Lower Columbia Conservation & Sustainable Fisheries Plan

2023 Progress Report

Lower Columbia Fish Recovery Board

Steve Manlow *Executive Director*

Amelia Johnson *Salmon Recovery Specialist*

Washington Department of Fish and Wildlife

Bryce Glaser *Southwest WA Fish Program Manager (Region 5)*

Thomas Buehrens *Senior Research Scientist*

Todd Hillson *ESA/Anadromous Fish Investigations Unit Lead (Region 5)*

Fish Science Solutions, Inc.

Ray Beamesderfer *Fish Scientist*

December 2023

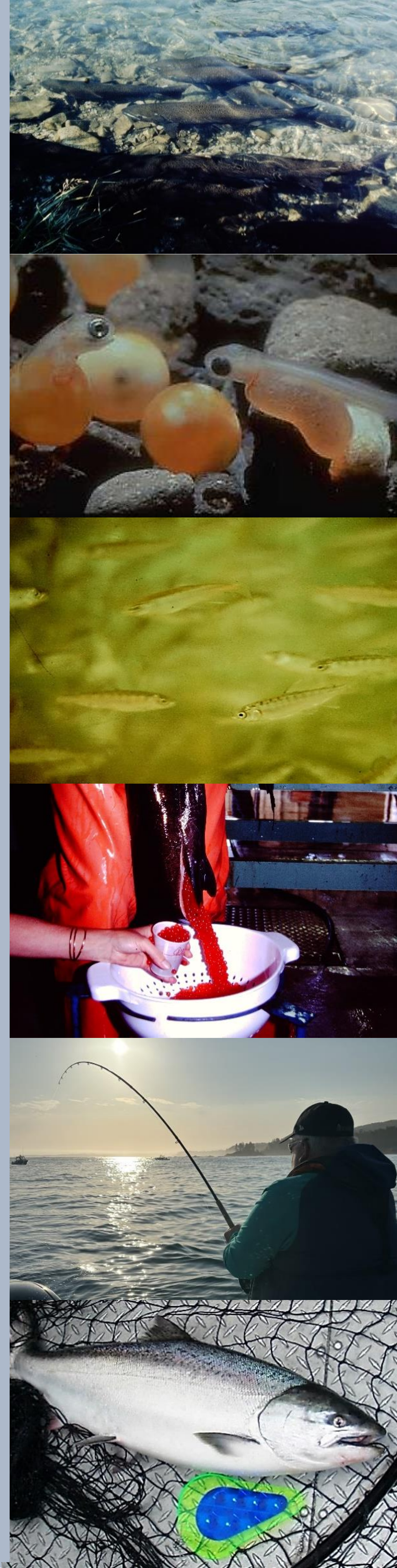


Table of Contents

Table of Figures

Table of Tables

The Washington Lower Columbia River Fish Recovery Board

The Lower Columbia Fish Recovery Board (LCFRB) is the State of Washington's regional organization for salmon recovery in Southwest Washington. This region extends from the mouth of the Columbia River upstream to, and including, the Little White Salmon River.

The LCFRB is one of eight regional recovery organizations established by the State of Washington to develop and facilitate implementation of salmon and steelhead recovery and sustainability plans, monitor implementation, and track and report on accomplishments. The regional recovery organizations are governed by local boards, assisted by technical experts and committees.

The LCFRB led the collaborative development of the Washington Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan for Chinook salmon, chum salmon, coho salmon, and steelhead listed under the Endangered Species Act (ESA).

Acknowledgements

This progress report would not be possible without the many Washington Department of Fish and Wildlife staff who collected, managed and developed population data used for this project. Feedback from Lower Columbia Fish Recovery Board members, Technical Advisory Committee members, staff and recovery partner community members on draft report products helped shape the final version of this report. This report was prepared with funding provided by the Washington State Recreation and Conservation Office and Washington Sea Grant under the National Oceanic and Atmospheric Administration.

SUMMARY

This report reviews current status of Southwest Washington salmon and steelhead, and effects of hatchery and fishery actions implemented since the Washington Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan (Recovery Plan) was completed for these ESA-listed species in 2010. Hatchery and fishery actions were previously described in a comprehensive implementation plan completed in 2017 by the Washington Department of Fish and Wildlife and the Lower Columbia Fish Recovery Board.

Fish status is assessed relative to ESA delisting goals identified in the Recovery Plan in terms of species and population viability, which is the ability to persist over an extended period of time. Viability in salmon is a function of four Viable Salmonid Population (VSP) parameters: abundance, diversity, productivity, and spatial structure.

Southwest Washington salmon and steelhead status is generally stable or has increased in the interim since baseline viability was estimated for the years 1998 and 1999. Annual numbers of salmon are inherently variable but long-term declining trends appear to have been arrested, at least for the time being. This assessment estimates that viability for 25 of the 72 populations (35%) is greater than baseline viability and 14 populations (19%) are currently at High or Very High viability. Species-level improvements have been identified for tule fall Chinook, coho, and chum salmon, winter- and summer-run steelhead, with average viability increasing from Very Low, to Low – Medium levels. Spring Chinook remain at Very Low viability today due to continued fish passage and reintroduction program establishment while Late fall Chinook remain the sole species-run timing group existing at Very High viability.

While current trends are encouraging, no listed salmon or steelhead species in the Washington lower Columbia region are anywhere close to meeting species scale recovery goals. Of the 72 historic populations, 46 (64%) are still at Low or Very Low viability. No species has achieved High or greater viability, which is necessary to assure long-term persistence and to consider ESA delisting.

Many species and populations have clearly benefited from conservation and recovery measures including fishery reductions, hatchery reforms, reintroduction programs and habitat protection and restoration. In some cases, more comprehensive stock assessments implemented since listing have found substantially greater numbers of natural-origin spawners than were previously known. This is the case for coho and chum salmon. At this time, it is difficult to distinguish trends from the effects of better stock assessment due to the lack of consistent long-term data for most natural-origin populations. Sustained conservation, restoration and assessment efforts will be critical to achieving long-term recovery goals for these listed salmon and steelhead species.

Additional details on hatchery and fishery actions will be provided in related chapters to be published in 2024.

INTRODUCTION

The *Recovery Plan for Lower Columbia River Salmon and Steelhead* (Recovery Plan) identifies a comprehensive suite of targets, strategies, and actions for reducing the impact of factors responsible for the long-term decline and subsequent listing in 1998-2005 of these species under the U.S. Endangered Species Act (LCFRB 2010; NMFS 2013). These factors include freshwater and estuary habitat, hydroelectric, ecological interactions, hatcheries, and fisheries.

A comprehensive implementation plan for Washington Lower Columbia hatchery and fishery actions was completed in 2017 by the Washington Department of Fish and Wildlife and the Lower Columbia Fish Recovery Board (WDFW and LCFRB 2017). This Conservation and Sustainable Fisheries Plan (CSFP) sets forth strategies, actions, and management practices consistent with efforts to return natural-origin lower Columbia salmon and steelhead to healthy, harvestable levels while sustaining Tribal, commercial, and recreational fisheries (LCFRB 2010; Murdoch and Marston 2020). The CSFP addresses Recovery Plan actions for hatchery and fishery threats that are within WDFW's authority. WDFW also addresses actions in other impact categories, such as ecological interactions and hydro-operations. Where WDFW does not have the sole authority to implement a given action, the agency works through other processes to achieve the desired result (e.g., ODFW and WDFW 2021). The CSFP also describes monitoring of population responses to fishery and hatchery actions, program refinements based on fish responses, and reporting of hatchery and fishery reform implementation and progress toward recovery targets.

This report reviews progress in implementation and the responses to hatchery and fishery strategies identified by the CSFP. The report reviews: 1) the current species and population status in the region relative to recovery goals; 2) hatchery reforms and benefits; and 3) fishery management protections and effects. Information is summarized for each salmon and steelhead species and run, and is presented within an All-H recovery framework. Additional hatchery and fishery actions expected to be implemented are identified. This initial progress report chapter addresses review step 1.

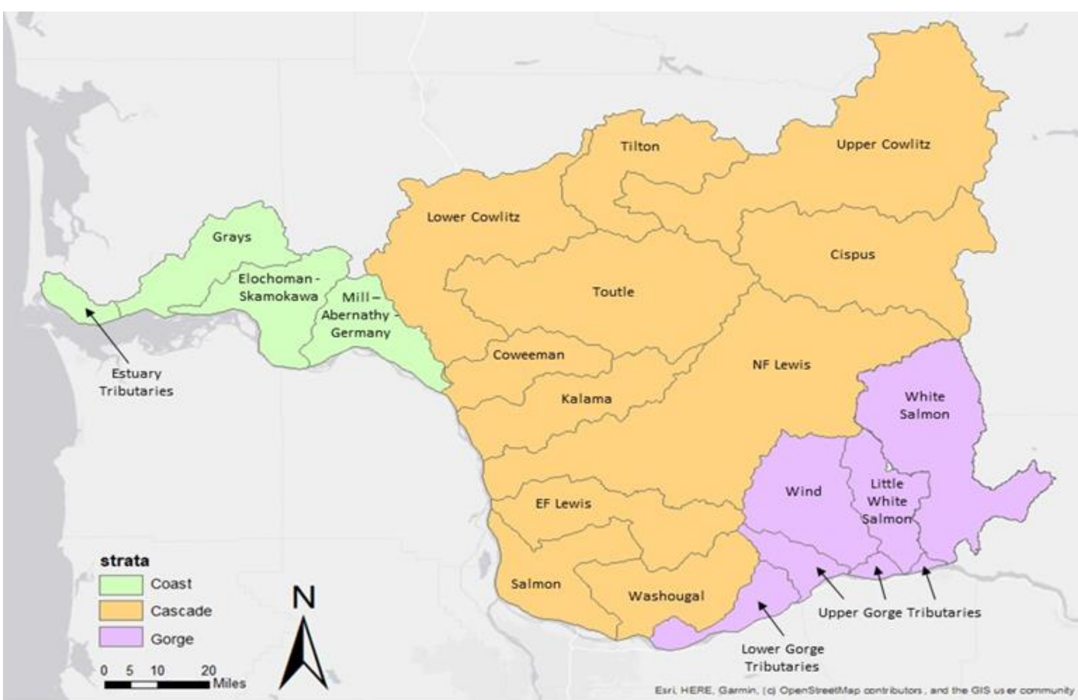


Figure 1. The Lower Columbia River region. Each subbasin is labeled and color coded by strata. NF Lewis = North Fork Lewis; EF Lewis = East Fork Lewis.

Status Assessment

This report reviews salmon and steelhead status in the Washington Lower Columbia region relative to goals identified in the Recovery Plan. Three Evolutionarily Significant Units (ESU) of salmon (Chinook, coho, chum) and one Distinct Population Segment (DPS) of steelhead are listed under the ESA in the Lower Columbia River region (Table 1). Each listing unit can also include multiple run types (spring, fall and late fall Chinook; winter and summer steelhead). A total of seventy-two populations are distributed across three strata (Coast, Cascade, Gorge), including winter steelhead in the Coast strata which are a part of the unlisted Southwest Washington Steelhead DPS.

Table 1. The four ESA-listed species in the Lower Columbia region and their federal ESA status and listing dates.

Species	Scientific Name	ESA Status	Initial ESA Listing
Lower Columbia River Steelhead	*Oncorhynchus mykiss*	Threatened	March 19, 1998
Lower Columbia River Chinook Salmon	*Oncorhynchus tshawytscha*	Threatened	March 24, 1999
Columbia River Chum Salmon	*Oncorhynchus keta*	Threatened	March 25, 1999
Lower Columbia River Coho Salmon	*Oncorhynchus kisutch*	Threatened	June 28, 2005

Recovery goals are defined in terms of species and population viability, which is the ability to persist over an extended period of time.[1] Viability is a function of four Viable Salmonid Population (VSP) parameters: abundance,[2] diversity, productivity, and spatial structure. Recovery criteria call for at least two populations achieving High or Very High viability in each of three geographic strata, and an average viability of Moderate across all populations in each stratum[3]. The Recovery Plan also includes a recovery scenario designating populations for different levels of viability contribution to recovery goals (Primary, Contributing, Stabilizing). Extensive descriptions of recovery definitions, criteria, and goals may be found in the Recovery Plan (LCFRB 2010; NMFS 2013).

Abundance is estimated by WDFW with a variety of methods appropriate to each species and population (Rawding et al. 2014; Wilson et al. 2019). These can include dam and weir counts where fish enter a trap or are counted as they pass a window. Many populations are monitored by spawning ground surveys where observers count fish or redds from shore, boat or by snorkeling. Hatchery-origin fish are typically distinguished from natural-origin fish by the absence of adipose fins which are removed at the hatcheries prior to release as juveniles.

LCFRB worked with WDFW to compile current data and information for this report. Some information is publicly available via online databases including WDFW's Salmon Conservation and Reporting Engine (SCoRE, https://fortress.wa.gov/dfw/score/) and the Pacific States Marine Fisheries Commission fisheries Coordinated Assessment Project (CAP) on StreamNet (https://www.streamnet.org/cap/). Other metrics and data sets were calculated, determined, and/or centralized internally by WDFW staff specifically for this report. Metrics and data format should align with updated hatchery metrics output funded through the 2020 SRFB Monitoring project (Lower Columbia Population Performance Reporting, Grant #20-1165). Future report iterations will align with status and trends analysis of adult abundance data by WDFW for biennial State of the Salmon in Watersheds reporting.

[1] *NOAA's Lower Columbia River Technical Recovery Team and the Recovery Plan define "long-term" risks based on a 100-year time frame (NMFS 2013).*

[2] *For the purposes of the viability reassessment, abundance is expressed as the recent 12-year geometric mean value consistent with guidance in the Recovery Plan.*

[3] *Viability scores are included in Table 4-1 of Volume I, Chapter 4 of the Recovery Plan (LCFRB 2010).*

Data availability was categorized for each population: 1 = good (annual statistical stream survey, dam or weir count), 2 = fair (periodic surveys, index counts), 3 = poor (lacking annual or periodic surveys, expert judgement, habitat model inference). Of the 72 populations in the region, 57 (79%) have annual monitoring data sets sufficient to support "good" estimates of current abundance (Table 2). Two additional populations have fair monitoring data sets and data is poor for 13 populations.

Table 2. Summary of population status data availability for lower Columbia River salmon and steelhead. Quality/type of recent abundance data: good (annual statistical stream survey, dam or weir count), fair (periodic surveys, index counts), poor (expert judgement, habitat model inference).

	No. of populations	Good	Fair	Poor
Spring Chinook	7	4	1	2
Fall Chinook	14	13	0	1
Late Fall Chinook	1	1	0	0
Coho	17	17	0	0
Chum	11	5	1	5
Winter Steelhead	17	13	1	3
Summer Steelhead	5	4	0	1
Totals	***72***	***57***	***2***	***13***

"Current" abundance is summarized in this report based on recent twelve- and four-year geometric means[4] per direction in the Recovery Plan and the related and comprehensive Research, Monitoring and Evaluation program identified by the LCFRB (2010). A 12-year geometric mean was selected to represent an interval of sustained abundance across multiple generational cycles. A 4-year geometric mean describes status of the latest fish generation. "Current" estimates included the most recent years available for each population which was typically 2008-2019 (12-year) and 2016-2019 (4-year). Full abundance data sets are included in Appendix A.

In cases where all twelve or four years were not available, the geometric mean included years where data were available within the prescribed period. Many populations do not have very long-term datasets for natural origin spawner estimates. For instance, comprehensive surveys of Chinook and coho were conducted by WDFW beginning only in 2010 (Rawding et al. 2014). In cases where no current stock assessment data were available, abundance estimates are based on best professional judgement or assumed baseline abundances from the Recovery Plan. In most cases, populations without current stock assessments are at Very Low viability. In some cases, best professional judgement of current abundance may differ slightly from assumed baseline population sizes. This may be because of assumed changes in population size since baseline conditions, but also may indicate new understanding of small populations even without regular monitoring.

Viability of each Washington Lower Columbia population was re-assessed in this report based on current abundance and related information on spatial structure, productivity, and diversity. This involved a multi-step process:

[4] *Geometric means are defined as the nth root of n products. Geometric means are considered to be a better measure of central tendency for data such as fish abundance which is typically highly skewed. The geometric mean smooths the contribution of periodic large run sizes which otherwise inflate simple averages relative to typical population values.*

1) Abundance of natural-origin spawners (12-year geometric mean) was compared with abundance benchmarks in the Recovery Plan defining different levels of viability for each individual population, resulting in an initial viability categorization (see Appendix E in LCFRB 2010).[5]
2) Initial viability levels defined by current abundance were then adjusted to account for productivity, diversity, and spatial structure VSP parameters, thus accounting for populations where spawning was narrowly distributed or where hatchery fish comprised a substantial portion of total spawners with the potential to reduce natural productivity and diversity. The corresponding adjustment scheme is described in Table 3 and Box 1. No adjustments were made to abundance-based viability when data were not available. The biggest example of a viability data gap is pHOS data for steelhead, which are not available for most populations.
3) After the initial abundance-based assessment and identified adjustments were complete, a review of viability status considered any factors beyond the scope of steps 1 and 2. If warranted, final viability status was adjusted at this stage. If abundance-based viability was based on professional judgement, baseline viability estimates were assumed. There were two adjustments in step 3 and their rationale is carefully detailed in the population descriptions later in this report along with details on abundance relative to Recovery Plan goals, distribution, hatchery fish impacts, and any unique challenges to recovery or population monitoring. A viability assignment example is presented in Box 2.

This assessment estimates that viability for 25 of the 72 populations (35%) is greater than reported in the Recovery Plan at the time of ESA listing. Fourteen of the 72 populations (19%) are currently at High or Very High viability (Table 4). In contrast, 46 populations (64%) are at Low or Very Low viability. Late fall Chinook are in the best shape based on a single population at Very High viability. Summer and winter steelhead viability average Moderate (M) across populations. Average viability is Low to Very Low for all other species and run types (Table 4). Many of these viability improvements are attributable to the implementation of a more comprehensive statistical assessment program of population status. For instance, new spawning ground surveys have documented substantially more natural-origin coho salmon spawning in streams than was previously known. Many species and populations have benefited from conservation and recovery measures including fishery reductions, hatchery reforms, reintroduction programs and habitat restoration. At this time, it is difficult to distinguish trends in actual improvement from the effects of better stock assessment due to the lack of consistent long-term data for most natural-origin populations.

Table 3. Number of viability category adjustments for a population when spatial structure, diversity and productivity VSP parameters were incorporated into categorization. Abundance-based viability was adjusted from its initial viability category based on impacts to viability resulting from hatchery origin spawner impacts (pHOS) or fish passage limitations due to blocked habitat and collection efficiency limitations. Adjustments were not made when pHOS and spatial structure data were unavailable.

pHOS	Spatial Structure		
	< 10% blocked habitat or >95% fish passage	**10% - 30% blocked habitat or 75 – 95% fish passage**	**> 30% blocked habitat or <75% fish passage**
<30% or unknown	0	-1	-2
30-50%	-1	-2	-3
>50%	-2	-3	-4

[5] *Most gorge stratum populations include fish in Oregon watersheds. For the purposes of this report, recovery abundance goals and targets are halved because population estimates are only for the Washington-based fish in these shared populations.*

Box 1. Viability adjustment criteria.

<u>Proportion of hatchery-origin spawners (pHOS)</u>

Hatchery-origin spawners can limit productivity and diversity of natural-origin populations. Average pHOS estimates are described in the Hatchery chapter of this report, and applied to viability adjustments in this chapter using the following rules:

- If pHOS averages are less than 30 percent, it is assumed hatchery-origin fish are not substantially limiting population viability because this level of influence is within the range identified for Primary populations impacted by integrated and segregated hatchery programs in the CSFP. No viability adjustments are made.
- If pHOS averages are 30 – 50%, within the goal range for Contributing populations impacted by integrated and segregated hatchery programs, a viability adjustment of one category is assumed.
- If pHOS averages are greater than 50%, a viability adjustment of two categories is assumed.

<u>Blocked Habitat</u>

Habitat blocked by dams, culverts, bridges and other passage constraints without supporting trap and haul programs can decrease distribution of natural-origin populations, reducing spatial structure, population capacity, and potentially productivity and diversity (Atlas et al. 2015). Adjustments in viability resulting from limited distribution were made using the following rules:

- If less than 10% of anadromous habitat is artificially blocked, no viability adjustments are assumed.
- If 10 – 30% of anadromous habitat is artificially blocked, a viability adjustment of one category is assumed because of some potential impacts to spatial structure.
- If more than 30% of anadromous habitat is artificially blocked, a viability adjustment of two categories is assumed because of potentially high impacts to spatial structure.

<u>Fish Passage</u>

Large artificial barriers may require trap and haul practices to provide fish passage. Productivity of natural-origin populations is limited when fish passage rates are low because non-passage acts demographically in an indistinguishable manner from other forms of density-independent mortality like low marine survival. Connectivity of habitats for fish migration, either through natural means or trap and haul, is therefore an essential component of population spatial structure.

Fish passage survival rate goals for upstream transport of adults (Cowlitz, Lewis, and Toutle basins) and downstream transport of smolts (Cowlitz and Lewis basins) are identified in the Biological Opinions issued by NOAA Fisheries that govern the operation of trap and haul programs in these watersheds. The Biological Opinions for the Cowlitz and Lewis River basins require 95% downstream fish passage survival for smolts, although 75% is a minimum compliance target in the Cowlitz River basin if 95% is not achieved using the best available technology. Upstream targets for all Cowlitz, Lewis and Toutle populations are all 95% or higher. No viability adjustments are proposed if 95% annual fish passage (adults and juveniles) is achieved (City of Tacoma et al. 2000, PacifiCorp et al. 2004). For adult passage we also considered whether adults were released at locations that facilitated their dispersal into available habitats. Viability adjustments are based on achievement of these agreed upon rates:

- If 95% or greater fish passage and adult dispersal are achieved, no viability adjustment is assumed.
- If 95% or greater fish passage is achieved but adult dispersal is not, a viability adjustment of one category is assumed.
- If 75 – 95% fish passage and adult dispersal are achieved, a viability adjustment of one category is assumed because some potential impacts to spatial structure.
- If less than 75% fish passage and adult dispersal are achieved, a viability adjustment of two categories is assumed because of potentially high impacts to spatial structure.

Box 2. Viability assignment examples.

Step 1: Calculate abundance-based viability. 12-year geometric mean abundance is calculated for all populations with available data. Estimates are then compared to abundance benchmarks defining different levels of viability in the Recovery Plan. In the absence of the availability of abundance data, best professional judgement was used to identify an assumed abundance.

<u>Example A: Toutle Tule fall Chinook</u>**.** Toutle Tule fall Chinook 12-year geometric abundance is estimated to be 328 fish (see **"Abundance, 12-yr" in Table 7**), which is greater than the abundance goal for Low viability of 300 fish but less than abundance goal for Medium viability of 1,520 fish. This results in an abundance-based viability estimate of Low (see **"Abundance-Based" viability in Table 8**).

<u>Example B: Coweeman coho</u>**.** Coweeman coho 12-year geometric abundance is estimated to be 2,544 fish (see **"Abundance, 12-yr" in Table 9**), which is greater than the abundance goal for Very High viability of 1,770 fish. This results in an abundance-based viability estimate of Very High (see **"Abundance-Based" viability in Table 10**).

Step 2: Calculate the number of viability category adjustments to account for productivity, diversity and spatial structure VSP parameters.

<u>Example A: Toutle Tule fall Chinook</u>. Toutle Tule fall Chinook have an average rate of 60% proportion hatchery-origin spawners (see **"pHOS" in Table 8**), an estimate of greater than 30% blocked habitat resulting from the Sediment Retention Structure in the North Fork Toutle (see **"% Blocked Habitat in Table 8**), and an estimate of 0% fish passage upstream of the Sediment Retention Structure (SRS) due to no fish being identified to date for trap and haul upstream (see **"Fish Passage" in Table 8**). These productivity, diversity and spatial structure VSP indicators align with a recommended adjustment of -4 viability categories (see **Table 3**).

<u>Example B: Coweeman coho</u>. Coweeman coho have an average rate of 10% proportion hatchery-origin spawners (see **"pHOS" in Table 10**), an estimate of less than 10% blocked habitat due to no major artificial passage constraints (**see "% Blocked Habitat in Table 8**), and no trap and haul fish passage programs in the Coweeman subbasin (see **"Fish Passage" in Table 10**). These productivity, diversity and spatial structure VSP indicators result in no recommended adjustments to abundance-based viability (see **Table 3**).

Step 3: Review the four VSP parameter viability estimate for alignment with professional judgement.

<u>Example A: Toutle Tule fall Chinook</u>. Toutle Tule fall Chinook abundance-based viability of Low is adjusted to Very Low viability, the minimum status, based on the recommended adjustment of -4 categories (see **"Final Viability" in Table 8)**.

<u>Example B: Coweeman coho</u>. Coweeman coho abundance-based viability of Very High is not adjusted to because limits in productivity, diversity and spatial structure VSP parameters are not identified (see **"Final Viability" in Table 10)**.

Step 4: Finalize viability estimates with supporting data (Step 1 and 2) and supporting rationales (Step 3).

<u>Example A: Toutle Tule fall Chinook</u>. No additional adjustments are made to the estimate of Very Low viability for Toutle Tule fall Chinook, meaning no viability improvements are identified since viability for this population was estimated to be Very Low at the time of ESA listings. Future reductions in pHOS, increased fish passage in the North Fork Toutle, and increased natural-origin spawning abundances could increase viability in the future.

<u>Example B: Coweeman coho</u>. No additional adjustments are made to the estimate of Very High viability for Coweeman coho, meaning viability is estimated to have improved four viability categories (Very Low to Very High) since ESA listings. The current viability estimate is greater than the population recovery goal of High viability, supporting ESU-scale recovery. Maintaining low pHOS and high rates of returning natural-origin spawners and habitat connectivity should support continued Very High viability in the future.

Table 4. Washington salmon and steelhead population viability level at listing and at present based on current information. Viability levels are separated by a "/" where current level has changed relative to the level identified in the Recovery Plan: Baseline Viability/Current Viability. Viabilities that are meeting recovery goals are identified with an asterisk (*) and viabilities that are surpassing recovery goals are identified with two (**). Populations without data to support viability estimates have cross-hatched highlights and are not accounted for in goal achievement totals.

	Subbasin	Chinook			Coho	Chum		Steelhead	
		Fall	L Fall	Spring		Fall	Summer	Winter	Summer
Coast	Grays/Chinook	VL	--	--	VL	M/VH*	--	M	--
	Eloch./Skam.	VL	--	--	VL	VL/L	--	M	--
	Mill/Aber./Ger.	VL	--	--	VL/L	VL	--	M	--
Cascade	Lower Cowlitz	VL/M	--	--	VL/H*	VL	VL	L/M*	--
	Coweeman	VL/M	--	--	VL/VH**			L/H*	--
	NF Toutle	VL	--	VL	VL			VL	--
	SF Toutle		--		VL/M			M/H	--
	Tilton	VL/M**	--	VL	VL*	--		VL	--
	Upper Cowlitz		--	VL	VL	--		VL	--
	Cispus		--	VL	VL	--	--	VL	--
	Kalama	VL/L	--	VL	VL	VL	--	L/VH**	M/L
	NF Lewis	VL/M	VH*	VL	VL	VL	--	VL	VL*
	EF Lewis		--	--	VL/L		--	M/H*	VL/VH**
	Salmon	VL*	--	--	VL/H**	VL*	--	VL*	--
	Washougal	VL	--	--	VL	VL/VH**	--	L/M*	M/VH**
Gorge	Lower Gorge	VL/M*	--	--	VL/M	H/VH*	--	L	--
	Upper Gorge	VL	--	--	VL	VL	--	L*	H
	White Salmon	VL	--	VL			--		--

No. @ Goal	2	1	0	3	3	0	5	2
No. @ Very High	0	1	0	1	1	0	1	2
No. @ High	0	0	0	2	2	0	3	1
No. @ Moderate	5	0	0	2	2	0	5	0
No. @ Low	1	0	0	2	2	0	2	1
No. @ Very Low	8	0	7	10	10	1	6	1
Avg. Viability (current)	L	VH	VL	L	L	VL	M	M
Avg. Viability (at listing)	VL	VH	VL	VL	VL	VL	L	L

Viability Key	VL = Very Low Score = 0	L = Low Score = 1	M = Medium Score = 2	H = High Score = 3	VH = Very High Score = 4

Spring Chinook

Spring Chinook historically returned to cool, snowmelt-driven Cascade strata streams but much of the spawning range was blocked by dams in the Cowlitz, Lewis, and White Salmon rivers (Figure 2). Large mitigation hatchery programs were developed, and returns are currently dominated by hatchery-origin fish. The lower Columbia was historically thought to produce around 59,000 spring Chinook per year, but now averages around 600 natural-origin fish (MAFAC 2020). Condit Dam in the White Salmon River was removed between 2011 and 2012, and reintroduction programs are being implemented in the Cowlitz and Lewis. Natural production remains at very low levels in all of these watersheds.

At the time of ESA listing in 1999, all seven Washington populations were estimated to be at Very Low levels of viability (Table 5). Two additional populations occur in Oregon (Sandy, and Hood). Very Low viability was due to low abundance, poor productivity, limited distribution and a loss of historical diversity.

Recent data shows no significant improvements in the abundance of natural-origin spring Chinook (Table 5, Figure 3). Abundance remains substantially less than ESA delisting goals and viability is Very Low in all Washington populations (Figure 2, Table 5). Viability adjustments are identified for all populations based on productivity, diversity and spatial structure, averaging adjustments to abundance-based viability of -2 across populations (Table 6). Although the viability goal for the Tilton spring Chinook population is Very Low, this population is not yet reintroduced and is thus not considered to be meeting goals. Upper Cowlitz, Cispus and NF Lewis spring Chinook populations have VSP adjustments identified based on pHOS, although elevated rates expected because these populations are in the early phases of recolonization, with reintroduction supported by hatchery broodstock fish. No other spring Chinook populations are meeting viability goals. Details are discussed for key populations in the following pages.

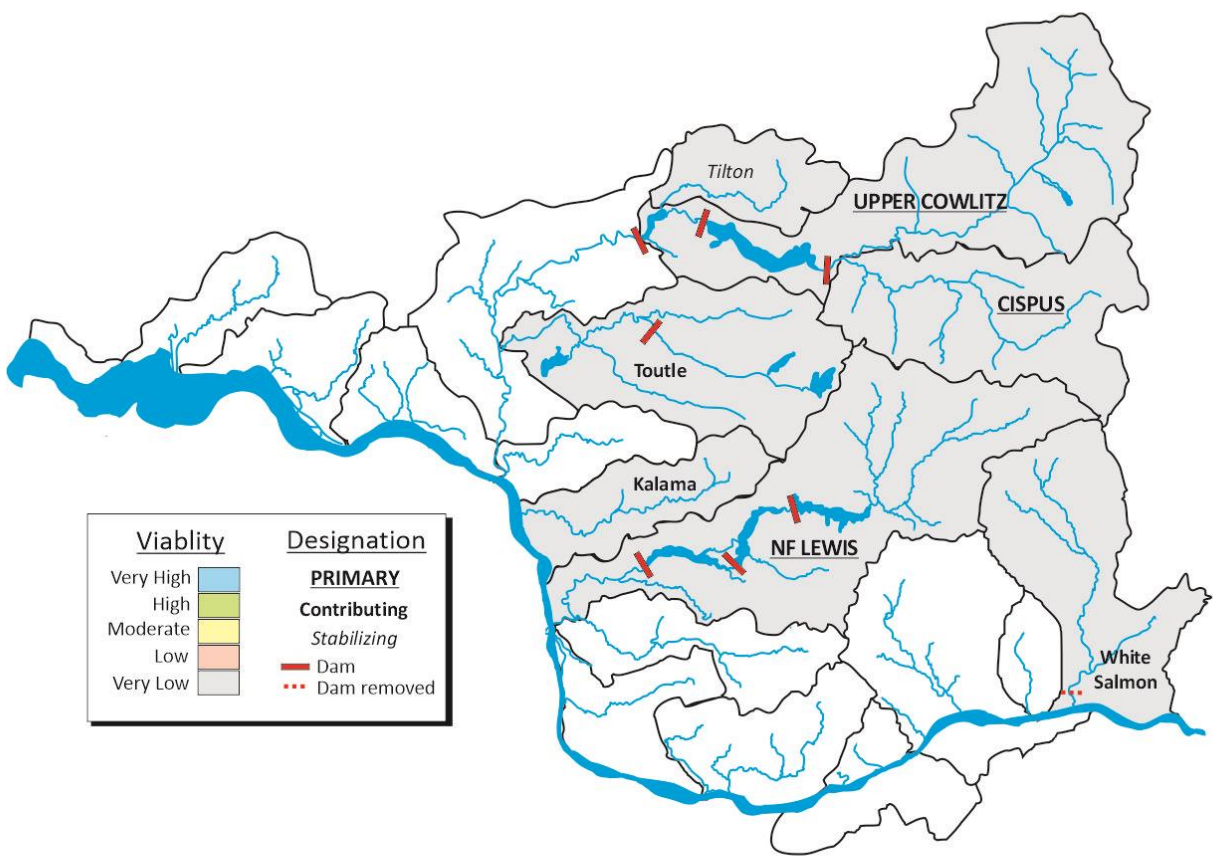


Figure 2. Current status (approximate) and Recovery Plan designations of Lower Columbia River populations of spring Chinook Salmon in Washington.

Table 5. Abundance relative to recovery objectives for Lower Columbia River populations of spring Chinook salmon in Washington. Abundance estimates based on professional judgment are identified with an asterisk (*).

Strata	Population	Desig.[1]	Abundance[2]						% of	Yrs Goal Met[9]		Data[10]
			Historical	@list[3]	Goal[4]	@High[5]	12-yr[6]	4-yr[7]	Goal[8]	12-yr	4-yr	
Cascade	Tilton	S	5,400	<100	<100	2,910	0	0	--	--	--	3
Cascade	U Cowlitz[11]	P	22,000	300	1,800	1,500	194	126	5%	0%	0%	1
Cascade	Cispus[13]	P	7,800	150	1,800	1,500						
Cascade	Toutle	C	3,100	100	1,100	1,500	<50*	<50*	<5%*	--	--	3
Cascade	Kalama	C	4,900	100	300	1,500	68	53	23%	0%	0%	1
Cascade	NF Lewis	P	15,700	300	1,500	1,500	244	245	16%	0%	0%	2
Gorge	White Salmon	C	n/a	<50	500	1,500	10	6	2%	0%	0%	1

[1] Priority designation identified in Recovery Plan (LCFRB 2010; NMFS 2013): P=Primary, C=Contributing, S=Stabilizing.

[2] Abundance of natural-origin spawners (geometric means).

[3] Status in the 1990s at the time of first listing.

[4] Recovery targets based on scenario identified in the Recovery Plan.

[5] Abundance at High viability (approximate value identified in Recovery Plan).

[6] Recent 12-year geometric means (typically 2008-2019) based on the best available information.

[7] Recent 4-year geometric means (typically 2016-2019) based on the best available information.

[8] Based on 12-year geometric mean abundances.

[9] Percentage of years for available data where recovery goal was met for 12-year and 4-year abundances.

[10] Quality/type of recent abundance data reported in this assessment: 1 = good (annual statistical stream survey, dam or weir count), 2= fair (periodic surveys, index counts), 3= poor (expert judgement, habitat model inference).

[11] U Cowlitz and Cispus spring Chinook populations are managed and monitored as one, combined population. Abundances are combined, although recovery goals remain independent.

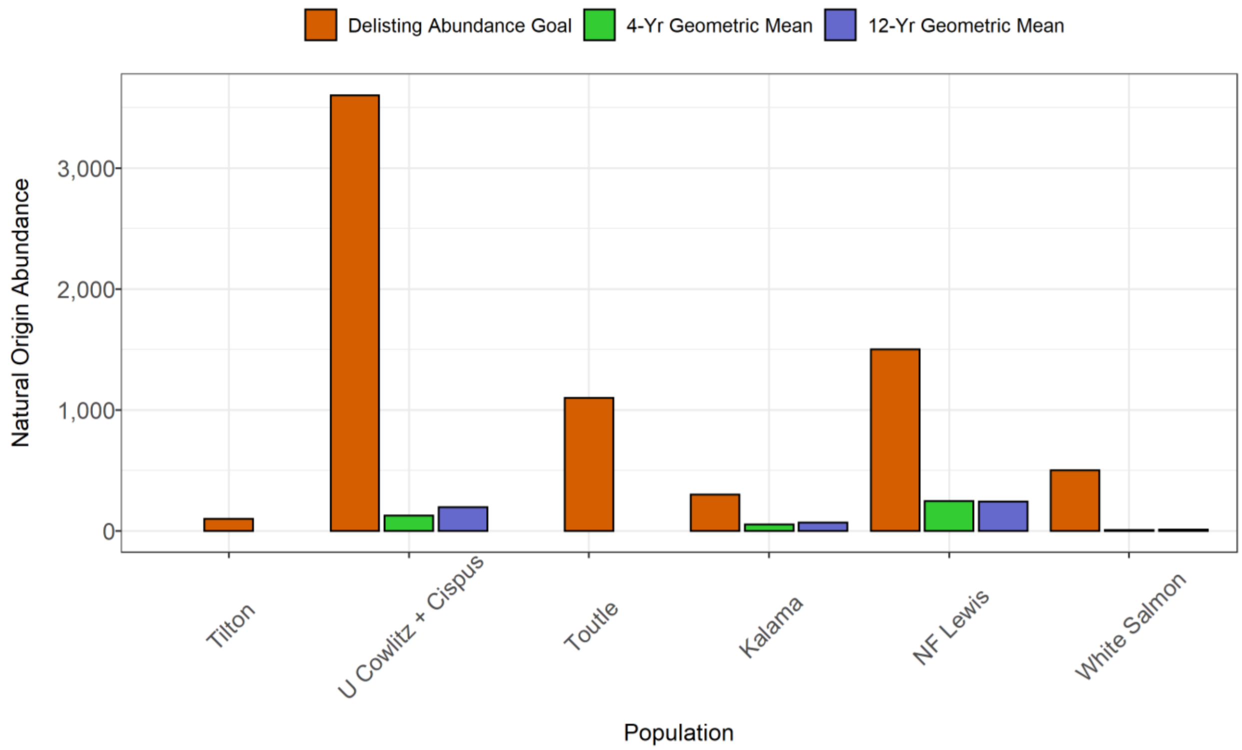


Figure 3. Recent natural-origin (NOR) 4-year and 12-year geometric mean abundance estimates for spring Chinook salmon populations in Washington relative to delisting abundance goals.

Table 6. Viability categorization process for Lower Columbia River populations of spring Chinook salmon in Washington. Abundance-based viability is based on 12-year geometric means unless population data is lacking and an assumed abundance estimate based on professional judgement is used (denoted with an asterisk). Viability categories: VH=Very High, H=High, M=Moderate, L=Low, VL = Very Low.

Strata	Population	@list	Goal	pHOS	Blocked Habitat	Fish Passage	Abundance -Based Viability	VSP Adjustment	Final Viability
Cascade	Tilton	VL	VL	--	>30%	0%	VL	-2	VL
	U Cowlitz	VL	H+	0.88	<10%	30%	VL	-4	VL
	Cispus	VL	H+		<10%				
	Toutle	VL	M	--	>30%	0%	VL*	-2	VL*
	Kalama	VL	L	0.35	<10%	N/A	VL	-1	VL
	NF Lewis	VL	H	--	>30%	33%	VL	-2	VL
Gorge	White Salmon	VL	L+	0.84	<10%	N/A	VL	-2	VL

Future prospects for recovery of spring Chinook remain uncertain and depend on the success of reintroduction programs which are currently in their early recolonization stages. Habitat upstream of the Cowlitz and Lewis hydroelectric systems is considered to be of relatively high quality. Most of these watersheds are managed as public lands by the U.S. Forest Service, resulting in limited development coupled with restoration of watershed processes through implementation of the Northwest Forest Plan. Habitat restoration in these watersheds is also funded through dedicated hydroelectric mitigation programs by Tacoma Power Utilities and PacifiCorp, providing additional support for long-term habitat improvements.

Population Descriptions

Tilton Spring Chinook – This Stabilizing population is not targeted for significant improvement from Very Low viability. Historically, spring Chinook are thought to have spawned in the Tilton River but this has not been confirmed and spawning distribution is unknown. Completion of Mayfield Dam at RM 52 blocked upstream migration in 1963 and upstream transport was terminated in 1968.

A FERC relicensing settlement agreement for Cowlitz River hydroelectric projects calls for taking significant steps to achieve a genetically viable, self-sustaining natural population in the Cowlitz basin above the dams. Spawning by hatchery and natural-origin adults occurs upstream of Cowlitz Falls Dam in the Cispus and Upper Cowlitz Rivers and is dependent on upstream trap and haul of adults from the Barrier Dam facility to release sites in the upper basin. Cowlitz reintroduction efforts have been underway since 1994. The Tilton River is not yet included in the reintroduction effort and no spring Chinook are present in the subbasin. There is no abundance goal or hatchery-origin spawner target for this Stabilizing population. Artificial barriers are assumed to substantially limit distribution (greater than 30% disconnected habitat). Viability remains Very Low because of the lack of effective passage for hatchery and natural-origin fish.

Upper Cowlitz & Cispus Spring Chinook - These Primary populations are identified as historical core and genetic legacy populations by the Willamette-Lower Columbia Technical Review Team and are targeted for improvements from Very Low to High+ viability. Current management does not separate these two populations, so monitoring data and recovery goals are combined. All spring Chinook in the Cowlitz River watershed historically spawned in the upper basin, particularly in the mainstem Cowlitz above Packwood and in the Cispus River.

Upstream migration was blocked by Mayfield Dam at River Mile (RM) 52 in 1963 and upstream transport was terminated in 1968. A FERC relicensing settlement agreement for Cowlitz River hydroelectric projects, calls for taking significant steps to achieve a genetically viable, self-sustaining natural population above the dams (City of Tacoma et al. 2000, Tacoma Power 2020). Hatchery and natural-origin adults are being trapped, transported and released upstream of Cowlitz Falls Dam to spawn in the Cispus and Upper Cowlitz Rivers. These reintroduction efforts have been underway since 1994, the year Cowlitz Falls Dam was completed.

Successful reintroduction upstream from the Cowlitz hydroelectric system is a top priority for spring Chinook recovery. Success depends on effective collection and passage survival of downstream migrating naturally produced juveniles at Cowlitz Falls Dam. Initial collection efforts have proven challenging, but collection efficiencies have improved somewhat since the Cowlitz Falls North Shore Collector was completed at Cowlitz Falls Dam in 2017. Collection efficiency targets identified in the Settlement Agreement are not being met today. The Settlement Agreement identifies a year-round collection efficiency goal of 95%. Collection efficiency of juvenile spring Chinook averaged 58% in 2017-2020 during the spring and summer trapping period, still below the program target of 95% year-round. This equates to a 29% collection efficiency if assuming equal rates of seasonal passage throughout the year. There are no adult trap efficiency targets or tracking at the Barrier Dam. Thus, it is assumed that current tributary hydroelectric impacts are reduced from the baseline estimate of 90% (Upper Cowlitz) and 100% (Cispus) to 71% today for the two combined populations.

The twelve-year geometric mean abundance is similar to the baseline estimates identified in the Recovery Plan but below the combined delisting goals for return years with available data (5% of combined delisting goal). The combined delisting abundance goal has not been met in any year. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin fish on average comprise 88% of total spawners while targets are less than 5% for both populations. However, the reintroduction program relies on hatchery-origin fish at this stage, so high pHOS is expected. An in-basin hatchery program is currently segregated but will shift to integrated to support reintroduction program efforts. Fish passage rates are below targets of 75 to 95%. Viability remains Very Low due to limits in abundance, productivity, spatial structure and diversity resulting from hatchery fish competition and interbreeding, blocked habitat and fish passage constraints.

Toutle Spring Chinook – This Contributing population is targeted for improvement from Very Low to Medium viability. Spring Chinook historically spawned in the upper reaches of the Toutle River including Coldwater Creek. Completion of the Sediment Retention Structure (SRS) on the North Fork (NF) Toutle blocked upstream migration beginning in 1989.

Successful reintroduction into habitat upstream of the SRS is a high priority for spring Chinook recovery. Reintroduction is planned but not yet initiated, so the trap and haul operations utilizing the fish collection facility are not yet targeting spring Chinook. Reintroduction program success depends on effective year-round juvenile fish collection and passage survival of upstream migrating spawners and downstream migrating naturally produced juveniles.

The NF Toutle hatchery released sub-yearling juveniles in 1953 and 1975, and yearlings in 1993, 1995, 1997-1999, 2001, and2002. No hatchery spring Chinook are released today.

Population size is assumed to be less than 50 fish, similar to the baseline estimate identified in the Recovery Plan and below the delisting goal (less than 5% of delisting goal). It is assumed that the delisting abundance goal is not met in any years of reported adult returns. Artificial barriers are assumed to substantially limit distribution (greater than 30% disconnected habitat). The percentage of hatchery-origin spawners is unknown but the target is less than 10%. Viability remains Very Low due to limits in abundance, productivity, spatial structure and diversity resulting from blocked habitat and fish passage constraints.

Kalama Spring Chinook – This Contributing population is targeted for improvement from Very Low to Low viability. Spring Chinook are thought to have historically spawned throughout the upper Kalama River above Kalama Falls. Only natural-origin fish are passed upstream from the Kalama Falls hatchery (RM 10.5) where the majority of spawning habitat for Spring Chinook is located.

Hatchery fish were historically released and continue to be released in the Kalama subbasin. A segregated spring Chinook program is currently operated in-basin. Spawning of hatchery-origin fish is limited to habitat downstream of Kalama Falls hatchery, where they comprise the majority of spawners.

The twelve-year geometric mean abundance aligns with the baseline estimate identified in the Recovery Plan but is below the delisting goal (23% of delisting goal). The delisting abundance goal is not met in any years of reported adult returns. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 35% of total spawners while the target is less than 10 percent. Viability remains Very Low due to limits in abundance, productivity, spatial structure and diversity resulting from hatchery fish competition and interbreeding.

North Fork Lewis Spring Chinook - This Primary population is identified as a historical core population by the Willamette-Lower Columbia Technical Review Team and is targeted for improvement from Very Low to High viability. Almost all historically spawning by spring Chinook in this system occurred in the upper basin. Construction of Merwin Dam blocked upstream migration in 1931. Since that time, natural spawning, predominantly by hatchery origin spring Chinook, has occurred in four miles of the North Fork mainstem downstream from Merwin Dam. An in-basin spring Chinook program is currently segregated but will shift to integrated to produce adults for a reintroduction program in the North Fork Lewis River subbasin.

Successful reintroduction into habitat upstream of the Lewis hydroelectric system is a high priority for spring Chinook recovery. A FERC relicensing settlement agreement for Lewis River hydroelectric projects calls for taking significant steps to achieve a genetically viable, self-sustaining natural population in the upper North Fork above the dams. Reintroduction efforts began in 2013, with the release of adult Chinook salmon into the upper basin and the operation of a juvenile collection facility in Swift Reservoir. Reintroduction program success depends on effective collection and fish passage survival of upstream migrating spawners and downstream migrating naturally produced juveniles at the Swift Reservoir juvenile collector. Collection efficiency targets identified in the Settlement Agreement are not being met today. Collection efficiency of juvenile spring Chinook averaged 33% from 2017 – 2020, still below the program target of 95% year-round. The Settlement Agreement identifies an adult trap efficiency goal of 98%. A trap efficiency assessment was conducted 2015 through 2019 but was abandoned because of insufficient spring Chinook returns. Thus, it is assumed that current tributary hydroelectric impacts are reduced from the baseline estimate of 95% to 62% today. Construction of adult and juvenile fish passage facilities in Merwin and Yale reservoirs has been delayed between one and five years depending on facility location, due to a proposal from the utilities to change fish passage prescriptions and associated review and dispute processes. However, in 2022 the federal services reaffirmed the requirement to construct fish passage facilities in both Yale and Merwin reservoirs.

The twelve-year geometric mean abundance is similar to the baseline estimate identified in the Recovery Plan but below the delisting goal (16% of delisting goal). The delisting abundance goal is not met in any years of reported adult returns. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). The percentage of hatchery-origin spawners is unknown but higher rates than the target (<30%) are expected given the reintroduction program relies on hatchery-origin fish at this stage. Fish passage rates are below targets of 75 to 95 percent. Viability remains Very Low due to limits in abundance, productivity, spatial structure and diversity resulting from hatchery fish competition and interbreeding, and historic and ongoing fish passage constraints.

White Salmon Spring Chinook - This Contributing population is targeted for improvement from Very Low to Low+ viability. Spring Chinook are thought to have historically spawned throughout the White Salmon River below BZ Falls (RM 12.3), possibly with greater use of areas above Husum Falls (RM 7.8) than fall Chinook. This population was extirpated when Condit Dam blocked upstream fish migration at River Mile 3 in 1913. Spring Chinook began to recolonize the White Salmon River following removal of Condit Dam in 2011, although numbers are very low: one of the four spawning spring Chinook detected in 2019 was observed upstream of the Condit Dam site (Olk and Dammerman 2020). No hatchery spring Chinook are released in the basin.

The twelve-year geometric mean abundance aligns with the baseline estimate identified in the Recovery Plan and is below the delisting goal (2% of delisting goal). The delisting abundance goal is not met in any years of reported adult returns. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 84% of total spawners while the target is less than 10%. Viability remains Very Low due to low abundance, productivity, spatial structure and diversity resulting from early recolonization of historically disconnected habitats and hatchery fish competition and interbreeding.

Fall Chinook

Two types of fall Chinook return to lower Columbia rivers and streams. Virtually all subbasins produce the tule stock of fall Chinook (Figure 4). A late Fall bright stock returns to the North Fork Lewis River as well as the Sandy River in Oregon. It is estimated that the historical Washington lower Columbia fall Chinook stock produced around 100,000 adult fish per year (LCFRB 2010).

At the time of ESA listing in 1999, twelve of twelve Washington populations, five of seven Oregon populations, and two of two shared populations of tule fall Chinook were estimated to be at Very Low levels of viability (Table 7). Very Low viability was associated with low abundance, poor productivity, limited distribution and a loss of historical diversity. The Lewis Late fall Chinook population is the rare example of a healthy highly viable salmon population.

Fall Chinook have long been a focus of WDFW spawning ground surveys, primarily to support management of Columbia River mainstem sport and commercial fisheries. Prior to mass marking of hatchery fish beginning in 2010, it was difficult to distinguish natural- and hatchery-origin spawners. In 2010, WDFW began implementation of an expanded monitoring program for Chinook salmon in the Lower Columbia region in order to gather data on VSP parameters including natural-origin spawner abundance, hatchery-origin spawner abundance, spatial distribution, diversity, and productivity.

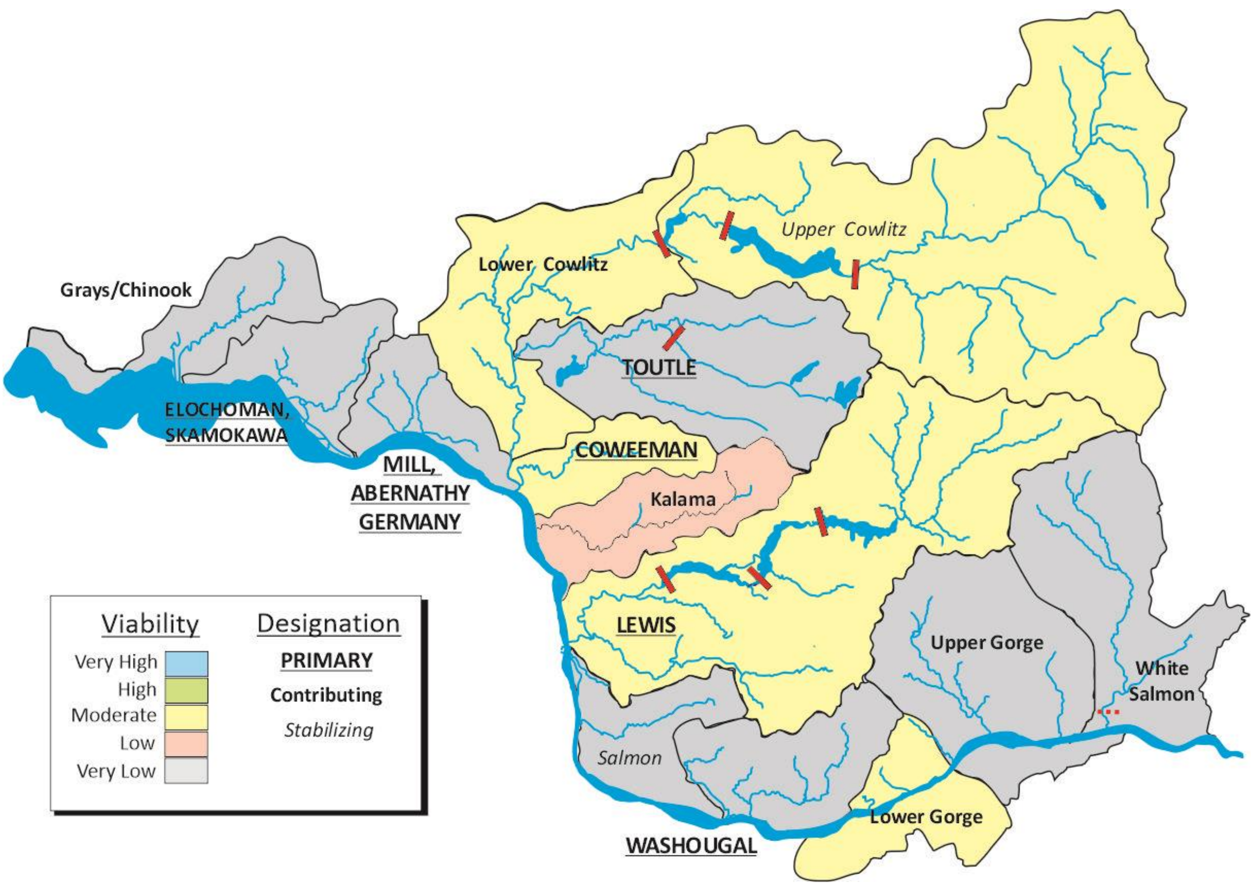


Figure 4. Current status (approximate) and Recovery Plan designations of Lower Columbia River populations of tule fall Chinook Salmon in Washington. (Late-run fall Chinook population in the North Fork Lewis River is not shown but is at Very High viability.)

Table 7. Viability and abundance relative to recovery objectives for Lower Columbia River populations of fall Chinook salmon in Washington.

Strata	Population	Desig.[1]	Abundance[2]						% of Goal[8]	Years Goals Met[9]		Data[10]
			Historical	@list[3]	Goal[4]	@High[5]	12-yr[6]	4-yr[7]		12-yr	4-yr	
Coast	Grays/Chinook	C	800	<50	1,000	2,040	128	254	13%	0%	0%	1
Coast	Eloch./Skam.	P	3,000	<50	1,500	1,540	80	52	5%	0%	0%	1
Coast	Mill/Aber./Ger.	P	2,500	50	900	870	40	18	4%	0%	0%	1
Cascade	L Cowlitz	C	24,000	500	3,000	3,630	2,966	3,268	99%	40%	50%	1
Cascade	U Cowlitz	S	28,000	0	--	1,100	2,207	1,761	--	--	--	1
Cascade	Toutle	P	11,000	<50	4,000	3,410	328	207	8%	0%	0%	1
Cascade	Coweeman	P	3,500	100	900	740	571	368	63%	20%	0%	1
Cascade	Kalama	C	2,700	<50	500	950	1,034	1,806	207%	80%	100%	1
Cascade	Lewis	P	2,600	<50	1,500	1,130	2,045	1,766	136%	80%	75%	1
Cascade	Salmon	S	N/A	<50	<50	1,100	--	--	--	--	--	3
Cascade	Washougal	P	2,600	<50	1,200	1,020	866	952	72%	25%	25%	1
Cascade	NF Lewis (late Fall)	P	23,000	7,300	7,300	1,300	9,459	7,793	130%	67%	50%	1
Gorge	L Gorge[11]	C	1,600	<50	600	550	2,188	7,090	365%	100%	100%	1
Gorge	U Gorge[11]	C	1,700	<50	600	550	554	441	92%	30%	0%	1
Gorge	White Salmon	C	1,000	<50	500	1,100	477	284	95%	50%	0%	1

[1] Priority designation identified in Recovery Plan: P=Primary, C=Contributing, S=Stabilizing.

[2] Abundance of natural-origin spawners (geometric means).

[3] Status in the 1990s at the time of first listing.

[4] Recovery targets based on scenario identified in the Recovery Plan.

[5] Abundance at High viability (approximate value identified in Recovery Plan). Values may vary depending on productivity.

[6] Recent 12-year geometric means (typically 2008-2019) based on the best available information. Data are not available prior to 2010 for many populations.

[7] Recent 4-year averages (typically 2016-2019) based on the best available information.

[8] Based on 12-year geometric mean abundances.

[9] Percentage of years for available data where recovery goal was met for 12-year and 4-year abundances.

[10] Quality/type of recent abundance data reported in this assessment: 1 = good (annual statistical stream survey, dam or weir count), 2= fair (periodic surveys, index counts), 3= poor (expert judgement, habitat model inference).

[11] Recovery abundance goal and @High viability abundance target are divided in half for combined Washington-Oregon populations because only Washington abundances are reported.

Recent data shows that six of fifteen Washington tule fall Chinook populations are more viable than believed at listing. Abundance of tule fall Chinook has generally increased since listing. Viability adjustments are identified for ten of fifteen fall Chinook populations based on productivity, diversity, and spatial structure, averaging two adjustment steps across populations (Table 8). Most VSP adjustments are related to elevated pHOS.

Six populations have improved viability since baseline conditions. Four have met their delisting abundance goal (Figure 5). While one population has achieved Very High viability, eight populations remain at Very Low levels of viability, including every Coast and two of three Gorge Stratum populations. The Lower Gorge Tributaries population has a final viability adjusted to Medium because of an ongoing WDFW genetic study which may change VSP parameter estimates. Fall Chinook are faring slightly better in the Cascade strata, where delisting abundance goals are occasionally reached in some years even if viability goals are not yet achieved (Table 8).

Improvements likely reflect a recent period of relatively favorable ocean conditions for lower Columbia River fall Chinook, benefits of fishery reductions since listing and improved stock-assessments of the natural-origin share of spawning escapements. Significant improvements in habitat conditions in the lower tributary mainstems where fall Chinook spawn have been difficult to achieve because they generally require large scale watershed improvements. Data on natural spawning escapements are generally not adequate to distinguish long term trends from the effects of annual variability in environmental conditions. Details are discussed for key populations in the pages following.

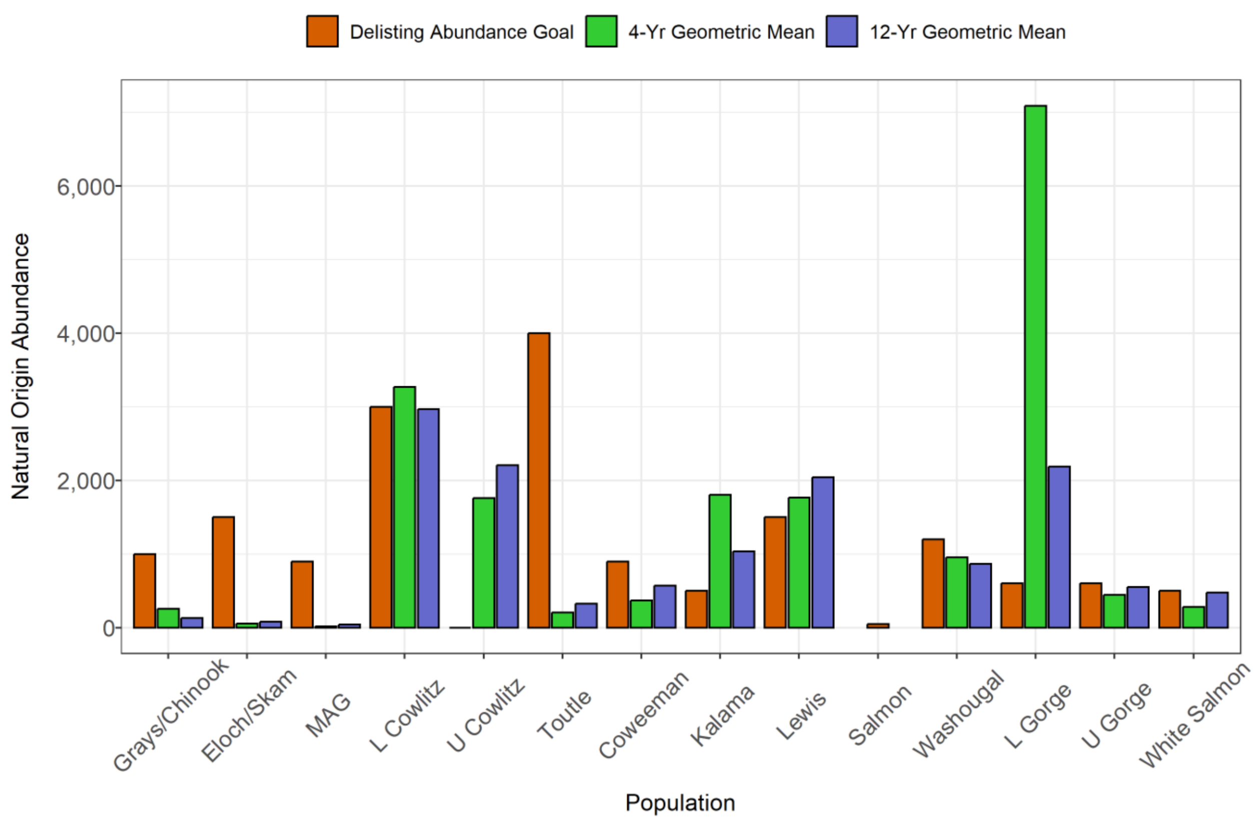


Figure 5. Recent natural-origin 4- and 12-year geometric mean abundance estimate for tule fall Chinook salmon populations in Washington relative to delisting abundance goals.

Table 8. Viability categorization process for Lower Columbia River populations of fall Chinook salmon in Washington. Abundance-based viability is based on 12-year geometric means unless population data is lacking and an assumed abundance estimate based on professional judgement is used (denoted with an asterisk). Final viabilities that are lower than abundance-based viabilities are highlighted in red, final viabilities bolded and italicized are greater than listing estimates but less than goals, and final viabilities bolded and underlined are meeting or surpassing goals. Viability categories: VH=Very High, H=High, M=Moderate, L=Low, VL = Very Low.

Strata	Population	@list	Goal	pHOS	Blocked Habitat	Fish Passage	Abundance -Based	VSP Adjustment	Final Viability
Coast	Grays/Chinook	VL	M+	0.66	<10%	N/A	VL	-2	VL
	Eloch./Skam.	VL	H	0.73	<10%	N/A	VL	-2	VL
	Mill/Aber./Ger.	VL	H	0.85	<10%	N/A	VL	-2	VL
Cascade	L Cowlitz	VL	M+	0.25	<10%	N/A	M	0	***M***
	U Cowlitz	VL	VL	0.44	>30%	75-95%	VH	-2	**<u>M</u>**
	Toutle	VL	H+	0.60	>30%	0%	L	-4	VL
	Coweeman	VL	H+	0.15	<10%	N/A	M	0	***M***
	Kalama	VL	M	0.68	<10%	N/A	H	-2	***L***
	Lewis	VL	H+	0.38	<10%	N/A	H	-1	***M***
	Salmon	VL	VL	N/A	<10%	N/A	VL*	0	VL*
	Washougal	VL	H+	0.53	<10%	N/A	M	-2	VL
	NF Lewis (Late Fall)	VH	VH	0	<10%	N/A	VH	0	**<u>VH</u>**
Gorge	L Gorge	VL	M	0.07	<10%	N/A	VH	0	**<u>M</u>**
	U Gorge	VL	M	0.51	<10%	N/A	L	-2	**VL**
	White Salmon	VL	M	0.32	<10%	N/A	L	-1	**VL**

Population Descriptions

<u>Grays/Chinook (Tule) Fall Chinook</u> -This Contributing population is targeted for improvement from Very Low to Medium+ viability. Fall Chinook spawn in the West Fork below the Grays River Salmon Hatchery (RM 1.4) and in the mainstem Grays River from the area of tidal influence to above the confluence of the West Fork (RM 8-14). It is unknown if current distribution mirrors historical distribution, or if significant spawning occurred upstream of the Grays canyon.

Grays River Hatchery at RM 1.4 of the West Fork, released fall Chinook from 1961 through 1997. While in-basin releases were discontinued after 1997, hatchery strays from outside the Grays subbasin continue to comprise significant portions of the spawning population. Recent genetic data indicates that the native wild stock has been diluted by stray hatchery-origin Rogue River bright fall Chinook from the lower Columbia River terminal fishery program (Anderson et al. 2020).

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan but below the delisting goal for return years with available data (13% of delisting goal). The delisting abundance goal is not met in any years of reported adult returns. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 66% of total spawners while the target is less than 10%. Viability remains Very Low due to limits in abundance, productivity and diversity resulting from low population numbers and hatchery fish competition and interbreeding.

<u>Elochoman/Skamokawa (Tule) Fall Chinook</u> – This Primary population is identified as a historical core population by the Willamette-Lower Columbia Technical Review Team and is targeted for improvement from Very Low to High viability. Fall Chinook spawn in the lower Elochoman above tidewater (RM 4 to the

confluence of the West Fork Elochoman at RM 15.6) as well as upstream in the West Fork and East Fork now that the hatchery barrier is removed. In Skamokawa Creek, spawning occurs primarily from Wilson Creek (RM 1.9) upstream to Standard and McDonald creeks (RM 6.8). The vast majority of adults return to the Elochoman River.

The Elochoman Hatchery released juvenile fall Chinook into the Elochoman River until 2008 when the program was terminated. No hatchery fish are released into Skamokawa Creek.

The twelve-year geometric mean abundance aligns with the baseline estimate identified in the Recovery Plan and is below the delisting goal for return years with available data (5% of delisting goal). The delisting abundance goal is not met in any years of reported adult returns. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 73% of total spawners while the target is less than 5%. Viability remains Very Low due to limits in abundance, productivity, and diversity resulting from low population numbers and hatchery fish competition and interbreeding.

Mill/Abernathy/Germany (Tule) Fall Chinook – This Primary population is targeted for improvement from Very Low to High viability. Fall Chinook spawn naturally in Mill Creek from the Mill Creek Bridge downstream to the mouth (2 miles); in Abernathy Creek from the Abernathy Fish Technology Center to the mouth (3 miles); and in Germany Creek from the mouth to 3.5 miles upstream. These tributaries are not thought to have supported large historical populations of fall Chinook.

The Spring Creek Hatchery stock released at the Abernathy Fish Technology Center was discontinued in 1995. Impacts from these releases on fish today are unknown, but a WDFW genetic analysis study is ongoing. No hatchery fall Chinook are released in the basin today.

The twelve-year geometric mean abundance aligns with the baseline estimate identified in the Recovery Plan and is below the delisting goal for return years with available data (4% of delisting goal). The delisting abundance is not met in any individual reported year. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 85% of total spawners while the target is less than 5%. Viability remains Very Low due to limits in abundance, productivity, and diversity resulting from low population numbers and hatchery fish competition and interbreeding.

Lower Cowlitz (Tule) Fall Chinook - This Contributing population is identified as a historical core population by the Willamette-Lower Columbia Technical Review Team and is targeted for improvement from Very Low to Medium+ viability. Spawning currently occurs over about 45 miles of the mainstem Cowlitz between the Kelso Bridge and the Cowlitz Salmon Hatchery with a concentration between river miles 51-52. Recent assessments have found this population to be several times more abundant than documented in the Recovery Plan and among the largest for this species in the region.

A segregated hatchery program was in operation through brood year 2018. An integrated hatchery program was instituted thereafter.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan and aligns with the delisting goal (99% of delisting goal). The delisting abundance is met in four years of reported adult returns. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 25% of total spawners, meeting the target of less than 30%. Viability has increased to Medium due to high abundances, limited hatchery fish competition and interbreeding and the lack of spatial structure and diversity limitations.

Upper Cowlitz (Tule) Fall Chinook – This Stabilizing population is not targeted for significant improvement from Very Low viability. At the time of listing, this population was functionally extinct. Completion of Mayfield Dam at River Mile 52 blocked upstream migration in 1963 and upstream transport was terminated in 1968. An integrated hatchery fall Chinook program is currently operated in-basin although a segregated program was in operation in 2018-19.

A FERC relicensing settlement agreement for Cowlitz River hydroelectric projects calls for taking significant steps to achieve a genetically viable, self-sustaining natural population in the Cowlitz basin above the dams (City of Tacoma et al. 2000, Tacoma Power 2020). Reintroduction into the Upper Cowlitz and Cispus River watersheds is delayed until spring Chinook populations are established. Reintroduction efforts have been conducted in the Tilton River since 1994. Hatchery and natural-origin adults are trapped at the Barrier Dam facility and released to spawn naturally in the Tilton River. Juvenile fall Chinook are collected at Mayfield Dam and released downstream. A considerable portion of juvenile fall Chinook also survive passage through the Mayfield turbines. However, Tacoma Power has not measured survival of out-migrating fish relative to their Biological Opinion and FERC license requirement of 95% for the Tilton sub-population in several decades and current overall passage survival is unknown. The ultimate success of the reintroduction effort will depend on improved juvenile collection efficiency and passage survival at Mayfield Dam and, in the long term, improved collection efficiency at the Cowlitz Falls Fish Facility to support greater distribution in the Cispus and Upper Cowlitz sub-populations.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan. There is no abundance goal for this Stabilizing population. Artificial barriers are assumed to limit distribution (greater than 30% disconnected habitat). Fish passage rates are assumed to be between 75 and 95% based on calculations made in the 1980s at Mayfield Dam. Hatchery-origin spawners on average comprise 44% of total spawners. No hatchery-origin spawner target is identified for this population. The abundance-based viability estimate is adjusted from Very High to Medium due to limits in spatial structure, productivity, and diversity resulting from hatchery fish competition and interbreeding, blocked habitat and fish passage constraints.

Toutle (Tule) Fall Chinook – This Primary population is identified as a historical core population by the Willamette-Lower Columbia Technical Review Team and is targeted for improvement from Very Low to High+ viability. Prior to the eruption of Mt. St. Helens in 1980, most fall Chinook spawned in the lower five miles of the mainstem Toutle and in the lower NF Toutle. Spawning also occurred upstream to the outlet of Spirit Lake. The eruption devastated much of the spawning area in the mainstem and North Fork Toutle. Completion of the SRS on the NF Toutle blocked upstream migration beginning in 1989. Current spawning primarily occurs in the Green River fork of the NF Toutle, and in the lower South Fork (SF) Toutle from the 4700 Bridge to the confluence with the mainstem Toutle River (~2.6 mi).

Reintroduction is in a planning phase but not yet initiated, so the trap and haul operations utilizing the fish collection facility are not yet targeting fall Chinook. Successful reintroduction into habitat upstream of the SRS is a high priority for fall Chinook recovery. Reintroduction is limited by a lack of mainstem release locations and effective year-round upstream adult fish collection and passage survival of upstream migrating spawners. Hatchery releases of fall Chinook have occurred in the Toutle River basin since 1951. An integrated fall Chinook program is currently operated in the Green River fork of the NF Toutle.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan but below the delisting goal for return years with available data (8% of delisting goal). The delisting abundance is not met in any year. Artificial barriers are assumed to substantially limit distribution (greater than 30% disconnected habitat). Hatchery-origin spawners average 60% of total spawners while the target is less than 30%. The abundance-based viability estimate is adjusted from Low to Very Low due to limits in spatial structure, productivity, and diversity resulting from hatchery fish competition and interbreeding, blocked habitat and fish passage limitations.

Coweeman (Tule) Fall Chinook – This Primary population is identified as a genetic legacy population by the Willamette-Lower Columbia Technical Review Team and is targeted for improvement from Very Low to High+ viability. Spawning occurs in the mainstem and major tributaries up to Washboard Falls (RM 31.2).

This population is one of only two fall Chinook populations without a history of significant hatchery influence from in-basin hatchery juvenile releases. No hatchery program occurs in the Coweeman subbasin.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan but below the delisting goal for return years with available data (63% of delisting goal). The delisting abundance goal is met in two of the last ten years. Artificial barriers do not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 15% of total spawners while the target is less than 10%. Viability has increased to Medium due to high abundances, limited hatchery fish competition and interbreeding and the lack of spatial structure and diversity limitations.

Kalama (Tule) Fall Chinook – This Contributing population is targeted for improvement from Very Low to Medium viability. Spawning primarily occurs in the mainstem between Kalama Falls Hatchery and the I-5 Bridge (10.5 miles). Lower Kalama Falls (RM 10.5) is a natural barrier to upstream migration. Hatchery releases of fall Chinook in the Kalama began in 1895 with the completion of the Lower Kalama (Fallert Creek) Hatchery at RM 4.8, the oldest hatchery in the Columbia basin. A segregated hatchery program is currently operated in-basin.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan and the delisting goal for return years with available data (207% of delisting goal). The delisting abundance goal is met in eight of the last ten years. Artificial barriers do not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 68% of total spawners while the target is less than 10%. The abundance-based viability estimate is adjusted from High to Low due to limits in productivity, and diversity resulting from hatchery fish competition and interbreeding.

Lewis (Bright) Fall Chinook – This Primary population is identified as a genetic legacy and historical core population by the Willamette-Lower Columbia Technical Review Team and is targeted for maintenance of Very High viability. Spawning occurs primarily in a four-mile reach between the Lewis River Salmon Hatchery and Merwin Dam at River Mile 19.

This is one of the healthiest salmon populations in the entire Columbia Basin. Hatchery releases of bright fall Chinook were discontinued in 1986 to eliminate interactions with the highly viable wild population.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan and the delisting goal (130% of delisting goal). The delisting abundance is met in eight of the last twelve years. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise < 0.1% of total spawners, meeting the target of less than 5%. This population is meeting its goal of Very High viability due to high abundances, limited hatchery fish competition and interbreeding and the lack of spatial structure and diversity limitations.

Lewis (Tule) Fall Chinook – This Primary population is identified as a genetic legacy population by the Willamette-Lower Columbia Technical Review Team and is targeted for improvement from Very Low to High+ viability. Tule fall Chinook occur in the North Fork Lewis River, East Fork Lewis River, and Cedar Creek. In the East Fork Lewis, spawning occurs from Lucia Falls (RM 21.2) downstream to RM 5.6. No hatchery releases of tule fall Chinook have occurred in the East Fork Lewis basin.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan and the delisting goal for return years with available data (136% of delisting goal). The delisting abundance is met in eight of the last ten years. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 38% of total spawners while the target is less than 5%. The abundance-based viability estimate is adjusted from High to Medium due to limits in productivity and diversity resulting from hatchery fish competition and interbreeding.

Salmon (Tule) Fall Chinook – This Stabilizing population is not targeted for significant improvement from Very Low viability. Fall Chinook historically spawned in the lower five miles of Salmon Creek and the lowest reach of Burnt Bridge Creek. These habitats in the urbanized lower reaches of this stream are highly degraded. No hatchery releases of fall Chinook have occurred in the Salmon Creek basin. No spawning surveys are conducted for this population because returns are assumed to be very low. An abundance delisting goal is not identified for this Stabilizing population. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). The percentage of hatchery-origin spawners is unknown and no target is identified. Viability remains Very Low because of a lack of information.

Washougal (Tule) Fall Chinook -This Primary population is targeted for improvement from Very Low to High+ viability. Spawning currently occurs from the railroad bridge (~RM 0.5) to Dougan Falls (RM 21.9), and in major tributaries. A genetic analysis project may adjust the annual population size estimates based on what portion of this population is derived from upriver bright fall Chinook salmon from outside of the Lower Columbia River ESU. An integrated fall Chinook program is currently operated in the basin.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan but below the delisting goal for return years with available data (72% of delisting goal). The delisting abundance goal is met in three of the last 12 years. Artificial barriers do not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 53% of total spawners while the target is less than 30%. The abundance-based viability estimate is adjusted from Medium to Very Low due to limits in productivity and diversity resulting from hatchery fish competition and interbreeding.

Lower Gorge (Tule) Fall Chinook – This Contributing population is targeted for improvement from Very Low to Medium viability. This population is shared with Oregon and recovery goals are halved for the purposes of our analysis because only Washington population data is reported. Fall Chinook historically spawned in the lower reaches of small streams like Hamilton, Hardy, and Duncan creeks and in the Columbia River mainstem. Columbia River spawning has been documented in the mainstem from the upper end of Pierce Island to the lower end of Ives Island, along the Washington shore in Hamilton Slough between the top of Ives Island to the mouth of Hardy Creek, and in the lower reaches of Hardy and Hamilton creeks.

Genetic analysis is underway to determine what portion of this population is derived from upriver bright fall Chinook salmon from outside of the Lower Columbia River ESU, which could change population size estimates. Bonneville Hatchery currently releases 1.85 million tule fall Chinook per year in the Oregon portion of this population. Additionally, while it's been seven – eight years since any on-station late (Bright) fall Chinook releases have occurred, several million out of ESU Bright stock juveniles are incubated and reared at Bonneville Hatchery for release at other locations in the Columbia River Gorge. Both tule and Bright hatchery stocks are currently segregated programs.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan and the delisting goal for return years with available data (365% of delisting goal). The delisting abundance goal is met in ten of the last ten years. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 7% of total spawners, meeting the target of less than 10%. Final viability is adjusted from Very High to Medium because of an ongoing WDFW genetic study which may change VSP parameter estimates. Viability has increased to Medium due to high abundances, limited hatchery fish competition and interbreeding and the lack of spatial structure and diversity limitations.

Upper Gorge (Tule) Fall Chinook – This Contributing population is identified as a historical core population by the Willamette-Lower Columbia Technical Review Team and is targeted for improvement from Very Low to Medium viability. This population is shared with Oregon and recovery goals are halved for the purposes of our analysis because only Washington population data is reported. Historically, fall Chinook were limited to the lower reaches of the Wind River, Little Wind River, and Little White Salmon River. Completion of Bonneville Dam in 1938 inundated primary fall Chinook spawning areas in these subbasins. A ladder was constructed in the Wind River at Shipherd Falls (RM 2) in 1956, providing fish access to the upper basin. Only steelhead and spring Chinook are currently passed at the Shipherd Falls ladder. Therefore, fall Chinook spawning is limited to the lower two miles of the mainstem. Spawning also occurs in the Little Wind River (RM 1) and in the Little White Salmon River in a ¼ mile stretch of river downstream from the Little White Salmon Hatchery and upstream of Drano Lake.

Genetic analysis is underway to determine what portion of this population is derived from upriver bright fall Chinook salmon from outside of the Lower Columbia River ESU, which could change population size estimates. In the Washington portion of this population, three segregated hatchery programs are operated by the USFWS, one producing tule fall Chinook (Spring Creek) and two producing upriver bright fall Chinook (Little White Salmon and Willard).

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan and near the delisting goal for return years with available data (92% of delisting goal). The delisting abundance goal is met in three of the last ten years. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 51% of total spawners while the target is less than 10%. The abundance-based viability estimate is adjusted from Low to Very Low due to limits in productivity and diversity resulting from hatchery fish competition and interbreeding.

White Salmon (Tule) Fall Chinook – This Contributing population is identified as a historical core population by the Willamette-Lower Columbia Technical Review Team and is targeted for improvement from Very Low to Medium viability. The construction of Condit Dam (RM 3) in 1913 blocked access to most of the historical spawning habitat, about 14 stream miles.

Since Condit Dam removal in 2011, tule and bright fall Chinook salmon have been observed to spawn in significant numbers downstream of the dam site but spawning has not been documented upstream (Olk and Dammerman 2020). Genetic analysis is underway to determine what portion of this population is derived from upriver bright fall Chinook salmon from outside of the Lower Columbia River ESU, which could change population size estimates. No hatchery fall Chinook are released into the White Salmon River.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan and near the delisting goal for return years with available data (95% of delisting goal). The delisting abundance goal is met in five of the last ten years. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 32% of total spawners while the target is less than 10%. The abundance-based viability estimate is adjusted from Low to Very Low due to limits in productivity and diversity resulting from hatchery fish competition and interbreeding.

Coho

Coho historically returned to all lower Columbia subbasins (Figure 6, Table 9). Spawning and rearing habitat was widely distributed in small to medium sized streams and rivers at low to moderate elevations. Development and land use has degraded coho streams particularly hard. Hatchery off-station planting of juvenile coho was historically commonplace throughout lower Columbia tributaries. Where the lower Columbia is thought to once produce 300,000 coho per year, numbers now average just 30,000 natural-origin coho per year (MAFAC 2020).

At the time of ESA listing in 2005, all 17 coho populations occurring in whole or part in Washington, were estimated to be at Very Low levels of viability (Table 9). Very Low viability was associated with low abundance, poor productivity, limited distribution, and a loss of historical diversity.

Stock assessments of natural-origin coho in Washington were generally lacking prior to 2010 as management was focused on hatchery fish released in large numbers for fishery mitigation purposes. In 2010, WDFW expanded coho monitoring efforts supported by mass marking of hatchery fish. Data was gathered on VSP parameters including natural-origin spawner abundance, hatchery-origin spawner abundance, spatial distribution, diversity, and productivity. All seventeen Washington populations are now monitored each year. Abundance estimates have been substantially improved since ESA listing. In many cases, populations are larger than previously estimated. Since 2010, coho escapements in Washington were generally around 25,000 natural-origin spawners, with a peak of over 60,000 in 2014.

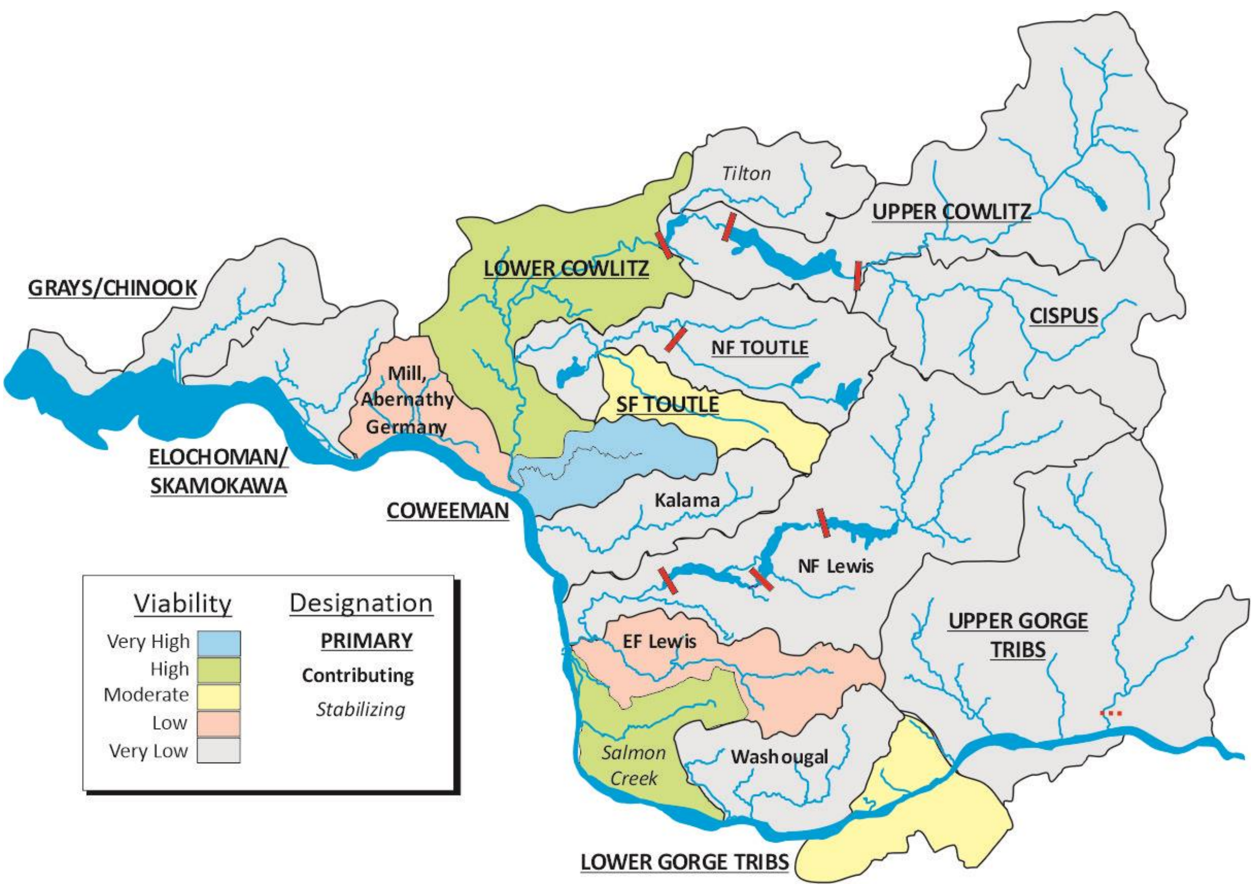


Figure 6. Current status (approximate) and Recovery Plan designations of Lower Columbia River populations of coho Salmon in Washington.

Table 9. Viability and abundance relative to recovery objectives for Lower Columbia River populations of coho salmon in Washington. Abundance estimates based on professional judgement are identified with an asterisk (*).

Strata	Population	Designation[1]	Abundance[2]						% of	Years Goal Met[9]		Data[10]
			Historical	@list[3]	Goal[4]	@High[5]	12-yr[6]	4-yr[7]	Goal[8]	12-yr	4-yr	
Coast	Grays/Chinook	P	3,800	<50	2,400	2,450	306	213	13%	11%	0%	1
	Eloch./Skam.	P	6,500	<50	2,400	2,390	640	545	27%	11%	0%	1
	Mill/Aber./Ger.	C	2,800	<50	1,800	2,000	674	682	37%	11%	0%	1
Cascade	Lower Cowlitz	P	18,000	500	3,700	3,720	3,738	2,531	101%	44%	25%	1
	Tilton	S	5,600	<50	<50	2,000	1,780	1,932	3,560%	100%	100%	1
	Upper Cowlitz	P	18,000	<50	2,000	2,000	1,345	625	34%	33%	0%	1
	Cispus	P	8,000	<50	2,000	2,000						
	NF Toutle	P	27,000	<50	1,900	1,890	1,082	765	57%	22%	0%	1
	SF Toutle	P		<50	1,900	1,890	1,566	1,039	82%	33%	25%	1
	Coweeman	P	5,000	<50	1,200	1,200	2,544	1933	212%	89%	75%	1
	Kalama	C	800	<50	500	2,000	23	43	5%	0%	0%	1
	NF Lewis	C	40,000	200	500	2,910	1,570	1,250	314%	89%	75%	1
	EF Lewis	P	3,000	<50	2,000	2,000	1,170	669	59%	22%	0%	1
	Salmon	S	5,300	<50	<50	1,340	1,533	1,501	3,067%	100%	100%	1
	Washougal	C	3,000	<50	1,500	2,000	301	172	20%	0%	0%	1
Gorge	L Gorge[11]	P	2350	<50	950	585	393	358	41%	0%	0%	1
	U Gorge	P	950	<50	1,900	1,170	300*	300*	2%*	--	--	2

[1] Priority designation identified in Recovery Plan: P=Primary, C=Contributing, S=Stabilizing.
[2] Abundance of natural-origin spawners (geometric means).
[3] Status in the 1990s at the time of first listing.
[4] Recovery targets based on scenario identified in the Recovery Plan.
[5] Abundance at High viability (approximate value identified in Recovery Plan).
[6] Recent 12-year geometric means (typically 2008-2019) based on the best available information. Data are not available prior to 2010 for many populations.
[7] Recent 4-year geometric means (typically 2016-2019) based on the best available information.
[8] Based on 12-year geometric mean abundances.
[9] Percentage of years for available data where recovery goal was met for 12-year and 4-year abundances.
[10] Quality/type of recent abundance data reported in this assessment: 1 = good (annual statistical stream survey, dam or weir count), 2= fair (periodic surveys, index counts), 3= poor (expert judgement, habitat model inference).
[11] Recovery abundance goal and @High viability abundance target are divided in half for combined Washington-Oregon populations because only Washington abundances are reported.

Recent data shows that natural-origin abundance of ten Washington populations is substantially greater than believed at listing with five populations meeting or exceeding delisting abundance goals (Figure 7). The largest populations are all located in the Cascade stratum. Coast and Gorge strata populations remain at Very Low to Medium abundances.

Viability adjustments are identified for eight of seventeen coho populations based on productivity, diversity, and spatial structure VSP parameters, averaging one adjustment step across populations (Table 10). Most VSP adjustments are related to elevated pHOS. Five populations have lower current viabilities following adjustments to abundance-based viability estimates.

Seven of seventeen Washington coho populations are more viable than believed at listing, and four have met or surpassed delisting viability goals. Three populations have High or Very High viability while ten populations remain at Very Low levels of viability, including two of three Coast strata populations. Coho are faring best in the Cascade strata, where five of the six populations with improved or goal viabilities achieved occur.

Coho salmon have benefitted from significant recovery efforts including reductions in harvest rates, region-wide hatchery reforms, and habitat improvements. Efforts to date have likely contributed to viability improvements although long-term data are not available by which any improvements can be measured directly. The majority of restoration and conservation habitat projects funded through the Salmon Recovery Funding Board have directly addressed coho freshwater habitat. Coho typically rely on smaller tributary and headwater habitat for rearing and spawning, and these habitat types often occur in industrial timber and public lands where larger parcels and undeveloped lands increase the feasibility of project implementation. Details are discussed for key populations in the pages following.

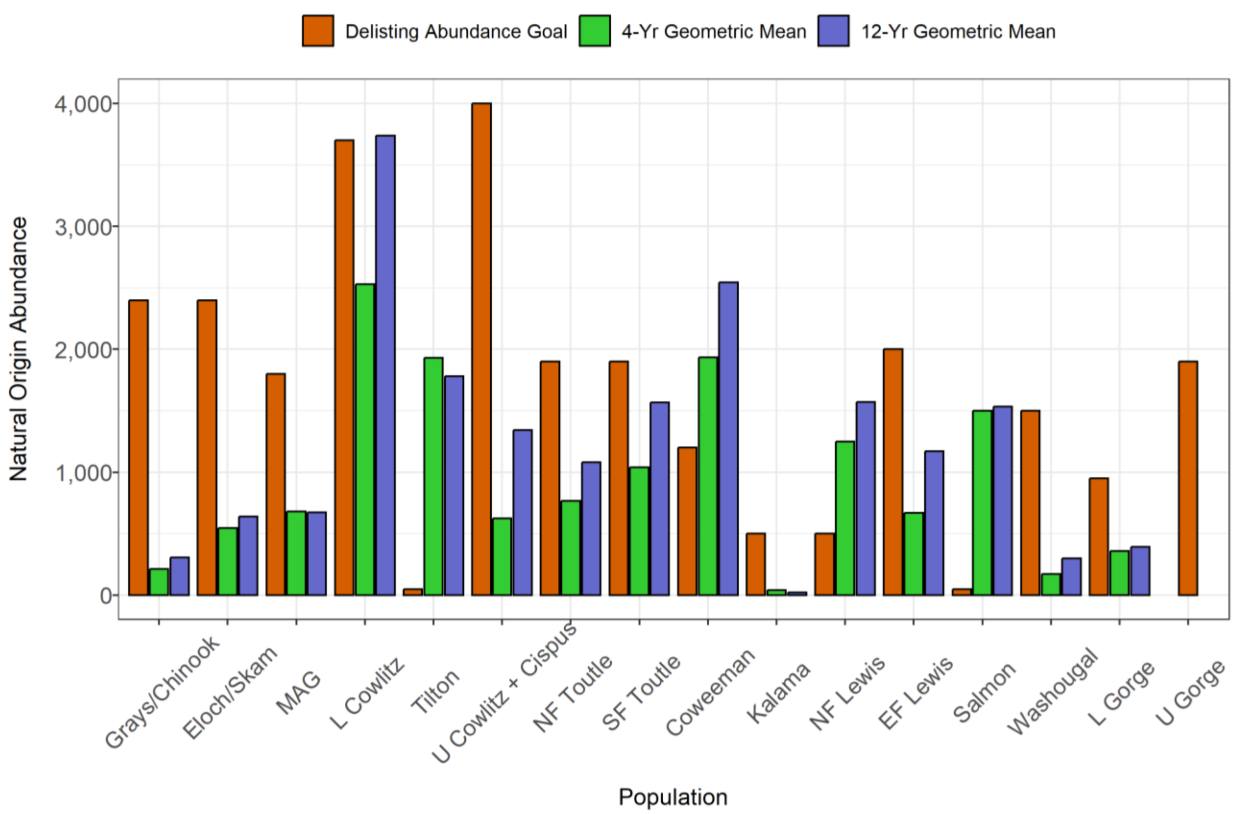


Figure 7. Recent natural origin (NOR) 4-year geometric mean abundance estimates for coho salmon populations in Washington relative to delisting abundance goals.

Table 10. Viability categorization process for Lower Columbia River populations of coho salmon in Washington. Abundance-based viability is based on 12-year geometric means unless population data is lacking and an assumed abundance estimate based on professional judgement is used (denoted with an asterisk). Final viabilities that are lower than abundance-based viabilities are highlighted in red, final viabilities bolded and italicized are greater than listing estimates but less than goals, and final viabilities bolded and underlined are meeting or surpassing goals. Viability categories: VH=Very High, H=High, M=Moderate, L=Low, VL = Very Low.

Strata	Population	@list	Goal	pHOS	Blocked Habitat	Fish Passage	Abundance -Based	VSP Adjustment	Final Viability
Coast	Grays/ Chinook	VL	H	0.68	<10%	N/A	VL	-2	VL
	Eloch./Skam.	VL	H	0.42	<10%	N/A	L	-1	VL
	Mill/Aber./Ger.	VL	M	0.11	<10%	N/A	L	0	***L***
Cascade	Lower Cowlitz	VL	H	0.14	<10%	N/A	H	0	**H**
	Tilton	VL	VL	0.58	<10%	75 – 95%	M	-3	**VL**
	U. Cowlitz Cispus	VL VL	H	0.79	<10%	<75%	M	-4	VL
	NF Toutle	VL	H	0.36	<10%	N/A	L	-3	VL
	SF Toutle	VL	H	0.18	<10%	N/A	M	0	***M***
	Coweeman	VL	H	0.10	<10%	N/A	VH	0	**VH**
	Kalama	VL	L	0.84	<10%	N/A	VL	-2	VL
	NF Lewis	VL	L	0.58	<10%	<75%	L	-4	**VL**
	EF Lewis	VL	H	0.21	<10%	N/A	L	0	***L***
	Salmon	VL	VL	0.04	<10%	N/A	H	0	**H**
	Washougal	VL	M+	0.51	<10%	N/A	VL	-2	VL
Gorge	L Gorge	VL	H	0.15	<10%	N/A	M	0	***M***
	U Gorge	VL	H	0.26	<10%	N/A	VL*	0	VL

Population Descriptions

Grays/Chinook Coho – This Primary population is targeted for improvement from Very Low to High viability. Natural spawning occurs primarily in upper Grays River mainstem and tributaries throughout the subbasin. Cascades and falls at river mile 13 (Grays River Falls) blocked salmon passage to the upper basin, except in some high-water seasons (Bryant 1949). In 1957, Grays River Falls were lowered using explosives to allow passage. There was also historically an impassable 18-foot splash dam five miles upstream of the South Fork Grays confluence on the mainstem and a 40-foot-tall splash dam on the South Fork Grays 260 yards upstream of the mouth. Coho distribution now extends above this canyon on the mainstem up to the confluence with the EF Grays and various tributaries. A large number of hatchery fish were previously released in this subbasin, but releases ended in 2018.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan but below the delisting goal for return years with available data (13% of delisting goal). The delisting abundance goal is met in one of the last nine years of reported adult returns. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 68% of total spawners while the target is less than 5%. Viability remains Very Low due to limits in abundance, productivity, and diversity resulting from low population numbers and hatchery fish competition and interbreeding.

Elochoman/Skamokawa Coho – This Primary population is targeted for improvement from Very Low to High viability. Natural spawning in the Elochoman is thought to occur in most areas accessible to coho with the majority of the spawning area in the upper watershed. In the Skamokawa Creek watershed, important spawning areas include the mainstem and major tributaries. An integrated on-station hatchery release coho program is currently operated in the Elochoman watershed.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan but below the delisting goal for return years with available data (27% of delisting goal). The delisting abundance goal is met in one of nine years of reported adult returns. Artificial barriers do not substantially limit distribution (less than 10% disconnected habitat), although the hatchery intake diversion structure may impede passage at times into upper Beaver Creek. Hatchery-origin spawners on average comprise 42% of total spawners while the target is less than 30%. The abundance-based viability estimate is adjusted from Low to Very Low due to limits in productivity and diversity resulting from hatchery fish competition and interbreeding.

Mill/Abernathy/Germany Coho – This Contributing population is targeted for improvement from Very Low to Medium viability. Natural spawning is thought to occur in most areas accessible to coho in Mill, Abernathy (including Cameron Creek), Germany, and Coal creeks. There are no hatcheries located in this subbasin and there have been no hatchery juveniles released since at least 2001.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan but below the delisting goal for return years with available data (37% of delisting goal). The delisting abundance goal is met in one of nine years of reported adult returns. Artificial barriers do not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 11% of total spawners while the target is less than 10%. Viability increased to Low due to high abundances, limited hatchery fish competition and interbreeding and the lack of spatial structure and diversity limitations.

Lower Cowlitz Coho – This Primary population is targeted for improvement from Very Low to High viability. This population was likely one of the largest historical populations in the lower Columbia with production occurring in many tributary streams. Significant natural production occurs in most tributaries accessible to coho including Olequa, Lacamas, Delameter, Ostrander, Brights, Blue, Otter, Mill, Arkansas, Foster, Stillwater, Campbell, and Hill creeks. Hatcheries currently release 2.4 million coho per year into the Cowlitz and Toutle rivers but straying into significant natural production areas is relatively low. An integrated coho program is currently operated in-basin although a segregated program was maintained through 2021.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan and meets the delisting goal for return years with available data (101% of delisting goal). The delisting abundance goal is met in four of none years of reported adult returns. Artificial barriers do not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 14% of total spawners while the target is less than 5%. Viability has increased to High due to high abundances, limited hatchery fish competition and interbreeding, and the lack of spatial structure and diversity limitations.

Tilton Coho – This Stabilizing population is not targeted for significant improvement from Very Low viability. Completion of Mayfield Dam at River Mile 52 blocked upstream migration in 1963 and upstream transport was terminated in 1968. This population has been reintroduced with releases of hatchery fish in natural spawning areas beginning in 1996. Historically, coho fry were found in the North Fork Tilton up to Winnie Creek, Wallanding Creek, Otter Creek, South Fork Tilton, East Fork Tilton, West Fork Tilton, Coon Creek, and Snow Creek in surveys from 1936 and 1937 (McIntosh et al. 1989).

A FERC relicensing settlement agreement for Cowlitz River hydroelectric projects calls for taking significant steps to achieve a genetically viable, self-sustaining natural population in the Cowlitz basin above the dams. Reintroduction is dependent on upstream trap and haul of adults from the Barrier Dam facility to release sites in the Tilton River. Juvenile coho salmon are collected at Mayfield Dam and released downstream. A considerable portion of juvenile coho also survive passage through the Mayfield turbines. However, Tacoma Power has not measured survival of out-migrating fish relative to their Biological Opinion license requirement of 95% in several decades and current passage survival is unknown. The ultimate success of the reintroduction effort will depend on improved juvenile collection efficiency and passage survival at Mayfield Dam. An in-basin integrated coho salmon program is currently operated to produce adults for a reintroduction program.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan. An abundance delisting goal is not identified for this population. Artificial barriers do not substantially limit distribution upstream from mainstem dams (less than 10% disconnected habitat). Fish passage rates are assumed to be between 75 and 95% based on calculations made in the 1980s at Mayfield Dam. Hatchery-origin spawners on average comprise 58% of total spawners and no hatchery fish target is identified for this population. The abundance-based viability estimate is adjusted from Medium to Very Low due to limits in spatial structure, productivity, and diversity resulting from hatchery fish competition and interbreeding and fish passage limitations.

Upper Cowlitz & Cispus Coho – These Primary populations are targeted for improvements from Very Low to High viability. Current management does not separate these two populations, so monitoring data and recovery goals are combined. Completion of Mayfield Dam at River Mile 52 blocked upstream migration in 1963 and upstream transport was terminated in 1968. A FERC relicensing settlement agreement for Cowlitz River hydroelectric projects calls for taking significant steps to achieve a genetically viable, self-sustaining natural population in the Cowlitz basin above the dams (City of Tacoma et al. 2000, Tacoma Power 2020). Spawning by hatchery and natural-origin adults occurs upstream of Cowlitz Falls Dam in the Cispus and Upper Cowlitz Rivers and is dependent on upstream trap and haul of adults from the Barrier Dam facility to release sites in the upper basin. These reintroduction efforts have been underway above Cowlitz River dams since 1994.

Successful reintroduction into habitat upstream of the Cowlitz hydroelectric system is a high priority for coho recovery. Reintroduction program success depends on effective collection and fish passage survival of downstream migrating naturally produced juveniles at Cowlitz Falls Dam. Initial juvenile collection efforts proved challenging, but collection efficiencies have improved somewhat since the Cowlitz Falls North Shore Collector was completed at Cowlitz Falls Dam in 2017. However, collection efficiency targets identified in the Settlement Agreement are still not being met. The Settlement Agreement identifies a collection efficiency goal of 95%. Collection efficiency of juvenile coho averaged approximately 70% in 2017-2020 during the spring and summer operating months, still below the program requirement of 95%. An unknown portion of coho migrate from late fall to mid spring when collection efficiency is 0% because the collector is not operated. This equates to about a 30% collection efficiency if assuming equal rates of seasonal passage across the year. Thus, we represent the current tributary hydropower impact as reduced from the baseline estimate of 100% to approximately 70% for the combined populations. An in-basin integrated coho program is currently operated to produce adults for a reintroduction program in the Upper Cowlitz and Cispus subbasins.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan but below the combined delisting goals for return years with available data (34% of combined delisting goal). The delisting abundance goal is met in four of eleven years of reported adult returns. Artificial barriers do not substantially limit distribution upstream from mainstem dams (less than 10% disconnected habitat). Hatchery-origin fish on average comprise 79% of total spawners while targets are less than 30% for both populations. However, the reintroduction program relies on hatchery-origin fish at this stage, so high pHOS is expected. Downstream fish passage rates are below the targeted 95% rate. The abundance-based viability estimate is adjusted from Medium to Very Low due to limits in spatial structure, productivity, and diversity resulting from hatchery fish competition and interbreeding, blocked habitat, and fish passage constraints.

North Fork Toutle Coho - This Primary population is targeted for improvement from Very Low to High viability. This river system likely provided the most productive coho salmon habitat in the Lower Columbia River basin. Natural spawning was thought to occur in most accessible areas including tributaries. Productivity in much of the North Fork was greatly reduced after the 1980 Mount St. Helens Eruption. However, the Green River and many other tributaries were less affected.

Completion of the SRS on the NF Toutle blocked upstream migration beginning in 1989. Natural-origin coho salmon are trapped at the Toutle Fish Collection Facility and transported above the SRS to allow access to select tributaries upstream. Coho salmon currently spawn primarily in Alder and Hoffstadt creeks above the SRS. Currently the most productive tributaries to the Toutle River are Outlet, Hemlock, and Silver creeks. The most productive tributary to the NF Toutle is Wyant Creek. The Green River has high productivity for coho in Devils Creek, Cascade Creek, Elk Creek, and Schultz creeks.

An integrated coho program is currently operated out of the North Fork Toutle Hatchery on the Green River less than a mile upstream from its confluence with the North Fork Toutle. Annual releases have been progressively reduced from production peaks in the 1990s and early 2000s to just around 100,000 currently.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan but below the delisting goal for return years with available data (57% of delisting goal). The delisting abundance goal is met in two of nine years of reported adult returns. Coho salmon are only released into two tributaries upstream of the SRS, so fish passage is assumed to be less than 75 percent. Hatchery-origin spawners on average comprise 36% while the target is less than 30 percent. The abundance-based viability estimate is adjusted from Low to Very Low due to limits in spatial structure and productivity resulting from fish passage constraints.

South Fork Toutle Coho – This Primary population is targeted for improvement from Very Low to High viability. Spawning occurs in most areas accessible to coho including the mainstem and tributaries. There are no hatcheries located in this watershed but an integrated coho salmon program is operated in the North Fork Toutle River watershed.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan but below the delisting goal for return years with available data (82% of delisting goal). The delisting abundance goal is met in three of nine years of reported adult returns. Artificial barriers do not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 18% of total spawners while the target is less than 5%. Viability increased to Medium Viability due to high abundances, limited hatchery fish competition and interbreeding, and the lack of spatial structure and diversity limitations.

Coweeman Coho - This Primary population is targeted for improvement from Very Low to High viability. Most spawning takes place in the mainstem Coweeman River and in tributaries such as Goble, Baird, and Mulholland creeks. Historical hatchery production included widespread transfers from other populations before the early 1990s.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan and the delisting goal for return years with available data (212% of delisting goal). The delisting abundance goal is met in eight of nine years of reported adult returns. Artificial barriers do not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 10% of total spawners while the target is less than 5%. Viability has increased to Very High Viability due to high abundances, limited hatchery fish competition, and interbreeding and the lack of spatial structure and diversity limitations.

Kalama Coho – This Contributing population is targeted for improvement from Very Low to Low viability. This population historically consisted primarily of later-timed fish. Natural spawning was limited to accessible tributaries below Kalama Falls (RM 10), including Spencer, Cedar, Fallert, and Indian creeks. A fish ladder was installed at Kalama Falls in 1936 to provide access above the falls. However, coho are not currently passed above the falls.

Hatchery coho have been planted in the Kalama basin since 1942. Both early and late stock coho were historically produced, although the early stock is eliminated today and in the last decade the late stock program has been reduced from historical highs. A segregated coho program is currently operated out of the Fallert Creek Hatchery at RM 4.3 and Kalama Falls Hatchery at RM 10.6.

The twelve-year geometric mean abundance is similar to the baseline estimate identified in the Recovery Plan and below the delisting goal for return years with available data (5% of delisting goal). The delisting abundance goal is not met in any of the nine years of reported adult returns. Artificial barriers do not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 84% of total spawners while the target is less than 10%. Viability remains Very Low due to limits in abundance, productivity, and diversity resulting from low population numbers and hatchery fish competition and interbreeding.

North Fork Lewis Coho – This Contributing population is targeted for improvement from Very Low to Low viability. A portion of this population historically spawned in the upper basin which was blocked by Merwin Dam in 1931. Coho currently spawn in the mainstem and several tributaries downstream of Merwin Dam. The most productive tributaries are Bratton, Hayes, Robinson, Ross, Houghton, Johnson, and Colvin creeks. Cedar Creek and its tributaries are also highly productive.

A FERC relicensing settlement agreement for Lewis River hydroelectric projects calls for taking significant steps to achieve a genetically viable, self-sustaining natural population in the upper North Fork above Merwin Dam. Reintroduction efforts began in 2013, with the release of adult coho salmon into the upper basin and the operation of a juvenile collection facility in Swift Reservoir.

Successful reintroduction into habitat upstream of the Lewis hydropower system is a priority for coho salmon recovery. Reintroduction program success depends on effective collection and fish passage survival of upstream migrating spawners and downstream migrating naturally produced juveniles at Swift Reservoir tributaries. Collection efficiency targets identified in the Settlement Agreement are not being met today. Collection efficiency of juvenile coho salmon averaged 42% from 2017 – 2020, still below the program target of 95% year-round. The Settlement Agreement identifies an adult trap efficiency goal of 98%. It is assumed that current tributary hydroelectric impacts are reduced from the baseline estimate of 85% to 43% today. Construction of adult and juvenile fish passage facilities in Merwin and Yale reservoirs has been delayed between one and five years depending on facility location, due to a proposal from the utilities to change fish passage prescriptions and associated review and dispute processes. However, in 2022 the federal services reaffirmed the requirement to construct fish passage facilities in both Yale and Merwin reservoirs. Segregated and integrated coho programs are currently operated in-basin.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan and the delisting goal for return years with available data (314% of delisting goal). The delisting abundance goal is met in eight of nine years of reported adult returns. Artificial barriers substantially limit distribution (greater than 30% disconnected habitat) because no passage is provided into the Merwin and Yale reservoir systems. Fish passage rates are less than 75% while targets range from 75 – 95%. Hatchery-origin spawners on average comprise 58% of total spawners while the target is less than 10%, but higher rates than targets are expected given the reintroduction program relies on hatchery-origin fish at this stage. The abundance-based viability estimate is adjusted from Low to Very Low due to limits in abundance, productivity, spatial structure, and diversity resulting from hatchery fish competition and interbreeding, blocked habitat and fish passage constraints.

East Fork Lewis Coho – This Primary population is targeted for improvement from Very Low to High viability. Natural spawning occurs downstream of Lucia Falls at River Mile 21 and in Jenny, McCormick, Brezee, Lockwood, Stoughton, Mason, Dyer, Dean, Mill, Manley, Rock, Brickle, and Charlie creeks. No hatchery releases of coho salmon have or currently occur in the East Fork Lewis subbasin.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan but below the delisting goal for return years with available data (59% of delisting goal). The delisting abundance goal is met in two of nine years of reported adult returns. Artificial barriers do not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 21% of total spawners while the target is less than 5%. Viability has increased to Low due to high abundances, limited hatchery fish competition, and interbreeding and the lack of spatial structure and diversity limitations.

Salmon Coho - This Stabilizing population is not targeted for significant improvement from Very Low viability. Natural spawning can occur throughout the basin, but principally in the upper mainstem and Whipple, Packard, Mill, Curtin, Weaver, Morgan, Gravel Point, Rock, Little Salmon, and Erion creeks. Coho spawning also exists in nearby streams, including Burnt Bridge Creek. No hatchery releases of coho salmon have or currently occurred in the subbasin.

The twelve-year geometric mean abundance is substantially greater than the baseline estimate identified in the Recovery Plan (3067% of baseline estimate). An abundance delisting goal is not identified for this Stabilizing population. Artificial barriers do not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 4% of total spawners and no hatchery fish target is identified for this population. Viability increased to High due to high abundances, limited hatchery fish competition and interbreeding and the lack of spatial structure and diversity limitations.

Washougal Coho Salmon –This Contributing population is targeted for improvement from Very Low to Medium+ viability. Historically, most spawning is thought to have taken place downstream of Salmon Falls (Myers et al 2006). Three dams owned by the Cotterell Power Company on the lower Washougal River blocked fish runs in the early 1900s (Bryant 1949), but have since been removed. Currently, this population spawns primarily in Lacamas, Little Washougal, EF Little Washougal, Boulder, Jones, Winkler, West Fork, and Wildboy creeks downstream of Dougan Falls in addition to the mainstem. An integrated coho salmon program is currently operated in-basin.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan but below the delisting goal for return years with available data (20% of delisting goal). The delisting abundance goal is not met in any of the nine reported years of adult returns. Artificial barriers do not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 51% of total spawners while the target is less than 30%. Viability remains Very Low due to limits in abundance, productivity, and diversity resulting from low population numbers and hatchery fish competition and interbreeding.

Lower Gorge Coho - This Primary population is targeted for improvement from Very Low to High viability. This population is shared with Oregon but most of the habitat exists in Washington. Recovery goals are halved for the purposes of this analysis because only Washington population data is reported. Spawning in Washington streams includes Gibbons, Campen, Wooding, Lawton, Walton, Indian Mary, Hardy, Duncan, Woodward, Hardy, Hamilton, Greenleaf, and Carpenter creeks.

Washougal Hatchery late coho were planted in Duncan and Greenleaf Creeks in 1983, with continued plants of juvenile coho in Duncan Creek into the late 1990s as mitigation for the dam at the mouth of this creek. No hatchery releases of coho salmon currently occur in the Washington portion of this subbasin. However, Oregon operates a large hatchery program in the subbasin just downstream from Bonneville Dam.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan but below the delisting goal for return years with available data (41% of delisting goal). The delisting abundance goal is not met in any of the nine reported years of adult returns. Artificial barriers do not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 15% of total spawners while the target is less than 5%. Viability increased to Medium due to greater abundance and limited hatchery fish competition and interbreeding and the lack of spatial structure and diversity limitations.

Upper Gorge Coho – This Primary population is targeted for improvement from Very Low to High viability. This population is shared with Oregon but most of the habitat exists in Washington. Recovery goals are halved for the purposes of this analysis because only Washington population data is reported. In the Washington portion of the subbasin, coho spawn in the Wind, White Salmon, and Little White Salmon rivers, Rock, Kanaka, Nelson, and Mill, Spring, Buck, Rattlesnake, Indian, Jewett, and Major creeks. The lower reaches of these tributaries were flooded after the construction of Bonneville Dam in 1938. No hatchery releases of coho salmon have or currently occurred in the Washington portion of this subbasin.

Data is only available for natural-origin spawners in the Little Wind River. The population size is assumed to be around 300 fish. Assumed abundance is greater than the baseline estimate identified in the Recovery Plan but below the delisting goal for return years with available data (2% of delisting goal).[7] It is assumed that the delisting abundance goal is not met in any years of reported adult returns. Artificial barriers do not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 26% of total spawners while the target is less than 5%. Viability remains Very Low due to limits in abundance, productivity, and diversity resulting from low population numbers.

Chum

Annual returns of chum Salmon to the Columbia River have declined from hundreds of thousands in the 1930s to fewer than 20,000 today (MAFAC 2020). Chum are extirpated or nearly so throughout most of their historical range (Figure 8). Only four lower Columbia populations continue to support significant numbers of spawners (Grays/Chinook, Elochoman/Skamokawa, Washougal, and Lower Gorge). At the time of ESA listing in 1999, eight of nine Washington populations, six of six Oregon populations, and one of two shared populations were estimated to be at Very Low levels of viability (Table 11). Very Low viability was associated with low abundance, poor productivity, limited distribution, and a loss of historical diversity.

Stock assessments for chum salmon were historically conducted primarily in the Grays River and Lower Gorge Tributary populations which are the strongest extant populations. In 2002, WDFW undertook a more comprehensive assessment of chum numbers throughout the lower Columbia River. Oregon also conducted additional surveys on their side of the river. This work identified significant populations in the Washougal and the Elochoman/Skamokawa subbasins that were larger than believed at listing. Small numbers of chum salmon were documented in other tributaries, but abundance data for many of these populations is limited by low returns such that quantitative estimates are available for only a few years.

Based on this new information, the viability status of several populations is re-evaluated in this report. We estimate that each stratum currently includes one population of High to Very High viability occurring in whole or in part in Washington (Figure 8, Table 11). Details are discussed for key population in the pages following.

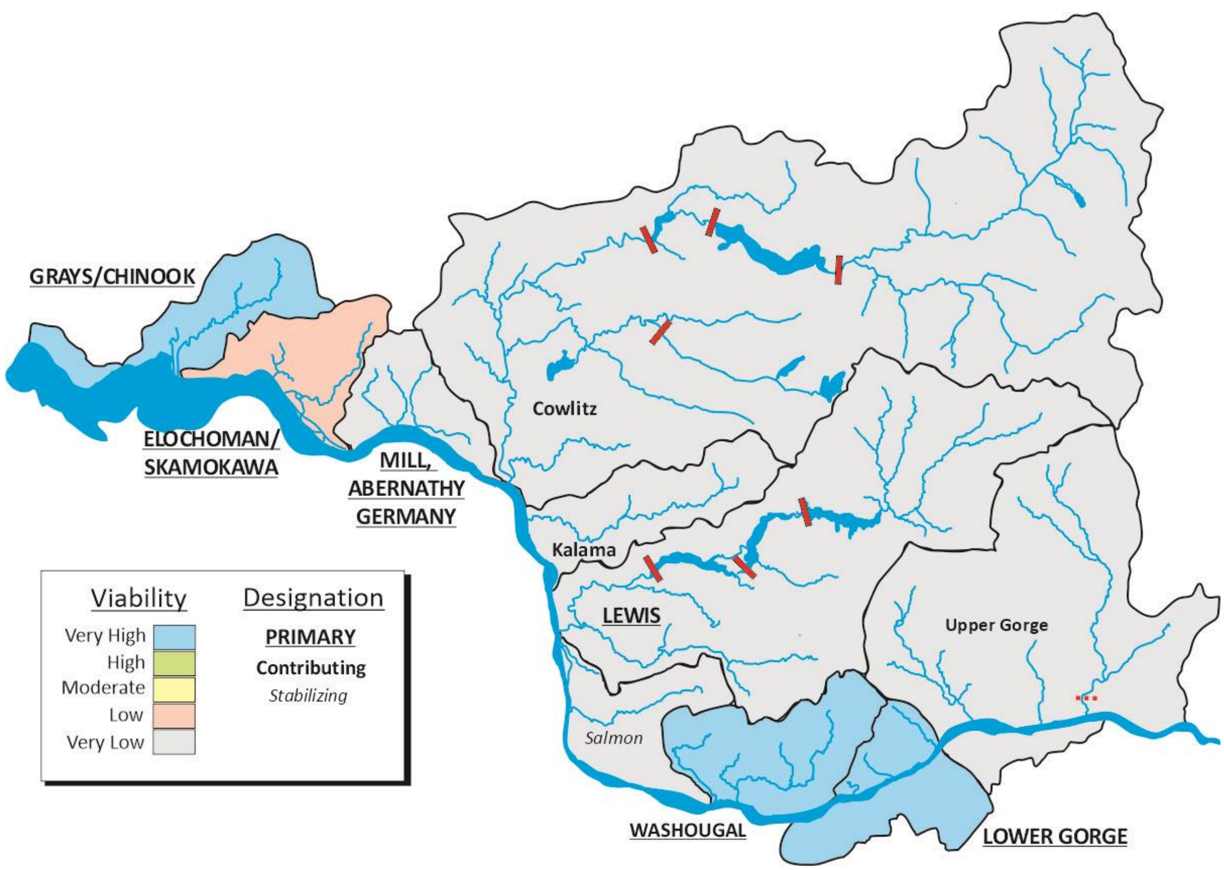


Figure 8. Current status and Recovery Plan designations of Lower Columbia River populations of chum salmon in Washington.

Table 11. Viability and abundance relative to recovery objectives for Lower Columbia River populations of chum salmon in Washington.

Strata	Population	Designation[1]	Abundance[2]						% of	Years goal met[9]		Data[10]
			Historical	@list[3]	Goal[4]	@High[5]	12-yr[6]	4-yr[7]	Goal[8]	12-yr	4-yr	
Coast	Grays/Chinook	P	10,000	1,600	1,600	1,120	6,523	9,563	408%	100%	100%	1
	Eloch./Skam.	P	16,000	<200	1,300	1,300	359	916	28%	33%	50%	2
	Mill/Aber./Ger.	P	7,000	<100	1,300	1,300	26	26	2%	--	--	3
Cascade	Cowlitz[11]	C	195,000	<300	900	1,300	<300	--	--	--	--	3
	Kalama	C	20,000	<100	900	1,300	<100	--	--	--	--	3
	Lewis	P	125,000	<100	1,300	1,300	<100	--	--	--	--	3
	Salmon	S	4,000	<100	100	1,300	<100	--	--	--	--	3
	Washougal	P	18,000	<100	1,300	1,300	2,009	2,262	155%	83%	100%	1
Gorge	Lower Gorge[12]	P	3,000	2,000	1,000	775	2,039	3,573	204%	100%	100%	1
	Upper Gorge[12]	C	5,500	<50	450	650	97	87	21%	0%	0%	1

[1] *Priority designation identified in Recovery Plan: P=Primary, C=Contributing, S=Stabilizing.*

[2] *Abundance of natural-origin spawners (geometric means).*

[3] *Status in the 1990s at the time of first listing.*

[4] *Recovery targets based on scenario identified in the Recovery Plan.*

[5] *Abundance at High viability (approximate value identified in Recovery Plan).*

[6] *Recent 12-year geometric means (typically 2008-2019) based on the best available information. Where recent survey data is not available, values were assumed to be those reported in the Recovery Plan.*

[7] *Recent 4-year geometric means (typically 2016-2019) based on the best available information.*

[8] *Based on 12-year geometric mean abundances.*

[9] *Percentage of years for available data where recovery goal was met for 12-year and 4-year abundances.*

[10] *Quality/type of recent abundance data reported in this assessment: 1 = good (annual statistical stream survey, dam or weir count), 2= fair (periodic surveys, index counts), 3= poor (expert judgement, habitat model inference).*

[11] *Recovery Plan reported that the Cowlitz historically supported fall and summer chum populations.*

[12] *Recovery abundance goal and @High viability abundance target are divided in half for combined Washington-Oregon populations because only Washington abundances are reported.*

Recent surveys have identified greater abundance and overall viability of natural-origin chum salmon than was estimated at listing. Viability adjustments are not identified for any of the chum based on productivity, diversity, and spatial structure, although related data are limited (Table 12). Four populations have greater viability relative to baseline conditions, and three of these have met delisting abundance goals (Figure 9) and are at Very High viability. The remaining six populations remain at Very Low levels of viability, including four of five Cascade strata populations.

Chum salmon have benefitted from a variety of conservation and restoration actions. Fishery impacts have been reduced to *de minimis* levels (<5%) since 1993 by prohibiting sport and commercial retention and limiting commercial seasons in late fall when chum salmon are present. Hatchery influence is limited to small scale supplementation and reintroduction programs designed to increase spatial distribution across the region. Spawning channels have been constructed in Crazy Johnson Creek, Skamokawa Creek, Duncan Creek, Hamilton Creek and the East Fork Lewis River to provide critically limiting habitat. Estuary habitat protection and restoration will likely benefit chum salmon during a critical life history stage. Chum salmon are also expected to benefit from other stream, floodplain, and watershed habitat protection and restoration efforts across the region although there is limited effort at this time in lower watershed areas favored by this species. Long-term success of chum salmon recovery efforts will depend on critical habitat restoration needed to expand spatial distribution beyond a few limited production areas. Details are discussed for key populations in the pages following.

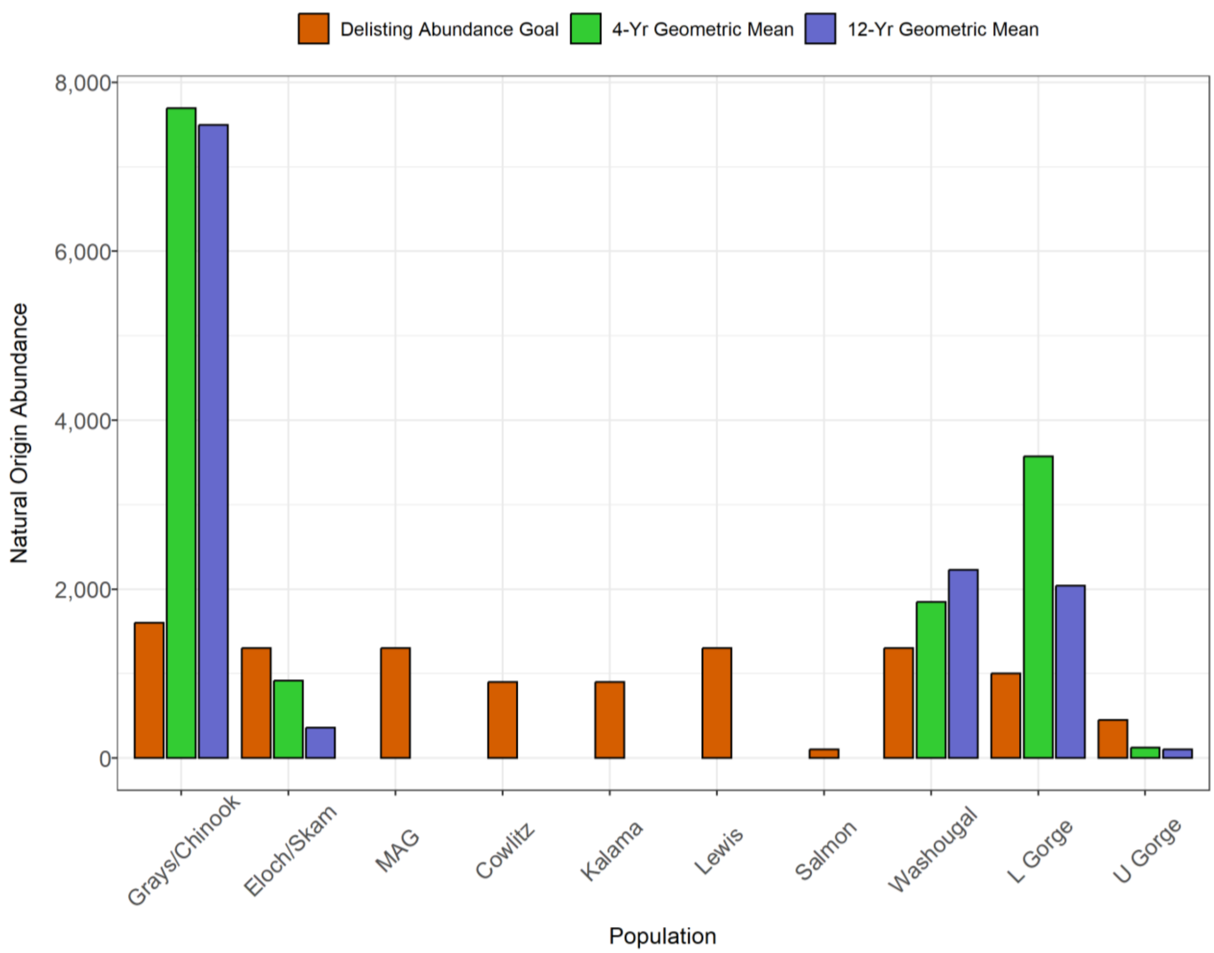


Figure 9. Recent natural origin 4-year and 12-year geometric mean abundance estimates for chum salmon populations in Washington relative to delisting abundance goals.

Table 12. Viability categorization process for Lower Columbia River populations of chum salmon in Washington. Abundance-based viability is based on 12-year geometric means unless population data is lacking and an assumed abundance estimate based on professional judgement is used (denoted with an asterisk). Final viabilities bolded and italicized are greater than listing estimates but less than goals, and final viabilities bolded and underlined are meeting or surpassing goals. Viability categories: VH=Very High, H=High, M=Moderate, L=Low, VL = Very Low.

Strata	Population	@list	Goal	pHOS	Blocked Habitat	Fish Passage	Abundance -Based	VSP Adjustment	Final Viability
Coast	Grays/Chinook	M	VH	0.07	<10%	N/A	VH	0	**<u>VH</u>**
	Eloch./Skam.	VL	H	NA	<10%	N/A	L	0	***L***
	Mill/Aber./Ger.	VL	H	NA	<10%	N/A	VL	0	VL
Cascade	Cowlitz	VL	M	NA	<10%	N/A	VL	0	VL
	Kalama	VL	M	NA	<10%	N/A	VL	0	VL
	Lewis	VL	H	NA	<10%	N/A	VL	0	VL
	Salmon	VL	VL	NA	<10%	N/A	VL	0	VL
	Washougal	VL	H+	0.01	<10%	N/A	VH	0	**<u>VH</u>**
Gorge	Lower Gorge WA	H	VH	0.01	<10%	N/A	VH	0	**<u>VH</u>**
	Upper Gorge WA	VL	M	NA	<10%	N/A	VL	0	VL

Population Descriptions

<u>Grays/Chinook Chum</u> –This Primary population is identified as a historical core and genetic legacy population by the Willamette-Lower Columbia Technical Review Team and is targeted for improvement from Medium to Very High viability. Spawners are distributed among the mainstem Grays River from RM 9.5-13.0, the lower 4.7 miles of the West Fork of the Grays River, and the lower 0.5 miles of Crazy Johnson Creek. An integrated chum salmon program producing fry for in-basin releases has operated since 1998.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan as well as the delisting goal for return years with available data (408% of delisting goal). The delisting abundance goal is met in 12 of 12 years of reported adult returns. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 7% of total spawners, meeting the target of less than 30%. Viability increased to Very High due to high abundances, limited hatchery fish competition, and interbreeding and the lack of spatial structure and diversity limitations.

<u>Elochoman/Skamokawa Chum</u> – This Primary population is identified as a historical core population by the Willamette-Lower Columbia Technical Review Team and is targeted for improvement from Very Low to High viability. Spawning occurs primarily in the lower mainstem Elochoman between tidewater and the now-closed Elochoman Hatchery (RM 9.5). The barrier at the Elochoman Hatchery was removed in 2018 and chum have been observed as far up as RM 12.9 post-removal. In Skamokawa Creek, spawning primarily occurs between tidewater and Standard and McDonald creeks (RM 6.8). With the exception of one release of approximately fifty thousand hatchery fry in 2020 in the Skamokawa subbasin, no hatchery releases of chum have occurred in the Elochoman/Skamokawa population. Spawning surveys are conducted weekly but population estimates are not made for all years due to difficulties in estimating very low returns.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan but below the delisting goal for return years with available data (28% of delisting goal). The delisting abundance goal is met in one of one year of reported adult returns. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). The percentage of hatchery-origin spawners is unknown but the target is less than 5%. Viability has increased to Low due to high abundances, assumed limited hatchery fish competition and interbreeding, and the lack of spatial structure and diversity limitations.

Mill/Abernathy/Germany Chum – This Primary population is targeted for improvement from Very Low to High viability. Chum salmon spawn in the lower 0.4 miles of Abernathy Creek and in the lower parts (above tidewater) of Mill and Germany Creeks. Hatchery fry releases of various chum stocks occurred from 1958-1991 in Abernathy Creek and 1982-1983 in Germany Creek.

After hatchery releases were discontinued in the 1990s, chum returns dropped dramatically, but appear to have increased in some years. Spawner area under the curve data (counts) are collected and abundance estimates should be available soon. Until estimates are developed, it is assumed abundance today is similar to the baseline estimate (less than 100 spawners). The assumed abundance is below the delisting goal (less than 2% of delisting goal). It is assumed that the delisting abundance goal is not met in any years of reported adult returns. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). The percentage of hatchery-origin spawners is unknown but the target is less than 5%. Viability remains Very Low because of a lack of information.

Cowlitz Chum- This Contributing population is identified as a historical core population by the Willamette-Lower Columbia Technical Review Team and is targeted for improvement from Very Low to Medium viability. This system historically supported the largest chum numbers in the basin including fall and possibly summer run populations. Spawning occurred primarily in the lower mainstem Cowlitz, Toutle, and Coweeman rivers and Ostrander Creek. Some chum historically migrated into areas upstream of Mayfield Dam. No hatchery releases of chum have occurred in the Cowlitz subbasin.

No chum specific spawning surveys are conducted for this population. Current returns are assumed to be similar to the baseline estimate (less than 300 spawners). Baseline abundance is below the delisting goal (less than 33% of delisting goal). It is assumed that the delisting abundance goal is not met in any years of reported adult returns. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat) and passage of chum is not required at Cowlitz basin dams. The percentage of hatchery-origin spawners is unknown but the target is less than 10%. Viability remains Very Low.

Kalama Chum - This Contributing population is targeted for improvement from Very Low to Medium viability. Chum salmon historically spawned in the mainstem Kalama and tributaries below Kalama Falls. Chum spawning today is likely limited to the mainstem Kalama River between Modrow Bridge (RM 2.4) and Lower Kalama Falls (RM 10). No hatchery releases of chum occur in the Kalama subbasin.

No chum specific spawning surveys are conducted for this population. Current returns are assumed to be similar to the baseline estimate (less than 100 spawners). Baseline abundance is below the delisting goal (less than 11% of delisting goal). It is assumed that the delisting abundance goal is not met in any years of reported adult returns. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). The percentage of hatchery-origin spawners is unknown but the target is less than 10%. Viability remains Very Low because of a lack of information.

Lewis Chum – This Primary population is identified as a historical core population by the Willamette-Lower Columbia Technical Review Team and is targeted for improvement from Very Low to High viability. Historically productive areas likely included the lower North Fork and East Fork Lewis rivers and Cedar Creek. Chum salmon currently spawn in the lower reaches of the mainstem North Fork River below Merwin Dam, RM 11.7 to 19.2, and East Fork Lewis River from RM 5.6 to 14.3. Beginning in spring 2016, approximately 100,000 hatchery-origin fed-fry have been released into the East Fork Lewis River annually to help re-build this population.

Spawning surveys are conducted weekly in both the NF and EF Lewis rivers but population estimates have not made for all years due to difficulties in estimating very low returns. Numbers are assumed to be similar to the baseline estimate (less than 100 spawners) which is below the delisting goal (less than 8% of delisting goal). It is assumed that the delisting abundance goal is not met in any years of reported adult returns. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat) and passage of chum is not required at Lewis basin dams. The percentage of hatchery-origin spawners is unknown but the target is less than 30%. Viability remains Very Low because of a lack of information.

Salmon Chum – This Stabilizing population is not targeted for significant improvement from Very Low viability. Spawning distribution is assumed to be from the mouth to RM 2.8 in Salmon Creek. No hatchery releases of chum have occurred in the Salmon Creek subbasin.

No chum specific spawning surveys are conducted for this population. Current returns are assumed to be similar to the baseline estimate (less than 100 spawners). Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). The percentage of hatchery-origin spawners is unknown and a target is not identified. Viability remains Very Low because of a lack of information.

Washougal Chum – This Primary population is targeted for improvement from Very Low to High+ viability. A large number of chum salmon spawn in the mainstem Columbia River near the mouth of the Washougal River. These fish spawn in two upwelling areas on the Washington shoreline just upstream from the Glen Jackson (I-205) Highway Bridge. Small numbers spawn in the lower mainstem Washougal River between RM 0.5 and 6.3 and in Lacamas Creek between RM 0 and 0.8.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan as well as the delisting goal for return years with available data (155% of delisting goal). The delisting abundance goal is met in 10 of 12 years of reported adult returns. Artificial barriers do not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 1% of total spawners, meeting the target of less than 5%. Viability increased to Very High due to high abundances, limited hatchery fish competition, and interbreeding and the lack of spatial structure and diversity limitations.

Lower Gorge Chum – This Primary population is identified as a historical core and genetic legacy population by the Willamette-Lower Columbia Technical Review Team and is targeted for improvement from Very Low to Very High viability. Recovery goals are halved for the purposes of this analysis because only Washington population data is reported. This population spawns in the lower reaches of Hardy, Hamilton creeks, and Duncan creeks, and in the mainstem Columbia at the Ives, Horsetail, Multnomah, and St Cloud sites.

Habitat work in Hamilton and Hardy creeks, along with artificial spawning channels in Duncan and Hamilton creek basins have increased the spatial distribution of this population. An integrated hatchery program releases fed-fry in the Duncan Creek subbasin to support re-introduction and research. Releases began in 2002 and have occurred annually since, except in 2004, 2007, and 2008.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan as well as the delisting goal for return years with available data (233% of delisting goal). The delisting abundance goal is met in 12 of 12 years of reported adult returns. Artificial barriers do not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 1% of total spawners, meeting the target of less than 30%. Viability increased to Very High due to high abundances, limited hatchery fish competition, and interbreeding and the lack of spatial structure and diversity limitations.

Upper Gorge Chum – This Contributing population is targeted for improvement from Very Low to Medium viability. This population is also shared with Oregon. Recovery goals are halved for the purposes of this analysis because only Washington population data is reported. The majority of the historical chum spawning habitat was flooded after the construction of Bonneville Dam in 1938. For the Washington portion of this population spawning is limited to the lower reaches of Rock Creek, the Wind River below Shipherd Falls, Little White Salmon and White Salmon rivers. No chum salmon hatchery program occurs in these subbasins.

The twelve-year geometric mean abundance (Bonneville Dam ladder counts) is similar to the baseline estimate identified in the Recovery Plan but less than delisting goal for return years with available data (21% of delisting goal). The delisting abundance goal is not met in any years of reported adult returns. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). The percentage of hatchery-origin spawners is unknown but the target is less than 10%. Viability remains Very Low because of a lack of information.

Steelhead

Lower Columbia steelhead are grouped by NOAA Fisheries into two distinct population segments (DPS). Winter steelhead populations in the Coast strata are part of the Southwest Washington DPS which is not listed under the ESA, but are part of the steelhead recovery strategy in the Recovery Plan. The Lower Columbia Steelhead DPS occurring in the Cascade and Gorge strata are listed as threatened under the ESA. Winter steelhead are the predominate run type in the Lower Columbia River and populations are present in practically all subbasins (Figure 10). Summer steelhead are present in a few areas where falls or cascades are barriers to winter steelhead passage during migration periods.

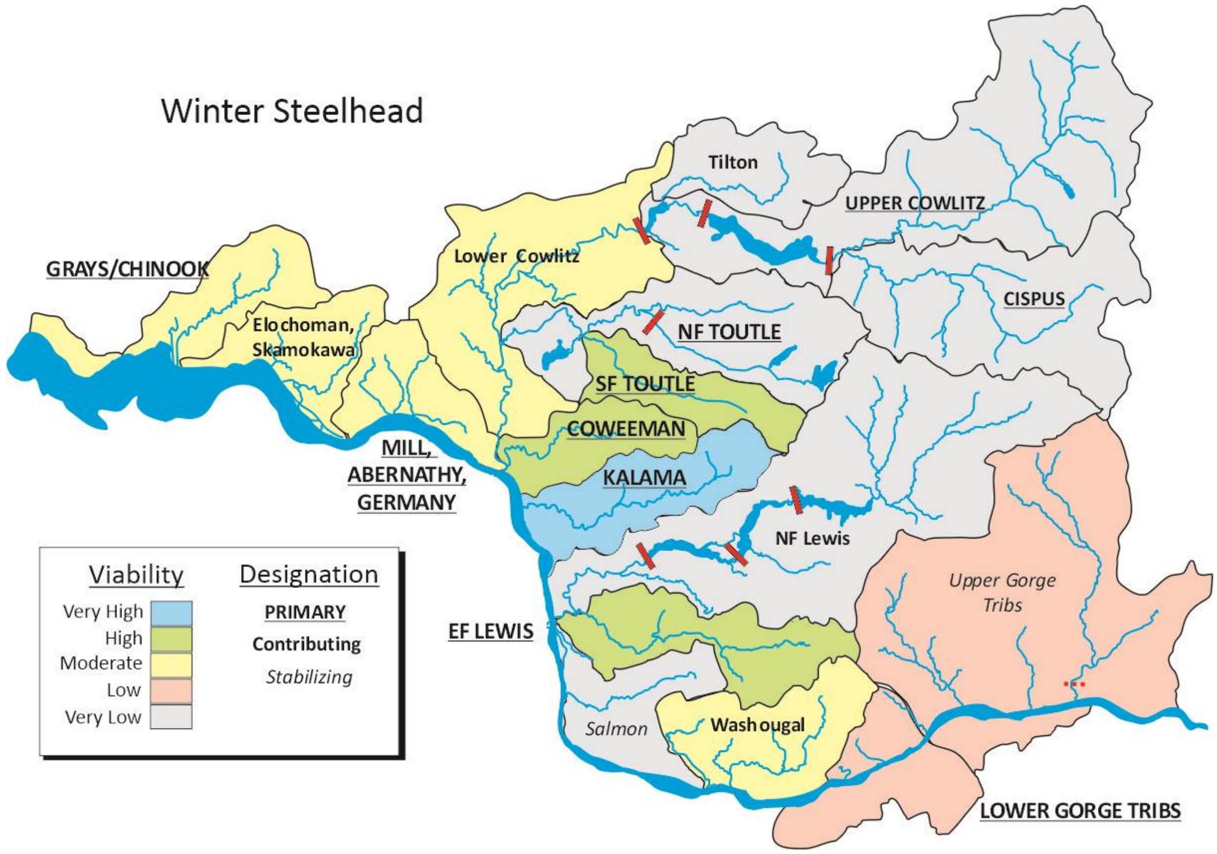
Stock assessment data is available since 2000 for most Washington steelhead populations. Long-term data is not available for a comparison of numbers before and after listing although the Recovery Plan estimated pre-listing abundance based on the best information available at that time.

At the time of ESA listing in 1999, Washington lower Columbia steelhead populations included eight at Very Low, six at Low, seven at Moderate and one at High Viability (Table 13). Six of eight populations occurring only in Oregon were at Moderate to Very High viability.

Eight populations meet or exceed delisting abundance targets (Figure 11, Figure 12). Viability adjustments are identified for five steelhead populations based on productivity, diversity, and spatial structure VSP parameters, averaging less than one adjusted step across populations (Table 14). Final viability is adjusted for Lower Gorge Tributaries winter steelhead because abundance is based on professional judgement. Most populations do not have pHOS data to consider for VSP adjustments; most adjustments are made based on fish passage limitations in the Cowlitz, Toutle, and Lewis River basins.

Eight of 22 Washington steelhead populations are now estimated to be more viable than believed at ESA listing. One population, Kalama summer steelhead, has a lower current viability estimate (Low) than at listing (Medium). Eight populations meet or exceed High and Very High viability criteria. Six populations have Very Low levels of viability, mostly in the Lewis and Cowlitz basins. Eleven populations have met or surpassed delisting viability goals. Populations achieving goals are found only in the Cascade and Gorge strata.

Steelhead appear to be making recovery progress. The majority of restoration and conservation habitat projects funded through the Salmon Recovery Funding Board have directly addressed winter steelhead freshwater habitat. Winter steelhead typically rely on smaller tributary and headwater habitat for rearing and spawning, and these habitat types are often located within industrial timber and public lands, where larger parcels and undeveloped lands increase feasibility of project implementation. Population details are discussed in the pages following.



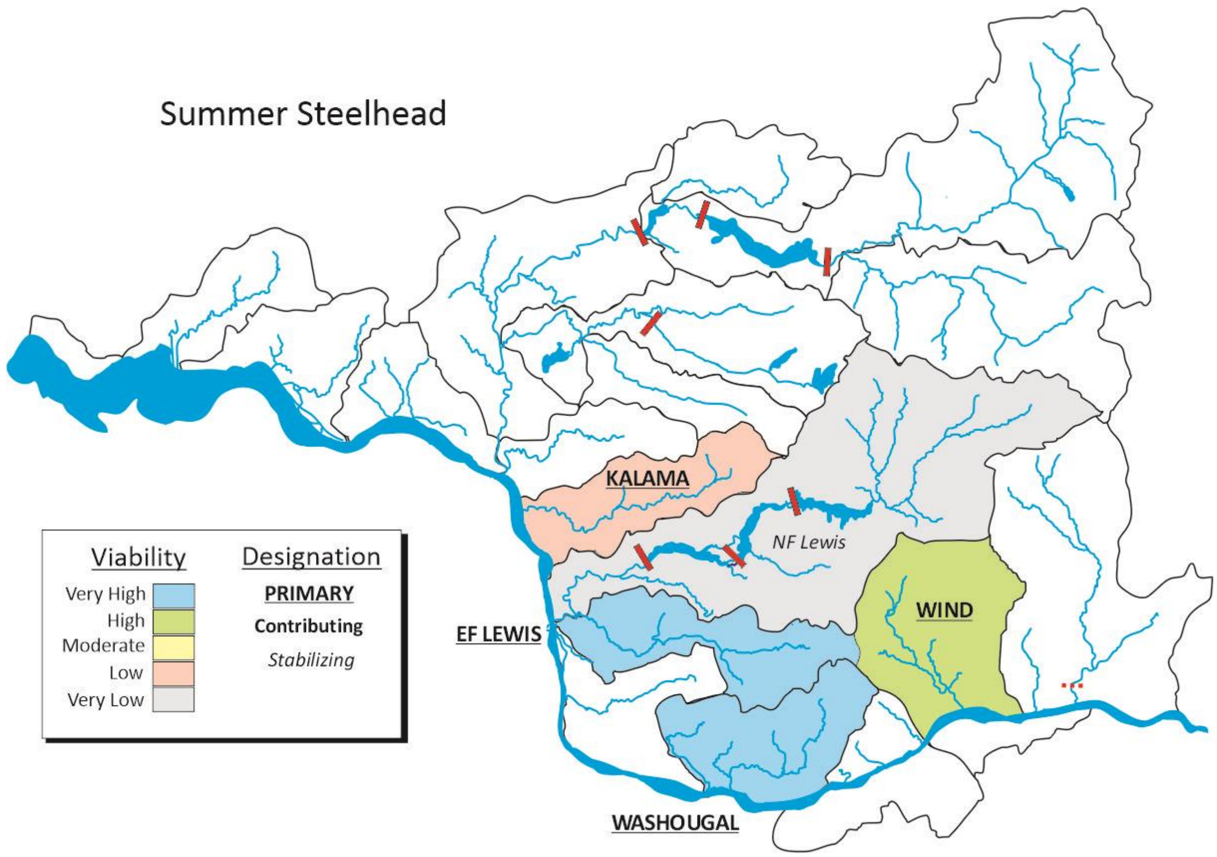


Figure 10. Current status (approximate) and Recovery Plan designations of Lower Columbia River populations of steelhead in Washington.

Table 13. Viability and abundance relative to recovery objectives for Lower Columbia River populations of steelhead in Washington. Abundance estimates based on professional judgment are identified with an asterisk (*).

Run	Strata	Population	Desig.[1]	Abundance[2]						% of	Years Goal Met[9]		Data[10]
				Historical	@list[3]	Goal[4]	@High[5]	12-yr[6]	4-yr[7]	Goal[8]	12-yr	4-yr	
Winter	Coast	Grays/Chinook	P	1,600	800	800	490	593	684	74%	25%	25%	1
		Eloch./Skam.	C	1,100	600	600	410	544	567	91%	33%	25%	1
		Mill/Aber./Ger.	P	900	500	500	420	321	244	64%	17%	0%	1
	Cascade	Lower Cowlitz	C	1,400	350	400	540	449	367	112%	57%	25%	1
		Tilton	C	1,700	<50	200	500	214	206	107%	50%	25%	1
		Upper Cowlitz	P	1,400	<50	500	500	259	187	26%	0%	0%	1
		Cispus	P	1,500	<50	500	500						
		NF Toutle	P	3,600	120	600	590	576	492	96%	42%	50%	1
		SF Toutle	P		350	600	450	519	553	87%	42%	50%	1
		Coweeman	P	900	350	500	470	509	457	102%	50%	25%	1
		Kalama	P	800	300	600	470	755	523	126%	83%	50%	1
		NF Lewis	C	8,300	150	400	500	400*	400*	100%*	--	--	3
		EF Lewis	P	900	350	500	470	489	597	98%	50%	75%	1
		Salmon	S	500	<50	<50	500	50*	50*	100%*	--	--	3
		Washougal	C	800	300	350	480	399	384	114%	67%	75%	1
	Gorge	Lower Gorge[11]	P	1,050	200	150	130	200*	200*	133%*	--	--	3
		Upper Gorge[11]	S	300	200	100	130	50*	50*	50%*	--	--	2
Summer	Cascade	Kalama	P	1,000	500	500	500	481	511	96%	50%	50%	1
		NF Lewis	S	6,500	150	150	560	50*	50*	33%*	--	--	3
		EF Lewis	P	600	<50	500	500	704	609	141%	83%	75%	1
		Washougal	P	2,200	400	500	450	648	613	130%	80%	75%	1
	Gorge	Wind	P	5,000	1,000	1,000	550	650	594	65%	25%	50%	1

[1] Priority designation identified in Recovery Plan: P=Primary, C=Contributing, S=Stabilizing.

[2] Abundance of natural-origin spawners (geometric means).

[3] Status in the 1990s at the time of first listing.

[4] Recovery targets based on scenario identified in the Recovery Plan.

[5] Abundance at High viability (approximate value identified in Recovery Plan).

[6] Recent 12-year geometric means (typically 2008-2019) based on the best available information. Where recent survey data is not available, values were assumed to be those reported in the Recovery Plan.

[7] Recent 4-year geometric means (typically 2016-2019) based on the best available information.

[8] Based on 12-year geometric mean abundances.

[9] Percentage of years for available data where recovery goal was met for 12-year and 4-year abundances.

[10] Quality/type of recent abundance data reported in this assessment: 1 = good (annual statistical stream survey, dam or weir count), 2= fair (periodic surveys, index counts), 3= poor (expert judgement, habitat model inference).

[11] Recovery abundance goal and @High viability abundance target are divided in half for combined Washington-Oregon populations because only Washington abundances are reported.

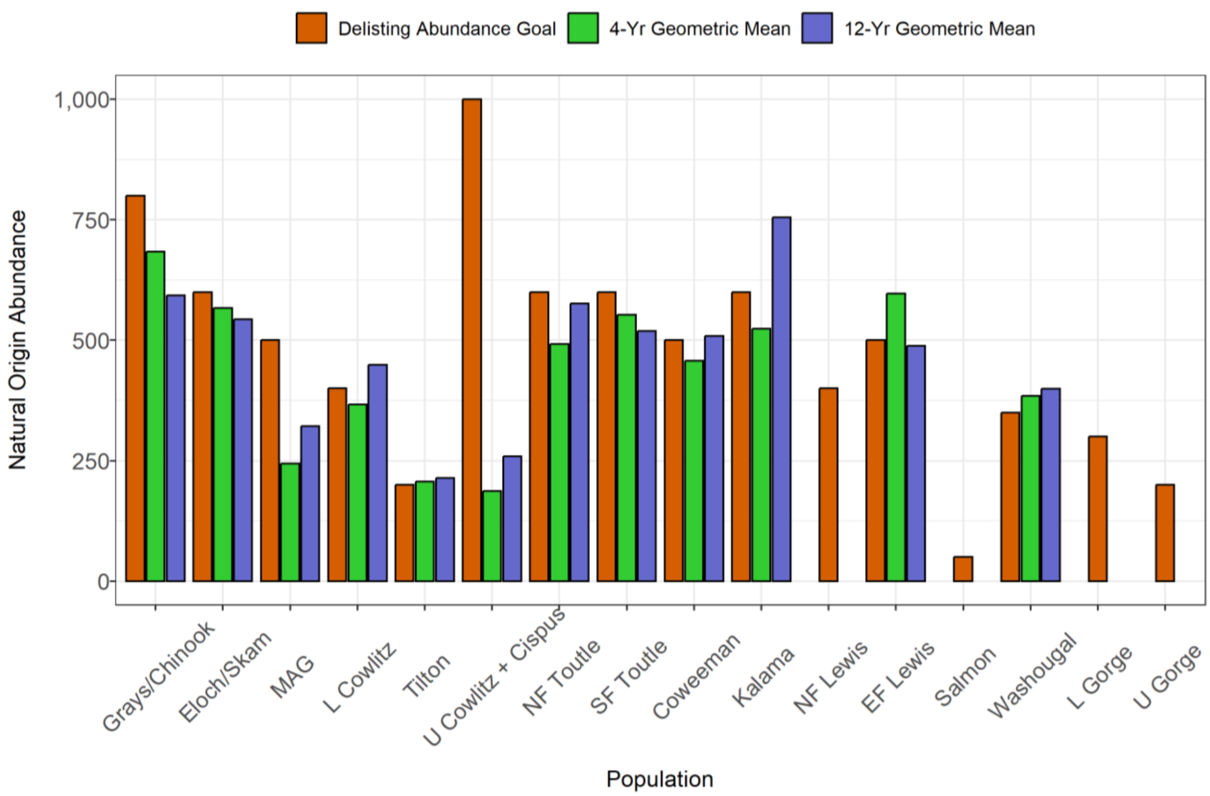


Figure 11. Recent natural origin 4-year and 12-year geometric mean abundance estimates for winter steelhead populations in Washington relative to delisting (or recovery in the case of unlisted Coast strata populations) abundance goals.

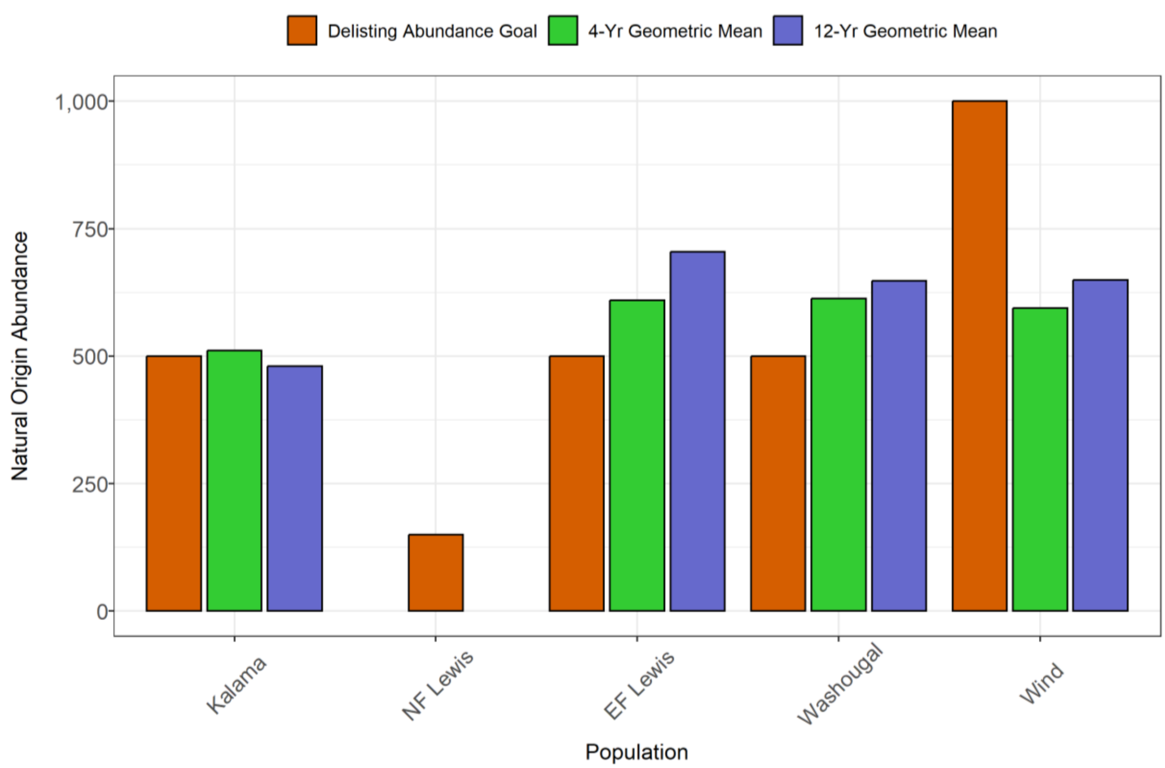


Figure 12. Recent natural origin 4-year and 12-year geometric mean abundance estimates for summer steelhead populations in Washington relative to delisting abundance goals.

Table 14. Viability categorization process for Lower Columbia River populations of steelhead in Washington. Abundance-based viability is based on 12-year geometric means unless population data is lacking and an assumed abundance estimate based on professional judgement is used (denoted with an asterisk). Final viabilities that are lower than abundance-based viabilities are highlighted in red, final viabilities bolded and italicized are greater than listing estimates but less than goals, and final viabilities bolded and underlined are meeting or surpassing goals. Viability categories: VH=Very High, H=High, M=Moderate, L=Low, VL = Very Low.

Run	Strata	Population	@list	Goal	pHOS	Blocked Habitat	Fish Passage	Abu. - Based	VSP Adjust.	Final Viability
Winter	Coast	Grays/Chinook	M	H	N/A	<10%	N/A	M	0	M
		Eloch./Skam.	M	M+	N/A	<10%	N/A	M	0	M
		Mill/Aber./Ger.	M	H	N/A	<10%	N/A	M	0	M
	Cascade	Lower Cowlitz	L	M	0.26	<10%	N/A	M	0	**M**
		Tilton	VL	L	0.25	<10%	75-95%	L	-1	VL
		Upper Cowlitz	VL	H	0.42	<10%	<75%	VL	-3	VL
		Cispus	VL	H						
		NF Toutle	VL	H	N/A	<10%	<75%	M	-2	***VL***
		SF Toutle	M	H+	N/A	<10%	N/A	H	0	***H***
		Coweeman	L	H	N/A	<10%	N/A	H	0	**H**
		Kalama	L	H+	N/A	<10%	N/A	VH	0	**VH**
		NF Lewis	VL	M	N/A	>30%	<75%	M*	-2	VL
		EF Lewis	M	H	N/A	<10%	N/A	H	0	**H**
		Salmon	VL	VL	N/A	<10%	N/A	VL	0	**VL**
		Washougal	L	M	N/A	<10%	N/A	M	0	**M**
	Gorge	L Gorge WA	L	H	N/A	<10%	N/A	VH*	0	L
		U Gorge WA	L	L	N/A	<10%	N/A	L*	0	L
Summer	Cascade	Kalama	M	H	0.42	<10%	N/A	M	-1	L
		NF Lewis	VL	VL	N/A	<10%	N/A	VL*	0	**VL***
		EF Lewis	VL	H	N/A	<10%	N/A	VH	0	**VH**
		Washougal	M	H	N/A	<10%	N/A	VH	0	**VH**
	Gorge	Wind	H	VH	0.01	<10%	N/A	H	0	H

Population Descriptions – Winter Steelhead

Grays/Chinook Winter Steelhead – This Primary population is targeted for improvement from Medium to High viability. Winter steelhead are distributed throughout the mainstem above tidal influence and throughout the East, West, and South forks. In 1957, Grays River Falls (RM 13) was lowered using explosives, providing easier upstream migration. During the 1950s, numerous other natural and man-made barriers above Grays River Falls were cleared to improve steelhead access to the upper watershed.

Following guidance in the Statewide Steelhead Management Plan, this population was established as a wild gene bank to support natural-origin steelhead recovery (WDFW 2008). Chambers Creek winter steelhead from the Elochoman and Cowlitz hatcheries were planted in the Grays River from 1957-2016.

The twelve-year geometric mean abundance is less than the baseline estimate identified in the Recovery Plan and below the delisting goal for return years with available data (74% of delisting goal). The delisting abundance goal is met in three of the last 12 years. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). The percentage of hatchery-origin spawners is unknown but the target is less than 5%. Viability remains Medium due to limits in abundance, productivity and diversity resulting from low population numbers.

Elochoman/Skamokawa Winter Steelhead - This Contributing population is targeted for improvement from Medium to Medium+ viability. Winter steelhead are distributed throughout the mainstem above tidal influence in both the Elochoman and Skamokawa watersheds. They are found within the mainstem Elochoman and its East and West forks and the tributary Otter Creek and in the Skamokawa tributaries of Wilson creek, Left Fork Skamokawa, Standard and McDonald creeks.

A segregated winter and summer steelhead program is operated at the Beaver Creek hatchery on the Elochoman River for in basin releases. There is no hatchery program or any releases of fish into Skamokawa Creek.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan but near the delisting goal for return years with available data (91% of delisting goal). The delisting abundance goal is met in four of the last 12 years. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat), although the hatchery intake diversion structure may impede passage at times into upper Beaver Creek. The percentage of hatchery-origin spawners is unknown but the target is less than 5%. Viability remains Medium due to limits in abundance, productivity, and diversity resulting from low population numbers.

Mill/Abernathy/Germany Winter Steelhead - This Primary population is targeted for improvement from Medium to High viability. Winter steelhead are widely distributed throughout the mainstems and major tributaries. Spawning in Mill Creek occurs in the mainstem, South Fork, and unnamed tributaries. Spawning in Abernathy Creek occurs in the mainstem, Ordway, Sarah, Erick, Weist and Cameron creeks. Spawning in Germany Creek occurs in the mainstem.

An early winter hatchery stock was planted annually from 1961 to 2000. An integrated winter steelhead hatchery program released fish in Abernathy Creek from the 2000s through 2010s but the program was discontinued due to a lack of effectiveness and documentation of domestication in the hatchery line. No hatchery steelhead are currently released in-basin.

The twelve-year geometric mean abundance is less than the baseline estimate identified in the Recovery Plan and the delisting goal for return years with available data (64% of delisting goal). The delisting abundance goal is met in two of the last 12 years. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). The percentage of hatchery-origin spawners is unknown but the target is less than 5%. Viability remains Medium due to limits in abundance, productivity and diversity resulting from low population numbers.

Lower Cowlitz Winter Steelhead – This Contributing population is targeted for improvement from Low to Medium viability. The Lower Cowlitz winter steelhead historical population may have been one of the largest in the lower Columbia Basin. Winter steelhead are distributed in several tributaries of the mainstem Cowlitz below Mayfield Dam including Olequa, Ostrander, Salmon, Arkansas, Delameter, and Stillwater creeks. Production of natural-origin winter steelhead is thought to be largely limited to tributaries due to high parasite densities (*Ceratonova shasta*) in the mainstem. *C. shasta* may limit wild parr productivity in the mainstem and is likely exacerbated by altered flow and sediment transport from the dams, and the hatchery located at the upstream end of the lower basin mainstem, which acts as a reservoir for parasites (Robinson et al. 2020).

Hatchery winter steelhead have been planted in the Cowlitz River basin since 1957 using broodstock from both the Cowlitz River and Chambers Creek (an early returning stock from south Puget Sound). The Chambers Creek broodstock program was eliminated in 2012. An integrated winter steelhead program was operated at the Cowlitz Trout Hatchery, located on the mainstem Cowlitz at RM 42 through 2021 but was then converted to a segregated program.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan and the delisting goal for return years with available data (112% of delisting goal). The delisting abundance goal is met in four of the last 12 years. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 26% of total spawners while the target is less than 30%. Viability remains Medium due to limits in abundance, productivity and diversity resulting from low population numbers.

Tilton Winter Steelhead – This Contributing population is targeted for improvement from Very Low to Low viability. Winter steelhead historically spawned in the lower and middle portions of the river. The upper 3.6 miles above the North Fork Tilton was blocked by a hydroelectric facility owned and operated by Western Gas and Electric. The dam was removed 9/24/1944 (McIntosh 1989). Completion of Mayfield Dam at River Mile 52 blocked upstream migration in 1963 and upstream transport was terminated in 1968.

A FERC relicensing settlement agreement for Cowlitz River hydroelectric projects calls for taking significant steps to achieve a genetically viable, self-sustaining natural population in the Cowlitz basin above the dams. Reintroduction is dependent on upstream trap and haul of adults from the Barrier Dam facility to release sites in the Tilton River, a program that began in 1994. Juvenile winter steelhead are collected at Mayfield Dam and released downstream. A considerable portion of juvenile steelhead also survive passage through the Mayfield turbines. However, Tacoma Power has not measured survival of out-migrating fish relative to their Biological Opinion license requirement of 95% in several decades and current passage survival is unknown. The ultimate success of the reintroduction effort will depend on improved juvenile collection efficiency and passage survival at Mayfield Dam and, in the long term, improved collection efficiency at the Cowlitz Falls Fish Facility to support greater distribution. An integrated winter steelhead program is operated at the Cowlitz Trout Hatchery, located on the mainstem Cowlitz at RM 42.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan and the delisting goal for return years with available data (107% of delisting goal). The delisting abundance goal is met in six of the last 12 years. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). Fish passage rates are assumed to be between 75 and 95% based on calculations made in the 1980s at Mayfield Dam. Hatchery-origin spawners on average comprise 25% of total spawners while the target is less than 30%. Abundance-based viability estimates are adjusted from Low to Very Low due to limits in spatial structure and productivity resulting from fish passage constraints.

Upper Cowlitz & Cispus Winter Steelhead – These Primary populations are identified as historical core and genetic legacy populations by the Willamette-Lower Columbia Technical Review Team and are targeted for improvements from Very Low to High viability. Current management does not separate these two populations, so monitoring data and recovery goals are combined. These populations rely on habitat upstream of the Cowlitz hydroelectric system. Completion of Mayfield Dam at River Mile 52 blocked upstream migration in 1963. Initial adult passage and transport efforts were discontinued in 1980. An integrated winter steelhead program is operated at the Cowlitz Trout Hatchery, located on the mainstem Cowlitz at RM 42, although a segregated program was maintained through 2021.

Successful reintroduction into habitat upstream of the Cowlitz hydroelectric system is a top priority for recovery. A FERC relicensing settlement agreement for Cowlitz River hydroelectric projects calls for taking significant steps to achieve a genetically viable, self-sustaining natural population in the Cowlitz basin above the dams (City of Tacoma et al. 2000; Tacoma Power 2020). Spawning by hatchery and natural origin adults occurs upstream of Cowlitz Falls Dam in the Cispus and Upper Cowlitz rivers and is dependent on upstream trap and haul of adults from the Barrier Dam facility to release sites in the upper basin. These reintroduction efforts have been underway above Cowlitz River dams since 1994.

Reintroduction success depends on effective collection and fish passage survival of downstream migrating naturally produced juveniles above Cowlitz Falls Dam. Initial juvenile collection efforts proved challenging, but collection efficiencies have improved somewhat since a north shore collector was completed at Cowlitz Falls Dam in 2017. However, collection efficiency targets identified in the Settlement Agreement are still not being met today. The Settlement Agreement identifies a collection efficiency goal of 95%. Collection efficiency of juvenile steelhead averaged 68% in 2017-2020 during the spring and summer trapping period. This equates to a 34% collection efficiency if assuming equal rates of seasonal passage throughout the year. There are no adult trap efficiency targets or tracking at the Barrier Dam. Thus, it is assumed that current tributary hydroelectric impacts are reduced from the baseline estimate of 100% to 66% today for the combined populations.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan but below the delisting goals (26% of delisting goal). The delisting abundance is not met in any individual reported year. Artificial barriers are assumed to not substantially limit distribution upstream from mainstem dams (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 42% of total spawners while the target is less than 30%. The reintroduction program relies on hatchery-origin fish at this stage, so high pHOS is expected to be higher than targets. Fish passage rates are below targets of 75 to 95%. Viability remains Very Low due to limits in abundance, productivity, spatial structure, and diversity resulting from hatchery fish competition and interbreeding and fish passage constraints.

North Fork Toutle Winter Steelhead – This Primary population is identified as a historical core population by the Willamette-Lower Columbia Technical Review Team and is targeted for improvement from Very Low to High viability. Winter steelhead spawn primarily in the NF Toutle River mainstem, Alder and Deer creeks. In the Green River they spawn in the mainstem and Devils, Elk, Cascade, Miners, and Shultz creeks. Productivity in much of the North Fork Toutle watershed was greatly reduced after the 1980 Mount St. Helens Eruption. However, the Green River and many other tributaries were less affected. Completion of the SRS on the NF Toutle blocked upstream migration beginning in 1989. Natural-origin winter steelhead are trapped at the Toutle Fish Collection Facility and transported above the SRS to allow access to Alder, Bear, Hoffstadt, and Pullen creeks upstream.

No steelhead hatcheries are currently operated in the North Fork Toutle watershed. Following guidance in the Statewide Steelhead Management Plan this population was established as a wild gene bank to support natural origin steelhead recovery (WDFW 2008). Hatchery winter steelhead were historically planted in the NF Toutle River basin from 1953-2014 using Elochoman and Cowlitz rivers (Chambers Creek stock). Releases were discontinued in 2014 to reduce detrimental effects on productivity and diversity.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan but below the delisting goal (96% of delisting goal). The delisting abundance goal is met in five of the last 12 years. Fish passage operations at the SRS only pass winter steelhead into two upstream tributaries, and fish passage is assumed to be less than 75 percent. The percentage of hatchery-origin spawners is unknown but the target is less than 5%. The abundance-based viability estimate is adjusted from Medium to Very Low due to limits in spatial structure and productivity resulting from fish passage constraints.

South Fork Toutle Winter Steelhead – This Primary population is targeted for improvement from Medium to High+ viability. Spawning occurs in the mainstem SF Toutle and Studebaker, Wyant, Johnson, Thirteen, Bear, Harrington, Loch, Clancy, Flye, Disappointment, Goat, Dollar, Trouble creeks, and one unnamed left-bank tributary at river mile 20.55.

Hatchery winter steelhead have not been released into the South Fork Toutle River watershed aside from several small fry plants from a segregated program at Skamania Hatchery in the Washougal basin following the 1980 eruption of Mount St. Helens.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan but below the delisting goal (87% of delisting goal). The delisting abundance is met in five of the last 12 years. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). The percentage of hatchery-origin spawners is unknown but the target is less than 5%. Viability has increased to High Viability due to high abundances and the lack of spatial structure and diversity limitations.

Coweeman Winter Steelhead – This Primary population is targeted for improvement from Low to High viability. Winter steelhead are distributed throughout the mainstem Coweeman, Goble Creek, and the lower reaches of Mulholland and Baird creeks.

Juvenile hatchery winter steelhead have been planted in the Coweeman River basin since 1957 from multiple sources (Elochoman and Cowlitz river and Chambers Creek stocks). The hatchery program shifted to an in-basin stock beginning in 2017 to reduce hatchery influences on productivity and diversity. The program was discontinued after last planting fish in 2018, due to the unavailability of acclimation sites (formerly on private property), which are required in order to meet hatchery impact reduction terms of the Mitchell Act Biological Opinion (NMFS 2017).

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan and the delisting goal (102% of delisting goal). The delisting abundance goal is met in six of the last 12 years. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). The percentage of hatchery-origin spawners is unknown but the target is less than 5%. Viability has increased to High Viability due to high abundances and the lack of spatial structure and diversity limitations.

Kalama Winter Steelhead – This Primary population is targeted for improvement from Low to High+ viability. Winter steelhead spawn in the mainstem Kalama River up to a 35-foot barrier falls (RM 36.8) and in Gobar, Elk, and Fossil creeks. Construction of a fish ladder at the falls provided upstream access to winter steelhead beginning in the mid-1950s. Natural passage would previously been precluded by high flows and low temperatures (Bradford et al. 1996). Improved passage likely benefited winter steelhead at the expense of summer steelhead and increased hybridization between the runs (Hemstrom et al. 2017; Kostow 2012).

The Fallert and Kalama Falls hatcheries operate segregated summer and winter steelhead programs. Both of these programs shifted to in-basin stocks beginning in 2017.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan and the delisting goal (126% of delisting goal). The delisting abundance goal is met in ten of the last 12 years. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). The percentage of hatchery-origin spawners is unknown but the target is less than

5%. Viability has increased to Very High Viability due to very high abundances and the lack of spatial structure and diversity limitations.

North Fork Lewis Winter Steelhead – This Contributing population is identified as a historical core population by the Willamette-Lower Columbia Technical Review Team and is targeted for improvement from Very Low to Medium viability. This population was once one of the largest in the Columbia basin. Construction of Merwin Dam in 1931 blocked access to approximately 80% of the winter steelhead spawning and rearing habitat in the NF Lewis. Spawning downstream of Merwin Dam is now limited to the mainstem, Cedar and Johnson creeks and other accessible tributaries. A dam on Cedar Creek was removed in 1946, restoring access to habitat throughout this tributary.

A FERC relicensing settlement agreement for Lewis River hydroelectric projects calls for taking significant steps to achieve a genetically viable, self-sustaining natural population in the upper North Fork Lewis above the dams. Successful reintroduction upstream of the Lewis hydroelectric system is a priority for recovery. Reintroduction efforts began in 2013, with the transport and release of adult winter steelhead into the upper basin and the operation of a juvenile collection facility in Swift Reservoir. Success will depend on effective collection and fish passage survival of upstream migrating spawners and downstream migrating naturally produced juveniles above Swift Reservoir and in Swift Reservoir tributaries.

Collection efficiency targets of 95% identified in the Settlement Agreement are not being met. Collection efficiency of juvenile winter steelhead averaged 34% from 2017 – 2020 (PacifiCorp et. al. 2018, 2019, 2020, 2021, 2022). The Settlement Agreement also identifies an adult trap efficiency goal of 98%. Given collection efficiency rates, it is assumed that current tributary hydroelectric impacts are reduced from the baseline estimate of 92% to 58% today. Construction of adult and juvenile fish passage facilities in Merwin and Yale reservoirs has been delayed between one and five years depending on facility location, due to a proposal from the utilities to change fish passage prescriptions and associated review and dispute processes. However, in 2022 the federal services reaffirmed the requirement to construct fish passage facilities in both Yale and Merwin reservoirs. Three steelhead hatchery programs are operated in the Lewis basin: a segregated summer steelhead program, an integrated winter steelhead program, and a segregated winter steelhead program.

Sub-population estimates are not yet available for this population, but returns are assumed to be around 400 adult fish. Assumed abundance is greater than the baseline estimate identified in the Recovery Plan and align with the delisting goal (100% of delisting goal). Artificial barriers are assumed to limit distribution (more than 30% disconnected habitat). The percentage of hatchery-origin spawners is unknown but the target is less than 30%. The assumed abundance-based viability estimate is adjusted from Medium to Very Low due to limits in spatial structure, productivity and diversity resulting from disconnected habitat and fish passage constraints.

East Fork Lewis Winter Steelhead – This Primary population is targeted for improvement from Medium to High viability. Spawning occurs in the mainstem as well as lower and upper Rock Creeks and other tributaries up to Horseshoe Falls, which is considered a barrier to winter steelhead passage.

No hatchery winter steelhead are currently released in this subbasin. The Statewide Steelhead Management Plan established this population as a wild gene bank to support natural origin steelhead recovery (WDFW 2008). Prior to the establishment of gene bank status, Chambers Creek and Skamania hatchery winter steelhead smolts were previously released to provide harvest opportunities.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan and similar to the delisting goal for return years with available data (98% of delisting goal).

The delisting abundance goal is met in six of the last 12 years. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). The percentage of hatchery-origin spawners is unknown but the target is less than 5%. Viability has increased to High Viability due to high abundances and the lack of spatial structure and diversity limitations.

Salmon Winter Steelhead – This Stabilizing population is not targeted for significant improvement from Very Low viability. Winter steelhead historically spawned throughout the Salmon Creek watershed, including the lower reaches of Gee, Whipple, Burnt Bridge, Mill, Curtin, Weaver, Baker, and Rock creeks, and portions of Lake River. Current distribution is assumed to be similar.

No hatcheries are operated in the Salmon Creek subbasin but hatchery winter steelhead have been planted in the basin since 1957 for harvest opportunity.

The current population status is unknown due to a lack of monitoring, but is thought to be similar to the baseline estimate identified in the Recovery Plan (less than 50 adult spawners). There is no abundance goal for this Stabilizing population. Artificial barriers do not substantially limit distribution (less than 10% disconnected habitat). The percentage of hatchery-origin spawners is unknown and a target is not identified. Viability remains Very Low due to a lack of information.

Washougal Winter Steelhead – This Contributing population is targeted for improvement from Low to Medium viability. Spawning historically occurred throughout the mainstem below Salmon Falls at River Mile 15.7 and in the little Washougal, Stebbins Creek, and lower half of the West Fork Washougal. Passage structures and dynamite were previously used to remove numerous obstructions, including Salmon Falls (Fulton 1970). Spawning now occurs in the mainstem Washougal and tributaries upstream to Dougan Falls which includes the Little Washougal and its tributaries, and the North Fork Washougal.

A segregated hatchery program currently releases summer and winter steelhead in the Washougal subbasin. An improved velocity barrier is operated at the Skamania Hatchery to increase collection efficiency of hatchery fish, but effectiveness is not yet evaluated. However, the velocity barrier is located upstream of most natural-origin winter-run spawning habitat and likely does not support substantial reductions in pHOS outside of fish spawning in the West Fork Washougal.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan and the delisting goal (114% of delisting goal). The delisting abundance goal is met in eight of the last 12 years. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). The percentage of hatchery-origin spawners is unknown but the target is less than 10%. Viability has increased to Medium viability due to moderate abundances and the lack of spatial structure and diversity limitations.

Lower Gorge Winter Steelhead - This Primary population is targeted for improvement from Low to High viability. This population is shared with Oregon but most of the habitat is assumed to exist in Washington. Recovery goals are halved for the purposes of this analysis because only Washington population data is reported. Winter steelhead spawn primarily in the lower five and a half miles of Hamilton Creek. Hatchery winter steelhead were planted in the subbasin beginning in 1958 but no hatchery steelhead are currently released.

The current population status is unknown due to a lack of monitoring outside of Hamilton, Hardy, and Woodward creeks, but is assumed to be similar to the baseline estimate identified in the Recovery Plan (200 adult spawners). Artificial barriers do not substantially limit distribution (less than 10% disconnected habitat). The percentage of hatchery-origin spawners is unknown but the target is less than 5%. Abundance-based viability is estimated to be Very High based on professional judgement. Viability is adjusted to the baseline estimate of Low until new population estimates are available to calculate an abundance-based viability.

Upper Gorge Winter Steelhead – This Stabilizing population is not targeted for significant improvement from Low viability. This population is shared with Oregon. Recovery goals are halved for the purposes of this analysis because only Washington population data is reported. Winter steelhead historically spawned in streams throughout the area including the Wind and White Salmon rivers below Condit Dam (RM 3). Construction of Bonneville Dam inundated the lower one mile of the Wind River, flooding spawning and rearing habitat. Shipherd Falls blocked most winter steelhead access until a fish ladder was constructed in 1956. Hemlock Dam was removed in 2009, providing steelhead access to Trout Creek in the Wind River watershed. Winter steelhead are currently distributed throughout the lower mainstem Wind River (~11 mi) and Trout Creek (confluence with the Wind River at RM 10.8). High drop-offs and waterfalls exist throughout the basin; some have been modified to promote fish passage while others remain as impediments to upstream winter steelhead migration.

Hatchery releases of Chambers Creek and Skamania winter steelhead stock occurred in the Wind River watershed between 1951 and 1963. The release of rainbow trout in Hemlock Lake for fishing was discontinued in 1994 to reduce potential for impacts to natural-origin steelhead. The release of hatchery-origin steelhead was discontinued in 1997.

Surveys are conducted below Shipherd Falls and abundance is estimated for this portion of the population. No surveys are conducted in other Upper Gorge tributaries. Total abundance is unknown, but is assumed to be around 50 fish. Assumed abundance is less than the baseline population estimate of 200 fish identified in the Recovery Plan. There is no abundance goal for this Stabilizing population. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). The percentage of hatchery-origin spawners is unknown and a target is not identified. Viability remains Low due to a lack of information.

Population Descriptions – Summer Steelhead

Kalama Summer Steelhead – This Primary population is identified as a historical core population by the Willamette-Lower Columbia Technical Review Team and is targeted for improvement from Medium to High viability. Summer steelhead spawn above Lower Kalama Falls in the mainstem, in the NF Kalama River, and throughout many tributaries including Gobar, Elk, Fossil, and Wild Horse creeks.

Winter steelhead historically could not pass Kalama Falls due to high flows and low temperatures (Bradford et al. 1996). A fish ladder now provides upstream access and has likely given winter steelhead a competitive advantage over summer steelhead. This benefit likely reduced summer steelhead viability and led to high levels of hybridization between the runs (Hemstrom et al. 2017; Kostow 2012).

The Fallert and Kalama Falls hatcheries operate an integrated summer steelhead program and both integrated and segregated winter steelhead programs. These programs shifted from nonlocal to in-basin stocks beginning in 2017.

The twelve-year geometric mean abundance is similar to the baseline estimate identified in the Recovery Plan and the delisting goal (96% of delisting goal). The delisting abundance goal is met in six of the last years. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 42% of total spawners, greater than the target of less than 5%. The abundance-based viability estimate is adjusted from Medium to Low due to limits in productivity and diversity resulting from hatchery fish competition and interbreeding.

North Fork Lewis Summer Steelhead – This Stabilizing population is not targeted for significant improvement from Very Low viability. Most historical spawning is believed to have occurred in Merwin and Yale Reservoir tributaries. These tributaries have been blocked since Merwin Dam was completed in 1931. While considered functionally extirpated, limited spawning, possibly East Fork Lewis strays or progeny of Skamania stock hatchery summer steelhead released into the North Fork Lewis River subbasin for harvest opportunities, currently occurs in the lower North Fork Lewis from approximately RM 7 to RM 20 and in tributaries below Merwin Dam. A dam located on Cedar Creek was removed in 1946, restoring access to habitat throughout this tributary. Passage of summer steelhead into waters above Merwin Dam is not currently supported.

Three steelhead hatchery programs are operated in the Lewis basin at the Merwin Hatchery located just below Merwin Dam: a segregated summer steelhead program, an integrated winter steelhead program, and a segregated winter steelhead program.

Natural-origin summer steelhead are not monitored, but returns are assumed to be around 50 adult fish. This number is less than the baseline estimate identified in the Recovery Plan. No delisting abundance goal is identified for this Stabilizing population. Artificial barriers do not substantially limit distribution (less than 10% disconnected habitat). The percentage of hatchery-origin spawners is unknown and no targets are identified. Viability remains Very Low due to a lack of information.

East Fork Lewis Summer Steelhead - This Primary population is identified as a genetic legacy population by the Willamette-Lower Columbia Technical Review Team and is targeted for improvement from Very Low to High viability. Spawning occurs primarily above Horseshoe Falls, and to a lesser extent in tributaries between Moulton Falls and Horseshoe Falls. Spawning distribution was increased in 1982 by "notching" Sunset Falls which lowered the falls from 13.5 to 8 feet, and likely facilitated more consistent access to upstream habitat by summer steelhead (the falls was passable but challenging to most fish prior to notching).

Following guidance from the Statewide Steelhead Management Plan, this population was established as a wild gene bank to support natural-origin steelhead recovery (WDFW 2008). Releases of hatchery-origin steelhead juveniles in the basin ended in 2014 to reduce hatchery influences on productivity and diversity. There are no hatcheries operated in the East Fork Lewis subbasin.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan and the delisting goal (141% of delisting goal). The delisting abundance goal is met in ten of the last 12 years. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). The percentage of hatchery-origin spawners is unknown but the target is less than 5%. Viability has increased to Very High due to very high abundances and the lack of spatial structure and diversity.

Washougal Summer Steelhead – This Primary population is identified as a historical core and genetic legacy population by the Willamette-Lower Columbia Technical Review Team and is targeted for improvement from Medium to High viability. Spawning occurs throughout the Washougal Basin, including the mainstem Washougal and tributaries upstream of Dougan Falls, the Little Washougal, and the North Fork Washougal rivers.

A segregated hatchery program at the Skamania Hatchery currently releases summer and winter-run steelhead in the Washougal River but interactions with natural-origin spawners are limited by Dougan Falls which most hatchery fish do not ascend. Interactions may also be reduced by an artificial velocity barrier operated at the Skamania Hatchery, but effectiveness of this barrier has not yet been evaluated.

The twelve-year geometric mean abundance is greater than the baseline estimate identified in the Recovery Plan and the delisting goal (130% of delisting goal). The delisting abundance goal is met in eight of the last 12 years. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). The percentage of hatchery-origin spawners is unknown but the target is less than 5%. Viability has increased to Very High due to very high abundances and the lack of spatial structure and diversity limitations.

Wind Summer Steelhead – This Primary population is identified as a historical core population by the Willamette-Lower Columbia Technical Review Team and is targeted for improvement from High to Very High viability. Spawning occurs throughout the Wind River basin including the mainstem Wind, and in Little Wind, Panther, Trout, Trapper, Dry, and Paradise creeks. High gradients and waterfalls exist throughout the basin. A fish ladder was installed at Shipherd Falls in 1956 to improve fish passage, with the primary target being hatchery-origin spring Chinook salmon. Hemlock Dam was removed in 2009, providing summer steelhead easier access to Trout Creek in the Wind River watershed.

The release of hatchery summer steelhead smolts for fishing was discontinued in 1996 to reduce potential for impacts to natural-origin steelhead. The release of hatchery-origin winter steelhead was discontinued in 1963. Following guidance from the Statewide Steelhead Management Plan this population was established as a wild gene bank to support natural-origin steelhead recovery (WDFW 2008).

The twelve-year geometric mean abundance is less than the baseline estimate identified in the Recovery Plan and the delisting goal (65% of delisting goal). The delisting abundance goal is met in three of the last 12 years. Artificial barriers are assumed to not substantially limit distribution (less than 10% disconnected habitat). Hatchery-origin spawners on average comprise 1% of total spawners, meeting the target of less than 5%. Viability remains High due to high abundances and the lack of spatial structure and diversity limitations.

WDFW has estimated using a Cormack-Jolly-Seber model that approximately 35% of Wind River steelhead that pass Bonneville Dam do not survive the 13 miles to the Shipherd Falls ladder. Possible mortality sources include natural mortality, which may be increased above historical levels by hydro-system effects on Bonneville Pool temperatures, and unaccounted fishery mortality. If this loss was reduced to zero, the population in the Wind would immediately increase by 35% (WDFW, unpublished data).

References

Atlas, W. I., T. W. Buehrens, D. J. McCubbing, R. Bison and J.W. Moore. 2015. Implications of spatial contraction for density dependence and conservation in a depressed population of anadromous fish. Canadian Journal of Fisheries and Aquatic Sciences, 72(11), 1682-1693. https://doi.org/10.1139/cjfas-2014-0532

Anderson, J. H., K. I. Warheit, B. E. Craig, T. R. Seamons and A. H. Haukenes. 2020. A review of hatchery reform science in Washington State. Washington Department of Fish and Wildlife Final Report to the Washington Fish and Wildlife Commission. A review of hatchery reform science in Washington State

Bradford, R. H., S. A. Leider, P. L. Hulett and C. W. Wagemann. 1996. Differential leaping success by adult summer and winter steelhead at Kalama Falls: implications for estimation of steelhead spawner escapement. Washington Department of Fish and Wildlife, Fish Management Technical Report RAD 96-02, Olympia. 56pp.

Bryant, F. G. 1949. A survey of the Columbia River and its tributaries with special references to management of its fishery resources. 2. Washington streams from the mouth of the Columbia River to and including the Klickitat River (Area I). U.S. Fish and Wildlife Service Special Sci. Rep. No. 62.

City of Tacoma et al. (City of Tacoma, Washington Department of Fish and Wildlife, Washington Department of Ecology, Washington State Parks and Recreation Commission, U.S. Fish and Wildlife Service, NOAA Fisheries, U.S. Forest Service, Interagency Committee for Outdoor Recreation, Lewis County, Confederated Tribes and Bands of the Yakama Nation, Washington Council of Trout Unlimited, Sport Fishing Guides of Washington, and American Rivers). 2000. Cowlitz River Hydroelectric Project settlement agreement. https://www.mytpu.org/wp-content/uploads/cowlitz-settlement-agreement.pdf

Hemstrom, W., S. V. Wetering and M. Banks. 2017. Fish ladder installation across a historical barrier asymmetrically increased conspecific introgressive hybridization between wild winter and summer run steelhead salmon in the Siletz River, Oregon. Canadian Journal of Fisheries and Aquatic Sciences. 75(9): 1383-1392. https://doi.org/10.1139/cjfas-2016-0411

Fulton, L. 1970. Spawning Areas and Abundance of steelhead Trout and coho, Sockeye, and chum Salmon in the Columbia River Basin – Past and Present. United States Dept of Commerce. National Oceanic and Atmospheric Administration, Special Scientific Report – Fisheries No. 618.

Kostow K. 2012. Strategies for reducing the ecological risks of hatchery programs: case studies from the Pacific Northwest. Environmental Biology of Fishes, 94(1): 285–310. 10.1007/s10641-011-9868-1

LCFRB (Lower Columbia Fish Recovery Board). 2010. Washington Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan. https://www.lcfrb.gen.wa.us/librarysalmonrecovery

McIntosh, B., S. Clarke and J. Sedell. 1989. Bureau of Fisheries Stream Habitat Surveys. Project No. 1989-10400, 407 electronic pages, (BPA Report DOE/BP-02246-4).

MAFAC (Marine Fisheries Advisory Committee). 2020. A vision for salmon and steelhead: Goals to restore thriving salmon and steelhead to the Columbia River Basin. Phase 2 Report of the Columbia Basin Partnership Task Force of the Marine Fisheries Advisory Committee. https://www.fisheries.noaa.gov/vision-salmon-and-steelhead-goals-restore-thriving-salmon-and-steelhead-columbia-river-basin

Murdoch, A., and G. Marston. 2020. WDFW hatchery and fishery reform policy implementation assessment, final report 2009-2019. Washington Department of Fish and Wildlife. [WDFW Hatchery and Fishery Reform Policy Implementation Assessment: Final Report, 2009-2019 (wa.gov)]

Myers, J., C. Busack, D. Rawding, A. Marshall, D. Teel, D. M. Van Doornik and M. T. Maher. 2006. Historical population structure of Pacific salmonids in the Willamette River and lower Columbia River basins. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-73, 311 p. https://repository.library.noaa.gov/view/noaa/3461

NMFS (NOAA's National Marine Fisheries Service). 2013. Recovery Plan for Lower Columbia River Coho Salmon, Lower Columbia River Chinook Salmon, Columbia River Chum Salmon, and Lower Columbia River Steelhead. Northwest Region, Portland, Oregon. https://repository.library.noaa.gov/view/noaa/16002

NMFS (NOAA's National Marine Fisheries Service). 2017. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH) Consultation NOAA's National Marine Fisheries Service's implementation of the Mitchell Act Final Environmental Impact Statement preferred alternative and administration of Mitchell Act hatchery funding. NMFS Consultation Number: NWR-2014-697. https://media.fisheries.noaa.gov/dam-migration/mitchell-act_opinion_011517.pdf

ODFW and WDFW (Oregon Department of Fish and Wildlife and Washington Department of Fish and Wildlife). 2021. Spring Chinook, Summer Chinook, Sockeye, steelhead and other species. Joint Columbia River Management Staff. https://www.dfw.state.or.us/fish/OSCRP/CRM/reports/21_reports/2021%20OR_WA%20Spring%20Joint%20Staff%20Report.pdf.

Olk, E., and K. Dammerman. 2020. 2019 White Salmon Chinook salmon spawning ground survey methods and results [Memorandum]. Washington Department of Fish and Wildlife.

PacifiCorp, Public Utility District No. 1 of Cowlitz County, National Marine Fisheries Service, National Park Service, U.S. Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Forest Service, Confederated Tribes and Bands of the Yakama Nation, Washington Department of Fish And Wildlife, Washington Interagency Committee for Outdoor Recreation, Cowlitz County, Cowlitz-Skamania Fire District No. 7, North Country Emergency Medical Service, City of Woodland, Woodland Chamber of Commerce, Lewis River Community Council, Lewis River Citizens at-Large, American Rivers, Fish First, I. Rocky Mountain Elk Foundation, Trout Unlimited, and The Native Fish Society. 2004. Lewis River Hydroelectric Projects Settlement Agreement: Concerning the relicensing of the Lewis River Hydroelectric Projects, FERC Project Nos. 935, 2071, 2111, 2213, Cowlitz, Clark, and Skamania Counties, Washington. https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/hydro/lewis-river/settlement-agreement-documents/Lewis_River_Settlement_Agreement_Final.pdf

PacifiCorp and Public Utility District No.1 of Cowlitz County. 2018. Lewis River Fish Passage Program 2017 Annual Report. FERC Project Nos. 935, 2071, 2111 and 2213. LR_2017_AR_FishPassage_web.pdf (pacificorp.com)

PacifiCorp and Public Utility District No.1 of Cowlitz County. 2019. Lewis River Fish Passage Program 2018 Annual Report. FERC Project Nos. 935, 2071, 2111 and 2213. 2018_LR_FishPass_AR_web.pdf (pacificorp.com)

PacifiCorp and Public Utility District No.1 of Cowlitz County. 2020. Lewis River Fish Passage Program 2019 Annual Report. FERC Project Nos. 935, 2071, 2111 and 2213. pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/hydro/lewis-river/license-implementation/reports/2019_LR_FishPassage_AR_Final.pdf

PacifiCorp and Public Utility District No.1 of Cowlitz County. 2021. Lewis River Fish Passage Program 2020 Annual Report. FERC Project Nos. 935, 2071, 2111 and 2213.

PacifiCorp and Public Utility District No.1 of Cowlitz County. 2022. Lewis River Fish Passage Program 2021 Annual Report. FERC Project Nos. 935, 2071, 2111 and 2213.

Rawding, D., B. Glaser and T. Buehrens. 2014. Lower Columbia fisheries and escapement evaluation in southwest Washington, 2010. Washington Department of Fish and Wildlife Report FPT 14-10. https://wdfw.wa.gov/publications/02069

Robinson, H. E., J. D. Alexander, S. L. Hallett and N. A. Som. 2020. Prevalence of infection in hatchery-origin Chinook salmon correlates with abundance of *Ceratonova shasta* spores: implications for management and disease risk. North American Journal of Fisheries Management. 40: 959-972. https://doi.org/10.1002/nafm.10456

Tacoma Power. 2020. Fisheries and Hatchery Management Plan (FHMP) Cowlitz Hydroelectric Project FERC No. 2016. https://www.mytpu.org/wp-content/uploads/FHMP-2020-FERC-FILING.pdf

WDFW (Washington Department of Fish and Wildlife). 2008. Statewide steelhead management plan: statewide policies, strategies, and actions. https://wdfw.wa.gov/publications/00149

WDFW (Washington Department of Fish and Wildlife) and LCFRB (Lower Columbia Fish Recovery Board). 2017. Lower Columbia conservation and sustainable fisheries plan. https://wdfw.wa.gov/publications/01767

Wilson, J., T. Buehrens, E. Olk and J. Quenette. 2019. Evaluation of adult fish weirs used to control the proportion of hatchery-origin fall Chinook Salmon in six Washington Lower Columbia River tributaries, 2013-2017. Washington Department of Fish and Wildlife. https://wdfw.wa.gov/publications/02117

APPENDIX A – ABUNDANCE DATA

Appendix Table 1. Spring Chinook natural-origin abundance data by population.

Populations	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Kalama	59	80	46	172	81	107	55	63	39	70	57	52	
NF Lewis			362	235	100		517	197	473	127			
U Cowlitz & Cispus			286	191	321	409	227	187	200	149	154	55	
White Salmon						15	21	15	6	5	9		
Total	*59*	*80*	*694*	*598*	*502*	*531*	*820*	*462*	*718*	*351*	*220*	*107*	

Appendix Table 2. Fall Chinook (tule) natural-origin abundance data by population.

Populations	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Coweeman			413	622	463	1,568	794	1,359	411	721	216	287	
Eloch./Skam.			136	63	62	80	147	230	90	77	27	38	
Grays/Chinook	33	210	83	62	35	91	185	219	80	295	515	344	
Kalama			593	428	288	812	764	2,889	2,539	1,732	1,643	1,474	
L Cowlitz			2,550	2,745	1,553	3,477	2,923	4,186	2,878	2,924	3,002	4,514	
L Gorge			639	1,181	631	1,215	1,190	1,445	8,240	2,204	16,033	8,676	
Lewis			1,583	1,672	1,320	3,796	2,861	3,466	2,211	1,994	1,422	1,553	
Mill/Aber./Ger.			156	94	21	127	35	80	87	17	6	12	
Toutle	1,216	480	227	198	235	914	403	374	367	312	138	116	
U Cowlitz			2,104	4,264	1,948	3,273	2,259	3,375	3,064	1,494	622		
U Gorge			441	1,186	338	608	541	1,225	544	577	218	555	
Washougal	2,317	822	589	473	256	1,197	997	1,332	883	655	903	1,575	
White Salmon			1,369	640	555	648	801	375	384	402	110	383	439
Total	*3,566*	*1,512*	*10,883*	*13,628*	*7,705*	*17,806*	*13,900*	*20,555*	*21,778*	*13,404*	*24,855*	*19,527*	*439*

Appendix Table 3. Late fall Chinook natural-origin abundance data by population.

Populations	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
NF Lewis	5,485	6,283	9,294	8,205	8,143	17,022	20,489	18,635	9,311	7,149	4,671	11,863	

Appendix Table 4. Coho natural- natural-origin abundance data by population.

Populations	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Coweeman			3,199	2,356	2,587	3,501	4,692	803	2,654	2,156	3,036		
EF Lewis			1,458	1,493	2,179	2,324	1,868	347	414	910	1,532		
Eloch./Skam.			603	551	367	650	2,572	204	589	780	944		
Grays/Chinook			269	53	421	677	2,826	145	489	175	165		
Kalama			2	5	24	45	58	12	79	53	65		
L Cowlitz			6,399	3,040	2,547	3,853	18,178	1,709	4,290	2,361	2,370		
L Gorge	223	468	386	453	454	553	564	323	543	406	404	184	
Mill/Aber./Ger.			828	397	368	566	1,941	492	944	633	734		
NF Lewis			1,780	3,834	1,375	1,216	2,078	395	1,782	2,890	1,202		
NF Toutle			1,076	538	978	2,273	4,598	518	1,405	712	661		
Salmon			1,572	1,236	1,284	1,668	2,218	731	1,546	1,900	2,364		
SF Toutle			1,490	847	1,582	3,125	7,781	838	2,168	832	771		
Tilton	915	1,306	979	2,087	1,444	2,744	9,070	1,394	2,667	2,803	1,336		
U Cowlitz & Cispus	4,749	5,751	2,905	7,878	1,687	8	6,921	381	906	2,621	169		
U Gorge	50	40	23	48	55	60	24	80	53	39	29	64	
Washougal			480	546	542	543	302	114	189	214	188		
Total	*5,937*	*7,565*	*23,449*	*25,362*	*17,894*	*23,806*	*65,691*	*8,486*	*20,718*	*19,485*	*15,970*	*248*	

Appendix Table 5. Chum natural-origin abundance data by population.

Populations	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Eloch./Skam.									4,011		209		
Grays/Chinook	2,401	2,776	6,082	10,052	7,782	4,832	4,267	10,857	30,408	6,217	6,320	7,001	
L Gorge	547	478	2,222	2,569	1,757	1,394	2,051	4,227	4,983	1,426	4,487	5,112	
Lewis													
Mill/Aber./Ger.													
U Gorge	75	109	124	50	65	167	122	176	47	21	180	316	182
Total	*3,667*	*4,481*	*10,576*	*17,472*	*12,102*	*7,757*	*7,827*	*19,954*	*44,511*	*9,234*	*13,680*	*13,755*	*182*

Appendix Table 6. Winter steelhead natural-origin abundance data by population.

Populations	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Coweeman	722	602	528	408	256	622	496	940	886	294	474	354	352
EF Lewis	548	688	336	308	272	488	414	678	984	746	538	322	728
Eloch./Skam.	666	222	534	442	378	784	502	1,244	754	540	432	586	370
Grays/Chinook	764	568	422	318	488	834	386	950	1,020	792	426	636	272
Kalama	742	1,044	961	622	1,061	811	948	1,206	1,203	686	594	153	491
L Cowlitz						503	556	728	719	292	365	236	271
MAG	528	396	398	270	184	402	310	666	436	224	184	196	232
NF Toutle	650	699	508	416	473	553	587	1,540	1,142	367	652	215	322
SF Toutle	412	498	274	210	378	972	708	1,340	1,532	344	624	284	148
Tilton	72	140	179	209	284	445	292	363	364	155	166	194	185
U Cowlitz & Cispus	517	513	614	627	580	343	24	151	120	216	400	631	
U Gorge	7	20	30	17	21	18	8	12	10	7	10	8	8
Washougal	732	418	232	204	306	678	388	648	636	602	438	130	258
Total	*6,360*	*5,808*	*5,016*	*4,051*	*4,681*	*7,453*	*5,619*	*10,466*	*9,806*	*5,265*	*5,303*	*3,945*	*3,637*

Appendix Table 7. Summer steelhead natural-origin abundance data by population.

Populations	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
EF Lewis	365	800	600	1,036	1,084	1,059	617	843	824	739	617	367	331
Kalama	237	308	370	534	646	738	400	814	868	647	321	377	311
Washougal	755	433	787		842		544	783	624	567	876	456	392
Wind	640	607	767	1,500	817	762	282	577	1,015	1,061	241	481	437
Total	*1,997*	*2,148*	*2,524*	*3,070*	*3,389*	*2,559*	*1,843*	*3,017*	*3,331*	*3,014*	*2,055*	*1,681*	*1,471*