany
WDFW Escapement Goal[31]	**1,486**	**853**	**508**
Washington Recovery Plan Minimum Viability Abundance Goal	**800**	**600**	**500**
2000	1,064	650	380
2001	1,130	656	458
2002	724	370	354
2003	1,200	668	342
2004	1,132	768	446
2005	396	376	274
2006	718	632	398
2007	724	490	376
2008	764	666	528
2009	568	222	396
2010	422	534	398
2011	318	442	270
3-year average (2009-2011)	436	399	355
5-year average (2007-2011)	559	471	394
10-year average (2002-2011)	697	517	378

[30] Populations that are shaded are Washington populations that are addressed in this document
[31] Source for escapement estimates: WDFW Data 2012

Table 7-2. Wild winter steelhead escapement estimates for select SW Washington DPS populations, current WDFW escapement goals and Washington Recovery Plan Minimum Viability Abundance Goals.

Location	Coweeman	SF Toutle	NF Toutle/ Green	Kalama	EF Lewis	Washougal
WDFW Escapement Goal	**1,064**	**1,058**	**NA**	**1,000**	**1,243**	**520**
Washington Recovery Plan Minimum Viability Abundance Goal	**500**	**600**	**600**	**600**	**500**	**350**
2000	530	490	----	921	NA	NA
2001	384	348	----	1,042	377	216
2002	298	640	----	1,495	292	286
2003	460	1,510	----	1,815	532	764
2004	722	1,212	----	2,400	1,298	1,114
2005	370	520	388	1,856	246	320
2006	372	656	892	1,724	458	524
2007	384	548	565	1,050	448	632
2008	722	412	650	776	548	732
2009	602	498	699	1,044	688	418
2010	528	274	508	961	336	232
2011	408	210	416	622	308	204
3-year average	513	327	541	876	444	285
5-year average	529	388	568	891	466	444
10-year average	487	648	*588	1,374	515	523

*7-year average for NF Toutle/Green

Table 7-3. Wild summer steelhead population estimates for lower Columbia populations from 2001 to 2011, current WDFW escapement goals, and Washington Recovery Plan Minimum Viability Abundance Goals.

Location	Kalama	EF Lewis	Washougal	Wind
WDFW Escapement Goal	**1,000**	**NA**	**NA**	**1,557**
Washington Recovery Plan Minimum Viability Abundance Goal	**500**	**500**	**500**	**1,000**
2001	286	271	184	457
2002	454	440	404	680
2003	817	910	607	1,096
2004	632	425	NA	861
2005	400	673	608	587
2006	387	560	636	632
2007	361	412	681	737
2008	237	365	755	614
2009	308	800	433	580
2010	370	602	787	788
2011	534	1,084*	956*	1,468
3-year average	404	829	725	945
5-year average	362	653	722	837
10-year average	450	627	652	804

* Preliminary estimates

Grays/Chinook Winter Steelhead

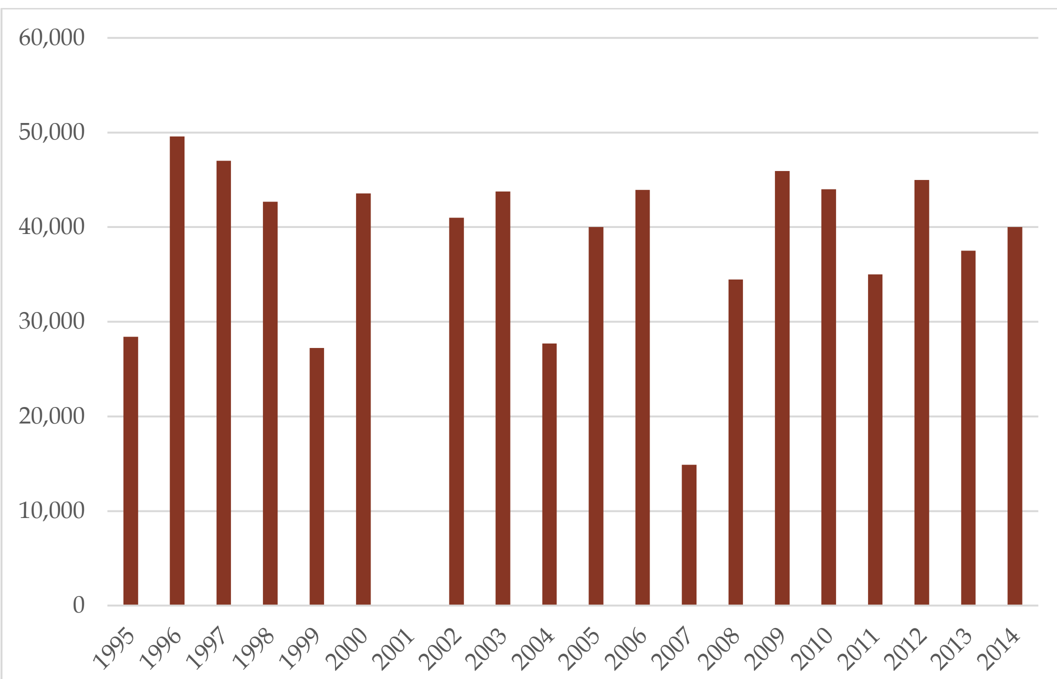
ESA Listing Status: Winter steelhead not listed   Population Designation: Primary

Goals		Historical	Washington Recovery Plan	
			Baseline	**Minimum Viability Goal**
Minimum Viability			Medium	High
Escapement	Natural Origin Fish	1,600	800	800
Gene Flow (pHOS or PNI)			pHOS <5%	pHOS <5%
Fitness			0.91	0.91
Harvest Rate	Hatchery Origin Fish		60%	NA
	Natural Origin Fish		10%	10%

HATCHERY RELEASE AND NATURAL ESCAPEMENT DATA

Hatchery Release Data:

- Graph below displays number of early winter steelhead smolts released in Grays basin since 1995
- No releases occurred in Chinook basin since the late 1990's



Natural Escapement Data:

- Escapement data for winter steelhead presented in Table 7-1 at the start of this section titled "Winter and Summer Steelhead Populations"

Integrated Hatchery Program:

- Data not available because early winter steelhead program in Grays basin is being operated as a segregated program

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Hatchery strays from within Grays basin – hatchery winter steelhead with non-native early winter genetics
- Harvest impacts were not identified as a limiting factor

Potential Hatchery and Harvest Reform Actions: Grays/Chinook Winter Steelhead	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Evaluate use of local broodstock program for winter steelhead		X		X
2. Maintain current hatchery releases of winter steelhead, consistent with HSRG standards, to support sport fishing opportunities in the Grays basin		X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Continue mark-selective steelhead fishery to assist in controlling hatchery fish on spawning grounds		X		X

CSF Plan Actions for Grays/Chinook Winter Steelhead

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- On-station acclimation of winter steelhead hatchery releases is occurring to reduce straying to surrounding basins and natural spawning areas **(Hatchery Action 1)**.
- Broodstock source has been converted to locally adapted Elochoman hatchery stock, but this is not an integrated program **(Hatchery Action 1)**.
- Hatchery releases are 40,000 **(Hatchery Action 2)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since the late 1980s **(Harvest Action 1)**.
- This tributary may be converted to a wild steelhead gene bank to meet WDFW policy objectives for steelhead populations.

Elochoman/Skamokawa Winter Steelhead

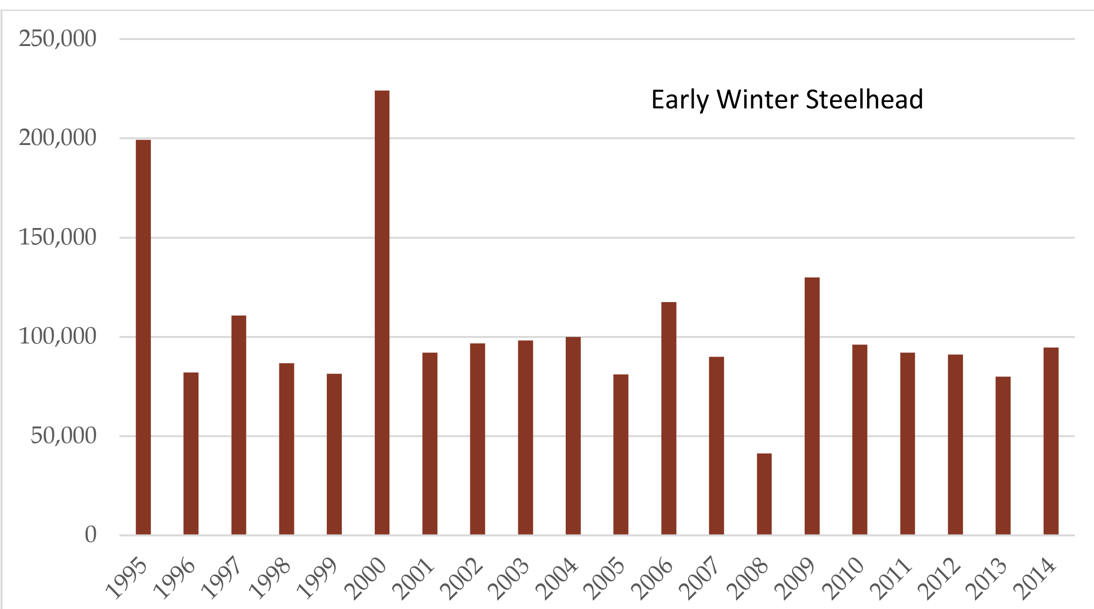
ESA Listing Status: Winter steelhead not listed   Population Designation: Winter: Contributing

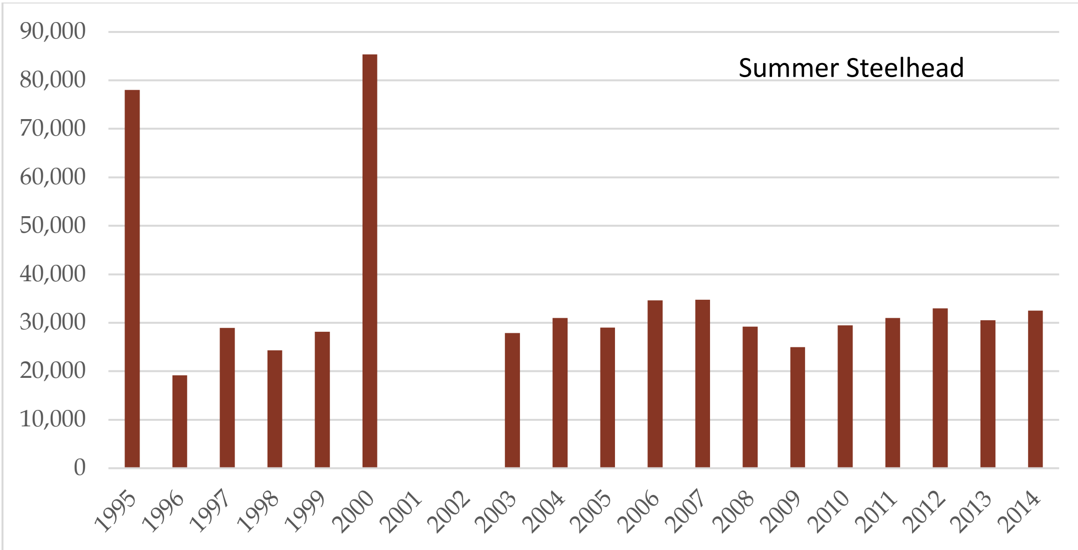
Goals		Historical	Washington Recovery Plan	
			Baseline	**Minimum Viability Goal**
Minimum Viability			Medium	Medium+
Escapement	Natural Origin Fish	1,100	600	600
Gene Flow (pHOS or PNI)			pHOS <10%	pHOS <10%
Fitness			0.58	0.58
Harvest Rate	Hatchery Origin Fish		60%	NA
	Natural Origin Fish		10%	10%

Hatchery Release and Natural Escapement Data

Hatchery Release Data:

- Graph below displays number of early winter steelhead smolts released in Elochoman basin since 1995
- Graph below displays number of summer steelhead smolts released in Elochoman basin since 1995
- No releases occurred in Skamokawa basin since the late 1990's





Natural Escapement Data:

- Escapement data for winter steelhead presented in Table 7-1 at the start of this section titled "Winter and Summer Steelhead Populations"

Integrated Hatchery Program:

- Data not available because early winter steelhead program in Elochoman basin is being operated as a segregated program

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Hatchery strays from within Elochoman basin – hatchery winter and summer steelhead with non-native early winter and non-native skamania summer genetics
- Harvest impacts were not identified as a limiting factor

Potential Hatchery and Harvest Reform Actions: Elochoman/Skamokawa Winter Steelhead	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Close Elochoman Hatchery and transfer production to Beaver Creek Hatchery	X	X	X	X
2. Establish local broodstock for winter steelhead (segregated program)		X		X
3. Maintain current hatchery releases of winter and summer steelhead, consistent with HSRG standards, to support fishing opportunities in the Elochoman basin		X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Continue mark-selective steelhead fishery to assist in controlling hatchery fish on spawning grounds		X		X

CSF Plan Actions for Elochoman/Skamokawa Winter Steelhead

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Elochoman Hatchery was closed in 2009 **(Hatchery Action 1)**.
- On-station acclimation of winter steelhead hatchery releases is occurring to reduce straying to surrounding basins and natural spawning areas **(Hatchery Action 1)**.
- Broodstock source has been converted to a locally adapted hatchery stock for winter steelhead, but this is not an integrated program **(Hatchery Action 2)**.
- Hatchery releases are 90,000 for winter steelhead and 30,000 for summer steelhead **(Hatchery Action 3)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since the late 1980s **(Harvest Action 1)**.
- This tributary may be converted to a wild steelhead gene bank to meet WDFW policy objectives for steelhead populations.

Mill/Abernathy/Germany (MAG) Creeks Winter Steelhead

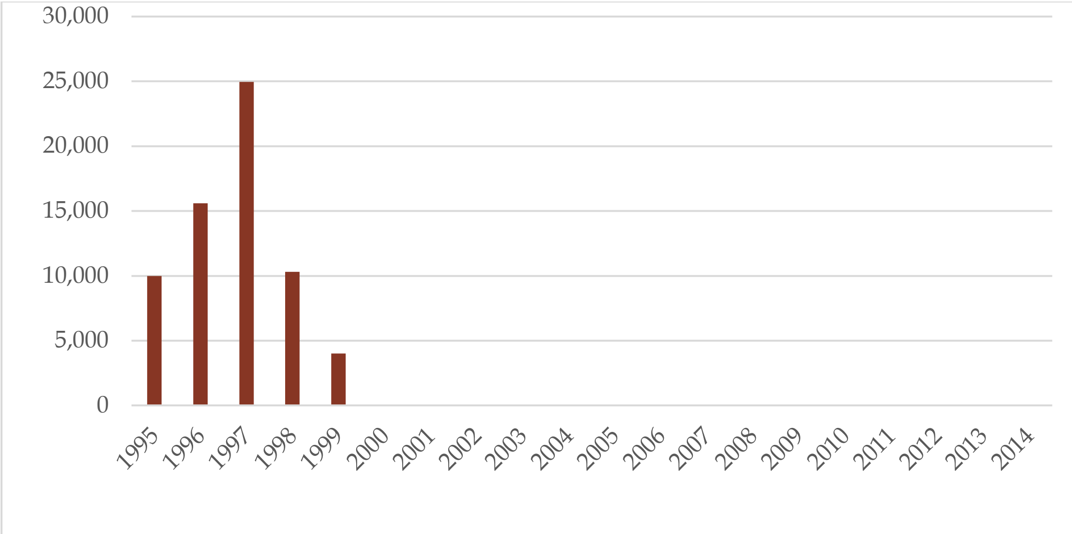
ESA Listing Status: Threatened Population Designation: Primary

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Medium	High
Escapement	Natural Origin Fish	900	500	500
Gene Flow (pHOS or PNI)			pHOS <5%	pHOS < 5%
Fitness			0.99	0.99
Harvest Rate	Hatchery Origin Fish		60%	NA
	Natural Origin Fish		10%	10%

HATCHERY RELEASE AND NATURAL ESCAPEMENT DATA

Hatchery Release Data:

- Graph below displays number of early winter steelhead smolts released in Abernathy Creek basin since 1995
- During 2004-2012 number of late winter steelhead smolts released in Abernathy Creek basin by the USFWS ranged between 17,000-25,000
- No releases occurred in Mill Creek or Germany Creek basins since the late 1990’s



Natural Escapement Data:

- Escapement data for winter steelhead presented in Table 7-1 at the start of this section titled "Winter and Summer Steelhead Populations"

Integrated Hatchery Program:

- Data not available because late winter steelhead program is operated by USFWS

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Hatchery strays from within basin – hatchery winter steelhead with native late winter genetics
- Harvest impacts were not identified as a limiting factor

Potential Hatchery and Harvest Reform Actions: Mill/Abernathy/Germany (MAG) Creeks Steelhead	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Maintain integrated hatchery winter steelhead program in Abernathy Creek in conjunction with BPA funded pedigree study concerning impact of hatchery program on wild production	X	X	X	X
Harvest Actions	**A**	**P**	**S**	**D**
1. Continue mark-selective steelhead fishery to assist in controlling hatchery fish on spawning grounds		X		X

CSF Plan Actions for Mill/Abernathy/Germany (MAG) Creeks Winter Steelhead

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal

for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- The only hatchery releases in these tributaries occur in Abernathy Creek as part of a research program conducted by the US Fish and Wildlife Service.
- On-station acclimation of winter steelhead hatchery releases is occurring to reduce straying to surrounding basins and natural spawning areas **(Hatchery Action 1)**.
- Broodstock source for the Abernathy program has been converted to a locally adapted integrated hatchery stock **(Hatchery Action 1)**.
- Future plant sizes will be as per Abernathy Fish Technology Center integration rate protocols, and will not exceed 20,000. This program is currently being reviewed and may be modified in the future **(Hatchery Action 1)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since the late 1980s **(Harvest Action 1)**.
- This tributary may be converted to a wild steelhead gene bank to meet WDFW policy objectives for steelhead populations

Lower Cowlitz Winter Steelhead

ESA Listing Status: Threatened　　　　Population Designation: Contributing

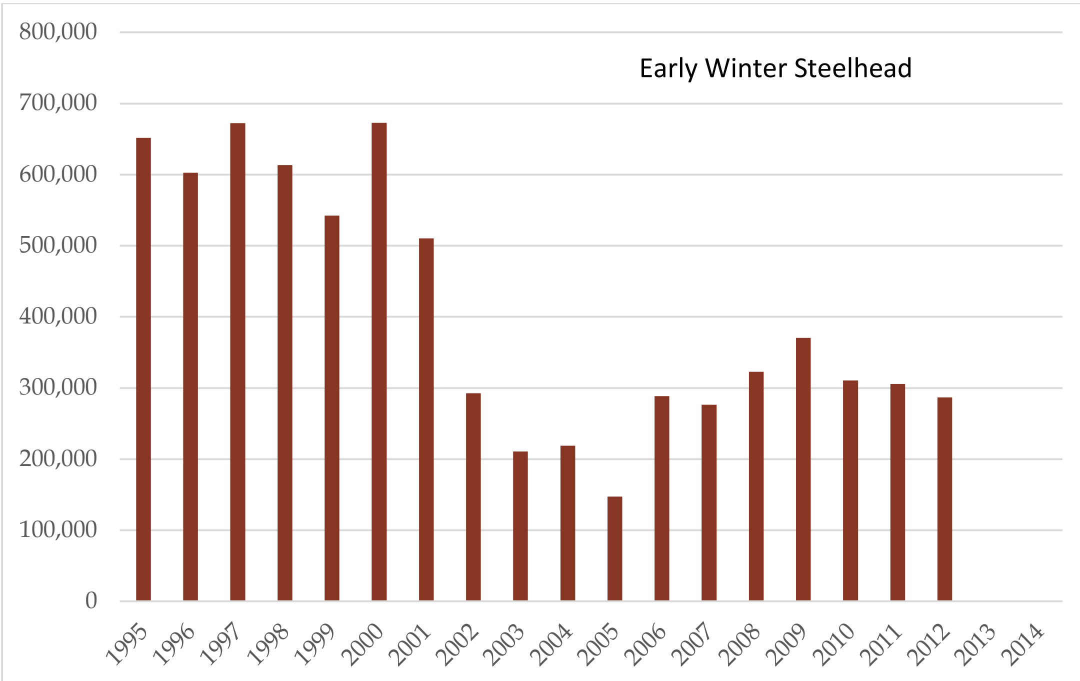
Goals		**Historical**	**Washington Recovery Plan**	
			Baseline	**Minimum Viability Goal**
Minimum Viability			Low	Medium
Escapement	Natural Origin Fish	1,400	350	400
Gene Flow (pHOS or PNI)			PNI <0.10	PNI >0.50
Fitness			0.50	0.52
Harvest Rate	Hatchery Origin Fish		60% (W) 70% (S)	NA (W) NA (S)
	Natural Origin Fish		10%	10%

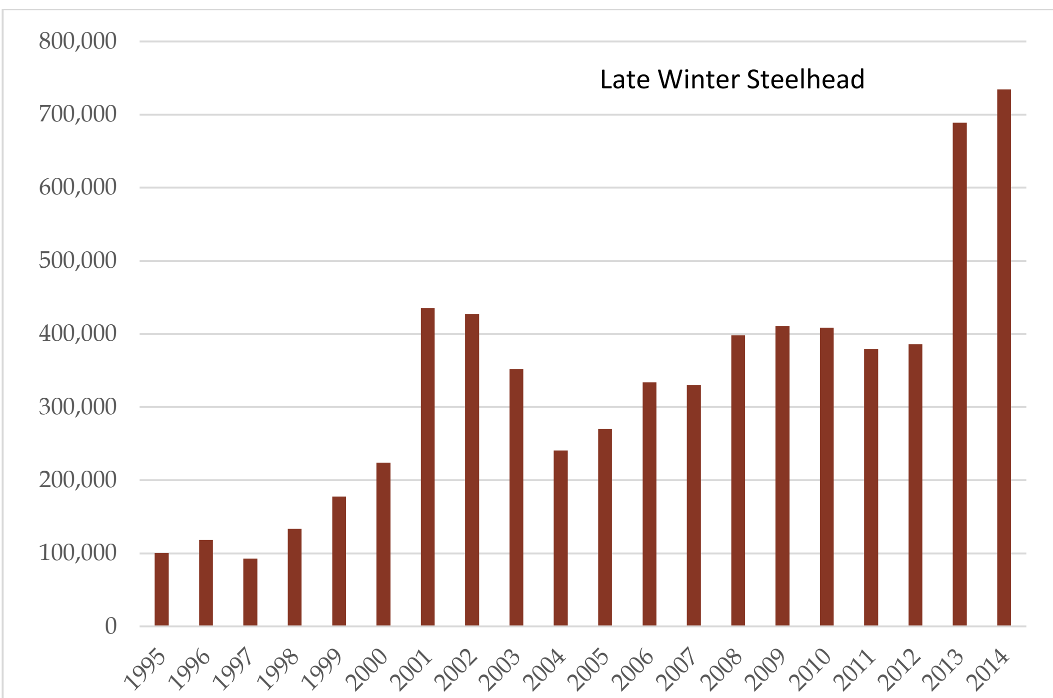
Hatchery Release And Natural Escapement Data

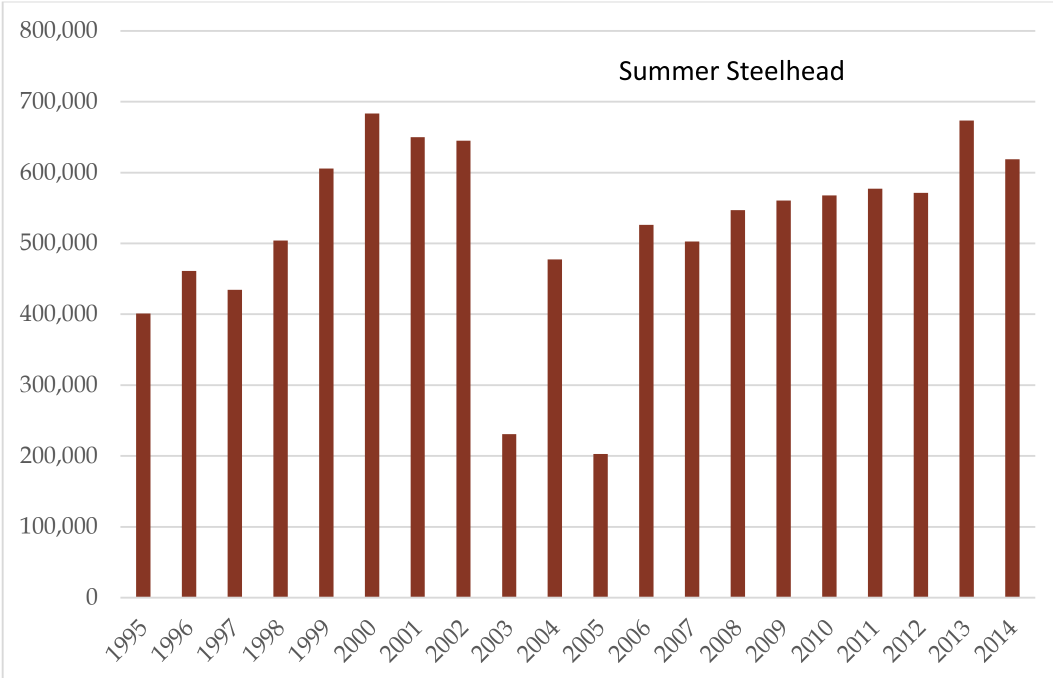
Hatchery Release Data:

- Graph below displays number of early winter steelhead smolts released in Lower Cowlitz basin since 1995
- Graph below displays number of late winter steelhead smolts released in Lower Cowlitz basin since 1995
- Graph below displays number of summer steelhead smolts released in Lower Cowlitz basin since 1995
- Late winter program converted from segregated to integrated in 2014

- Integrated programs were initiated in the Tilton basin and the Upper Cowlitz and Cispus basins with releases to occur in the lower Cowlitz River from the Cowlitz Salmon Hatchery (included in late winter steelhead smolt release graph for Lower Cowlitz winter steelhead)







Natural Escapement Data:

- Escapement estimates for winter steelhead are unavailable

Integrated Hatchery Program:

- Data not available because early winter steelhead program in Lower Cowlitz basin was operated as a segregated program
- Data not available because late winter steelhead integrated program was initiated in 2012

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Hatchery strays from within Lower Cowlitz basin – hatchery winter and summer steelhead with non-native early winter, non-native skamania summer and natvie late winter genetics
- Fitness of fish impacted by historic straying.
- Harvest impacts were not identified as a limiting factor

Potential Hatchery and Harvest Reform Actions: Lower Cowlitz Winter Steelhead	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Manage hatchery production program to achieve recovery goals and support Cowlitz River fisheries through implementation of the Cowlitz Fisheries and Hatchery Management Plan Update		X		X
2. Implement integrated broodstock program for late winter steelhead consistent with HSRG standards	X	X	X	X

3. Eliminate early (out-of-basin) winter steelhead program		X		X
4. Annually evaluate program and escapement data and adjust program size to meet HSRG standards as per Fisheries and Hatchery Management Plan Update	X	X	X	X
5. Complete recycling study to determine destination (e.g. hatchery, creel) of summer steelhead recycled one time		X		X
6. Determine how to proceed regarding summer steelhead recycling based on results of recycling study		X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Continue mark-selective steelhead fishery to assist in controlling hatchery fish on spawning grounds		X		X
2. Increase daily bag limit on hatchery origin fish		X		X

CSF Plan Actions for Lower Cowlitz Winter Steelhead

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Beginning in 2014, program was changed to integrated **(Hatchery Action 1,2).**
- The out of basin (Chambers Creek) stock was eliminated and the program was converted to historically present local stock (Hatchery Action 1,3).
- On-station acclimation of winter steelhead hatchery releases is occurring to reduce straying to surrounding basins and natural spawning areas **(Hatchery Action 1)**.
- Weirs operated in select tributaries to remove hatchery fish and collect natural origin broodstock for the integrated program. Effectiveness of this weir in meeting overall CSF Plan objectives is being evaluated. **(Hatchery Action 1).**
- Broodstock source has been converted to a locally adapted hatchery stock **(Hatchery Action 1,2)**.
- Currently, about 484,000 hatchery smolts are released **(Hatchery Action 4)**.
- Recycling study for summer steelhead was conducted in 2012 and 2013, study showed low levels of straying and recycling started in 2014 **(Hatchery Action 5,6)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since the late 1980s **(Harvest Action 1)**.
- All programs in the Cowlitz basin are reviewed annually as part of the Annual Project Review (APR) process and are subject to annual modifications.

Tilton Winter Steelhead

ESA Listing Status: Threatened　　　　Population Designation: Contributing

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	Low
Escapement	Natural Origin Fish	1,700	<50	200
Gene Flow (pHOS or PNI)			pHOS >50%	pHOS <10%
Fitness			0.50	0.75
Harvest Rate	Hatchery Origin Fish		60%	NA
	Natural Origin Fish		10%	5%

HATCHERY RELEASE AND NATURAL ESCAPEMENT DATA

Hatchery Release Data:

- No releases occurred in Tilton basin since the late 1990's
- Integrated hatchery program using natural origin broodstock (100% in 2012 and 100% in 2013) was initiated in 2012 with smolt releases to occur in the Lower Cowlitz River from Cowlitz Salmon Hatchery (included in late winters steelhead smolt release graph for Lower Cowlitz winter steelhead)
- Hatchery returns from the integrated program only will be transported and released in the Tilton Basin beginning in 2015
- All natural origin fish of Tilton origin will be transported and released in the Tilton basin

Natural Escapement Data:

- Escapement estimates for winter steelhead are unavailable

Integrated Hatchery Program:

- Data not available because integrated late steelhead program for Tilton basin was initiated in 2012

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Population limited by dam on the mainstem Cowlitz River, juvenile fish passage survival rate which is currently under evaluation by Tacoma Power (previous estimate 90% based on passage study conducted in 2003)
- Harvest impacts were not identified as a limiting factor

Potential Hatchery and Harvest Reform Actions: Tilton Winter Steelhead	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Implement integrated reintroduction program (50,000), consistent with HSRG standards, for upper Cowlitz basin through implementation of the Cowlitz River Fisheries and Hatchery Management Plan	X	X	X	X
2. Continue to estimate natural origin juvenile out migrating smolts from the Tilton basin for evaluation of smolt to adult survival	X	X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Continue mark-selective steelhead fishery to assist in controlling hatchery fish on spawning grounds		X		X
2. Implement mark-selective steelhead fishery in upper Cowlitz basin to assist in reestablishing populations that is adapted to the upper Cowlitz basin		X		X

CSF Plan Actions for Tilton Winter Steelhead

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Since about 2001, a limited number of hatchery winter steelhead adults were transported and released in the Tilton basin
- Only returns from the integrated hatchery winter steelhead program and natural origin steelhead will be transported and released upstream of Cowlitz Falls Dam beginning in 2015.
- Integrated winter steelhead broodstock was developed using natural origin adults returning to the Tilton basin **(Hatchery Action 1).**
- Beginning in 2013, program was changed to integrated **(Hatchery Action 1).**
- Broodstock source has been converted to a locally adapted stock **(Hatchery Action 1)**.
- On-station acclimation of winter steelhead hatchery releases is occurring to reduce straying to surrounding basins and natural spawning areas **(Hatchery Action 1)**.
- Currently, about 50,000 integrated hatchery smolts are released in the lower Cowlitz River and upon return adults will be transported and released in the Tilton River **(Hatchery Action 1)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since the late 1980s **(Harvest Action 1)**.
- All programs in the Cowlitz basin are reviewed annually as part of the Annual Project Review (APR) process and are subject to annual modifications.

Upper Cowlitz and Cispus Winter Steelhead

ESA Listing Status:
Upper Cowlitz-Threatened
Cispus-Threatened

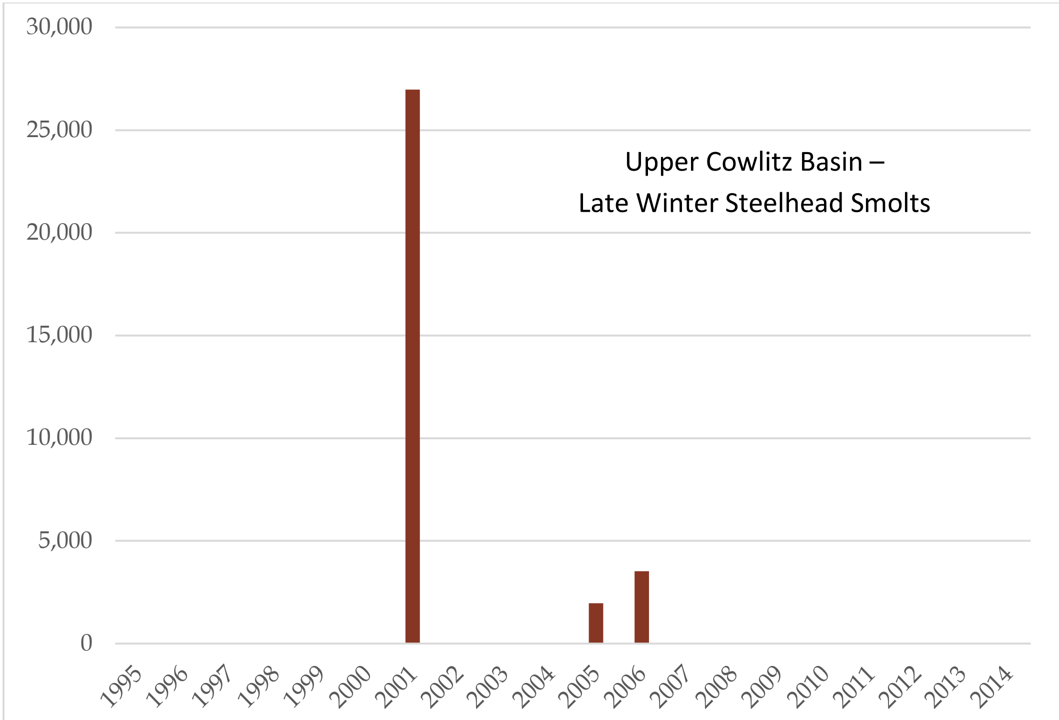
Population Status:
Upper Cowlitz-Primary
Cispus-Primary

Goals		Historical	Washington Recovery Plan: Baseline	Washington Recovery Plan: Minimum Viability Goal
Minimum Viability			Very Low Very Low	High High
Escapement	Natural Origin Fish	1,400 (UC) 1,500 (Cis)	<50 <50	500 500
Gene Flow (pHOS or PNI)			pHOS >50% pHOS > 50%	pHOS< 5% pHOS<5%
Fitness			0.50 0.50	0.75 0.75
Harvest Rate	Hatchery Origin Fish		60% 60%	NA
Harvest Rate	Natural Origin Fish		10% 10%	5% 5%

Hatchery Release and Natural Escapement Data

Hatchery Release Data:

- Graph below displays number of late winter steelhead smolts released in Upper Cowlitz basin since 1995
- Graph below displays number of late winter steelhead fry released in Upper Cowlitz basin since 1995
- Graph below displays number of late winter steelhead smolts released in Cispus basin since 1995
- Graph below displays number of late winter steelhead fry released in Cispus basin since 1995
- Integrated hatchery program using natural origin broodstock (87% in 2012 and 100% in 2013) was initiated in 2012 with smolt releases to occur in the Lower Cowlitz River from Cowlitz Salmon Hatchery (included in late winter steelhead smolt release graph for Lower Cowlitz winter steelhead)
- Hatchery returns from the integrated program only will be transported and released in the Upper Cowlitz and Cispus basins beginning in 2015
- All natural origin fish of Upper Cowlitz or Cispus origin will be transported and released in the Upper Cowlitz or Cispus basin


Upper Cowlitz Basin –
Late Winter Steelhead Smolts
30,000
25,000
20,000
15,000
10,000
5,000
0
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
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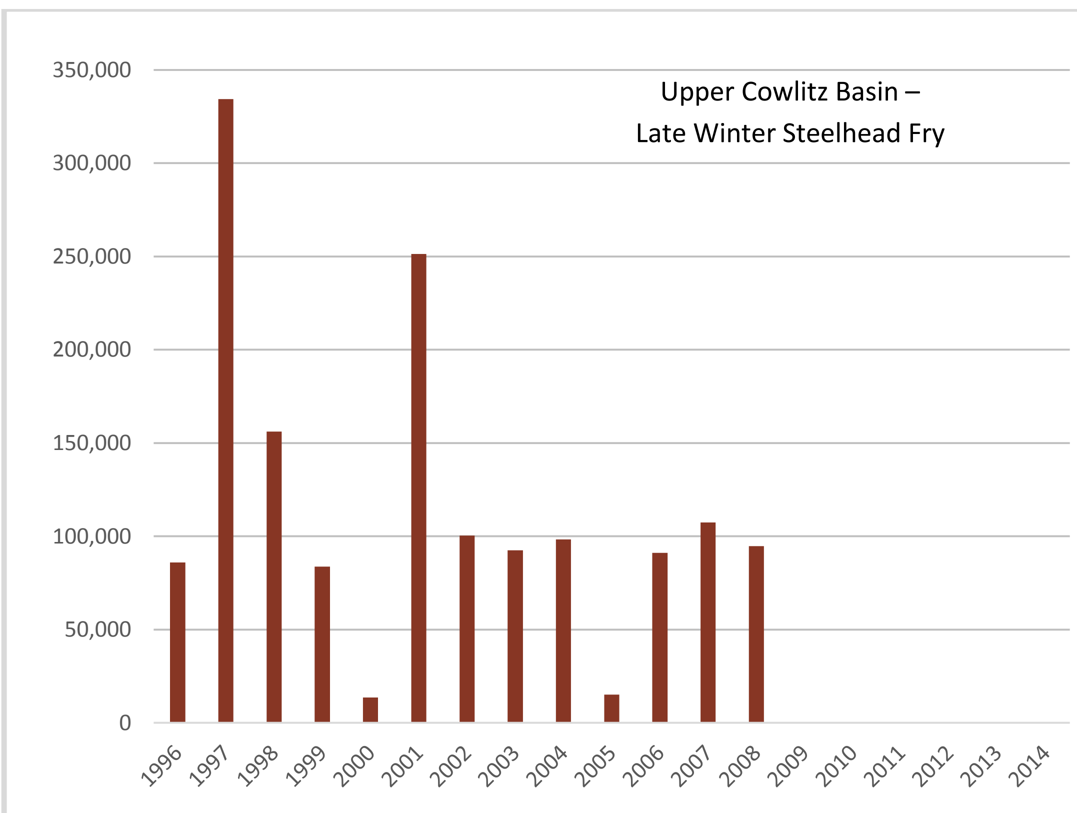
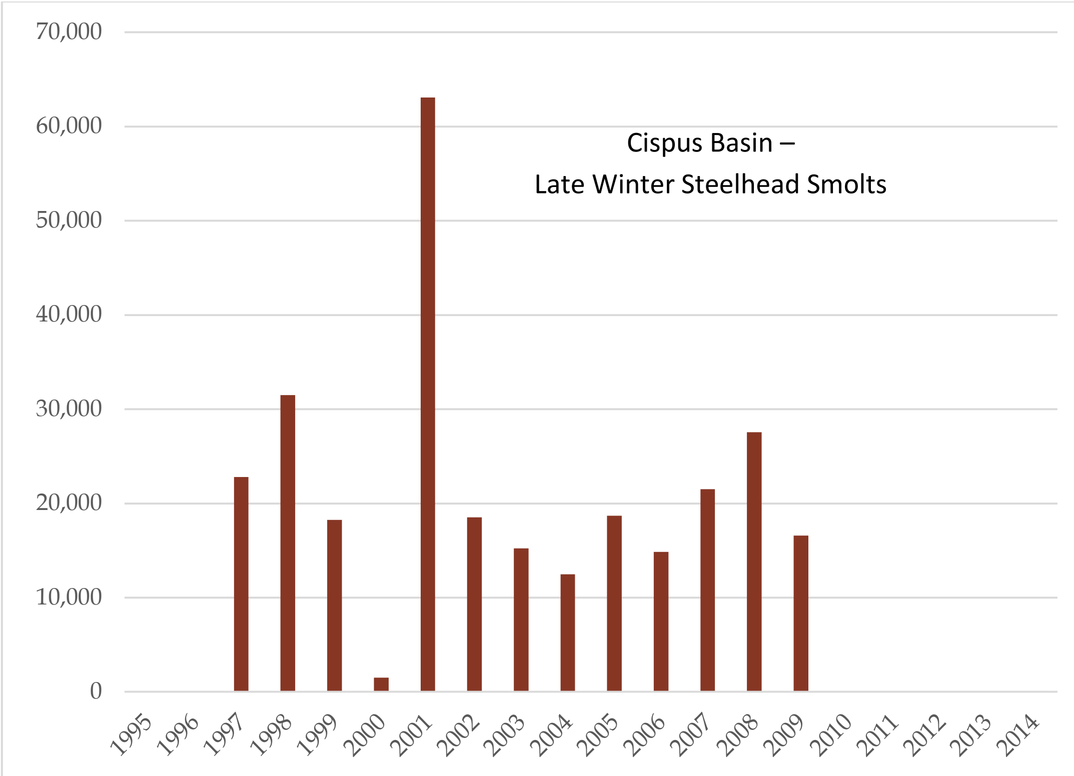
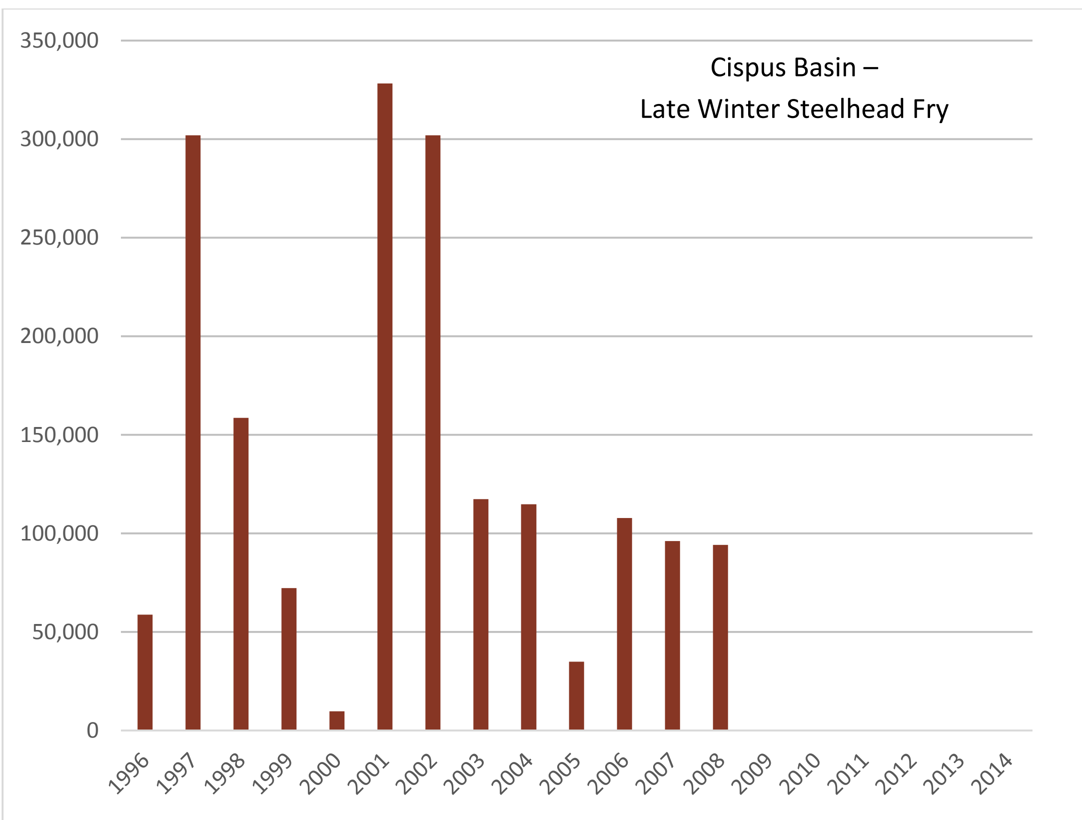
2009
2010
2011
2012
2013
2014


Upper Cowlitz Basin –
Late Winter Steelhead Fry
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014


70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Cispus Basin –
Late Winter Steelhead Smolts
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014


350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
Cispus Basin –
Late Winter Steelhead Fry
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014

Natural Escapement Data:

- Escapement estimates for winter steelhead are unavailable

Integrated Hatchery Program:

- Data not available because integrated late steelhead program for Upper Cowlitz and Cispus basins was initiated in 2012

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Population limited by 3 dams on the mainstem Cowlitz River and low fish collection efficiency at Cowlitz Falls Dam
- Hatchery strays from within basin (past fry and smolt plant and recently initiated smolt program) – hatchery winter steelhead with native late winter genetics
- Harvest impacts were not identified as a limiting factor

Potential Hatchery and Harvest Reform Actions: Upper Cowlitz and Cispus Winter Steelhead	**Viable Salmonid Population (VSP) Parameters Addressed**			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Implement integrated reintroduction program (118,000), consistent with HSRG standards, for upper Cowlitz basin through implementation of the Cowlitz River Fisheries and Hatchery Management Plan	X	X	X	X
2. Transport only adults from integrated program upstream of Cowlitz Falls Dam	X	X		X
3. Continue to work to increase juvenile fish collection at Cowlitz Falls Dam and potentially in upper Riffe Lake	X	X	X	X
4. Manage adults transferred to upper Cowlitz basin to achieve HSRG standards when juvenile collection rate (5-yr avg.) achieves 50%	X	X	X	X
Harvest Actions	**A**	**P**	**S**	**D**
1. Continue mark-selective steelhead fishery to assist in controlling hatchery fish on spawning grounds		X		X
2. Implement mark-selective steelhead fishery in upper Cowlitz basin to assist in reestablishing populations that is adapted to the upper Cowlitz basin		X		X

CSF Plan Actions for Upper Cowlitz and Cispus Winter Steelhead

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal

for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Currently, about 118,000 hatchery smolts are released into the lower Cowlitz River. Upon return, the adults will be released above Cowlitz Falls Dam (**Hatchery Action 1)**.
- On-station acclimation of winter steelhead hatchery releases is occurring to reduce straying to surrounding basins and natural spawning areas.
- Integrated winter steelhead broodstock developed using natural origin adults returning to the upper Cowlitz basin **(Hatchery Action 1).**
- Reintroduction efforts for winter steelhead will begin in 2015 using adult supplementation **(Hatchery Action 1,2,4).**
- Design has been completed for a new collector at Cowlitz Falls Dam. Construction of a new collector is expected to be completed in 2017. Testing for an additional collector just downstream of Cowlitz Falls Dam is underway (Hatchery Action 3).
- Success is determined by juvenile fish collection efficiency at Cowlitz Falls Dam **(Hatchery Action 3).**
- On-station acclimation of winter steelhead hatchery releases is occurring to reduce straying to surrounding basins and natural spawning areas.
- Winter steelhead hatchery adults transported and released upstream of Cowlitz Falls Dam since 1997 through about 2007 and in 2014 to support harvest and assist in reintroduction efforts **(Hatchery Action 1,4 and Harvest Action 2).**
- Only returns from integrated winter steelhead hatchery program and natural origin returns will be transported and reeleased upsteam of Cowlitz Falls Dam beginning in 2015 **(Hatchery Action 1,2).**
- Mark-selective sport fisheries have been in place in lower Columbia River tributaries and upper Cowlitz basin since the late 1980s **(Harvest Action 1)**.
- All programs in the Cowlitz basin are reviewed annually as part of the Annual Project Review (APR) process and are subject to annual modifications.

North Fork Toutle Winter Steelhead

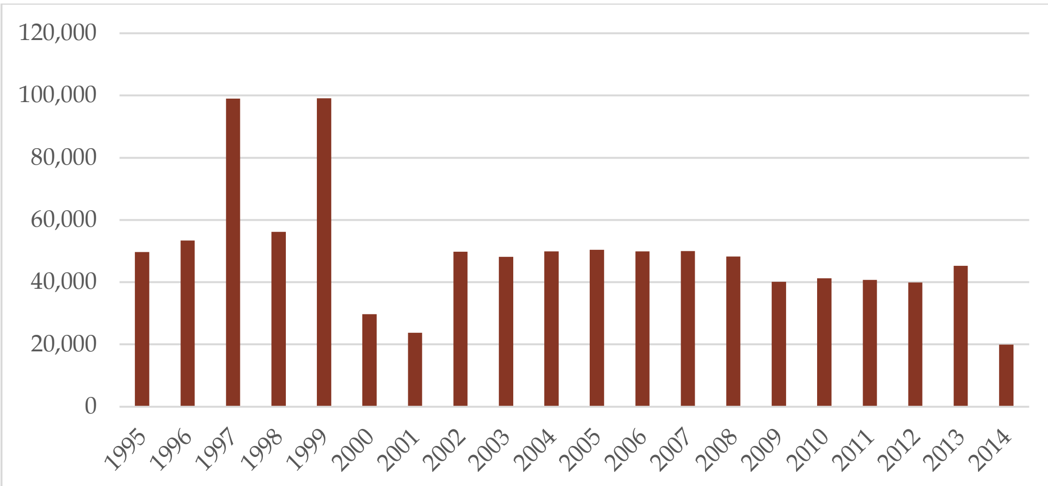
ESA Listing Status: Winter: Threatened Population Designation: Winter: Primary

Goals		Historical	Washington Recovery Plan	
			Baseline	**Minimum Viability Goal**
Minimum Viability			Very Low	High
Escapement	Natural Origin Fish	3,600 for SF and NF	120	600
Gene Flow (pHOS or PNI)			pHOS >5%	pHOS < 5%
Fitness			0.67	0.74
Harvest Rate	Hatchery Origin Fish		70%	NA
	Natural Origin Fish		10%	8%

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Graph below displays number of summer steelhead smolts released in North Fork Toutle basin (released from North Fork Toutle Hatchery in Green River) since 1995
- Only natural origin winter steelhead are transported and released upstream of the Sediment Retention Structure on the North Fork Toutle River



Natural Escapement Data:

- Escapement data for winter steelhead presented in Table 7-2 at the start of this section titled "Winter and Summer Steelhead Populations"

Integrated Hatchery Program:

- Data not available because steelhead hatchery program was discontinued in 2014
- Data not available because summer steelhead program in North Fork Toutle basin is being operated as a segregated program

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Hatchery strays from within basin (recently discontinued program) – hatchery summer steelhead with non-native skamania genetics
- Fitness of fish impacted by historic straying
- Harvest impacts were not identified as a limiting factor

Potential Hatchery and Harvest Reform Actions: North Fork Toutle Winter Steelhead	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Establish North Fork Toutle as a wild fish refuge for wild winter steelhead	X	X	X	X
2. Eliminate hatchery releases in North Fork Toutle basin		X	X	X

Harvest Actions	A	P	S	D
1. Continue mark-selective steelhead fishery to assist in controlling hatchery fish on spawning grounds		X		X
2. Increase bag limit on hatchery origin fish		X		X

CSF Plan Actions for North Fork Toutle Winter Steelhead

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- The NF Toutle/Green was designated as a wild steelhead gene bank **(Hatchery Action 1).**
- Hatchery program eliminated in 2014 for the Green/NF Toutle – last release was in 2013 **(Hatchery Action 1,2).**
- Operational changes were made at the NF Toutle Fish Collection Facility to improve fish collection and passage into the upper NF Toutle.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since the late 1980s **(Harvest Action 1)**.

South Fork Toutle Winter Steelhead

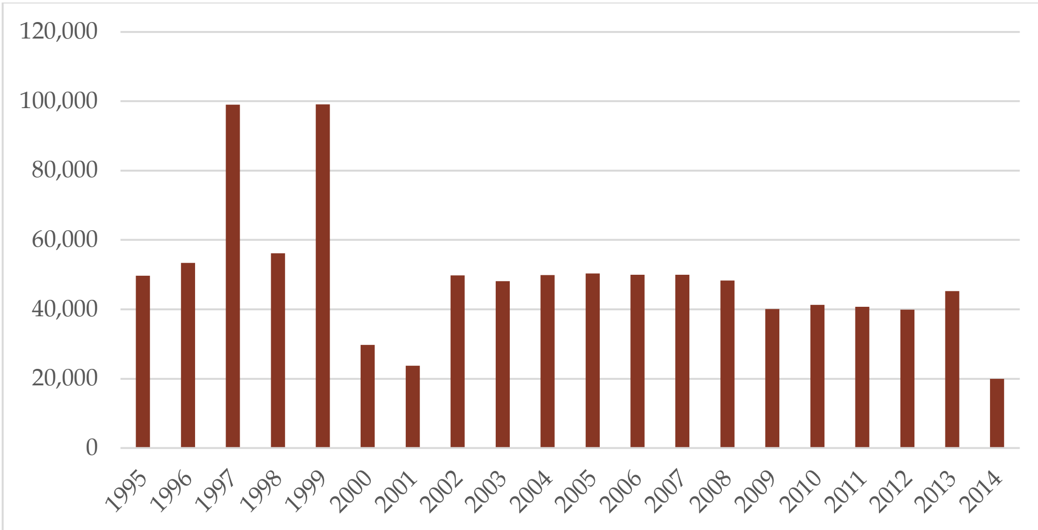
ESA Listing Status: Winter: Threatened Population Designation: Winter: Primary

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Medium	High+
Escapement	Natural Origin Fish	3,600 for SF and NF	350	600
Gene Flow (pHOS or PNI)			pHOS >10%	pHOS < 5%
Fitness			0.50	0.54
Harvest Rate	Hatchery Origin Fish		70%	NA
	Natural Origin Fish		10%	9%

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Graph below displays number of summer steelhead smolts released in South Fork Toutle basin since 1995



Natural Escapement Data:

- Escapement data for winter steelhead presented in Table 7-2 at the start of this section titled "Winter and Summer Steelhead Populations"

Integrated Hatchery Program:

- Data not available because summer steelhead program in South Fork Toutle basin is being operated as a segregated program

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Hatchery strays from within South Fork Toutle basin – hatchery summer steelhead with non-native skamania summer genetics
- Fitness of fish impacted by historic straying.
- Harvest impacts were not identified as a limiting factor

Potential Hatchery and Harvest Reform Actions: South Fork Toutle Winter Steelhead	**Viable Salmonid Population (VSP) Parameters Addressed**			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Reduce hatchery program from 25,000 to 20,000 smolts (20%), consistent with HSRG standards		X		X
2. Investigate potential to collect un-harvested hatchery adults at Cowlitz Game and Anglers rearing pond		X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Continue mark-selective steelhead fishery to assist in controlling hatchery fish on spawning grounds		X		X
2. Implement multi-year study to determine in-river harvest rate and escapement of hatchery fish to natural spawning locations		X	X	X

CSF Plan Actions for South Fork Toutle Winter Steelhead

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Acclimation of winter steelhead hatchery releases is occurring to reduce straying to surrounding basins and natural spawning areas **(Hatchery Action 1)**. An acclimation pond (South Fork Toutle Pond) is located at river kilometer 16.1 on the South Fork Toutle River.
- Hatchery releases are 20,000 smolts **(Hatchery Action 1)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since the late 1980s **(Harvest Action 1)**.
- A creel study to estimate total harvest and impact rates to natural origin steelhead was conducted for several years. Results are pending **(Harvest Action 2)**.

Coweeman Winter Steelhead

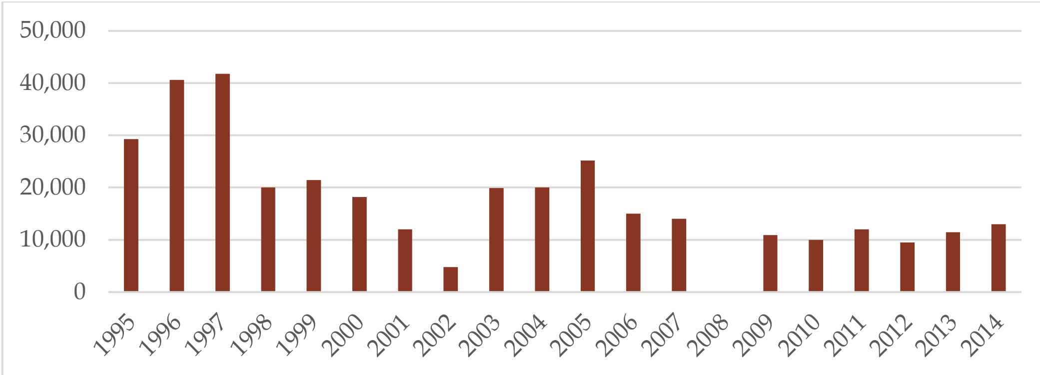
ESA Listing Status: Threatened Population Designation: Primary

Goals		Historical	Washington Recovery Plan	
			Baseline	**Minimum Viability Goal**
Minimum Viability			Low	High
Escapement	Natural Origin Fish	900	350	500
Gene Flow (pHOS or PNI)			pHOS <10%	pHOS <5%
Fitness			0.84	0.86
Harvest Rate	Hatchery Origin Fish		60%	NA
	Natural Origin Fish		10%	9%

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Graph below displays number of early winter steelhead smolts released in Coweeman basin since 1995



Natural Escapement Data:

- Escapement data for winter steelhead presented in Table 7-2 at the start of this section titled "Winter and Summer Steelhead Populations"

Integrated Hatchery Program:

- Data not available because early winter steelhead program in Coweeman basin is being operated as a segregated program

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Hatchery strays from within Coweeman basin – hatchery winter steelhead with non-native early winter genetics
- Fitness of fish impacted by historic straying.
- Harvest impacts were not identified as a limiting factor

Potential Hatchery and Harvest Reform Actions: Coweeman Winter Steelhead	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Reduce steelhead releases in the Coweeman River from 20,000 to 12,000 (40%), consistent with HSRG standards		X		X
Harvest Actions	**A**	**P**	**S**	**D**
2. Continue mark-selective steelhead fishery to assist in controlling hatchery fish on spawning grounds		X		X

CSF Plan Actions for Coweeman Winter Steelhead

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal

for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Acclimation of winter steelhead hatchery releases is occurring to reduce straying to surrounding basins and natural spawning areas **(Hatchery Action 1)**. Acclimation occurs in an acclimation pond at river kilometer 16.1 on the Coweeman River.
- Hatchery winter steelhead released reduced in 2009 to meet HSRG standards (Hatchery Action 1).
- Hatchery releases are 12,000 **(Hatchery Action 1)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since the late 1980s **(Harvest Action 1)**.
- Additional area was opened to sport fishing in the upper Coweeman to provide additional access and promote increased harvest rates of hatchery steelhead.

Kalama Winter and Summer Steelhead

ESA Listing Status:
Winter: Threatened
Summer: Threatened

Population Designation:
Winter: Primary
Summer: Primary

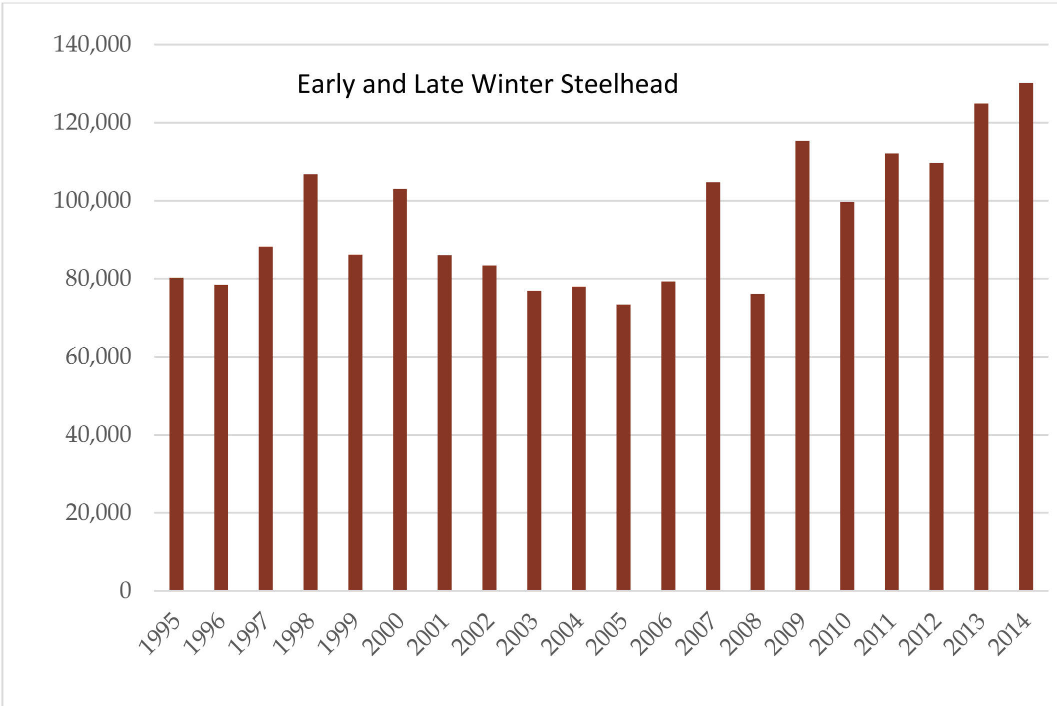
WINTER		**Historical**	**Washington Recovery Plan**	
Goals			**Baseline**	**Minimum Viability Goal**
Minimum Viability			Low	High+
Escapement	Natural Origin Fish	800	300	600
Gene Flow (pHOS or PNI)			pHOS <5%	pHOS < 5%
Fitness			0.97	0.98
Harvest Rate	Hatchery Origin Fish		60%	NA
	Natural Origin Fish		10%	7%
SUMMER		**Historical**	**Washington Recovery Plan**	
Goals			**Baseline**	**Minimum Viability Goal**
Minimum Viability			Med	High
Escapement	Natural Origin Fish	1,000	500	500
Gene Flow (pHOS or PNI)			pHOS <5%	pHOS < 5%
Fitness			0.98	0.99
Harvest Rate	Hatchery Origin Fish		70%	NA
	Natural Origin Fish		10%	10%

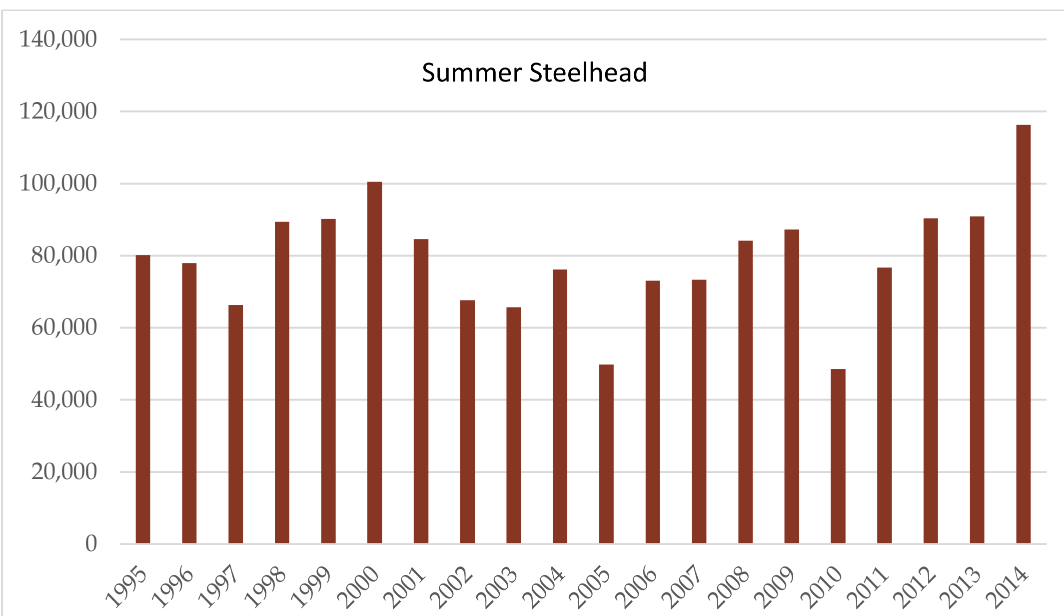
Hatchery Release and Natural Escapement Data

Hatchery Release Data:

- Graph below displays number of winter steelhead smolts released in Elochoman basin since 1995

- Graph below displays number of summer steelhead smolts released in Elochoman basin since 1995
- Both winter and summer programs include both and integrated hatchery program using natural origin broodstock and a segregated hatchery program using only hatchery origin broodstock
- Early winter steelhead is a segregated program and late winter steelhead is an integrated program
- Summer steelhead integrated and segregated programs have similar return timing
- During 2008-2014 percent natural origin fish in broodstock has averaged 100% for the late winter steelhead integrated program and 87% for the summer steelhead integrated program





Natural Escapement Data:

- Escapement data for winter steelhead presented in Table 7-2 at the start of this section titled "Winter and Summer Steelhead Populations"
- Escapement data for summer steelhead presented in Table 7-3 at the start of this section titled "Winter and Summer Steelhead Populations"

Integrated Hatchery Program:

- Data not available because steelhead program in Kalama basin two the four programs are being operated as a segregated program
- Table below provides metrics for integrated late winter steelhead hatchery program in Kalama basin

Integrated Hatchery Program Metrics for Kalama Late Winter Steelhead			
Year	**pNOB***	**pHOS****	**PNI*****
2008	1.00	0.08	0.93
2009	1.00	0.08	0.93
2010	1.00	0.08	0.93
2011	1.00	0.08	0.93
2012	1.00	0.08	0.93
2013	1.00	0.07	.093
2013	1.00	0.07	0.93
Average	1.00	0.07	0.93

Integrated Hatchery Program Metrics for Kalama Summer Steelhead			
Year	**pNOB***	**pHOS****	**PNI*****
2008	0.74	0.04	0.95
2009	0.70	0.04	0.95
2010	0.67	0.04	0.94
2011	1.00	0.04	0.96
2012	1.00	0.04	0.96
2013	1.00	0.07	0.93
2014	1.00	0.07	0.93
Average	0.87	0.07	0.93

* Integrated program implemented since 2008 using nattural origin fish returning to Kalama Falls hatchery
** Annual pHOS estimated based on actual observations from spawning ground surveys (see escapement estimates above)
** Average (2008-2013) reduced by 20% to account for reduced productivity resulting from hatchery fish spawning in natural spawning locations
*** PNI calcuated using annual estimates for individual year and average estimates for muli-year average

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Hatchery strays from within Kalama basin – hatchery winter and summer steelhead with non-native early winter, non-native skamania summer, native late winter and native kalama summer genetics
- Harvest impacts were not identified as a limiting factor

Potential Hatchery and Harvest Reform Actions: Kalama Winter and Summer Steelhead	**Viable Salmonid Population (VSP) Parameters Addressed**			
Hatchery Actions+	**A**	**P**	**S**	**D**
1. Utilize trap at Kalama Falls Hatchery to limit number of hatchery steelhead passed upstream to the upper Kalama River (above Kalama Falls)	X	X	X	X

2. Maintain current hatchery releases of winter and summer steelhead, consistent with HSRG standards, to support sport fishing opportunities in Kalama basin		X		X
3. Continue current integrated and segregated production programs in lower Kalama River		X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Increase the harvest of hatchery fish		X		X
2. Continue mark-selective steelhead fishery to assist in controlling hatchery fish on spawning grounds		X		X
3. Implement mark-selective fisheries upstream of Kalama Falls to reduce hatchery fish on spawning grounds		X		X
4. Evaluate current 1-time recycling program and use results for study using Cowlitz summer steelhead to inform decision		X		X

CSF Plan Actions for Kalama Winter and Summer Steelhead

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Integrated winter steelhead broodstock developed using natural origin adults returning to Kalama Falls Hatchery **(Hatchery Action 2, 3).**
- Integrated summer steelhead broodstock developed using natural origin adults returning to Kalama Falls Hatchery **(Hatchery Action 2, 3).**
- Only natural origin winter and summer steelhead and a portion of the returns from the summer integrated program are transported and released upstream of Kalama Falls Hatchery **(Hatchery Action 1)**. Transporting hatchery fish above the falls is continually evaluated and may not always occur.
- WDFW has requested funding to improve the barrier at Kalama Falls Hatchery. The barrier is intended to prevent summer steelhead from going above the hatchery.
- On-station acclimation of winter steelhead hatchery releases is occurring to reduce straying to surrounding basins and natural spawning areas **(Hatchery Action 1)**.
- Broodstock source for the early winter and summer segregated programs have been converted to a locally adapted hatchery stock **(Hatchery Action 2)**.
- Hatchery releases for summer steelhead are 60,000 wild and 30,000 early hatchery origin **(Hatchery Action 2,3)**.
- Hatchery releases for winter steelhead are 45,000 late winter and 45,000 early winter **(Hatchery Action 2,3)**.
- Mark-selective sport fisheries have been in place most in lower Columbia River tributaries since the late 1980s **(Harvest Action 1)**.
- Implement mark-selective fisheries upstream of Kalama Falls to reduce hatchery fish on spawning grounds **(Harvest Action 3)**.

North Fork Lewis Winter and Summer Steelhead

ESA Listing Status:
Winter: Threatened
Summer: Threatened

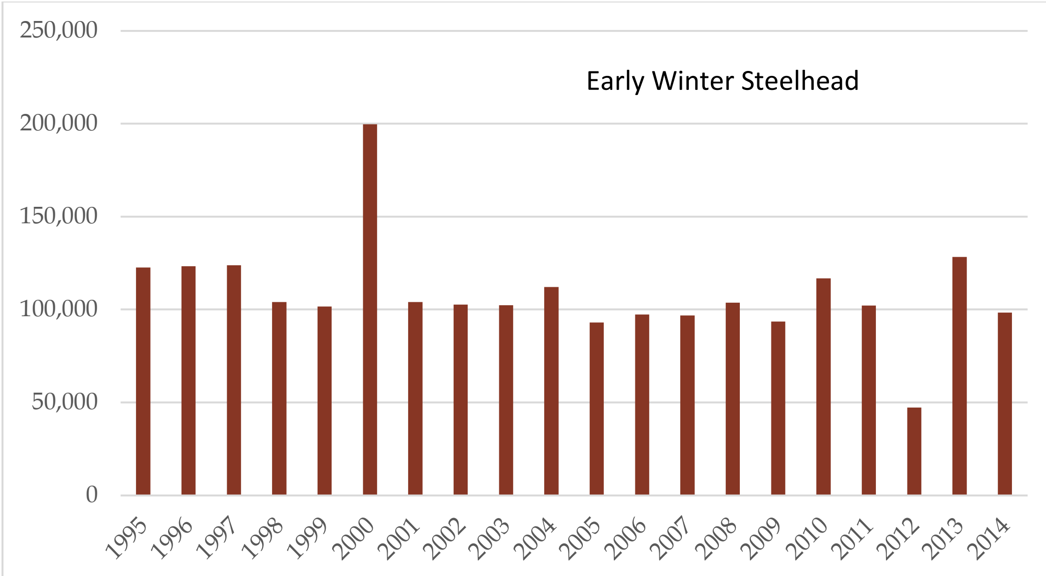
Population Designation:
Winter: Contributing
Summer: Stabilizing

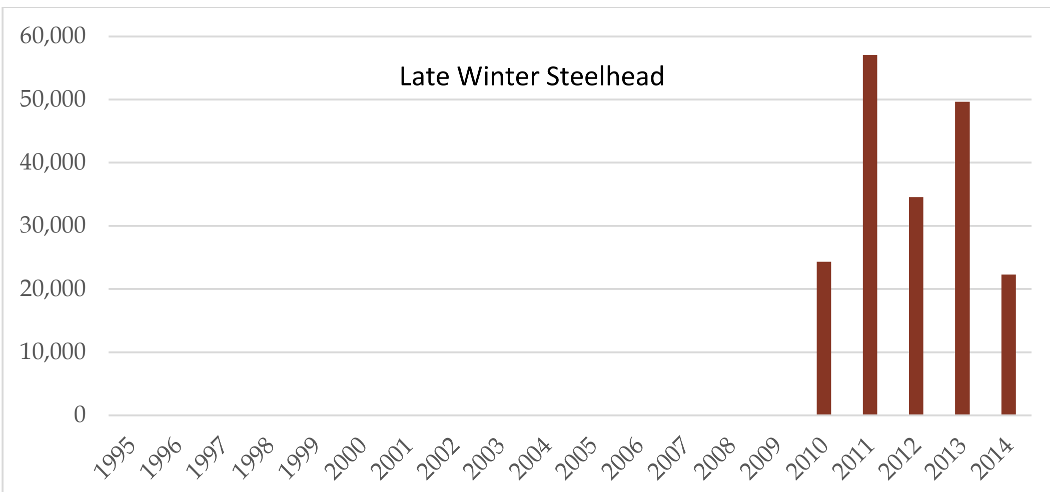
WINTER		Historical	Washington Recovery Plan	
Goals			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	Medium
Escapement	Natural Origin Fish	8,300	150	400
Gene Flow (pHOS or PNI)			pHOS >50%	pHOS <10%
Fitness			0.50	0.75
Harvest Rate	Hatchery Origin Fish		60%	NA
	Natural Origin Fish		10%	5%
SUMMER		**Historical**	**Washington Recovery Plan**	
Goals			**Baseline**	**Minimum Viability Goal**
Minimum Viability			Very Low	Very Low
Escapement	Natural Origin Fish	Na	150	150
Gene Flow (pHOS or PNI)			pHOS >50%	pHOS current
Fitness			0.52	0.52-
Harvest Rate	Hatchery Origin Fish		70%	NA
	Natural Origin Fish		10%	10%

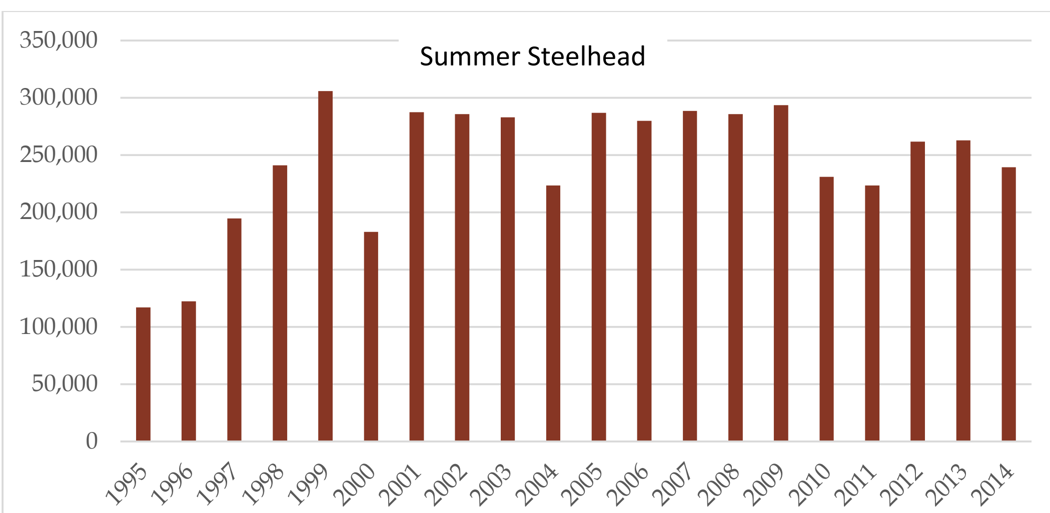
Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Graph below displays number of early winter steelhead smolts released in North Fork Lewis basin since 1995
- Graph below displays number of late winter steelhead smolts released in North Fork Lewis basin since 1995
- Graph below displays number of summer steelhead smolts released in North Fork Lewis basin since 1995
- Late winter steelhead program is an integrated program and during 2008-2014


Early Winter Steelhead
250,000
200,000
150,000
100,000
50,000
0
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014


Late Winter Steelhead
60,000
50,000
40,000
30,000
20,000
10,000
0
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014


Summer Steelhead
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014

Natural Escapement Data:

- Escapement estimates for winter and summer steelhead are unavailable

Integrated Hatchery Program:

- Data not available because early winter steelhead program in North Fork Lewis basin is being operated as a segregated program
- Table below provides metrics for integrated late winter steelhead hatchery program in North Fork Lewis basin

Integrated Hatchery Program Metrics for North Fork Lewis Late Winter Steelhead			
Year	**pNOB***	**pHOS****	**PNI*****
2008	1.00	0.20	0.83
2009	1.00	0.20	0.83
2010	1.00	0.20	0.83
2011	1.00	0.20	0.83
2012	1.00	0.20	0.83
2013	1.00	0.20	0.83
Average	1.00	0.20	0.83

* Integrated program initiated in 2008 natural origin collected from lower North Fork Lewis River
** Annual pHOS estimated based on actual observations from spawning ground surveys (see escapement estimates above)
** Average (2008-2013) reduced by 20% to account for reduced productivity resulting from hatchery fish spawning in natural spawning locations
*** PNI calcuated using annual estimates for individual year and average estimates for muli-year average

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Hatchery strays from within wateshed – hatchery summer and winter steelhead with non-native early winter, non-native skamania summer and native late winter genetics
- Fitness of fish impacted by historic straying
- Harvest impacts were not identified as a limiting factor
- Historic habitat for winter steelhead blocked by 3 dams on the mainstem North Fork Lewis River

Potential Hatchery and Harvest Reform Actions: North Fork Lewis Winter and Summer Steelhead	**Viable Salmonid Population (VSP) Parameters Addressed**			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Reduce summer steelhead hatchery releases in the North Fork Lewis River by 18%		X		X
2. Implement an integrated reintroduction program (above Swift Dam) for wild winter steelhead	X	X	X	X
3. Implement study to determine final destination (e.g. Merwin trap, natural spawning grounds) of adult offspring from integrated reintroduction program		X	X	X
4. Reintroduction efforts dependent on fish collection facilities that began operation in December 2012	X	X	X	X
5. Maintain current winter steelhead hatchery releases, consistent with HSRG standards, to support fishing opportunities in the lower North Fork Lewis River		X		X

6. Review hatchery program production level through Aquatic Coordinating Committee as natural populations are reestablished in the upper North Fork Lewis basin	X	X	X	X
7. Evaluate current 1-time recycling program for summer steelhead and use Cowlitz study to inform decision		X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Continue mark-selective steelhead fishery to assist in controlling hatchery fish on spawning grounds		X		X
2. Close North Fork Lewis basin to sport angling for salmon and steelhead until reestablished population has achieved a healthy and harvestable level	X	X		X

CSF Plan Actions for North Fork Lewis Winter and Summer Steelhead

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Integrated winter steelhead broodstock developed using natural origin adults returning the the lower North Fork Lewis River **(Hatchery Action 2)**.
- Reintroduction efforts for winter steelhead are underway using adult supplementation **(Hatchery Action 2)**.
- Only returns from integrated winter steelhed hatchery program transported and released upstream of Swift Reservior since 2011 **(Hatchery Action 2)**.
- Success is to be determined by juvenile fish collection efficiency at Swift Dam **(Hatchery Action 4)**.
- Hatchery releases for winter steelhead are 100,000 early winter and 50,000 late winter **(Hatchery Action 5)**.
- The program size for hatchery summer steelhead was reduced from 285,000 to 235,000 in 2010 **(Hatchery Action 1,5)**.
- WDFW and LCFRB staff will remain active participants in the ACC **(Hatchery Action 6).**
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since the late 1980s **(Harvest Action 1)**.

East Fork Lewis Winter and Summer Steelhead

ESA Listing Status:
Winter: Threatened
Summer: Threatened

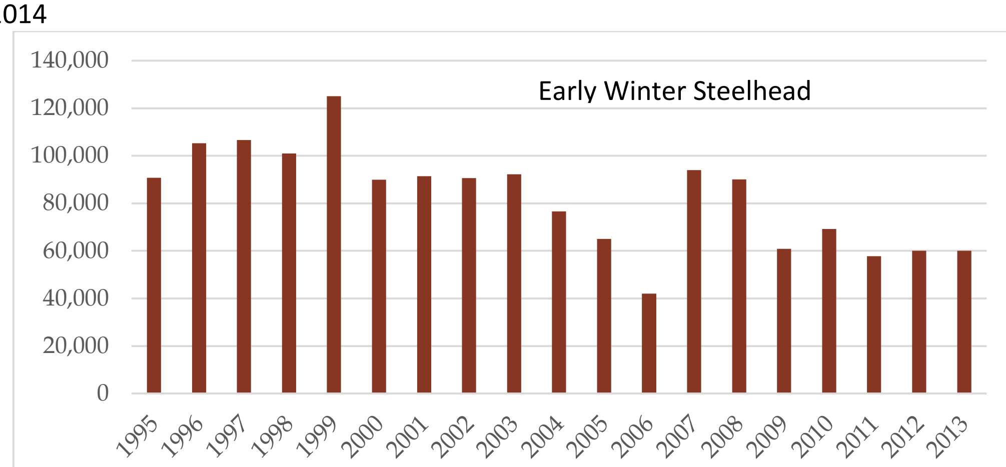
Population Designation:
Winter: Primary
Summer: Primary

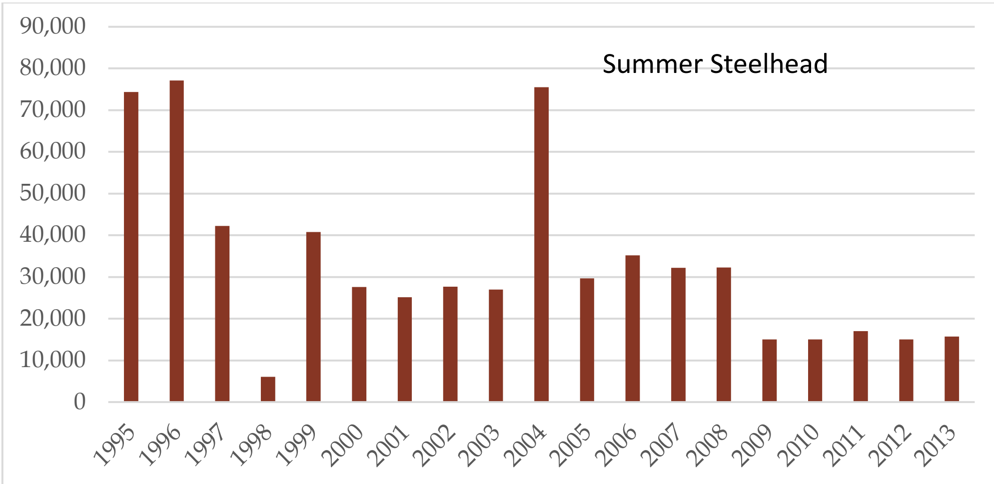
WINTER		Historical	Washington Recovery Plan	
Goals		**Historical**	**Baseline**	**Minimum Viability Goal**
Minimum Viability			Medium	High
Escapement	Natural Origin Fish	900	350	500
Gene Flow (pHOS or PNI)			pHOS >10%	pHOS <5%
Fitness			0.50	0.55
Harvest Rate	Hatchery Origin Fish		60%	NA
	Natural Origin Fish		10%	9%
SUMMER			**Washington Recovery Plan**	
Goals		**Historical**	**Baseline**	**Baseline**
Minimum Viability			Very Low	High
Escapement	Natural Origin Fish	600	<50	500
Gene Flow (pHOS or PNI)			pHOS >10%	pHOS <5%
Fitness			0.50	0.75
Harvest Rate	Hatchery Origin Fish		70%	NA
	Natural Origin Fish		10%	5%

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Graph below displays number of early winter steelhead smolts released in East Fork Lewis basin since 1995
- Graph below displays number of summer steelhead smolts released in East Fork Lewis basin since 1995
- Hatchery releases (both early winter and summer) in East Fork Lewis basin were discontinued in 2014





Natural Escapement Data:
- Escapement data for winter steelhead presented in Table 7-2 at the start of this section titled "Winter and Summer Steelhead Populations"
- Escapement data for summer steelhead presented in Table 7-2 at the start of this section titled "Winter and Summer Steelhead Populations"

Integrated Hatchery Program:
- Data not available because early winter and summer steelhead programs in East Fork Lewis basin are being operated as a segregated program

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors
- Hatchery strays from within East Fork Lewis basin – hatchery winter and summer steelhead with non-native early winter and non-native skamania genetics
- Fitness of fish impacted by historic straying.
- Harvest impacts were not identified as a limiting factor

Potential Hatchery and Harvest Reform Actions: East Fork Lewis Winter and Summer Steelhead	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Reduce hatchery winter steelhead releases in the East Fork Lewis River from 90,000 to 60,000 (33% reduction)		X		X
2. Reduce hatchery summer steelhead releases in the East Fork Lewis River from 30,000 to 15,000 (50% reduction)		X		X
3. Evaluate establishment of wild summer and winter steelhead refuges as part of WDFW's steelhead watershed planning process				
Harvest Actions	**A**	**P**	**S**	**D**
1. Continue mark-selective steelhead fishery to assist in controlling hatchery fish on spawning grounds		X		X
2. Increase bag limit on hatchery origin fish		X		X

CSF Plan Actions for East Fork Lewis Winter and Summer Steelhead

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Hatchery winter and summer steelhead releases reduced in about 2009 to meet HSRG standards. Winter steelhead were reduced from 90,000 to 60,000 and summer steelhead were reduced from 30,000 to 15,000 **(Hatchery Action 1,2).**
- 2013 was the last release of summer and winter steelhead in the East Fork Lewis River. Hatchery releases were eliminated in 2014. **(Hatchery Action 3)**.
- The EF Lewis was designated as a wild steelhead gene bank **(Hatchery Action 3).**
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since the late 1980s **(Harvest Action 1)**.

Salmon Creek Winter Steelhead

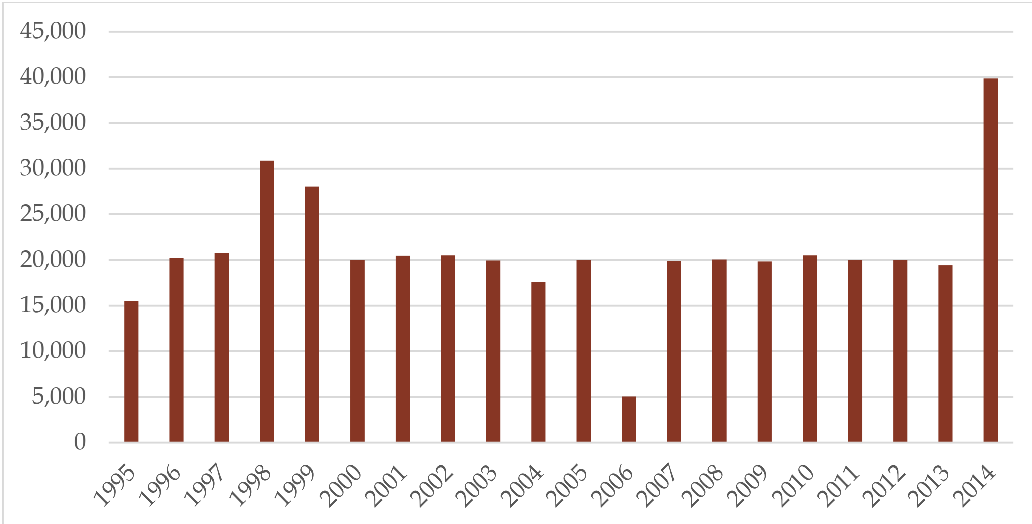
ESA Listing Status: Threatened Population Designation: Stabilizing

Goals		Historical	Washington Recovery Plan Baseline	Washington Recovery Plan Minimum Viability Goal
Minimum Viability			Very Low	Very Low
Escapement	Natural Origin Fish	NA	<50	unknown
Gene Flow (pHOS or PNI)			unknown	unknown
Fitness			0.50	0.50
Harvest Rate	Hatchery Origin Fish		60%	NA
	Natural Origin Fish		10%	10%

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Graph below displays number of early winter steelhead smolts released in Salmon Creek basin since 1995



Natural Escapement Data:

- Escapement estimates for winter steelhead are unavailable

Integrated Hatchery Program:

- Data not available because early winter steelhead program in Salmon Creek basin is being operated as a segregated program
- Data not available because steelhead reintroduction program for upper Lewis basin was initiated in 2013
- Data not available because late winter steelhead program is operated by USFWS

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Hatchery strays from within Salmon Creek basin – hatchery winter steelhead with non-native early winter genetics
- Fitness of fish impacted by historic straying
- Harvest impacts were not identified as a limiting factor

Potential Hatchery and Harvest Reform Actions: Salmon Creek Winter Steelhead	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Increase hatchery releases of winter steelhead, consistent with HSRG standards, to compensate for reductions in East Fork Lewis		X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Continue mark-selective steelhead fishery to assist in controlling hatchery fish on spawning grounds		X		X

CSF Plan Actions for Salmon Creek Winter Steelhead

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Acclimation of winter steelhead hatchery releases is occurring to reduce straying to surrounding basins and natural spawning areas **(Hatchery Action 1)**.
- Releases were increased in 2014 to compensate for reductions in East Fork Lewis production. Releases are currently 40,000 **(Hatchery Action 1)**.
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since the late 1980s **(Harvest Action 1)**.

Washougal Winter and Summer Steelhead

ESA Listing Status:
Winter: Threatened
Summer: Threatened

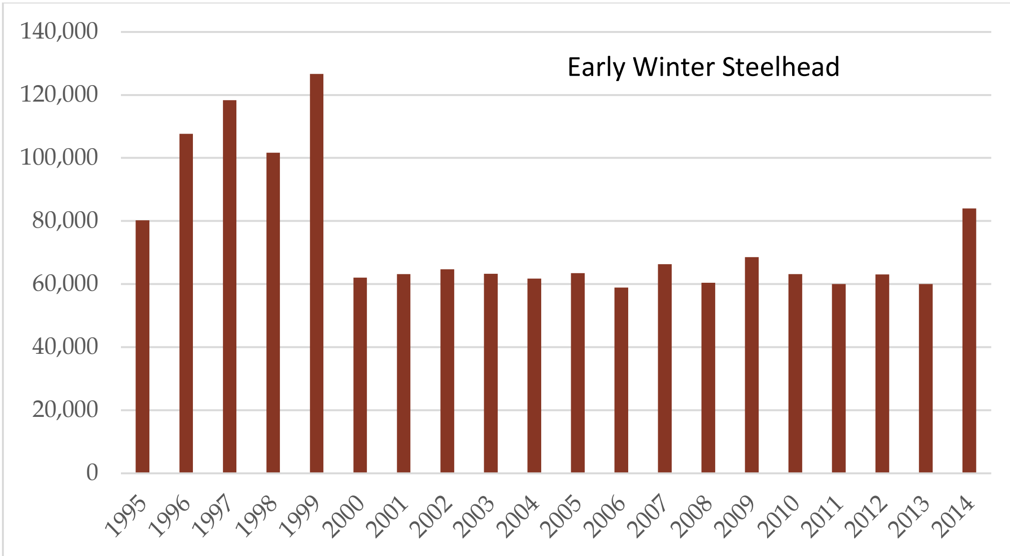
Population Designation:
Winter: Contributing
Summer: Primary

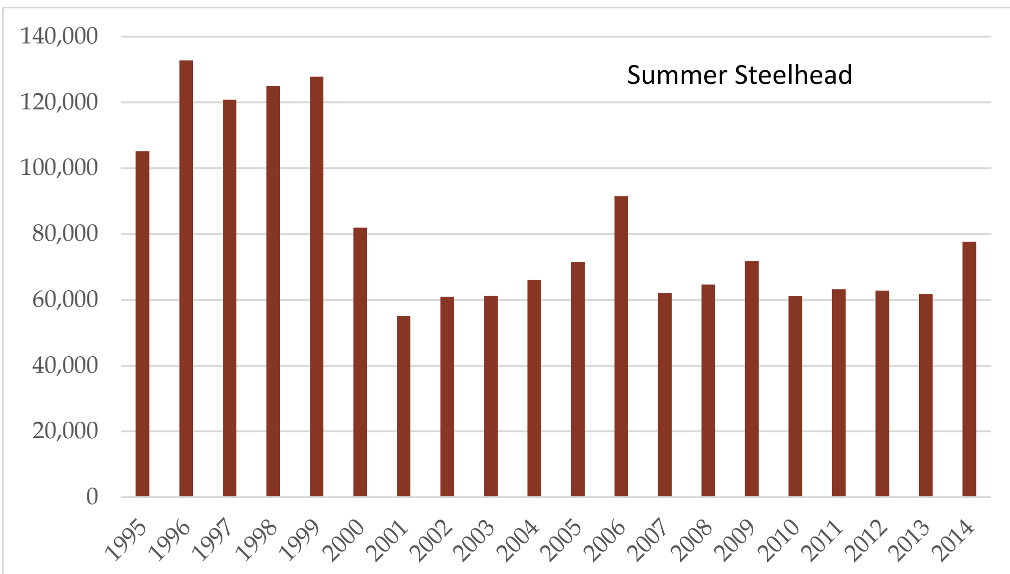
WINTER		Historical	Washington Recovery Plan	
Goals			**Baseline**	**Minimum Viability Goal**
Minimum Viability			Low	Medium
Escapement	Natural Origin Fish	800	300	350
Gene Flow (pHOS or PNI)			pHOS <10%	pHOS <10%
Fitness			0.89	0.90
Harvest Rate	Hatchery Origin Fish		60%	NA
	Natural Origin Fish		10%	9%
SUMMER		**Historical**	**Washington Recovery Plan**	
Goals			**Baseline**	**Baseline**
Minimum Viability			Medium	High
Escapement	Natural Origin Fish	2,200	400	500
Gene Flow (pHOS or PNI)			pHOS <5%	pHOS <5%
Fitness			0.59	0.67
Harvest Rate	Hatchery Origin Fish		70%	NA
	Natural Origin Fish		10%	8%

HATCHERY RELEASE AND NATURAL ESCAPEMENT DATA

Hatchery Release Data:

- Graph below displays number of early winter steelhead smolts released in Washougal basin since 1995
- Graph below displays number of summer steelhead smolts released in Washougal basin since 1995





Natural Escapement Data:

- Escapement data for winter steelhead presented in Table 7-2 at the start of this section titled "Winter and Summer Steelhead Populations"
- Escapement data for summer steelhead presented in Table 7-3 at the start of this section titled "Winter and Summer Steelhead Populations"

Integrated Hatchery Program:

- Data not available because early winter and summer steelhead programs in Washougal basin are being operated as a segregated program

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Hatchery strays from within basin – hatchery winter and summer steelhead with non-native early winter and native skamania summer steehead
- Harvest impacts were not identified as a limiting factor

Potential Hatchery and Harvest Reform Actions: Washougal Winter and Summer Steelhead	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Increase hatchery releases of winter steelhead, consistent with HSRG standards, to compensate for reductions in East Fork Lewis		X		X
2. Increase hatchery releases of summer steelhead, consistent with HSRG standards, to compensate for reductions in East Fork Lewis and North Toutle		X		X
3. Upgrade fish ladder at Washougal Hatchery intake to meet NMFS standards, control hatchery fish on spawning grounds and mark wild summer steelhead to assist in annual abundance estimation		X	X	X
Harvest Actions	**A**	**P**	**S**	**D**
1. Continue mark-selective steelhead fishery to assist in controlling hatchery fish on spawning grounds		X		X
2. Implement multi-year creel study to determine annual harvest rates of hatchery fish and handle rates of wild fish	X	X	X	X

CSF Plan Actions for Washougal Winter and Summer Steelhead

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Increase hatchery releases of winter steelhead to compensate for reductions in East Fork Lewis **(Hatchery Action 1)**.
- The current program sizes were increased; winter steelhead releases went from 60,000 to 85,000 smolts; summer steelhead releases went from 60,000 to 70,000 smolts **(Hatchery Action 1,3)**.
    - Increase hatchery releases of summer steelhead, consistent with HSRG standards, to compensate for reductions in East Fork Lewis and North Toutle **(Hatchery Action 1)**.
- Creel surveys have been conducted in the Washougal River for several years to estimate total harvest and impacts to NOR steelhead during fisheries. Results are pending. **(Hatchery Action 2)**.

- A velocity barrier weir is scheduled to be installed in 2015-2016 at Skamania Hatchery to prevent hatchery fish from passing upstream of the hatchery **(Hatchery Action 1, 2)**.
- A fish ladder was installed at the Washougal Hatchery intake in 2011 to improve fish passage over the barrier **(Hatchery Action 3).**
- Mark-selective sport fisheries have been in place in most lower Columbia River tributaries since the late 1980s **(Harvest Action 1)**.

Chum Populations

Figure 7-.7.Current status of historical demographically-independent lower Columbia chum populations.

Fall Chum Populations and Recovery Plan Designations[32]			
Coast Stratum	***Population Designation***	***Cascade Strata***	***Population Designation***
Youngs Bay	Stabilizing	Cowlitz (summer)	Contributing
Big Creek	Stabilizing	Cowlitz (fall)*	Contributing
Grays/Chinook	Primary	Kalama	Contributing
Elochoman/ Skamokawa	Primary	Lewis	Primary
Mill/Abernathy/Germany	Primary	Salmon	Stabilizing
Clatskanie	Primary	Washougal	Primary
		Lower Gorge	Primary
Scappoose	Primary	Clackamas	Contributing
		Sandy	Primary

*Cowlitz (fall) includes Toutle and Coweeman

[32] Populations that are shaded are Washington populations that are addressed in this document

Table 7-4. Population Estimates for select subpopulations of Chum Salmon in the Columbia River.

Location	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Crazy Johnson Creek	---	---	1,051	1,418	3,819	870	1,093	996	865	2,304	3,475
WF Grays River	---	---	6,970	1,407	1,377	1,902	793	1,130	1,814	5,996	2,817
Mainstem Grays River	---	---	5,696	1,379	1,510	1,227	721	750	3,701	2,509	1,717
I-205 area	3,160	2,932	2,324	923	869	576	644	1,154	2,148	4,912	2,586
Multnomah area	1,627	1,174	733	214	321	148	31	106	458	647	120
St Cloud area	---	220	126	97	180	3	1	29	126	343	1
Horsetail area	---	---	115	13	65	25	36	6	54	119	92
Ives area[a]	4,344	808	357	288	466	132	295	171	214	162	230
Duncan Creek[b]	13	16	2	7	42	9	2	26	48	85	4
Hardy Creek	343	413	52	74	109	12	3	46	175	157	75
Hamilton Creek	1,000	435	497	178	251	133	118	142	404	542	352
Hamilton Spring Channel	794	386	220	88	227	47	114	94	190	325	137
Grays return[c]	12,041	16,974	14,020	4,336	6,824	4,133	2,695	2,984	6,667	11,104	8,229
I-205 to Bonneville return	11,280	6,384	4,427	1,882	2,531	1,086	1,244	1,773	3,818	7,291	3,597
Sum	23,321	23,358	18,447	6,218	9,355	5,219	3,939	4,757	10,485	18,395	11,826

Source: Todd Hillson - WDFW Chum Program 2012

[a] Ives area counts are the carcass tagging estimate plus fish removed for broodstock, except for 2010 through 2012, which were done by a subtraction method.

[b] Totals for Duncan Creek do not include broodstock brought in from mainstem spawning areas, adult trap catch or surveys below monitoring weirs only.

[c] Grays return totals include natural spawners and removed for broodstock.

Grays/Chinook Fall Chum

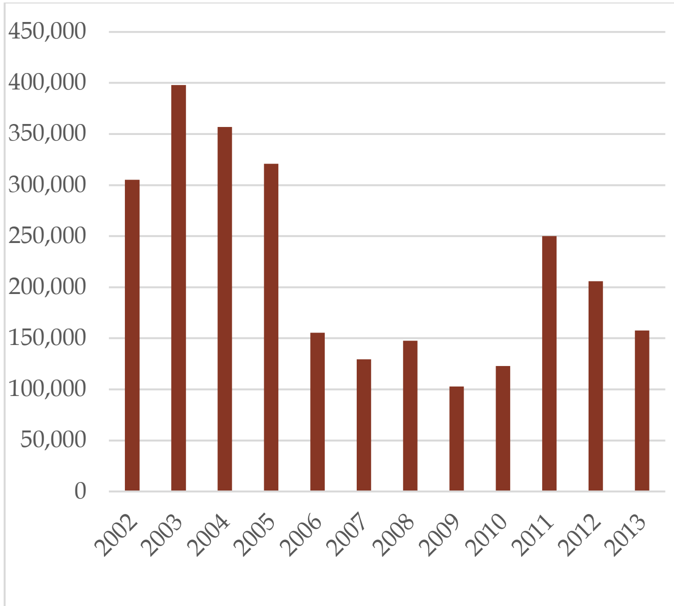
ESA Listing Status: Threatened Population Designation: Primary

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Medium	Very High
Escapement	Natural Origin Fish	10,000	1,600	1,600
Gene Flow (pHOS or PNI)			PNI >0.50	PNI >0.67
Fitness			0.89	0.90
Harvest Rate	Hatchery Origin Fish		NA	NA
	Natural Origin Fish		NA	NA

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Graph below displays number of chum fry released in Grays basin since 1995
- Historically no releases occurred in Chinook basin



Natural Escapement Data:

- Chum escapement data presented in Table 7-4 at the start of this section titled "Chum Populations"

Integrated Hatchery Program:

- Table below provides metrics for integrated chum hatchery program in Washougal basin

Integrated Hatchery Program Metrics for Grays Chum			
Year	**pNOB***	**pHOS****	**PNI*****
2008	0.90	0.08	0.92
2009	0.92	0.04	0.96
2010	0.93	0.05	0.95
2011	1.00	0.07	0.93
2012	1.00	0.03	0.97
2013	1.00	0.03	0.97
Average	0.96	0.05	0.95

* Integrated program initiated in 1998 by using natural origin fish from Grays River
** Annual pHOS estimated based on actual observations from spawning ground surveys (see pHOS column in this table)
** Average (2008-2013) not adjusted because supplementation program using natural origin adults and fry releases does not have a significant impact on productivity of natural origin spawning adults
*** PNI calcuated using annual estimates for individual year and average estimates for muli-year average

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Current hatchery program has been used to successfully increase natural spawning abundance
- Harvest not identified as a limiting factor

Potential Hatchery and Harvest Reform Actions: Grays/Chinook Fall Chum	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Evaluate need for continuing current program (ongoing)	X	X		X
Harvest Actions	**A**	**P**	**S**	**D**
1. Continue recreational fishing closures	X	X		X
2. Continue to manage Columbia River commercial fisheries to minimize handle of chum	X			

CSF Plan Actions for Grays/Chinook Fall Chum

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Hatchery fry released into Grays River during March to reduce demographic risk and support chum reintroduction program for the lower Columbia River.
- Recreational fisheries are closed to chum retention in the Columbia River basin **(Harvest Action 1)**.
- Commercial fisheries are managed to reduce handling chum by time and area closures **(Harvest Action 2)**.

Elochoman/Skamokawa Fall Chum

ESA Listing Status: Threatened Population Designation: Primary

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	High
Escapement	Natural Origin Fish	16,000	<200	1,300
Gene Flow (pHOS or PNI)			unknown	TBD
Fitness			0.97	0.99
Harvest Rate	Hatchery Origin Fish		NA	NA
	Natural Origin Fish		NA	NA

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Historically no releases occurred in Elochoman and Skamokawa basins

Natural Escapement Data:

- Chum escapement data is unavailable

Integrated Hatchery Program:

- No chum hatchery program is currently being operated in Elochoman/Skamokawa basin

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- No hatchery program in basin
- Population has substaintial demographic risk
- Harvest not identified as a limiting factor
- Access to available habitat limited by Beaver Creek Hatchery intakes (both on Beaver Creek and Elochoman River)

Potential Hatchery and Harvest Reform Actions: Elochoman/Skamokawa Fall Chum	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Develop a conservation program to reduce demographic risk to population	X	X	X	X
2. Update Beaver Creek Hatchery intakes to allow for passage at all stream flows – completed in 2012	X	X	X	
Harvest Actions	**A**	**P**	**S**	**D**
1. Continue recreational fishing closures	X	X		X
2. Continue to manage Columbia River commercial fisheries to minimize handle of chum	X			

CSF Plan Actions for Elochoman/Skamokawa Fall Chum

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Hatchery fry releases into Elochoman/Skamokawa basin are expected to begin as early as 2017 as part of the chum reintroduction program in the lower Columbia River **(Hatchery Action 1)**.
- Recreational fisheries are closed to chum retention in the Columbia River basin **(Harvest Action 1)**.
- Commercial fisheries are managed to reduce handling chum by time and area closures **(Harvest Action 2)**.

Mill/Abernathy/Germany (MAG) Creeks Fall Chum

ESA Listing Status: Threatened Population Designation: Primary

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	High
Escapement	Natural Origin Fish	7,000	<100	1,300
Gene Flow (pHOS or PNI)			unknown	TBD
Fitness			0.97	0.99
Harvest Rate	Hatchery Origin Fish		NA	NA
	Natural Origin Fish		NA	NA

HATCHERY RELEASE AND NATURAL ESCAPEMENT DATA

Hatchery Release Data:

- Hatchery releases Mill Creek, Abernathy Creek or Germany Creek basins were discontinued by 1992
- Hatchery fry were released into Germany Creek in 1982 and 1983 and from 1958 to 1991 in Abernathy Creek. Annual releases in Abernathy Creek averaged 450,000 fry

Natural Escapement Data:

- Chum escapement data is unavailable

Integrated Hatchery Program:

- No chum hatchery program is currently operating in Mill/Abernathy/Germany basin

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- No hatchery program in basin
- Population has substaintial demographic risk
- Harvest not identified as a limiting factor

Potential Hatchery and Harvest Reform Actions: Mill/Abernathy/Germany (MAG) Creeks Fall Chum	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Evaluate need for a conservation program to reduce demographic risk to population	X			X
Harvest Actions	**A**	**P**	**S**	**D**
1. Continue recreational fishing closures	X	X		X
2. Continue to manage Columbia River commercial fisheries to minimize handle of chum	X			

CSF Plan Actions for Mill/Abernathy/Germany (MAG) Creeks Fall Chum

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- No releases of hatchery adults have occurred in Mill, Abernathy or Germany creeks.
- No chum hatchery program currently operates in these creeks; however, chum salmon from other programs may stray into this stream.
- Recreational fisheries are closed to chum retention in the Columbia River basin **(Harvest Action 1)**.
- Commercial fisheries are managed to reduce handling chum by time and area closures **(Harvest Action 2)**.

Cowlitz Fall Chum

- The Lower Columbia Recovery Plan combined lower Cowlitz, Toutle and Coweeman into a single population

ESA Listing Status: Threatened Population Designation: Contributing

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	Medium
Escapement	Natural Origin Fish	195,000	<300	900
Gene Flow (pHOS or PNI)			unknown	TBD
Fitness			0.97	0.99
Harvest Rate	Hatchery Origin Fish		NA	NA
	Natural Origin Fish		NA	NA

Hatchery Release and Natural Escapement Data

Hatchery Release Data:

- Historically no releases occurred in Cowlitz basin

Natural Escapement Data:

- Chum escapement data is unavailable

Integrated Hatchery Program:

- No chum hatchery program is currently operating in the Cowlitz basin

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- No hatchery program in basin
- Population has substantial demographic risk
- Harvest not identified as a limiting factor

Potential Hatchery and Harvest Reform Actions: Cowlitz Fall Chum	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Evaluate need for a conservation program to reduce demographic risk to population	X			X
Harvest Actions	**A**	**P**	**S**	**D**
1. Continue recreational fishing closures	X	X		X
2. Continue to manage Columbia River commercial fisheries to minimize handle of chum	X			

CSF Plan Actions for Cowlitz Fall Chum

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- No releases of hatchery juveniles or adults have occurred in the Cowlitz basin.
- Recreational fisheries are closed to chum retention in the Columbia River basin **(Harvest Action 1)**.
- Commercial fisheries are managed to reduce handling chum by time and area closures **(Harvest Action 2)**.

Cowlitz Summer Chum[33]

ESA Listing Status: Threatened Population Designation: Contributing

[33] The Lower Columbia Recovery Plan combined lower Cowlitz, Toutle and Coweeman into a single population

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	Medium
Escapement	Natural Origin Fish	NA	NA	900
Gene Flow (pHOS or PNI)			unknown	TBD
Fitness			0.97	0.99
Harvest Rate	Hatchery Origin Fish		NA	NA
	Natural Origin Fish		NA	NA

Hatchery Release And Natural Escapement Data

Hatchery Release Data:
- Historically no releases occurred in Cowlitz basin

Natural Escapement Data:
- Chum escapement data is unavailable

Integrated Hatchery Program:
- No chum hatchery program is currently operating in the Cowlitz basin

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors
- No hatchery program in basin
- Population has substantial demographic risk
- Harvest not identified as a limiting factor

Potential Hatchery and Harvest Reform Actions: Cowlitz Summer Chum	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Evaluate need for a conservation program to reduce demographic risk to population	X			X
Harvest Actions	**A**	**P**	**S**	**D**
1. Continue recreational fishing closures	X	X		X
2. Continue to manage Columbia River commercial fisheries to minimize handle of chum	X			

CSF Plan Actions for Cowlitz Summer Chum

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal

for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- No releases of hatchery juveniles or adults have occurred in the Cowlitz River basin.
- Recreational fisheries are closed to chum retention in the Columbia River basin **(Harvest Action 1)**.
- Commercial fisheries are managed to reduce handling chum by time and area closures **(Harvest Action 2)**.

Kalama Fall Chum

ESA Listing Status: Threatened   Population Designation: Contributing

Goals		Historical	Washington Recovery Plan	
			Baseline	**Minimum Viability Goal**
Minimum Viability			Very Low	Medium
Escapement	Natural Origin Fish	20,000	<100	900
Gene Flow (pHOS or PNI)			unknown	TBD
Fitness			0.99	0.99
Harvest Rate	Hatchery Origin Fish		NA	NA
	Natural Origin Fish		NA	NA

Hatchery Release and Natural Escapement Data

Hatchery Release Data:

- Historically no releases occurred in Kalama basin

Natural Escapement Data:

- Chum escapement data is unavailable

Integrated Hatchery Program:

- No chum hatchery program is currently operating in the Kalama basin

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- No hatchery program in basin
- Population has substaintial demographic risk
- Harvest not identified as a limiting factor

Potential Hatchery and Harvest Reform Actions: Kalama Fall Chum	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Evaluate need for a conservation program to reduce demographic risk to population	X			X
Harvest Actions	**A**	**P**	**S**	**D**
1. Continue recreational fishing closures	X	X		X
2. Continue to manage Columbia River commercial fisheries to minimize handle of chum	X			

CSF Plan Actions for Kalama Fall Chum

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- No releases of hatchery juveniles or adults have occurred in the Kalama River basin.
- Recreational fisheries are closed to chum retention in the Columbia River basin **(Harvest Action 1)**.
- Commercial fisheries are managed to reduce handling chum by time and area closures **(Harvest Action 2)**.

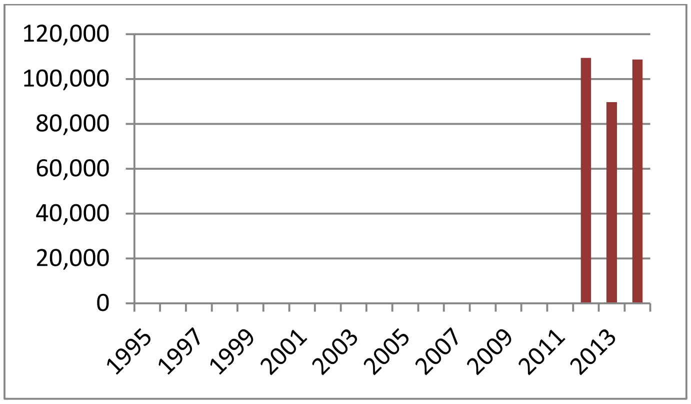
Lewis Fall Chum

ESA Listing Status: Threatened Population Designation: Primary

Goals		Historical	Washington Recovery Plan	
			Baseline	**Minimum Viability Goal**
Minimum Viability			Very Low	High
Escapement	Natural Origin Fish	125,000	<100	1,300
Gene Flow (pHOS or PNI)			unknown	TBD
Fitness			0.99	0.99
Harvest Rate	Hatchery Origin Fish		NA	NA
	Natural Origin Fish		NA	NA

Hatchery Release and Natural Escapement Data

Hatchery Release Data:



Natural Escapement Data:

- Chum escapement data is unavailable

Integrated Hatchery Program:

- Data not available because no chum have returned from this program to date

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- Hatchery fry released into the East Fork Lewis River basin began in 2011 as part of chum reintroduction program for the lower Columbia River
- Population has substaintial demographic risk
- Harvest not identified as a limiting factor

Potential Hatchery and Harvest Reform Actions: Lewis Fall Chum	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Develop a conservation program to reduce demographic risk to population	X	X	X	X
Harvest Actions	**A**	**P**	**S**	**D**
1. Continue recreational fishing closures	X	X		X
2. Continue to manage Columbia River commercial fisheries to minimize handle of chum	X			

CSF Plan Actions for Lewis Fall Chum

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Hatchery fry released into the East Fork Lewis River basin began with the 2011 brood as part of chum reintroduction program for the lower Columbia River. Broodstock source was I-205 stock **(Hatchery Action 1)**.

- Recreational fisheries are closed to chum retention in the Columbia River basin **(Harvest Action 1)**.
- Commercial fisheries are managed to reduce handling chum by time and area closures **(Harvest Action 2)**.

Salmon Creek Fall Chum

ESA Listing Status: Threatened Population Designation: Stabilizing

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	Very Low
Escapement	Natural Origin Fish	NA	<100	--
Gene Flow (pHOS or PNI)			unknown	TBD
Fitness			0.98	0.98
Harvest Rate	Hatchery Origin Fish		NA	NA
	Natural Origin Fish		NA	NA

HATCHERY RELEASE AND NATURAL ESCAPEMENT DATA

Hatchery Release Data:

- Historically no releases occurred in Salmon Creek basin

Natural Escapement Data:

- Chum escapement data is unavailable

Integrated Hatchery Program:

- No chum hatchery program is currently operating in Salmon Creek basin

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- No improvments described in the Washington Recovery Plan

Potential Hatchery and Harvest Reform Actions: Salmon Creek Fall Chum	Viable Salmonid Population (VSP) Parameters Addressed			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Population currently meeting goals				
Harvest Actions	**A**	**P**	**S**	**D**
1. Continue recreational fishing closures	X	X		X
2. Continue to manage Columbia River commercial fisheries to minimize handle of chum	X			

CSF Plan Actions for Salmon Creek Fall Chum

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- No releases of hatchery juveniles or adults have occurred in the Salmon Creek basin
- Recreational fisheries are closed to chum retention in the Columbia River basin **(Harvest Action 1)**.
- Commercial fisheries are managed to reduce handling chum by time and area closures **(Harvest Action 2)**.

Washougal Fall Chum

ESA Listing Status: Threatened Population Designation: Primary

Goals		Historical	Washington Recovery Plan	
			Baseline	Minimum Viability Goal
Minimum Viability			Very Low	High +
Escapement	Natural Origin Fish	18,000	<100	1,300
Gene Flow (pHOS or PNI)			unknown	TBD
Fitness			0.98	0.99
Harvest Rate	Hatchery Origin Fish		NA	NA
	Natural Origin Fish		NA	NA

Hatchery Release And Natural Escapement Data

Hatchery Release Data:

- Historically no releases occurred in Washougal basin

Washougal and Vancouver hatcheries are used rear chum for other programs

Natural Escapement Data:

- Chum escapement data is unavailable for Washougal basin
- Chum escapement data for mainstem Columbia River at the I-205 Bridge is presented in Table 7-4 at the start of this section titled “Chum Populations”
- The I-205 sub-population is considered part of the Washougal population

Integrated Hatchery Program:

- Data not available because no chum hatchery program is currently releasing fry into Washougal basin

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- No hatchery program releases in basin, hatchery program in Duncan Creek

- Population may have demographic risk, spawning occurs in mainstem Columbi River at the I-205 bridge
- Harvest not identified as a limiting factor

Potential Hatchery and Harvest Reform Actions: Washougal Fall Chum	**Viable Salmonid Population (VSP) Parameters Addressed**			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Develop a conservation program to reduce demographic risk to population	X	X	X	X
Harvest Actions	**A**	**P**	**S**	**D**
1. Continue recreational fishing closures	X	X		X
2. Continue to manage Columbia River commercial fisheries to minimize handle of chum	X			

CSF Plan Actions for Washougal Fall Chum

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Recreational fisheries are closed to chum retention in the Columbia River basin **(Harvest Action 1)**.
- Commercial fisheries are managed to reduce handling chum by time and area closures **(Harvest Action 2)**.

Lower Gorge (Columbia) Fall Chum

ESA Listing Status: Threatened Population Designation: Primary

Goals		**Historical**	**Washington Recovery Plan**	
			Baseline	**Minimum Viability Goal**
Minimum Viability			Very Low	Very High
Escapement	Natural Origin Fish	6,000	2,000	2,000
Gene Flow (pHOS or PNI)			unknown	TBD
Fitness			0.98	0.99
Harvest Rate	Hatchery Origin Fish		NA	NA
	Natural Origin Fish		NA	NA

HATCHERY RELEASE AND NATURAL ESCAPEMENT DATA

Hatchery Release Data:

- Limited number of chum fry released in Duncan Creek basin during 2001-2012, ranging between 20,000-80,000, except for 2002 when release total 217,000

Natural Escapement Data:

- Chum escapement data for mainstem Columbia River from are presented in Table 7-4 at the start of this section titled "Chum Populations"
- The following sub-populations are considered part of the Lower Gorge population; St. Cloud, Multnomah, Horsetail, Ives, Duncan, Hardy and Hamilton creek and springs channel

Integrated Hatchery Program:

- Table below provides metrics for integrated chum hatchery program in Duncan Creek using broodstock spawned at Washougal Hatchery and fed fry released into Duncan Creek

Integrated Hatchery Program Metrics for Duncan Creek Chum using Fed Fry			
Year	**pNOB***	**pHOS****	**PNI*****
2002	1.0	0.0	1.00
2003	1.0	0.0	1.00
2004	NA	0.0	NA
2005	0.886	0.0	0.98
2006	0.98	0.0	1.00
2007	NA	0.0	NA
2008	NA	0.0	NA
2009	1.0	0.0	1.0
2010	1.0	0.0	1.00
2011	1.0	0.0	1.00
2012	1.0	0.0	1.00
2013	0.993	0.0	1.00

* Integrated program initiated in 2002 by using natural origin fish collected in mainstem Columbia River
** Annual pHOS estimated based on actual observations from spawning ground surveys (see pHOS column in this table)
*** PNI calcuated using annual estimates for individual year and average estimates for muli-year average

Factors Associated with Populations Meeting Recovery Goals and Targets

Hatchery and Harvest Factors

- No hatchery program releases in basin, hatchery program in Duncan Creek
- Population may have demographic risk, spawning occurs in mainstem Columbi River
- Harvest not identified as a limiting factor

Potential Hatchery and Harvest Reform Actions: Lower Gorge (Columbia) Fall Chum	**Viable Salmonid Population (VSP) Parameters Addressed**			
Hatchery Actions	**A**	**P**	**S**	**D**
1. Develop a conservation program to reduce demographic risk to population	X	X	X	X
Harvest Actions	**A**	**P**	**S**	**D**
1. Continue recreational fishing closures	X	X		X
2. Continue to manage Columbia River commercial fisheries to minimize handle of chum	X			

CSF Plan Actions for Lower Gorge (Columbia) Fall Chum

Predicted outcomes of the implementation of CSF Plan to achieve hatchery and harvest impact levels outlined in the Washington Recovery Plan. Predicted outcomes for hatchery and harvest, in combination with reduced impacts from other threats are predicted to achieve recovery goal for minimum population viability, but additional improvements will be required for populations to reach healthy and harvestable status.

- Hatchery fry released into Duncan Creek starting in 2001 as part of chum reintroduction program for lower Columbia River. **(Hatchery Action 1)**.
- Recreational fisheries are closed to chum retention in the Columbia River basin **(Harvest Action 1)**.
- Commercial fisheries are managed to reduce handling chum by time and area closures **(Harvest Action 2)**.

CHAPTER 8 PROJECTED FITNESS IMPROVEMENTS

The goal of the CSF Plan is to reduce adverse impacts on population productivity resulting from current hatchery and harvest management strategies. As presented in Chapter 5 the impact of hatchery and harvest reform actions on population productivity can be evaluated by measuring changes in fitness of a natural origin population prior to and after implementation of the CSF Plan. Since fitness is directly linked to productivity this metric can be used to determine if the actions being implemented through the CSF Plan will be adequate to achieve Washington Recovery Plan productivity improvement targets for hatchery and harvest threats.

WDFW, in consultation with LCFRB and HSRG, has utilized the AHA tool to estimate: 1) the baseline fitness (1998) and 2) the predicted fitness after CSF Plan hatchery and harvest reform actions have been implemented. Table 8-1 below summarizes changes in fitness expected from implementation of the CSF Plan. Table 8-1 also presents the fitness estimates that correspond to the Washington Recovery Plan productivity improvement targets and whether implementation of the CSF Plan is expected to provide enough improvement in fitness to achieve Washington Recovery Plan targets for productivity improvement.

As with any model, the AHA tool is built upon multiple assumptions that need to be verified and tested using empirical data collected in the field. As WDFW increases and improves monitoring efforts in the lower Columbia River, data necessary to verify and/or modify these assumptions will be collected, and the AHA tool will be adjusted accordingly. Implementing the adaptive management strategy described in Chapter 10 will allow WDFW to incorporate updated information and modeling results and adjust hatchery and harvest actions as needed to achieve the productivity improvement targets set forth in the Washington Recovery Plan.

WDFW is in the initial stage of implementation a hatchery reform program for the lower Columbia and data from returning adults will be necessary to fully evaluate the effects of hatchery reform actions implemented to date. As this data becomes available WDFW will utilize this information to make the necessary adjustments in hatchery reform actions. This adaptive management approach towards the implementation of hatchery reform is critical to recovery of these populations. For some populations, there are factors outside of WDFW's control that may limit WDFW's ability to achieve productivity improvement targets. These include:

- Some ocean fisheries occur outside of Washington state's management authority
- Oregon hatchery programs may adversely impact some Washington populations
- Current natural origin fish abundance may be too low to absorb impacts from any lower Columbia River hatchery program
- Habitat in some areas is in such poor condition that it negates improvements implemented to address hatchery and harvest threats
- Hydro-system license agreements in the Lewis and Cowlitz basins

Table 8.1 includes a total of nine populations that are impacted by hydro-system license agreements. The six populations in the upper Cowlitz and Cispus rivers are dependent on the success of juvenile collection efforts being conducted by Tacoma Power. To date juvenile collection efforts have not been effective, which limits the capacity of the AHA model to predict the results of the reintroduction programs recently initiated for the Upper Cowlitz and Cispus rivers. A similar situation exists in the North Fork Lewis River where reintroduction efforts are in their infancy with 2015 being the second year in which PacifiCorp has operated a juvenile collection facility in the upper river. Benefits of hatchery and harvest reform actions will not be realized until juvenile collection improves significantly in both basins.

For 17 populations, the outcome of the CSF plan is identified as “To Be Determined”. Chum populations account for 10 of these 17 populations. Currently lower Columbia chum populations are in a depressed state, primarily due to degraded habitat conditions. WDFW has recently initiated a chum reintroduction program to rebuild these populations. This program will require a large scale effort that depends on a variety of factors to be successful and will take many years, and in some cases decades, to reintroduce chum throughout its geographic range in the lower Columbia. Due to these uncertainties, it is not possible to predict the outcome of this reintroduction program, which is key to achieving productivity improvement targets. Of the remaining seven populations, five also require reintroduction efforts to either access habitat upstream of dams or rebuild depressed populations. Several factors can impact the success of these rebuilding efforts, such as effectiveness in collecting outmigrating juveniles and population responses to habitat restoration efforts, which precludes the ability to predict the populations’ responses to hatchery and harvest reform actions. In general the major limiting factor for these populations is habitat – harvest and hatchery issues are primarily manageable.

Current modeling results indicate that for 43 of the 52 populations, hatchery and harvest reform actions to be implemented through the CSF Plan are expected to achieve the productivity improvement target set forth in the Washington Recovery Plan. For the nine remaining populations, it is uncertain whether the proposed actions will be sufficient, primarily due to small population’s sizes. The majority of the populations reside in small basins without the capacity to produce large resilient populations. In some cases spawning and rearing habitat is severely degraded while for other population’s hatchery programs operated by other agencies result in excessive numbers of hatchery fish returning to natural spawning areas.

Table 8-1 below summarizes the expected outcomes of CSF Plan implementation, as compared to Washington Recovery Plan targets, for all lower Columbia populations.

Table 8-1. Assessment of natural origin population fitness changes resulting from implementation of CSF Plan.

Fitness Prior CSF Plan (2008) was less than Washington Recovery Plan Target
Projected fitness after CSF Plan is less than Washington Recovery Plan Target; therefore, impact reduction may not be achieved
Projected fitness after CSF Plan is greater than Washington Recovery Plan Target; therefore, impact reduction is projected to be achieved

Basin	Species	Population Designation	Fitness Estimates			Achieve Washington Recovery Plan Target
			Prior to CSF Plan (2008)	WA Recovery Plan Target	CSF Plan Outcome	
Grays/ Chinook	Fall Chinook	*Contributing*	0.50	0.66	0.64	Uncertain
	Coho	*Primary*	0.50	0.71	0.88	Yes
	Winter Steelhead	*Primary*	0.91	0.91	0.92	Yes
	Chum	*Primary*	0.89	0.90	TBD	TBD based on habitat restoration efforts
Elochoman/ Skamokawa	Fall Chinook	*Primary*	0.50	0.60	0.86	Yes
	Coho	*Primary*	0.50	0.65	0.80	Yes
	Winter Steelhead	*Contributing*	0.58	0.58	0.59	Yes
	Chum	*Primary*	0.97	0.99	TBD	TBD based on reintroduction efforts
(MAG) Mill/ Abernathy/ Germany	Fall Chinook	*Primary*	0.51	0.59	0.52	Uncertain
	Coho	*Contributing*	0.50	0.90	0.85	Uncertain
	Winter Steelhead	*Primary*	0.99	0.99	0.99	Yes
	Chum	*Primary*	0.97	0.99	TBD	TBD based on reintroduction efforts
Coweeman	Fall Chinook	*Primary*	0.62	0.67	0.84	Yes
	Coho	*Primary*	0.74	0.80	0.89	Yes
	Winter Steelhead	*Primary*	0.84	0.86	0.89	Yes
	Chum	*Contributing*	TBD	TBD	TBD	TBD based on reintroduction efforts
Lower Cowlitz	Fall Chinook	*Contributing*	0.50	0.51	0.92	Yes
	Coho	*Primary*	0.50	0.55	0.85	Yes
	Winter Steelhead	*Contributing*	0.50	0.52	0.73	Yes

Basin	Species	Population Designation	Fitness Estimates: Prior to CSF Plan (2008)	Fitness Estimates: WA Recovery Plan Target	Fitness Estimates: CSF Plan Outcome	Achieve Washington Recovery Plan Target
	Chum	*Contributing*	0.97	0.99	TBD	TBD based on reintroduction efforts
South Fork Toutle	Spring Chinook	*Contributing*	0.50	0.75	TBD	TBD depending on potential reintroduction efforts
	Fall Chinook	*Primary*	0.50	0.60	0.87	Yes
	Coho	*Primary*	0.50	0.56	0.83	Yes
	Winter Steelhead	*Primary*	0.50	0.54	0.80	Yes
	Chum	*Contributing*	TBD	TBD	TBD	TBD based on reintroduction efforts
North Fork Toutle	Spring Chinook	*Contributing*	0.50	0.75	TBD	TBD depending on potential reintroduction efforts
	Fall Chinook	*Primary*	0.50	0.60	0.87	Yes
	Coho	*Primary*	0.50	0.56	0.83	Yes
	Winter Steelhead	*Primary*	0.67	0.74	0.77	Yes
	Chum	*Contributing*	TBD	TBD	TBD	TBD based on reintroduction efforts
Tilton	Spring Chinook	*Stabilizing*	0.50	0.50	0.50	Yes
	Fall Chinook	*Stabilizing*	0.50	0.50	0.50	Yes
	Coho	*Stabilizing*	0.50	0.50	0.50	Yes
	Winter Steelhead	*Contributing*	0.50	0.75	0.89	Yes
Upper Cowlitz	Spring Chinook	*Primary*	0.50	0.75	TBD	Yes assuming juvenile collection rates exceed 60%
	Fall Chinook	*Stabilizing*	0.50	0.50	0.50	Yes
	Coho	*Primary*	0.50	0.75	TBD	Yes assuming juvenile collection rates exceed 50%

Basin	Species	Population Designation	Fitness Estimates: Prior to CSF Plan (2008)	Fitness Estimates: WA Recovery Plan Target	Fitness Estimates: CSF Plan Outcome	Achieve Washington Recovery Plan Target
	Winter Steelhead	*Primary*	0.50	0.75	TBD	Yes assuming juvenile collection rates exceed 60%
	Chum	*Contributing*	Not Present	Not Present	Not Present	Not Present
Cispus	Spring Chinook	*Primary*	0.50	0.75	See Upper Cowlitz	Yes assuming juvenile collection rates exceed 60%
	Fall Chinook	*Stabilizing*	0.50	0.50	See Upper Cowlitz	Yes
	Coho	*Primary*	0.50	0.75	See Upper Cowlitz	Yes assuming juvenile collection rates exceed 50%
	Winter Steelhead	*Primary*	0.50	0.75	See Upper Cowlitz	Yes assuming juvenile collection rates exceed 60%
Kalama	Spring Chinook	*Contributing*	0.50	0.75	0.50	Uncertain
	Fall Chinook	*Contributing*	0.50	0.55	0.50	Uncertain
	Coho	*Contributing*	0.50	0.60	0.50	Uncertain
	Winter Steelhead	*Primary*	0.97	0.98	0.98	Yes
	Summer Steelhead	*Primary*	0.98	0.99	0.99	Yes
	Chum	*Contributing*	0.99	0.99	TBD	TBD based on reintroduction efforts
Lewis	Fall Chinook	*Primary*	0.50	0.59	TBD	TBD depending on strays from other programs
North Fork Lewis	Spring Chinook	*Primary*	0.50	0.75	TBD	TBD based on reintroduction efforts
	Fall Chinook (bright)	*Primary*	0.95	0.95	0.97	Yes
	Coho	*Contributing*	0.76	0.78	TBD	TBD based on reintroduction efforts

Basin	Species	Population Designation	Fitness Estimates			Achieve Washington Recovery Plan Target
			Prior to CSF Plan (2008)	WA Recovery Plan Target	CSF Plan Outcome	
	Winter Steelhead	*Contributing*	0.50	0.75	TBD	TBD based on reintroduction efforts
	Summer Steelhead	*Stabilizing*	0.52	0.52	0.79	Yes
	Chum	*Primary*	0.99	0.99	TBD	TBD based on reintroduction efforts
East Fork Lewis	Coho	*Primary*	0.78	0.89	0.85	Uncertain
	Coho	*Primary*	0.78	0.89	0.85	Uncertain
	Winter Steelhead	*Primary*	0.50	0.55	0.98	Yes
	Summer Steelhead	*Primary*	0.50	0.75	0.94	Yes
	Chum	*Primary*	0.99	0.99	TBD	TBD based on reintroduction efforts
Salmon Cr.	Fall Chinook	*Stabilizing*	0.50	0.50	0.50	Yes
	Coho	*Stabilizing*	0.50	0.50	0.50	Yes
	Winter Steelhead	*Stabilizing*	0.50	0.50	0.50	Yes
	Chum	*Stabilizing*	0.98	0.98	0.98	Yes
Washougal	Fall Chinook	*Primary*	0.50	0.60	0.80	Yes
	Coho	*Contributing*	0.50	0.75	0.72	Uncertain
	Winter Steelhead	*Contributing*	0.89	0.90	0.94	Yes
	Summer Steelhead	*Primary*	0.59	0.67	0.87	Yes
	Chum	*Primary*	0.98	0.99	TBD	TBD based on reintroduction efforts

CHAPTER 9 IMPLEMENTATION

Implementation of the CSF Plan will utilize an adaptive management approach beginning with near-term actions and the monitoring of population responses. Longer term actions will be informed by the population responses to near-term actions and information collected through the expanded monitoring activities described in Chapter 10. The pace of implementation will depend on the availability of necessary resources. Funding will be necessary to maintain ongoing activities; support implementation of near- and long-term hatchery and harvest actions; expand monitoring programs to collect data necessary to measure progress towards interim benchmarks and overall threat reduction targets set forth in the Washington Recovery Plan; and implement capital improvements to hatchery facilities and physical infrastructure.

Near-Term Actions

Implementation of near-term actions has occurred concurrently with the development of the CSF Plan and will continue into the near future (next 3 years). These actions address many of the measures set forth in the Washington Recovery Plan. Near-term actions can be implemented quickly thereby maintaining fishing opportunities while making immediate and significant progress towards achieving recovery goals; however, it is expected that additional actions will be necessary to fully implement all Washington Recovery Plan measures and achieve overall recovery goals. These actions will be implemented over the next decade or more (see “Long-Term Actions” section below). Near-term reform actions implemented include programmatic changes to hatchery programs, modifications to monitoring efforts and improvements to facility infrastructure.

The first step in developing near-term actions was to evaluate hatchery programs to determine if they were meeting the HSRG criteria for hatchery influence on natural populations; and if not, what kinds of production and operational changes would be necessary to achieve these criteria. These initial evaluations were completed in 2009. Based on the results of these evaluations, efforts have been initiated to strategically realign WDFW hatchery programs for the purposes of reducing adverse impacts of hatchery programs on natural origin fish and sustaining productive fisheries. In some cases, hatchery programs were shifted to other facilities or reduced in size in order to minimize these interaction to the fullest extent possible. For other populations hatchery programs were eliminated completely to establish refuges/gene banks for natural origin fish. Additional actions to be implemented include controlling hatchery fish on spawning grounds, utilizing natural origin fish in hatchery broodstock and evaluating potential supplementation program(s) to rebuild depressed populations.

Changes to hatchery infrastructure have also been evaluated to determine if existing facilities could be modified, or new facilities constructed, that would assist in achieving hatchery threat reductions. Infrastructure actions include establishing weirs to manage the number of hatchery fish reaching natural spawning locations, improving adult fish passage to areas upstream of hatchery facilities, improving hatchery facilities to meet NOAA operational guidelines (e.g. intake structures) and improving handling of natural origin adults at WDFW operated facilities.

Harvest actions implemented primarily took the form of continued mass-marking of hatchery fish, adoption of sliding scale harvest rate matrices based on annual abundance estimates and expansion of mark-selective fisheries. The use of alternative commercial fishing gears and methods to allow for the implementation of mark-selective fisheries for fall Chinook and coho are being investigated.

Most recently, monitoring programs are being modified to collect additional data necessary to evaluate population viability and determine the level of interaction between hatchery and natural origin fish in natural spawning locations, consistent with NMFS guidance for monitoring Pacific Northwest salmon and steelhead populations (NMFS, 2011b). Actions implemented to date include modification of adult fall Chinook survey methodologies and implementation of adult coho spawning ground surveys.

Near-term actions implemented to date and planned for approximately the next three years are included in Chapter 7. Table 9-1 presents infrastructure improvements and monitoring efforts implemented since 2009. It should be noted that some of the actions included in Table 9-1 represent best management actions and are not necessarily required to implement the Washington Recovery Plan. While the projects presented in Table 9-1 effectively initiated the hatchery and harvest reform process, additional monitoring efforts and infrastructure improvements will be necessary to fully implement the CSF Plan in a manner that achieves the Washington Recovery Plan threat reduction targets, as planned.

Long-Term Actions

Long-term actions provide two critical functions in the CSF Plan: 1) ensure that benefits accrued from near-term actions are maintained over the 50-year benefit realization time frame envisioned by the Washington Recovery Plan and 2) make adjustments to near-term actions or implement additional actions as necessary to fully address all Washington Recovery Plan measures and achieve the overall recovery goal of restoring all lower Columbia salmon and steelhead populations to healthy and harvestable levels. Implementation of long-term actions will require an effective monitoring program that tracks fish population responses to recovery actions and adaptive management process to adjust the course as needed to stay on a recovery trajectory (See Chapter 10).

In addition to continued maintenance and upgrades of existing facilities, long-term implementation will include continued operation and maintenance of additional infrastructure established (e.g. weirs to control hatchery fish on natural spawning areas and facility improvements). Modified monitoring activities implemented as near-term actions to achieve NMFS guidance for monitoring Pacific Northwest salmon and steelhead populations will also need to be continued in the long-term (NMFS, 2011b). While these activities were initiated as near-term actions they will need to continue throughout the implementation of the CSF Plan to inform the adaptive management process and achieve recovery goals.

The full suite of long-term actions to be implemented over the next 1-2 decades are unknown at this time. The results of monitoring programs recently implemented will provide the information and data necessary to determine what actions should be implemented in the long-term to achieve goals set forth in the Washington Recovery Plan. Long-term actions implemented will be guided in part by population responses to near-term actions implemented as part of the CSF Plan. WDFW has strategically implemented near-term actions that are known to have immediate benefits; and will determine, and implement, other actions over the long term that will ensure a successful implementation of the CSF Plan, as measured by the achievement of impact reduction targets set forth in the Washington Recovery Plan. While some of the long-term actions are captured in the CSF Plan (see Chapter 7), many are not identified at this time because additional information necessary to determine the best course of action is currently not available. These long term actions will depend, in part on the results of habitat restoration activities currently underway whose benefits to fish populations accrue over a longer time frame than do hatchery and harvest reform actions.

Funding

Implementation of the CSF Plan will require funding for both near- and long-term actions. Hatchery and harvest reform actions (primarily monitoring activities and hatchery program changes) need to be well coordinated with infrastructure improvements to make effective use of this funding. Funding of monitoring programs needs to be a priority to support implementation of the adaptive management process and determine if hatchery and harvest reform actions are performing as intended and achieving the benchmarks set forth in the Washington Recovery Plan.

Current hatchery, harvest and monitoring programs in the lower Columbia River are funded through a number of sources, as shown below. Each funding source supports a different suite of activities. Using these funding sources in a strategic manner will be necessary for WDFW to implement a comprehensive program the supports recovery activities and sustains productive fisheries while maintaining monitoring programs to ensure that reform actions implemented produce the desired results.

Mitchell Act:

- Salmon and steelhead production
- Hatchery reform activities
- Hatchery facility infrastructure improvements
- Hatchery sampling and monitoring programs
- Population status and trends monitoring

Pacific Coast Salmon Restoration Funds (PCSRF):

- Hatchery reform activities
- Hatchery facility infrastructure improvements necessary to achieve recovery goals.
- Fishery reform activities
- Population status and trends monitoring

Bonneville Power Administration (BPA):

- Salmon production
- Fishery reform activities
- Fishery sampling and monitoring programs

Population status and trends monitoring

Private and Public Utilities:

Salmon and steelhead production
Hatchery reform activities
Hatchery facility infrastructure improvements
Hatchery sampling and monitoring
Population status and trends monitoring

State of Washington General Fund and Wildlife Fund (WDFW):

Salmon and steelhead production
Hatchery reform activities
Hatchery facility infrastructure improvements
Fishery sampling and monitoring
Hatchery sampling and monitoring
Population status and trends monitoring

Table 9-1 includes cost estimates for hatchery and harvest reform actions implemented to date, including ongoing monitoring activities, as part of the CSF Plan. This table captures activities that required increased funding above the base budget to implement. A variety of the funding sources listed above were used to implement these projects. By strategically utilizing this suite of funding sources WDFW has implemented many hatchery and harvest reform actions to date; however, much more work needs to be accomplished, and additional funding will be necessary to implement actions required to achieve the Washington Recovery Plan population goals and impact reduction targets.

Some of the projects, primarily monitoring activities and facilities maintenance, will include ongoing actions that require funding in future years to continue their implementation. In other cases, such as facility infrastructure improvements, the project has a specific end date. Table 9-1 also provides good examples of the types of actions that will require future funding to fully implement this plan. Recent increases in funding will need to continue into the future to support ongoing activities and maintain facility improvement implemented to date. Funding will be required to implement necessary long-term actions and achieve impact reduction targets set forth in the Washington Recovery Plan. Continued funding for near-term actions and additional funding for long-term actions will be necessary for several decades to achieve the results envisioned by the CSF and Washington Recovery Plans.

WDFW will continue to work with the entities listed above to maintain funding for ongoing projects and obtain funds for future projects. Past budgets have supported basic maintenance activities but have not provided sufficient funds to upgrade aging facilities. As part of the CSF Plan WDFW is completing a long-term plan for capital investments at Washington facilities, and the information provided in the HAIPs, the HSRG review and the CSF Plan will form the basis for these investments. Upon completion of the CSF Plan, WDFW will develop a funding strategy to implement facility improvements at WDFW operated facilities. Additional funding will also be required for near-term actions requiring continued operation and maintenance in the long-term.

WDFW will also work with the state legislature through their biennial budget development process to obtain additional funds and secure authority to utilize other funding sources to support implementation of the CSF Plan. WDFW will continue to evaluate reform needs and funding levels to prioritize hatchery and harvest reform activities to maximize their benefit to natural origin populations and support for sustainable productive fisheries.

Table 9-1. Facility investments and improvements in monitoring programs implemented during 2009-2014.

				Populations			What is Addressed					
				Affected: Listed Species								
Subbasin	**Project** *Projects in italics are ongoing and all costs are annual)*	**Total/annual Cost**	**Status: Complete = C, Ongoing = O, Proposed = P**	**Primary Populations**	**Contributing Populations**	**Stabilizing Populations**	**Adult Management**	**Wild Fish Protection**	**Environmental Compliance**	**Implement CSF Plan**	**Implement ESA Recovery Plan**	**Consistent with HSRG**
	COASTAL STRATA											
Grays/Elochoman	*Operate weirs on Elochoman and Grays rivers to remove hatchery fish*	*$235,000*	O	Eloch-Fall CK, CO, CH Grays- CO, CH, Wtr SH	Grays- Fall CK		√	√		√	√	√
	Beaver Creek Hatchery- River Intake Fish Passage	$150,000	C	Fall CK, CO, CH	Wtr SH			√	√	√	√	√
	Elochoman Hatchery - Remove Barrier	$250,000	O	Eloch-Fall CK, CO, CH	Wtr SH			√	√	√	√	√
	Elochoman- Clear Creek Intake Fish Passage	$250,000	O	Fall CK, CO, CH	Wtr SH			√	√	√	√	√
	Beaver Creek/ Grays Transition	$1,100,000	P	Fall CK, CO, CH	Wtr SH		√	√	√			√
	CASCADE STRATA											
Coweeman	Coweeman Weir Construction	$200,000	C	Fall CK, CO, Wtr SH				√		√		√
	Operate weir on Coweeman River to remove hatchery fish	*$100,000*	O	Fall CK, CO, Wtr SH			√	√			√	√

Cowlitz	*Cowlitz Salmon Hatchery Remodel*	*$30,000,000*	C	Lower Cowlitz - CO, Upper Cowlitz/Cispus - Sp CK, CO, Wtr SH	Lower Cowlitz - Fall CK, CH, Wtr SH, Upper Cowlitz - CH, Tilton - Wtr SH	Upper Cowlitz/Cispus/Tilton - Fall CK, Tilton - Sp CK, CO	√	√		√	√	√
	Cowlitz Trout Hatchery Upgrades	*$2,500,000*	O	Lower Cowlitz - CO, Upper Cowlitz/Cispus - Sp CK, CO, Wtr SH	Lower Cowlitz - Fall CK, CH, Wtr SH, Upper Cowlitz - CH, Tilton - Wtr SH	Upper Cowlitz/Cispus/Tilton - Fall CK, Tilton - Sp CK, CO				√	√	√
	Cowlitz Falls Dam North Shore Juvenile Collector	$33,000,000	O	Lower Cowlitz - CO, Upper Cowlitz/Cispus - Sp CK, CO, Wtr SH	Lower Cowlitz - Fall CK, CH, Wtr SH, Upper Cowlitz - CH, Tilton - Wtr SH	Upper Cowlitz/Cispus/Tilton - Fall CK, Tilton - Sp CK, CO		√			√	
	Cowlitz Falls Tailrace Juvenile Collector	*$100,000*	O	Lower Cowlitz - CO, Upper Cowlitz/Cispus - Sp CK, CO, Wtr SH	Lower Cowlitz - Fall CK, CH, Wtr SH, Upper Cowlitz - CH, Tilton - Wtr SH	Upper Cowlitz/Cispus/Tilton - Fall CK, Tilton - Sp CK, CO		√		√	√	
	Mayfield Dam Juvenile Collection System	$15,000,000	O	Lower Cowlitz - CO, Upper Cowlitz/Cispus - Sp CK, CO, Wtr SH	Lower Cowlitz - Fall CK, CH, Wtr SH, Upper Cowlitz - CH, Tilton - Wtr SH	Upper Cowlitz/Cispus/Tilton - Fall CK, Tilton - Sp CK, CO		√			√	
	Cowlitz Falls Dam North Shore Collector Operations, Maintanance and Annual Studies	*$450,000*	O	Lower Cowlitz - CO, Upper Cowlitz/Cispus - Sp CK, CO, Wtr SH	Lower Cowlitz - Fall CK, CH, Wtr SH, Upper Cowlitz - CH, Tilton - Wtr SH	Upper Cowlitz/Cispus/Tilton - Fall CK, Tilton - Sp CK, CO		√			√	
	Cowlitz Falls Dam Tailrace Juvenile Collector Operations, Maintanance and Annual Studies	*$150,000*	O	Lower Cowlitz - CO, Upper Cowlitz/Cispus - Sp CK, CO, Wtr SH	Lower Cowlitz - Fall CK, CH, Wtr SH, Upper Cowlitz - CH, Tilton - Wtr SH	Upper Cowlitz/Cispus/Tilton - Fall CK, Tilton - Sp CK, CO		√			√	
	Mayfield Dam Juvenile Collection System Operations, Maintanance and Annual Studies	*$700,000*	O	Lower Cowlitz - CO, Upper Cowlitz/Cispus - Sp CK, CO, Wtr SH	Lower Cowlitz - Fall CK, CH, Wtr SH, Upper Cowlitz - CH, Tilton - Wtr SH	Upper Cowlitz/Cispus/Tilton - Fall CK, Tilton - Sp CK, CO		√			√	

Kalama	Kalama River Broodstock Management	$10,400,000	O	Wtr and Sum SH	Fall CK, Spr CK, CO, CH		**√**	**√**		**√**	**√**	**√**
	Modrow Weir Modifications & Fish Handling	$2,500,000	C	Wtr and Sum SH	Fall CK, Spr CK, CO, CH		**√**	**√**		**√**	**√**	**√**
	Fallert Creek Hatchery - Construct pollution control system	$1,500,000	P	Wtr and Sum SH	Fall CK, Spr CK, CO, CH			**√**	**√**			**√**
	Fallert Creek Hatchery- Kalama River Pump Intake (Design/Construct)	$2,500,000	P	Wtr and Sum SH	Fall CK, Spr CK, CO, CH			**√**	**√**	**√**	**√**	**√**
North Fork Lewis	Lewis River Hatchery Adult Sorting Facility	$4,500,000	C	Fall CK, Late Fall CK, Spr CK, CH	Wtr SH, CO	Sum SH	**√**	**√**		**√**	**√**	**√**
	Merwin Trap Adult Trapping Facility	$43,000,000	C	Fall CK, Late Fall CK, Spr CK, CH	Wtr SH, CO	Sum SH	**√**	**√**		**√**	**√**	**√**
	Swift Downstream Juvenile Collector	$50,000,000	C	Fall CK, Late Fall CK, Spr CK, CH	Wtr SH, CO	Sum SH		**√**		**√**	**√**	
Washougal	Washougal River Weir and Handling facilities (Design/Construct)	$850,000	C	Fall CK, CH, Sum SH	CO, Wtr SH		**√**	**√**		**√**	**√**	**√**
	Operate weir on Washougal River to remove hatchery fish	*$100,000*	O	Fall CK, CH, Sum SH	CO, Wtr SH		**√**	**√**			**√**	**√**
	Washougal Hatchery - Pond Refurbishment (Construct)	$1,236,000	P	Fall CK, CH, Sum SH	CO, Wtr SH					**√**		**√**
	Washougal Hatchery Intake Fishway and Trap (Design/Construct)	$585,000	C	Fall CK, CH, Sum SH	CO, Wtr SH			**√**	**√**	**√**	**√**	**√**
	Skamania Weir and Adult Handling Facilities (Design/Construct)	$750,000	O	Fall CK, CH, Sum SH	CO, Wtr SH		**√**	**√**		**√**	**√**	**√**
	Skamania Hatchery -Intake (Design/Construct)	$3,500,000	C	Fall CK, CH, Sum SH	CO, Wtr SH			**√**	**√**	**√**	**√**	**√**

Toutle	North Toutle Hatchery - Rebuild weir to allow year around operation(Design/Construct)	$750,000	P	Fall CK, Wtr SH, CO	Spr CK, CH		√	√		√	√	√
	North Toutle Hatchery - Green River Gravity Intake (Design/Construct)	$1,750,000	P	Fall CK, Wtr STHD, CO	Spr CK, CH			√	√	√	√	√
	GORGE STRATA											
Wind	*Wind River- Sheppard Falls PIT tag detection*	*$75,000*	P	CO, Sum SH	Fall CK, CH	Wtr STHD	√	√				√
	CROSS-STRATA											
	Lower Columbia Viable Salmonid Population (VSP) Monitoring (PSCRF)	*$750,000*	O		All populations	All populations	√	√		√	√	√
	Lower Columbia Viable Salmonid Population (VSP) Monitoring (Mitchell Act)	*$628,000*	O		All populations	All populations	√	√		√	√	√
	Develop and Implement Selective Commercial Gear (OR/WA) (2009-2014)	$7,000,000	O		All populations	All populations		√		√		√
	Annually monitor Alternative Gear Fisheries	*$250,000*	O		All populations	All populations	√	√		√	√	√
	Externally mass mark and tag hatchery production (Mitchell Act production)	*$1,600,000*	O		All populations	All populations	√	√		√	√	√

CHAPTER 10 MONITORING AND ADAPTIVE MANAGEMENT

The Washington Recovery Plan calls for an adaptive management plan that includes both: 1) tracking progress towards achieving threat-specific impact reduction targets and 2) a process for refining approaches or objectives for achieving recovery. The intent of this adaptive management strategy is to maintain a positive recovery trajectory that will ultimately achieve the Washington Recovery Plan overall vision of recovering lower Columbia salmon and steelhead to healthy and harvestable levels.

A cornerstone of this adaptive management process are interim benchmarks for threat specific impact reductions. The Washington Recovery Plan sets a total of four 12-year benchmark periods between 1999 and 2048. These benchmarks serve as milestones for tracking and evaluating progress and changing course when and where necessary. A coordinated and robust monitoring plan will be necessary to collect the data needed to assess progress towards the interim benchmarks and to support the adaptive management process.

Recently the focus of population monitoring programs has shifted from simply tracking abundance to monitoring viability of naturally produced populations (see Chapter 3). This shift in focus requires implementation of new methodologies to collect data regarding population viability, and associated VSP parameters (abundance, spatial distribution, productivity and diversity), consistent with NMFS guidance regarding monitoring of Pacific Northwest salmon and steelhead populations (NMFS, 2011b)

WDFW has modified monitoring programs in response to this shift in focus and the NMFS guidance; however, these programs are in their infancy and WDFW is just beginning to understand what the actual natural origin population sizes are in many systems. Continued implementation of recent modifications, and implementation of additional modifications to lower Columbia monitoring programs is a necessity in order to implement the adaptive management process and determine what long-term actions are needed to achieve the threat reduction targets set forth in the Washington Recovery Plan.

This chapter lays out a monitoring component for collecting the data necessary to evaluate the effectiveness of hatchery and harvest actions and track progress towards achieving impact reductions targets as well as overall recovery abundance and productivity goals. The monitoring component includes population status and trends monitoring of VSP parameters to assist in identifying the benefits of recovery actions being implemented by WDFW and other entities participating in this recovery effort. Current monitoring efforts are limited by funding; therefore, WDFW will have to be strategic in how monitoring activities are implemented to ensure that efforts are focused on the highest priority populations and parameters/metrics.

An effective monitoring program will need to integrate data collection and analysis on three fronts: population monitoring, hatchery program monitoring and harvest monitoring. Full implementation of this monitoring program will be critical to the success of the CSF Plan, and the overall implementation of the Washington Recovery Plan.

Population Monitoring

Historically, population monitoring of salmon and steelhead has primarily focused on adult spawner abundance. In recent years, increased understanding of population dynamics has resulted in a more sophisticated population status evaluation that focuses on population viability. The NMFS defines viable independent populations as having a negligible risk of extinction (<5%) over a 100-year time frame due to threats from demographic variation, local environmental variation, and genetic diversity changes. The NMFS has identified four parameters for assessing viability: abundance, productivity, spatial structure, and diversity. These four VSP parameters are used in the Washington Recovery Plan to evaluate baseline population status and set biological targets for measuring progress towards recovery (McElhany et. al. 2000, 2003, 2006, and 2007).

In 2011, NMFS provided guidance for monitoring of Pacific Northwest salmon and steelhead (NMFS, 2011b). WDFW has evaluated their salmonid status and trend monitoring programs and identified gaps where populations are not being monitored or monitoring is not consistent with the guidance set forth by NMFS. Additionally, WDFW identified improvements to their current monitoring programs that could assist in collecting data regarding the VSP parameters and make progress towards achieving NMFS monitoring guidance. In conjunction with the CSF Plan, WDFW will modify existing or initiating new monitoring efforts to collect data for the four VSP parameters and to make progress towards achieving the accuracy and precision standards set forth by NMFS. Some recent improvements to WDFW's monitoring program include:

- Implementation of spawning ground surveys for coho to collect data necessary to estimate total abundance and proportion of hatchery fish on spawning grounds and collect VSP data,
- Modification of spawning ground surveys for Chinook and steelhead to more effectively collect data on VSP parameters and to better estimate the proportion of hatchery fish in natural spawning areas,
- Working with utilities to implement monitoring programs in the Lewis and Cowlitz subbasins to collect VSP data and achieve NMFS monitoring guidance

Additional progress is needed on the following activities:

- Expansion of fish-in fish-out sampling (i.e. monitoring of adult spawner abundance (fish-in) and the subsequent juvenile outmigrants they produce (fish-out)),
- Implementation of additional juvenile distribution sampling,
- Increasing precision and accuracy of VSP parameter estimates to meet NMFS standards, where needed,
- Estimation of gene flow from hatchery origin populations to natural origin populations for steelhead as measured in natural spawning areas

Achieving NMFS guidelines for accuracy and precision in all populations will require additional funding; therefore, WDFW is prioritizing monitoring of VSP parameters and populations to be consistent with the Washington Recovery Plan. Populations designated as "primary" have the highest monitoring priority and those designated "stabilizing" have the lowest. Among VSP parameters, abundance and spatial structure are of highest priority for all populations.

Productivity and diversity are more data intensive, and accordingly, sampling will occur in fewer basins in a manner that can be extrapolated to other basins. Even at full funding WDFW monitoring efforts will vary between basins and species depending on population designation, ongoing monitoring programs, and existing infrastructure.

In prioritizing VSP monitoring efforts WDFW also utilized information and analyses completed as part of the Integrated Status and Trends Monitoring (ISTM) Program. The purpose of the ISTM program is to improve the integration of existing and new monitoring efforts to better address population status and trend monitoring needs. LCFRB and WDFW participated in the development and implementation of this program for the lower Columbia River. Objective 1 of this program was to prioritize management decisions, questions and objectives, and this objective was completed in 2010 (Rawding D., J. Rodgers and B. Graham Hudson, 2010). Objective 2 of this program was to evaluate the extent to which existing programs align with these decisions, and this was completed in 2013 (Rawding D. and J. Rodgers). The results of these analyses are being used by WDFW to guide prioritization of monitoring of Washington salmon and steelhead populations the lower Columbia.

These recent and planned future modifications to lower Columbia monitoring programs will provide WDFW with the information necessary to evaluate the status and trends of natural origin populations and the population's response to hatchery and harvest reforms implemented through the CSF Plan. The results of these evaluations will inform long-term actions to be implemented as part of the adaptive management process, but will likely require additional funding above and beyond current base budgets to fully implement the monitoring program envisioned by the Washington Recovery Plan and consistent with NMFS guidance.

Hatchery Program Monitoring

The HSRG provided recommendations regarding hatchery operations performance criteria and standards (i.e. HSRG's criteria for hatchery influence on natural populations). WDFW is using these criteria and standards to evaluate the impact of hatchery programs on natural origin populations.

The WFWC adopted a Hatchery and Fishery Reform Policy (C-3619) (WFWC 2009). This policy directed WDFW to implement hatchery programs in a manner that achieves HSRG performance standards and criteria, including criteria regarding hatchery program influence on natural origin populations. The policy also requires the use these standards and criteria to assess hatchery operations. Hatchery sampling programs are being modified to collect the additional data necessary to determine if hatchery programs are being operated in a manner consistent with the HSRG performance standards and criteria.

Data collected at the hatcheries will be used in combination with data collected from natural spawning areas to fully evaluate overall performance of WDFW hatchery programs, as measured by: 1) quality fish produced, 2) impact on natural origin populations and 3) consistency with HSRG performance standards and criteria. Metrics that will be used to evaluate WDFW hatchery programs overall performance will include:

- Number of adults returning to hatchery
- Smolt to adult (number of fish entering ocean fisheries) survival rate (SAR)
- Percentage of hatchery broodstock that are natural origin fish (pNOB)
- Percentage of natural spawners that are hatchery origin fish (pHOS)
- Measure of mean fitness of an integrated population relative to natural population (PNI)
- Contribution to individual freshwater and ocean fisheries

Specific management questions being addressed by this data include: 1) are hatchery programs providing adequate adult returns to support fisheries as intended, and 2) are hatchery programs reducing impacts on natural origin populations to a level necessary to achieve threat reduction targets and benchmarks set forth in the Washington Recovery Plan and 3) are hatchery programs meeting HSRG standards per the WFWC Hatchery and Fishery Reform policy (WFWC 2009).

Harvest Monitoring

The Washington Recovery Plan vision includes achieving sustainable and productive recreational, tribal, and commercial fisheries through a combination of hatchery programs and recovery of natural populations to healthy and harvestable levels. The plan also calls for reduced fishery impacts on natural origin fish, especially in the near-term, to assist in the recovery of ESA-listed populations. Achieving these two goals requires an effective harvest monitoring program to collect data from fisheries that can be used to estimate harvest of hatchery origin fish and total mortalities to natural origin fish. These data are also necessary to complete run reconstruction analyses for naturally and hatchery produced stocks. Total abundance estimates produced by run reconstruction analyses are used to help track status and trends of individual stocks and/or populations, and to determine if fishery objectives and biological targets set forth in the Washington Recovery Plan are being achieved.

Fisheries impacting lower Columbia River populations include recreational fisheries in Columbia River tributaries; recreational and commercial fisheries in the mainstem Columbia River (including Buoy 10); ocean recreational fisheries (including charter boats), ocean commercial fisheries (California through Alaska) and ocean tribal fisheries. Current sampling programs for ocean and mainstem Columbia River fisheries are more intensive and provide higher levels of data accuracy and precision, as compared to sampling programs currently in place for tributary fisheries in the lower Columbia River. Ocean and Columbia River fisheries utilize statistical creel sampling programs utilizing paid staff to collect catch and effort data. Tributary fishery catch information is provided by a statistical Catch Record Card (CRC) program that depends on anglers voluntarily returning CRC's at the end of each year. Creel survey programs, which collect encounter rate information (e.g. ratio of number of natural origin to hatchery origin fish are handled, including both kept and released fish) not recorded through the CRC system, occur in some tributaries.

Mark-selective harvest is helping to increase harvest of hatchery fish; thereby reducing number of hatchery fish returning to natural spawning areas. The recent implementation of mark-selective fisheries for Chinook and coho requires modifications to traditional sampling programs that historically focused primarily on landed catch. Sampling of mark-selective fisheries requires the estimation of released fish to estimate the total handle of unmarked or natural origin fish. Post release mortality rates will also be necessary to estimate the total number of unmarked or natural origin mortalities for a given fishery. Mortalities to natural origin fish are critical to evaluating the benefit and/or adverse impact from implementation of mark-selective fisheries.

Sampling programs are being modified to collect additional data necessary for evaluating fisheries and determining if hatchery programs are supporting productive fisheries and being operated consistent with HSRG performance standards and criteria. Metrics that will be used to evaluate and, as necessary, adjust fishery performance and impacts on natural origin populations will include (for some species):

- Effort levels: angler trips for sport fisheries and hours open or number of landings for commercial fisheries
- Catch rates: number of fish landed per angler trip or hour for sport fisheries and number of fish landed per boat or delivery for commercial fisheries
- Number of hatchery and natural origin fish handled
- Number of hatchery fish retained by stock or population
- Number of natural origin fish retained by stock or population
- Number of natural origin fish released by stock or population and number of released fish that were mortalities
- Estimated harvest or exploitation rates for hatchery fish by stock or population
- Estimated impact rates (mortalities/populations size) on natural origin fish by stock or population

Specific management questions being addressed by this data include: 1) What level of benefit are fisheries providing in terms of fishing opportunity for recreational and commercial fisheries (days open to fishing, catch rates and landed catch), 2) are current fisheries being managed within NMFS impact limits and what are the number of mortalities to natural origin fish that occur in each fishery and 3) are harvest practices reducing impacts on natural origin populations to a level necessary to achieve threat reduction targets and benchmarks set forth in the Washington Recovery Plan.

Adaptive Management

The CSF Plan was initiated in 2009 with the completion of the HAIPs and the development of the initial hatchery and harvest reform actions. Implementation of these reform actions began in 2009 and modification to monitoring programs began shortly thereafter. The CSF Plan incorporates hatchery reform actions beginning in 2009 and further refines and also identifies additional hatchery and harvest reform actions to be implemented. Fully implementing the CSF Plan will depend on an adaptive management process that allows WDFW to adjust actions as needed to achieve the impact reduction and productivity improvement targets set forth in the Washington Recovery Plan.

As described in Chapter 4 the HSRG developed a fitness metric that can be used to measure productivity, which is the end result of reducing impacts from hatchery and harvest threats. An effective and comprehensive monitoring program will be required to collect the data necessary to estimate this fitness metric. WDFW will utilize this fitness metric the evaluate the impacts of their hatchery and harvest reform actions and to determine if they are achieving productivity improvement targets for each lower Columbia salmon and steelhead population.

The adaptive management process will be iterative in nature. Hatchery and harvest reform actions will be implemented. Population monitoring information will be collected in successive years. Results from the monitoring program will be used to evaluate whether hatchery and harvest reform actions implemented are achieving productivity improvement targets set forth in the Washington Recovery Plan. Additional reform actions will be implemented as needed for populations that are not achieving their productivity targets.

The success of this adaptive management process hinges on the WDFW being able to implement necessary hatchery and harvest reform actions and to monitor populations to evaluate their responses to these reform actions. It is expected that achieving recovery goals of lower Columbia populations will require several decades; therefore, a long-term funding strategy will be necessary to both implement reform actions and continue to collect monitoring data.

Wild Salmon and Steelhead Populations Current Monitoring

VSP Parameter	Chinook	Steelhead	Coho	Chum
Adult Abundance	• Census counts - enumeration of live fish captured at weirs/traps and released upstream • Mark- Recapture: Genetic, carcass tagging, and/or live tagging • Area-Under-the-Curve (expansion of live fish counts) • Redd count expansion (Aerial or ground surveys) • Peak count expansion of live and dead counts	• Census counts - enumeration of live fish captured at weirs/traps and released upstream • Mark-Recapture: live tagging with kelt recapture or re-sight via snorkeling • Redd count expansion (ground surveys)	• Census counts - enumeration of live fish captured at weirs/traps and released upstream • Mark- Recapture: via live tagging • Spatially balanced (GRTS) surveys of redds, live fish and carcasses	• Census counts - enumeration of live fish captured at weirs/traps and released upstream • Mark- Recapture: carcass tagging, and/or live tagging • Area-Under-the-Curve (expansion of live fish counts) • For very low abundance or extirpated populations, presence/absence surveys are conducted
Adult Productivity	• Combines other VSP metrics: adult abundance, diversity (age data, sex ratio) • pHOS from carcass recoveries in stream surveys • Harvest estimates from sport and commercial fishery sampling in mainstem Columbia and major tributaries via CWT and PIT tag expansions	• Combines other VSP metrics: adult abundance, diversity (age data, sex ratio) • pHOS collection from traps/weirs, seining and snorkel surveys in some watersheds • Incidental fishery impact estimates from mainstem sport and commercial fishery sampling for LCR aggregate	• Combines other VSP metrics: adult abundance, diversity (age data, sex ratio) • pHOS from carcass recoveries and live observations in stream surveys • Harvest estimates from sport and commercial fishery sampling in mainstem Columbia and major tributaries via CWT and PIT tag analysis	• Combines other VSP metrics: adult abundance, diversity (age data, sex ratio) • pHOS:otolith sampling and/or Parental Based Tagging (PBT) used to determine origin (hatchery/wild) • Incidental fishery impact estimates from sport and commercial fishery sampling in mainstem Columbia
Juvenile Productivity	• Smolt abundance using traps and mark-recapture, • Smolt enumeration at collectors • Smolt per adult ratio data and smolt to adult returns (SAR) calculated from smolt and adult estimates	• Smolt abundance using traps and mark-recapture • Smolt enumeration at collectors • Smolt per adult ratio data and smolt to adult returns (SAR) calculated from smolt and adult estimates	• Smolt abundance using traps and mark-recapture • Smolt enumeration at collectors • Smolt per adult ratio data and smolt to adult returns (SAR) calculated from smolt and adult estimates	• Smolt abundance using traps and mark-recapture • Smolt per adult ratio data and smolt to adult returns (SAR) calculated from smolt and adult estimates

Spatial Distribution	• Redds, live fish, and carcass counts by survey reach • GPS locations for individual redds in surveyed areas for some populations	• Redd, live fish, and carcass counts by survey reach • GPS locations for individual redds in surveyed areas	• Fish counts by section in spatially balanced (GRTS) index reaches • Redd density and reach occupancy rates (% of reaches with at least one redd) • GPS locations for individual redds in survey areas	• Redds, live fish, and carcass counts by survey reach • GPS locations for individual redds in surveyed areas for some populations
Species Diversity	• Adult age, length and sex ratio from seining, traps, weirs or stream surveys • Juvenile age and length data from smolt traps • Adult entry timing from weir/trap,Redd construction timing from stream surveys • Juvenile outmigration timing from smolt trap • Genetic sampling from adults at weir/trap and juveniles at smolt traps	• Adult age, length and sex ratio from seining, traps, weirs or stream surveys • Juvenile age and length data from smolt traps • Adult entry timing from weir/trap • Redd construction timing from stream surveys • Juvenile outmigration timing from smolt trap • Genetic baseline collected for certain systems • Genetic introgression monitoring in key watersheds	• Adult age, length and sex ratio from seining, traps, weirs or stream surveys • Juvenile age and length data from smolt traps • Adult entry timing from weir/trap • Redd construction timing from stream surveys • Juvenile outmigration timing from smolt trap • Genetic baseline samples collected for certain systems (not analyzed)	• Adult age, length and sex ratio from seining, traps, weirs or stream surveys • Juvenile age and length data from smolt traps • Redd construction timing from stream surveys • Juvenile outmigration timing from smolt trap • Genetic baseline from samples have been collected for certain systems

Wild Salmon and Steelhead Populations Monitoring Improvement Actions Needed

VSP Parameter	Chinook	Steelhead	Coho	Chum
Adult Abundance	• Continued development and maintenance of database infrastructure • Refine suite of monitoring methods annually to improve accuracy and precision of estimates • Continue to improve and expand implementation of genetic mark/recapture, where appropriate • Continue to improve annual data analysis process and reporting structure	• Continued development and maintenance of database infrastructure • Develop alternative/ improved study design for winter steelhead abundance estimates with estimates of precision • Develop LCR specific redds/female and sex ratio data for winter steelhead • Test assumptions of mark/recapture estimates used for summer steelhead estimates • Continue to improve annual data analysis process and reporting structure	• Continued development and maintenance of database infrastructure • Refine suite of monitoring methods annually to improve accuracy and precision of estimates • Develop a new GRTS draw from newly available master sample framework • Add additional sampling locations to develop annual estimates of redds/female needed for abundance estimates • Continue to improve annual data analysis process and reporting structure	• Continued development and maintenance of database infrastructure • Refine suite of monitoring methods annually to improve accuracy and precision of estimates • Continue to improve annual data analysis process and reporting structure
Adult Productivity	• Improve estimates of incidental mortality in mark-selective fisheries • Refine sport and commercial sampling program to improve harvest estimates • Continue to explore use of PIT tag data and Parental Based Tagging (PBT) as tools for harvest assessment • Identify where fish management weirs are not meeting monitoring and management objectives, and determine infrastructure or operational needs to improve	• Improve estimates of incidental mortality in mark-selective fisheries • Develop stock specific impact rates in mainstem fisheries • Develop additional methods for estimating gene flow and/or pHOS in steelhead • Determine misclassification rate of male versus female and/or summer versus winter (ultra sound fish or genetic markers)	• Improve estimates of incidental mortality in mark-selective fisheries • Improve estimates of pHOS through continued review of surveying protocols	• Improve estimates of incidental mortality in LCR mainstem and tributary fisheries • Continue to expand use of Parental Based Tagging to estimate origin of spawners

Juvenile Productivity	• Improve smolt trap efficiency by operation of second trap, alternate site, or weir panels • Implement additional juvenile monitoring programs via smolt traps in key watersheds • Extend smolt trap seasons to account for additional species • Improve methods to account for missed smolt trapping days	• Improve smolt trap efficiency by operation of second trap, alternate site, or weir panels • Implement additional juvenile monitoring programs via smolt traps in key watersheds • Extend smolt trap seasons to account for additional species • Improve methods to account for missed smolt trapping days	• Improve smolt trap efficiency by operation of second trap, alternate site, or weir panels • Implement additional juvenile monitoring programs via smolt traps • Extend smolt trap seasons to account for additional species • Improve methods to account for missed smolt trapping days	• Improve smolt trap efficiency by operation of second trap, alternate site, or weir panels • Implement additional juvenile monitoring programs via smolt traps • Extend smolt trap seasons to account for additional species • Improve methods to account for missed smolt trapping days
Spatial Distribution	• Finalize spatial extent of spawning (sample frame) • Improve ability to map and disseminate spatial data to fish managers	• Finalize spatial extent of spawning (sample frame) • Consider spatially balanced (GRTS) juvenile parr sampling • Improve ability to map and disseminate spatial data to fish managers	• Finalize spatial extent of spawning (sample frame) • Consider spatially balanced (GRTS) juvenile parr sampling • Improve ability to map and disseminate spatial data to fish managers	• Finalize spatial extent of spawning (sample frame) • Improve ability to map and disseminate spatial data to fish managers
Species Diversity	• Develop long-term ESU phenotypic and genetic monitoring and sampling plan • Re-evaluate genetic baseline for fall (tule) Chinook now that mass marking has been fully implemented and NOR samples are identifiable	• Develop DPS phenotypic and genetic monitoring and sampling plan • Continue implementation of genetic introgression study	• Develop ESU phenotypic and genetic monitoring and sampling plan • Analyze archived genetic baseline samples	• Develop ESU phenotypic and genetic monitoring and sampling plan

Hatchery Monitoring

Current	Improvement Actions Needed
In-Facility	
• In-season management of adult salmonid returns, broodstock collection and spawning protocols	• Development of updated Hatchery and Genetic Management Plans (HGMP) for each hatchery program consistent with implementation of the Conservation and Sustainable Fisheries plan and incorporate HSRG standards and submit to NMFS for permitting
• Enumeration of hatchery origin and natural origin returns to hatchery collection facilities and final disposition of each	• Development of natural origin run and/or spawn timing curves to guide collection of natural origin broodstock for integrated programs
• For integrated programs – enumeration of the number of hatchery and natural origin fish used in the broodstock for each species to calculate pNOB	• Review and update protocols for spawning, incubation, rearing, and release strategies based on best available science
• Hatchery return timing, age composition (from scales), stock composition (CWT analysis), sex ratio and length data for run reconstruction and forecasting	
• Survival to each life history stage during incubation and rearing (Green egg, Eyed egg, Fry, Parr, Smolt)	
• Growth/feed conversions and condition	
• Monthly fish health monitoring	
• Number of smolts released and size and condition factor at release	
• Water quality - regulated by Washington Department of Ecology - weekly and/or monthly samples to ensure facility compliance	

Current	Improvement Actions Needed
Performance Measures	
• All hatchery origin adults are identifiable - juveniles are marked pre-release by one or more of the following: adipose fin-clip, CWT in snout, otolith marking (chum)	• Estimate pHOS based on visual identification of hatchery origin fish (i.e. adipose fin-clips) where possible and explore methods to improve pHOS estimates for all species
• Harvest rates – contribution to commercial and sport fisheries	• Develop methods and reports on hatchery fish contribution to fisheries
• Hatchery smolt to adult survival rates	•
• pHOS via CWT expansion when appropriate and via otolith analysis and/or Parental Based tagging for chum (from supplementation program)	• Calculation of pNOB, pHOS and PNI statistics annually for each hatchery program and development of a reporting format to track hatchery performance measures
	• Development and implementation of methods to estimate pHOS and/or gene flow for winter steelhead
	• Develop nutrient enhancement goals for watershed and include in updated escapement goals
	• Develop a regional monitoring plan for genetic and ecological interactions by hatchery-and natural-origin juveniles to assess impacts to the natural origin population
	• As additional data is collected and new methodologies become available, modify programs to achieve goals for PNI, pHOS and pNOB

CHAPTER 11 REFERENCES AND ACRONYMS

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Acronyms

AHA	All H Analyzer
BPA	Bonneville Power Administration
CSF	Conservation and Sustainable Fisheries
DPS	Distinct Population Segment
EDT	Ecosystem Diagnosis and Treatment
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FCRPS	Federal Columbia River Power System
FEIS	Final Environmental Impact Statement
HAIP	Hatchery Action Implementation Plan
HGMP	Hatchery Genetic Management Plan
HSRG	Hatchery Scientific Review Group
ISTM	Integrated Status and Trends Monitoring
LCFRB	Lower Columbia Fish Recovery Board
MU	Management Unit
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
ODFW	Oregon Department of Fish and Wildlife
OR/WA/CA	Oregon/Washington/California
PCSRF	Pacific Coast Salmon Recovery Fund
PFMC	Pacific Fishery Management Council
pHOS	Proportion of effective Hatchery-Origin Spawners
PNI	Proportionate Natural Influence
pNOB	Proportion of Natural-Origin Spawners
SAR	Smolt to Adult Survival Rate
TRT	Technical Review Team
USFWS	United States Fish and Wildlife Service
VSP	Viable Salmonid Populations
Washington Recovery Plan	Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan
WDFW	Washington Department of Fish and Wildlife
WFWC	Washington Fish and Wildlife Commission

Appendix 1 HATCHERY AND HARVEST REFORM STRATEGIES AND MEASURES

The Washington Recovery Plan[1] developed an integrated regional implementation strategy that set a roadmap for recovery by initially identifying the threats and limiting factors that impact salmon and steelhead populations in each of the Lower Columbia ESUs. The cornerstone of this integrated regional strategy is the identification of strategies and measures needed to address each of the threat categories that abundance and productivity of natural origin populations. The strategies and measures included in the Washington Recovery Plan provide initial guidance based on the current state of understanding of limiting factors and threats. It is expected that refinements will occur as the strategies, measures and actions are implemented. Below are the relevant sections for hatchery and harvest strategies and measures as outlined in the Washington Recovery Plan.

Strategies and Measures

Strategies and measures are fundamentally intended to produce biological results but are also based on economic, political, social, and cultural considerations. These considerations are critical to the prospects for developing and implementing and effective and equitable plan. Regional strategies and measures were developed in a series of meeting and workshops involving a working group of representative from implementing and affected agencies. The strategies and measures include in this Plan provide initial guidance based on the current state of our understanding of limiting factors and threats. It is expected that refinements will occur during the Plan implementation process.

The Washington Recovery Plan specifically defines strategies and measures as:

- Strategies: provide broad guidance
- Measures: provide specific descriptions of the mechanisms or categories of actions needed to carry out the strategies.

Hatchery

The hatchery strategy described in the Washington Recovery Plan includes both near-term and long-term strategies and measures to ensure that hatcheries support recovery of naturally spawning fish. Some subbasins will be free of hatchery influence and hatchery programs. In other subbasins hatchery programs will serve specific conservation and harvest purposes consistent with goals for naturally-spawning populations. This mosaic of programs is designed to ensure that overall each ESU will be naturally self-sustaining and sustain productive fishing opportunities.

[1] LCFRB, 2010, Volume 1, Chapter 5

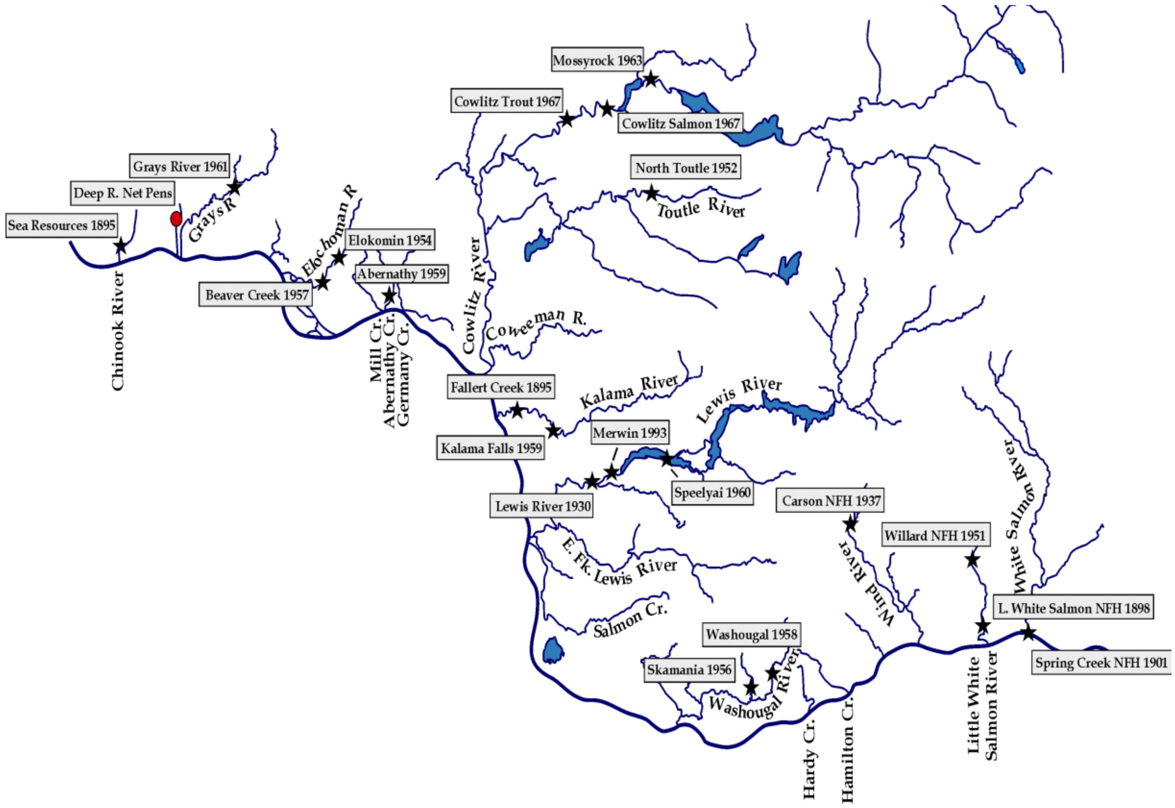


Figure 5-0-1. Lower Columbia production fish hatcheries and beginning dates of operation.

Working Hypotheses

- Historic hatchery operations in conjunction with other factors posed significant risks to the continued existence of many naturally-spawning populations.
- Changes in hatchery operations have and will continue to contribute to reduce risks to naturally-spawning populations.
- Additional reductions in hatchery impacts are needed to support the recovery of naturally-spawning populations.
- Conservation hatchery programs can contribute to recovery through the preservation, reintroduction, and supplementation of naturally-spawning populations.
- Hatcheries can provide harvest opportunities consistent with measures to restore and maintain healthy, harvestable naturally-spawning populations.
- Some hatchery programs have legal obligations to provide fish for mitigation purposes and those obligations will likely be offset to varying degrees by increases in natural production.
- Returning adults from some hatchery programs currently sustain some natural populations.

- Conservation and harvest benefits from hatchery programs can be realized with acceptable risks to naturally-spawning populations through effective integrated or segregated hatchery programs.
- Restoration of healthy, harvestable naturally-spawning populations cannot be achieved solely by eliminating the effects of hatcheries either by closing all existing facilities or by replacing all production programs with conservation programs.

Strategies

- Expand use of hatchery reintroduction and supplementation programs to conserve and recover naturally-spawning fish when and where appropriate.
- Reconfigure production-based hatchery programs for harvest to support populations and region-wide recovery goals while limiting or eliminating detrimental impacts on naturally-spawning populations.
- Until harvestable naturally-spawning populations are restored, many lower Columbia River hatchery programs will continue to be operated to produce fish for harvest purposes in a manner consistent with restoring and maintaining healthy, harvestable naturally-spawning populations.
- Base hatchery reform on a comprehensive assessment of the risks and benefits posed by artificial production programs.
- Operate hatcheries to promote region-wide recovery through the application of appropriate risk containment measures for: 1) hatchery origin adults returning to natural spawning areas, 2) release of hatchery juveniles, 3) handling of natural origin adults at hatchery facilities, 4) water quality and effective disease control, and 5) mixed stock fisheries.
- Assist in the design of hatchery programs to be consistent with recovery goals for lower Columbia ESUs and the ecological context of the watershed, including the characteristics of the habitat and the natural fish populations.
- Promote local adaptation of natural and hatchery populations by managing hatchery broodstock to achieve proper genetic integration with, or segregation from, natural populations.
- Minimize adverse ecosystem effects of and ecological interactions with hatchery-origin fish.
- Develop marking programs to assure that hatchery-produced fish are identifiable for harvest management and escapement accounting.
- Use adaptive management to ensure that hatchery programs respond to new knowledge of how to further protect and enhance natural production and improve operational efficiencies.
- Promote public education concerning the role of hatcheries in the protection of natural populations.
- Document and formalize hatchery operations through the use of the existing Hatchery Genetic Management Plans (HGMPs).

- Seek flexibility in current funding to assure hatcheries have the resources to achieve complementary harvest and natural production objectives.

Measures

Fall Chinook

- Reconfigure and reform hatchery programs for fall Chinook consistent with responsibilities identified in this Recovery Plan and standards established by the Hatchery Scientific Review Group.
- Maintain or establish wild fish refuges for fall Chinook in selected watersheds by eliminating or limiting release and escapement of hatchery-origin fish into natural spawning areas.
- Implement hatchery reforms for fall Chinook in phases in order to limit demographic risks of the reduction in hatchery supplementation of natural abundance in the interim until natural habitat and population productivity is sufficient to sustain local populations.
- Use local watershed brood stock and integrated production strategies in fall Chinook hatchery programs in order to promote local adaptation and natural productivity.
- Use fall Chinook juvenile release strategies to minimize ecosystem effects of and ecological interactions.
- Use hatchery operation strategies to protect Lewis River naturally-spawning fall Chinook from ecosystem effects and ecological interactions.
- Mark hatchery fall Chinook in priority watersheds to promote fishery utilization, facilitate the utilization of natural-origin fish in integrated programs, and enumerate hatchery fish in natural spawning areas.
- Continue to produce, in a manner consistent with other recovery strategies and measures, sufficient numbers of hatchery fall Chinook to sustain significant fishery opportunities until harvestable naturally-spawning populations are restored.

Spring Chinook

- Reconfigure and reform hatchery programs for spring Chinook consistent with responsibilities identified in this Recovery Plan and standards established by the Hatchery Scientific Review Group.
- Reintroduce spring Chinook in upper Cowlitz and Lewis beginning with hatchery supplementation.
- Develop plans for future hatchery programs with reestablished natural-origin spring Chinook populations, including integrated and segregated options.
- Develop and apply hatchery brood stock watershed transfer policies for spring Chinook.
- Use spring Chinook juvenile release strategies to minimize ecosystem effects and ecological interactions.

- Mark spring Chinook hatchery production for identification and harvest.
- Continue to produce, in a manner consistent with other recovery strategies and measures, sufficient numbers of hatchery spring Chinook to sustain significant fishery opportunities until harvestable naturally-spawning populations are restored.

Coho

- Reconfigure and reform hatchery programs for coho consistent with responsibilities identified in this Recovery Plan and standards established by the Hatchery Scientific Review Group.
- Maintain or establish wild fish refuges for coho in selected watersheds by limiting or eliminating release and escapement of hatchery-origin fish into natural spawning areas.
- Expand use of local watershed brood stock and integrated production strategies in selected coho hatchery programs in order to promote local adaptation and natural productivity.
- Improve segregated programs for coho, where appropriate, to meet established wild population protection criteria.
- Develop conservation hatchery programs to restore native for coho in selected populations.
- Reintroduce coho in upper Cowlitz and upper Lewis rivers.
- Develop coho transfer policies as local brood stock is developed.
- Use coho juvenile release strategies to minimize detrimental ecosystem impacts and ecological interactions.
- Mark coho hatchery harvest production.
- Establish naturally-spawning production sanctuary areas to be used for coho indicator stock programs.
- Continue to produce, in a manner consistent with other recovery strategies and measures, sufficient numbers of hatchery coho to sustain significant fishery opportunities harvestable naturally-spawning populations are restored.

Steelhead

- Reconfigure and reform hatchery programs for steelhead consistent with responsibilities identified in this Recovery Plan and standards established by the Hatchery Scientific Review Group.
- Maintain or establish wild fish refuges for steelhead in selected watersheds by limiting or eliminating release and escapement of hatchery-origin fish into natural spawning areas.
- Expand use of local watershed brood stock and integrated production strategies in selected steelhead hatchery programs in order to promote local adaptation and natural productivity.
- Improve segregated programs for steelhead, where appropriate, to meet established wild population protection criteria.

- Use steelhead juvenile release strategies to minimize detrimental ecosystem impacts and ecological interactions.
- Utilize hatchery production to reintroduce winter steelhead in upper Cowlitz and Lewis rivers.
- Continue to mark steelhead hatchery production.
- Maximize harvest and removal of non-local summer and early winter steelhead produced from segregated hatchery programs.
- Continue to produce, in a manner consistent with other recovery strategies and measures, sufficient numbers of hatchery steelhead to sustain significant fishery opportunities until harvestable naturally-spawning populations are restored.

CHUM

- Implement and expand hatchery programs for chum consistent with responsibilities identified in this Recovery Plan and standards established by the Hatchery Scientific Review Group.
- Continue to enhance local chum populations using Grays and Chinook hatcheries.
- Initiate additional conservation propagation programs for chum in order to restore depleted or extirpated populations and to reduce demographic risk.
- Use DNA data to select appropriate chum brood stock.
- Develop and apply hatchery brood stock watershed transfer policies for chum.

Harvest

Near-term and long-term strategies and measures set forth in the Washington Recovery Plan focus on two harvest aspects. The first is to limit harvest impacts on recovery efforts and to assist in ultimately restoring naturally-spawning fish populations to harvestable levels. The second is to preserve fishery opportunities focusing on hatchery fish and strong natural origin populations in a manner that does not adversely affect recovery efforts. Measures are included to integrate consideration of recovery goals into the Pacific Salmon Treaty, Pacific Fishery Management Council, and *U.S. v. Oregon* Management Agreement processes; and to improve marking and fishery monitoring programs.

Working Hypotheses

- Salmon recovery is predicated on restoration of healthy, harvestable naturally-spawning populations.
- Historic fishing rates in conjunction with other factors posed significant risks to the continued existence of many naturally-spawning populations and were not sustainable.
- Changes in fishery management to protect weak stocks have reduced harvest of some naturally-spawning populations in recent years.

- Additional fishery management opportunities exist for reducing near term population risks for some species such as fall Chinook but opportunities for others such as chum salmon and steelhead are limited.
- Additional fishery restrictions involve tradeoffs in foregone catch of healthy hatchery and naturally-spawning stocks in freshwater and ocean fisheries.
- Reductions in fishing rates gradually reach a point of diminishing returns where further reductions do not significantly affect population risks.
- Restoration of healthy, harvestable naturally-spawning populations will ultimately depend on a combination of actions involving harvest management, hatchery operations, habitat protection and restoration, and ecological interactions.

Strategies

- Assure fishery impacts to lower Columbia naturally spawning populations are managed to contribute to recovery.
- Preserve fishery opportunity focused on hatchery fish and strong naturally spawning stocks in a manner that does not adversely affect recovery efforts.
- Revise or adjust Fishery Management Plans for lower Columbia ESUs as needed to support the Lower Columbia Recovery goals and priorities.
- Consider recovery goals for lower Columbia salmon and steelhead populations as identified in the Lower Columbia Recovery Plan in annual fishery management processes.
- Ensure that scientific review of Lower Columbia Recovery Plan harvest objectives and current ESA management objectives occurs as part of the process in fishery management forums.
- Research and employ best available technology to reduce incidental mortality of non-target fish in selective fisheries.
- Seek to maintain and/or establish programs, priorities, regulatory frameworks, and coordination mechanisms for effective enforcement of fishery rules and regulations for the protection of fish and wildlife resources.

Measures

Fall Chinook

- Implement actions to limit the exploitation rate of lower Columbia River tule fall Chinook in order to protect weak populations.
- Define appropriate fishery impact rates for fall Chinook based on assessments of near- and long-term risks to species viability and considerations of the needs to preserve fishery viability, manage hatchery surpluses, and promote implementation of other recovery measures.

- Consider and expressly evaluate the potential for a sliding scale harvest plan based on annual abundance indicators for representative tule fall Chinook populations.
- Conduct periodic reviews of fall Chinook harvest relative to habitat productivity and capacity to assure harvest objectives are synchronized with habitat changes.
- Seek commitment from agencies and tribes in the Pacific Fisheries Management Council, North of Falcon, and Columbia River Compact processes to specifically manage annually for lower Columbia naturally-spawning fall Chinook and to establish a collaborative U.S. policy position for the international table at the Pacific Salmon Commission.
- Improve tools to monitor and evaluate fishery catch to assure impacts to naturally-spawning fall Chinook are maintained within agreed limits.
- Manage ocean, Columbia River, and tributary fisheries to meet the spawning escapement goal for lower Columbia bright fall Chinook.
- Develop a more detailed process for in-season monitoring of stock specific harvest of fall Chinook in the Columbia River.
- Implement basin wide marking for hatchery tule fall Chinook that is adequate for monitoring interception rates in specific fisheries, tributary harvest management, and monitoring escapement of naturally-spawning fish.
- Address technical and policy issues regarding mass-marking and help develop programs to mark and monitor recoveries of fall Chinook in fisheries and escapement.

SPRING CHINOOK

- Define appropriate fishery impact rates for spring Chinook based on assessments of near- and long-term risks to species viability and considerations of the needs to preserve fishery viability, manage hatchery surpluses, and promote implementation of other recovery measures.
- Continue to monitor Columbia River mark-selective fisheries and provide estimates of impacts to naturally produced lower Columbia spring Chinook.
- Monitor and evaluate handling mortality impacts to released naturally-spawning spring Chinook in Columbia River fisheries.
- Develop gear and handling techniques, as well as regulatory options in both commercial and sport fisheries, to minimize mark-selective fishery impacts to naturally-spawning spring Chinook.
- Develop a lower Columbia naturally-spawning spring Chinook harvest rate plan for management of Columbia River fisheries at such time as significant populations are re-established.
- Manage Columbia River commercial fisheries by time, area and mark-selective requirements to target hatchery fish and minimize impacts to naturally spawning spring Chinook.

COHO

- Define appropriate fishery impact rates for coho based on assessments of near- and long-term risks to species viability and considerations of the needs to preserve fishery viability, manage hatchery surpluses, and promote implementation of other recovery measures.
- Implement actions to regulate the fishery impact rate on naturally-spawning lower Columbia River coho in order to protect weak indeed populations and reduce risks using a sliding scale harvest based on annual abundance indicators.
- Maintain mark-selective sport fisheries in ocean, Columbia River, and tributaries and monitor impacts on naturally-spawning coho stocks.
- Manage Columbia River commercial fisheries by time and area to target hatchery fish and to minimize impacts to naturally-spawning coho.
- Review and evaluate the harvest management strategy developed to protect naturally-spawning Clackamas late coho in terms of its ability to protect naturally-spawning Washington late coho.

STEELHEAD

- Define appropriate fishery impact rates for steelhead based on assessments of near- and long-term risks to species viability and considerations of the needs to preserve fishery viability, manage hatchery surpluses, and promote implementation of other recovery measures.
- Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.
- Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.
- Establish specific naturally-spawning steelhead encounter triggers for in-season Columbia River fishery adjustments needed to support lower Columbia recovery goals and strategies.
- Work through *U.S. v. Oregon* and with Columbia River treaty Indian tribes to develop harvest plans for Wind River summer steelhead.
- Monitor naturally-spawning steelhead handle rate in tributary salmon and steelhead fisheries.
- Manage Columbia River commercial fisheries by time, area and gear to target hatchery fish and minimize impacts to naturally spawning steelhead.

CHUM

- Columbia River Compact agencies will evaluate effectiveness of the baseline time and area management strategy for chum protection in the commercial fishery.
- Develop more specific chum management details for pre-season and in-season management of the late fall commercial fishery.
- Monitor chum handle rate in tributary winter steelhead and late coho sport fisheries.

Impact	Action #	Description	Program	How does program address the action	Program Element	Status	Anticipated Completion date	Challenges and Constraints	Coordinating Partners	Impacted subbasins	Target Species	Other species	Costs associated with the ESA listings
Hatchery	512	Maintain or establish wild fish refuges for fall Chinook in selected watersheds by eliminating or limiting release & escapement of hatchery-origin fish into natural spawning areas	Fall Chinook	No releases of fall chinook will occur in these basins to reduce interaction between hatchery and natural origin fish	Wild fish refuges	Completed		pHOS from outside programs, habitat productivity and capacity	none	Grays, Elochoman, MAG, Coweeman, NF Toutle, NF Lewis, EF Lewis, Salmon	Fall Chinook	Other wild salmonid species	None
				Weirs or other facilities will be operated to limit number of hatchery origin fish that can access natural spawning areas	Hatchery fish straying	Ongoing		all of these locations are being reviewed based on weir efficiency, funding and land owner agreements	NMFS	Elochoman, Coweeman, NF Toutle, Kalama, Washougal	Fall Chinook	Other wild salmonid species	$400,000
Hatchery	513	Implement hatchery reforms for fall Chinook in phases in order to limit demographic risks of the reduction in hatchery supplementation of natural abundance in the interim until natural habitat and population productivity is sufficient to sustain local populations	Fall Chinook	Plant limited numbers of juvenile hatchery fish to maintain minimum population size to avoid demographic risk	Conservation/ supplementation programs	Being considered	2016 for completion of conservation/ supplementation plan	Appropriate broodstock, natural population size	NMFS	Elochoman (proposed)	Fall Chinook	None	$100,000
			Fall Chinook	Evaluate need for conservation brood stock program to maintain genetic legacy that is threatened by low adult abundance	Conservation/ supplementation programs	Being considered	2016 for completion of conservation/ supplementation plan	Natural population size	NMFS	Grays; MAG future possibility	Fall Chinook	None	$250,000
Hatchery	514	Use local watershed brood stock and integrated production strategies in fall Chinook hatchery programs in order to promote local adaptation and natural productivity	Fall Chinook	Incorporate wild fish into hatchery brood stock to reduce genetic separation between hatchery and natural origin stocks	Integrated programs	Ongoing		Collecting natural origin broodstock	Tacoma Power, NMFS and public	Lower Cowlitz, NF Toutle, Kalama, Washougal	Fall Chinook	None	$45,000
Hatchery	515	Use fall Chinook juvenile release strategies to minimize ecosystem effects and ecological interactions	Fall Chinook	Ensure juveniles are fully smolted and released at a time when then move swiftly to the ocean to minimize interactions with natural origin juveniles in freshwater	Production programs	Ongoing		Smolt outmigration behavior	Tacoma Power and NMFS	Lower Cowlitz, Toutle, Kalama, Washougal	Fall Chinook	Other wild salmonid species	None
Hatchery	516	Use hatchery operation strategies to protect Lewis River naturally-spawning fall Chinook from ecosystem effects and ecological interactions	Fall Chinook	Practice of not releasing hatchery fall chinook will minimize direct interactions, for coho and steelhead a combination of volitional releases and rearing to proper size at proper time will minimize interaction with juvenile fall chinook rearing in lower North Fork Lewis	Production programs	Ongoing		Smolt outmigration behavior	Tacoma Power and NMFS	NF Lewis	Fall Chinook	Other wild salmonid species	None
Hatchery	517	Mark hatchery fall Chinook fish in priority watersheds to promote fishery utilization, facilitate the utilization of natural-origin fish in integrated programs, and enumerate hatchery fish in natural spawning areas	Fall Chinook	All hatchery fall chinook releases downstream of Bonneville Dam are mass marked with and adipose fin clip to support mark-selective fisheries and allow for estimation of pHOS in natural spawning areas	Production programs	Ongoing		Marking logistics	Tacoma Power and NMFS	Grays, Lower Cowlitz, Toutle, Kalama, Washougal	Fall Chinook	None	$1,000,000
Hatchery	519	Reintroduce spring Chinook in upper Cowlitz and Lewis beginning with hatchery supplementation	Spring Chinook	Natural origin and surplus hatchery origin adults are being transported upstream and 1000,000 juvenile spring chinook are acclimated and released in the upper North Fork Lewis basin to initiate the establishment of a naturally produced population in the Lewis subbasin	Reintroduction programs	Ongoing		Broodstock, juvenile downstream collection	Tacoma, PacifiCorp and NMFS	NF Lewis, Cowlitz	Spring Chinook	Other wild salmonid species	$70,000
Hatchery	520	Develop plans for future hatchery programs relationship with reestablished natural-origin spring Chinook populations, including integrated and segregated options Ch: develop plans for future hatchery programs	Spring Chinook	Collaborate with PacifiCorp and Tacoma Power to develop Hatchery and Supplementation Plans and Fisheries and Hatchery Management Plan (FHMP) that guide future spring chinook hatchery programs in an adaptive manner to achieve goal of a self-sustaining natural origin spring chinook populations in the Lewis and Cowlitz subbasins	Reintroduction programs	Ongoing		Broodstock, juvenile downstream collection	Tacoma, PacifiCorp and NMFS	NF Lewis, Cowlitz	Spring Chinook	Other wild salmonid species	$10,000

Impact	Action #	Description	Program	How does program address the action	Program Element	Status	Anticipated Completion date	Challenges and Constraints	Coordinating Partners	Impacted subbasins	Target Species	Other species	Costs associated with the ESA listings
Hatchery	521	Develop and apply hatchery brood stock watershed transfer policies for spring Chinook	Spring Chinook	Current protocols have been established to regulate transfers between basins	Production programs	Completed		Diesease and inpact to natural local population	Tacoma, PacifiCorp, USFWS and NMFS	Upper Cowlitz, Toutle, Kalama, NF Lewis	Spring Chinook	Other wild salmonid species	None
Hatchery	522	Use spring Chinook juvenile release strategies to minimize ecosystem effects and ecological interactions	Spring Chinook	Ensure juveniles are fully smolted and released at a time when then move swiftly to the ocean to minimize interactions with natural origin juveniles in freshwater	Production programs	Ongoing		Smolt outmigration behavior	Tacoma, PacifiCorp and NMFS	Lower Cowlitz, Upper Cowlitz Kalama, NF Lewis	Spring Chinook	Other wild salmonid species	None
Hatchery	523	Mark spring Chinook hatchery production for identification and harvest	Spring Chinook	All hatchery fall chinook releases downstream of Bonneville Dam are mass marked with and adipose fin clip to support mark-selective fisheries	Production programs	Ongoing		Marking logistics	Tacoma, PacifiCorp and NMFS	Lower Cowlitz, Upper Cowlitz Kalama, NF Lewis	Spring Chinook	None	None
Hatchery	524	Initiate additional conservation propagation programs for chum in order to restore depleted or extirpated populations and to reduce demographic risk.	Chum	Construct spawning channels and expand hatchery program using natural origin brood stock to seed channels with fry for the purposes of increasing abundance and expanding geographical range of natural origin populations	Supplementation programs	in progress	2018	Funding, land owner agreements, logistics, permitting	BPA, NMFS, land owners, USFWS, conservation districts	EF Lewis Spawning channel has been constructed and populated. Elochoman, Skamokawa and NF Lewis are in the planning stage. MAG, Lower Cowlitz, Kalama, Washougal are in scoping phase	Chum	Other wild salmonid species	2 Million
Hatchery	525	Continue to enhance local chum populations using Grays and Chinook hatcheries	Chum	Maintain conservation hatchery program at Grays River using natural origin brood stock from Grays River to supplement populations in the Grays Subbasin as safety net in case of natural catastrophe and reintroduce chum into other streams in Coast Strata, including Oregon tributaries	Supplementation and reintroduction programs	in progress	2018	Broodstock collection, operation of Sea Resources Hatchery	BPA, NMFS, ODFW and Sea Resources	Grays, Oregon estuary tributaries are on-going - Elochoman, Skamokawa, Chinook are proposed	Chum	None	None
Hatchery	527	Use DNA data to select appropriate brood stock for chum	Chum	Complete DNA analysis that will show genetic similarities or difference between Lower Columbia chum populations and develop protocol for how existing populations can be best used to support reintroduction efforts	Supplementation programs	in progress	2018	Funding, land owner agreements, logistics, permitting	BPA, NMFS, land owners, USFWS, conservation districts	Elochoman, MAG, Lower Cowlitz, Kalama, NF Lewis, EF Lewis, Washougal, Lower Gorge	Chum	None	None
Hatchery	528	Develop and apply hatchery brood stock watershed transfer policies for chum	Chum	Once developed, these plans will provide guidance for transfer of broodstock	Production programs	Completed		Diesease and inpact to natural local population	USFWS and NMFS	Elochoman, MAG, Lower Cowlitz, Kalama, NF Lewis, EF Lewis, Washougal, Lower Gorge	Chum	None	None
Hatchery	529	Utilize hatchery production to reintroduce winter steelhead in upper Cowlitz and Lewis rivers	Steelhead	In Cowlitz transport surplus integrated hatchery fish upstream to Upper Cowlitz, Cispus and Tilton and program has been converted to an integrated broodstock program; In Lewis transport returns from a natural origin brood program using lower river fish to above Swift Reservoir for reintroduction purposes	Reintroduction programs	Ongoing		Broodstock, juvenile downstream collection and passage	Tacoma, PacifiCorp and NMFS	Upper Cowlitz, NF Lewis	Steelhead	None	$62,000

Impact	Action #	Description	Program	How does program address the action	Program Element	Status	Anticipated Completion date	Challenges and Constraints	Coordinating Partners	Impacted subbasins	Target Species	Other species	Costs associated with the ESA listings
Hatchery	532	Use steelhead juvenile release strategies to minimize detrimental ecosystem impacts and ecological interactions	Steelhead	Ensure juveniles are fully smolted and released at a time when then move swiftly to the ocean to minimize interactions with natural origin juveniles in freshwater; use acclimation facilities for off station programs to reduce stray rates to natural spawning areas	Production programs	Ongoing		Smolt outmigration behavior	Tacoma Power, PacifiCorp and NMFS	Grays, Elochoman, Mag, Lower Cowlitz, Toutle, Coweeman, Kalama, NF Lewis, EF Lewis, Salmon, Washougal	Fall Chinook	Other wild salmonid species	None
Hatchery	534	Continue to mark steelhead hatchery production	Steelhead	Fund marking program that uses adipose fin clip mass mark all hatchery produced steelhead for identification upon return to freshwater	Production programs	Ongoing		Marking logistics	Tacoma, PacifiCorp, USFWS and NMFS	Grays, Elochoman, MAG, Lower Cowlitz, Upper Cowlitz, Toutle, Coweeman, Kalama, NF Lewis, Salmon, Washougal	Steelhead	None	None
Hatchery	535	Maximize harvest and removal of non-local summer and early winter steelhead produced from segregated hatchery programs		Remove hatchery fish at weirs and WDFW hatcheries	Production programs	Ongoing		Handling Logistics, adequate sites, land owner agreements	Tacoma Power, PacifiCorp, NMFS, land owners and USFWS	Mag, Lower Cowlitz, Toutle, Kalama, NF Lewis, Washougal	Steelhead	none	$300,000 to operate weirs on lower Cowlitz
Hatchery	536	Develop conservation hatchery programs to restore native coho in selected populations	Coho	Reduce hatchery program size to 150,000 smolts to reduce impact of hatchery program on natural origin production for key watersheds in the lower Columbia	Conservation/ production programs	Ongoing		Broodstock Collection	NMFS	Grays, Toutle, Washougal	coho	Other wild salmonid species	None
Hatchery	537	Reintroduce coho in upper Cowlitz and upper Lewis rivers	Coho	Initiate reintroduction by transporting surplus hatchery fish to seed watershed, the Cowlitz hatchery program is operated as an integrated broodstock program. The Lewis program will convert to integrated hatchery program when natural origin population becomes self-sustaining	Reintroduction programs	Ongoing		Broodstock, juvenile downstream collection and passage	Tacoma, PacifiCorp and NMFS	Upper Cowlitz, NF Lewis	coho	Other wild salmonid species	$90,000
Hatchery	539	Develop and apply hatchery brood stock watershed transfer policies for coho	Coho	Current protocols do not allow for transfers between that have listed populations	Production programs	Ongoing		Diesease and impact to natural local population	Tacoma, PacifiCorp and NMFS	Grays, Elochoman, Lower Cowlitz, Kalama, NF Lewis, Washougal	coho	None	None
Hatchery	540	Use coho juvenile release strategies to minimize detrimental ecosystem impacts and ecological interactions	Coho	Ensure juveniles are fully smolted and released at a time when then move swiftly to the ocean to minimize interactions with natural origin juveniles in freshwater	Production programs	Ongoing		Smolt outmigration behavior	Tacoma Power, PacifiCorp and NMFS	Grays, Lower Cowlitz, Upper Cowlitz, Toutle, Kalama, NF Lewis, Washougal	coho	Other wild salmonid species	None
Hatchery	541	Mark coho hatchery harvest production	Coho	All hatchery coho releases downstream of Bonneville Dam are mass marked with and adipose fin clip to support mark-selective fisheries and allow for estimation of pHOS in natural spawning areas	Production programs	Ongoing		Marking logistics	Tacoma, PacifiCorp and NMFS	Grays, Lower Cowlitz, Upper Cowlitz, Toutle, Kalama, NF Lewis, Washougal	coho	Other wild salmonid species	None
Hatchery	542	Establish naturally-spawning production sanctuary areas to be used for coho indicator stock programs	Coho	Watersheds will be identified where hatchery coho releases will not occur to establish wild fish refuges	Wild fish refuges	Completed		pHOS from outside programs	none	Elochoman, MAG, Coweeman, NF Toutle, SF Toutle, EF Lewis	coho	Other wild salmonid species	None

Impact	Action #	Description	Program	How does program address the action	Program Element	Status	Anticipated Completion date	Challenges and Constraints	Coordinating Partners	Impacted subbasins	Target Species	Other species	Costs associated with the ESA listings
Hatchery	544	Reconfigure and reform hatchery programs for Fall Chinook consistent with responsibilities identified in this Recovery Plan and standards established by the Hatchery Scientific Review Group	Fall Chinook	Program sizes were modified to achieve: 1)hatchery threat reduction benchmarks, as measured by improved fitness, 2)achieve pHOS and PNI levels that will meet criteria for hatchery influence set forth by HSRG, 3)mitigation requirements in Cowlitz Settlement Agreement and 4)production levels that wills sustain productive fisheries	Production programs	Ongoing		Natural population size, straying form other production programs, facility constraints, mitigation goals	Tacoma Power and NMFS	Grays (Deep River), Lower Cowlitz, Toutle, Kalama, Washougal	Fall Chinook	Other wild salmonid species	None
Hatchery	545	Continue to produce, in a manner consistent with other recovery strategies and measures, sufficient numbers of hatchery fall Chinook to sustain significant fishery opportunities until harvestable naturally-spawning populations are restored	Fall Chinook	Number of smolts released after implementation of CSF will exceed 87% of the pre-CSF plan production to support existing ocean and freshwater fisheries, as natural origin population increases production levels and fishery performance will be evaluated resulting in consideration of future production changes	Production programs	Ongoing		Funding, fisheries support, natural population size	Tacoma Power, NMFS	Grays (Deep River), Lower Cowlitz, Toutle, Kalama, Washougal	Fall Chinook	none	None
Hatchery	546	Reconfigure and reform hatchery programs for Spring Chinook consistent with responsibilities identified in this Recovery Plan and standards established by the Hatchery Scientific Review Group	Spring Chinook	Program sizes were modified to achieve: 1)hatchery threat reduction benchmarks, as measured by improved fitness, 2)achieve pHOS and PNI levels that will meet criteria for hatchery influence set forth by HSRG, 3)mitigation requirements in Cowlitz and Lewis Settlement Agreements and 4)production levels that wills sustain productive fisheries	Production programs	Ongoing		Natural population size, straying form other production programs, facility constraints, mitigation goals, fishing opportunity	Tacoma Power, PacifiCorp and NMFS	Cowlitz, Toutle, Kalama, Lewis	Spring Chinook	Other wild salmonid species	None
Hatchery	547	Continue to produce, in a manner consistent with other recovery strategies and measures, sufficient numbers of hatchery spring Chinook to sustain significant fishery opportunities until harvestable naturally-spawning populations are restored	Spring Chinook	Number of smolts released after implementation of CSF will exceed 107% of the pre-CSF plan production to support existing ocean and freshwater fisheries, as natural origin population increases production levels and fishery performance will be evaluated resulting in consideration of future production changes	Production programs	Ongoing		Funding, fisheries support, natural population size	Tacoma Power, PacifiCorp and NMFS	Lower Cowlitz, Kalama, NF Lewis	Spring Chinook	None	None
Hatchery	548	Implement and expand hatchery programs for chum consistent with responsibilities identified in this Recovery Plan and standards established by the Hatchery Scientific Review Group	Chum	implement chum reintroduction programs to achieve: 1)reduce demographic risks in terms of abundance and geographic distribution and 2)achieve pHOS and PNI levels that will meet criteria for hatchery influence set forth by HSRG	Reintroduction programs	in progress	2018	Broodstock Collection, natural origin population	BPA, NMFS, USFWS	Grays, Elochoman, MAG, Lower Cowlitz, Kalama, NF Lewis, EF Lewis, Washougal	Chum	Other wild salmonid species	None
Hatchery	549	Reconfigure and reform hatchery programs for steelhead consistent with responsibilities identified in this Recovery Plan and standards established by the Hatchery Scientific Review Group	Steelhead	Program sizes were modified to achieve: 1)hatchery threat reduction benchmarks, as measured by improved fitness, 2)achieve pHOS and PNI levels that will meet criteria for hatchery influence set forth by HSRG, 3)mitigation requirements in Lewis and Cowlitz Settlement Agreement and 4)production levels that will sustain productive fisheries	Production programs	Ongoing		Natural population size, straying form other production programs, facility constraints, mitigation goals, fishing opportunity	Tacoma Power, PacifiCorp and NMFS	Grays, Elochoman, Mag, Lower Cowlitz, Toutle, Coweeman, Kalama, NF Lewis, EF Lewis, Salmon, Washougal	Steelhead	Other wild salmonid species	None
Hatchery	550	Maintain or establish wild fish refuges for steelhead in selected watersheds by limiting or eliminating release and escapement of hatchery-origin fish into natural spawning areas	Steelhead	As per WDFW's Statewide Steelhead Management Plans, identify a minimum of 1 basin per DPS that will be classified as a winter and/or steelhead refuge and will receive no plants of hatchery winter and/or summer steelhead	Wild fish refuges	in progress	2015	pHOS from outside programs	USFWS, public	NF Toutle/Green, EF Lewis, Coastal Strata - To Be Determined	Steelhead	Other wild salmonid species	None
Hatchery	551	Expand use of local watershed brood stock and integrated production strategies in selected steelhead hatchery programs in order to promote local adaptation and natural productivity	Steelhead	Incorporate natural origin fish into hatchery brood stock to reduce genetic separation between hatchery and natural origin stocks	Integrated Programs	Ongoing		Collecting natural origin broodstock	Tacoma Power, PacifiCorp NMFS, USFWS	Cowlitz, Kalama, NF Lewis, MAG	Steelhead	None	$50,000
			Steelhead	Convert programs using out-of basin hatchery stocks (i.e. Chambers creek) to hatchery programs using fish produced within the basin	Harvest programs	Ongoing		Collecting in basin broodstock,Maintaining run timing defferences	Tacoma Power, PacifiCorp, NMFS	Elochoman, Cowlitz, Kalama, NF Lewis Skamaina	Steelhead	none	$50,000

Impact	Action #	Description	Program	How does program address the action	Program Element	Status	Anticipated Completion date	Challenges and Constraints	Coordinating Partners	Impacted subbasins	Target Species	Other species	Costs associated with the ESA listings
Hatchery	552	Improve segregated programs for steelhead, where appropriate, to meet established wild population protection criteria	Steelhead	Hatchery program sizes adjusted to meet HSRG criteria for hatchery influence and to achieve recovery plan threat reduction targets, as measured by improved fitness	Harvest programs	Ongoing		Natural population size, straying form other production programs, facility constraints, mitigation goals, fishing opportunity	Tacoma Power, PacifiCorp, NMFS	Grays, Elochoman, Toutle, Coweeman, Kalama, NF Lewis, Salmon, Washougal	Steelhead	none	None
Hatchery	553	Continue to produce, in a manner consistent with other recovery strategies and measures, sufficient numbers of hatchery steelhead to sustain significant fishery opportunities until harvestable naturally-spawning populations are restored	Steelhead	Number of smolts released after implementation of CSF will exceed 95% of the pre-CSF plan production to support existing fisheries, as natural origin population increases production levels and fishery performance will be evaluated resulting in consideration of future production changes	Harvest programs	Ongoing		Funding, fisheries support, natural population size	Tacoma Power, PacifiCorp, NMFS	Grays, Elochoman, Mag, Lower Cowlitz, Toutle, Coweeman, Kalama, NF Lewis, EF Lewis, Salmon, Washougal	Steelhead	none	None
Hatchery	554	Reconfigure and reform hatchery programs for coho consistent with responsibilities identified in this Recovery Plan and standards established by the Hatchery Scientific Review Group	Coho	Program sizes were modified to achieve: 1)hatchery threat reduction benchmarks, as measured by improved fitness, 2)achieve pHOS and PNI levels that will meet criteria for hatchery influence set forth by HSRG, 3)mitigation requirements in Lewis and Cowlitz Settlement Agreement and 4)production levels that will sustain productive fisheries	Production programs	Ongoing		Natural population size, straying form other production programs, facility constraints, mitigation goals, fishing opportunity	Tacoma Power, PacifiCorp and NMFS	Grays, Lower Cowlitz, Upper Cowlitz, Toutle, Kalama, NF Lewis, Washougal	Steelhead	Other wild salmonid species	None
Hatchery	555	Maintain or establish wild fish refuges for coho in selected watersheds by limiting or eliminating release and escapement of hatchery-origin fish into natural spawning areas	Coho	No releases of coho will occur in these basins to reduce interaction between hatchery and natural origin fish	Wild fish refuges	Completed		pHOS from outside programs, habitat productivity and capacity	none	MAG, Coweeman, EF Lewis - coho are not currently released into the Elochoman but may be released in the future.	coho	Other wild salmonid species	None
			Coho	Weirs or other facilities will be operated to limit number of hatchery origin fish that can access natural spawning areas	Hatchery fish straying	Ongoing		all of these locations are being reviewed based on weir efficiency, funding and land owner agreements	NMFS	Elochoman, Lower Cowlitz, Toutle	coho	Other wild salmonid species	$175,000
Hatchery	556	Expand use of local watershed brood stock and integrated production strategies in selected coho hatchery programs in order to promote local adaptation and natural productivity	Coho	Incorporate wild fish into hatchery brood stock to reduce genetic separation between hatchery and natural origin stocks	Integrated Programs	Ongoing		Collecting natural origin broodstock	Tacoma Power, PacifiCorp NMFS, USFWS	Grays, Upper Cowlitz, Toutle, Kalama, NF Lewis, Washougal	coho	None	$200,000 for 100% CWT on Cowlitz
Hatchery	557	Improve segregated programs for coho, where appropriate, to meet established wild population protection criteria	Coho	Hatchery program sizes adjusted to meet HSRG criteria for hatchery influence and to achieve recovery plan threat reduction targets, as measured by improved fitness. Reintroduction program on the Lewis will require fish collection standards to be achieved in order to meet HSRG standards	Harvest programs	Ongoing		Natural population size, straying form other production programs, facility constraints, mitigation goals, fishing opportunity	Tacoma Power, PacifiCorp, NMFS	Lower Cowlitz, NF Lewis	coho	None	None
Hatchery	558	Continue to produce, in a manner consistent with other recovery strategies and measures, sufficient numbers of hatchery coho to sustain significant fishery opportunities until harvestable naturally-spawning populations are restored.	Coho	Number of smolts released after implementation of CSF will exceed 81% of the pre-CSF plan production to support existing ocean and freshwater fisheries, as natural origin population increases production levels and fishery performance will be evaluated resulting in consideration of future production changes	Harvest programs	Ongoing		Funding, fisheries support, natural population size	Tacoma Power, PacifiCorp, NMFS	Grays (Deep River), Grays, Lower Cowlitz, Upper Cowlitz, Toutle, Kalama, NF Lewis, Washougal	coho	None	None

Impact	Action #	Description	Program	How does program address the action	Program Element	Status	Anticipated Completion date	Challenges and Constraints	Coordinating Partners	Impacted subbasins	Target Species	Other species	Costs associated with the ESA listings
Harvest	407	Consider and expressly evaluate the potential for a sliding scale harvest plan based on annual abundance indicators for representative tule fall Chinook populations	Fall Chinook (Tule Stock)	Worked through PFMC process to adopt an abundance based harvest matrix. This framework sets the annual exploitation rate limit depending on the abundance of Lower River Hatchery (LRH) tule Chinook. It was demonstrated that LRH fish are a valid indicator of the relative abundance of natural-origin tule Chinook. It was also demonstrated that the abundance framework, if implemented over time, would have a conservation benefits that was equal or greater to a fixed exploitation rate of 0.36. This is accomplished by reducing harvest when abundance is low and populations are most in need of protection while providing some increase in opportunity when abundance is relatively high.	Fishery management	completed		natural origin abundance	NMFS, PFMC, ODFW, CRITFC, NWIFC, public	Grays, Elochoman, MAG, Lower Cowlitz, Upper Cowlitz, Toutle (Green), Coweeman, Kalama, NF Lewis, EF Lewis, Salmon, Washougal	fall Chinook	none	None
Harvest	408	Conduct periodic reviews of fall Chinook harvest relative to habitat productivity and capacity to assure harvest objectives are synchronized with habitat changes	Fall Chinook (Tule Stock)	A Risk assessment was completed as part of the adoption of the abundance based fishery management matrix, Risk assessment utilized EDT information from Recovery Plan regarding habitat productivity and capacity. A updated risk assessment review is expected in the future concurrent with the abundance based management matrix.	Risk assessment	ongoing		Funding for monitoring, updated habitat data	NMFS, PFMC, ODFW, CRITFC, NWIFC, public	Grays, Elochoman, MAG, Lower Cowlitz, Upper Cowlitz, Toutle (Green), Coweeman, Kalama, NF Lewis, EF Lewis, Salmon, Washougal	fall Chinook	none	None
Harvest	408	Conduct periodic reviews of fall Chinook harvest relative to habitat productivity and capacity to assure harvest objectives are synchronized with habitat changes	Fall Chinook (Tule Stock)	Participate in NOAA Fisheries 5-year status review process, which will evaluate all H's.	Status review	ongoing		Scope of work, updated habitat data	NMFS, Tacoma Power, PacifiCorp, Cowlitz Tribe	Grays, Elochoman, MAG, Lower Cowlitz, Upper Cowlitz, Toutle (Green), Coweeman, Kalama, NF Lewis, EF Lewis, Salmon, Washougal	fall Chinook	none	None
Harvest	409	Seek commitment from agencies and tribes in the Pacific Fisheries Management Council, North of Falcon, and Columbia River Compact processes to specifically manage annually for lower Columbia naturally-spawning tule fall Chinook and to establish a collaborative US policy position for the international table at the Pacific Salmon Commission	Fall Chinook (Tule Stock)	All of the ocean and freshwater fisheries from Alaska to Mexico are managed to comply with the abundance-based management model adopted by the PFMC.	Fishery management	completed		Constrains fisheries	NMFS, PFMC, ODFW, CRITFC, NWIFC, public	Grays, Elochoman, MAG, Lower Cowlitz, Upper Cowlitz, Toutle (Green), Coweeman, Kalama, NF Lewis, EF Lewis, Salmon, Washougal	fall Chinook	none	None
Harvest	410	Improve tools to monitor and evaluate fishery catch to assure impacts to naturally-spawning fall Chinook are maintained within agreed limits	Fall Chinook (Tule Stock)	Fisheries are managed based on CWT, PIT, VSI and DNA analysis. Monitoring and evaluation methods are reviewed and updated.	Harvest monitoring	ongoing		Funding	NMSF, Columbia Treaty tribes, IDFG, ODFW, USFWS, BPA	Grays, Elochoman, MAG, Lower Cowlitz, Upper Cowlitz, Toutle (Green), Coweeman, Kalama, NF Lewis, EF Lewis, Salmon, Washougal	fall Chinook	none	None
Harvest	411	Manage ocean, Columbia River, and tributary fisheries to meet the spawning escapement goal for lower Columbia bright fall Chinook	Fall Chinook (Bright Stock)	Annual PFMC/North of Falcon and Columbia River Compact fall season setting processes use the 5,700 fish escapement goal to the Lewis River to limit fisheries, up to and including closing fisheries	Fishery management	ongoing		Wild fish collection and tagging, hydro operations, harvest monitoring	PacifiCorp, ODFW	NF Lewis	fall Chinook	none	None

Impact	Action #	Description	Program	How does program address the action	Program Element	Status	Anticipated Completion date	Challenges and Constraints	Coordinating Partners	Impacted subbasins	Target Species	Other species	Costs associated with the ESA listings
Harvest	412	Develop a more detailed process for in-season monitoring of stock specific harvest of fall Chinook in the Columbia River	Fall Chinook	Fishery managers use CWT analysis in-season to manage all Columbia River fisheries. Run sizes are updated based on dam counts. Escapment information is used when possible to provide information on run strength.	Fishery management	ongoing		Funding	NMSF, Columbia Treaty tribes, IDFG, ODFW, USFWS, BPA	Grays, Elochoman, MAG, Lower Cowlitz, Upper Cowlitz, Toutle (Green), Coweeman, Kalama, NF Lewis, EF Lewis, Salmon, Washougal	fall Chinook	none	None
Harvest	413	Implement a basin wide marking plan for hatchery tule fall Chinook that is adequate for monitoring interception rates in specific fisheries, tributary harvest management, and monitoring escapement of naturally-spawning fish	Fall Chinook (tule Stock)	All hatchery tule fall chinook are released with and adipose fin clip for identification in fisheries and on spawning grounds. The CWT marking programs allows for population specific harvest estimates. In conjunction these two programs support fishery monitoring needs	Stock identification	ongoing		Funding	NMFS, Tacoma Power, ODFW	Grays, Elochoman, MAG, Lower Cowlitz, Upper Cowlitz, Toutle (Green), Coweeman, Kalama, NF Lewis, EF Lewis, Salmon, Washougal	fall Chinook	one	None
Harvest	414	Address technical and policy issues regarding mass marking and help develop programs to mark and monitor recovery of fall Chinook in fisheries and escapement	Fall Chinook	Mark-selective fisheries are evaluated.	Fishery monitoring	ongoing		Funding, monitoring, tribal concerns, complexity of fisheries analysis, release mortality rates	NMSF, Columbia Treaty tribes, IDFG, ODFW, USFWS	Grays, Elochoman, MAG, Lower Cowlitz, Upper Cowlitz, Toutle (Green), Coweeman, Kalama, NF Lewis, EF Lewis, Salmon, Washougal	fall Chinook	none	$15,000
Harvest	415	Columbia River Compact agencies will develop a management strategy to protect chum during late fall commercial fisheries. The strategy would evaluate information acquired in recent years and would develop specific criteria for in-season fishery adjustments based on chum encounter rates in the fishery	Chum	Commercial fisheries are mostly scheduled to be completed before the end of October when the chum begin to migrate into the Columbia River.	Fishery management	ongoing		funding, monitor handle in fisheries	ODFW	Grays, Elochoman, MAG, Lower Cowlitz, Touitled, Coweeman, Kalama, NF Lewis, EF Lewis, Salmon, Washougal, Lower Gorge	chum	coho	none
Harvest	417	Monitor chum handle rate in tributary winter steelhead and late coho sport fisheries	Chum	Chum handle is recorded in all areas where creel programs occur.	Fishery monitoring	ongoing		funding, limited creel programs	none	Grays, Elochoman, MAG, Lower Cowlitz, Touitled, Coweeman, Kalama, NF Lewis, EF Lewis, Salmon, Washougal	chum	none	None
Harvest	418	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries	Steelhead	Impacts are estimated for each fishery in the mainstem Columbia River and reported in Joint Staff Compact Reports. Impacts in tributary fisheries are included in the FMEPs.	Fishery monitoring	ongoing		funding, DNA analysis, fishery monitoring	NMFS, ODFW	Grays, Elochoman, MAG, Lower Cowlitz, Upper Cowlitz, Toutle, Coweeman, Kalama, NF Lewis, EF Lewis, Salmon, Washougal	steelhead	none	None

Impact	Action #	Description	Program	How does program address the action	Program Element	Status	Anticipated Completion date	Challenges and Constraints	Coordinating Partners	Impacted subbasins	Target Species	Other species	Costs associated with the ESA listings
Harvest	419	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead	Steelhead	This is accomplished in the mainstem commercial fishery via time, area and gear restrictions. In the mainstem sport fishery, all wild fish are released. In the tributary sport fisheries, regulations are set to avoid times and areas where wild steelhead or their offspring are present. Gear restrictions are also used in some areas to provide additional protection to wild steelhead.	Fishery management	ongoing		Implementation of Alternative Gear, release mortality, harvest goals for other species	ODFW, NMFS	Grays, Elochoman, MAG, Lower Cowlitz, Upper Cowlitz, Toutle, Coweeman, Kalama, NF Lewis, EF Lewis, Salmon, Washougal	steelhead	none	None
Harvest	420	Establish specific naturally-spawning steelhead encounter triggers for in-season Columbia River fishery adjustments needed to support lower Columbia recovery goals and strategies	Steelhead	ESA impact limits have been established by NMFS and are managed for in the fisheries.	Fishery management	ongoing		funding, DNA analysis, fishery monitoring	ODFW, NMFS	Grays, Elochoman, MAG, Lower Cowlitz, Upper Cowlitz, Toutle, Coweeman, Kalama, NF Lewis, EF Lewis, Salmon, Washougal	steelhead	none	None
Harvest	421	Work through U.S. v. Oregon and with Columbia River treaty Indian tribes to develop harvest plans for Wind River summer steelhead	Steelhead	The Wind River was established as a wild steelhead refuge (gene bank) as part of WDFW's Statewide Steelhead Management Plan. The treaty indian fisheries are managed based on abundance based harvest rate for steelhead, with limits in place to protect wild stocks.	Fishery management	ongoing		location of the treaty fishery in relation to the Wind River	NMSF, Columbia Treaty tribes, IDFG, ODFW, USFWS	Wind	steelhead	none	None
Harvest	422	Monitor naturally-spawning steelhead handle rate in tributary salmon and steelhead fisheries	Steelhead	Implemented creel program for winter steelhead fisheries for the purpose of estimating handle of natural origin steelhead in steelhead sport fisheries, creel programs rotates between basins every 3 years	Fishery monitoring	ongoing		Funding	WDFW, Columbia River Salmon and Steelhead endorsement fund	Coweeman, Kalama, EF Lewis, Washougal, Rock Creek (Stevenson) and Wind River	steelhead	none	$300,000
Harvest	423	Manage Columbia River commercial fisheries by time, area, and gear to target hatchery fish and minimize impacts to naturally-spawning steelhead	Steelhead	Time, area and area closures have been used in the Columbia River for over 100 years and continue to a greater extent currently.	Fishery management	ongoing		Implementation of Alternative Gear, release mortality, harvest goals for other species	ODFW	Grays, Elochoman, MAG, Lower Cowlitz, Upper Cowlitz, Toutle, Coweeman, Kalama, NF Lewis, EF Lewis, Salmon, Washougal	steelhead	none	None
Harvest	425	Maintain selective sport fisheries in Ocean, Columbia River, and tributaries and monitor naturally-spawning coho stock impacts	Coho	The Buoy 10, Lower Columbia and tributaries fisheries are all mark-selective, most ocean fisheries are mark selective. Spawning surveys to estimate natural coho abundance is occurring in the lower Columbia tributaries (beginning in 2010).	Fishery management and monitoring	ongoing		funding, monitoring of fisheries and spawning grounds	PFMC, ODFW	Grays, Elochoman, MAG, Lower Cowlitz, Upper Cowlitz, Toutle, Coweeman, Kalama, NF Lewis, EF Lewis, Salmon, Washougal	coho	none	None

Impact	Action #	Description	Program	How does program address the action	Program Element	Status	Anticipated Completion date	Challenges and Constraints	Coordinating Partners	Impacted subbasins	Target Species	Other species	Costs associated with the ESA listings
Harvest	426	Manage Columbia River commercial fisheries managed by time, area, and gear to target hatchery fish and minimize impacts to naturally-spawning coho	Coho	Time, area and area closures have been used in the Columbia River for over 100 years and continue to a greater extent currently. The new Washington Columbia River Fishery Management Policy includes provisions to incorporate additional mark-selective commercial fisheries and focusing the commercial fishery in off-channel sites. Coho tangle net fisheries have been implemented in the Columbia River with a lower release mortality rate compared to traditional gill nets. Alternative gear (beach and purse seines) is being implemented for use in mainstem Columbia River commercial fisheries.	Fishery management	ongoing		Implementation of Alternative Gear, release mortality, harvest goals for other species		Grays, Elochoman, MAG, Lower Cowlitz, Upper Cowlitz, Toutle, Coweeman, Kalama, NF Lewis, EF Lewis, Salmon, Washougal	coho	none	None if you don't include Alternative Gear Project. If you include Alternative Gear Project then it would be over $7 million for Washington only
Harvest	427	Review and evaluate the harvest management strategy developed to protect naturally-spawning Clackamas late coho in terms of its ability to protect naturally-spawning Washington late coho	Coho	A risk assessment for Washington coho populations was conducted through the PFMC in 2013-2014. The risk assessment was used to develop an abundance-based harvest rate matrix for lower Columbia natural coho.	Fishery management	completed		natural origin abundance	NMFS, PFMC, ODFW, CRITFC, NWIFC, public	Grays, Elochoman, MAG, Lower Cowlitz, Upper Cowlitz, Toutle (Green), Coweeman, Kalama, NF Lewis, EF Lewis, Salmon, Washougal	coho	none	None
Harvest	428	Continue to monitor Columbia River selective fisheries and provide estimates of impacts to naturally produced lower Columbia spring Chinook	Spring Chinook	Recovery efforts for spring Chinook in the ESU are focused on re-introduction programs in the Lewis and Cowlitz River above the dams. There are not significant numbers of naturally spawning spring Chinook in the lower Columbia tributaries. All fisheries are monitored to estimate handle and mortality of unmarked spring Chinook.	Fishery Monitoring	ongoing		Funding, fishery monitoring	ODFW	Cowlitz, Kalama, Lewis	spring Chinook	none	None
Harvest	429	Monitor and evaluate handling mortality impacts to released naturally-spawning spring Chinook in Columbia River fisheries	Spring Chinook	Impacts to spring Chinook released from Columbia River fisheries are estimated in the fishery model. All fisheries are monitored to estimate handle and mortality of unmarked spring Chinook.	Fishery Monitoring	ongoing		Funding, fishery monitoring	ODFW	Upper/Lower Cowlitz, Kalama, NF Lewis	spring Chinook	none	None
Harvest	430	Develop gear and handling techniques, as well as regulatory options in both commercial and sport fisheries, to minimize selective fishery impacts to naturally-spawning spring Chinook	Spring Chinook	Implemented commercial fisheries using tangle nets with recovery boxes and sport fisheries requiring barbless hooks to maximize post release survival rates for natural origin spring chinook. All commercial fishers are required to take a class on fish handling and release techniques to minimize mortality.	Fishery management	ongoing		Release mortality rates, public education, funding for monitoring	ODFW, NMFS	Upper/Lower Cowlitz, Kalama, NF Lewis	spring Chinook	none	None
Harvest	431	Develop a lower Columbia naturally-spawning spring Chinook harvest rate plan for management of Columbia River fisheries at such time as significant populations are re-established	Spring Chinook	WDFW will work with NMFS and Columbia River Compact to establish allowable harvest rates for Lower Columbia natural origin spring chinook	Fishery management	TBD		natural origin abundance	PacifiCorp, Tacoma Power, NMFS, ODFW	Upper Cowltiz, NF Lewis	spring Chinook	none	None
Harvest	432	Manage Columbia River commercial fisheries by time, area, and mark-selective requirements to target hatchery fish and minimize impacts to naturally spawning spring Chinook	Spring Chinook	Time and area closures are used to focus fishery on times and areas where hatchery abundance is high and and avoid times and area where natural origin fish are in high abundance and tangle nets with recovery boxes are used to minimize impacts on natural origin spring chinook	Fishery Management	ongoing		natural origin abundance	PacifiCorp, Tacoma Power, NMFS, ODFW	Upper/Lower Cowlitz, Kalama, NF Lewis	spring Chinook	none	None

Impact	Action #	Description	Program	How does program address the action	Program Element	Status	Anticipated Completion date	Challenges and Constraints	Coordinating Partners	Impacted subbasins	Target Species	Other species	Costs associated with the ESA listings
Harvest	433	Implement actions to limit the exploitation rate of lower Columbia River tule Fall Chinook in order to protect weak populations	Fall Chinook (Tule Stock)	Mark-selective fisheries are being evaluated. Worked through PFMC process to adopt an abundance based harvest matrix. This framework sets the annual exploitation rate limit depending on the abundance of Lower River Hatchery (LRH) tule Chinook. It was demonstrated that LRH fish are a valid indicator of the relative abundance of natural-origin tule Chinook. It was also demonstrated that the abundance framework, if implemented over time, would have a conservation benefits that was equal or greater to a fixed exploitation rate of 0.36. This is accomplished by reducing harvest when abundance is low and populations are most in need of protection while providing some increase in opportunity when abundance is relatively high.	Fishery management	completed		natural origin abundance	NMFS, PFMC, ODFW, CRITFC, NWIFC, public	Grays, Elochoman, MAG, Lower Cowlitz, Upper Cowlitz, Toutle (Green), Coweeman, Kalama, NF Lewis, EF Lewis, Salmon, Washougal	fall Chinook	none	None
Harvest	437	Implement actions to regulate the fishery impact rate on naturally-spawning lower Columbia River coho in order to protect weak populations and reduce risks using a sliding scale harvest based on annual abundance indicators	Coho	A risk assessment for Washington coho populations was conducted through the PFMC in 2013-2014. The risk assessment was used to develop an abundance-based harvest rate matrix for lower Columbia natural coho. This new matrix is expected to be adopted by PFMC and NMFS in 2015.	Fishery management	completed		natural origin abundance	NMFS, PFMC, ODFW, CRITFC, NWIFC, public	Grays, Elochoman, MAG, Lower Cowlitz, Upper Cowlitz, Toutle (Green), Coweeman, Kalama, NF Lewis, EF Lewis, Washougal	coho	none	None

Impact	Action #	Description	Program	How does program address the action	Program Element	Status	Anticipated Completion date	Challenges and Constraints	Coordinating Partners	Impacted subbasins	Target Species	Other species	Costs associated with the ESA listings
Monitoring	837	Maintain current biological sampling efforts for representative priority populations of all species and strata.	VSP Monitoring	Annual sampling results produce abundance estimates for most lower Columbia populations. Highest priority are primary populations and populations with large hatchery programs. Other VSP parameters estimated for a subset of lower Columbia populations.	Population Status	ongoing		funding, sampling design, implementation logistics, landowner access, mass marking	PacifiCorp, Tacoma Power, BPA, NMFS	Grays/Chinook, Elochoman/Skamokawa, MAG, Lower Cowlitz, Coweeman, SF Toutle, NF Toutle, Upper Cowlitz, Cispus, Tilton, Kalama, NF Lewis, EF Lewis, Salmon, Washougal, Lower Gorge, Upper Gorge	spring chinook, fall chinook, coho, chum, winter steelhead, summer steelhead	none	3.5 million
Monitoring	838	Implement additional intensive biological monitoring for juveniles and/or adults in all strata to meet representative monitoring needs of multiple species.	VSP Monitoring	Conduct Fish In Fish Out (FIFO) sampling for selected population or sub-populations to estimate juvenile production and freshwater productivity.	Population Status	ongoing		funding, sampling design, implementation logistics, landowner access	PacifiCorp, Tacoma Power, BPA, NMFS	Grays/Chinook, MAG, Lower Cowlitz, Coweeman, Upper Cowlitz, Cispus, Tilton, Kalama, NF Lewis, Lower Gorge, Upper Gorge	fall chinook, coho, chum, winter and summer steelhead	none	1.0 million
Monitoring	839	Implement a comprehensive natural coho sampling program in Washington in all strata.	VSP Monitoring	A comprehensive LCR ESU monitoring program has been initiated to estimate coho adult abundance for the ESU, including individual estimates for most lower Columbia River populations. Expanded Action #837 to include coho adult abundance monitoring throughout the LCR ESU.	Abundance Estimation	ongoing		funding, sampling design, implementation logistics, landowner access	PacifiCorp, Tacoma Power, BPA, NMFS	Grays/Chinook, Elochoman/Skamokawa, MAG, Lower Cowlitz, Coweeman, SF Toutle, NF Toutle, Upper Cowlitz, Cispus, Tilton, Kalama, NF Lewis, EF Lewis, Salmon, Washougal, Lower Gorge	coho	fall chinook, chum	500,000
Monitoring	840	Expand current chum salmon sampling efforts to include more Intensive and Inventory monitoring of adults and juveniles.	VSP Monitoring	Intensive monitoring for adult and juveniles occurs for the Grays population and for adults for the Lower Gorge (Below Bonneville) population. Limited presence/absence monitoring occcurs in other populations where abundance is very low or considered extirpated.	Population Status	ongoing		funding, sampling design, implementation logistics, small natural origin population size	PacifiCorp, Tacoma Power, BPA, NMFS	**Grays/Chinook**, Elochoman/Skamokawa, MAG, Lower Cowlitz, Coweeman, Kalama, NF Lewis, EF Lewis, Washougal, Lower Gorge, Upper Gorge	chum	fall chinook, coho	750,000
Monitoring	841	Augment current sampling programs for fall Chinook and winter steelhead with more intensive adult and juvenile sampling levels in selected areas.	VSP Monitoring	Improvement of study designs and increased survey effort to estimate NOR/HOR abundance (pHOS) with the goal of meeting NOAA monitoring guidance standards for fall Chinook. Increased survey effort for winter steelhead monitoring . Initiating efforts to improve winter steelhead monitoring study design.	Population Status	ongoing		funding, sampling design, implementation logistics, landowner access	PacifiCorp, Tacoma Power, BPA, NMFS	Grays/Chinook, Elochoman/Skamokawa, MAG, Lower Cowlitz, Coweeman, SF Toutle, NF Toutle, Upper Cowlitz, Cispus, Tilton, Kalama, NF Lewis, EF Lewis, Salmon, Washougal, Lower Gorge, Upper Gorge	fall chinook, winter steelhead	coho and chum	500,000
Monitoring	860	Continue to implement intensive monitoring and evaluation of reintroduction efforts for coho, spring Chinook and steelhead in the upper Cowlitz and Cispus rivers.	VSP Monitoring	Current program estimates adult escapement (truck and haul) and juvenile outmigrants based on juvenile collection efficiency for re-introduced populations. Program to be expanded to evaluate other VSP parameters when populations become self-sustaining.	Population Status	ongoing		funding, implementation logistics, small natural origin populaton size, poor juvenile collection efficiency	WDFW, Tacoma Power, NMFS	Upper Cowlitz, Cispus	spring chinook, coho, winter steelhead	none	1.5 million
Monitoring	861	Implement intensive monitoring and evaluation of reintroduction efforts for coho, spring Chinook and steelhead in the upper Lewis River as per license direction and agreements.	Species Reintrodution	Current program estimates adult escapement (truck and haul) and juvenile outmigrants based on juvenile collection efficiency for re-introduced populations. Have initiated expanded program to evaluate other VSP parameters (i.e., spatial distribution) while reintroduction is being implemented.	Population Status	ongoing		funding, sampling design, implementation logistics, small natural orign population size, poor juvenile collection efficiency	WDFW, PacifiCorp, NMFS	NF Lewis	spring chinook, coho, winter steelhead	none	1.5 million

Impact	Action #	Description	Program	How does program address the action	Program Element	Status	Anticipated Completion date	Challenges and Constraints	Coordinating Partners	Impacted subbasins	Target Species	Other species	Costs associated with the ESA listings
Monitoring	863	Implement focused investigations of critical assumptions and uncertainties in current hydro-related monitoring and evaluation efforts.											
Monitoring	864	Maintain current monitoring programs of annual harvest and harvest rates of representative index stocks in ocean, Columbia River mainstem, and tributary fisheries.	Harvest Management	CWT marking programs in place for lower Columbia River indicator stocks (e.g., Cowlitz fall chinook, Lewis natural origin fall chinook, Lewis coho DIT). Sampling programs in ocean and freshwater are designed to estimate harvest of these indicator stocks.	Harvest Impacts	ongoing		funding, mark-selective fisheries, CWT marking	PacifiCorp, Tacoma Power, NMFS, BPA	Grays/Chinook, Elochoman/Skamokawa, MAG, Lower Cowlitz, Coweeman, SF Toutle, NF Toutle, Upper Cowlitz, Cispus, Tilton, Kalama, NF Lewis, EF Lewis, Salmon, Washougal, Lower Gorge, Upper Gorge	spring chinook, fall chinook, coho	none	None
Monitoring	865	Implement additional intensive biological monitoring of wild adult escapements of all species in order to improve the accuracy of fishery impact assessments.	Harvest Management	Annual sampling results produce abundance estimates for most lower Columbia populations. Highest priority are primary populations and populations with large hatchery programs. Other VSP parameters estimated for a subset of lower Columbia populations.	Abundance Estimation	ongoing		funding, sampling design, implementation logistics, landowner access, mass marking	PacifiCorp, Tacoma Power, BPA, NMFS	Grays/Chinook, Elochoman/Skamokawa, MAG, Lower Cowlitz, Coweeman, SF Toutle, NF Toutle, Upper Cowlitz, Cispus, Tilton, Kalama, NF Lewis, EF Lewis, Salmon, Washougal, Lower Gorge, Upper Gorge	spring chinook, fall chinook, coho, chum, winter steelhead, summer steelhead	none	None
Monitoring	866	Evaluate and expand where appropriate current Chinook and coho wild index stock marking efforts to provide an adequate basis for stock identification and fishery impact estimation.	Harvest Management	Current marking of wild index stocks- Lewis Fall Chinook, Coweeman Fall Chinook, Upper Cowlitz coho. A comprehensive marking program for wild Chinook and coho index stocks still needs to be developed and implemented for in the future when funding becomes avaialble.	Marking	ongoing		funding, juvenile fish collection	PacifiCorp, Tacoma Power, NMFS	Grays/Chinook, Elochoman/Skamokawa, MAG, Lower Cowlitz, Coweeman, SF Toutle, NF Toutle, Upper Cowlitz, Cispus, Tilton, Kalama, NF Lewis, EF Lewis, Salmon, Washougal, Lower Gorge, Upper Gorge	Chinook and coho	none	None
Monitoring	867	Implement focused investigations of critical assumptions and uncertainties in current fishery monitoring and evaluation efforts (to include efficacy of selective fisheries).	Harvest Management	Conducted study to estimate post-release mortality rates for fall chinook, coho and summer steelhead captured in beach and purse seines. Need additional modeling work to evaluate effectiveness of selective fisheries and implement Columbia River Policy.	Harvest Impacts	ongoing		funding, study designs, data analyses, study implementation logistics, mass marking, mark selective fisheries	ODFW, NMFS	Grays/Chinook, Elochoman/Skamokawa, MAG, Lower Cowlitz, Coweeman, SF Toutle, NF Toutle, Upper Cowlitz, Cispus, Tilton, Kalama, NF Lewis, EF Lewis, Salmon, Washougal, Lower Gorge, Upper Gorge	spring chinook, fall chinook, coho, chum, winter steelhead, summer steelhead	none	500,000
Monitoring	868	Develop and implement a comprehensive annual assessment and report of fishery impact, effect, and opportunity information for each listed ESU (to include assessments of the accuracy of impact estimates and effects on ESU viability).	Harvest Management	Provide stock specific stock specific catch and impact estimates through PFMC's annual North of Falcon process, which includes report containing this data. Need for improved reporting on tributary fishery impacts covered by the LCR FMEP.	Harvest Impacts	ongoing		funding, selective fisheries, cwt marking, low sample rates for tributary fisheries	ODFW, NMFS, PFMC	Grays/Chinook, Elochoman/Skamokawa, MAG, Lower Cowlitz, Coweeman, SF Toutle, NF Toutle, Upper Cowlitz, Cispus, Tilton, Kalama, NF Lewis, EF Lewis, Salmon, Washougal, Lower Gorge, Upper Gorge	spring chinook, fall chinook, coho, chum, winter steelhead, summer steelhead	none	200,000

Impact	Action #	Description	Program	How does program address the action	Program Element	Status	Anticipated Completion date	Challenges and Constraints	Coordinating Partners	Impacted subbasins	Target Species	Other species	Costs associated with the ESA listings
Monitoring	869	Maintain current monitoring programs for performance and practice of every hatchery.	Hatchery Practices	Currently evaluate hatchery rearing practices with respect to fish health and quality of product. Key performance metrics evaluated include SAR, number and size of smolts released, condition factor, results of disease evaluation.	Peformance Standards	ongoing		funding, data management and analyses		Grays, Lower Cowlitz, Coweeman, SF Toutle, Tilton, Upper Cowlitz, Cispus, Kalama, NF Lewis, Salmon Creek, Washougal	spring chinook, fall chinook, coho, chum, winter steelhead, summer steelhead	none	None
Monitoring	870	Implement additional biological monitoring of adult escapements of all species in order to accurately assess levels of hatchery contribution to natural production.	Hatchery Evaluation	Improvement of study designs and increased survey effort to estimate NOR/HOR abundance (pHOS) with the goal of meeting NOAA monitoring guidance standards for fall Chinook, coho and chum. Initiated steelhead introgression study to evaluate gene flow from segregated steelhead programs.	Peformance Standards	ongoing		funding, sampling design, implementation logistics, landowner access	PacifiCorp, Tacoma Power, BPA, NMFS	Grays/Chinook, Elochoman/Skamokawa, MAG, Lower Cowlitz, Coweeman, SF Toutle, NF Toutle, Upper Cowlitz, Cispus, Tilton, Kalama, NF Lewis, EF Lewis, Salmon, Washougal, Lower Gorge, Upper Gorge	fall chinook, coho, chum, winter steelhead, summer steelhead	none	500,000
Monitoring	871	Develop and implement a comprehensive regular assessment and report of hatchery impact, performance, and practice for all lower Columbia hatchery programs for use in periodic recovery action effectiveness assessments.	Hatchery Evaluation	Currently evaluate hatchery rearing practices with respect to fish health and quality of product. Key performance metrics evaluated include SAR, number and size of smolts released, condition factor, results of disease evaluation. In the process of developing annual operation reports for each lower Columbia hatchery facility and expanding evaluation and reporting to include HSRG metrics (e.g., PNI) and fishery contributions. Reports will also include information regarding the infastructure, operations protocols and perfomance metrics.	Hatchery Operations	ongoing		funding, data management and analyses		Grays/Chinook, Elochoman/Skamokawa, MAG, Lower Cowlitz, Coweeman, SF Toutle, NF Toutle, Upper Cowlitz, Cispus, Tilton, Kalama, NF Lewis, EF Lewis, Salmon, Washougal	spring chinook, fall chinook, coho, chum, winter steelhead, summer steelhead	none	None
Monitoring	872	Implement collaborative research to resolve critical uncertainties regarding hatchery-wild interactions to guide assessments of hatchery effects.	Hatchery Evaluation	Initiated steelhead introgression study to evaluate gene flow from segregated steelhead programs. Look for opportunities to expand this work including additional RRS studies for stocks impacted by hatchery programs.	Performance Standards	ongoing		funding, prioritization for investigations, study design development, infrastucture	NMFS, ODFW, LCFRB, IDFG, USFWS, CRITFC, NWIFC, Consultants	Grays/Chinook, Elochoman/Skamokawa, MAG, Lower Cowlitz, Coweeman, SF Toutle, NF Toutle, Upper Cowlitz, Cispus, Tilton, Kalama, NF Lewis, EF Lewis, Salmon, Washougal, Lower Gorge, Upper Gorge	spring chinook, fall chinook, coho, chum, winter steelhead, summer steelhead	none	250,000
Monitoring	880	Conduct research of salmonid status and population viability to evaluate critical assumptions, reduce uncertainty, and guide Recovery Plan implementation.	VSP Monitoring	WDFW completing Statewide Steelhead At-risk report as called for in SSMP which includes viability analysis and identifies key populations to monitor in the future. Initiated efforts to identify Biological Reference Points (BRP) for steelhead, fall Chinook, coho and chum to guide fishery and hatchery management decisions.	Population Status	ongoing		funding, prioritization for investigations, lack of long term data sets (i.e., coho),	NMFS, BPA, ODFW, LCFRB, IDFG, USFWS, CRITFC, NWIFC, Consultants	Grays/Chinook, Elochoman/Skamokawa, MAG, Lower Cowlitz, Coweeman, SF Toutle, NF Toutle, Upper Cowlitz, Cispus, Tilton, Kalama, NF Lewis, EF Lewis, Salmon, Washougal, Lower Gorge, Upper Gorge	spring chinook, fall chinook, coho, chum, winter steelhead, summer steelhead	none	None
Monitoring	882	Conduct research on hydropower operations and impacts to evaluate critical assumptions, reduce uncertainty, and guide Recovery Plan implementation.											

Impact	Action #	Description	Program	How does program address the action	Program Element	Status	Anticipated Completion date	Challenges and Constraints	Coordinating Partners	Impacted subbasins	Target Species	Other species	Costs associated with the ESA listings
Monitoring	883	Conduct research on fisheries impacts to evaluate critical assumptions, reduce uncertainty, and guide Recovery Plan implementation.	Harvest Management	Conducted study to estimate post-release mortality rates for fall chinook, coho and summer steelhead captured in beach and purse seines. Need additional modeling work to evaluate effectiveness of selective fisheries and implement Columbia River Policy. Initiated LCR steelhead creel surveys to evaluate impacts of tributary steelhead fisheries on wild steelhead populations.	Fisheries Evaluation	ongoing		funding, study designs, prioritization for investigations	NMFS, ODFW, LCFRB, IDFG, USFWS, CRITFC, NWIFC, Consultants	Grays/Chinook, Elochoman/Skamokawa, MAG, Lower Cowlitz, Coweeman, SF Toutle, NF Toutle, Upper Cowlitz, Cispus, Tilton, Kalama, NF Lewis, EF Lewis, Salmon, Washougal	spring chinook, fall chinook, coho, chum, winter steelhead, summer steelhead	none	100,000
Monitoring	884	Conduct research on hatchery impacts to evaluate critical assumptions, reduce uncertainty, and guide Recovery Plan implementation.	Hatchery Evaluation	Initiated steelhead introgression study to evaluate gene flow from segregated steelhead programs. Look for opportunities to expand this work including additional RRS studies for stocks impacted by hatchery programs. Initiated efforts to identify Biological Reference Points (BRP) for steelhead, fall Chinook, coho and chum to guide fishery and hatchery management decisions.	Hatchery Investigations	ongoing		funding, prioritization for investigations, study design development, infrastucture	NMFS, ODFW, LCFRB, IDFG, USFWS, CRITFC, NWIFC, Consultants	Grays/Chinook, Elochoman/Skamokawa, MAG, Lower Cowlitz, Coweeman, SF Toutle, NF Toutle, Upper Cowlitz, Cispus, Tilton, Kalama, NF Lewis, EF Lewis, Salmon, Washougal, Lower Gorge, Upper Gorge	spring chinook, fall chinook, coho, chum, winter steelhead, summer steelhead	none	Included in Action #872

APPENDIX 3

WA Department of Fish and Wildlife
Hatchery Action Implementation Plans
(HAIP)

June 30, 2009

Table of Contents

Acronyms

AUC	Area Under the Curve
BWT	Blank Wire Tag
CWT	Coded Wire Tag
DNA	Deoxyribonucleic acid
DPS	Distinct Population Segment
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FGE	Fish Guidance Efficiency
FHMP	Fisheries and Hatchery Management Plan
GPS	Global Positioning Satellite
HGMP	Hatchery and Genetic Management Plan
GRTS	Generalized Random Tessellation Stratified master sampling design
HOR	Hatchery Origin
HSRG	Hatchery Scientific Review Group
LCR	Lower Columbia River
NOR	Natural Origin
pHOS	Proportion of hatchery origin spawners
pNOB	Proportion of natural origin fish in broodstock
PNI	Proportionate Natural Influence
RSI	Remote Site Incubator
TCF	Toutle Collection Facility

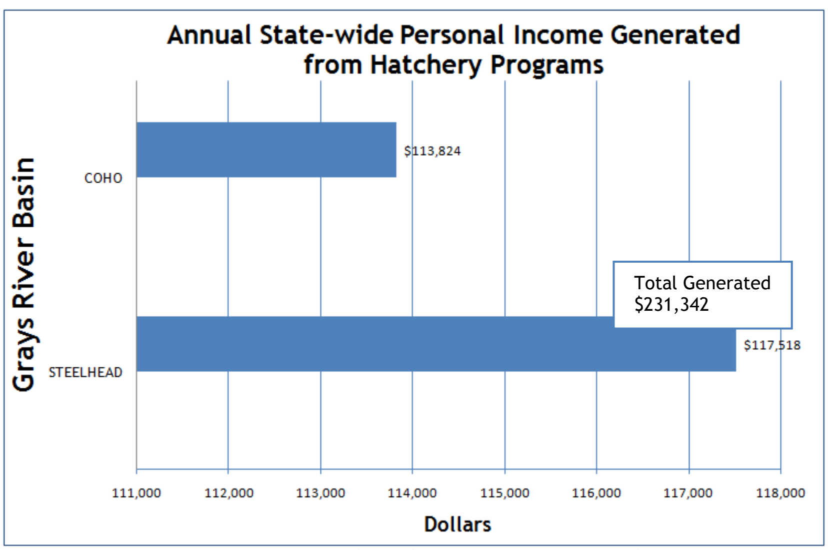
Grays/Chinook Subbasin

Wild Salmon & Steelhead

Chinook: ESA Listed
Steelhead: SW Populations not included in the LCR ESA Listings
Coho: ESA Listed
Chum: ESA Listed

Hatchery Programs

Grays River (WDFW)
Deep River Net Pens (SAFE/WDFW)
Sea Resources

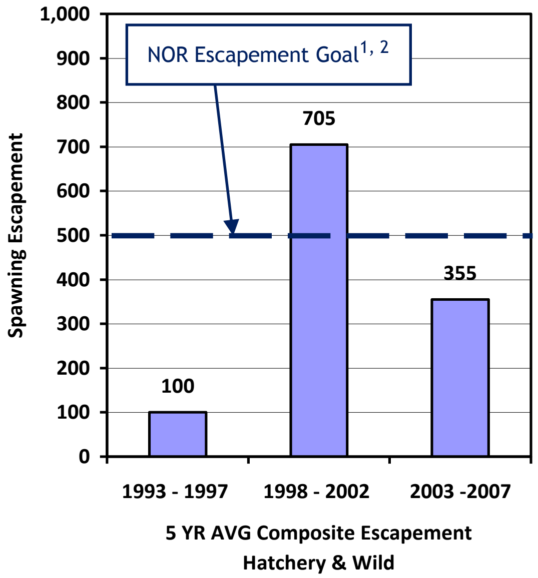


Source: Wegge, T. 2009 (June) Technical Memo. Economic Analysis of WDFW Hatchery Programs
Chart does not include coho and spring Chinook production released from Deep River Net Pens (SAFE)

Wild Salmon & Steelhead

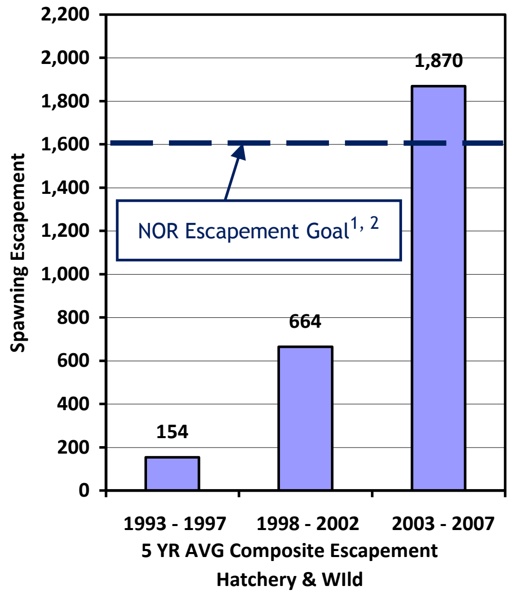
Fall Chinook

ESA Listing Status: Threatened
Populations: Grays River (Contributing)



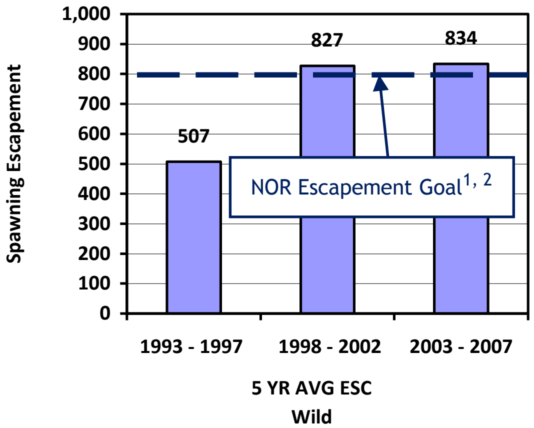
Chum

ESA Listing Status: Threatened
Populations: Grays River (Primary)



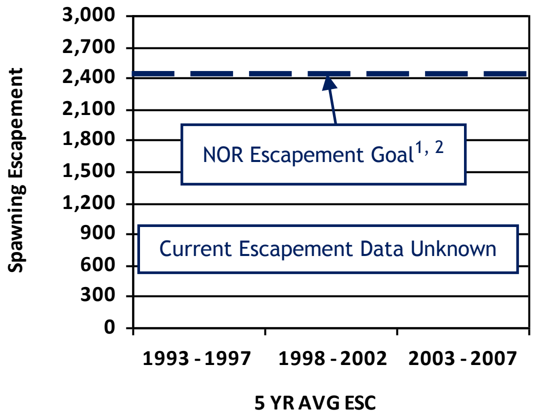
Winter Steelhead

ESA Listing Status: NA
Populations: Grays River (Primary)



Coho

ESA Listing Status: Threatened
Populations: Grays River (Primary)



[1]Number of natural origin spawners necessary to achieve population viability standards established by NOAA's TRT.

[2]Washington LCFRB Proposed Scenario Revisions (6/16/09 Draft).

Hatcheries

Grays River Hatchery (WDFW)

Salmon and Steelhead Programs

Type N Coho
Purpose: Harvest/Conservation
Goal: Currently under development[1]
Broodstock Strategy: Integrated
Program Size: 150,000 yearlings (C&SFP)

Early Winter Steelhead
Purpose: Harvest
Goal: Currently under development[1]
Broodstock Strategy: Segregated
Program Size: 40,000 yearling release, transferred in as eggs from Beaver Creek Hatchery

Chum
Purpose: Conservation
Goal: Currently under development[1]
Broodstock Strategy: Integrated
Program Size: Up to 395,000 fry

Type S Coho
Purpose: Harvest
Goal: Currently under development[1]
Broodstock Strategy: Segregated
Program Size: 800,000 transferred in from Lewis River and Washougal for release at Deep River Net Pens (C&SFP).

Spring Chinook
Purpose: Harvest
Goal: Currently under development[1]
Broodstock Strategy: Segregated
Program Size: 400,000 transferred in as eggs from Cowlitz and Speelyai for release at Deep River Net Pens.

[1]Program specific goals are under development through completion of broodstock Management Plans. Overall production levels for Lower Columbia River have been evaluated through Conservation and Sustainable Fisheries Plan.

Broodstock Management

Type N Coho
Short-term Benchmark: PNI > N/A
Long-term Goal: PNI > .67
Action Plan: Implement Conservation and harvest goals for the Primary population in the Grays.

Early Winter Steelhead
Short-term Benchmark: Gene Flow < 2%
Long-term Goal: Gene Flow < 2%
Action Plan: Release steelhead at Grays River Hatchery to allow homing to the West Fork.

Chum
Short-term Benchmark: PNI > N/A
Long-term Goal: PNI > .67
Action Plan: Continue integrated program consistent with Primary population.

Type S Coho
Short-term Benchmark: PNI > N/A
Long-term Goal: pHOS < 5%
Action Plan: Continue to monitor impacts.

Spring Chinook
Short-term Benchmark: PNI > N/A
Long-term Goal: pHOS < 5%
Action Plan: Continue to monitor impacts.

Grays River Hatchery (WDFW)

Environmental Compliance

Cleanwater Act
Action Plan: Renovate P.A. pond discharge. Maintain NPDES compliance.
Cost & Schedule: $4,000 (2010)

Passage
Action Plan: Maintain weirs and fish ladders.

Intake Screening
Action Plan: New intake screens/structure.
Cost & Schedule: 4.5 million (2010-2011)

Water Withdrawal
Compliant with water rights formalized thru Trust water right # River Intake S2-*08674CWRIS - S2-CCVOL2P755 Incubation Well G2-21976CWRIS
Monthly NPDES reporting to Dept of Ecology

Capital Needs

Incubation
Action Plan: Install more magnum deeps for eyeing (2009) $2,500 and a new well water supply (2011).
Cost & schedule: TBD (2011)

Rearing
Action Plan: Renovate hatchery release site. Install more intermediate raceways for early rearing.
Cost & schedule: $5,000 (2009)

Adult Processing
Action Plan: Renovate ladder and attraction to adult collection site.
Cost & Schedule: $20,000 (2009)

Other
Action Plan: New roofs for hatchery & residences. Remodel carport eves, trusses, & roofs.
Cost & Schedule: TBD (2011)

Deep River Net Pens (SAFE/WDFW)

Salmon and Steelhead Programs

Type S Coho
Purpose: Harvest
Goal: Currently under development[1]
Broodstock Strategy: Segregated
Program Size: 800,000 yearlings, 450,000 from Grays River Hatchery (Lewis stock) and 350,000 from Washougal Hatchery (Lewis Stock) (C&SFP).

Spring Chinook
Purpose: Harvest
Goal: Currently under development[1]
Broodstock Strategy: Segregated
Program Size: 400,000 yearlings from Grays River. 200,000 are Cowlitz stock and 200,000 are Lewis Stock.

Fall Chinook
Purpose: Harvest
Goal: Currently under development[1]
Broodstock Strategy: Segregated
Program Size: 1,000,000 sub-yearlings from Beaver Creek Hatchery (currently Elochoman stock) (C&SFP).

[1]Program specific goals are under development through completion of broodstock Management Plans. Overall production levels for Lower Columbia River have been evaluated through Conservation and Sustainable Fisheries Plan.

Environmental Compliance

Cleanwater Act
Action Plan: Maintain NPDES compliance.

Passage - NA

Intake Screening
Action Plan: Maintain nets to assure no pre release escapement for the protection of wild chum in Grays Bay.
Cost & Schedule: $5,000 (annually)

Water Withdrawal
No water withdrawal at this site

Broodstock Management

Type S Coho
Short-term Benchmark: PNI > N/A
Long-term Goal: pHOS < 5%
Action Plan: Continue to monitor impacts.

Spring Chinook
Short-term Benchmark: PNI > N/A
Long-term Goal: pHOS < 5%
Action Plan: Continue to monitor impacts.

Fall Chinook
Short-term Benchmark: PNI > N/A
Long-term Goal: pHOS < 5%
Action Plan: Program will be evaluated for impacts to Grays and Elochoman/Skamokawa populations.

Capital Needs

Incubation
Action Plan: No incubation needs at this site.

Rearing
Action Plan: Maintain/purchase equipment and infrastructure for continued success (predation netting, dock materials, pumps, pilings, net pens, boat upkeep, ect…).
Cost & schedule: $50,000 (annually)

Adult Processing
Action Plan: No adult collection needs at this site.

Other
Action Plan: Change outboard motor to prop drive. Construct barge for hauling and storing fish feed.
Cost & Schedule: $25,000 (2009)

Hatcheries

Sea Resources

Salmon and Steelhead Programs

Program under review. Need to develop joint program for future production and operations.

For additional information contact
Kenny Osborne – 360-777-8757

Broodstock Management

Fall Chinook

Short-term Benchmark:	PNI > 0.00
Long-term Goal:	PNI > 0.00

Action Plan: Program under review.

Coho

Short-term Benchmark:	PNI > 0.00
Long-term Goal:	PNI > 0.00

Action Plan: Program under review

Chum

Short-term Benchmark:	PNI > 0.00
Long-term Goal:	PNI > 0.67

Action Plan: Start chum conservation program.

Monitoring

Biological Monitoring - Current

Wild Salmon and Steelhead Populations				
VSP Parameter	Fall Chinook	Winter Steelhead	Coho	Chum
Adult Abundance	• Estimate of total spawners via a combination of: 1) enumeration of live fish at lower Grays River weir, 2) live fish counts for AUC, and 3) mark/recapture via carcass tagging and live fish tagging • No monitoring on Chinook River	• Estimate of total spawners via redd count expansion • Assume few to no steelhead in Chinook River or independent tributaries, so no surveys in these areas • Assume all redds are from wild fish based on timing	• Index counts only from stream surveys in the fall focused on early hatchery coho distribution & spawning time • Natural origin late coho are currently not monitored	• Estimate of total spawners - From 2004 to present, Jolly-Seber mark-recapture carcass tagging with proportional expansion for small tributaries
Adult Productivity	• pHOS via CWT expansion* • Currently, no mark selective fisheries in mainstem Columbia* • Selective harvest only in Grays River to remove stray hatchery fish • Harvest estimates from CWT analysis	• LCR Fisheries - Wild steelhead release, but stock specific incidental impacts are unknown • No pHOS data	• LCR sport fisheries - Wild coho release • Stock specific incidental fishery impacts are unknown • Sex ratio, pHOS, and age structure from stream surveys for early coho in index areas only	• Retention prohibited in fisheries, but stock specific incidental impacts are unknown • Sex ratio, pHOS (from supplementation program), and scales from stream surveys
Juvenile Productivity	• Smolt trap @ RM 11.8 • Smolt to adult ratio data collected	• Smolt trap @ RM 11.8 • Smolt to adult ratio data collected	• Smolt trap @ RM 11.8 • Smolt to adult ratio data collected	• Smolt trap @ RM 11.8 • Smolt to adult ratio data collected
Spatial Diversity	• GPS locations for individual redds in surveyed areas	• GPS locations for individual redds in surveyed areas	• Fish counts by section for early coho in index areas only	• Live fish, carcass and redd counts made by section on weekly surveys • The scale for spatial analysis is the river mile for high use spawning areas and variable scale for low use areas
Species Diversity	• Age, sex ratios and lengths for cohort structure • Run timing from weir • Spawn timing from stream surveys • Genetic sampling from adults at weir and juveniles at smolt trap	• Spawn timing from stream surveys • Genetic baseline from samples collected in 2005-07, samples have been analyzed	• Age, sex ratios and lengths for cohort structure from early component only • Spawn timing for early component from stream surveys • Some LCR baseline DNA samples recently collected, but no annual genetic sampling program, samples have not been analyzed	• Sex ratio, scales, otolith marks, & lengths collected for cohort structure • Spawning timing from stream surveys • Genetic DNA baseline collected and analyzed
*Mass marking of fall Chinook is underway with all LCR Tule fall Chinook (age 2-5) mass marked by the 2011 return. Mass marking programs are already in place for coho and steelhead.				

Biological Monitoring – Improvement Actions Needed

Wild Salmon and Steelhead Populations				
VSP Parameter	Fall Chinook	Winter Steelhead	Coho	Chum
Adult Abundance	• Database infrastructure • Develop LCR specific observer efficiency and residence time needed for Chinook AUC abundance estimates • Improve AUC based population estimates to account for both spatial/temporal sampling errors and observation/ measurement errors • Develop sampling program for Chinook River • Identify spatial extent of spawning (sample frame) • Estimate precision • Conduct power analysis	• Database infrastructure • Develop alternative/ improved methods for abundance estimates • Identify spatial extent of spawning (sample frame) • Develop LCR specific redds/female and sex ratio data • Monitor hatchery escapement • Estimate precision • Conduct power analysis	• Database infrastructure • Develop and implement monitoring plan for early and late component • Identify spatial extent of spawning (sample frame) • Develop LCR specific redds/female, observer efficiency, and residence time • Monitor hatchery escapement • Conduct power analysis • Estimate precision	• Database infrastructure • Identify spatial extent of spawning (sample frame) • Finalize sampling designs to estimate adult abundance • Estimate precision (CV) for current and historical data
Adult Productivity	• Pursue options for selective fisheries • Determine pHOS based on ad-clips as mass marked returns are realized • Install Grays weir in mid-August and operate through mid-November to increase the number of fish sampled	• Estimate pHOS/gene flow • Estimate incidental mortality in LCR mainstem and tributary fisheries	• Estimate incidental mortality in LCR mainstem and tributary fisheries	• Analyze otoliths to determine hatchery contribution to natural spawning. • Estimate incidental mortality in LCR mainstem and tributary fisheries
Juvenile Productivity	• Improve trap efficiency by operation of second trap, alternate site, or weir panels • Improve mark-recapture point and variance estimates to account for missed smolt trapping days	• Improve trap efficiency by operation of second trap, alternate site, or weir panels • Improve mark-recapture point and variance estimates to account for missed smolt trapping days	• Improve trap efficiency by operation of second trap, alternate site, or weir panels • Improve mark-recapture point and variance estimates to account for missed smolt trapping days	• Improve trap efficiency by operation of second trap, alternate site, or weir panels • Improve mark-recapture point and variance estimates to account for missed smolt trapping days
Spatial Diversity	• Determine upper extent of distribution on WF Grays. • Develop & implement improved sampling design to estimate spatial distribution.	• Consider alternate sampling designs to the current index/supplemental approach.	• Develop & implement sampling designs to estimate spatial distribution.	• Review spatial distribution sampling plan
Species Diversity	• Develop long-term ESU phenotypic and genetic monitoring and sampling plan.	• Operation of WF Grays hatchery weir, Grays river adult weir, or other methods to collect origin, sex ratio, and length data for cohort analysis • Develop DPS phenotypic and genetic monitoring and sampling plan	• Develop ESU phenotypic and genetic monitoring and sampling plan • Analyze archived genetic baseline samples. • Sample over entire run to estimate origin, scales and sex ratio for cohort analysis	• Develop ESU phenotypic and genetic monitoring and sampling plan

Monitoring

Hatchery Monitoring - Current

In-Facility	Performance Measures
• In-season management of adult salmonid returns, broodstock collection and spawning protocols • Enumeration of hatchery origin and natural origin returns to hatchery collection facilities and final disposition of each • For integrated programs – enumeration of the number of hatchery and natural origin fish used in the broodstock for each species to calculate pNOB • Hatchery return timing, age composition (from scales), stock composition (CWT analysis), sex ratio and length data for run reconstruction and forecasting • Survival to each life history stage during incubation and rearing (Green egg, Eyed egg, Fry, Parr, Smolt) • Growth/feed conversions and condition • Monthly fish health monitoring • Number of smolt released- size and condition factor at release • Water quality - regulated by Washington Department of Ecology - weekly and/or monthly samples to ensure facility compliance	• All hatchery origin adults are identifiable - juveniles are marked pre-release by one or more of the following: adipose fin-clip, CWT in snout, otolith marking (chum) • Harvest rates – contribution to commercial and sport fisheries. • Hatchery smolt to adult survival rates • pHOS for fall Chinook via CWT expansion • pHOS for chum (from supplementation program) via otolith analysis

Monitoring

Hatchery Monitoring – Improvement Actions Needed

In-Facility	Performance Measures
• Development of updated Hatchery and Genetic Management Plans (HGMP) for each hatchery program consistent with implementation of the Conservation and Sustainable Fisheries plan and incorporate HSRG standards • Development of natural origin run and/or spawn timing curves to guide collection of natural origin broodstock for integrated programs • Review and update spawning protocols and incubation, rearing & release strategies	• Estimate pHOS for fall Chinook based on visual identification of hatchery origin fish (i.e. adipose fin-clips) rather than CWT expansion, as mass marked returns of fall Chinook are realized. • Development and implementation of methods to estimate pHOS for coho • Development and implementation of methods to estimate pHOS and/or gene flow for winter steelhead • Calculation of pNOB, pHOS and PNI statistics annually for each hatchery program and development of a reporting format to track hatchery performance measures • Develop a regional monitoring plan for genetic and ecological interactions by hatchery-and natural-origin juveniles to assess impacts to the natural origin population • As additional data is collected and new methodologies become available, modify programs to achieve goals for PNI, pHOS and pNOB • Develop nutrient enhancement goals for watershed and include in updated escapement goals

Implementation Schedule

Preliminary Grays/Chinook Subbasin hatchery action implementation plan. Actions and schedule will be reviewed, evaluated, and updated annually.

Year	Facility	Action	Fund Source	Cost
2009	Grays River	**Facility Improvement:** Unclog spawning drains	Federal (BPA/M.A.)	$2,500
2009	Grays River	**Facility Improvement:** New bird netting for pond 13 and all standard ponds	Federal (BPA/M.A.)	$5,000
2009	Grays River	**Facility Improvement:** Install more magnum deeps in incubation	Federal (BPA/M.A.)	$2,500
2009	Grays River	**Facility Improvement:** Renovate fish ladder and adult attraction	Federal (BPA/M.A.)	$5,000
2009	Grays River	**Facility Improvement:** Excavate hatchery release site	Federal (BPA/M.A.)	$4,000
2009	Grays River	**Facility Improvement:** Install more Int. raceways	Federal (BPA/M.A.)	$5,000
2009	Grays River	Excavate P.A. pond discharge	Federal (BPA/M.A.)	$4,000
2009	Deep River Net Pens	**Facility Improvement:** Repair net pen dock decking	Federal (BPA/M.A.)	$5,000
2011	Grays River	**Facility Improvement:** Extend well water line for all ponds	Federal (BPA/M.A.)	TBD
2011	Grays River	**Facility Improvement:** New garage and residence roofs	Federal (BPA/M.A.)	TBD
2011	Grays River	**Facility Improvement:** New hatchery roof	Federal (BPA/M.A.)	TBD
2011	Deep River Net Pens	**Facility Improvement:** Prop drive for outboard	Federal (BPA/M.A.)	TBD
2011	Deep River Net Pens	**Facility Improvement:** Construct feed barge	Federal (BPA/M.A.)	TBD
2011	Deep River Net Pens	**Facility Improvement:** New rearing nets for juveniles	Federal (BPA/M.A.)	TBD
2011	Grays River	**Environmental Compliance:** New intake structure and screens with reuse pumping capabilities	Federal M.A./ State	$4.5 mil.
2011	Grays River	**Facility Improvement:** New well water supply	Federal (BPA/M.A.)	TBD
2011	Deep River Net Pens	**Facility Improvement:** New pilings for additional pens or sites	Federal (BPA/M.A.)	TBD

Elochoman/Skamokawa Subbasin

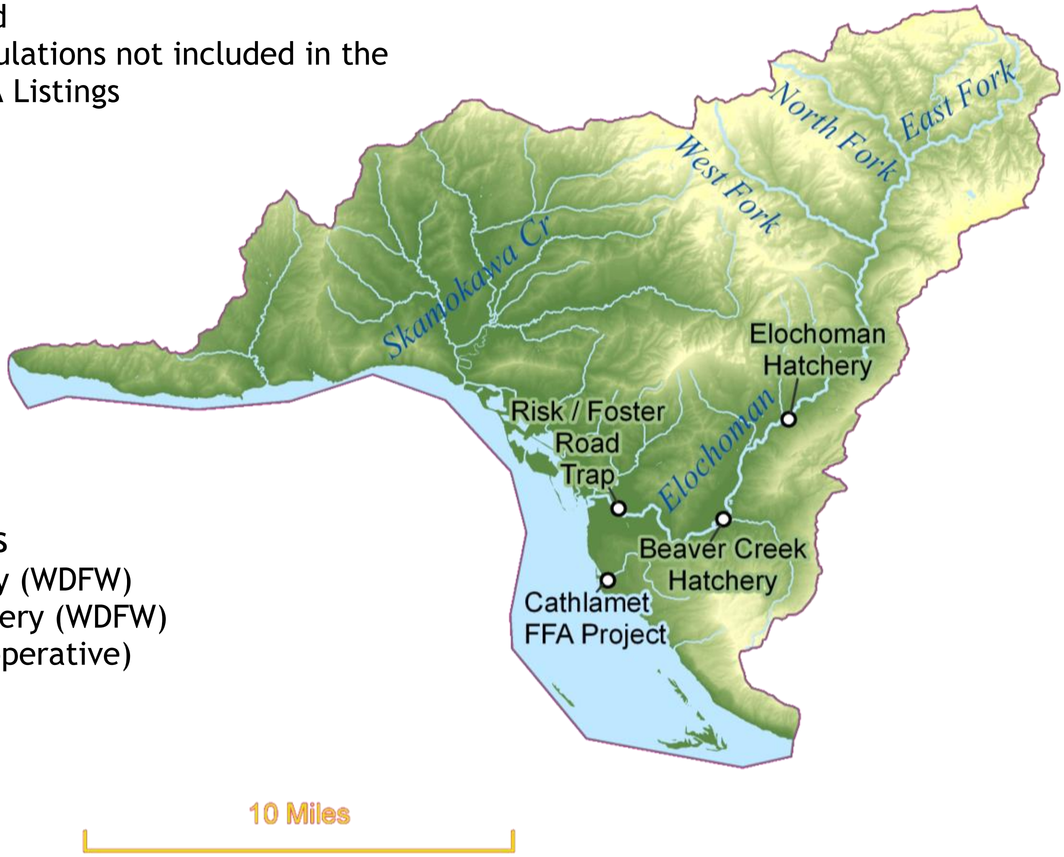
Wild Salmon & Steelhead

Chinook: ESA Listed

Steelhead: SW Populations not included in the LCR ESA Listings

Coho: ESA Listed

Chum: ESA Listed

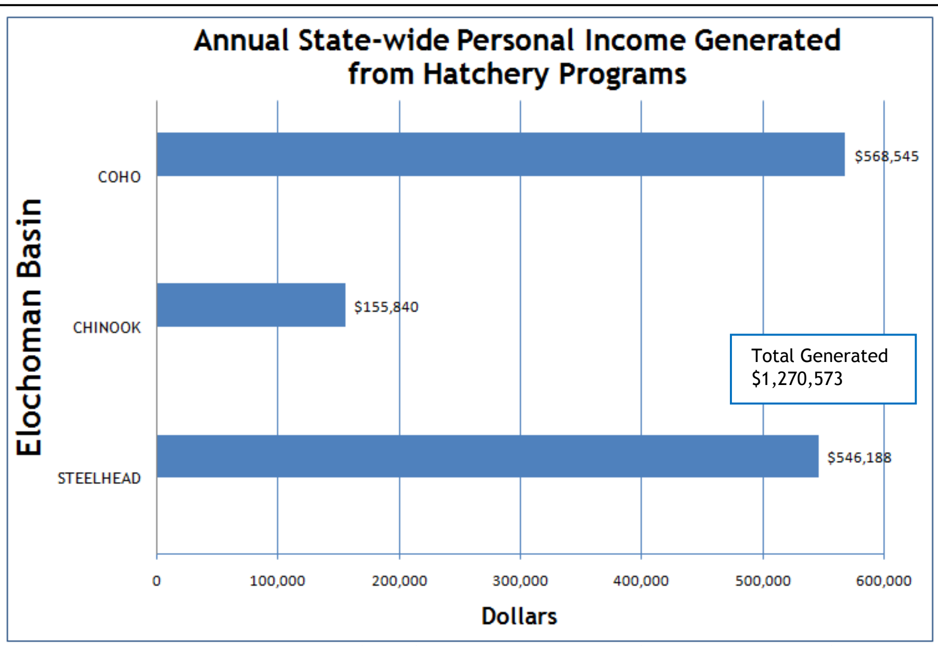


Hatchery Programs

Elochoman Hatchery (WDFW)

Beaver Creek Hatchery (WDFW)

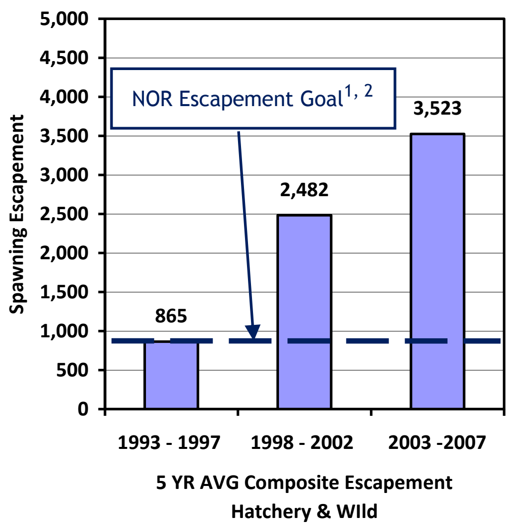
Cathlamet FFA (Cooperative)



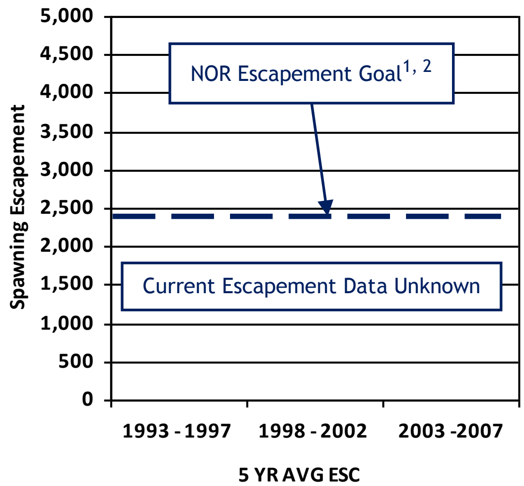
Source: Wegge, T. 2009 (June) Technical Memo. Economic Analysis of WDFW Hatchery Programs

Wild Salmon & Steelhead

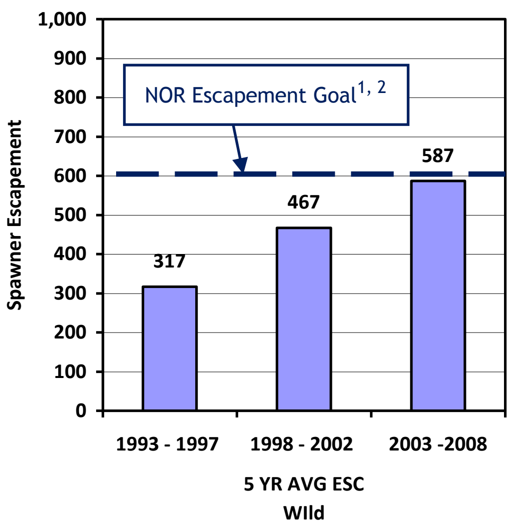
Fall Chinook
ESA Listing Status: Threatened
Populations: Elochoman/Skamokawa (Primary)



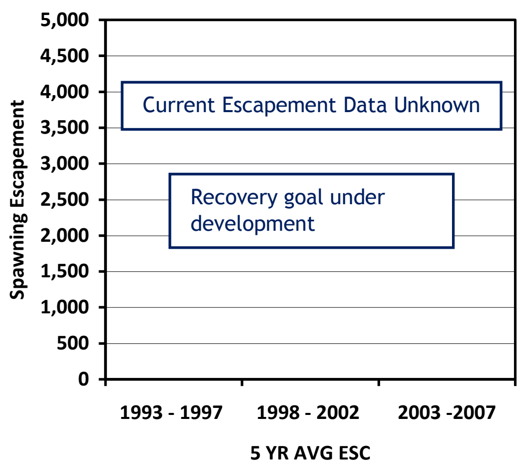
Coho
ESA Listing Status: Threatened
Populations: Elochoman/Skamokawa (Primary)



Winter Steelhead
ESA Listing Status: Not Warranted
Populations: Elochoman/Skamokawa (Contributing)



Chum
ESA Listing Status: Threatened
Populations: Elochoman/Skamokawa (Primary)



[1]Number of natural origin spawners necessary to achieve population viability standards established by NOAA's TRT.

[2]Washington LCFRB Proposed Scenario Revisions (6/16/09 Draft).

Hatcheries

Elochoman Hatchery (WDFW)

Salmon and Steelhead Programs

Type N Coho
Purpose: Harvest/Conservation
Broodstock Strategy: Integrated
Program Size: 496,000 yearlings

Winter/Summer Steelhead
Purpose: Harvest
Broodstock Strategy: Segregated
Program Size: 110K/30K yearlings

Type S Coho
Purpose: Harvest
Broodstock Strategy: Segregated
Program Size: 415,000 yearlings

Fall Chinook
Purpose: Harvest/Conservation
Broodstock Strategy: Integrated
Program Size: 2,000,000 sub-yearlings

***All salmon programs discontinued to establish wild stock refuge January 2009 (C&SFP).**

Broodstock Management

Type N Coho
Short-term Benchmark: PNI > N/A
Long-term Goal: pHOS < 5%
Action Plan: Discontinue all late coho production (C&SFP).

Winter/Summer Steelhead
Short-term Benchmark: Gene Flow < 2%
Long-term Goal: Gene Flow < 2%
Action Plan: Move steelhead programs to Beaver Creek Hatchery on the Elochoman River (C&SFP).

Type S Coho
Short-term Benchmark: PNI > N/A
Long-term Goal: pHOS < 5%
Action Plan: Discontinue all early coho production (C&SFP).

Fall Chinook
Short-term Benchmark: PNI > N/A
Long-term Goal: pHOS < 5%
Action Plan: Discontinue all fall Chinook production (C&SFP).

***Elochoman Hatchery closed 1/2009 (C&SFP)**

Environmental Compliance

Cleanwater Act
Action Plan: NA

Passage
Action Plan: Maintain fish passage above Elochoman barrier dam
Cost & Schedule: Annually

Intake Screening
Action Plan: NA

Water Withdrawal
Compliant with water rights formalized thru trust water right # Upper River Intake S2-*09765CWRIS Lower river Intake S2-*23896CWRIS Clear Creek Intake CCVOL2P913 Water rights will be put in trust. NPDES to be suspended

Capital Needs

Incubation
Nothing needed for future production. Hatchery is closed.

Rearing
Nothing needed for future production. Hatchery is closed.

Adult Processing
Action Plan: NA
Cost & Schedule: NA

Other
Nothing needed for future production. Hatchery is closed.

Beaver Creek Hatchery (WDFW)

Salmon and Steelhead Programs

Early Winter Steelhead
Purpose: Harvest
Goal: Currently under development[1]
Broodstock Strategy: Segregated
Program Size: 90,000 yearlings (C&SFP)

Summer Steelhead
Purpose: Harvest
Goal: Currently under development[1]
Broodstock Strategy: Segregated
Program Size: 30K yearlings (Lewis River Stock) (C&SFP)

Fall Chinook
Purpose: Harvest
Goal: Currently under development[1]
Broodstock Strategy: Integrated
Program Size: 1,000,000 fingerlings (C&SFP)

[1]Program specific goals are under development through completion of broodstock Management Plans. Overall production levels for Lower Columbia River have been evaluated through Conservation and Sustainable Fisheries Plan

Broodstock Management

Winter Steelhead
Short-term Benchmark: Gene Flow < 2%
Long-term Goal: Gene Flow < 2%
Action Plan: Rear & release both stocks from Beaver Creek Hatchery for homing back to the lower Elochoman River. Continue segregated program consistent with contributing population.

Summer Steelhead
Short-term Benchmark: Gene Flow < 2%
Long-term Goal: Gene Flow < 2%
Action Plan: Rear & release both stocks from Beaver Creek Hatchery for homing back to the lower Elochoman River and to maintain local broodstock. Continue segregated program consistent with contributing population.

Fall Chinook
Short-term Benchmark: PNI > N/A
Long-term Goal: pHOS < 5%
Action Plan: Program will be evaluated for impacts to Grays and Elochoman/Skamokawa populations.

Environmental Compliance

Cleanwater Act
Action Plan: Maintain NPDES compliance.

Passage
Action Plan: Renovate Beaver Creek barrier/fish ladder to allow sorting and passage of ESA listed fish.
Cost & Schedule: $870,000 (2010)

Intake Screening
Action Plan: Renovate & maintain intake screens for ESA compliance.
Cost & Schedule: Included in passage dollars (2010)

Water Withdrawal
Compliant with water rights formalized thru trust water right # S2-*13718CWRIS, # S2-*13719CWRIS, # G2-*04790CWRIS
Monthly NPDES reporting to Dept of Ecology

Capital Needs

Incubation
Action Plan: NA
Cost & Schedule: NA

Rearing
Action Plan: Purchase equipment and infrastructure for continued success (predation netting, fish and trash pumps, bridge and rearing pond decking materials, etc…).
Cost & schedule: $40,000 (2010-2011)

Adult Processing
Action Plan: Renovate adult trapping and holding facilities.
Cost & schedule: TBD (2011)

Other
Replace domestic water transfer system.
Cost & schedule: TBD (2011)

Cathlamet FFA (Cooperative)

Salmon and Steelhead Programs

Type N Coho
Purpose: Harvest
Goal: Currently under development[1]
Broodstock Strategy: Integrated
Program Size: 16,000 yearlings from Grays River Hatchery

[1]Program specific goals are under development through completion of broodstock Management Plans. Overall production levels for Lower Columbia River have been evaluated through Conservation and Sustainable Fisheries Plan

Broodstock Management

Type N Coho
Short-term Benchmark: PNI > .04
Long-term Goal: PNI > .67
Action Plan: Continue FFA program with changes to holding site. Consider future production change to chum.

Environmental Compliance

Cleanwater Act
Action Plan: Compliant, no action necessary

Passage
Action Plan: Maintain fish ladder for compliance.

Intake Screening
Action Plan: Compliant no screening

Water Withdrawal
Instream pond- no water right required

Facility Condition

Incubation
Action Plan: No incubation needs at this site.

Rearing
Action Plan: Incorporate a specially designed net pen for fish. This would allow students more time to culture the fish and ensure their captivity until release.
Cost & Schedule: TBD (2010)

Adult Processing
Action Plan: No adult collection needs at this site.

Other
Action Plan: Nothing at this time.

Biological Monitoring – Current

Wild Salmon and Steelhead Populations				
VSP Parameter	Fall Chinook	Winter Steelhead	Coho	Chum
Adult Abundance	• Estimate of total spawners via peak count expansion for Elochoman and Skamokawa • Elochoman Hatchery counts of fish placed upstream • Counts at Lower Elochoman River weir/trap (Risk rd.)	• Estimate of total spawners via redd count expansion for Elochoman and Skamokawa • Assume few or no steelhead in independent tributaries between Elochoman and Skamokawa, so no surveys in these areas • Assume all redds are from wild fish based on timing	• Index counts only from stream surveys in the fall focused on early hatchery coho distribution & spawning time • Elochoman Hatchery count • Natural origin late coho are currently not monitored	• Exploratory surveys from 1999-2006 with AUC estimates for index areas only • No current monitoring
Adult Productivity	• pHOS via CWT expansion* • Currently, no mark selective fisheries in mainstem Columbia* • Hatchery Tule production from the Elochoman discontinued with 2008 release • No hatchery production or fishery in Skamokawa creek • Harvest estimates from CWT analysis	• LCR Fisheries – Wild steelhead release, but stock specific incidental impacts are unknown • No pHOS data	• LCR sport fisheries – Wild coho release • Stock specific incidental fishery impacts are unknown • Sex ratio, pHOS, and age structure from stream surveys for early coho in index areas only and from hatchery sampling	• Retention prohibited in fisheries, but stock specific incidental impacts are unknown • Limited samples for sex ratio, pHOS, and age from stream surveys • Otoliths have been collected to identify out of basin strays from supplementation programs, but not processed
Juvenile Productivity	• No smolt monitoring	• No smolt monitoring	• No smolt monitoring	• No smolt monitoring
Spatial Diversity	• Redd counts by spawning reach during stream surveys	• GPS locations for individual redds in surveyed areas	• Fish counts by section for early coho in index areas only	• 1999-2006 counts by section in index areas • No current monitoring
Species Diversity	• Age, sex ratios and lengths for cohort structure • Run timing from weir (Risk Rd.) • Spawn timing from stream surveys • No genetic sampling	• Spawn timing from stream surveys • Genetic baseline from samples collected in 2005-07, samples have been analyzed	• Age, sex ratios and lengths for cohort structure from early component only • Spawn timing for early component from stream surveys • Run timing from hatchery counts • Some LCR baseline DNA samples recently collected, but no annual genetic sampling program, samples have not been analyzed	• Sex ratio, scales, otolith marks, & lengths collected for cohort structure – limited samples • Spawning timing from stream surveys • Baseline DNA samples collected, have not been analyzed
*Mass marking of fall Chinook is underway with all LCR Tule fall Chinook (age 2-5) mass marked by the 2011 return. Mass marking programs are already in place for coho and steelhead.				

Biological Monitoring – Improvement Actions Needed

Wild Salmon and Steelhead Populations				
VSP Parameter	Fall Chinook	Winter Steelhead	Coho	Chum
Adult Abundance	• Database infrastructure • Develop alternative/ improved methods for abundance estimates; e.g. AUC or mark/recapture • Identify spatial extent of spawning (sample frame) • Estimate precision • Conduct power analysis	• Database infrastructure • Develop alternative/ improved methods for abundance estimates • Identify spatial extent of spawning (sample frame) • Develop LCR specific redds/female and sex ratio data • Monitor hatchery escapement • Estimate precision • Conduct power analysis	• Database infrastructure • Develop and implement monitoring plan for early and late component • Identify spatial extent of spawning (sample frame) • Develop LCR specific redds/female, observer efficiency, and residence time • Monitor hatchery escapement • Conduct power analysis • Estimate precision	• Database infrastructure • Identify spatial extent of spawning (sample frame) • Develop & implement sampling designs to estimate adult abundance • Develop LCR specific observer efficiency and residence time • Estimate precision for current and historical data • Conduct power analysis
Adult Productivity	• Pursue options for selective fisheries • Determine pHOS based on ad-clips as mass marking is completed	• Estimate pHOS/gene flow • Estimate incidental mortality in LCR mainstem and tributary fisheries	• Estimate incidental mortality in LCR mainstem and tributary fisheries	• Analyze otoliths to determine out of basin supplementation program contribution to natural spawning • Estimate incidental mortality in LCR mainstem and tributary fisheries
Juvenile Productivity	• Implement periodic juvenile monitoring program via rotary screw trap	• Implement periodic juvenile monitoring program via rotary screw trap	• Implement periodic juvenile monitoring program via rotary screw trap	• Implement periodic juvenile monitoring program via rotary screw trap
Spatial Diversity	• Collect GPS locations for individual redds in surveyed areas • Develop & implement sampling designs to estimate spatial distribution	• Consider alternate sampling designs to the current index/supplemental approach	• Develop & implement sampling designs to estimate spatial distribution	• Develop & implement sampling designs to estimate spatial distribution
Species Diversity	• Develop long-term ESU phenotypic and genetic monitoring and sampling plan.	• Methods to collect origin, age, length and sex ratio data • Develop DPS phenotypic and genetic monitoring and sampling plan	• Develop ESU phenotypic and genetic monitoring and sampling plan • Analyze archived genetic baseline samples • Sample over entire run to estimate origin, scales and sex ratio for cohort analysis	• Develop ESU phenotypic and genetic monitoring and sampling plan • Analyze archived genetic baseline samples

Monitoring

Hatchery Monitoring – Current

In-Facility	Performance Measures
• In-season management of adult salmonid returns, broodstock collection and spawning protocols. • Enumeration of hatchery origin and natural origin returns to hatchery collection facilities and final disposition of each • For integrated programs – enumeration of the number of hatchery and natural origin fish used in the broodstock for each species to calculate pNOB • Hatchery return timing, age composition (from scales), stock composition (CWT analysis), sex ratio and length data for run reconstruction and forecasting • Survival to each life history stage during incubation and rearing (Green egg, Eyed egg, Fry, Parr, Smolt) • Growth/feed conversions and condition • Monthly fish health monitoring • Number of smolt released- size and condition factor at release • Water quality - regulated by Washington Department of Ecology - weekly and/or monthly samples to ensure facility compliance	• All hatchery origin adults are identifiable - juveniles are marked pre-release by one or both of the following: adipose fin-clip, CWT in snout • Harvest rates – contribution to commercial and sport fisheries. • Hatchery smolt to adult survival rates • pHOS for fall Chinook via CWT expansion

Monitoring

Hatchery Monitoring - Improvement Actions Needed

In-Facility	Performance Measures
• Development of updated Hatchery and Genetic Management Plans (HGMP) for each hatchery program consistent with implementation of the Conservation and Sustainable Fisheries plan and incorporate HSRG standards • Development of natural origin run and/or spawn timing curves to guide collection of natural origin broodstock for integrated programs • Review and update spawning protocols and incubation, rearing & release strategies	• Estimate pHOS for fall Chinook based on visual identification of hatchery origin fish (i.e. adipose fin-clips) rather than CWT expansion, as mass marked returns of fall Chinook are realized • Development and implementation of methods to estimate pHOS for coho • Development and implementation of methods to estimate pHOS and/or gene flow for winter steelhead • Analysis of otolith samples from chum to estimate contribution (stray rate) from Grays River supplementation program • Calculation of pNOB, pHOS and PNI statistics annually for each hatchery program and development of a reporting format to track hatchery performance measures • Develop a regional monitoring plan for genetic and ecological interactions by hatchery-and natural-origin juveniles to assess impacts to the natural origin population • As additional data is collected and new methodologies become available, modify programs to achieve goals for PNI, pHOS and pNOB • Develop nutrient enhancement goals for watershed and include in updated escapement goals

Implementation Schedule

Preliminary Elochoman/Skamokawa Subbasin hatchery action implementation plan. Actions and schedule will be reviewed, evaluated, and updated annually.

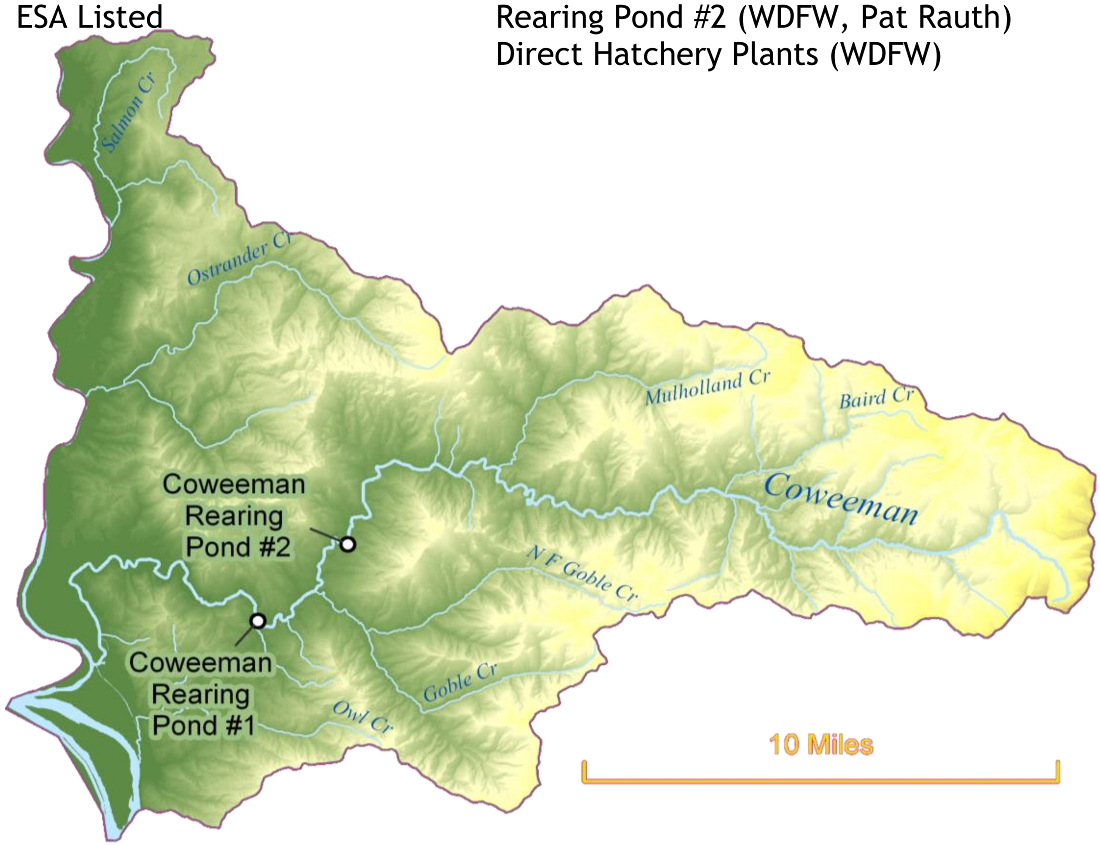
Year	Facility	Action	Fund Source	Cost
2009	Beaver Creek	**Facility Improvement**: Set up vertical incubation for fall Chinook	Federal (M.A.)	$5,000
2009	Beaver Creek	**Facility Improvement**: Repair bird netting around raceways and install bird netting on the rearing pond	Federal (M.A.)	$15,000
2009	Beaver Creek	**Facility Improvement**: Repair rearing pond docks	Federal (M.A.)	$5,000
2009	Beaver Creek	**Facility Improvement**: Repair bridge to rearing pond	Federal (M.A.)	$5,000
2010	Beaver Creek	**Environmental Compliance:** Repair B.C. barrier dam and fish ladder/collection facilities	Federal (M.A.)	$870,000
2011	Beaver Creek	**Facility Improvement**: Replace domestic water transfer system	Federal (M.A.)	TBD
2011	Beaver Creek	**Facility Improvement**: Upgrade fish collection facility	Federal (M.A.)	TBD
2011	Beaver Creek	**Facility Improvement**: Replace hatchery residence roofs	Federal (M.A.)	TBD
2011	Cathlamet FFA	**Facility Improvement**: Construct a site specific net pen	Federal (M.A.)	TBD

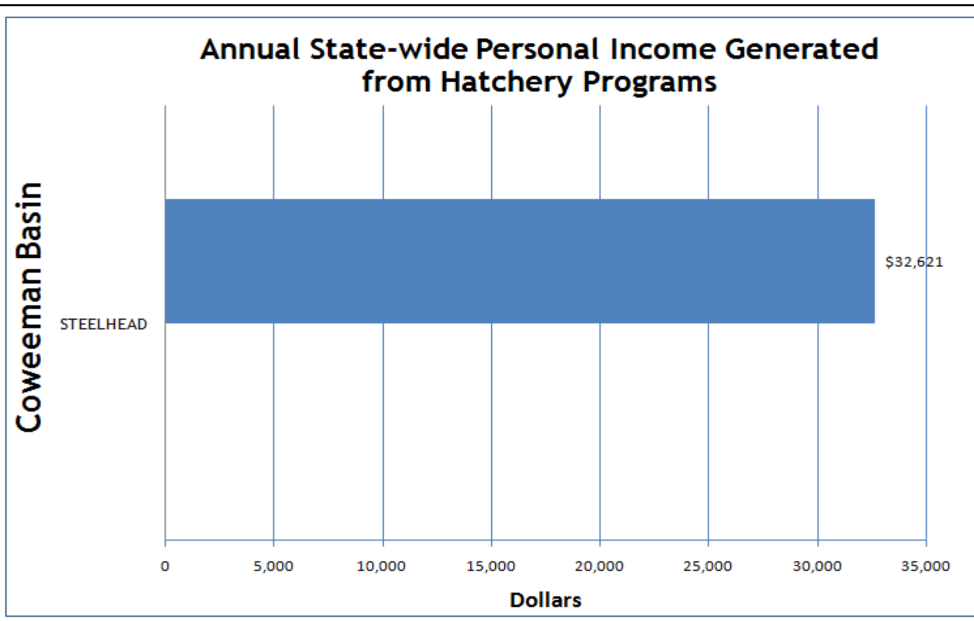
Wild Salmon & Steelhead

Fall Chinook: ESA Listed
Winter Steelhead: ESA Listed
Coho: ESA Listed
Chum: ESA Listed

Hatchery Programs

Rearing Pond#1(WDFW, Cowlitz Game & Anglers)
Rearing Pond #2 (WDFW, Pat Rauth)
Direct Hatchery Plants (WDFW)

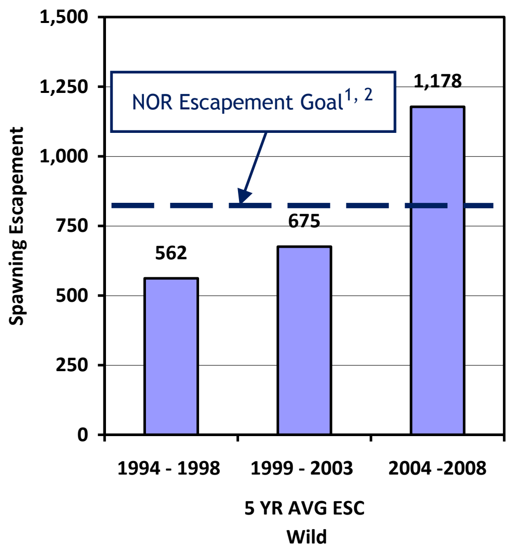




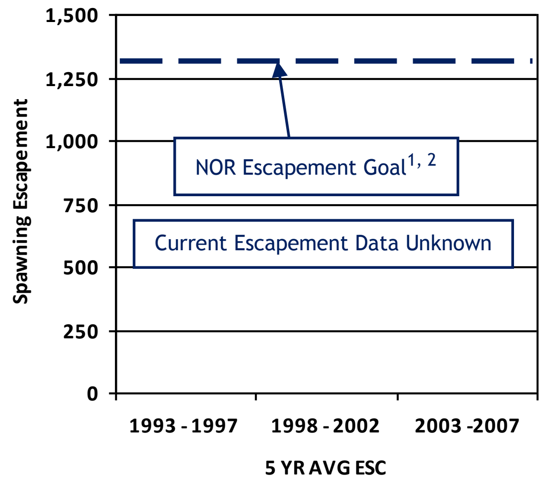
Source: Wegge, T. 2009 (June) Technical Memo. Economic Analysis of WDFW Hatchery Programs

Wild Salmon & Steelhead

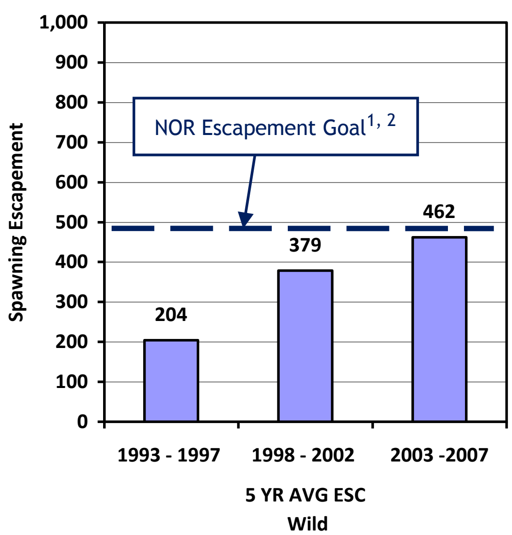
Fall Chinook
ESA Listing Status: Threatened
Population: Coweeman (Primary)



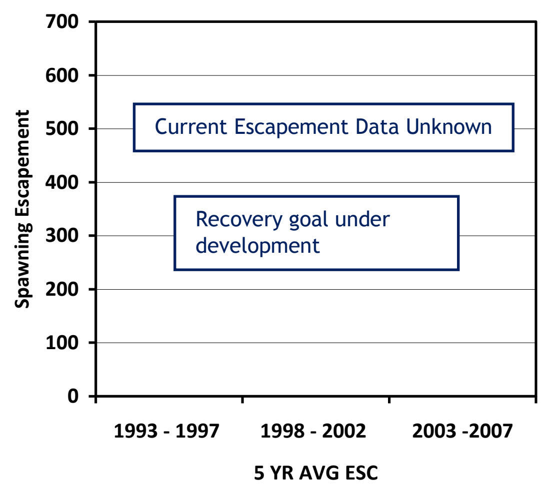
Coho
ESA Listing Status: Threatened
Population: Coweeman (Primary)



Winter Steelhead
ESA Listing Status: Not Warranted
Population: Coweeman (Primary)



Chum
ESA Listing Status: Threatened
Population: Lower Cowlitz (Contributing)



[1]Number of natural origin spawners necessary to achieve population viability standards established by NOAA's TRT.

[2]Washington LCFRB Proposed Scenario Revisions (6/16/09 Draft)

Hatcheries

Salmon and Steelhead Programs

No hatchery programs for Chinook, chum, coho or summer steelhead.

Early Winter Steelhead
Purpose: Harvest
Goal: Currently under development[1]
Broodstock Strategy: Segregated
Program Size: 10,000 yearlings (C&SFP)
Origin: Transfer from Beaver Creek

Coweeman Rearing Pond #1:
(WDFW, Cowlitz Game & Anglers)
Up to 5,000 yearlings for acclimation.

Coweeman Rearing Pond #2:
(WDFW, Pat Rauth – landowner)
Up to 5,000 yearlings for acclimation.

Direct Plant: Libby Road Bridge
Balance of non-acclimated fish (up to 10,000)

[1]Program specific goals are under development through completion of broodstock Management Plans. Overall production levels for Lower Columbia River have been evaluated through Conservation and Sustainable Fisheries Plan.

Broodstock Management

Early Winter Steelhead
Short-term Benchmark: Gene Flow < 2%
Long-term Goal: Gene Flow < 2%
Action Plan: Program will be evaluated during development of the Coweeman steelhead management plan.

Environmental Compliance

Clean Water Act
NA

Passage
NA

Intake Screening at Rearing Pond 1 & 2
Action Plan: Need to be evaluated.
Cost & Schedule: TBD

Water Withdrawal
NA

Capital Needs

Incubation
NA

Rearing
NA

Adult Processing
NA

Other
Action Plan: Assess acclimation pond intakes.
Cost & Schedule: TBD

Biological Monitoring – Current

Wild Salmon and Steelhead Populations				
VSP Parameter	Fall Chinook	Winter Steelhead	Coho	Chum
Adult Abundance	• Estimate of total spawners via AUC and mark/recapture. • Exploring use of DIDSON (sonar)	• Estimate of total spawners via redd count expansion	• GRTS surveys for adult monitoring	• Component of the Cowlitz chum population • 1999-2006 occasional • presence/absence surveys only • No current monitoring
Adult Productivity	• pHOS via CWT expansion* • Currently, no mark selective fisheries in mainstem Columbia* • No fishery in Coweeman • Harvest estimates from CWT analysis using Cowlitz stock as a surrogate	• LCR Fisheries – Wild steelhead release, but stock specific incidental impacts are unknown • No pHOS data	• LCR sport fisheries – Wild coho release • Stock specific incidental fishery impacts are unknown • Sex ratio, pHOS, and age structure from stream surveys	• Retention prohibited in fisheries, but stock specific incidental impacts are unknown • No samples for age, sex ratio, & origin
Juvenile Productivity	• Smolt trap at RM 6 for 2005-2008 • No current monitoring	• Smolt trap at RM 6 for 2005-2008 • No current monitoring	• Smolt trap at RM 6 for 2005-2008 • No current monitoring	• Smolt trap at RM 6 for 2005-2008, but location was likely above a significant portion of potential chum spawning habitat • No current monitoring
Spatial Diversity	• GPS locations for individual redds during stream surveys	• GPS locations for individual redds in surveyed areas	• GRTS sampling provides spatial distribution information	• No current monitoring
Species Diversity	• Age, sex ratios and lengths for cohort structure • Run timing from DIDSON (sonar) • Spawn timing from stream surveys • Genetic sampling from smolt trapping	• Spawn timing from stream surveys • Genetic baseline from samples collected in 2005-07, samples have been analyzed	• Age, sex ratios and lengths for cohort structure • Some LCR baseline DNA samples recently collected, but no annual genetic sampling program, sampled have not been analyzed	• No data
*Mass marking of fall Chinook is underway with all LCR Tule fall Chinook (age 2-5) mass marked by the 2011 return. Mass marking programs are already in place for coho and steelhead.				

Biological Monitoring – Improvement Actions Needed

Wild Salmon and Steelhead Populations				
VSP Parameter	Fall Chinook	Winter Steelhead	Coho	Chum
Adult Abundance	• Database infrastructure • Develop LCR specific observer efficiency and residence time needed for Chinook AUC abundance estimates • Identify spatial extent of spawning (sample frame) • Estimate precision • Conduct power analysis	• Database infrastructure • Develop alternative/ improved methods for abundance estimates • Identify spatial extent of spawning (sample frame) • Develop LCR specific redds/female and sex ratio data • Monitor hatchery escapement • Estimate precision • Conduct power analysis	• Database infrastructure • Develop and implement monitoring plan • Identify spatial extent of spawning (sample frame) • Develop LCR specific redds/female, observer efficiency, and residence time • Monitor hatchery escapement (strays) • Conduct power analysis • Estimate precision	• Database infrastructure • Identify spatial extent of spawning (sample frame) • Develop & implement sampling designs to detect and estimate adult abundance • Develop LCR specific observer efficiency and residence time
Adult Productivity	• Pursue options for selective fisheries • Determine pHOS based on ad-clips as mass marked returns are realized	• Estimate pHOS/gene flow • Estimate incidental mortality in LCR mainstem and tributary fisheries	• Estimate incidental mortality in LCR mainstem and tributary fisheries	• Determine LCR supplementation program contributions to natural spawning • Estimate incidental mortality in LCR mainstem and tributary fisheries
Juvenile Productivity	• Implement periodic juvenile monitoring program via rotary screw trap	• Implement periodic juvenile monitoring program via rotary screw trap	• Implement periodic juvenile monitoring program via rotary screw trap	• Implement periodic juvenile monitoring program via rotary screw trap
Spatial Diversity	• Develop & implement improved sampling design to estimate spatial distribution	• Consider alternate sampling designs to the current index/supplemental approach	• Develop & implement sampling designs to estimate spatial distribution	• Develop & implement sampling designs to estimate spatial distribution
Species Diversity	• Develop long-term ESU phenotypic and genetic monitoring and sampling plan	• Methods to collect origin, age, length and sex ratio data • Develop DPS phenotypic and genetic monitoring and sampling plan	• Develop ESU phenotypic and genetic monitoring and sampling plan • Analyze archived genetic baseline samples	• Develop ESU phenotypic and genetic monitoring and sampling plan

Monitoring

Hatchery Monitoring – Current

In-Facility	Performance Measures
• No hatcheries are located in the Coweeman Subbasin	• All hatchery origin adults are identifiable – steelhead released in the subbasin are adipose fin-clipped • pHOS for fall Chinook via CWT expansion • pHOS for coho from stream surveys

Hatchery Monitoring – Improvement Actions Needed

In-Facility	Performance Measures
• No hatcheries are located in the Coweeman Subbasin	• Estimate pHOS for fall Chinook based on visual identification of hatchery origin fish (i.e. adipose fin-clips) rather than CWT expansion, as mass marked returns of fall Chinook are realized • Development and implementation of methods to estimate pHOS and/or gene flow for winter steelhead • Develop a regional monitoring plan for genetic and ecological interactions by hatchery-and natural-origin juveniles to assess impacts to the natural origin population • Develop nutrient enhancement goals for watershed and include in updated escapement goals

Implementation Schedule

Coweeman basin does not have any hatchery facilities. There is an acclimation pond that is used for rearing winter steelhead.

Cowlitz Basin (Upper and Lower Subbasins)

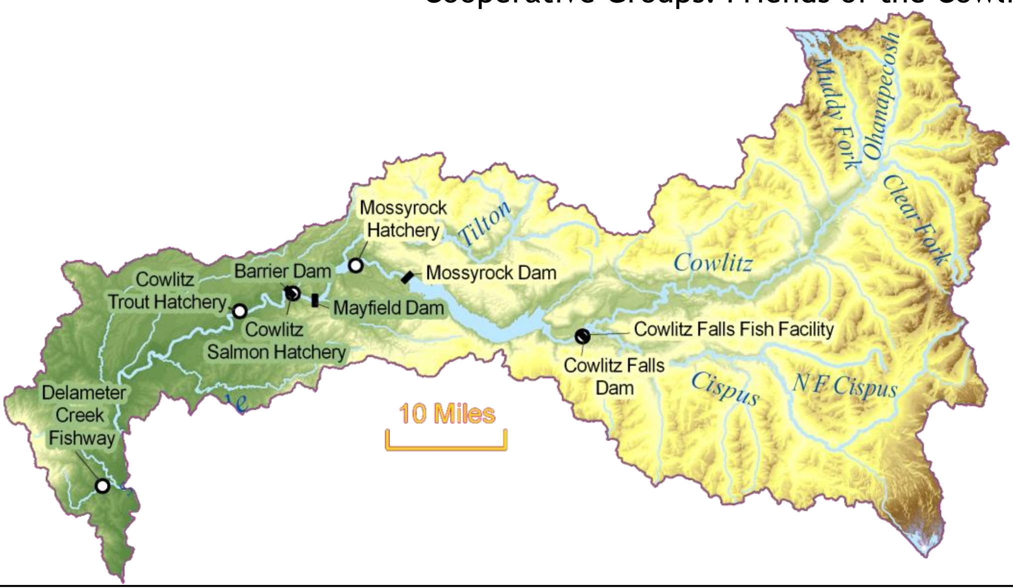
Wild Salmon & Steelhead

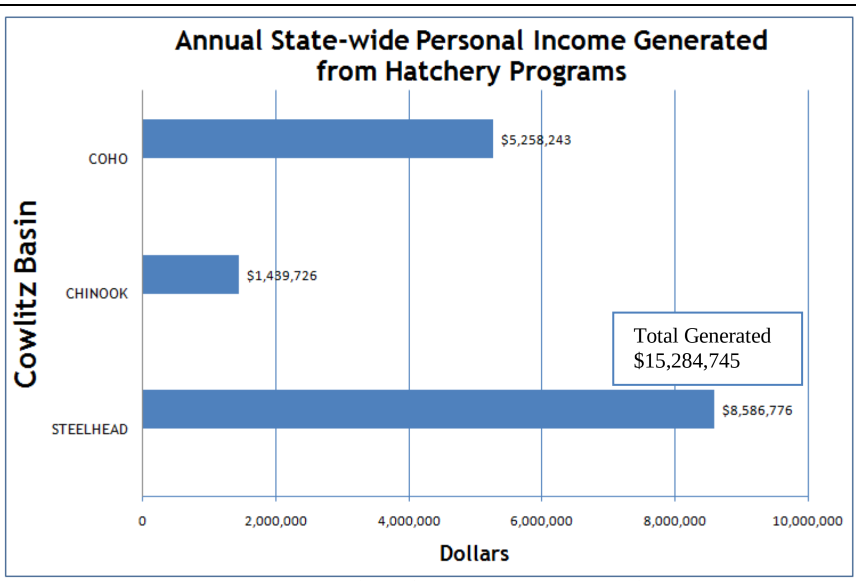
Fall Chinook: ESA Listed
Spring Chinook: ESA Listed
Winter Steelhead: ESA Listed
Classroom Coho: ESA Listed
the Cowlitz)
Chum: ESA Listed

Hatchery Programs

Cowlitz Trout (WDFW)
Cowlitz Salmon (WDFW)
Cowlitz Game & Anglers, Kraus Pond and Salmon in the
Toledo Sand & Gravel Net Pens (Friends of

Upper Cowlitz Restoration (WDFW & PSMFC)
Wallace Net Pens (Friends of the Cowlitz)
Lou Reebs Net Pen (Friends of the Cowlitz)
Hall Creek Rearing Pond (Cowlitz Game & Anglers)
Cooperative Groups: Friends of the Cowlitz



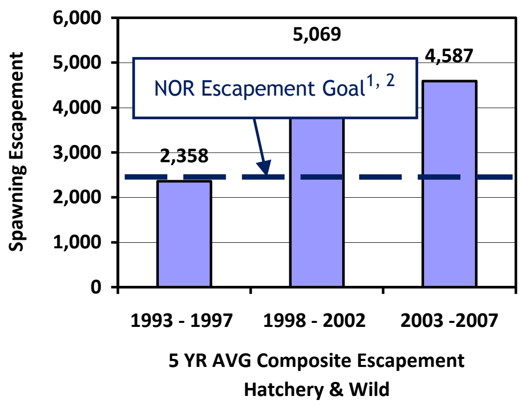


Source: Wegge, T. 2009 (June) Technical Memo. Economic Analysis of WDFW Hatchery Programs

Wild Salmon & Steelhead

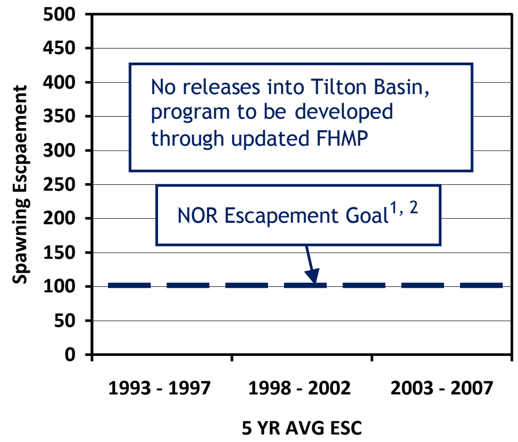
Fall Chinook

ESA Listing Status: Threatened
Populations: Lower Cowlitz (Contributing), including Upper Cowlitz (Stabilizing)



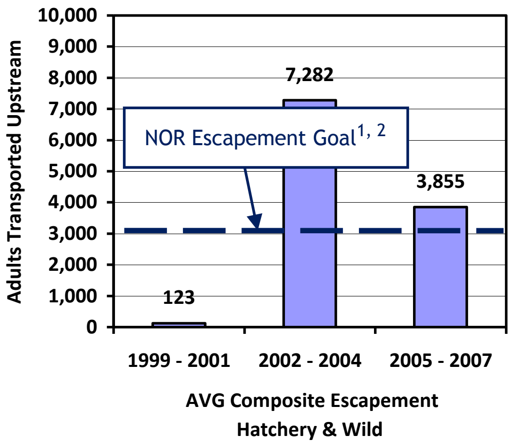
Spring Chinook

ESA Listing Status: Threatened
Populations: Tilton (Stabilizing)



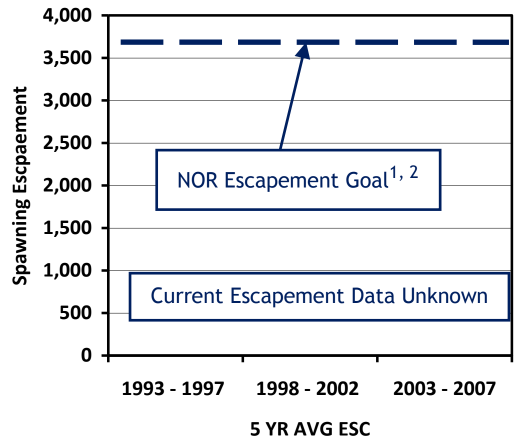
Spring Chinook

ESA Listing Status: Threatened
Populations: Upper Cowlitz, including Cispus (Primary)



Coho

ESA Listing Status: Threatened
Populations: Lower Cowlitz (Primary)

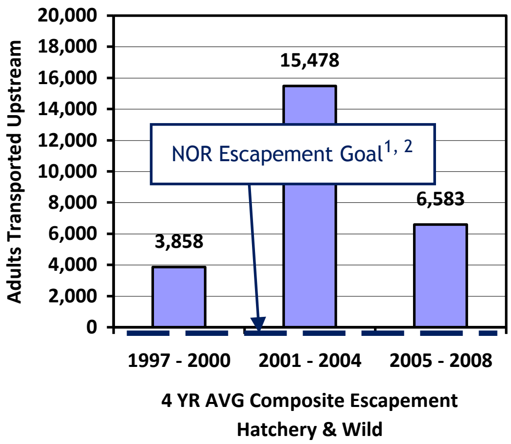


[1] Number of natural origin spawners necessary to achieve population viability standards established by NOAA's TRT.

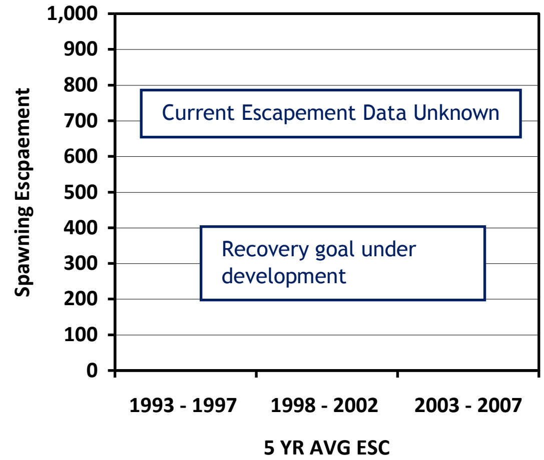
[2]Washington LCFRB Proposed Scenario Revisions (6/16/09 Draft).

Wild Salmon & Steelhead

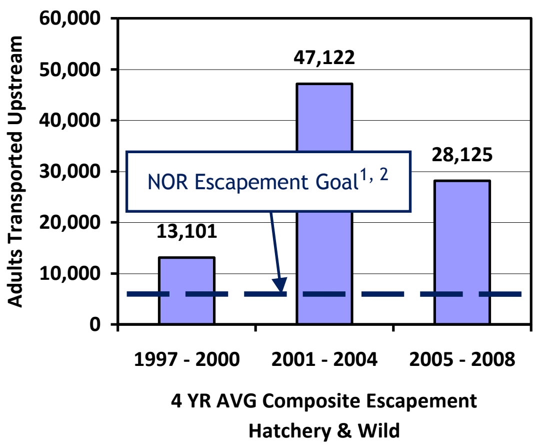
Coho
ESA Listing Status: Threatened
Populations: Cowlitz (Tilton) (Stabilizing)



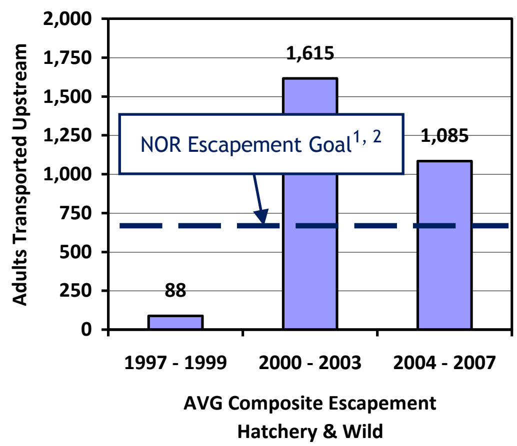
Chum
ESA Listing Status: Threatened
Populations: Cowlitz (Contributing)



Coho
ESA Listing Status: Threatened
Populations: Upper Cowlitz, including Cispus (Primary)



Winter Steelhead
ESA Listing Status: Threatened
Populations: Upper Cowlitz, including Cispus (Primary)

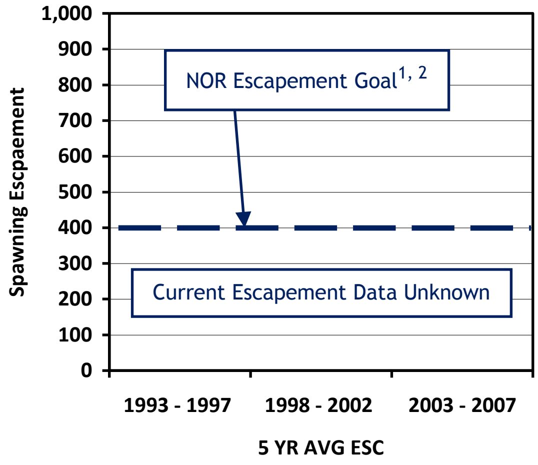


[1] Number of natural origin spawners necessary to achieve population viability standards established by NOAA's TRT.

[2] Washington LCFRB Proposed Scenario Revisions (6/16/09 Draft).

Winter Steelhead

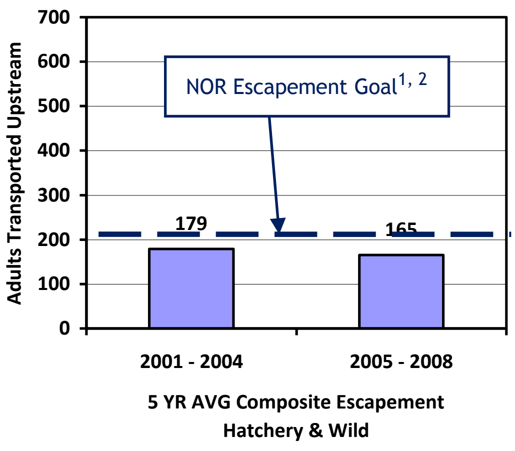
ESA Listing Status: Threatened
Populations: Lower Cowlitz (Contributing)



Winter Steelhead

ESA Listing Status: Threatened

Populations: Cowlitz (Tilton)
(Contributing)



[1] Number of natural origin spawners necessary to achieve population viability standards established by NOAA's TRT.
[2]Washington LCFRB Proposed Scenario Revisions (6/16/09 Draft).

Hatcheries

Cowlitz Salmon Hatchery (WDFW)

Salmon Programs

Spring Chinook
Purpose: Harvest/Conservation
Goal: Currently under development[1]
Brood stock Strategy: Segregated
Program Size: 912,000 yearling release, see joint programs for additional plants and transfers (300,000 sub-yearlings, 55,000 yearlings and 250,000 eyed eggs).

Fall Chinook
Purpose: Harvest/Conservation
Goal: Currently under development[1]
Brood stock Strategy: Integrated
Program Size: 5,000,000 sub-yearlings

Type N Coho (Hatchery)
Purpose: Harvest/Conservation
Goal: Currently under development[1]
Brood stock Strategy: Segregated
Program Size: 1,835,434 yearling, see joint programs for additional plants and transfers (1,000 sub-yearlings, 271,250 eyed eggs).

Type N Coho (Wild)
Purpose: Harvest/ Conservation
Goal: Currently under development[1]
Brood stock Strategy: Integrated
Program Size: 1,000,000 yearlings

[1]Program specific goals are under development through completion of broodstock Management Plans. Overall production levels for Lower Columbia River have been evaluated through Conservation and Sustainable Fisheries Plan.

Broodstock Management

Spring Chinook
Short-term Benchmark: PHOS < 5%
Long-term Goal: PNI ≥ .67
Action Plan: Implement alternatives developed through the updated Cowlitz FHMP.

Fall Chinook
Short-term Benchmark: PHOS < 30%
Long-term Goal: PNI ≥ 0.50
Action Plan: Implement alternatives developed through the updated Cowlitz FHMP.

Type N Coho (Hatchery) - Lower Subbasin
Short-term Benchmark: PHOS < 5%
Long-term Goal: PNI ≥ .67
Action Plan: Implement alternatives developed through the updated Cowlitz FHMP.

Type N Coho (Wild) - Upper Subbasin
Short-term Benchmark: PHOS < 5%
Long-term Goal: PNI ≥ .67
Action Plan: Implement alternatives developed through the updated Cowlitz FHMP.

Hatcheries

Cowlitz Salmon Hatchery (WDFW)

Environmental Compliance

Clean Water Act
Action Plan: Compliant, no action necessary

Passage
Action Plan: Compliant, no action necessary

Intake Screening
Action Plan: Out of Compliance, does not meet NOAA criteria.
Action Plan: Bring intake screens into compliance.
Cost & Schedule: 5 million dollars, (2020)

Water Withdrawal
Water Rights are formalized from the Dept. of Ecology. Pond Use: 90,300 gpm, Wells: 1625 gpm, Monthly NPDES reporting to Dept. of Ecology

Capital Needs

Incubation
Action Plan: Complete hatchery remodel
Cost & Schedule: $ 25 million (2008-2010)

Rearing
Action Plan: Complete hatchery remodel
Cost & Schedule: $ 25 million (2008-2010)

Adult Processing
Action Plan: Complete hatchery remodel
Cost & Schedule: $ 25 million (2008-2010)

Other
Action Plan: Hatchery Intake needs to be brought into compliance.
Cost & Schedule: 5 million dollars, (2020)

Hatcheries

Cowlitz Trout Hatchery (WDFW)

Steelhead Programs

Early Winter Steelhead
Purpose: Harvest
Goal: Currently under development[1]
Broodstock Strategy: Segregated
Program Size: 300,000 yearlings

Summer Steelhead
Purpose: Harvest
Goal: Currently under development[1]
Broodstock Strategy: Segregated
Program Size: 450,000 yearling release, see joint programs for additional plants and transfers (100,000 yearlings).

Late Winter Steelhead
Purpose: Conservation/Harvest
Goal: Currently under development[1]
Broodstock Strategy: Segregated
Program Size: 315,000 yearling release, see joint programs for additional plants and transfers (75,000 yearlings, 200,000 fingerlings)

Coastal Cutthroat
Purpose: Conservation/Harvest
Goal: Currently under development[1]
Broodstock Strategy: Segregated
Program Size: 150,000 yearling release, see joint programs for additional plants and transfers (10,000 yearlings)

[1]Program specific goals are under development through completion of broodstock Management Plans. Overall production levels for Lower Columbia River have been evaluated through Conservation and Sustainable Fisheries Plan.

Broodstock Management

Early Winter Steelhead
Short-term Benchmark: Gene Flow < 10%
Long-term Goal (Upper): NA
Long-term Goal: (Lower) Gene Flow < 10%
Action Plan: Implement alternatives developed through the updated Cowlitz FHMP.

Summer Steelhead
Short-term Benchmark: Gene Flow < 10%
Long-term Goal (Upper): NA
Long-term Goal: (Lower) Gene Flow < 10%
Action Plan: Implement alternatives developed through the updated Cowlitz FHMP.

Late Winter Steelhead
Short-term Benchmark: Gene Flow < 10%
Long-term Goal (Upper): PNI > 0.67
Long-term Goal: (Lower) Gene Flow < 10%
Action Plan: Implement alternatives developed through the updated Cowlitz FHMP.

Coastal Cutthroat
Short-term Benchmark: Gene Flow TBD
Long-term Goal: Gene Flow TBD
Action Plan: Implement alternatives developed through the updated Cowlitz FHMP.

Hatcheries

Environmental Compliance

Clean Water Act
Action Plan: Compliant, no action necessary

Passage
Action Plan: Compliant, no action necessary

Intake Screening
Action Plan: Out of compliance, resize intake screens to minimize impacts to ESA listed fish.
Cost & Schedule: $1,000,000 (2011-2013)

Water Withdrawal
Compliant with water rights formalized thru
trust water rights #S2-*19839CWRIS & #G2-*08491CWRIS
Use: 56 CFS surface water & 860-gpm ground
water.
Monthly NPDES reporting to Dept of Ecology

Facility Condition

Incubation
Action Plan: All incubation will be moved to a new incubation system located at the Cowlitz Salmon Hatchery.
Cost & schedule: $1,000,000 (2010)

Rearing
Action Plan: All early rearing (>300 fpp) will be at the new remodeled Cowlitz Salmon Hatchery with 10 rearing troughs 60'x3'x3'. Final rearing (<300 fpp) will be at the Cowlitz Trout Hatchery in 30 concrete raceways and 4 rearing lakes. All trout hatchery raceways need reconditioning.
Cost & schedule: $3,000,000 (2013)

Adult Processing
Action Plan: All adult trapping is being moved to the Cowlitz Salmon Hatchery.
Cost & Schedule: NA

Other
Action Plan: Facility improvements – See implementation schedule.
Cost & Schedule: $3,000,000—5,000,000 (2015-2020)

Joint Programs (WDFW w/ Others)

Summer Steelhead
36,000 yearlings to Toledo Sand & Gravel Net Pens for Friends of the Cowlitz (FOC)
64,000 yearlings to Wallace Net Pens for Friends of the Cowlitz (FOC)

Coastal Cutthroat
10,000 yearlings to Lou Reebs Net Pens for Friends of the Cowlitz (FOC)

Late Winter Steelhead
12,000 yearlings to Hall Creek Rearing pond for Cowlitz Game & Anglers (CGA)
Current Status; Inactive

Upper Cowlitz Restoration Project (UCR)
Spring Chinook
Transfer 300,000 sub-yearlings @ 110 fpp to UCR staff for Upper subbasin plants.

Friends of the Cowlitz (FOC)
Spring Chinook
Transfer 55,000 ad clipped fish @ 12 fpp to the Wallace Net Pens in November. These fish are counted in our hatchery release numbers.

Grays River Hatchery
Spring Chinook
Transfer 250,000-eyed eggs for SAFE program

Friends of the Cowlitz (FOC)
Type N Coho
Transfer 230,000-eyed eggs for RSI's

Cowlitz Game and Anglers (CGA)
Type N Coho
Transfer 40,000-eyed eggs for RSI's

Kraus Ryderwood Project
Type N Coho
Transfer 1,000 ad clipped sub-yearlings to the Kraus pond.

Salmon in the Classroom
Type N Coho

Mossyrock High School
Transfer 500-eyed eggs

Castle Rock High School
Transfer 500-eyed eggs

Watershed Voyages
Transfer 250-eyed eggs

White Pass High School
Transfer 250-eyed eggs

Winlock High School
Transfer 250-eyed eggs

Biological Monitoring - Current

Lower Cowlitz River - Wild Salmon and Steelhead Populations				
VSP Parameter	Fall Chinook	Winter Steelhead	Coho	Chum
Adult Abundance	• Estimate of total spawners expanded from aerial redd counts • Expansion Factor based on historic mark/recapture work (1970's) and correction factor from fixed wing to helicopter • Spawning ground surveys to recover carcasses	• Index surveys on major Lower Cowlitz tributaries only • Assume all redds are from wild fish based on timing; however, late timed Cowlitz hatchery steelhead have same spawning time as wild stock	• Limited stream surveys in index reaches of Lower Cowlitz tributaries	• Cowlitz Barrier Dam Counts only • No estimate of total abundance
Adult Productivity	• pHOS via CWT expansion* • Currently, no mark selective fisheries in mainstem Columbia* • Harvest estimates from CWT analysis	• LCR Fisheries – wild steelhead release, but stock specific incidental impacts are unknown • No pHOS data	• LCR sport fisheries - Wild coho release • Stock specific incidental fishery impacts are unknown • Sex ratio, pHOS, and age structure from stream surveys in index areas	• Retention prohibited in fisheries, but stock specific incidental impacts are unknown • Limited samples for sex ratio
Juvenile Productivity	• No smolt monitoring • Juvenile fall Chinook tagging (CWT) project via seining	• No smolt monitoring	• No smolt monitoring	• No smolt monitoring
Spatial Diversity	• Aerial redd counts broken by section at landmarks • Exploring capturing GPS locations for redds from the air via helicopter	• GPS locations for individual redds in Lower Cowlitz tributary index areas	• Fish counts by section for coho in index areas only	• No monitoring of spatial structure
Species Diversity	• Age, sex ratios and lengths for cohort structure • Run timing from Cowlitz Barrier Dam • Spawn timing from stream surveys • No genetic sampling	• Spawn timing from stream surveys • Genetic baseline from samples collected in 2005-07, winter STHD have been analyzed • Lower Cowlitz tributary genetic sampling project in 2008-09	• Age, sex ratios and lengths for cohort structure from index areas • Spawn timing from stream surveys • Some LCR baseline DNA samples recently collected, but no annual genetic sampling program, samples have not been analyzed	• Few scales & lengths collected for cohort structure • Run timing from dam counts • Baseline DNA samples collected
*Mass marking of fall Chinook is underway with all LCR Tule fall Chinook (age 2-5) mass marked by the 2011 return. Mass marking programs are already in place for coho and steelhead.				

Upper Cowlitz River (including Tilton and Cispus rivers) - Wild Salmon and Steelhead Populations				
VSP Parameter	Fall Chinook	Spring Chinook	Winter Steelhead	Coho
Adult Abundance	• No fall Chinook are currently transported into the Upper Cowlitz/Cispus • Fall Chinook are currently transported into the Tilton Cowlitz FHMP is being updated • Escapement is assumed to equal the number of fish trapped and hauled into the Tilton	• No spring Chinook are currently transported into the Tilton River • Spring Chinook are currently transported into the Upper Cowlitz/Cispus • Escapement is assumed to equal the number of fish trapped and hauled above Cowlitz Barrier Dam; however, the proportion using Upper Cowlitz and Cispus is unknown	• Escapement is assumed to equal the number of fish trapped and hauled above Cowlitz Barrier Dam; however, the proportion using Upper Cowlitz and Cispus is unknown • Limited spawning ground surveys will begin in 2009 – index areas only	• **Upper Cowlitz/Cispus -** Escapement is assumed to equal the number of fish trapped and hauled above Cowlitz Barrier Dam; however, the proportion using Upper Cowlitz and Cispus is unknown • Limited spawning ground surveys will begin in 2009 – index areas only • **Tilton River** - Escapement is assumed to equal the number of fish trapped and hauled above Cowlitz Barrier Dam and released
Adult Productivity	• Sex ratio from trap; currently, no scale analysis or lengths • pHOS - BWT and no ad-clip indicate Tilton natural production. Other fish transported upstream are of unknown origin until mass marking is complete* • Currently, non-selective fisheries in mainstem Columbia* • Harvest estimates from CWT analysis	• Sex ratio, pHOS from sampling at Cowlitz Barrier Dam • No scale analysis or lengths on wild fish. Available from hatchery broodstock as a surrogate for hatchery fish transported upstream • Selective fisheries in lower Columbia and tributaries with wild fish release • Sport and commercial fishery sampling in mainstem Columbia and major tributaries to assess impacts via CWT Recovery project	• LCR Fisheries – Wild steelhead release, but stock specific incidental impacts are unknown • pHOS from trap and haul counts	• LCR sport fisheries – Wild coho release • Stock specific incidental fishery impacts are unknown • Sex ratio and pHOS at Cowlitz Barrier Dam
Juvenile Productivity	• Smolt monitoring at Mayfield dam with an FGE based on work that was conducted 40 yrs ago • Fall Chinook outmigrants (from Tilton) are given a BWT • Annual genetic sampling to develop % composition fall and spring Chinook. Spring Chinook captured are assumed to be from Upper Cowlitz/Cispus	• Smolt monitoring at Cowlitz Falls dam, which is the aggregate of Upper Cowlitz and Cispus production	• Smolt monitoring at Cowlitz Falls dam, which is the aggregate of Upper Cowlitz and Cispus production.	• **Upper Cowlitz/ Cispus** - Smolt monitoring at Cowlitz Falls dam, which is the aggregate of Upper Cowlitz and Cispus production • Smolt yield is the number transported downstream and released mark groups are used to estimate FGE • **Tilton River** - Smolt monitoring at Mayfield dam
Spatial Diversity	• Spatial distribution is not monitored	• Weekly redd surveys above Muddy Fork on Upper Cowlitz throughout spawning timeframe, assumed to be a census count for this area • Redd surveys on Cispus once or twice per season; covering ~80% of high use area on mainstem • Poor GPS coverage; Counts are partitioned by geographical features (bridges, tributary mouths, etc.) • Poor visibility below Muddy Fork prevents surveys	• Radio telemetry study with USGS to examine adult distribution; report is not finalized • Limited spawning ground surveys will begin in 2009 – index areas only	• **Upper Cowlitz/ Cispus** Radio telemetry study with USGS to examine adult distribution; report is not finalized • Limited spawning ground surveys will begin in 2009 – index areas only • **Tilton River** - Spatial distribution is not monitored

Species Diversity	• No scales or lengths collected from for cohort structure – Lower Cowlitz sampling provides a surrogate • Run timing from trap and haul operation • No genetic sampling of adults	• No scales or lengths collected from wild fish for cohort structure, limited carcass sampling on stream surveys in Upper Cowlitz • Run timing from trap and haul operation • No genetic sampling program	• Scales, origin, & lengths collected for cohort structure • Run timing from trap and haul operation • Baseline DNA samples collected in 2005-07 for aggregate at CSH, samples have been analyzed	• Run timing from trap and haul operations • Some LCR baseline DNA samples recently collected, but no annual genetic sampling program, samples have not been analyzed
*Mass marking of fall Chinook is underway with all LCR Tule fall Chinook (age 2-5) mass marked by the 2011 return. Mass marking programs are already in place for coho and steelhead.				

Biological Monitoring – Improvement Actions Needed

Lower Cowlitz River - Wild Salmon and Steelhead Populations				
VSP Parameter	Fall Chinook	Winter Steelhead	Coho	Chum
Adult Abundance	• Database infrastructure • Develop alternative/ improved methods for abundance estimates; e.g. AUC or mark/recapture • Update expansion factor for aerial redd count expansion • Estimate precision • Conduct power analysis	• Database infrastructure • Develop alternative/ improved methods for abundance estimates • Identify spatial extent of spawning (sample frame) • Develop LCR specific redds/female and sex ratio data • Monitor winter and summer steelhead hatchery escapement • Estimate precision • Conduct power analysis	• Database infrastructure • Develop and implement monitoring plan • Identify spatial extent of spawning (sample frame) • Develop LCR specific redds/female, observer efficiency, and residence time • Monitor hatchery escapement • Conduct power analysis • Estimate precision	• Database infrastructure • Identify spatial extent of spawning (sample frame) • Develop & implement sampling designs to estimate adult abundance • Develop LCR specific observer efficiency and residence time • Estimate precision for current and historical data • Conduct power analysis
Adult Productivity	• Pursue options for selective fisheries • Determine pHOS based on ad-clips as mass marked returns are realized	• Estimate pHOS/gene flow for hatchery winter and summer steelhead • Estimate incidental mortality in LCR mainstem and tributary fisheries	• Estimate incidental mortality in LCR mainstem and tributary fisheries	• Collect otoliths to determine out of basin supplementation program contribution to natural spawning • Estimate incidental mortality in LCR mainstem and tributary fisheries
Juvenile Productivity	• Implement periodic juvenile monitoring program via rotary screw trap	• Implement periodic juvenile monitoring program via rotary screw trap	• Implement periodic juvenile monitoring program via rotary screw trap	• Implement periodic juvenile monitoring program via rotary screw trap
Spatial Diversity	• Collect GPS locations for individual redds on stream surveys • Develop & implement sampling designs to estimate spatial distribution	• Consider alternate sampling designs to the current index/supplemental approach	• Develop & implement sampling designs to estimate spatial distribution	• Develop & implement sampling designs to estimate spatial distribution
Species Diversity	• Develop long-term ESU phenotypic and genetic monitoring and sampling plan	• Methods to collect origin, age, length and sex ratio data • Develop DPS phenotypic and genetic monitoring and sampling plan • When complete, report on Lower Cowlitz genetic study	• Develop ESU phenotypic and genetic monitoring and sampling plan • Analyze archived genetic baseline samples	• Develop ESU phenotypic and genetic monitoring and sampling plan • Analyze archived genetic baseline samples

Monitoring

Upper Cowlitz River (including Tilton and Cispus rivers) - Wild Salmon and Steelhead Populations				
VSP Parameter	Fall Chinook	Spring Chinook	Winter Steelhead	Coho
Adult Abundance	• Database infrastructure	• Database infrastructure • Develop alternate sampling designs to partition Cispus & Upper Cowlitz components (radio tags) and address fallback • Identify spatial extent of spawning (sample frame) • Estimate precision • Conduct power analysis	• Database infrastructure • Develop alternate sampling designs to partition Cispus & Upper Cowlitz components (radio tags) and address fallback • Identify spatial extent of spawning (sample frame) • Estimate precision • Conduct power analysis	• Database infrastructure • Develop alternate sampling designs to partition Cispus & Upper Cowlitz components (radio tags) and address fallback • Identify spatial extent of spawning (sample frame) • Estimate precision • Conduct power analysis
Adult Productivity	• Pursue options for selective fisheries • Determine pHOS based on ad-clips as mass marked returns are realized	• Implement scale and length sampling at Cowlitz Barrier Dam	• Estimate incidental mortality in LCR mainstem and tributary fisheries	• Estimate incidental mortality in LCR mainstem and tributary fisheries
Juvenile Productivity	• Develop monitoring program if FHMP update identifies spring Chinook transportation to Tilton or fall Chinook transportation to Upper Cowlitz/Cispus • Update estimates of FGE	• Smolt yield is the number transported downstream and released mark groups are used to estimate FGE • Review FGE study design • Examine approaches to differentiate aggregate including genetic analysis or use of screw trap	• Smolt yield is the number transported downstream and released mark groups are used to estimate FGE • Review FGE study design • Examine approaches to differentiate aggregate including genetic analysis or use of screw trap	• **Upper Cowlitz/ Cispus** - • Review FGE study design • Examine approaches to differentiate aggregate including genetic analysis or use of screw trap • **Tilton River -** Update estimates of FGE
Spatial Diversity	• Develop & implement sampling designs to estimate spatial distribution	• Develop spatial distribution study design that includes parr distribution or radio tags • Explore improved GPS capability for mapping redds (i.e. external antennas, Trimble Units)	• Develop spatial distribution study design • Complete data analysis and report for radio telemetry study	• Develop spatial distribution study design • Complete data analysis and report for radio telemetry study
Species Diversity	• Collect scales and lengths from fish at Cowlitz Barrier Dam • Develop long-term ESU phenotypic and genetic monitoring and sampling plan	• Develop ESU phenotypic and genetic monitoring and sampling plan	• Develop DPS phenotypic and genetic monitoring and sampling plan	• Develop ESU phenotypic and genetic monitoring and sampling plan • Analyze archived genetic baseline samples

Monitoring

Hatchery Monitoring – Current

In-Facility	Performance Measures
• In-season management of adult salmonid returns, broodstock collection and spawning protocols • Enumeration of hatchery origin and natural origin returns to hatchery collection facilities and final disposition of each • For integrated programs – enumeration of the number of hatchery and natural origin fish used in the broodstock for each species to calculate pNOB • Hatchery return timing, age composition (from scales), stock composition (CWT analysis), sex ratio and length data for run reconstruction and forecasting • Survival to each life history stage during incubation and rearing (Green egg, Eyed egg, Fry, Parr, Smolt) • Growth/feed conversions and condition • Monthly fish health monitoring • ELISA testing of spring Chinook for levels of Bacterial Kidney Disease • Number of smolt released- size and condition factor at release • Water quality - regulated by Washington Department of Ecology - weekly and/or monthly samples to ensure facility compliance	• All hatchery origin adults are identifiable - juveniles are marked pre-release by one or more of the following: adipose fin-clip, CWT in snout, BWT in snout • Harvest rates – contribution to commercial and sport fisheries • Hatchery smolt to adult survival rates **Lower Cowlitz** • pHOS for fall Chinook via CWT expansion • pHOS for coho in tributary index areas **Upper Cowlitz/Cispus/Tilton** • pHOS for fall Chinook in Tilton River based on BWT and CWT analysis • pHOS for spring Chinook, steelhead and coho from Cowlitz Barrier Dam counts and trap/haul program

Monitoring

Hatchery Monitoring – Improvement Actions Needed

In-Facility	Performance Measures
• Development of updated Hatchery and Genetic Management Plans (HGMP) for each hatchery program consistent with implementation of the Conservation and Sustainable Fisheries plan and incorporate HSRG standards • Development of natural origin run and/or spawn timing curves to guide collection of natural origin broodstock for integrated programs • Review and update spawning protocols and incubation, rearing & release strategies	• Estimate pHOS for fall Chinook based on visual identification of hatchery origin fish (i.e. adipose fin-clips) rather than CWT expansion, as mass marked returns of fall Chinook are realized • Development and implementation of methods to better estimate pHOS for coho in the Lower Cowlitz • Development and implementation of methods to estimate pHOS and/or gene flow for hatchery winter and summer steelhead in the Lower Cowlitz • Collect otolith samples from chum carcasses to estimate contribution (stray rate) from LCR supplementation programs • Calculation of pNOB, pHOS and PNI statistics annually for each hatchery program and development of a reporting format to track hatchery performance measures • Develop a regional monitoring plan for genetic and ecological interactions by hatchery-and natural-origin juveniles to assess impacts to the natural origin population • As additional data is collected and new methodologies become available, modify programs to achieve goals for PNI, pHOS and pNOB • Develop nutrient enhancement goals for watershed and include in updated escapement goals

Implementation Schedule

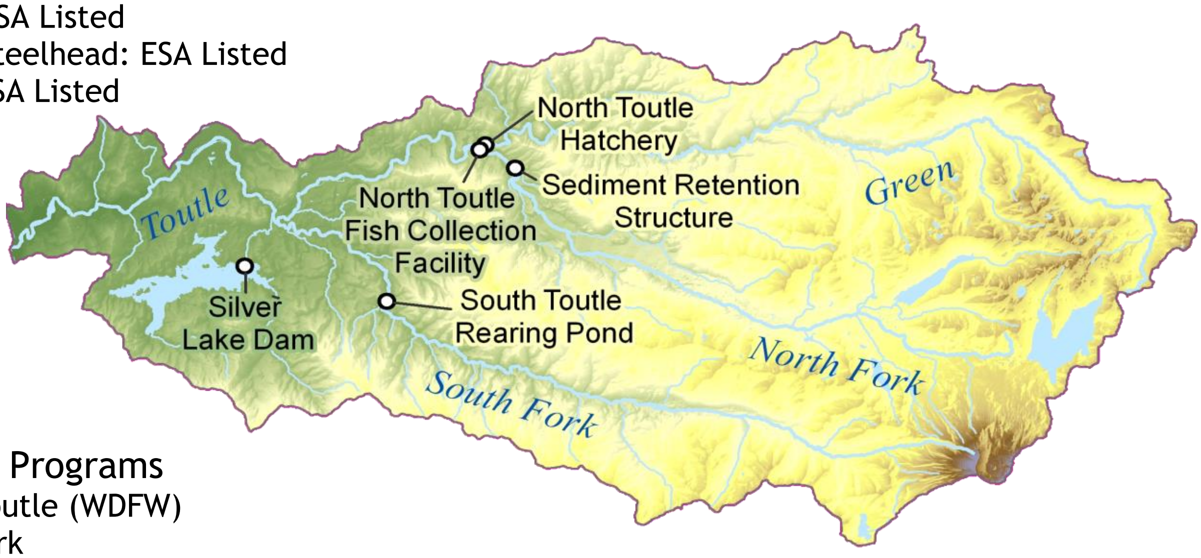
Preliminary Cowlitz Subbasin hatchery action implementation plan. Actions and schedule will be reviewed, evaluated, and updated annually.

Year	Facility	Action	Fund Source	Cost
2008-2010	Cowlitz Salmon Hatchery	**Facility Improvement**: Total Hatchery Rebuild and upgrade of Facility.	Tacoma Power	+/- $25 mil.
2010	Cowlitz Trout Hatchery	**Environmental Compliance**: Blue Creek flooding and/or potential emergence with hatchery discharge ditch	Tacoma Power	$250,000
2011	Cowlitz Trout Hatchery	**Facility Improvement**: Predator abatement on the rearing lakes by adding netting and/or hazing	Tacoma Power	$750,000
2012	Cowlitz Trout Hatchery	**Facility Improvement**: Bird netting on concrete raceways	Tacoma Power	$1.0 mil.
2012	Cowlitz Trout Hatchery	**Facility Maintenance:** Ozone plant renovation (plumbing, generators, stones, etc.)	Tacoma Power	$2.0 mil.
2013	Cowlitz Trout Hatchery	**Environmental Compliance:** Resizing the screen mesh on the intake screens	Tacoma Power	TBD
2013	Cowlitz Trout Hatchery	**Facility Maintenance:** Reconditioning concrete raceways (leak, cracks, etc.)	Tacoma Power	$3.0 mil.
2015	Cowlitz Trout Hatchery	**Facility Improvement:** Increase/sustain south well (incubation/early rearing) supply	Tacoma Power	TBD
2015	Cowlitz Trout Hatchery	**Facility Improvement**: Install an isolated ozone plant supply line to conserve ground water supply	Tacoma Power	$1.0 mil.

Toutle Subbasin (NF, SF and Green)

Wild Salmon & Steelhead

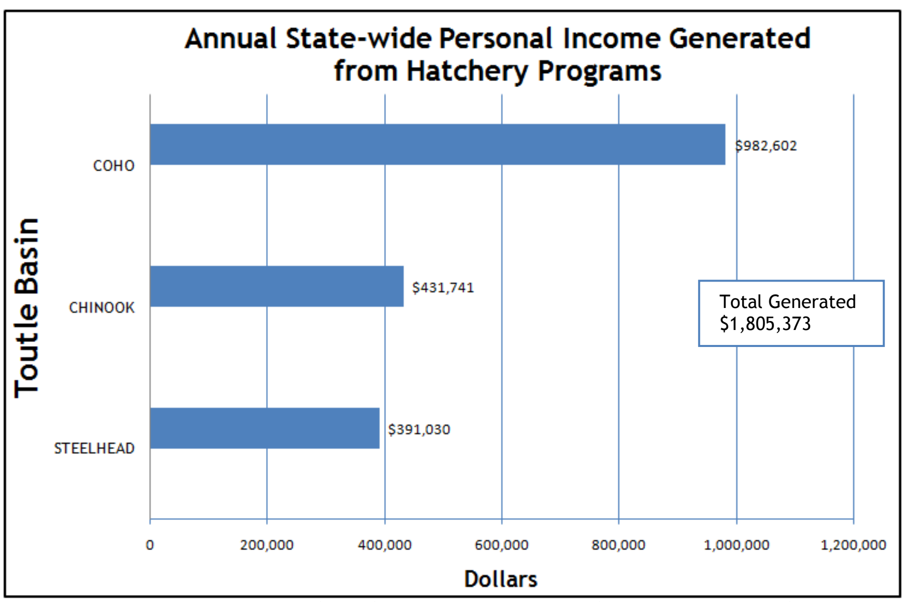
Fall Chinook: ESA Listed
Spring Chinook: ESA Listed
Coho: ESA Listed
Winter Steelhead: ESA Listed
Chum: ESA Listed



Hatchery Programs

North Toutle (WDFW)
South Fork
Toutle Ponds (Cowlitz Game & Anglers)

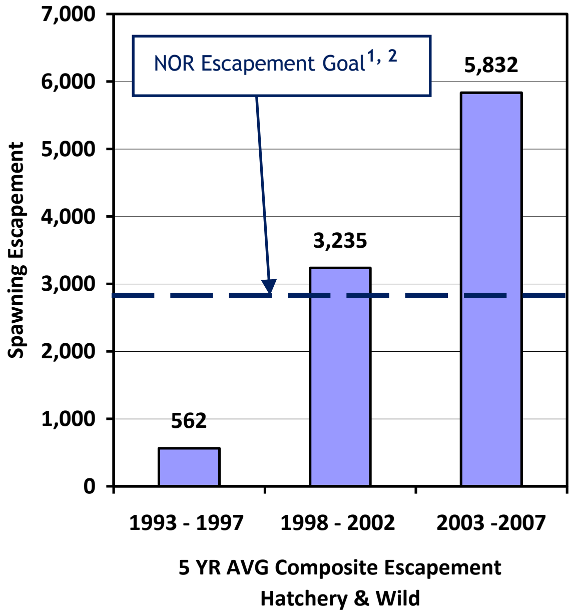
Wild Salmon & Steelhead
Fall Chinook: ESA Listed
Spring Chinook: ESA Listed



Source: Wegge, T. 2009 (June) Technical Memo. Economic Analysis of WDFW Hatchery Programs

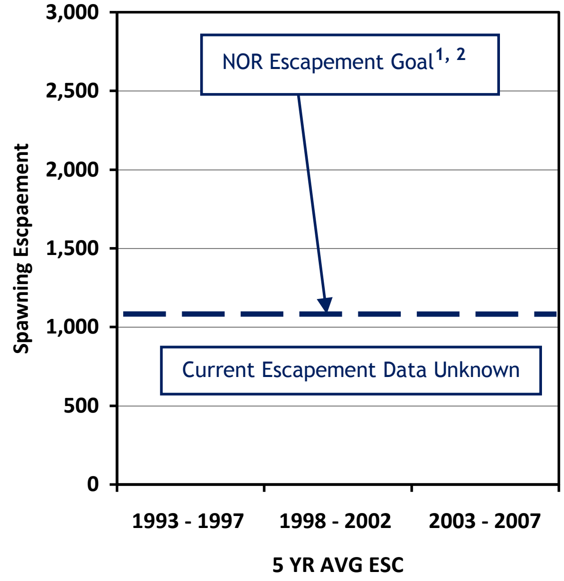
Fall Chinook

ESA Listing Status: Threatened
Populations: Toutle (Primary)



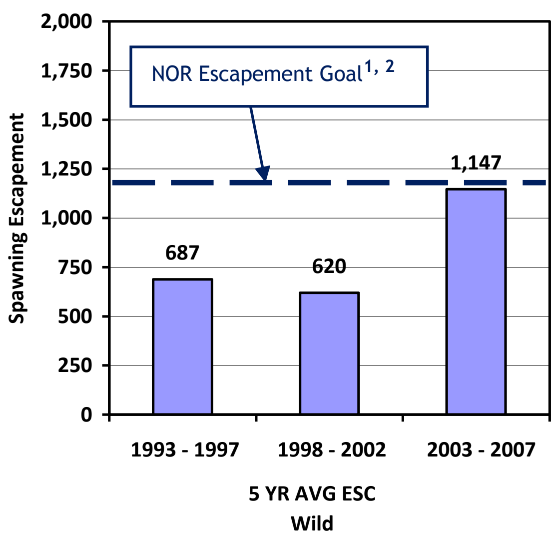
Spring Chinook

ESA Listing Status: Threatened
Populations: Toutle (Contributing)



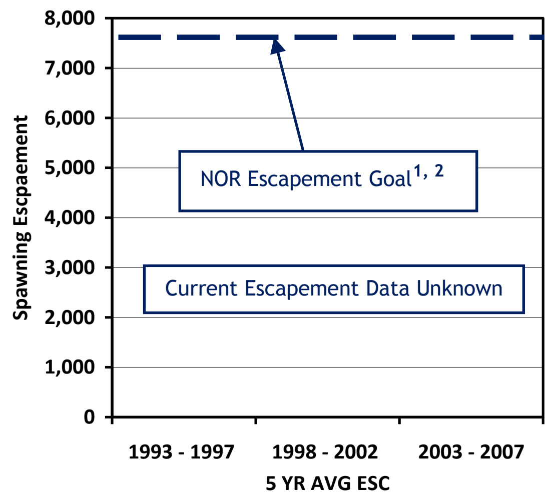
Winter Steelhead

ESA Listing Status: Threatened
Populations: Toutle (Primary)



Coho

ESA Listing Status: Threatened
Populations: Toutle (Primary)

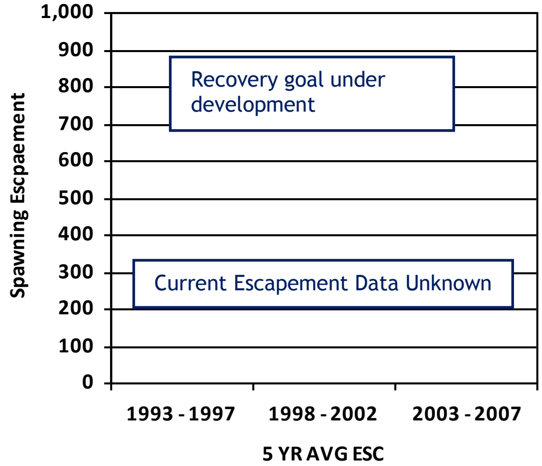


[1] Number of natural origin spawners necessary to achieve population viability standards established by NOAA's TRT.

[2] Washington LCFRB Proposed Scenario Revisions (6/16/09 Draft).

Chum

ESA Listing Status: Threatened
Populations: Toutle (Contributing)
Component of Cowlitz Population



[1] Number of natural origin spawners necessary to achieve population viability standards established by NOAA's TRT.

[2]Washington LCFRB Proposed Scenario Revisions (6/16/09 Draft).

North Toutle (WDFW)

Salmon and Steelhead Programs

Fall Chinook
Purpose: Harvest/Conservation
Goal: Currently under development[1]
Broodstock Strategy: Integrated
Program Size: 1,400,000 sub-yearlings (C&SFP)

Type S Coho
Purpose: Harvest/Conservation
Goal: Currently under development[1]
Broodstock Strategy: Integrated
Program Size: 150,000 yearlings (C&SFP)

NF Summer Steelhead[2]
Purpose: Harvest
Goal: Currently under development[1]
Broodstock Strategy: Segregated
Program Size: 25,000 yearlings (C&SFP)

SF Summer Steelhead[3]
Purpose: Harvest
Goal: Currently under development[1]
Broodstock Strategy: Segregated
Program Size: 15,000 yearlings (C&SFP)

[1]Program specific goals are under development through completion of broodstock Management Plans. Overall production levels for Lower Columbia River have been evaluated through Conservation and Sustainable Fisheries Plan.

[2]Shipped from Skamania Hatchery, acclimated and released from North Toutle Hatchery

[3]Shipped from Skamania Hatchery, acclimated and released from Cowlitz Game & Anglers pond on SF Toutle.

Broodstock Management

Fall Chinook
Short-term Benchmark: PNI > 0.5
Long-term Goal: PNI > 0.67
Action Plan: Continue integrated program consistent with a Primary population.

Type S Coho
Short-term Benchmark: PNI > 0.5
Long-term Goal: PNI > 0.67
Action Plan: Continue integrated program consistent with a Primary population.

NF & SF Summer Steelhead
Short-term Benchmark: Gene Flow <2%
Long-term Goal: Gene Flow <2%
Action Plan: Continue actions described in C&SFP. Install temporary weir at hatchery intake to increase harvest rate (C&SFP).

Hatcheries Broodstock Management

Fall Chinook
Short-term Benchmark: PNI > 0.5
Long-term Goal: PNI > 0.67
Action Plan: Continue integrated program consistent with a Primary population.

Type S Coho
Short-term Benchmark: PNI > 0.5
Long-term Goal: PNI > 0.67
Action Plan: Continue integrated program
consistent with a Primary population.

Hatcheries

North Toutle (WDFW)

Environmental Compliance

Cleanwater Act
Action Plan: Compliant, no action necessary

Passage
Action Plan: Compliant, no action necessary

Intake Screening
Action Plan: Bring intake into compliance
Renovate/replace screens
Cost & Schedule: $ 250,000 Design Only (2010)

Water Withdrawal
Compliant with water rights formalized thru trust water right #S2-24831CWRIS
Use : 20.00 CFS
Monthly NPDES reporting to Dept of Ecology

Capital Needs

Incubation
Action Plan: Replace incubation water source and facilities.
Cost & schedule: TBD 2012

Rearing
Action Plan: Replace raceways and related pipes.
Cost & schedule: TBD 2015

Adult Processing
Action Plan: Improve weir and adult handling facilities.
Cost & Schedule: TBD 2017

Other
Action Plan: Miscellaneous facility
Cost & Schedule: TBD 2020

Monitoring

Biological Monitoring – Current

Wild Salmon and Steelhead Populations					
VSP Parameter	Fall Chinook	Spring Chinook	Winter Steelhead	Coho	Chum
Adult Abundance	• Estimate of total spawners via peak count expansion for Green and SF Toutle rivers • Hatchery counts at North Toutle Hatchery on the Green River • NF Toutle Collection Facility (TCF) - total count; however rarely encounter fall Chinook • No other monitoring on NF/mainstem Toutle - high turbidity prevents surveying • Assumed to be limited successful spawning in NF Toutle/mainstem due to high sediment loads	• No monitoring for spring Chinook • Spring Chinook in Toutle are believed to be extirpated	**NF & Mainstem Toutle** (including Green River) • Estimate of total spawners via redd count expansion for Green River • NF Toutle Collection Facility (TCF) - total count of steelhead passed upstream • No other surveys on NF or mainstem due to turbidity **SF Toutle** • Estimate of total spawners via redd count expansion	**NF & Mainstem Toutle** (including Green River) • NF Toutle Collection Facility (TCF) - total count of coho passed upstream • Hatchery counts at North Toutle Hatchery on the Green River • No monitoring in mainstem & lower NF Toutle and tributaries **SF Toutle** • No directed monitoring • Ancillary spawner count during fall Chinook surveys in index areas only	• Component of the Cowlitz chum population • 1999-2006 occasional presence/ absence surveys only • No current monitoring
Adult Productivity	• pHOS via CWT expansion* • Currently, no mark selective fisheries in mainstem Columbia* • Harvest estimates from CWT analysis	• No monitoring	• LCR Fisheries - Wild steelhead release, but stock specific incidental impacts are unknown **NF & Mainstem Toutle** (including Green River) • Sex ratio, pHOS and age data from TCF **SF Toutle** • No sex ratio, pHOS or age data	• LCR sport fisheries - Wild coho release • Stock specific incidental fishery impacts are unknown **NF & Mainstem Toutle** (including Green River) • Sex ratio, pHOS and age data from TCF **SF Toutle** • No pHOS data	• Retention prohibited in fisheries, but stock specific incidental impacts are unknown • No samples for age, sex ratio, & origin
Juvenile Productivity	• No smolt monitoring	• No monitoring	• No smolt monitoring	• No smolt monitoring	• No smolt monitoring
Spatial Diversity	• Redd counts by spawning reach during stream surveys	• No monitoring	• GPS locations for individual redds in surveyed areas of the Green and SF Toutle rivers	• No monitoring program in place	• No current monitoring
Species Diversity	• Age, sex ratios and lengths for cohort structure from North Toutle hatchery and stream surveys • Run timing from North Toutle hatchery counts • Spawn timing from stream surveys • No genetic sampling	• No monitoring	**NF & Mainstem Toutle** (including Green River) • Age, sex ratios and lengths for cohort structure from TCF • Run-timing at TCF • Spawn timing from redd surveys on Green • Annual collection of DNA samples at TCF since early 2000s, samples have been analyzed **SF Toutle** • Spawn timing from stream surveys • Genetic baseline from samples collected in 2005-07, samples have	**NF & Mainstem Toutle** (including Green River) • Age, sex ratios and lengths for cohort structure from TCF • Run-timing at TCF • Annual collection of DNA samples at TCF since early 2000s, samples have not been analyzed **SF Toutle** • No monitoring program in place • Some genetic samples are archived	• No data

			been analyzed		

*Mass marking of fall Chinook is underway with all LCR Tule fall Chinook (age 2-5) mass marked by the 2011 return. Mass marking programs are already in place for coho and steelhead.

Biological Monitoring – Improvement Actions Needed

Wild Salmon and Steelhead Populations					
VSP Parameter	Fall Chinook	Spring Chinook	Winter Steelhead	Coho	Chum
Adult Abundance	• Database infrastructure • Develop LCR specific observer efficiency and residence time needed for Chinook AUC abundance estimates • Identify spatial extent of spawning (sample frame) • Estimate precision • Conduct power analysis	• N/A	• Database infrastructure • Develop alternative/ improved methods for abundance estimates in SF Toutle and Green rivers • Develop monitoring program for mainstem Toutle (DIDSON) • Identify spatial extent of spawning (sample frame) • Develop LCR specific redds/female and sex ratio data • Monitor hatchery escapement for winter and summer steelhead planted in the subbasin • Estimate precision • Conduct power analysis	• Database infrastructure • Develop and implement monitoring plan • Identify spatial extent of spawning (sample frame) • Develop LCR specific redds/female, observer efficiency, and residence time • Monitor hatchery escapement • Estimate precision Conduct power analysis	• Database infrastructure • Identify spatial extent of spawning (sample frame) • Develop & implement sampling designs to estimate adult abundance • Develop LCR specific observer efficiency and residence time • Estimate precision for current and historical data Conduct power analysis
Adult Productivity	• Pursue options for mark selective fisheries • Determine pHOS based on ad-clips as mass marked returns are realized	• N/A	• Estimate pHOS/gene flow for Green and SF Toutle rivers • Estimate incidental mortality in LCR mainstem and tributary fisheries	• Estimate incidental mortality in LCR mainstem and tributary fisheries	• Determine LCR supplementation program contributions to natural spawning • Estimate incidental mortality in LCR mainstem and tributary fisheries
Juvenile Productivity	• Implement periodic juvenile monitoring program via rotary screw trap	• N/A	• Implement periodic juvenile monitoring program via rotary screw trap	• Implement periodic juvenile monitoring program via rotary screw trap	• Implement periodic juvenile monitoring program via rotary screw trap
Spatial Diversity	• Collect GPS locations for individual redds on stream surveys • Develop & implement sampling designs to estimate spatial distribution	• N/A	• Consider alternate sampling designs to the current index/supplemental approach for SF Toutle and Green rivers • Develop sampling approach for NF and mainstem Toutle	• Develop & implement sampling design	• Develop & implement sampling designs to estimate spatial distribution
Species Diversity	• Develop long-term ESU phenotypic and genetic monitoring and sampling plan	• N/A	• Develop DPS phenotypic and genetic monitoring and sampling plan	• Develop ESU phenotypic and genetic monitoring and sampling plan • Analyze archived genetic baseline samples	• Develop ESU phenotypic and genetic monitoring and sampling plan

Monitoring

Hatchery Monitoring - Current

In-Facility	Performance Measures
• In-season management of adult salmonid returns, broodstock collection and spawning protocols • Enumeration of hatchery origin and natural origin returns to hatchery collection facilities and final disposition of each • For integrated programs – enumeration of the number of hatchery and natural origin fish used in the broodstock for each species to calculate pNOB • Hatchery return timing, age composition (from scales), stock composition (CWT analysis), sex ratio and length data for run reconstruction and forecasting • Survival to each life history stage during incubation and rearing (Green egg, Eyed egg, Fry, Parr, Smolt) • Growth/feed conversions and condition • Monthly fish health monitoring • Number of smolt released- size and condition factor at release • Water quality - regulated by Washington Department of Ecology - weekly and/or monthly samples to ensure facility compliance	• All hatchery origin adults are identifiable - juveniles are marked pre-release by one or both of the following: adipose fin-clip, CWT in snout • Harvest rates – contribution to commercial and sport fisheries. • Hatchery smolt to adult survival rates • pHOS for fall Chinook via CWT expansion on SF Toutle and Green rivers • pHOS for coho and steelhead at the TCF on the NF Toutle

Monitoring

Hatchery Monitoring – Improvement Actions Needed

In-Facility	Performance Measures
• Development of updated Hatchery and Genetic Management Plans (HGMP) for each hatchery program consistent with implementation of the Conservation and Sustainable Fisheries plan and incorporate HSRG standards • Development of natural origin run and/or spawn timing curves to guide collection of natural origin broodstock for integrated programs • Review and update spawning protocols and incubation, rearing & release strategies	• Estimate pHOS for fall Chinook based on visual identification of hatchery origin fish (i.e. adipose fin-clips) rather than CWT expansion, as mass marked returns of fall Chinook are realized • Development and implementation of methods to estimate pHOS for coho in all areas other than NF Toutle (TCF) • Development and implementation of methods to estimate pHOS and/or gene flow for hatchery winter and summer steelhead • Calculation of pNOB, pHOS and PNI statistics annually for each hatchery program and development of a reporting format to track hatchery performance measures • Develop a regional monitoring plan for genetic and ecological interactions by hatchery-and natural-origin juveniles to assess impacts to the natural origin population • As additional data is collected and new methodologies become available, modify programs to achieve goals for PNI, pHOS and pNOB • Develop nutrient enhancement goals for watershed and include in updated escapement goals

Implementation Schedule

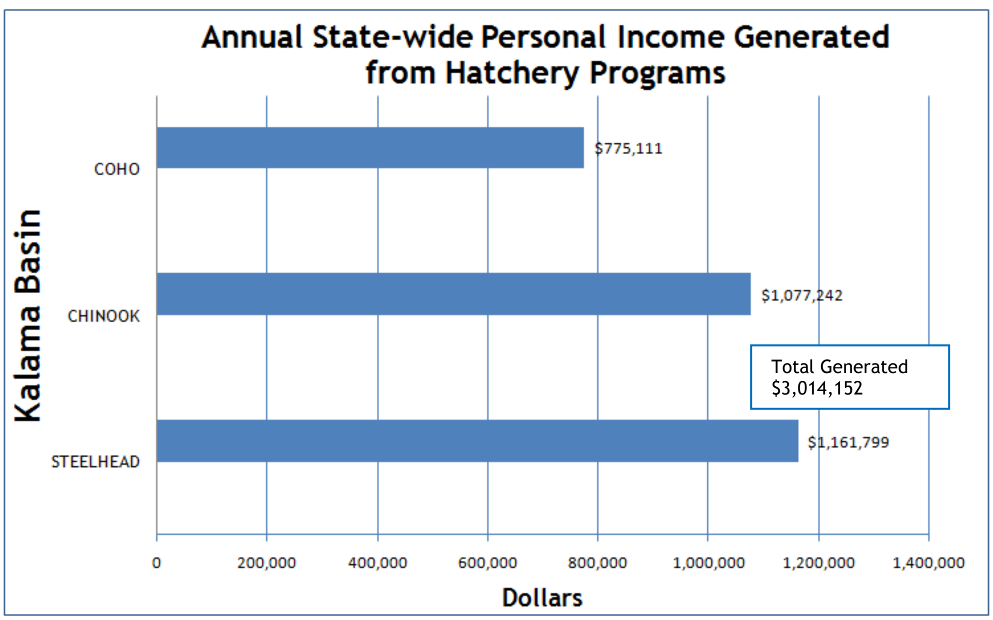
Preliminary Toutle Subbasin hatchery action implementation plan. Actions and schedule will be reviewed, evaluated, and updated annually.

Year	Facility	Action	Fund Source	Cost
2010	North Toutle Hatchery	**Environmental Compliance**: Replace intake.	Federal	Design Only $250,000
2011	North Toutle Hatchery	**Facility Improvement:** Install weir capable of operating during high water events.	Federal	$170,038
2012	North Toutle Hatchery (FCF)	**Facility Maintenance:** Improve trapping efficiency and staffing at Fish Collection Facility.	Federal	TBD
2012	North Toutle Hatchery	**Environmental Compliance**: Replace intake.	Federal	TBD
2012	North Toutle Hatchery	**Facility Maintenance:** Replace main pipeline and raceway headers	Federal	TBD
2014	North Toutle Hatchery	**Facility Maintenance:** Repair leaking concrete raceways.	Federal	TBD
2016	North Toutle Hatchery	**Facility Improvement:** Repair and update incubation facilities.	Federal	TBD
2016	North Toutle Hatchery	**Facility Improvement:** Install well water for incubation.	Federal	TBD
2016	North Toutle Hatchery (FCF)	**Facility Improvement:** Repair Residence at FCF.	Federal	TBD
2017	North Toutle Hatchery	**Facility Improvement:** Build automated adult handling facilities.	Federal	TBD
2020	North Toutle Hatchery	**Facility Improvement**: Build 2 onsite houses.	Federal	TBD
2021	North Toutle Hatchery	**Facility Improvement**: Build bridge over Green River for public access and staff safety.	Federal	TBD
2029	North Toutle Hatchery	**Broodstock Management**: Maintain wild broodstock collection for Chinook and coho programs.	Federal	TBD
2025	North Toutle Hatchery	**Facility Maintenance**: Miscellaneous.	Federal	TBD
2025	North Toutle Hatchery (FCF)	**Facility Maintenance**: Miscellaneous.	Federal	TBD

Kalama Subbasin

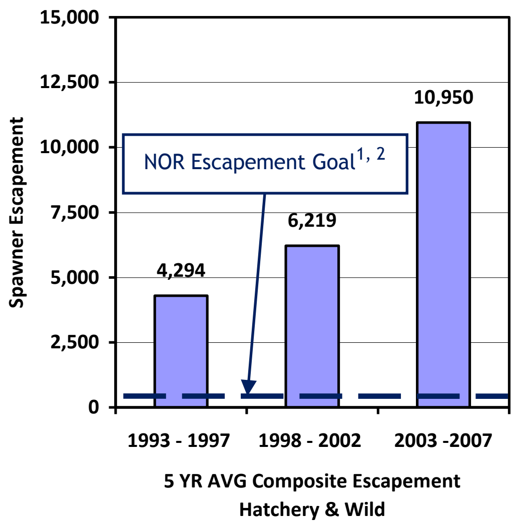
Wild Salmon & Steelhead

Fall Chinook: ESA Listed
Spring Chinook: ESA Listed
Winter Steelhead: ESA Listed
Summer Steelhead: ESA Listed

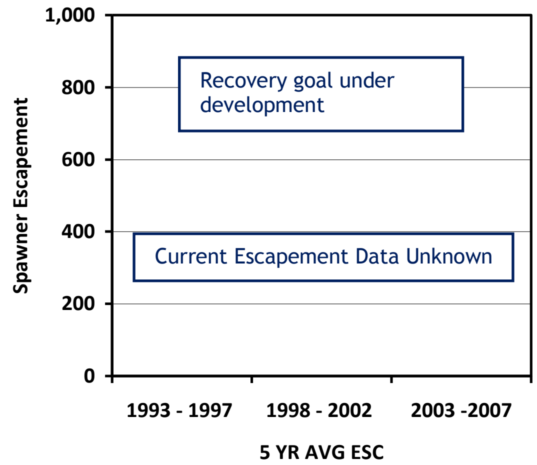


Source: Wegge, T. 2009 (June) Technical Memo. Economic Analysis of WDFW Hatchery Programs

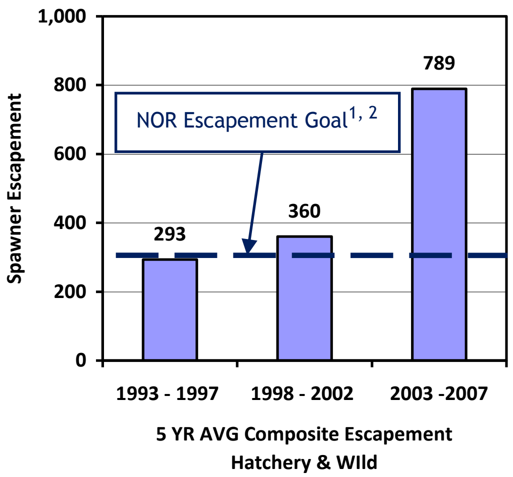
Fall Chinook
ESA Listing Status: Threatened
Populations: Kalama (Contributing)



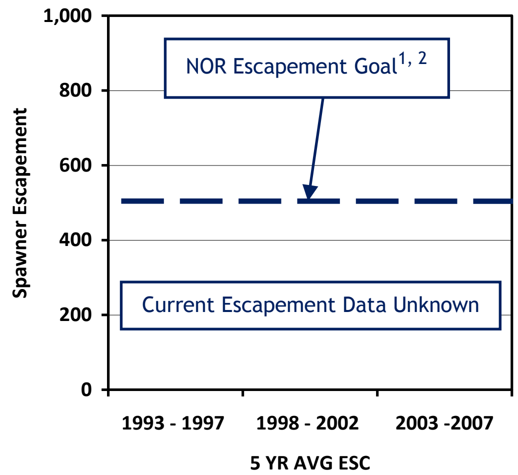
Chum
ESA Listing Status: Threatened
Populations: Kalama (Contributing)



Spring Chinook
ESA Listing Status: Threatened
Populations: Kalama (Contributing)



Coho
ESA Listing Status: Threatened
Populations: Kalama (Contributing)

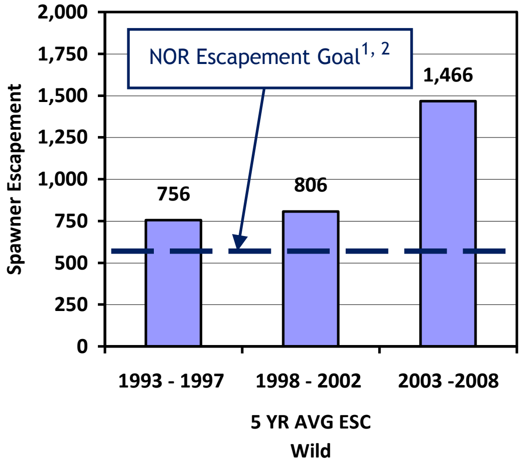


[1]Number of natural origin spawners necessary to achieve population viability standards established by NOAA's TRT.

[2]Washington LCFRB Proposed Scenario Revisions (6/16/09 Draft).

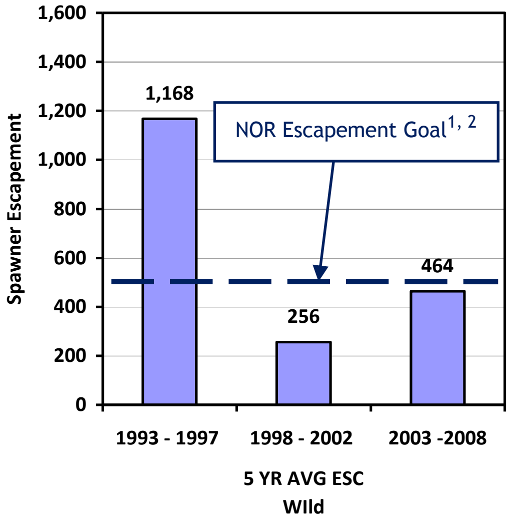
Winter Steelhead

ESA Listing Status: Threatened
Populations: Kalama (Primary)



Summer Steelhead

ESA Listing Status: Threatened
Populations: Kalama (Primary)



[1]Number of natural origin spawners necessary to achieve population viability standards established by NOAA's TRT.

[2]Washington LCFRB Proposed Scenario Revisions (6/16/09 Draft).

Kalama Falls Hatchery (WDFW)

Salmon and Steelhead Programs

Fall Chinook
Purpose: Harvest/Conservation
Goal: Currently under development[1]
Broodstock Strategy: Integrated
Program Size: 3,500,000 sub-yearlings (C&SFP), Additional 250 eyed eggs to Salmon in the Classroom project.

Spring Chinook[2]
Purpose: Harvest/Conservation
Goal: Currently under development[1]
Broodstock Strategy: Integrated
Program Size: 375,000 yearlings reared at Kalama, acclimated and released from Gobar pond

Summer Steelhead[2]
Purpose: Harvest, Conservation
Goal: Currently under development[1]
Broodstock Strategy: Integrated (100% wild brood)
Program Size: 60,000 yearlings, additional 10,000 eyed eggs transferred to Fish First's Indian Creek project.

Early Winter Steelhead
Purpose: Harvest
Goal: Currently under development[1]
Broodstock Strategy: Segregated
Program Size: 45,000

Type N Coho
Purpose: Harvest, Conservation
Goal: Currently under development[2]
Broodstock Strategy: Integrated
Program Size: 600,000 yearlings (C&SFP)

[1] Program specific goals are under development through completion of broodstock Management Plans. Overall production levels for Lower Columbia River have been evaluated through Conservation and Sustainable Fisheries Plan.

[2]These fish are acclimated and released from Gobar pond into Gobar creek a tributary to the Kalama River about 6 RM above Kalama Falls Hatchery.

Broodstock Management

Fall Chinook
Short-term Benchmark: PNI > 0.24
Long-term Goal: PNI > 0.50
Action Plan: Continue integrated program consistent with a Contributing population.

Spring Chinook
Short-term Benchmark: PNI > 0.40
Long-term Goal: PNI > 0.50
Action Plan: Continue integrated program consistent with a Contributing population.

Summer Steelhead
Short-term Benchmark: PNI >0.67
Long-term Goal: PNI >0.67
Action Plan: Reduce the proportion of hatchery fish passed upstream and continue integrated program (100% wild brood) consistent with Primary population.

Early Winter Steelhead
Short-term Benchmark: Gene Flow <2%
Long-term Goal: Gene Flow <2%
Action Plan: Continue with program as is (exclude from Upper River).

Type N Coho
Short-term Benchmark: PNI >0.11
Long-term Goal: PNI >0.50
Action Plan: Continue integrated program consistent with a Contributing population.

Broodstock Management

Fall Chinook

Hatcheries

Kalama Falls Hatchery (WDFW)

Environmental Compliance

Clean Water Act -
Action Plan: Compliant, no action necessary- Facility

Passage
Action Plan: See adult processing
Cost: $ TBD

Intake Screening
Action Plan: Compliant, no action necessary –
Cost & Schedule:

Water Withdrawal
Compliant with water rights formalized thru trust water right # S2-*18989CWRIS (Creek @ 3cfs)
S2-*18990CWRIS (Creek @ 2cfs)
S2- CCVOL1-2P641 (Kalama River @ 26cfs)
Monthly NPDES reporting to Dept. of Ecology

Environmental Compliance

Clean Water Act

Facility Condition

Incubation
Action Plan: Renovate incubation Heath trays. Improvements to pathogen free water supplies.
Cost & Schedule: TBD - 2012

Rearing
Action Plan: Adult holding/ponds need to be replaced or rebuilt. Bottoms are on the verge of collapse due to undermining. Also need a new pond(s) built to help facilitate added production.
Cost & Schedule: TBD – 2011-2013

Adult Processing
Action Plan: Improve staff safety and handling of ESA listed fish by improving adult collection, holding and sorting facility.
Cost & Schedule: TBD – 2011-2013

Other
Action Plan: Yearly intake pump gallery cleaning, and Misc. facility improvements
Cost & Schedule: $30,000 - 2009

Joint Programs (WDFW w/ Public)

Summer Steelhead
10,000 eyed eggs to Fish First RSI on Indian Creek

Fall Chinook
250 eyed eggs to Region 5 Educational COOPS-Bob Lucas

Hatcheries

Fallert Creek Hatchery (WDFW)

Salmon and Steelhead Programs

Fall Chinook
Purpose: Harvest/Conservation
Goal: Currently under development[1]
Broodstock Strategy: Integrated
Program Size: 3,500,000 sub-yearlings (C&SFP)

Spring Chinook
Purpose: Harvest/Conservation
Goal: Currently under development[1]
Broodstock Strategy: Integrated
Program Size: 125,000 yearlings

Late Winter Steelhead[2]
Purpose: Harvest/Conservation
Goal: Currently under development[1]
Broodstock Strategy: Integrated (100% wild brood)
Program Size: 45,000 yearlings reared at Fallert, acclimated and released from Gobar pond

Summer Steelhead
Purpose: Harvest
Goal: Currently under development[1]
Broodstock Strategy: Segregated
Program Size: 30,000 yearlings transferred in from Skamania Hatchery

Type S Coho
Purpose: Harvest, Conservation
Goal: Currently under development[1]
Broodstock Strategy: Integrated
Program Size: 100,000 yearlings (C&SFP)

[1]Program specific goals are under development through completion of broodstock Management Plans. Overall production levels for Lower Columbia River have been evaluated through Conservation and Sustainable Fisheries Plan.

[2] These fish are acclimated and released from Gobar pond into Gobar creek, a tributary to the Kalama River about 6 RM above Kalama Falls Hatchery.

Broodstock Management

Fall Chinook
Short-term Benchmark: PNI >0.24
Long-term Goal: PNI >0.50
Action Plan: Continue integrated program consistent with a contributing population.

Spring Chinook
Short-term Benchmark: PNI >0.40
Long-term Goal: PNI >0.50
Action Plan: Continue integrated program consistent with a contributing population.

Late Winter Steelhead
Short-term Benchmark: PNI >0.67
Long-term Goal: PNI >0.67
Action Plan: Continue integrated Program (100% wild brood) consistent with Primary population.

Summer Steelhead
Short-term Benchmark: Gene Flow <2%
Long-term Goal: Gene Flow <2%
Action Plan: Continue with program as is (exclude from Upper River)

Type S Coho
Short-term Benchmark: PNI >0.11
Long-term Goal: PNI >0.50
Action Plan: Continue integrated program consistent with a contributing population.

Hatcheries

Environmental Compliance

Clean Water Act
Action Plan: Install pollution abatement pond
Cost: $1,500,000 (2011-2013)

Passage
Action Plan: Compliant, no action necessary
Cost:

Intake Screening
Action Plan: Renovate both Kalama River and Hatchery Cr. Intakes/screens, (non compliant)
Cost & Schedule: $250,000 (design only) – 2010

Water Withdrawal
Compliant with water rights formalized thru trust water right # S2-049176CL (Hatchery-Fallert Creek @ 2cfs)
S2-21710AWRIS (Kalama River @ 8.67cfs)
Monthly NPDES reporting to Dept. of Ecology

Environmental Compliance

Facility Condition

Incubation
Action Plan: Renovate entire incubation facility
Cost & Schedule: TBD - 2012

Rearing
Action Plan: Renovate rearing ponds
Cost & Schedule: TBD - 2011

Adult Processing
Action Plan: Renovate adult/holding spawning facility
Cost & Schedule: TBD - 2012

Other
Action Plan: See intake screening
Cost & Schedule: TBD - 2011

Monitoring**Facility Condition**

Incubation
Action Plan: Renovate entire incubation facility

Biological Monitoring – Current

Wild Salmon and Steelhead Populations						
VSP Parameter	Fall Chinook	Spring Chinook	Winter Steelhead	Summer Steelhead	Coho	Chum
Adult Abundance	• Estimate of total spawners via peak count expansion • Hatchery counts at KFH • Counts at Lower Kalama River weir/trap (Modrow Rd.) • No fall Chinook are passed above KFH	• Estimate of total spawners via peak count expansion • Counts at KFH for fish passed upstream	• Estimate of total spawners - total count above KFH & redd count expansion below KFH (mix of NOR and HOR from wild broodstock)	• Estimate of total spawners via mark-resight (snorkeling) above KFH • No estimate below KFH, usage of this area is assumed to be minimal	• No directed monitoring • Ancillary spawner count during fall Chinook surveys in index areas only • Hatchery counts at KFH • No coho are passed above KFH	• 1999-2006 Estimates of abundance in index areas only • No current monitoring • No chum are passed above KFH
Adult Productivity	• pHOS via CWT expansion* • Currently, no mark selective fisheries in mainstem Columbia* • Harvest estimates from CWT analysis	• pHOS from ad-clips on stream surveys and hatchery counts • Selective fisheries in lower Columbia and tributaries with wild fish release • Sport and commercial fishery sampling in mainstem Columbia and major tributaries to assess impacts	• LCR Fisheries – Wild steelhead release, but stock specific incidental impacts are unknown • pHOS above KFH from hatchery counts • No pHOS below KFH	• LCR Fisheries - Wild steelhead release, but stock specific incidental impacts are unknown • pHOS from snorkel surveys above KFH	• LCR sport fisheries – Wild coho release • Stock specific incidental fishery impacts are unknown • No pHOS data	• Retention prohibited in fisheries, but stock specific incidental impacts are unknown • Limited samples for age, sex ratio, & origin
Juvenile Productivity	• No smolt monitoring in Lower Kalama below KFH	• Smolt trap at RM 10 (KFH) • Trapping period does not cover entire outmigration	• Smolt trap at RM 10 (KFH) • Smolt to adult ratio data collected • Cannot distinguish winters and summers	• Smolt trap at RM 10 (KFH) • Smolt to adult ratio data collected • Cannot distinguish winters and summers	• No smolt monitoring in Lower Kalama below KFH	• No smolt monitoring in Lower Kalama below KFH
Spatial Diversity	• Redd counts by spawning reach during stream surveys	• No monitoring above KFH • Total redd counts by section during stream surveys below KFH	• No monitoring above KFH • GPS locations for individual redds below KFH	• No monitoring above KFH	• No monitoring program in place	• 1999-2006 counts by section in index areas • No current monitoring
Species Diversity	• Age, sex ratios and lengths for cohort structure from KFH and stream surveys • Run timing from Modrow Rd. weir/trap • Spawn timing from stream surveys • No genetic sampling	• Age, sex ratios and lengths for cohort structure from KFH and stream surveys • Run-timing from KFH trap • Spawn timing from stream surveys • No genetic sampling	• Age, sex ratios and lengths for cohort structure from KFH • Run-timing at KFH trap • Spawn timing from redd surveys • Genetic sampling program at KFH - reproductive success study	• Age, sex ratios and lengths for cohort structure from KFH • Run-timing at KFH trap • Genetic sampling program at KFH -reproductive success study	• No monitoring program in place • Some genetic samples are archived, but not analyzed	• Limited samples for age, sex ratio, length & origin for cohort structure • Spawn timing from stream surveys • Baseline DNA samples collected, but not analyzed

Monitoring

Biological Monitoring – Improvement Actions Needed

Wild Salmon and Steelhead Populations						
VSP Parameter	Fall Chinook	Spring Chinook	Winter Steelhead	Summer Steelhead	Coho	Chum
Adult Abundance	• Database infrastructure • Develop alternative/ improved methods for abundance estimates; e.g. AUC or mark/recapture • Identify spatial extent of spawning (sample frame) • Estimate precision • Conduct power analysis	• Database infrastructure • Develop alternative/ improved methods for abundance estimates; e.g. AUC or mark/recapture • Identify spatial extent of spawning (sample frame) • Estimate precision • Conduct power analysis	• Database infrastructure • Develop improved methods for abundance estimates below KFH • Develop LCR specific redds/female and sex ratio data • Monitor hatchery escapement below KFH • Estimate precision • Conduct power analysis	• Database infrastructure • Improve mark-resight point and variance estimates • Improve estimates of upstream migrant passage after snorkel survey. • Alternative methods to distinguish summer and winter steelhead. • Monitor hatchery escapement below KFH	• Database infrastructure • Develop and implement monitoring plan • Identify spatial extent of spawning (sample frame) • Develop LCR specific redds/female, observer efficiency, and residence time • Monitor hatchery escapement • Estimate precision • Conduct power analysis	• Database infrastructure • Identify spatial extent of spawning (sample frame) • Develop & implement sampling designs to estimate adult abundance • Develop LCR specific observer efficiency and residence time • Estimate precision for current and historical data • Conduct power analysis
Adult Productivity	• Pursue options for mark selective fisheries • Determine pHOS based on ad-clips as mass marked returns are realized	• Improve estimates of incidental mortality in LCR mainstem and tributary fisheries	• Estimate pHOS/gene flow • Estimate incidental mortality in LCR mainstem and tributary fisheries	• Estimate incidental mortality in LCR mainstem and tributary fisheries. • Ultrasound fish @ KFH or use correction factor derived from analyses of sex markers	• Estimate incidental mortality in LCR mainstem and tributary fisheries	• Determine LCR supplementation program contributions to natural spawning • Estimate incidental mortality in LCR mainstem and tributary fisheries

VSP Parameter	Fall Chinook	Spring Chinook	Winter Steelhead	Summer Steelhead	Coho	Chum
Juvenile Productivity	• Implement periodic juvenile monitoring program via rotary screw trap below KFH	• Extend smolt trap season for duration of spring Chinook outmigration • Improve mark-recapture point and variance estimates to account for missed smolt trapping days • Periodic trapping below KFH to account for lower river production	• Explore second trap to improve precision • Improve mark-recapture point and variance estimates to account for missed smolt trapping days • Periodic trapping below KFH to account for lower river production	• Explore second trap to improve precision • Improve mark-recapture point and variance estimates to account for missed smolt trapping days • Periodic trapping below KFH to account for lower river production	• Implement periodic juvenile monitoring program via rotary screw trap below KFH	• Implement periodic juvenile monitoring program via rotary screw trap below KFH
Spatial Diversity	• Collect GPS locations for individual redds in surveyed areas • Develop & implement sampling designs to estimate spatial distribution	• Collect GPS locations for individual redds in surveyed areas • Develop & implement sampling design	• Develop approach for above KFH • Potentially, GRTS juvenile parr sampling	• Develop approach for monitoring above KFH • Potentially, GRTS juvenile parr sampling	• Develop & implement sampling design	• Develop & implement sampling designs to estimate spatial distribution.
Species Diversity	• Develop long-term ESU phenotypic and genetic monitoring and sampling plan.	• Develop long-term ESU phenotypic and genetic monitoring and sampling plan	• Develop DPS phenotypic and genetic monitoring and sampling plan	• Develop DPS phenotypic and genetic monitoring and sampling plan	• Develop ESU phenotypic and genetic monitoring and sampling plan • Analyze archived genetic baseline samples	• Develop ESU phenotypic and genetic monitoring and sampling plan • Analyze archived genetic baseline samples

*Mass marking of fall Chinook is underway with all LCR Tule fall Chinook (age 2-5) mass marked by the 2011 return. Mass marking programs are already in place for coho and steelhead.

Monitoring

Hatchery Monitoring – Current

In-Facility	Performance Measures
• In-season management of adult salmonid returns, broodstock collection and spawning protocols • Enumeration of hatchery origin and natural origin returns to hatchery collection facilities and final disposition of each • For integrated programs – enumeration of the number of hatchery and natural origin fish used in the broodstock for each species to calculate pNOB • Hatchery return timing, age composition (from scales), stock composition (CWT analysis), sex ratio and length data for run reconstruction and forecasting • Survival to each life history stage during incubation and rearing (Green egg, Eyed egg, Fry, Parr, Smolt) • Growth/feed conversions and condition • Monthly fish health monitoring • Number of smolt released- size and condition factor at release • Water quality - regulated by Washington Department of Ecology - weekly and/or monthly samples to ensure facility compliance	• All hatchery origin adults are identifiable - juveniles are marked pre-release by one or both of the following: adipose fin-clip, CWT in snout • Harvest rates – contribution to commercial and sport fisheries. • Hatchery smolt to adult survival rates • pHOS for fall Chinook via CWT expansion • pHOS for spring Chinook above KFH via hatchery counts • pHOS for summer steelhead above KFH via hatchery counts and snorkel surveys • pHOS for winter steelhead above KFH via hatchery counts

Monitoring

Hatchery Monitoring – Improvement Actions Needed

In-Facility	Performance Measures
• Development of updated Hatchery and Genetic Management Plans (HGMP) for each hatchery program consistent with implementation of the Conservation and Sustainable Fisheries plan and incorporate HSRG standards • Development of natural origin run and/or spawn timing curves to guide collection of natural origin broodstock for integrated programs$ • Review and update spawning protocols and incubation, rearing & release strategies	• Estimate pHOS for fall Chinook based on visual identification of hatchery origin fish (i.e. adipose fin-clips) rather than CWT expansion, as mass marked returns of fall Chinook are realized • Development and implementation of methods to estimate pHOS for coho • Development and implementation of methods to estimate pHOS and/or gene flow for winter and summer steelhead below KFH • Collect otolith samples from chum carcasses to estimate contribution (stray rate) from LCR supplementation programs • Calculation of pNOB, pHOS and PNI statistics annually for each hatchery program and development of a reporting format to track hatchery performance measures • Develop a regional monitoring plan for genetic and ecological interactions by hatchery-and natural-origin juveniles to assess impacts to the natural origin population • As additional data is collected and new methodologies become available, modify programs to achieve goals for PNI, pHOS and pNOB • Develop nutrient enhancement goals for watershed and include in updated escapement goals

Implementation Schedule

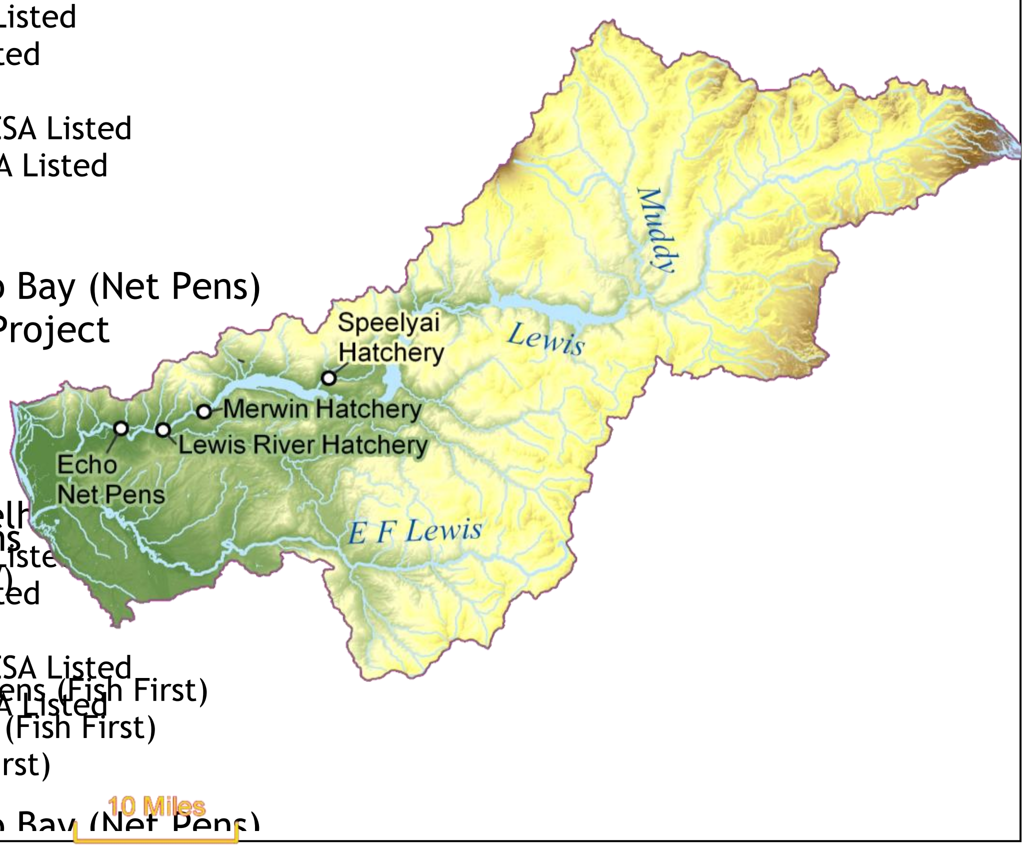
Preliminary Kalama Subbasin Hatchery action implementation plan. Actions and schedule will be reviewed, evaluated, and updated annually.

Year	Facility	Action	Fund Source	Cost
2011	Kalama Falls Hatchery	**Facility Improvement.** Improve staff safety and handling of ESA listed fish for processing adults, rebuild/replace fish ladder, sorting/holding area etc.	Federal	TBD
2011	Kalama Falls Hatchery	**Facility Improvement.** Rebuild or replace holding ponds	Federal	TBD
2011	Kalama Falls Hatchery	**Facility Improvement.** Build new pond(s) to help facilitate production increase	Federal	TBD
2011	Fallert Creek Hatchery	**Environmental Compliance.** Design Kalama River intake	Federal	$250,000
2011	Fallert Creek Hatchery	**Environmental Compliance.** Renovate Kalama R. and Hatchery Cr. Intake screens	Federal	TBD
2011	Fallert Creek Hatchery	**Facility Maintenance.** Renovate earthen pond bottoms	Federal	TBD
2011	Modrow Trap	**Facility Improvement.** Rebuild or replace entire trapping facility	Federal	TBD
2012	Kalama Falls Hatchery	**Facility Maintenance.** Renovate incubation trays	Federal	TBD
2012	Kalama Falls Hatchery	**Facility Improvement.** Install heaters and chillers in incubation	Federal	TBD
2012	Kalama Falls Hatchery	**Facility Maintenance.** Improvements to pathogen free water supply intakes and pipelines	Federal	TBD
2012	Kalama Falls Hatchery	**Facility Improvement.** Need access to creek intake across river (cable car etc.?)	Federal	TBD
2012	Kalama Falls Hatchery	**Facility Improvement.** Repair or resurface existing raceways	Federal	TBD
2013	Fallert Creek Hatchery	**Environmental Compliance.** Install pollution abatement pond	Federal	$1.5 mil.
2014	Kalama Falls Hatchery	**Facility Improvement.** Improve manifold design on raceways	Federal	TBD
2015	Kalama Falls Hatchery	**Facility Improvement.** Install additional river intake pumps	Federal	TBD
2015	Kalama Falls Hatchery	**Facility Improvement.** Make improvements to fish barrier	Federal	TBD
2016	Kalama Falls Hatchery	**Facility Improvement.** Replaces all valves pre 1970	Federal	TBD

Wild Salmon & Steelhead

Spring Chinook: ESA Listed
Fall Chinook: ESA Listed
Coho: ESA Listed
Summer Steelhead: ESA Listed
Winter Steelhead: ESA Listed
Chum: ESA Listed

Fish First Echo Bay (Net Pens)
Fish First RSI Project

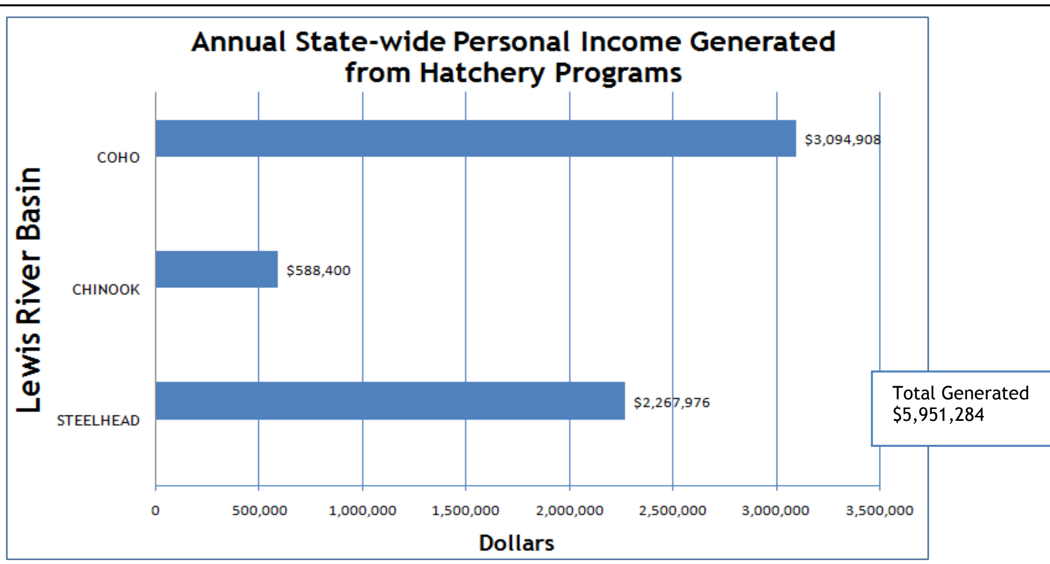


Wild Salmon & Steelhead
Spring Chinook: ESA Listed
Fall Chinook: ESA Listed
Coho: ESA Listed
Summer Steelhead: ESA Listed
Winter Steelhead: ESA Listed
Chum: ESA Listed

Hatchery Programs

Lewis River (WDFW)
Merwin (WDFW)
Speelyai (WDFW)
Speelyai Bay Net Pens (Fish First)
Echo Bay Net Pens (Fish First)
RSI Project (Fish First)

Fish First Echo Bay (Net Pens)

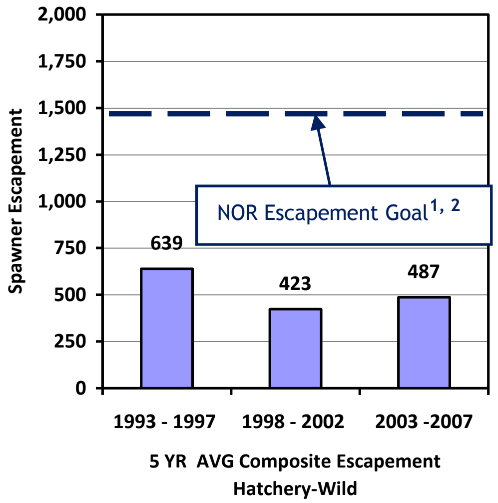


Source: Wegge, T. 2009 (June) Technical Memo. Economic Analysis of WDFW Hatchery Programs

Wild Salmon & Steelhead

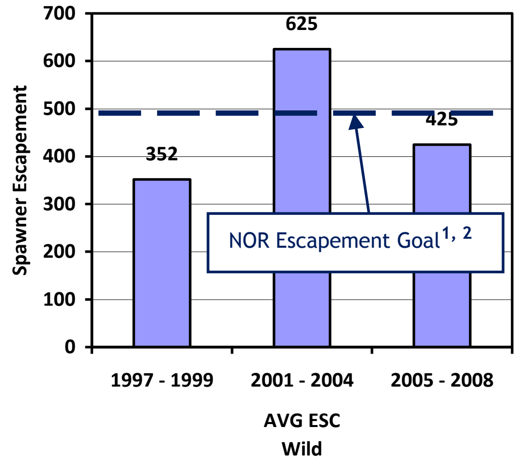
Spring Chinook

ESA Listing Status: Threatened
Populations: North Fork Lewis (Primary)



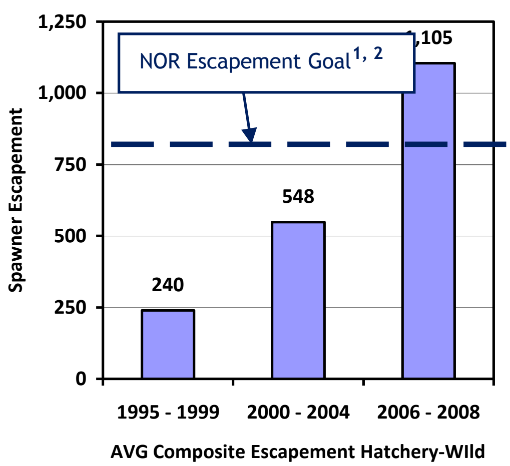
Winter Steelhead

ESA Listing Status: Threatened
Populations: East Fork Lewis (Primary)



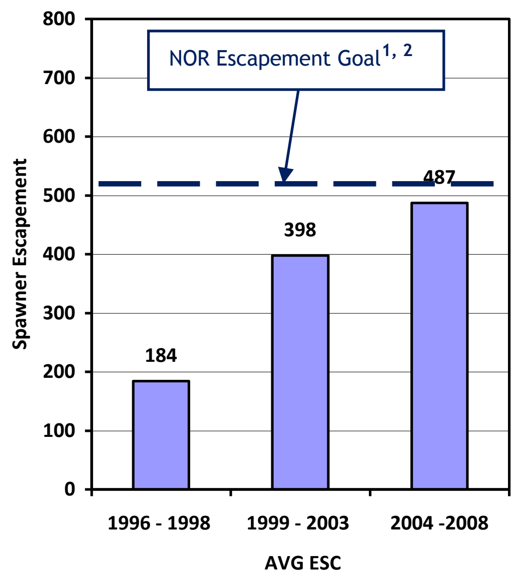
Fall Chinook

ESA Listing Status: Threatened
Populations: Lewis River Tule, including Salmon Creek (Primary)



Summer Steelhead

ESA Listing Status: Threatened
Populations: East Fork Lewis (Primary)



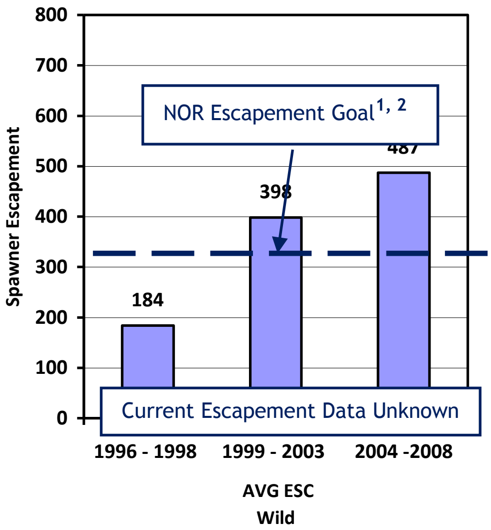
[1] Number of natural origin spawners necessary to achieve population viability standards established by NOAA's TRT.

[2] Washington LCFRB Proposed Scenario Revisions (6/16/09 Draft).

Wild Salmon & Steelhead

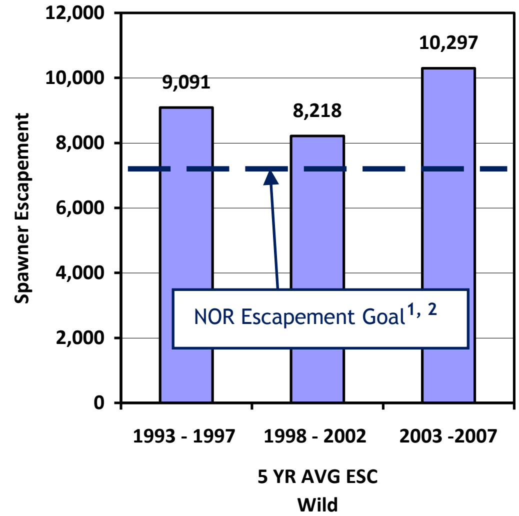
Winter Steelhead

ESA Listing Status: Threatened
Populations: North Fork Lewis (Contributing)



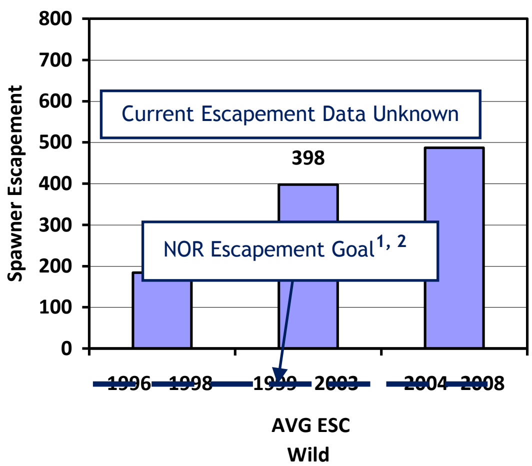
Late Fall Chinook

ESA Listing Status: Threatened
Populations: North Fork Lewis River Bright Stock (Primary)



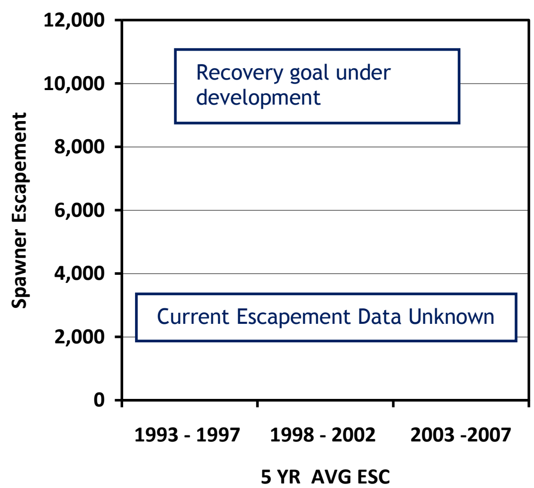
Summer Steelhead

ESA Listing Status: Threatened
Populations: North Fork Lewis (Stabilizing)



Chum

ESA Listing Status: Threatened
Populations: Lewis River (Primary)

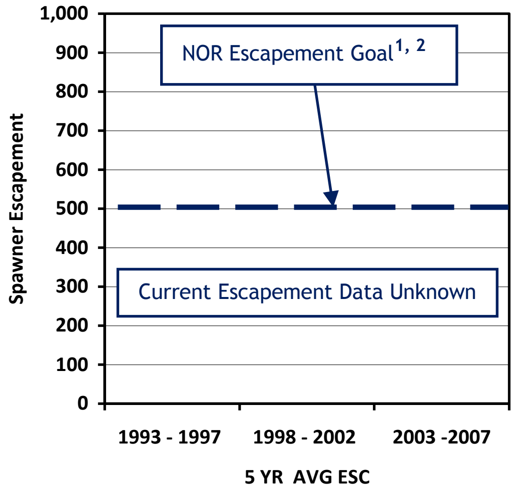


[1]Number of natural origin spawners necessary to achieve population viability standards established by NOAA's TRT.

[2]Washington LCFRB Proposed Scenario Revisions (6/16/09 Draft).

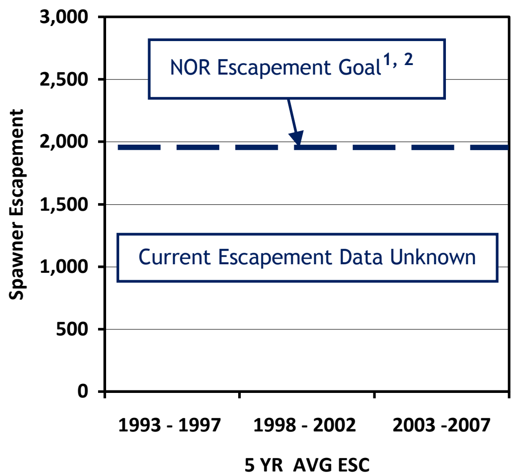
Coho

ESA Listing Status: Threatened
Populations: North Fork Lewis (Contributing)



Coho

ESA Listing Status: Threatened
Populations: East Fork Lewis (Primary)



[1]Number of natural origin spawners necessary to achieve population viability standards established by NOAA's TRT.

[2]Washington LCFRB Proposed Scenario Revisions (6/16/09 Draft).

Lewis River Hatchery (WDFW)

Salmon and Steelhead Programs

Spring Chinook
Purpose: Harvest/Conservation
Goal: Currently under development[1]
Broodstock Strategy: Segregated
Program Size: 900,000 yearling release

Type S Coho
Purpose: Harvest/Conservation
Goal: Currently under development[1]
Broodstock Strategy: Segregated
Program Size: 880,000 yearling release, receive eyed eggs from Speelyai Hatchery

Type N Coho
Purpose: Harvest
Goal: Currently under development[1]
Broodstock Strategy: Segregated
Program Size: 815,000 yearling release, see joint programs for additional plants and transfers (1.35 million green eggs, 646,500 eyed eggs).

[1]Program specific goals are under development through completion of broodstock Management Plans. Overall production levels for Lower Columbia River have been evaluated through Conservation and Sustainable Fisheries Plan.

Note: Complete facility program can be found on the future brood document.

Broodstock Management

Spring Chinook
See Speelyai Broodstock

Type S Coho
See Speelyai Broodstock

Type N Coho
Short-term Benchmark: pHOS < 10%
Long-term Goal: pHOS < 10%
Action Plan: Continue integrated program consistent with a Contributing population.

Note: Adults collected from either Lewis River Hatchery or Merwin Dam Fish Collection Facility.
See Lewis River Settlement Agreement for additional information.

Hatcheries

Lewis River Hatchery (WDFW)

Environmental Compliance

Clean Water Act
Action Plan: Compliant, no action necessary

Passage
Action Plan: Compliant, no action necessary
Non-target recruitment returned to stream per existing protocols.

Intake Screening
Action Plan: Out of compliance, repair damaged screen at Upstream Intake (USI). Resize Downstream Intake screens (DSI).
Cost & Schedule: (USI) $ 1,500,000; 2010, (DSI) 1,200,000; 2011

Water Withdrawal
Compliant with water rights formalized thru trust water right #S2-24939
Use: DSI – 7,200 gpm; USI – 22,500 gpm
Monthly NPDES reporting to Dept of Ecology

Facility Condition

Incubation
Action Plan: Install water thermo-regulators
Cost & schedule: $ 15,000; 2013

Rearing
Action Plan: Rebuild rearing ponds 13, 14, 16
Cost & schedule: $ 3,750,000; 2010-2011

Adult Processing
Action Plan: Rebuild Adult Facility
Cost & Schedule: $ 4,500,000; 2009

Other
Action Plan: See intake screening
Cost & Schedule:

Facility Condition

Incubation
Action Plan: Install water thermo-regulators
Cost & schedule: $ 15,000; 2013

Speelyai Hatchery (WDFW)

Salmon and Steelhead Programs [2]

Spring Chinook
Purpose: Harvest/Conservation
Goal: Currently under development[1]
Broodstock Strategy: Segregated
Program Size: 900,000 sub-yearlings shipped to Lewis River Hatchery, see joint programs for additional plants and transfers (150,000 yearlings, 270,000 green eggs)

Type S Coho
Purpose: Harvest / Conservation
Goal: Currently under development[1]
Broodstock Strategy: Segregated
Program Size: 1.05 million eyed eggs transferred to Lewis River Hatchery

Type N Coho
Purpose: Conservation
Goal: Currently under development[1]
Broodstock Strategy: Integrated (100% wild brood)
Program Size: Up to 400,000 eyed eggs shipped to Washougal Hatchery for thermal marking (Fish First- Cedar Creek RSI Program)

[1]Program specific goals are under development through completion of broodstock Management Plans. Overall production levels for Lower Columbia River have been evaluated through Conservation and Sustainable Fisheries Plan.

[2]Other species reared: rainbow trout and Kokanee

Broodstock Management

Spring Chinook
Short-term Benchmark: NA See action plan
Long-term Goal: PNI > 0.67
Action Plan: Start reintroduction program in 2011. Integrate entire program once a self-sustainable wild population is established. Program will increase from 900,000 to 1.2 million by 2010.

Type S Coho
Short-term Benchmark: NA See action plan
Long-term Goal: PNI > 0.50
Action Plan: Continue reintroduction to upper watershed. Begin integrated program for Upper River. Integrate entire program once a self-sustainable wild population is established. Increasing PNI value requires upper watershed habitat improvements.

Type N Coho
Action Plan: Evaluate program to determine best management practices in the future.

Note: Adults collected at Lewis River Hatchery or Merwin Dam Fish Collection Facility (FCF)

See Lewis River Settlement Agreement for additional information.

Hatcheries

Speelyai Hatchery (WDFW)

Environmental Compliance/Monitoring

Clean Water Act
Action Plan: Out of compliance, combine all three effluents to dilute formalin during adult treatments.
Cost: $150,000; 2012

Passage
Action Plan: No anadromous fish passage or ESA listed fish in Speelyai Creek.

Intake Screening
Action Plan: Out of compliance, screens need to be resized.
Cost & Schedule: TBD

Water Withdrawal
Compliant with water rights formalized thru trust water right #S2-10532 (WDFW) and #S2-21697 (PacifiCorp) Use : 20 cfs (9170gpm)
Monthly NPDES reporting to Dept of Ecology

Environmental Compliance/Monitoring

Clean Water Act

Facility Condition

Incubation
Action Plan: Add additional 10 stacks of heath trays and 1 deep trough for Spring Chinook.
Cost & schedule: $80,000; 2010

Rearing
Action Plan: Repair/rebuild 2 banks of burrows ponds. Convert pond 14 into raceways.
Cost & schedule: bank 1- burrows = $800,000; 2009, bank 2- burrows = $800,000; 2010, pond 14 = $1,200,000; 2012

Adult Processing
Action Plan: Remodel spawning area.
Construct Kokanee trap.
Cost & Schedule: Spawning area = $120,000; 2012, kokanee trap = $50,000; 2011

Other
Action Plan: Replace and stabilize existing dam at water intake and replace all valves.
Cost & Schedule: $250,000; 2011

Hatcheries Facility Condition

Incubation

Merwin Hatchery (WDFW)

Salmon and Steelhead Programs[2]

Early Winter Steelhead

Purpose: Harvest
Goal: Currently under development[1]
Broodstock Strategy: Segregated
Program Size: 100,000 yearling release

Summer Steelhead

Purpose: Harvest
Goal: Currently under development[1]
Broodstock Strategy: Segregated
Program Size: 175,000 yearling release, see joint programs for additional plants and transfers (95,000 yearlings).

Late Winter Steelhead

Purpose: Conservation
Goal: 800 adults for upstream passage
Broodstock Strategy: Integrated (100% wild brood)
Program Size: 50,000 Yearlings

[1]Program specific goals are under development through completion of broodstock Management Plans. Overall production levels for Lower Columbia River have been evaluated through Conservation and Sustainable Fisheries Plan.

[2]Rainbow trout also reared at facility.

Broodstock Management

Early Winter Steelhead

Short-term Benchmark: Gene Flow <2%
Long-term Goal: Gene Flow < 2%
Action Plan: Continue integrated program consistent with a Contributing population.

Summer Steelhead

Short-term Benchmark: Gene Flow < 2%
Long-term Goal: Gene Flow < 2%
Action Plan: Continue integrated program consistent with a Stabilizing population.

Late Winter Steelhead

100% genetic analysis wild brood program.
Action Plan: Continue wild brood program for 12 years. Reintroduce returning adults from program into upper watershed.

Note: Adults collected at Merwin Dam FCF

See Lewis River Settlement Agreement for additional information.

Merwin Hatchery (WDFW)

Environmental Compliance

Clean Water Act
Action Plan: Compliant, no action necessary

Passage
Action Plan: Fish collection facility at Merwin Dam scheduled to be rebuilt in 2012: Adults will be hauled upstream and a downstream smolt collector is scheduled to be built in 2012 and operational by 2013.

Intake Screening
Action Plan: Intake is owned and operated by PacifiCorp.

Water Withdrawal
Compliant with water rights formalized thru trust water right #S2-28311
Use : 11 cfs (4939gpm)
Monthly NPDES reporting to Dept of Ecology

Environmental Compliance

Clean Water Act
Action Plan: Compliant, no action necessary

Facility Condition

Incubation
Action Plan: Add a backup generator for the ozone treatment plant for incubation.
Cost & schedule: $75,000; 2010

Rearing
Action Plan: Replace Risers in rearing ponds with screened up wells and larger valves to improve flow patterns and exchange rates.
Cost & schedule: $500,000; 2010

Adult Processing
Action Plan: Rebuild Merwin Dam Fish Collection Facility. Purchase one additional fish hauling truck for reintroduction.
Cost & Schedule: $38,000,000; 2012; $180,000; 2011

Other
Action Plan: Build and place smolt collector in upper watershed
Cost & Schedule: $70,000,000; 2012

Hatcheries Facility Condition

Hatcheries

Joint Programs (WDFW and Others)

Lewis River Hatchery[1]

Type N Coho:

460,000 Eyed Eggs to Fish First RSI's[2]
1,300,000 Green Eggs to Washougal
70,000 Eyed Eggs to Clark County PUD
5,000 Eyed Eggs to Steve Syverson Project
21,500 Eyed Eggs to Region 5 ED COOP
90,000 Eyed Eggs to Venersborg Firefighters

[1] Additional program details can be found on the Future Brood Document on the WDFW website.

[2]Location of RSI's can be found on the Future Brood Document.

Lewis River Hatchery[1]

Merwin Hatchery[1]

Summer Steelhead:

60,000 yearlings to Speelyai Net Pens, transferred to Echo Net Pens for release (Fish First)

35,000 yearlings to Beaver Creek Hatchery

[1] Additional program details can be found on the Future Brood Document on the WDFW website.

Speelyai Hatchery[1]

Spring Chinook:

270,000 Eyed Eggs to Grays River Hatchery for SAFE project

150,000 yearlings to Echo Bay Net Pens for Fish First

Type N Coho

400,000 Eyed Eggs to Fish First RSI's (Wild Stock) (thermal marked at Washougal Hatchery)

[1] Additional program details can be found on the Future Brood Document on the WDFW website.

East Fork Lewis Plants[1]
(From Skamania Hatchery)

Summer Steelhead

15,000 yearlings to East Fork Lewis (C&SFP)
Action Plan: Continue actions described in C&SFP

Winter Steelhead

60,000 yearlings to East Fork Lewis (C&SFP)
Action Plan: Continue actions described in C&SFP

[1] Additional program details can be found on the Future Brood Document on the WDFW website.

Biological Monitoring - Current

Lewis River (North Fork) - Wild Salmon and Steelhead Populations						
VSP Parameter	Fall Chinook	Spring Chinook	Winter Steelhead	Summer Steelhead	Coho	Chum
Adult Abundance	**Tule Stock** • EF and NF Lewis components considered a single population • Estimate of total spawners via peak count expansion • Counts at Cedar Creek fish ladder and weir and Merwin Dam **Bright Stock** • Estimate of total spawners via mark /recapture • Counts at Cedar Creek fish ladder and weir and Merwin Dam	• Re-introduction into Upper Lewis is beginning with counts at Merwin Dam of fish trucked upstream • Lower River - estimate of total spawners via peak count expansion • Counts at Cedar Creek fish ladder and weir - few spring Chinook	• Estimate of total spawners via redd count expansion for NF Lewis (began in 2008) • Estimate of total spawners via mark/recapture in Cedar Creek • No surveys in other NF Lewis tributaries • Re-introduction into Upper Lewis beginning in 2012	• Status of remnant population below Merwin Dam is unknown and not monitored • Limited collection of wild fish at Merwin Dam	• Estimate of total spawners via mark/recapture on Cedar Ck • Merwin Dam counts • No other monitoring on NF Lewis or other tributaries	• EF and NF Lewis components considered a single population • Estimate of total spawners via AUC • Timing overlaps with Late Fall Bright surveys
Adult Productivity	**Tule and Bright Stocks** • pHOS via CWT expansion* • Currently, no mark selective fisheries in mainstem Columbia* • Harvest estimates from CWT analysis	• pHOS from ad-clips on stream surveys and hatchery counts • Selective fisheries in lower Columbia and tributaries with wild fish release • Sport and commercial fishery sampling in mainstem Columbia and major tributaries to assess impacts	• LCR Fisheries - Wild steelhead release, but stock specific incidental impacts are uknown • Sex ratio, pHOS, and age collected at Cedar Creek traps and limited collection at Merwin Dam • No pHOS for lower NF Lewis	• LCR Fisheries - Wild steelhead release, but stock specific incidental impacts are uknown. • No current monitoring	• LCR sport fisheries - Wild coho release • Stock specific incidental fishery impacts are unknown • Sex ratio, pHOS, and age collected at Cedar Creek traps and limited collection at Merwin Dam	• Retention prohibited in fisheries, but stock specific incidental impacts are unknown • Limited samples for age, sex ratio, & origin
Juvenile Productivity	• Smolt trap at RM 2 on Cedar Creek • 100,000 CWT applied from mainstem seining (Bright Stock only)	• Smolt trap at RM 2 on Cedar Creek - few spring Chinook • Juvenile fish collection facility above dams will come on-line in 2013	• Smolt trap at RM 2 on Cedar Creek • Smolt to adult ratio data collected	• No current monitoring	• Smolt trap at RM 2 on Cedar Creek • Smolt to adult ratio data collected	• No current monitoring
Spatial Diversity	• Redd counts by spawning reach during stream surveys	• Total redd counts by section during stream surveys	• GPS locations for all individual redds during NF surveys	• No current monitoring	• No monitoring program in place	• Counts by section from stream surveys
Species Diversity	• Age, sex ratios and lengths for cohort structure from Merwin & Cedar Ck traps and stream surveys • Run timing from Merwin & Cedar Ck traps • Spawn timing from stream surveys • No genetic sampling	• Age, sex ratios and lengths for cohort structure from stream surveys • Run timing from Merwin & Cedar Ck traps • Spawn timing from stream surveys • No genetic sampling	• Age, sex ratios and lengths for cohort structure from Merwin & Cedar Ck traps • Run-timing from traps • Spawn timing from redd surveys • DNA samples collected since mid-2000s at Cedar Creek trap and Merwin Dam, samples have been analyzed	• No current monitoring	• Age, sex ratios and lengths for cohort structure from Merwin & Cedar Ck traps • Run-timing from traps • Some genetic samples are archived, but not analyzed	• Limited samples for age, sex ratio, length & origin for cohort structure • Spawn timing from stream surveys • Baseline DNA samples collected and anolyzed
*Mass marking of fall Chinook is underway with all LCR Tule fall Chinook (age 2-5) mass marked by the 2011 return. Mass marking programs are already in place for coho and steelhead.						

East Fork Lewis River - Wild Salmon and Steelhead Populations					
VSP Parameter	Fall Chinook	Winter Steelhead	Summer Steelhead	Coho	Chum
Adult Abundance	**Tule Stock** • EF and NF Lewis components considered a single population • Estimate of total spawners via peak count expansion • 2005-2008 – estimates from AUC, and mark/recapture	• Estimate of total spawners via redd count expansion • Assume no winter steelhead above Horseshoe Falls and unknown number of summer steelhead redds below Horseshoe Falls	• Estimate of total spawners via mark-resight (snorkeling) above Lucia Falls • No estimate below Lucia Falls, usage of this area is assumed to be minimal	• No directed monitoring • Ancillary spawner count during fall Chinook surveys in index areas only	• EF and NF Lewis components considered a single population • 1999-2006 Estimates of abundance in index areas only • No current monitoring
Adult Productivity	• pHOS via CWT expansion* • Currently, no mark selective fisheries in mainstem Columbia* • Harvest estimates from CWT analysis	• LCR Fisheries – Wild steelhead release, but stock specific incidental impacts are unknown. • No pHOS data	• LCR Fisheries – Wild steelhead release, but stock specific incidental impacts are unknown • pHOS from seining and snorkel surveys above Lucia Falls	• LCR sport fisheries – Wild coho release • Stock specific incidental fishery impacts are unknown • No pHOS data	• Retention prohibited in fisheries, but stock specific incidental impacts are unknown • Limited samples for age, sex ratio, & origin
Juvenile Productivity	• No smolt monitoring	• No smolt monitoring	• No smolt monitoring	• No smolt monitoring	• No smolt monitoring
Spatial Diversity	• GPS locations from individual redds during stream surveys	• GPS locations for individual redds in surveyed areas	• No current monitoring	• No monitoring program in place	• 1999-2006 counts by section in index areas • No current monitoring
Species Diversity	• Age, sex ratios and lengths for cohort structure from stream surveys • Spawn timing from stream surveys • No genetic sampling	• Spawn timing from stream surveys • Genetic baseline from samples collected in 2005-07	• Age, sex ratios and lengths for cohort structure from seining • Genetic samples collected annually, but not analyzed	• No monitoring program in place • Some genetic samples are archived, but not analyzed	• Limited samples for age, sex ratio, length & origin for cohort structure • Spawn timing from stream surveys • Baseline DNA samples collected and analyzed
*Mass marking of fall Chinook is underway with all LCR Tule fall Chinook (age 2-5) mass marked by the 2011 return. Mass marking programs are already in place for coho and steelhead.					

Biological Monitoring – Improvement Actions Needed

Lewis River - Wild Salmon and Steelhead Populations						
VSP Parameter	Fall Chinook	Spring Chinook	Winter Steelhead	Summer Steelhead	Coho	Chum
Adult Abundance	• Database infrastructure • Develop LCR specific observer efficiency and residence time needed for Chinook AUC abundance estimates • Identify spatial extent of spawning (sample frame) • Estimate precision • Conduct power analysis	• Database infrastructure • Develop alternative/ improved methods for abundance estimates; e.g. AUC or mark/recapture • Identify spatial extent of spawning (sample frame) • Estimate precision • Conduct power analysis	• Database infrastructure • Develop improved methods for abundance estimates • Conduct redd surveys in other NF Lewis tribs • Develop LCR specific redds/female and sex ratio data • Monitor hatchery escapement • Estimate precision • Conduct power analysis	• Database infrastructure • Develop adult abundance monitoring plan	• Database infrastructure • Develop and implement monitoring plan • Identify spatial extent of spawning (sample frame) • Develop LCR specific redds/female, observer efficiency, and residence time • Monitor hatchery escapement • Estimate precision • Conduct power analysis	• Database infrastructure • Identify spatial extent of spawning (sample frame) • Develop LCR specific observer efficiency and residence time • Estimate precision for current and historical data • Conduct power analysis
Adult Productivity	• Pursue options for mark selective fisheries • Determine pHOS based on ad-clips as mass marking is completed	• Improve estimates of incidental mortality in LCR mainstem and tributary fisheries	• Estimate pHOS/gene flow for lower NF • Estimate incidental mortality in LCR mainstem and tributary fisheries	• Develop adult productivity monitoring plan	• Estimate incidental mortality in LCR mainstem and tributary fisheries	• Determine LCR supplementation program contributions to natural spawning • Estimate incidental mortality in LCR mainstem and tributary fisheries
Juvenile Productivity	• Implement periodic juvenile monitoring program via rotary screw trap in NF Lewis	• Juvenile fish collection facility proposed for construction in Swift Reservoir for operation in 2013 • Implement periodic juvenile monitoring program via rotary screw trap in lower NF Lewis	• Implement periodic juvenile monitoring program via rotary screw trap in NF Lewis • Cedar Ck - Improve mark-recapture point and variance estimates to account for missed smolt trapping days	• Implement periodic juvenile monitoring program via rotary screw trap in NF Lewis	• Implement periodic juvenile monitoring program via rotary screw trap in NF Lewis • Cedar Ck - Improve mark-recapture point and variance estimates to account for missed smolt trapping days	• Implement periodic juvenile monitoring program via rotary screw trap in NF Lewis
Spatial Diversity	• Collect GPS locations for individual redds on stream surveys • Develop & implement sampling designs to estimate spatial distribution	• Collect GPS locations for individual redds in survey areas • Develop & implement sampling design	• Consider alternate sampling designs to the current index/supplemental approach • Collect GPS locations for individual redds on Cedar Creek	• Develop & implement sampling design	• Develop & implement sampling design	• Develop & implement sampling designs to estimate spatial distribution
Species Diversity	• Develop long-term ESU phenotypic and genetic monitoring and sampling plan	• Develop long-term ESU phenotypic and genetic monitoring and sampling plan	• Develop DPS phenotypic and genetic monitoring and sampling plan	• Develop DPS phenotypic and genetic monitoring and sampling plan	• Develop ESU phenotypic and genetic monitoring and sampling plan • Analyze archived genetic baseline samples	• Develop ESU phenotypic and genetic monitoring and sampling plan • Analyze archived genetic baseline samples

East Fork Lewis River - Wild Salmon and Steelhead Populations					
VSP Parameter	Fall Chinook	Winter Steelhead	Summer Steelhead	Coho	Chum
Adult Abundance	• Database infrastructure • Develop LCR specific observer efficiency and residence time needed for Chinook AUC abundance estimates • Identify spatial extent of spawning (sample frame) • Estimate precision • Conduct power analysis	• Database infrastructure • Develop alternative/ improved methods for abundance estimates • Identify spatial extent of spawning (sample frame) • Develop LCR specific redds/female and sex ratio data • Monitor hatchery escapement • Estimate precision • Conduct power analysis	• Database infrastructure • Improve mark-resight point and variance estimates to account for snorkeler efficiency and tag loss • Improve estimates of upstream migrant passage after snorkel survey • Alternative methods to distinguish summer and winter steelhead. • Monitor hatchery escapement	• Database infrastructure • Develop and implement monitoring plan. • Identify spatial extent of spawning (sample frame) • Develop LCR specific redds/female, observer efficiency, and residence time • Monitor hatchery escapement • Estimate precision • Conduct power analysis	• Database infrastructure • Identify spatial extent of spawning (sample frame) • Develop & implement sampling designs to estimate adult abundance • Develop LCR specific observer efficiency and residence time • Estimate precision for current and historical data • Conduct power analysis
Adult Productivity	• Pursue options for mark selective fisheries • Determine pHOS based on ad-clips as mass marked returns are realized	• Estimate pHOS/gene flow • Estimate incidental mortality in LCR mainstem and tributary fisheries.	• Estimate incidental mortality in LCR mainstem and tributary fisheries	• Estimate incidental mortality in LCR mainstem and tributary fisheries.	• Determine LCR supplementation program contributions to natural spawning • Estimate incidental mortality in LCR mainstem and tributary fisheries
Juvenile Productivity	• Implement periodic juvenile monitoring program via rotary screw trap	• Implement periodic juvenile monitoring program via rotary screw trap	• Implement periodic juvenile monitoring program via rotary screw trap	• Implement periodic juvenile monitoring program via rotary screw trap	• Implement periodic juvenile monitoring program via rotary screw trap
Spatial Diversity	• Develop & implement sampling designs to estimate spatial distribution.	• Consider alternate sampling designs to the current index/supplemental approach.	• GRTS juvenile parr sampling or juvenile PIT tagging	• Develop & implement sampling design	• Develop & implement sampling designs to estimate spatial distribution.
Species Diversity	• Develop long-term ESU phenotypic and genetic monitoring and sampling plan.	• Methods to collect origin, age, length and sex ratio data. • Develop DPS phenotypic and genetic monitoring and sampling plan	• Develop DPS phenotypic and genetic monitoring and sampling plan	• Develop ESU phenotypic and genetic monitoring and sampling plan • Analyze archived genetic baseline samples.	• Develop ESU phenotypic and genetic monitoring and sampling plan • Analyze archived genetic baseline samples.

Monitoring

Hatchery Monitoring - Current

In-Facility	Performance Measures
• In-season management of adult salmonid returns, broodstock collection and spawning protocols • Enumeration of hatchery origin and natural origin returns to hatchery collection facilities and final disposition of each • For integrated programs – enumeration of the number of hatchery and natural origin fish used in the broodstock for each species to calculate pNOB • Hatchery return timing, age composition (from scales), stock composition (CWT analysis), sex ratio and length data for run reconstruction and forecasting • Survival to each life history stage during incubation and rearing (Green egg, Eyed egg, Fry, Parr, Smolt) • Growth/feed conversions and condition • Monthly fish health monitoring • ELISA testing of spring Chinook for levels of Bacterial Kidney Disease • Number of smolt released- size and condition factor at release • Water quality - regulated by Washington Department of Ecology - weekly and/or monthly samples to ensure facility compliance	• All hatchery origin adults are identifiable - juveniles are marked pre-release by one or both of the following: adipose fin-clip, CWT in snout • Harvest rates – contribution to commercial and sport fisheries. • Hatchery smolt to adult survival rates • pHOS for NF and EF Lewis fall Chinook (Tule and Bright stocks) via CWT expansion • pHOS for NF Lewis spring Chinook from Merwin Dam counts and spawning ground surveys • pHOS for NF Lewis winter steelhead at Cedar Creek trap and Merwin Dam • pHOS for NF Lewis coho at Cedar Creek trap and Merwin Dam • pHOS for EF Lewis summer steelhead above Lucia Falls via seining and snorkel surveys

Monitoring

Hatchery Monitoring – Improvement Actions Needed

In-Facility	Performance Measures
• Development of updated Hatchery and Genetic Management Plans (HGMP) for each hatchery program consistent with implementation of the Conservation and Sustainable Fisheries plan and incorporate HSRG standards • Development of natural origin run and/or spawn timing curves to guide collection of natural origin broodstock for integrated programs • Review and update spawning protocols and incubation, rearing & release strategies	• Estimate pHOS for fall Chinook based on visual identification of hatchery origin fish (i.e. adipose fin-clips) rather than CWT expansion, as mass marked returns of fall Chinook are realized • Development and implementation of methods to estimate pHOS for coho in EF Lewis and non-monitored areas of the NF Lewis • Development and implementation of methods to estimate pHOS and/or gene flow for winter steelhead in the EF Lewis and non-monitored areas of the NF Lewis • Development and implementation of methods to estimate pHOS and/or gene flow for summer steelhead in the lower EF Lewis and NF Lewis • Collect otolith samples from chum carcasses to estimate contribution (stray rate) from LCR supplementation programs • Calculation of pNOB, pHOS and PNI statistics annually for each hatchery program and development of a reporting format to track hatchery performance measures • Develop a regional monitoring plan for genetic and ecological interactions by hatchery-and natural-origin juveniles to assess impacts to the natural origin population • As additional data is collected and new methodologies become available, modify programs to achieve goals for PNI, pHOS and pNOB • Develop nutrient enhancement goals for watershed and include in updated escapement goals

Implementation Schedule

Preliminary Lewis River Subbasin hatchery action implementation plan. Actions and schedule will be reviewed, evaluated, and updated annually.

Year	Facility	Action	Fund Source	Cost
2009	Lewis River	**Facility Improvement:** Remodel Adult Pond and sorting facility	Local (PacifiCorp)	$4.5 mil.
2009	Lewis River	**Safety:** Upgrade outlet screen hoist structure	Local (PacifiCorp)	$15,000
2009	Speelyai Hatchery	**Facility Improvement:** Remodel first bank burrows ponds	Local (PacifiCorp)	$800,000
2010	Lewis River	**Facility Improvement:** Remodel Rearing ponds 13 and 14	Local (PacifiCorp)	$2.5 mil.
2010	Lewis River	**Facility Improvement:** Replace hatchery outlet screens	Local (PacifiCorp)	$8,000
2010	Lewis River	**Facility Maintenance:** Repair miscellaneous valves	Local (PacifiCorp)	$100,000
2010	Lewis River	**Environmental Compliance:** Bring downstream intake screening into compliance	Local (PacifiCorp)	$1.2 mil.
2010	Merwin Hatchery	**Facility Improvement:** Ozone treatment plant upgrade	Local (PacifiCorp)	$150,000
2010	Merwin Hatchery	**Facility Improvement:** Improve flow pattern and inflow to Rearing Ponds	Local (PacifiCorp)	$100,000
2010	Merwin Hatchery	**Facility Improvement:** Build a backup system for ozone treated water to incubation building	Local (PacifiCorp)	$25,000
2010	Merwin Hatchery	**Facility Improvement:** Modify smolt release ponds to accommodate summer steelhead broodstock collection	Local (PacifiCorp)	$65,000
2010	Merwin Hatchery	**Facility Improvement:** Increase water rights usage and run the existing third pump at the pump deck	Local (PacifiCorp)	$25,000
2010	Merwin Hatchery	**Facility Improvement:** Install 4 16' circular tanks for wild winter steelhead adult rearing / kelt reconditioning	Local (PacifiCorp)	$80,000
2010	Speelyai Hatchery	**Facility Improvement:** Remodel second bank burrows ponds	Local (PacifiCorp)	$800,000
2010	Speelyai Hatchery	**Facility Improvement:** Increase size of spawning area	Local (PacifiCorp)	$85,000
2011	Lewis River	**Facility Improvement:** Remodel Rearing pond 16	Local (PacifiCorp)	$1.25 mil.
2011	Merwin Dam FCF	**Facility Improvement:** Purchase additional fish hauling truck for supplementation and reintroduction	Local (PacifiCorp)	$180,000

Year	Facility	Action	Fund Source	Cost
2011	Speelyai Hatchery	**Environmental Compliance:** Replace existing dam and valves at intake	Local (PacifiCorp)	$250,000
2011	Speelyai Hatchery	**Facility Improvement:** Construct kokanee trap	Local (PacifiCorp)	$50,000
2012	Lewis River	**Environmental Compliance:** Repair damaged upstream intake structure	Local (PacifiCorp)	$1.5 mil.
2012	Merwin Dam FCF	**Facility Improvement:** Rebuild Trap and sorting facility	Local (PacifiCorp)	$4.0 mil.
2012	Speelyai Hatchery	**Facility Improvement:** Convert pond 14 into raceways	Local (PacifiCorp)	$1.2 mil.
2012	Speelyai Hatchery	**Environmental Compliance:** Combine effluents into one common effluent	Local (PacifiCorp)	$150,000
2012	Speelyai Hatchery	**Facility Improvement:** Remodel adult pond 13	Local (PacifiCorp)	$1.2 mil.
2013	Lewis River	**Facility Improvement:** Install thermo-regulation system in incubation	Local (PacifiCorp)	$15,000
2013	Lewis River	**Facility Improvement:** Improve screening in hatchery incubation head troughs	Local (PacifiCorp)	$25,000
2013	Lewis River	**Facility Improvement:** Change 40hp booster pump to variable speed	Local (PacifiCorp)	$15,000
2013	Lewis River	**Facility Improvement:** Repair raceway degassing tower valve	Local (PacifiCorp)	$15,000
2013	Speelyai Hatchery	**Facility Improvement:** Install venturi system for pond cleaning	Local (PacifiCorp)	$175,000
2014	Lewis River	**Facility Improvement:** Modify raceway outlet for friendly fish releases	Local (PacifiCorp)	$15,000
2014	Merwin Hatchery	**Facility Improvement:** Construct smolt collection facilities in Swift, Yale, Merwin	Local (PacifiCorp)	$4.0 mil.
2016	Lewis River	**Facility Improvement:** Purchase/install 6th pump for USI - variable speed	Local (PacifiCorp)	$25,000
2016	Lewis River	**Facility Improvement:** Replace DSI generator set	Local (PacifiCorp)	$60,000
2020	Lewis River	**Facility Improvement:** Re-orient hatchery outlet to improve adult collection efficiency	Local (PacifiCorp)	$25,000
2020	Lewis River	**Facility Improvement:** Study Colvin/Davis Creeks for possible hatchery water supply	Local (PacifiCorp)	$50,000

Salmon Creek Subbasin

Wild Salmon & Steelhead

Chinook: ESA Listed

Steelhead: ESA Listed

Hatchery

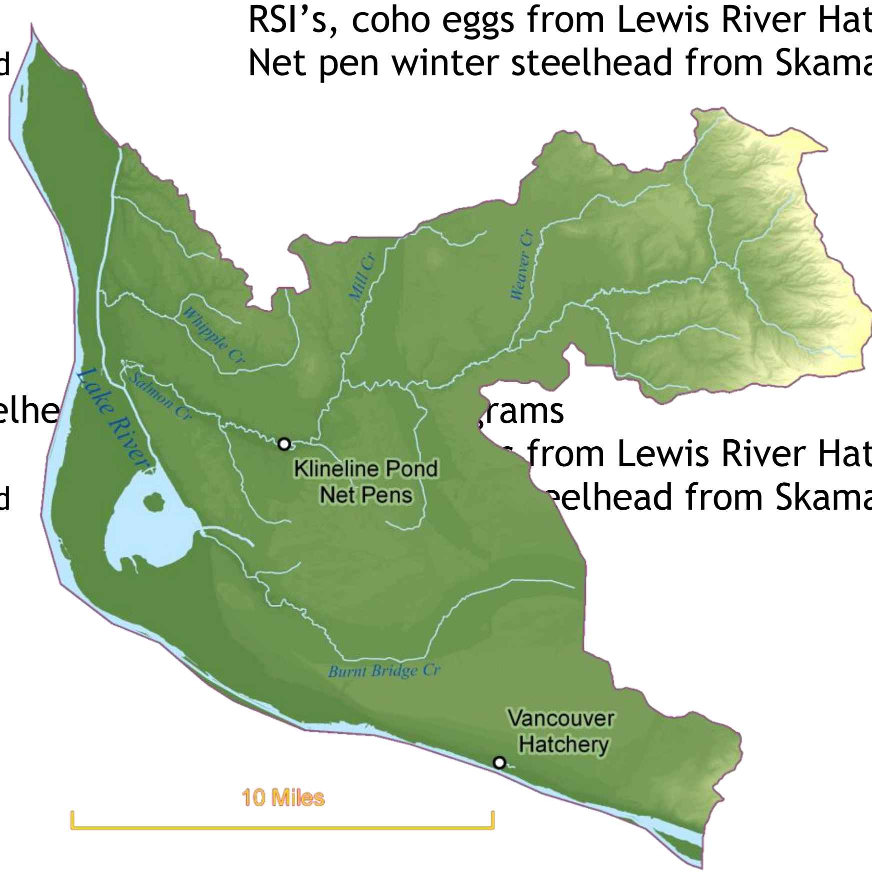
Coho: ESA Listed

Chum

Hatchery Programs

RSI's, coho eggs from Lewis River Hatchery

Net pen winter steelhead from Skamania



Wild Salmon & Steelhe
Chinook: ESA Listed
Steelhead: ESA Listed
Hatchery
Coho: ESA Listed
Chum
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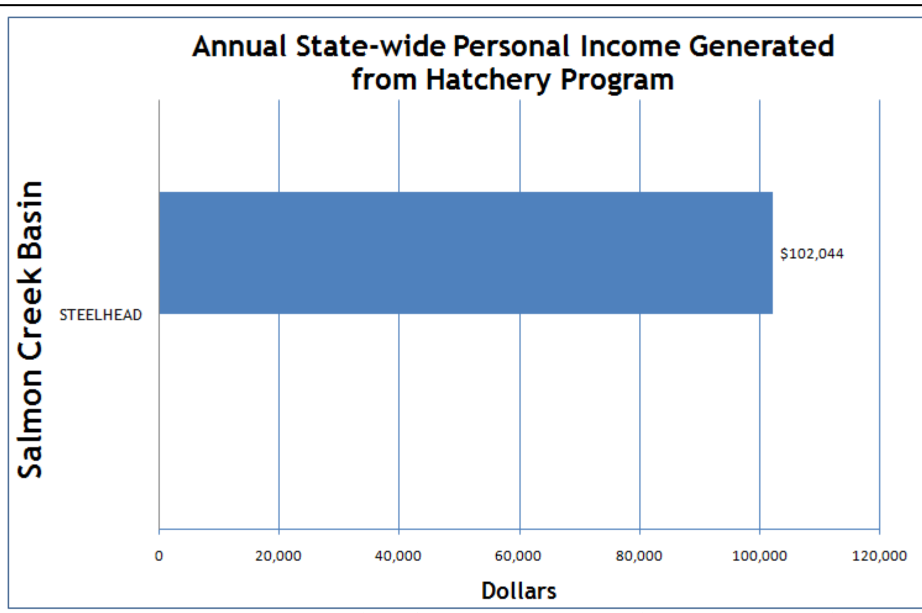
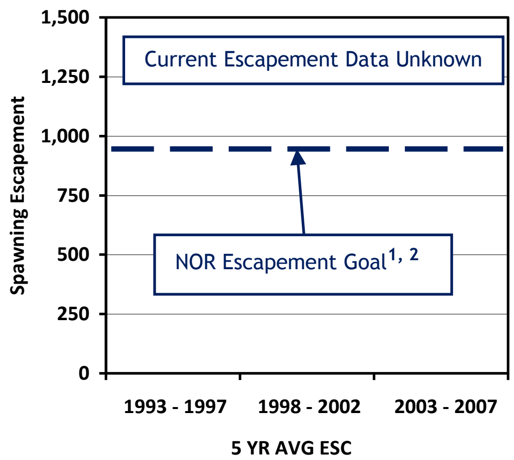
from Lewis River Hatchery
eelhead from Skamania



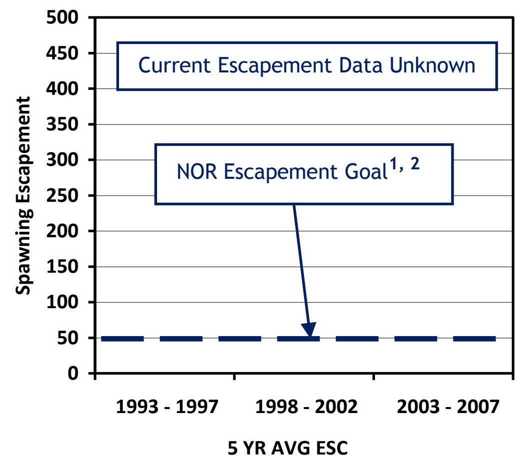
Source: Wegge, T. 2009 (June) Technical Memo. Economic Analysis of WDFW Hatchery Programs

Wild Salmon & Steelhead

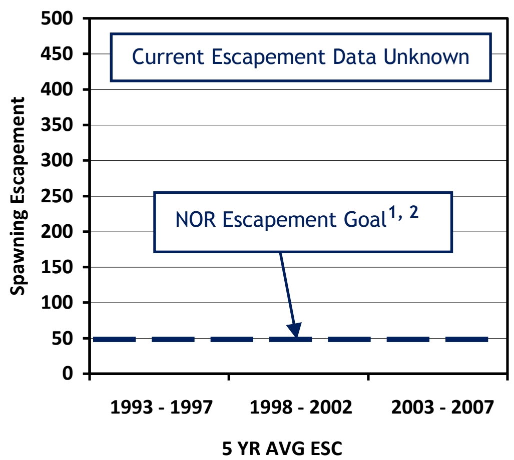
Fall Chinook
ESA Listing Status: Threatened
Populations: Salmon Creek (Stabilizing) Component of Lewis Population



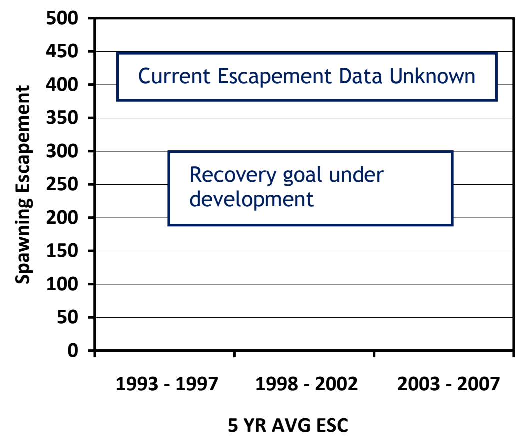
Winter Steelhead
ESA Listing Status: Threatened
Populations: Salmon Creek (Stabilizing)



Coho
ESA Listing Status: Threatened
Populations: Salmon Creek (Stabilizing)



Chum
ESA Listing Status: Threatened
Populations: Salmon Creek (Stabilizing)



[1]Number of natural origin spawners necessary to achieve population viability standards established by NOAA's TRT.

[2] Washington LCFRB Proposed Scenario Revisions (6/16/09 Draft).

Joint Programs (WDFW w/ Others)

Type N Coho

70,000 Eyed Eggs to Clark County PUD
5,000 Eyed Eggs to Steve Syverson Project
90,000 Eyed Eggs to Venersborg Firefighters

Additional program details can be found on the Future Brood Document on the WDFW website.

Location of RSI's can be found on the Future Brood Document.

Winter Steelhead

20,000 yearlings plant to Salmon Creek (WDFW)

Additional program details can be found on the Future Brood Document on the WDFW website.

Winter Steelhead

Monitoring

Biological Monitoring - Current

Wild Salmon and Steelhead Populations				
VSP Parameter	Fall Chinook	Winter Steelhead	Coho	Chum
Adult Abundance	• No current monitoring	• Limited redd surveys in index areas only in cooperation with Clark County and AmeriCorp	• No directed monitoring • Weir/trap installed in 2009 to assess passage at Hwy 99 bridge replacement –index counts only • Program duration unknown • Limited stream surveys in index areas	• No current monitoring
Adult Productivity	• No current monitoring • Currently, no mark selective fisheries in mainstem Columbia*	• LCR Fisheries - Wild steelhead release, but stock specific incidental impacts are unknown • No pHOS data	• LCR sport fisheries - Wild coho release • Stock specific incidental fishery impacts are unknown	• Retention prohibited in fisheries, but stock specific incidental impacts are unknown • No samples for age, sex ratio, & origin
Juvenile Productivity	• No current monitoring	• No current monitoring	• No current monitoring	• No current monitoring
Spatial Diversity	• No current monitoring	• GPS locations for individual redds in surveyed areas	• Counts from stream surveys in index areas	• No current monitoring
Species Diversity	• No current monitoring	• Spawn timing from stream surveys	• No current monitoring	• No current monitoring
*Mass marking of fall Chinook is underway with all LCR Tule fall Chinook (age 2-5) mass marked by the 2011 return. Mass marking programs are already in place for coho and steelhead.				

Biological Monitoring – Improvement Actions Needed

Wild Salmon and Steelhead Populations				
VSP Parameter	Fall Chinook	Winter Steelhead	Coho	Chum
Adult Abundance	• Database infrastructure • Develop and implement monitoring plan • Identify spatial extent of spawning (sample frame) • Monitor hatchery escapement (strays) • Estimate precision • Conduct power analysis	• Database infrastructure • Develop alternative/ improved methods for abundance estimates • Identify spatial extent of spawning (sample frame) • Develop LCR specific redds/female and sex ratio data • Monitor hatchery escapement • Estimate precision • Conduct power analysis	• Database infrastructure • Develop and implement monitoring plan • Identify spatial extent of spawning (sample frame). • Develop LCR specific redds/female, observer efficiency, and residence time • Monitor hatchery escapement (strays) • Conduct power analysis • Estimate precision	• Database infrastructure • Identify spatial extent of spawning (sample frame) • Develop & implement sampling designs to detect and estimate adult abundance • Develop LCR specific observer efficiency and residence time
Adult Productivity	• Determine pHOS based on ad-clips as mass marked returns are realized	• Estimate pHOS/gene flow • Estimate incidental mortality in LCR mainstem and tributary fisheries	• Estimate incidental mortality in LCR mainstem and tributary fisheries • Collect sex ratio, pHOS, and age structure from weir and stream surveys	• Determine LCR supplementation program contributions to natural spawning • Estimate incidental mortality in LCR mainstem and tributary fisheries
Juvenile Productivity	• Implement periodic juvenile monitoring program via rotary screw trap	• Implement periodic juvenile monitoring program via rotary screw trap	• Implement periodic juvenile monitoring program via rotary screw trap	• Implement periodic juvenile monitoring program via rotary screw trap
Spatial Diversity	• Develop & implement sampling design to estimate spatial distribution	• Consider alternate sampling designs to the current index/supplemental approach	• Develop & implement sampling designs to estimate spatial distribution	• Develop & implement sampling designs to estimate spatial distribution
Species Diversity	• Develop long-term ESU phenotypic and genetic monitoring and sampling plan	• Methods to collect origin, age, length and sex ratio data. • Develop DPS phenotypic and genetic monitoring and sampling plan	• Develop ESU phenotypic and genetic monitoring and sampling plan	• Develop ESU phenotypic and genetic monitoring and sampling plan

Monitoring

Hatchery Monitoring – Current

In-Facility	Performance Measures
• No hatcheries are located in the Salmon Creek Subbasin	• All hatchery origin adults are identifiable – steelhead released in the subbasin are adipose fin-clipped

Hatchery Monitoring – Improvement Actions Needed

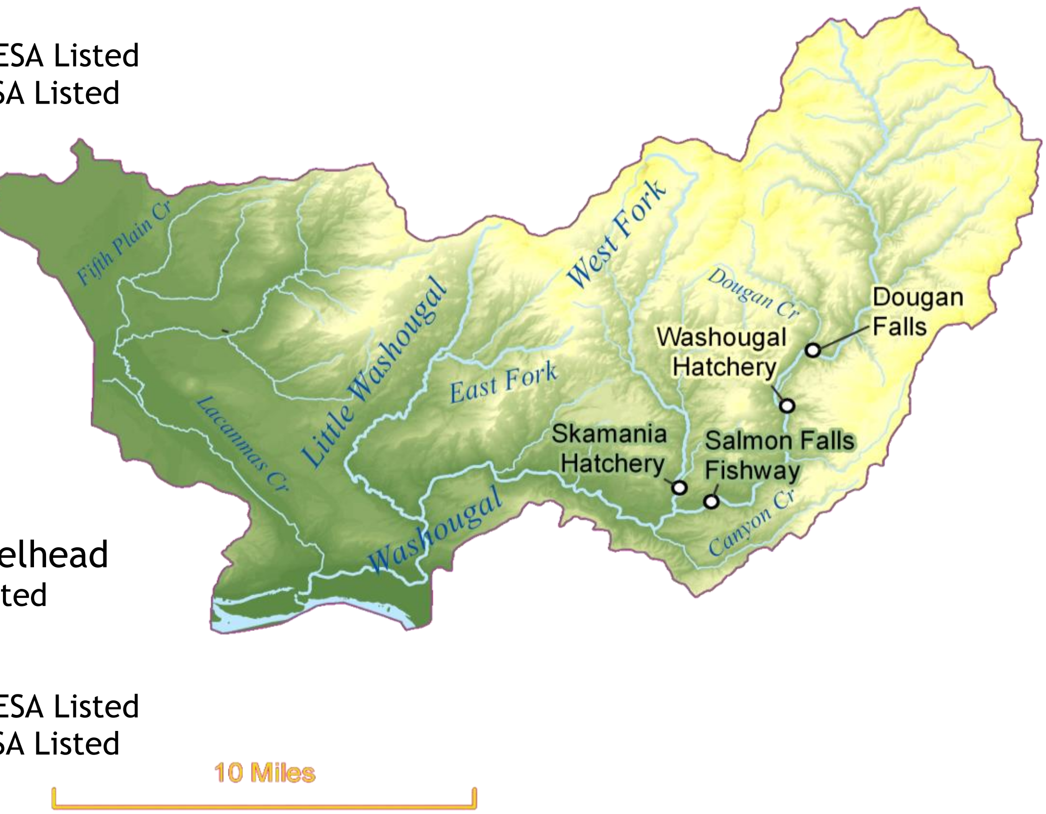
In-Facility	Performance Measures
• No hatcheries are located in the Salmon Creek Subbasin	• Develop monitoring program for fall Chinook - Estimate pHOS for fall Chinook based on visual identification of hatchery origin fish (i.e. adipose fin-clips) rather than CWT expansion, as mass marked returns of fall Chinook are realized • Development and implementation of methods to estimate pHOS and/or gene flow for winter steelhead • Development and implementation of methods to estimate pHOS for coho • Develop a regional monitoring plan for genetic and ecological interactions by hatchery-and natural-origin juveniles to assess impacts to the natural origin population • Develop nutrient enhancement goals for watershed and include in updated escapement goals

Implementation Schedule

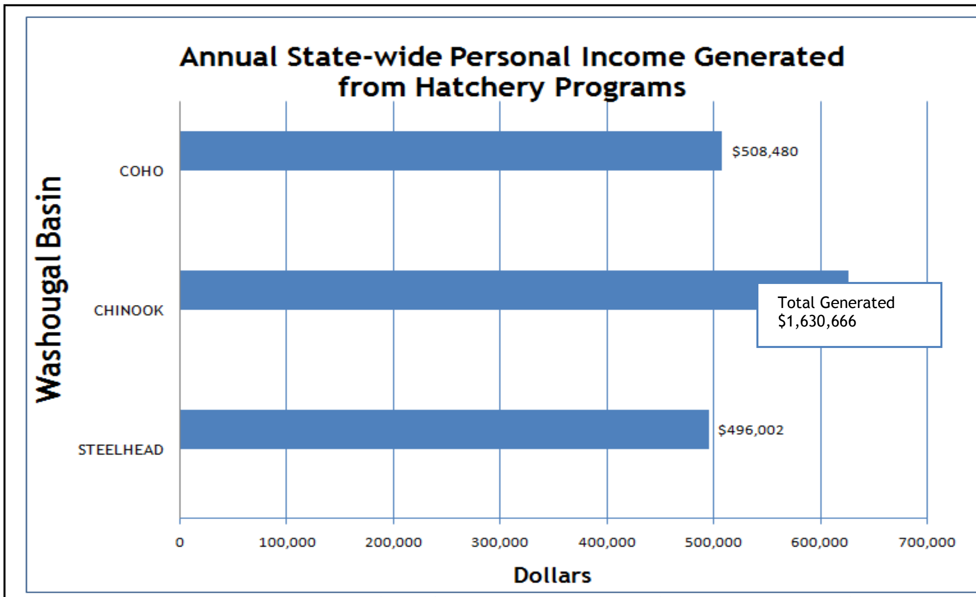
Salmon Creek does not have any hatchery facilities or infrastructure.

Wild Salmon & Steelhead
Fall Chinook: ESA Listed
Coho: ESA Listed
Chum: ESA Listed
Summer Steelhead: ESA Listed
Winter Steelhead: ESA Listed

Hatchery Programs
Washougal (WDFW)
Skamania (WDFW)



Wild Salmon & Steelhead
Fall Chinook: ESA Listed
Coho: ESA Listed
Chum: ESA Listed
Summer Steelhead: ESA Listed
Winter Steelhead: ESA Listed

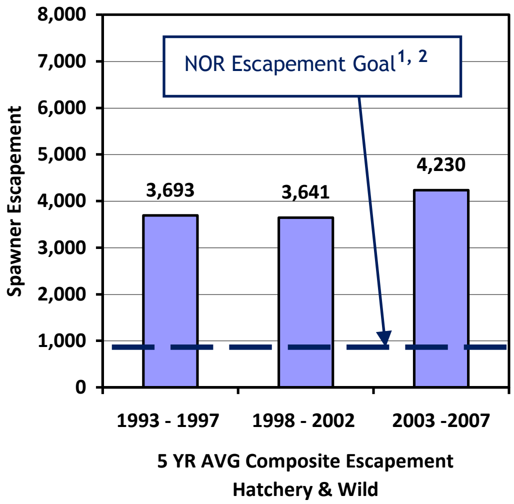


Source: Wegge, T. 2009 (June) Technical Memo. Economic Analysis of WDFW Hatchery Programs

Wild Salmon & Steelhead

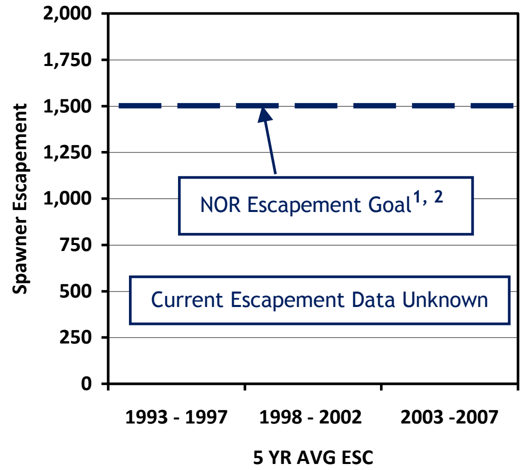
Fall Chinook

ESA Listing Status: Threatened
Populations: Washougal (Primary)



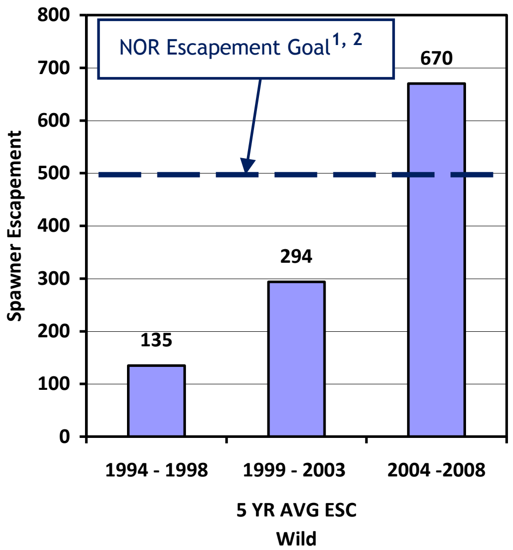
Coho

ESA Listing Status: Threatened
Populations: Washougal (Contributing)



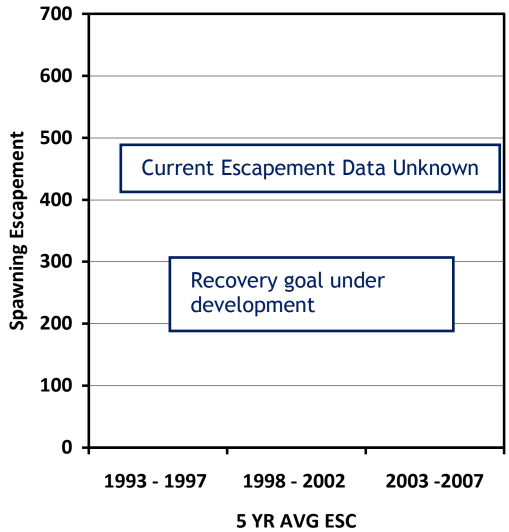
Summer Steelhead

ESA Listing Status: Threatened
Populations: Washougal (Primary)



Chum

ESA Listing Status: Threatened
Populations: Washougal (Primary)

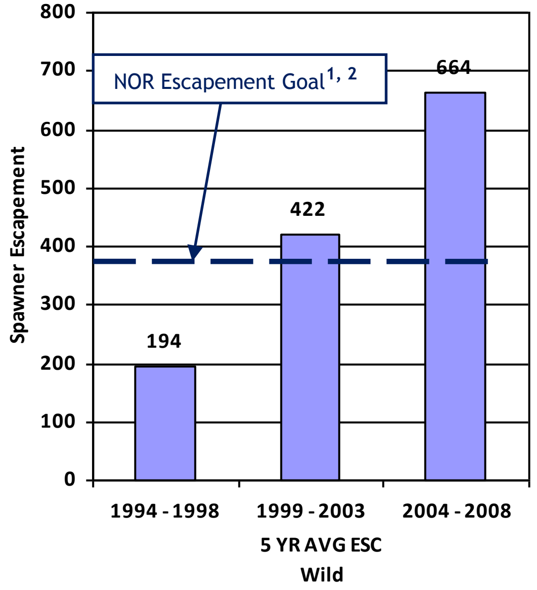


[1]Number of natural origin spawners necessary to achieve population viability standards established by NOAA's TRT.

[2]Washington LCFRB Proposed Scenario Revisions (6/16/09 Draft).

Winter Steelhead

ESA Listing Status: Threatened
Populations: Washougal (Contributing)



[1]Number of natural origin spawners necessary to achieve population viability standards established by NOAA's TRT.

[2]Washington LCFRB Proposed Scenario Revisions (6/16/09 Draft).

Washougal Hatchery (WDFW)

Salmon and Steelhead Programs

Fall Chinook
Purpose: Harvest/Conservation
Goal: Currently under development[1]
Brood stock Strategy: Integrated
Program Size: On-station release, 900,000 sub-yearlings (C&SFP), see joint programs for additional plants and transfers (2.1 million sub-yearling) (C&SFP).

Type N Coho
Purpose: Harvest/Conservation
Goal: Currently under development[1]
Brood stock Strategy: Integrated
Program Size: On-Station release, 150,000 Yearlings (C&SFP), see joint programs for additional plants and transfers (1.3 million eyed eggs, 1.75 million yearlings).

[1]Program specific goals are under development through completion of broodstock Management Plans. Overall production levels for Lower Columbia River have been evaluated through Conservation and Sustainable Fisheries Plan

Brood stock Management

Fall Chinook
Short-term Benchmark: PNI > 0.11
Long-term Goal: PNI > 0.67
Action Plan: Install weir on Lower River to manage composition on the spawning grounds consistent with the standards of a primary population (C&SFP). Continue integrated program consistent with Primary population (C&SFP).

Type N Coho
Short-term Benchmark: PNI > 0.11
Long-term Goal: PNI > 0.50
Action Plan: Continue integrated program consistent with a Contributing population (C&SFP).

Chum
Action Plan: Funding is being reinstated in 2009 to support supplementation program.

Environmental Compliance

Cleanwater Act
Action Plan: Compliant, no action necessary - Cost: NA

Passage
Action Plan: Rebuild fish ladder at diversion dam and install adult trapping capability.
Cost & Schedule: $585,000; (2010) (PCSRF)

Intake Screening
Action Plan: Complete rebuild, out of compliance for intake screening criteria and approach velocity.
Cost & Schedule: $8-10 million; 2015

Water Withdrawal
Compliant with water rights formalized through Trust water right #s2-25274, s2-09760, s2-09762.
Monthly NPDES reporting to Dept. of Ecology

Capital Needs

Incubation
Action Plan: Rebuild pressure relief valve and plumbing leading to incubation room
Cost & schedule: $ 10,000 (2012)

Rearing
Action Plan: Rebuild rearing ponds
Cost & schedule: $ 1.2 million (2010)

Adult Processing
Action Plan: Rebuild adult holding and sorting facility
Cost & Schedule: TBD (2012)

Other
Action Plan: Replace turbine pumps, replace decking on river rack.
Cost & Schedule: $ 25,000 (2009-2010)

Capital Needs

Hatcheries

Skamania Hatchery (WDFW)

Steelhead Programs

Summer Steelhead
Purpose: Harvest
Goal: Currently under development[1]
Brood stock Strategy: Segregated
Program Size: On-station release 60,000 yearlings, see joint programs for additional plants and transfers (70,000 fry, 129,000 yearlings).

Early Winter Steelhead
Purpose: Harvest
Goal: Currently under development[1]
Brood stock Strategy: Segregated
Program Size: On-station release 60,000 yearlings, see joint programs for additional plants and transfers (100,000 yearlings).

[1]Program specific goals are under development through completion of broodstock Management Plans. Overall production levels for Lower Columbia River have been evaluated through Conservation and Sustainable Fisheries Plan.

Other species reared at facility: Cutthroat trout and brown trout.

Broodstock Management

Summer Steelhead
Short-term Benchmark: Gene Flow < 2%
Long-term Goal: Gene Flow < 2%
Action Plan: Develop a wild integrated (40,000 smolts) program and continue a smaller segregated (20,000) hatchery program (C&SFP).

Early Winter Steelhead
Short-term Benchmark: Gene Flow < 2%
Long-term Goal: Gene Flow < 2%
Action Plan: Continue segregated program consistent with contributing population.

Environmental Compliance

Clean Water Act
Action Plan: Compliant, no action necessary
Cost:

Passage
Action Plan: Compliant, no action necessary
Cost:

Intake Screening
Action Plan: Installed criteria screening at point of diversion.
Cost & Schedule: $ 115,000 (2009)

Water Withdrawal
Compliant with water rights formalized through Trust water right # S2-*12684CWRIS and S2-*12685CWRIS
Monthly NPDES reporting to Dept. of Ecology

Capital Needs

Incubation
Action Plan: Add incubation holding capacity for fish health management.
Cost & schedule: TBD (2012)

Rearing
Action Plan: Replace part of raceways with large rearing ponds.
Cost & schedule: TBD (2014)

Adult Processing
Action Plan: Renovate adult holding and sorting area for employee safety and handling of ESA listed fish.
Cost & Schedule: TBD 2016

Other
Action Plan: NA
Cost & Schedule: NA

Hatcheries

Joint Programs (WDFW and Others)

Washougal Hatchery

Fall Chinook

2,100,000 sub-yearlings to SAFE net pen Project (C&SFP).

Type N Coho

Receive 1,300,000 green eggs from Lewis River, transfer eyed eggs to Klickitat Hatchery (YN) (Lewis River Stock)
1,750,000 yearlings to Klickitat River from Washougal (YN)

Type S Coho

400,000 Eggs received from Lewis River (Speelyai), transfer 350,000 yearlings to Deep River Net Pens (C&SFP)

Type N Wild Coho

Receive 400,000 eyed eggs from Speelyai Hatchery, thermal mark and transfer to Cedar Creek RSI (Fish First) (Lewis River Stock)

Skamania Hatchery

Summer Steelhead

Off Station Release Programs
90,000 yearlings plant to Klickitat River (US v. OR)
24,000 yearlings plant to White Salmon (WDFW)
30,000 fingerling transfer to Fallert Creek Hatchery (WDFW)
25,000 fingerling transfer to North Toutle Hatchery (WDFW)
15,000 fingerling transfer to South Fork Toutle (C&SFP) (Cowlitz Game & Anglers)
15,000 yearlings plant to E. Fork Lewis River (C&SFP) (WDFW)

Winter Steelhead

Off Station Release Programs
60,000 yearlings plant to E. Fork Lewis River (C&SFP) (WDFW)
20,000 yearlings plant to Salmon Creek (WDFW)
20,000 yearlings plant to White Salmon

Coho

750,000 yearlings to Klickitat River from Skamania (YN)

Monitoring

Biological Monitoring - Current

Wild Salmon and Steelhead Populations					
VSP Parameter	Fall Chinook	Winter Steelhead	Summer Steelhead	Coho	Chum
Adult Abundance	• Estimate of total spawners via peak count expansion • Hatchery counts	• Estimate of total spawners via redd count expansion	• Estimate of total spawners via mark-resight (snorkeling)	• No directed monitoring • Ancillary spawner count during fall Chinook surveys in index areas only	• 1999-2006 Estimates of abundance in index areas only • No current monitoring
Adult Productivity	• pHOS via CWT expansion* • Currently, no mark selective fisheries in mainstem Columbia* • Harvest estimates from CWT analysis	• LCR Fisheries - Wild steelhead release, but stock specific incidental impacts are unknown • No pHOS data	• LCR Fisheries - Wild steelhead release, but stock specific incidental impacts are unknown • pHOS from seining and snorkel surveys above Washougal Hatchery	• LCR sport fisheries - Wild coho release • Stock specific incidental fishery impacts are unknown • No pHOS data	• Retention prohibited in fisheries, but stock specific incidental impacts are unknown • Limited samples for age, sex ratio, & origin
Juvenile Productivity	• No smolt monitoring	• No smolt monitoring	• No smolt monitoring	• No smolt monitoring	• No smolt monitoring
Spatial Diversity	• Redd counts by spawning reach during stream surveys	• GPS locations for individual redds in surveyed areas	• No spawning distribution data	• No monitoring program in place	• 1999-2006 counts by section in index areas • No current monitoring
Species Diversity	• Age, sex ratios and lengths for cohort structure • Run timing from hatchery weir/trap • Spawn timing from stream surveys • No genetic sampling	• Spawn timing from stream surveys • Genetic baseline from samples collected in 2005-07, samples have been analyzed	• Age, length, & sex ratio data via seining • Genetic samples collected annually, but not analyzed	• No monitoring program in place • Some genetic samples are archived, but not analyzed	• Limited samples for age, sex ratio, length & origin for cohort structure • Spawn timing from stream surveys • Baseline DNA samples collected, but not analyzed
*Mass marking of fall Chinook is underway with all LCR Tule fall Chinook (age 2-5) mass marked by the 2011 return. Mass marking programs are already in place for coho and steelhead.					

Biological Monitoring – Improvement Actions Needed

Wild Salmon and Steelhead Populations					
VSP Parameter	Fall Chinook	Winter Steelhead	Summer Steelhead	Coho	Chum
Adult Abundance	• Database infrastructure • Develop alternative/ improved methods for abundance estimates; e.g. AUC or mark/recapture • Identify spatial extent of spawning (sample frame) • Estimate precision • Conduct power analysis	• Database infrastructure • Develop alternative/ improved methods for abundance estimates • Conduct population monitoring in NF Washougal • Identify spatial extent of spawning (sample frame) • Develop LCR specific redds/female and sex ratio data • Monitor hatchery escapement • Estimate precision • Conduct power analysis	• Database infrastructure • Improve mark-resight point and variance estimates to account for snorkeler efficiency and tag loss • Conduct population monitoring in NF Washougal • Conduct power analysis • Operate trap at Washougal hatchery to capture more fish for tagging (mark/resight)	• Database infrastructure • Develop and implement monitoring plan. • Identify spatial extent of spawning (sample frame). • Develop LCR specific redds/female, observer efficiency, and residence time • Monitor hatchery escapement. • Conduct power analysis • Estimate precision	• Database infrastructure • Identify spatial extent of spawning (sample frame) • Develop & implement sampling designs to estimate adult abundance • Develop LCR specific observer efficiency and residence time • Estimate precision for current and historical data • Conduct power analysis
Adult Productivity	• Pursue options for mark selective fisheries • Determine pHOS based on ad-clips as mass marked returns are realized	• Estimate pHOS/gene flow • Estimate incidental mortality in LCR mainstem and tributary fisheries	• Estimate incidental mortality in LCR mainstem and tributary fisheries • Estimate pHOS/gene flow in NF and lower Washougal	• Estimate incidental mortality in LCR mainstem and tributary fisheries	• Determine LCR supplementation program contributions to natural spawning • Estimate incidental mortality in LCR mainstem and tributary fisheries
Juvenile Productivity	• Implement periodic juvenile monitoring program via rotary screw trap	• Implement periodic juvenile monitoring program via rotary screw trap	• Implement periodic juvenile monitoring program via rotary screw trap	• Implement periodic juvenile monitoring program via rotary screw trap	• Implement periodic juvenile monitoring program via rotary screw trap
Spatial Diversity	• Collect GPS locations for individual redds in survey areas • Develop & implement sampling designs to estimate spatial distribution	• Consider alternate sampling designs to the current index/supplemental approach	• GRTS juvenile parr sampling or juvenile PIT tagging	• Develop & implement sampling designs to estimate spatial distribution	• Develop & implement sampling designs to estimate spatial distribution
Species Diversity	• Develop long-term ESU phenotypic and genetic monitoring and sampling plan	• Methods to collect origin, age, length and sex ratio data • Develop DPS phenotypic and genetic monitoring and sampling plan	• Develop DPS phenotypic and genetic monitoring and sampling plan • Process existing genetic samples • Document run timing	• Develop ESU phenotypic and genetic monitoring and sampling plan • Analyze archived genetic baseline samples	• Develop ESU phenotypic and genetic monitoring and sampling plan • Analyze archived genetic baseline samples

Monitoring

Hatchery Monitoring - Current

In-Facility	Performance Measures
• In-season management of adult salmonid returns, broodstock collection and spawning protocols • Enumeration of hatchery origin and natural origin returns to hatchery collection facilities and final disposition of each • For integrated programs – enumeration of the number of hatchery and natural origin fish used in the broodstock for each species to calculate pNOB • Hatchery return timing, age composition (from scales), stock composition (CWT analysis), sex ratio and length data for run reconstruction and forecasting • Survival to each life history stage during incubation and rearing (Green egg, Eyed egg, Fry, Parr, Smolt) • Growth/feed conversions and condition • Monthly fish health monitoring • Number of smolt released- size and condition factor at release • Water quality - regulated by Washington Department of Ecology - weekly and/or monthly samples to ensure facility compliance	• All hatchery origin adults are identifiable - juveniles are marked pre-release by one or both of the following: adipose fin-clip, CWT in snout • Harvest rates – contribution to commercial and sport fisheries. • Hatchery smolt to adult survival rates • pHOS for fall Chinook via CWT expansion • pHOS for summer steelhead above Washougal Hatchery via seining and snorkel surveys

Monitoring

Hatchery Monitoring – Improvement Actions Needed

In-Facility	Performance Measures
• Development of updated Hatchery and Genetic Management Plans (HGMP) for each hatchery program consistent with implementation of the Conservation and Sustainable Fisheries plan and incorporate HSRG standards • Development of natural origin run and/or spawn timing curves to guide collection of natural origin broodstock for integrated programs • Review and update spawning protocols and incubation, rearing & release strategies	• Estimate pHOS for fall Chinook based on visual identification of hatchery origin fish (i.e. adipose fin-clips) rather than CWT expansion, as mass marked returns of fall Chinook are realized • Development and implementation of methods to estimate pHOS for coho • Development and implementation of methods to estimate pHOS and/or gene flow for winter steelhead and for summer steelhead below the Washougal Hatchery • Calculation of pNOB, pHOS and PNI statistics annually for each hatchery program and development of a reporting format to track hatchery performance measures • Develop a regional monitoring plan for genetic and ecological interactions by hatchery-and natural-origin juveniles to assess impacts to the natural origin population • As additional data is collected and new methodologies become available, modify programs to achieve goals for PNI, pHOS and pNOB • Develop nutrient enhancement goals for watershed and include in updated escapement goals

Implementation Schedule

Preliminary Washougal Hatchery action implementation plan. Actions and schedule will be reviewed, evaluated, and updated annually.

Year	Facility	Action	Fund Source	Cost
2009	Washougal Hatchery	**Maintenance:** Replace electric intake Pump #1.	Federal	$15,000
2009	Washougal Hatchery	**Maintenance:** Replace decking on river weir.	Federal	$10,000
2010	Washougal Hatchery	**Capital Needs:** Renovate earthen rearing pond	State Capital	$1.2 mil.
2010	Washougal Hatchery	**Maintenance:** Replace turbine pumps at intake.	Federal	$15,000
2010	Washougal Hatchery	**Brood stock Management:** Install weir and adult fish sorting facility on Lower River.	Federal	Design Only $100,000
2011	Washougal Hatchery	**Capital Needs:** Design and provide adult fish passage over intake barrier.	Federal	$585,000
2012	Washougal Hatchery	**Capital Needs**: Improve adult holding and sorting facility.	Federal	TBD
2012	Washougal Hatchery	**Maintenance:** Replace pressure relief valve for incubation.	Federal	TBD
2014	Washougal Hatchery	**Maintenance:** Replace pollution abatement lift pump, electrical panels and aerators.	Federal	TBD
2015	Washougal Hatchery	**Environmental Compliance:** Replace river intake screens.	Federal	TBD
2017	Washougal Hatchery	**Maintenance:** Replace sumps and screen channels on raceways.	Federal	TBD
2020	Washougal Hatchery	**Maintenance:** Replace 24 raceways.	Federal	TBD
2025	Washougal Hatchery	**Maintenance:** Replace intake screening and structure at both creek intakes.	Federal	TBD
2027	Washougal Hatchery	**Maintenance:** Miscellaneous.	Federal	TBD

Implementation Schedule

Preliminary **Skamania Hatchery** action implementation plan. Actions and schedule will be reviewed, evaluated, and updated annually.

Year	Facility	Action	Fund Source	Cost
2009	Skamania Hatchery	**Environmental Compliance:** Install new rotating screens and fixed screens on N. Fork Washougal intake.	Federal	$115,000
2012	Skamania Hatchery	**Capital Needs:** Add incubation holding capacity with addition of added pathogen free water supply.	Federal	TBD
2014	Skamania Hatchery	**Capital Needs:** Deconstruct raceways 17-32 and replace with 2 – 160x20x5 super raceways.	Federal	TBD
2014	Skamania Hatchery	**Capital Needs:** Renovate adult holding and sorting area for employee safety and workload efficiency.	Federal	TBD
2018	Skamania Hatchery	**Capital Needs:** Replace raceways 1-16.	Federal	TBD