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

Dedication

The Columbia Basin Partnership Task Force dedicates this report to the memory of our Partnership colleague and friend, Bob Austin (1951–2020). Bob was a peacemaker who worked diligently to bring people together for positive change. He was committed to open dialogue and honest conversations. His last job was his dream job, working for the Upper Snake River Tribes Foundation. There, he helped facilitate the return of salmon to communities who had not seen them in too long. His wisdom and thoughtfulness of resource issues and human dynamics helped the Partnership achieve many successes. Bob will forever be a source of inspiration for all of us.

For more information on the CBP Task Force please visit:
https://www.fisheries.noaa.gov/west-coast/partners/columbia-basin-partnership-task-force

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NOAA Fisheries West Coast Region at (503) 230-5400 or visit:
https://www.fisheries.noaa.gov/west-coast/partners/columbia-basin-partnership-task-force

Cover image: Juvenile steelhead by John McMillan

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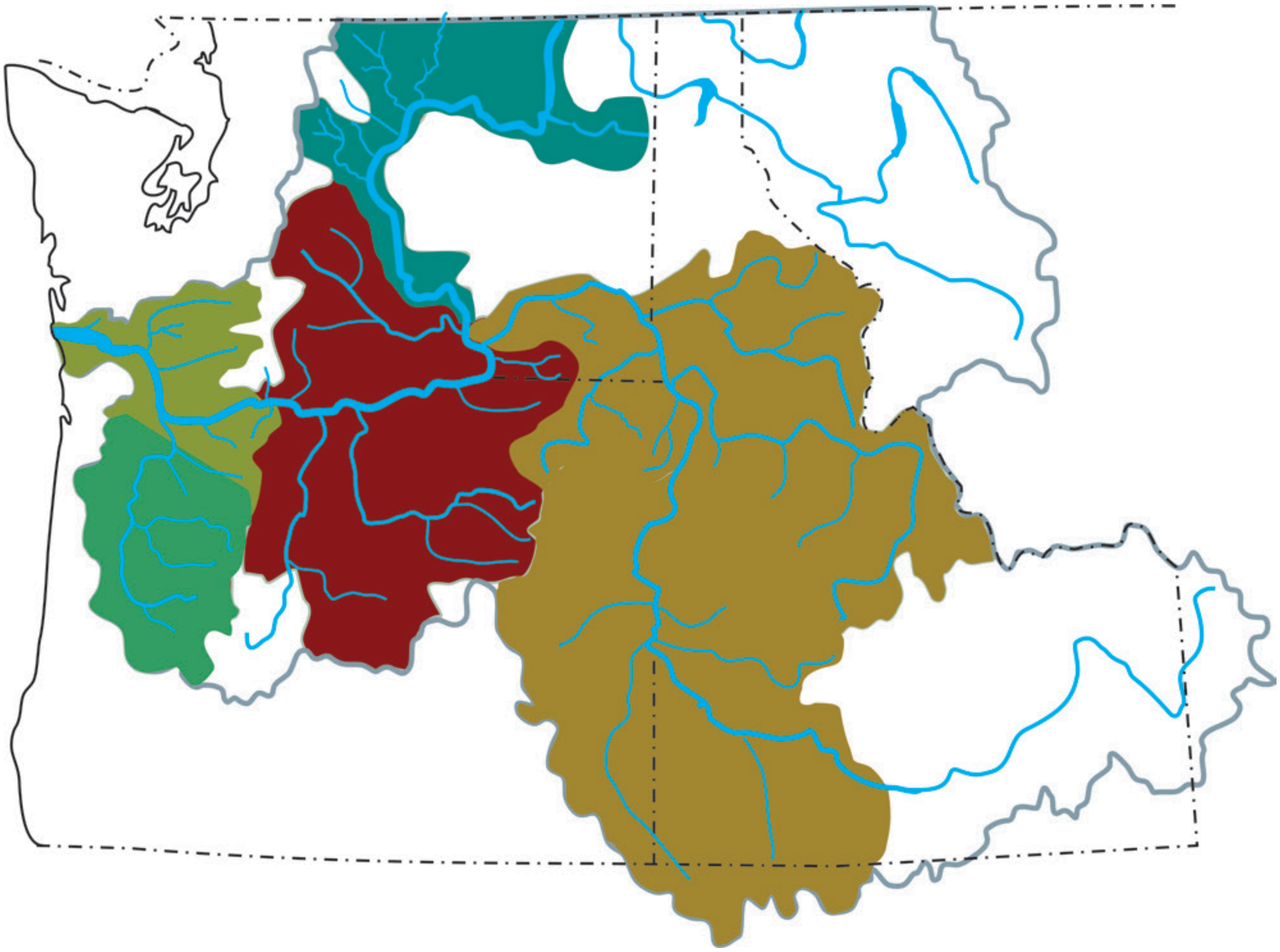

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October 2020

Spring chinook salmon digging redd. Credit: Rich Gross

The Context for Shared Goals for Columbia Basin Salmon and Steelhead

A Note from Barry Thom, Regional Administrator, NOAA Fisheries West Coast Region, and Convener, Columbia Basin Partnership Task Force

People have been trying to figure out how to rebuild and sustain Columbia River salmon and steelhead runs for well over a century. The ensuing web of laws, regulations, plans, groups and funding has not been enough to get us where we need to go. The Partnership task force is not just another group. We have tried to integrate the aspirations and desires of many stakeholders for a new path forward. This took many years of planning and work, but has resulted in alignment on a comprehensive vision and set of goals for the Basin from a broad group of sovereign entities and stakeholders.

I applaud our members for their patience and mutual respect. Our broad group spent time listening and learning about and from each other, and they now understand better what it means to consider walking in each other's shoes. I am grateful for all the experts across the region who contributed to ensuring a solid foundation for our work. I am especially proud that we set our goals high and aspirational.

There's still so much left to do. Now we need to determine how best to achieve those goals. There will be hard conversations and difficult choices ahead. I hope that through our improved relationships, we continue to show support for each other in our efforts on implementation.

The Partnership has left me with a renewed sense of hope and optimism for the salmon, steelhead, and people of the Basin. I hope this report offers people who were not with us some insights for moving forward with us.

Contents

Contents

Tables and Figures

TABLES

FIGURES

Yakima River at the Westside Canal Diversion. Credit: Kittitas Reclamation District

Acronyms and Abbreviations

BPA	Bonneville Power Administration
CBP	Columbia Basin Partnership
Council	Northwest Power and Conservation Council
CRS	Columbia River system
DDT	dichlorodiphenyltrichloroethane
DO	dissolved oxygen
DPS	distinct population segment
Ecology	Washington Department of Ecology
EDT	Ecosystem Diagnosis and Treatment
ESA	Endangered Species Act
ESU	evolutionarily significant unit
ISAB	Independent Scientific Advisory Board
KRD	Kittitas Reclamation District
LCEP	Lower Columbia Estuary Partnership
MAFAC	NOAA Marine Fisheries Advisory Committee
Mid-C PUDs	Mid-Columbia Public Utility Districts
NMFS (or NOAA Fisheries)	NOAA's National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
ODFW	Oregon Department of Fish and Wildlife
Partnership	Columbia Basin Partnership Task Force
PBDEs	polybrominated diphenyl ethers
PCB	polychlorinated biphenyls
pHOS	proportion of hatchery-origin spawners
PIT	passive integrated transponder
pNOB	proportion of natural-origin broodstock
PUD	Public Utility District
Reclamation	U.S. Bureau of Reclamation
TDG	total dissolved gas
USRT	Upper Snake River Tribes
YBIP	Yakima Basin Integrated Water Resource Management Plan

Definitions of Key Terms

Escapement Escapement typically refers to the number of adult salmon or steelhead surviving harvest and other mortality factors to reach a particular point in their return to freshwater.

Harvestable Species, stocks, or populations of salmon and steelhead that are sufficiently viable, abundant, and productive to sustain significant levels of exploitation and harvest. Harvestable stocks are typically managed to produce optimum or maximum sustained yield. Harvest ability can encompass both numbers of fish harvested and qualities of fisheries, including opportunity and success. Harvestable can be broadly defined to include "fishable," which refers to fishery opportunities that may not include direct harvest (e.g., catch and release recreational fisheries).

Hatchery-origin fish Fish that were spawned and/or reared during a portion of their life cycle in an artificial production facility.

Healthy Salmon or steelhead populations, ESUs, DPSs, or stocks that are abundant, productive, widely distributed, diverse, and resilient to environmental perturbations including climate change; can sustain significant levels of harvest; and support a full range of ecological benefits including the needs of dependent species. Generally, healthy refers to a point substantially above ESA delisting on the spectrum from threatened/endangered to extremely low extinction risk.

Mitigation hatchery production Hatchery fish production used for conservation or harvest purposes that is funded through legislation or legal agreement to compensate for natural production lost due to a specific action, such as construction and operation of a dam.

Natural production Natural production, or naturally produced fish, refers to the progeny of fish that spawn in the wild, regardless of parental origin (wild, natural, or hatchery). This term is interchangeable with the term natural-origin fish. It is important to distinguish natural production from natural productivity, which refers to the rate at which natural origin fish are able to produce offspring.

Recovery Recovery in general refers to improvement in the biological status of a depleted, weak, or at-risk species to a high level of viability and function.

NOAA Fisheries uses the term *ESA recovery* to refer to reducing threats and improving a species status to a point where it is no longer threatened or endangered and can be removed from ESA protection. For salmon and steelhead, this involves improving the species' abundance, productivity, spatial structure, and diversity to levels which provide a high likelihood of long-term persistence (i.e., viable with a low risk of extinction).

NOAA Fisheries uses the term *broad sense* recovery to define further improvements in a species' status. Broad sense recovery goals, generally defined by state and tribal entities or stakeholders, go beyond the requirements for ESA delisting to achieve even lower extinction risk and/or to address other legislative mandates or social, cultural, economic, or ecological values.

Stock A group of fish of the same species that spawns in a particular lake or stream (or portion thereof) at a particular season and which, to a substantial degree, does not interbreed with fish from any other group spawning in a different place or in the same place in a different season. For the purposes of the Columbia Basin Partnership Task Force, a stock is defined for Columbia Basin salmon and steelhead based on species (Chinook salmon, coho salmon, sockeye salmon, chum salmon, steelhead), region of origin (e.g., Lower Columbia, Middle Columbia, Upper Columbia, Snake, or Willamette) and run type (e.g. spring, summer, fall, late fall).

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Columbia Basin Partnership Task Force Members, June 2018.
Credit: Tony Grover

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True collaboration: honestly sharing, attentively listening, and mutual discovery through shared experiences and conversations is the path to Basinwide solutions for the challenges on the table before us.

— Mike Edmondson,
Idaho Governor's Office of Species Conservation

Steelhead. Credit: Rich Gross

Executive Summary

NOAA Fisheries and its Marine Fisheries Advisory Committee (MAFAC) convened the Columbia Basin Partnership Task Force (Partnership) in 2017, bringing together diverse representatives from across the Columbia Basin to establish a common vision and goals for the Basin and its salmon and steelhead. The diverse group of parties on the Partnership includes Columbia Basin tribes; fishing, agriculture, conservation, river transportation, port, and hydropower interests; and the states of Idaho, Montana, Washington, and Oregon. All of these parties want to ensure that healthy runs of salmon and steelhead thrive into the future. Meeting the needs of our diverse social, cultural, and economic landscape — while leaving future generations with abundant, resilient salmon and a healthy ecosystem — will take ingenuity, innovation, and partnership.

This report summarizes Partnership efforts and accomplishments through September 2020. An overarching message from Partnership members is a strong sense of urgency that immediate action is needed to address salmon and steelhead declines. This report provides recommendations for continuing collaboration going forward to further define and implement strategies to achieve the Partnership Goals. The report serves as the Partnership's final recommendations to the NOAA Marine Fisheries Advisory Committee.

Partnership Process and Approach

During Phase 1, the Partnership sought to build a common understanding of the need to increase salmon abundance and of the needs of the communities and ecosystems that depend on salmon. Partnership members explored the causes of salmon declines; shared their different experiences, perspectives, and interests; and developed constructive relationships out of mutual understanding and respect. Together, they found common ground, shaped an overarching Vision for the Columbia Basin, and crafted a set of shared Qualitative and provisional Quantitative Goals to reflect the Vision. This Vision and related Goals aspire to a Columbia Basin ecosystem with

Salmon Fry and Eggs. Credit: Shutterstock

The Columbia Basin Partnership has provided an opportunity to view the river system through a different lens as diverse stakeholders work toward a common vision for the future of the basin. All of us want the same things: thriving salmon, thriving communities, thriving economies. It is truly remarkable to see this process in action. We are stronger when we work together!
— Paul Arrington, *Idaho Water Users Association*

thriving salmon and steelhead that are naturally persistent while also supporting the Basin's social, cultural, and economic needs, including honoring tribal treaty and trust responsibilities. The Vision and set of Goals defined in Phase 1 provided the foundation for further exploration in Phase 2 of the Partnership process.

During Phase 2, the Partnership refined the provisional Quantitative Goals from Phase 1 and adopted a final set of Goals for the 27 stocks of salmon and steelhead in the Columbia Basin. The members then focused on exploring different pathways to achieve the set of Quantitative Goals. They developed a range of scenarios, or combinations of biological and other strategies that address different social, cultural, economic, and ecological considerations. The members understand that these different considerations often present significant challenges to implementing actions for salmon and steelhead, and that sustainable solutions need to integrate these considerations into decisions about fish and habitat management. Together, the scenarios capture a range of choices for reaching desired Goals for salmon and steelhead across the Columbia Basin.

Snake River sockeye. Credit: Mike Peterson, Idaho Department of Fish and Game

Looking forward, the Partnership recognizes that much more work is needed to define how best to achieve the Goals for salmon and steelhead over the short, medium, and long term. The Partnership emphasizes that a sustainable future for salmon and steelhead requires urgent action. With the Partnership Vision and Goals as building blocks, the next step is to set a course to achieve the Goals. Boldness and innovation are needed with respect to salmon management strategies and actions to meet the needs of salmon while maintaining healthy economies. The envisioned path forward promotes further exploration of the feasibility of specific actions, challenges to achieving success, innovative approaches, and other opportunities to achieve the Goals. The Partnership recommends continued collaboration to create a sense of collective ownership, increase transparency, and enhance public confidence in investments to rebuild salmon runs.

In USRT's effort to develop, and incorporate, quantitative goals for the blocked areas of the Upper Snake River Basin, building relationships with task force members outside of formal Partnership meetings was key. Achieving goals requires difficult dialogue, unconventional methods, dedication to the mission, and persistence. — Scott Hauser, *Upper Snake River Tribes Foundation, Shoshone-Paiute Tribes of the Duck Valley Reservation, Shoshone-Bannock Tribes of the Fort Hall Reservation, Fort McDermitt Paiute and Shoshone Tribe, and Burns Paiute Tribe.*

Partnership Accomplishments

Over the last few years, the Partnership worked together to forge agreement on a long-term Vision for the Columbia Basin and a set of related Goals for salmon and steelhead. The group also explored different approaches to achieving the Goals, examined potential impacts of those approaches on people's lives and livelihoods, and developed key messages for future decision-makers. These important achievements set a constructive stage to define a path forward to actualize the Vision and achieve the Goals.

Vision for the Columbia Basin

The Partnership shaped a powerful Vision as a call for action: ***A healthy Columbia Basin ecosystem with thriving salmon and steelhead that are indicators of clean and abundant water, reliable and clean energy, a robust regional economy, and vibrant cultural and spiritual traditions, all interdependent and existing in harmony.***

Qualitative Goals

The Qualitative Goals capture different social, cultural, economic, and ecological values and describe desired outcomes throughout the Columbia Basin. The Goals call to:

1. Restore salmon and steelhead in the Columbia Basin to healthy and harvestable/fishable levels.
2. Provide diverse, productive, and dependable tribal and non-tribal harvest and fishing opportunities for Columbia Basin salmon and steelhead in fresh and marine waters.
3. Produce hatchery salmon and steelhead to support conservation, mitigate for lost natural production, and support fisheries, in a manner that strategically aligns hatchery production with natural production recovery goals.
4. Make decisions within a broader context that reflects and considers effects to the full range of social, cultural, economic, and ecosystem values and diversity in the Columbia Basin.

Together the Goals recognize a sense of urgency to help Columbia Basin salmon and steelhead now and well into the future.

Quantitative Goals

The Partnership's Quantitative Goals identify a range of abundance numbers for adult salmon and steelhead. Goals are identified for natural-origin ESA-listed and non-listed salmon and steelhead in the U.S. portion of the Columbia Basin and its tributaries, including many historical production areas that are currently blocked. The Goals are based, wherever possible, on goals from existing management plans. They account for ESA recovery goals, cultural needs of tribes, habitat constraints and potential, density dependence, fishing interests, tribal treaty and trust responsibilities, mitigation responsibilities, and other factors. The Partnership also quantified current and anticipated levels of hatchery production and current and potential harvest as reference points for related Qualitative Goals.

Biological Analyses

Biological analyses helped the Partnership understand factors that limit natural-origin Columbia Basin salmon and steelhead abundance and define potential pathways to increase abundance and achieve the Quantitative Goals. The Partnership explored the various limiting factors that impact salmon and steelhead across their life cycles. The results of the analyses show that no single strategy (e.g., reducing predation, increasing habitat, reducing harvest) will achieve the Goals on its own. Instead, improvements in multiple factors will be needed to increase abundance to desired levels for most stocks. Together, these improvements create synergies that compound benefits greater than those achievable through single actions. For example, improving smolt-to-adult survival will enable fish to better utilize existing habitats and take advantage of any future improvements in spawning and rearing habitats.

The effort required to gather, support, and empower a diverse group of people with a wide breadth of knowledge, experience, and perspective is always challenging and worthwhile. A lot of valuable work has been accomplished around the table, but it is time for us all to push our chairs away from that table and implement the necessary work now; immediately. — Liza Jane McAlister, *6 Ranch, Inc.*

Social, Cultural, Economic, and Ecological Considerations

Learning from each other played an important role in the Partnership process as the group sought to integrate the "people side" of the Columbia Basin into discussions about the future of salmon. Partnership members described their communities, constituents, and experiences. Together, their stories highlight the complex mix of challenges and opportunities in the Basin, and also the collective interest in having sustainable salmon and steelhead runs and a healthy ecosystem.

Scenarios and Strategies

Partnership members developed different scenarios to explore alternative pathways to achieve the Goals. Together, the scenarios capture a range of choices and challenges confronting the region about how to reduce threats to achieve the Goals. Most scenarios describe biological strategies, but some scenarios include other components, such as analytical tools and steps to address social, cultural, economic, and ecological considerations. The Strategies chapter describes a range of possible strategies that could be used to help achieve the Goals. The exploration of different scenarios and strategies, and their implications, contributed to the Partnership's understanding and consideration of the different potential paths forward.

Celebrating a summer Chinook from the Lower Columbia River. Credit: Liz Hamilton

Partnership Recommended Path Forward

The Vision of the Columbia Basin Partnership Task Force — a sustainable future with thriving salmon and steelhead — provides a powerful mission for the people of the Columbia Basin and coming generations. Achieving this Vision and Goals for the Basin's rivers, fish, and people will take all of us, working together. The envisioned path promotes exploration of opportunities, including innovative approaches, to achieve the Goals. Continued collaboration will be paramount. The enhanced understanding and positive working relationships established by the Partnership create a critical foundation to align the management decisions needed to move the Basin toward achieving the Vision and Goals.

Key Messages and Recommendations

The Partnership provided key messages to guide actions moving forward:

A Call to Action

Time is of the Essence. Since the late 1800s, immigrants to the Pacific Northwest changed the Columbia River Basin ecosystem at the expense of salmon. At the writing of this report, natural-origin fish runs are less than 10 percent of what they were historically. In some areas of the Basin, wild salmon and steelhead no longer exist. The status quo is unacceptable: without significant change, imperiled salmon and steelhead will disappear forever.

The Partnership's shared goals for the future of Columbia Basin salmon and steelhead reflect the trust, relationships, and understanding built over the last few years. On this foundation, we must quickly pivot to implement actions urgently needed to help the fish right now. — Liz Hamilton, *Northwest Sport Fishing Industry Association*

We Must Act Now with Urgency. If we take action now, we can reintroduce and return wild salmon and steelhead to abundance. Readers 20 years from now should be able to review the work of the Columbia Basin Partnership and see that 2020 was a turning point for the return of healthy and abundant salmon and steelhead to the Columbia River.

Salmon Will Indicate the Health of the Basin. The Partnership adopts this call to action: "A sustainable future with thriving salmon and steelhead that are indicators of clean and abundant water, reliable and clean energy, a robust regional economy, healthy watersheds, and vibrant cultural and spiritual traditions all interdependent and existing in harmony for generations to come."

The Path Forward Needs a Salmon Ethic, Strong Leadership, and Collaboration

The Tribes, Salmon, and Ecosystem are Interconnected. This ethic should guide our collective pathway to implement Qualitative and Quantitative Goals, strategies, and actions to ensure we consider the impacts on salmon and steelhead and all parts of the ecosystem.

Leadership is Essential. Strong public resolve and leadership at every level are needed to prioritize salmon and steelhead, particularly with increasing and uncertain impacts from climate change and population growth. Integrating and aligning salmon management decisions, strategies, and actions is critical to maximize effectiveness, meet treaty rights and trust responsibilities, ensure strategic use of funds, and increase transparency.

Collaboration is Needed. Not all voices have been heard and respected. Problems exist. There are hard choices and decisions ahead of us. Conflict will happen and we will need to work through it. A structured forum where representatives of sovereigns and stakeholders engage in direct dialogue is key to collaborative problem-solving. Success will be achieved when everyone joins together to implement a common set of actions. Collaboration is vital to identifying and implementing solutions.

Science Plus Accountability Delivers a Healthy Ecosystem and a Vibrant Quality of Life

Continuous Improvement and Innovation Moves Us Forward. We need to adapt how we live with salmon. The opportunity and challenge is to socially and economically innovate. Success requires bold action, risk-taking, learning from mistakes, and building on local successes.

Make Scientifically Based Decisions. Actions must be driven by science and informed by research that is inclusive of traditional ecological knowledge. Critical uncertainties must be resolved through adequately funded scientific experiments with rigorous monitoring and evaluation that remains adaptive to emerging information. Our scientifically based actions must enable the river to produce salmon and steelhead at the levels this Task Force has identified.

Benchmarks Provide Accountability. Using the Partnership Goals, we need to establish quantitative targets for each stock, with timeframes to measure progress, assess the impact of actions, adapt as needed, and respond to changing circumstances. Everyone in the Basin is responsible for the outcome.

Reliable and Predictable Funding is Essential. Funding must be targeted to achieve the Partnership's Quantitative and Qualitative Goals. New funding sources should be identified. Funding must come from multiple sources, consider the burden across communities, and account for past, present, and potential impacts.

Yakama fisher along Klickitat River, Washington. Credit: CRITFC

Overview of Partnership Process and Progress

The Columbia Basin Partnership Task Force (Partnership), convened by NOAA Fisheries and its Marine Fisheries Advisory Committee (MAFAC) in 2017, brings together diverse representatives from across the Columbia Basin (or Basin) to establish common goals and foster a collaborative approach to ensure healthy salmon and steelhead for future generations. The collaboration of parties includes representatives from environmental, fishing, agricultural, conservation, river transportation, ports, and hydropower energy interests; federally recognized tribes in the region; and the states of Idaho, Montana, Washington, and Oregon. These parties hold both shared goals for salmon and steelhead and sometimes divergent views about how to achieve them.

The process arose out of frustration across the region with the uneven progress and conflicts around fish conservation and restoration approaches. While significant effort is underway in different parts of the Columbia Basin to address problems that keep fish from thriving, the actions often focus on specific areas or purposes and do not provide a comprehensive suite of complementary goals for salmon and steelhead. Further, past discussions among the various parties often focused on their differences instead of their commonalities and frequently resulted in litigation. What has been missing is a coordinated, Basinwide, multi-partner approach, and a shared regional definition of success. Different existing plans and goals provide important guidance, but they each measure success through their own yardstick, leaving open the questions: *Where are we, and our salmon and steelhead, headed? What unifying goals should lead us there?*

The Partnership brought the different representatives together at one table to forge a shared vision and goals for the future of salmon and steelhead in the Columbia Basin; an understanding of different social, cultural, ecological, and economic values; and a path forward with a spirit of mutual respect. The members share a common purpose — a desire that future generations will enjoy healthy and abundant salmon and steelhead runs across the Columbia Basin landscape. The Partnership's shared Goals will help align federal, tribal, and state managers and stakeholder interests on a common path. The Partnership process stresses the importance of approaching decision-making holistically.

Salmon on Spawning Grounds. Credit: NOAA Fisheries West Coast Region

This group is a unique solution to big issues. It laid the groundwork for finding common solutions to restoring healthy salmon populations to their historic ranges. Creating a constructive space representing the interests and the geography of the Basin, allowed development of key fundamental outputs that I'm hopeful have laid the groundwork for substantive improvements for salmon in the future. This type of approach has the best chance to create effective and aligned solutions. — Marla Harrison, *Port of Portland*

Phase 1 of the Partnership Process

During Phase 1 of the Partnership process, the different representatives from across the Basin came together with the intent to find common ground and forge a path forward for the long-term recovery of Columbia Basin salmon and steelhead to healthy and harvestable levels. They recognized the sense of urgency to help salmon and steelhead, the people and communities that rely on them, and the wildlife, such as Southern Resident killer whales, that depend on them for survival.

Partnership members began to focus on their commonalities during Phase 1 of the process. They shaped an overarching Vision for the future of the Columbia Basin, and a set of shared Qualitative and provisional Quantitative Goals to reflect the Vision. This Vision and related Goals aspire to leave future generations with resilient, naturally produced salmon and steelhead runs while also meeting the needs of the Basin's diverse social, cultural, and economic landscape, such as supporting sustainable fisheries and honoring tribal treaty and trust responsibilities.

Vision for the Basin

The Partnership's shared purpose — a desire that future generations will enjoy healthy and abundant salmon and steelhead runs across the Columbia Basin landscape — formed its overarching Vision statement for the future.

VISION FOR THE COLUMBIA BASIN

A healthy Columbia Basin ecosystem with thriving salmon and steelhead that are indicators of clean and abundant water, reliable and clean energy, a robust regional economy, and vibrant cultural and spiritual traditions, all interdependent and existing in harmony.

TASK FORCE GUIDING PRINCIPLES

Fairness: Foster a culture of respect, equity, and generosity and be accountable for our interests.

Openness and Transparency: Everything is on the table. Recognize yours and others' needs; acknowledge fears, threats, and limitations to success; and be willing to re-evaluate them together.

Obligations and Responsibilities: Honor legal, statutory, treaty/trust and regulatory obligations, rights, and responsibilities.

Clarity: Collaboratively arrive at solutions that improve regulatory and legal certainty.

Sustainability: Strive for durable and practical outcomes and seek clarity while acknowledging a dynamic social, cultural, economic, and natural landscape.

Knowledge and Wisdom: Ground decisions and recommendations in science, while accepting that science may not be definitive.

Innovation and Adaptiveness: Plan for the long-term, act in the short-term, and be bold in the face of uncertainty and change.

Interconnection and Complexity: Envision a healthy and resilient ecosystem. Assume there are multiple solutions to resolving Basin issues.

Shared Qualitative and Quantitative Goals

The Partnership's set of shared Qualitative and provisional Quantitative Goals provide parameters for achieving the Vision. Defining these long-term, shared Goals helps align the region on a common path toward recovering salmon and steelhead in the Columbia Basin. Having common Goals also provides a means to define success, measure progress, and maintain accountability. They set the stage for the next phase of important regional conversations.

Qualitative Goals

Four overarching Qualitative Goals recognize, integrate, and balance the different, sometimes competing, values and purposes in the Basin:

1. Restore salmon and steelhead in the Columbia Basin to healthy and harvestable/fishable levels.
2. Provide diverse, productive, and dependable tribal and non-tribal harvest and fishing opportunities for Columbia Basin salmon and steelhead in fresh and marine waters.
3. Produce hatchery salmon and steelhead to support conservation, mitigate for lost natural production, and support fisheries, in a manner that strategically aligns hatchery production with natural production recovery goals.
4. Make decisions within a broader context that reflects and considers effects to the full range of social, cultural, economic, and ecosystem values and diversity in the Columbia Basin.

Quantitative Goals

The Quantitative Goals provide a range of abundance levels for salmon and steelhead. The Partnership considered its Phase 1 Quantitative Goals provisional, meaning that members agreed to them in principle but supported further exploration and refinement. The provisional Quantitative Goals described natural production levels for each salmon and steelhead stock, both ESA-listed and non-listed, in the U.S. portion of the Columbia Basin and its tributaries, including some historical production areas that are currently blocked. The Goals were based, wherever possible, on existing management plans and goals. They took into account a number of factors, including ESA delisting requirements, habitat constraints and production potential, density dependence, cultural needs of tribes, fishing interests, needs of dependent wildlife, sustainability, and mitigation responsibilities.

Together, these provisional Quantitative Goals translated into a total increase of naturally produced salmon and steelhead from the current annual average of 400,000 to as high as 3.6 million adults. This increase represents an eightfold improvement from current levels but is considerably less than the number of salmon and steelhead that the Basin is believed to have produced historically.

The Partnership also quantified current and anticipated hatchery production consistent with the goals for natural production, and current and potential harvest and fisheries, to provide a complete accounting of future needs and desires for Columbia Basin salmon and steelhead. Correspondingly, the annual average total Columbia River run of natural- plus hatchery-origin fish would increase from 2.3 million to approximately 8.0 million fish.

The Vision and set of Qualitative and provisional Quantitative Goals defined in Phase 1 provided a common foundation for moving forward in Phase 2 of the Partnership process. The Partnership recommended and planned to further refine the provisional Quantitative Goals during Phase 2.

Phase 2 of the Partnership Process

Before finalizing the Quantitative Goals, the Partnership requested that MAFAC extend their original term so the Partnership could explore how the provisional Quantitative Goals might be achieved, and this permission was granted for an additional two years. Members wanted to identify alternative biological strategies for achieving the Goals. Importantly, members also wanted to address some of the social, cultural, economic, and ecological considerations associated with those biological strategies. Some of the greatest challenges to implementing actions to support salmon and steelhead are economic, social, and political hurdles, rather than biological.

During Phase 2, the Partnership held nine meetings. Technical experts continued their work from Phase 1 and played a significant role in developing and refining the biological and analytical tools to inform Partnership members. Additionally, two technical workshops brought all experts together to help synthesize information

I am proud to be associated with the quantitative and qualitative goals developed by the Phase Two CBP Task Force. However, I am saddened that the knowledge and friendships achieved during this 3+ year process may be coming to an end. I believe the region would benefit greatly from continuing the efforts undertaken by this diverse group. A governance framework is needed to analyze and implement the multitude of measures required to restore abundant fish runs. My hope is that the path forward has Sovereigns, Federal Agencies and Stakeholders at the same table working together to bring back our iconic fish runs. — David Doeringsfeld, *Port of Lewiston*

across stocks. The Integration Team continued to synthesize information in between full Partnership meetings. Partnership members and technical experts also met together in each of the regional areas to focus on region-specific considerations. A new team, the Path Forward Team, focused on defining the next steps to be addressed beyond Phase 2.

The Partnership used the information gained from its deliberations to refine the provisional Quantitative Goals and develop a final set of Goals for the 27 stocks of salmon and steelhead in the Columbia Basin. The members also explored different pathways to achieve the Quantitative Goals. They held several brainstorming sessions to identify key questions to address and potential strategies and actions that could achieve the Quantitative Goals. These sessions allowed an open discussion of different perspectives and interests, provided the space to learn from each other, and generated a wide range of ideas. Members contributed not only biological strategies and actions, but also generated ideas around social strategies, including the importance of addressing public support; enhancing public awareness of the problem and related regional and area-specific challenges and potential solutions; and providing future governance. Small group discussions focused on drawing out overarching themes from the lists and ideas for how to organize them.

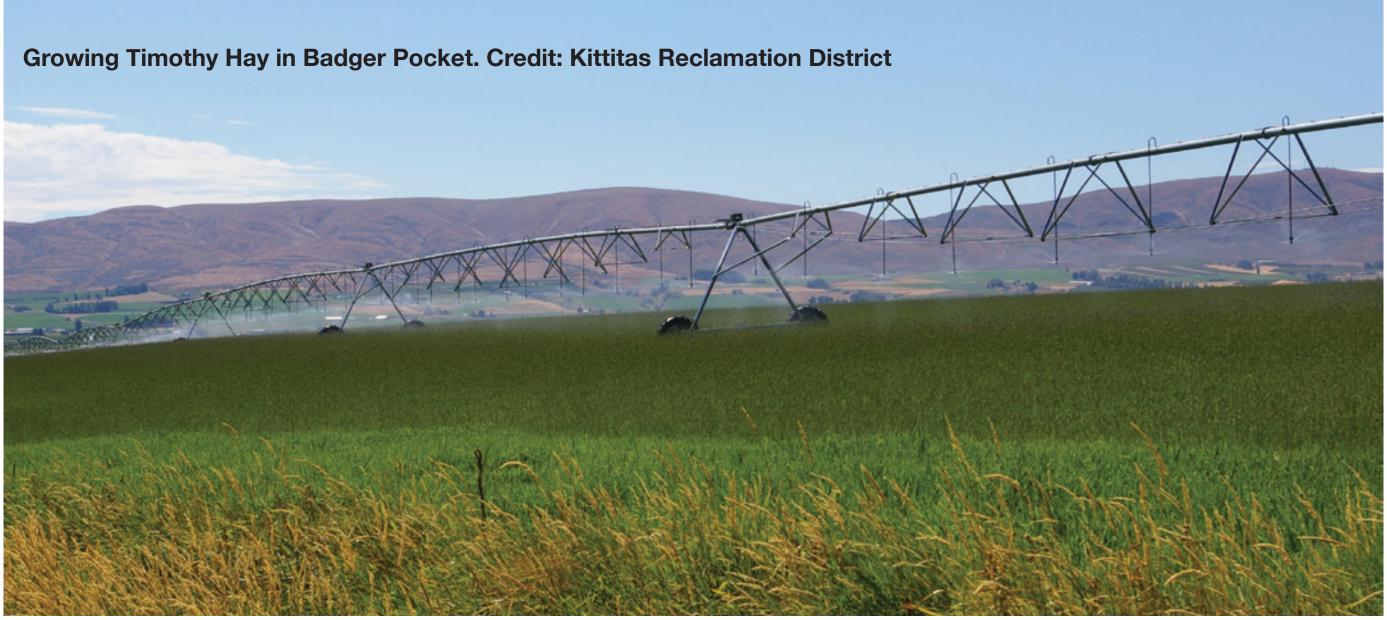
Concepts generated during the brainstorming sessions contributed to the next steps and discussions throughout Phase 2. Many concepts became components of scenarios. Other concepts, strategies, and actions of a finer scale did not fit into the scope of the analytical capacity of this phase of work. The Path Forward Team recommends taking up many of the non-biological ideas for further development during future conversations.

Scenarios and Strategies

The Partnership used the concept of scenarios to explore different pathways to achieve the Goals. The scenarios were designed to present options and choices confronting the region and to capture various combinations of biological and other strategies. The scenarios represent different pathways to rebuild salmon runs and illustrate the implications of alternative approaches to inform future management decisions. The scenarios generally center on biological strategies for achieving the Goals, but some contain other components. For example, several scenarios include benchmarks, where implementation would begin on a certain path but if identified benchmarks were not met after a defined period then additional actions would be triggered. Other components of the scenarios address social, cultural, economic, and ecological interests; critical uncertainties and research needs; and other regional concerns. Together, these added components helped the Partnership understand and begin to weigh different possible options for achieving the Goals.

Overall — while the scenario process was not rooted in an intensive analytical framework or peer-reviewed process — these scenarios provide an opportunity for Partnership members and decision-makers to:

- Consider the biological strategies and levels of effort that might be required to achieve the Goals.
- Evaluate qualitatively the likelihood of achieving the Goals or the length of time it might take to achieve the Goals.


Growing Timothy Hay in Badger Pocket. Credit: Kittitas Reclamation District

- Conduct discussions with regional technical experts to explore outcomes for specific stocks and areas.
- Examine alternative themes or approaches to achieving the Goals, including what the implications might be of a new approach to funding and governing salmon recovery efforts, what the potential strategies might be under different scenarios for future climate change and population growth, and what maximum efforts to achieve the Goals might look like.

The scenarios include a range of strategies that address categories of factors limiting salmon and steelhead and other concerns. The strategies provide a range of potential choices to help achieve salmon and steelhead Goals. Further exploration of these strategies is needed going forward.

Biological Analyses

To support a deeper exploration into the biological options, the Partnership employed several tools to better understand the factors (or threats) affecting salmon and steelhead survival. Through regional meetings and several workshops, technical experts contributed their knowledge of tributary habitat, estuary habitat, hydropower system, hatchery, harvest, predation, climate change, and other factors for each of the 27 stocks of salmon and steelhead. From this effort, the resulting Salmon Analyzer tool and heat map provided valuable biological information for Partnership members to consider.

Social, Cultural, Economic, and Ecosystem Considerations

One of the Qualitative Goals established by the Partnership in Phase 1 calls on future decision-makers to consider a broad context that reflects and considers effects to the full range of diverse social, cultural, economic, and ecosystem values in the Columbia Basin, including providing sustainable fisheries and honoring tribal treaty and trust responsibilities. The goal stresses the importance of approaching decision-making holistically, including, but not limited to traditional economics. The goal also recognizes that all of these values and benefits are interconnected. In Phase 2, the Partnership explored the range of social, cultural, economic, and ecological considerations reflected on the Partnership and how they might influence current and future management decisions.

As a starting point, the Partnership utilized a process called Relationship Flow Mapping developed by SERA Architects of Portland, Oregon. The SERA team led a visual exercise involving icons that represented various interests. Partnership members worked in groups to identify interests/icons within a sub-region of the Columbia Basin and discussed the interconnectedness with other interests/icons. The interests generated through this exercise served as the basis for exploring the topical social, cultural, economic, and ecological considerations in greater depth. The SERA report is included as Appendix D.

Discussion at the Partnership level continued to explore and delve into each other's interests and the issues that underlay individual member's various positions. Partnership members were concerned with improving salmon abundance across the Basin without harming lives and livelihoods in the process. These discussions, which are included in this chapter, generated a greater understanding of each other's motivations. Using scenarios, Partnership members were then able to consider their own interests, the collective

Steelhead. Credit: John McMillan

THE ROLE OF COLUMBIA BASIN PARTNERSHIP TASK FORCE GOALS

The Columbia Basin Partnership Task Force supports a shared Vision that future generations will enjoy abundant salmon and steelhead runs across the Columbia Basin landscape. The Qualitative and Quantitative Goals represent that Vision in a measurable way. The Partnership members developed high abundance goals of healthy and harvestable salmon, and recognize minimum goals numbers set under the Endangered Species Act.

These Goals are not regulatory or enforceable. They do not constitute a comprehensive management plan and should not be incorporated as terms and conditions of any permit or license without approval of the parties involved. Rather, they represent the aspirations of states, tribes, and stakeholders from across the Basin. It is the intent and hope of this Partnership that regional managers adopt these Goals in their various planning process and work together to achieve the Goals over time.

There is a powerful sense of urgency among Partnership members to address fish declines now.

Implementation of strategies and actions to achieve the Goals will occur within existing or new management forums and entities across the Basin. There are near-term actions with proven outcomes that can be readily implemented without much controversy, mainly because they have already been identified or are in progress and simply have not been fully implemented for funding or other reasons. Support from Partnership members can help to secure funding for those actions. More controversial or complex strategies identified by the Partnership warrant serious consideration and further exploration.

Regions may take different paths and timeframes for achieving the Goals for different stocks. Each stock faces unique conditions and each region of the Columbia Basin has unique social, cultural, and economic opportunities and challenges to address. For example, in some place where habitat improvements are needed, restoration may take longer before that habitat is productive for fish. In other cases, such as in currently blocked areas of the upper Snake Basin, existing agreements will need to play out before significant changes can occur. Variability and flexibility in implementation are expected across such a large, diverse and complex Basin.

Topics such as feasibility, funding, and priorities will also need to be addressed within existing or new management forums and processes. These conversations will not be easy. While the Quantitative Goals were developed using a generally consistent approach, to some extent they also reflect local approaches and perspectives. Therefore, they are not intended to direct Columbia Basinwide resource allocation or funding decisions.

It will take all regional interests working together — integrated and efficiently — to achieve healthy and harvestable levels of salmon and steelhead.

We are asking too much of Columbia Basin salmon. Salmon need us to start meeting their needs. With this report, the Task Force has created a road map with multiple routes (recommendations/scenarios) toward destinations (goals) that we all want to get to, both in the near- and long-term. Yet these goals and recommendations are by no means "the" exhaustive list of everything we can do, nor are they the final destinations that we all want to reach. With this report, the efforts and intentions of this Task Force are just getting started. It will be up to the readers and users of this report to take these goals, recommendations, and narratives toward a future with abundant salmon. — **Zach Penney,** *Columbia Inter-Tribal Fish Commission, Nez Perce Tribe, Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes of the Warm Springs Reservation of Oregon, and Confederated Tribes and Bands of the Yakama Nation*

Basinwide interest, and the opportunities and challenges moving forward.

As the Partnership discussed these social, cultural, economic, and ecological interests, it became clear that sustainable solutions require integrating tribal, energy, agriculture, transportation, recreation, fishery, and other community considerations into decisions about salmon management. Solving complex challenges for future success will require continued collaboration among these diverse parties.

Throughout the Partnership process, members recognized it would be important to solicit the next generation's views on how to achieve the long-term Vision and Goals over the next 100 years. To kick off that engagement, Partnership members developed a "Student Engagement Survey" in mid-March 2020 for student input. The survey asked questions that addressed Partnership Goals and was sent to 245 university and college programs throughout the Pacific Northwest. Several professors then invited Partnership members to present the Columbia Basin Partnership work to their classes. Survey results are summarized in the Next Generation Perspective section.

Path Forward Considerations

While the Partnership succeeded in its primary mission to identify long-term Qualitative and Quantitative Goals for salmon and steelhead, it recognizes that much more work is needed to determine how best to achieve these Goals.

Partnership members saw great value in continuing this comprehensive collaboration effort into the future. They formed a Path Forward Team and asked the team to develop ideas about a future effort. The Path Forward Team met nine times to advance concepts for future collaboration. The Path Forward Team considered attributes of other collaborative examples from across the country. They focused their efforts on adding value to existing regional processes and filling collaborative gaps. These recommendations are captured in the Path Forward chapter.

Moving Forward

Moving forward, the Partnership sees the importance of continuing this comprehensive collaboration to discuss, evaluate, and define the best paths forward to achieve the Goals and integrate biological and socioeconomic factors. Strategies and actions must be adapted locally to reflect the specific fish, places, and people in an area. Some of the conversations going forward will be difficult but to achieve the Partnership Goals, bold actions and difficult choices will be needed.

The Partnership members hope the respectful approach they demonstrated throughout this process will set the stage for those conversations to be well informed and inclusive. The envisioned path forward for the Partnership promotes effective team problem solving and building on and improving existing regional processes to identify ways to achieve the short, medium, and long-term Quantitative Goals.

Key Messages and Recommendations

Several key messages and recommendations from the Partnership will frame future efforts.

A Call to Action

Time is of the Essence. Since the late 1800s, immigrants to the Pacific Northwest changed the Columbia River Basin ecosystem at the expense of salmon. At the writing of this report, natural-origin fish runs are less than 10 percent of what they were historically. In some areas of the Basin wild salmon and steelhead no longer exist. The status quo is unacceptable: without significant change, imperiled salmon and steelhead will disappear forever.

We Must Act Now with Urgency. If we take action now, we can reintroduce and return wild salmon and steelhead to abundance. Readers 20 years from now should be able to review the work of the Partnership and see that 2020 was a turning point for the return of healthy and abundant salmon and steelhead to the Columbia River.

Salmon Will Indicate the Health of the Basin. The Partnership adopts this call to action: "A sustainable future with thriving salmon and steelhead that are indicators of clean and abundant water, reliable and clean energy, a robust regional economy, healthy watersheds, and vibrant cultural and spiritual traditions all interdependent and existing in harmony for generations to come."

The efforts of the Columbia Basin Partnership to define quantitative recovery goals for salmon and steelhead highlight the magnitude of the challenge facing the region. The development of scenarios presents an important illustration of the diverse opinions and identification of the difficult decisions required to make important changes across the salmon life cycle. It is my firm belief that progress towards these goals will only be possible with a strong community response with contributions from all Northwest Citizens. — Joe Lukas, *Western Montana Electric Generating and Transmission Cooperative*

Research crew looking for salmon parr on Lower Big Creek, Idaho. Credit: NOAA Fisheries West Coast Region

The Path Forward Needs a Salmon Ethic, Strong Leadership, and Collaboration

The Tribes, Salmon, and Ecosystem are Interconnected. This ethic should guide our collective pathway to implement Qualitative and Quantitative Goals, strategies, and actions to ensure we consider the impacts on salmon and steelhead and all parts of the ecosystem.

Leadership is Essential. Strong public resolve and leadership at every level are needed to prioritize salmon and steelhead, particularly with increasing and uncertain impacts from climate change and population growth. Integrating and aligning salmon management decisions, strategies, and actions is critical to maximize effectiveness, meet treaty rights and trust responsibilities, ensure strategic use of funds, and increase transparency.

Collaboration is Needed. Not all voices have been heard and respected. Problems exist. There are hard choices and decisions ahead of us. Conflict will happen and we will need to work through it. A structured forum where representatives of sovereigns and stakeholders engage in direct dialogue is key to collaborative problem-solving. Success will be achieved when everyone joins together to implement a common set of actions. Collaboration is vital to identifying and implementing solutions.

Science Plus Accountability Delivers a Healthy Ecosystem and a Vibrant Quality of Life

Continuous Improvement and Innovation Moves Us Forward. We need to adapt how we live with salmon. The opportunity and challenge is to socially and economically innovate. Success requires bold action, risk-taking, learning from mistakes, and building on local successes.

Make Scientifically Based Decisions. Actions must be driven by science and informed by research that is inclusive of traditional ecological knowledge. Critical uncertainties must be resolved through adequately funded scientific experiments with rigorous monitoring and evaluation that remains adaptive to emerging information. Our scientifically based actions must enable the river to produce salmon and steelhead at the levels this Partnership has identified.

Benchmarks Provide Accountability. Using the Partnership Qualitative and Quantitative Goals, we need to establish quantitative targets for each stock, with timeframes to measure progress, assess the impact of actions, adapt as needed, and respond to changing circumstances. Everyone in the Basin is responsible for the outcome.

Reliable and Predictable Funding is Essential. Funding must be targeted to achieve the Partnership Goals. New funding sources should be identified. Funding must come from multiple sources, consider the burden across communities, and account for past, present, and potential impacts.

Qualitative Goals

During Phase 1, the Partnership identified several Qualitative Goals to clarify an approach to achieve their Vision for the Columbia Basin. The Qualitative Goals capture different social, cultural, economic, and ecological values, and reflect desired outcomes in terms of human experience, opportunity, and the biological status of the Columbia Basin environment. The Goals set parameters for integrating and balancing sometimes competing values and purposes. Together, they represent important values that need to be realized throughout the Columbia Basin for this effort to be successful. They provide context for the Quantitative Goals, which are linked to the Qualitative Goals and provide numeric measures of success.

In establishing the Goals, the Partnership recognized the need and opportunity to act today, while at the same time envisioning salmon and steelhead runs 100 years from now. Consequently, the first three goals have a subset of goals that anticipates progress in 25 years, 50 years, and 100 years. These timeframes, however, are intended to provide a general sense of how the Basin might anticipate steady progress over time and do not set a starting or ending point for any particular action. Also, a long timeline does not provide an excuse for postponing necessary measures. Actions should be taken as soon as practicable, wherever practical, and sustained for as long as necessary to achieve the Goals. Low-range, medium-range, and high-range goals may be achievable for some or many stocks in the near term depending on the actions taken. For some salmon and steelhead stocks, some subgoals may be more attainable than others, depending on the opportunities to take corrective actions to address them. Other subgoals will, by their very nature, take much longer to achieve. Overall, achieving the shared Vision for salmon and steelhead will take a multitude of actions, starting immediately and applied in an orderly sequence.

The fourth goal does not include a timeframe because the values it describes are constant. Over time, the decisions that reflect those values may change, but the values themselves will not.

TASK FORCE QUALITATIVE GOALS

Restore salmon and steelhead in the Columbia Basin to healthy and harvestable/fishable levels.

Provide diverse, productive, and dependable tribal and non-tribal harvest and fishing opportunities for Columbia Basin salmon and steelhead in fresh and marine waters.

Produce hatchery salmon and steelhead to support conservation, mitigate for lost natural production, and support fisheries, in a manner that strategically aligns hatchery production with natural production recovery goals.

Make decisions within a broader context that reflects and considers effects to the full range of social, cultural, economic, and ecosystem values and diversity in the Columbia Basin.

Salmon fry. Credit: NOAA Fisheries West Coast Region

My Partnership takeaways include: a) to confidently and collectively embrace rigorous evidence- and experienced-based observation and knowledge that comprise the foundation of salmon science; b) respect and undertake the necessary and challenging effort to integrate wild salmon ecology with civic ecology in our systemic, holistic comprehension of Basin functions; c) with history as our guide, we must clearly identify any "false equivalencies" that could distort our evaluations and assignments of future burden sharing. Lastly and most critical, that trusted working relationships, constantly re-affirmed, enable us to find the ways to set and achieve agreed-upon goals.

If we ever pause from exasperation, hesitate from exhaustion, or question our commitment to boldness, we need only look to salmon for inspiration, to the miraculous journey they undertake, without doubt or faint of heart, to further the future of their species.

— **Kevin Scribner,** *Salmon Safe*

Goal 1. Restore salmon and steelhead in the Columbia Basin to healthy and harvestable/fishable levels.

The natural production goal contains five subgoals with corresponding temporal achievements (Table 1). For ESA-listed fish, the first three subgoals reflect a progression from current population status to delisting to broad sense recovery. For non-listed fish, the progression is from the current population status to broad sense recovery. The last two subgoals address spatial distribution and run timing, and diversity and resiliency as fish populations, both listed and non-listed, increase under the first three subgoals. These ongoing concerns must be addressed if we are to achieve and sustain healthy and harvestable/fishable salmon and steelhead.

TABLE 1. Natural production goal and subgoals for Columbia Basin salmon and steelhead.

GOAL 1. Restore salmon and steelhead in the Columbia Basin to healthy and harvestable levels.			
Subgoals	Within 25 years	Within 50 years	Within 100 years
1-A. **Prevent Declines:** Reverse and prevent declines of both listed and unlisted salmon and steelhead.	a. Reverse and prevent declines of both listed and unlisted salmon and steelhead.		
1-B. **Achieve ESA Delisting:** Recover ESA-listed salmon and steelhead to a point where they are no longer threatened or endangered.	a. Achieve ESA delisting for at least some salmon ESUs and steelhead DPSs.	b. Achieve ESA delisting for additional salmon ESUs and steelhead DPSs.	c. Achieve ESA delisting for all listed salmon and steelhead.
1-C. **Achieve Broad Sense Recovery:** Restore listed and unlisted salmon and steelhead to healthy and harvestable levels.	a. Make significant, measurable progress toward broad sense recovery of all salmon and steelhead.	b. Achieve healthy and harvestable levels for some salmon and steelhead.	c. Achieve healthy and harvestable levels for all salmon and steelhead.
1–D. **Expand Spatial and Temporal Range:** Rebuild spatial distribution and run timing of salmon and steelhead at local and Basinwide scales, including in currently inaccessible areas within the historical range.	a. Make significant, measurable progress toward rebuilding spatial distribution and run timing of salmon and steelhead at local and Basinwide scales, including beginning to study, develop, and implement plans for restoring salmon and steelhead to currently inaccessible areas within their historical range.	b. Continue rebuilding spatial distribution and run timing of salmon and steelhead at local and Basinwide scales, including in currently inaccessible areas within their historical range.	c. Complete rebuilding of spatial distribution and run timing of salmon and steelhead at local and Basinwide scales, including in currently inaccessible areas within their historical range.
1-E. **Expand Diversity and Resiliency:** Rebuild salmon and steelhead runs that are adaptive and resilient to climate change and other environmental perturbations.	a. Rebuild salmon and steelhead runs that are adaptive and resilient to climate change and other environmental perturbations.	b. Continue rebuilding adaptive and resilient salmon and steelhead runs and proactively and adaptively manage for a changing climate.	c. Ensure continued resiliency of salmon and steelhead runs and continue to adaptively manage for a changing climate.

Goal 2. Provide diverse, productive, and dependable tribal and non-tribal harvest and fishing opportunities for Columbia Basin salmon and steelhead in fresh and marine waters.

In-river and ocean harvest is currently regulated and constrained by various state, federal, and tribal entities based on *U.S. v. Oregon, U.S. v. Washington*, and corresponding agreements; the Magnuson–Stevens Fishery Conservation and Management Act; the Pacific Salmon Treaty; the Marine Mammal Protection Act; the Endangered Species Act; and state and tribal statutes, regulations, and policies. Fisheries data show that harvest rates have been reduced as wild stocks have declined.

This harvest and fishing opportunity goal presumes that, moving forward in recovery, increased natural production will result in fewer legal constraints, which then will result in increased and more consistent harvest and fishing opportunities for both hatchery and natural stocks. The overriding theme of Goal 2 is to align harvest and fishing with the need to restore natural production consistent with the Partnership's Vision for thriving future salmon and steelhead populations throughout most of the Columbia Basin. The goal includes three subgoals (Table 2).

TABLE 2. Harvest and fishing opportunity goal and subgoals for Columbia Basin salmon and steelhead.

GOAL 2. Provide diverse, productive, and dependable tribal and non-tribal harvest and fishing opportunities for Columbia Basin salmon and steelhead in fresh and marine waters.			
Subgoals	Within 25 years	Within 50 years	Within 100 years
2-A. **Ensure Sustainability:** Manage harvest and fisheries at levels consistent with conserving natural salmon and steelhead populations.	a. Ensure that fishery impacts on weak and listed stocks allow rebuilding of natural stocks and do not impede recovery.	b. Manage fisheries based on annual abundance to promote rebuilding of natural production and share the recovery burden.	c. Manage for optimum sustainable harvest and fishing opportunity as healthy stocks are restored.
2-B. **Optimize Harvest and Fishery Opportunity:** Optimize fishery opportunity and harvest of healthy natural and hatchery stocks based on availability.	a. Optimize fishery opportunity and access to harvestable surpluses of unlisted and hatchery stocks consistent with conservation.	b. Expand fishery opportunity concurrent with progress toward ESA delisting and broad sense recovery.	c. Fully realize harvest potential with increasing opportunity throughout the range of salmon and steelhead stocks.
2-C. **Share Benefits:** Realize all fishery obligations and share benefits among users.	a. Meet fishery obligations and share available harvest within the constraints imposed by conservation.	b. As constraints are reduced, move into focusing fisheries on sharing the benefits of increasing numbers of harvestable stocks.	c. Realize all fishery obligations and share benefits among users.

Goal 3. Produce hatchery salmon and steelhead to support conservation, mitigate for lost natural production, and support fisheries, in a manner that strategically aligns hatchery production with natural production recovery goals.

The hatchery/mitigation goal includes three subgoals that recognize that artificial production is an important tool for supporting conservation and providing fish for harvest (Table 3). Each hatchery subgoal requires consistency with natural production goals, and it is presumed that hatchery managers will use best management practices to achieve conservation needs.

TABLE 3. Hatchery/mitigation goal and subgoals for Columbia Basin salmon and steelhead.

GOAL 3. Produce hatchery salmon and steelhead to support conservation, mitigate for lost natural production, and support fisheries, in a manner that strategically aligns hatchery production with natural production recovery goals.

Subgoals	Within 25 years	Within 50 years	Within 100 years
3-A. **Support Natural Production:** Utilize hatcheries to maintain, support, and restore natural production where appropriate.	a. As appropriate, continue to utilize hatcheries to maintain, support, and restore at-risk populations, including those affected by climate change.	b. Use conservation hatchery strategies as needed to proactively address future threats, including climate change.	c. Achieve a future where conservation hatcheries are not necessary unless unforeseen natural events require an emergency response.
3-B. **Mitigate for Lost Production and Support Fisheries:** Produce hatchery fish to support tribal treaty/trust responsibilities and meaningful fishery opportunities to mitigate for historical losses due to development and to enhance fisheries.	a. Make progress in reducing reliance on hatchery production for mitigation consistent with improvements in natural production.	b. Consider changes in hatchery objectives and production levels as overall fishery opportunities are maintained through increased fish abundance.	c. Achieve a future where the Basin relies less on hatchery production for mitigation and fishery enhancement only when natural production has increased.
3-C. **Fish Protection:** Strategically align hatchery production with natural production recovery goals, consistent with tribal treaty/trust responsibilities, and with other legal and mitigation requirements.	a. Continue to implement changes in hatchery practices and programs based on best available science (including, in some cases, changes in stocks or species produced) to minimize adverse effects of hatchery-origin salmon and steelhead on naturally produced salmon and steelhead.	b. Continue to refine hatchery production, strategies, and practices based on assessments of effectiveness and technology advances to minimize hatchery impacts on natural salmon and steelhead.	c. Reduce long-term hatchery impacts by rebuilding abundance, productivity, diversity, and distribution of natural salmon and steelhead.

Goal 4. Make decisions within a broader context that reflects and considers effects to the full range of social, cultural, economic, and ecosystem values and diversity in the Columbia Basin.

Society today places a high value on protecting and preserving salmon and steelhead runs and their watersheds. The role that salmon and steelhead play in the overall health of Pacific Northwest ecosystems, and the economic and other non-monetary benefits, are better understood than in the past. Together, four social, cultural, economic, and ecosystem subgoals of Goal 4 reflect the importance of approaching decision-making holistically, including but not limited to traditional economics (Table 4). Many important social and cultural values, as well as major ecological values, represent important benefits to society as a whole. Although these other values may be difficult to monetize, they are essential to the identity of the Columbia Basin.

Goal 4 recognizes that all of these values and benefits are interconnected, entwined, and to the extent that one suffers, they all suffer. Salmon and steelhead are the common denominators, indicators creating an important bond between humans, animals, and the ecosystem. Goal 4 asks decision-makers to acknowledge and respect this interconnection.

In future deliberations, it is hoped that managers continue to explore how to balance the achievement of these Qualitative Goals on a stock-by-stock basis. The different Goals may be prioritized differently for the individual stocks to reflect desired benefits for the natural resource and people interacting with that resource, but in a manner that achieves the Partnership's overall Vision.

TABLE 4. Social, cultural, economic, and ecosystem goal and subgoals for Columbia Basin salmon and steelhead.

GOAL 4. Make decisions within a broader context that reflects, and considers effects to, the full range of social, cultural, economic, and ecosystem values and diversity in the Columbia Basin.
4-A. **Social Goal:** Make decisions that reflect the social importance of salmon and steelhead to people throughout the Columbia Basin, recognizing the full range of social diversity and values that are present.
4-B. **Cultural Goal:** Make decisions that reflect the cultural importance of salmon and steelhead to people throughout the Columbia Basin, recognizing the full range of cultural values that are present.
4-C. **Economic Goal:** Make decisions that are based on the principle of equitable sharing of costs and benefits across economic sectors. Also, make decisions that recognize the great economic value of the Columbia River and its tributaries, and the importance of this natural capital as a major driver of the present and future economy for all in the Pacific Northwest.
4-D. **Ecosystem Goal:** Make decisions that consider the role of salmon and steelhead in the ecosystem and that support a full range of ecological benefits, including the needs of dependent wildlife.[a]
[a] For instance, while Pacific lamprey are not addressed in this report, their distribution overlaps with salmon and steelhead throughout the Columbia Basin and their restoration is important ecologically and culturally.


Warm Springs Tribe's Middle Fork John Day River restoration site. Credit: CRITFC

Quantitative Goals

The Partnership identified Quantitative Goals, measured in numbers of adult salmon and steelhead, which translate the Qualitative Goals into measurable and specific conditions. Several characteristics define the Quantitative Goals:

- Adult fish numbers are an essential measure and common currency for fish status, fishery value, and hatchery mitigation purposes.
- Natural production goals established by the Partnership are combined with anticipated hatchery production and potential harvest to estimate run sizes to the Columbia River mouth (Figure 1).
- Quantitative Goals are ranges rather than single-point estimates to reflect a continuum of progressive improvements. Goal ranges also reflect the increasing benefits that more fish will provide, including higher viability of fish species, increased fishing opportunities, and enhanced social, cultural, economic, and ecological benefits.
- Current and historical salmon and steelhead numbers are also documented to place Quantitative Goals into context.

This chapter describes the approach and goal values identified by the Partnership. Appendix A provides further documentation.

FIGURE 1. Categories of goals addressed by the Columbia Basin Partnership Task Force.

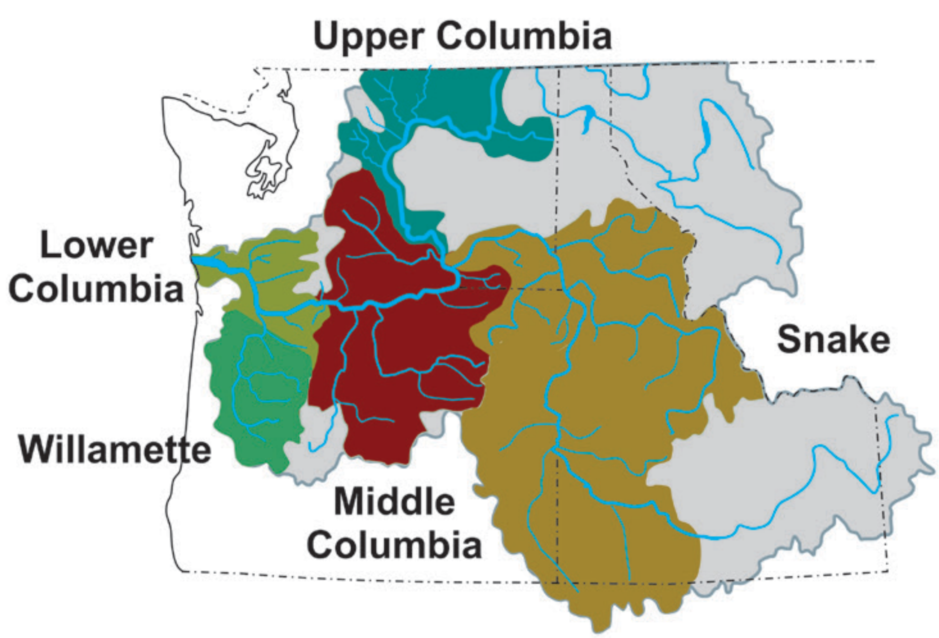
The Partnership reinforced for me, how much we can achieve when we open up or step out of our familiar circles. It's so easy to surround ourselves with those who do similar work for similar reasons with similar or complementary expertise; what is more important is sitting with people who share the goal of a healthy planet whose work and purposes are different. The Partnership members brought these differences and were open in sharing them. Attending to each other's needs keeps me hopeful and is why I believe the work that evolves from more diverse perspectives will be more sustainable, especially in facing the decisions ahead. — Deb Marriott, *Lower Columbia Estuary Partnership*

Approach

Regional Technical Teams

To develop the Quantitative Goals and access numerous data sources, NOAA Fisheries convened four regional technical teams with the subject matter and geographic expertise for that given region (Figure 2). The NOAA Fisheries Project Team provided guidance to the regional technical teams. Regional technical team members generally included staff from state and tribal entities and other Partnership member organizations. These regional technical teams operated under the Guiding Principles adopted by the Partnership, including the principle that all products be grounded in sound science. Where possible, the Quantitative Goals are based on existing goals established by state, federal, and tribal entities. Quantitative Goals for stocks in each region were developed using a generally consistent approach but, to some extent, also reflect local approaches and perspectives.[1] All products developed by the regional technical teams were provided for Partnership consideration.

FIGURE 2. Areas addressed by regional technical teams: Lower Columbia/ Willamette, Middle Columbia, Upper Columbia, and Snake.



Foundation of Goals in Existing Plans

The Quantitative Goals are based on conservation, recovery, management, and mitigation plans developed throughout the region to address various purposes and programs. In some cases, these plans contain numerical goals that various entities identified for different purposes. The Partnership considered these different goals and integrated or reconciled them based on input from its regional technical teams. Situations also

[1] Because of regional differences in the information available and its application to goal setting, Quantitative Goals are not intended to direct resource allocation or funding decisions among regions within the Basin.

arose where Quantitative Goals had not yet been identified for specific stocks or outcomes. In these cases, the Partnership identified appropriate goals based on input from its regional technical teams.

Several key sources of existing goals provided a foundation for the Quantitative Goals:

ESA Recovery Plans. NOAA Fisheries has adopted ESA recovery plans for all listed salmon and steelhead in the Columbia Basin.[2,3,4,5,6,7] These plans were developed with local partners.

Northwest Power and Conservation Council Fish and Wildlife Program. The Northwest Power and Conservation Council (Council) was established pursuant to the Pacific Northwest Electric Power Planning and Conservation Act of 1980. The Act authorizes the Council to serve as a comprehensive planning agency for energy, fish, and wildlife policy, and citizen involvement in the Columbia Basin. Council members represent the states of Idaho, Montana, Oregon, and Washington.

Tribal Plans. Tribal plans include the Spirit of the Salmon Plan (Wy-Kan-Ush-Mi Wa-Kish-Wit) and local plans developed by individual tribes. Wy-Kan-Ush-Mi Wa-Kish-Wit is a regional fish restoration plan that was adopted in 1995 and updated in 2014 by the Nez Perce, Umatilla, Warm Springs, and Yakama Tribes.[8] A Nez Perce tribal fisheries management plan identifies specific abundance objectives and thresholds at the species and population levels for salmon and steelhead within Nez Perce tribal usual and accustomed fishing areas of the Snake River Basin, and corresponding hatchery and harvest strategies.[9] The Upper Snake River Tribes, comprised of the Burns Paiute Tribe, Fort McDermitt Paiute and Shoshone Tribe, Shoshone-Bannock Tribes of the Fort Hall Reservation, and the Shoshone-Paiute Tribes of the Duck Valley Reservation, developed the Hells Canyon Complex Fisheries Resource Management Plan.[10]

State Plans. The states of Washington, Oregon, and Idaho have adopted salmon and steelhead goals and related policies in a variety of forums. Guidance is also available in other state programs, plans, and policies for conservation, hatchery operations, and fisheries. In Washington, a series of regional salmon recovery boards worked with partners to develop regional recovery plans in the Columbia Basin in conjunction with the Northwest Power Conservation Council's subbasin planning process and NOAA Fisheries. In Oregon, the Oregon Department of Fish and Wildlife led the development of an overarching statewide conservation strategy to provide priorities for fish and wildlife. Oregon also developed conservation and recovery plans for specific regions. In Idaho, the state joined NOAA Fisheries and other federal agencies; the states of Washington and Oregon; the Nez Perce, Shoshone-Bannock, and Shoshone-Paiute Tribes; and other entities to develop ESA recovery plans. The Idaho Department of Fish and Game also provides policy and strategic guidance regarding state management of fish and fisheries in several multi-year management plans. Idaho's Office of Species Conservation within the Office of the Governor, which was created by the Idaho legislature, provides coordination, cooperation, and consultation among the state and federal agencies with ESA responsibilities in Idaho.

Hatchery/Mitigation Plans and Policies. A variety of plans and policies define goals and govern the use of the more than 80 hatchery facilities operated by federal and state agencies, tribes, and private interests to produce salmon and steelhead in the Columbia Basin. Major hatchery programs

2 Upper Columbia Salmon Recovery Board. 2007. Upper Columbia spring Chinook salmon and steelhead recovery plan, 8/1/2007.

3 National Marine Fisheries Service. 2013. ESA recovery plan for lower Columbia River coho salmon, lower Columbia River Chinook salmon, Columbia River chum salmon, and lower Columbia River steelhead. National Marine Fisheries Service, Northwest Region, 6/2013.

4 National Marine Fisheries Service. 2015. ESA Recovery Plan for Snake River Sockeye Salmon (*Oncorhynchus nerka*). National Marine Fisheries Service, West Coast Region, 6/8/2015.

5 National Marine Fisheries Service. 2017a. ESA Recovery Plan for Snake River Fall Chinook Salmon (*Oncorhynchus tshawytscha*). West Coast Region. Portland, Oregon. https://www.fisheries.noaa.gov/resource/document/recovery-plan-snake-river-fall-chinook-salmon

6 National Marine Fisheries Service. 2017b. ESA Recovery Plan for Snake River Spring/Summer Chinook (*Oncorhynchus tshawytscha*) and Snake River Steelhead (*Oncorhynchus mykiss*). https://www.fisheries.noaa.gov/resource/document/recovery-plan-snake-river-spring-summer-chinook-salmon-and-snake-river-basin.

7 Oregon Department of Fish and Wildlife and Washington Department of Fish and Wildlife. 2019. Joint Staff Report: Stock status and fisheries for Spring Chinook, Summer Chinook, Sockeye, Steelhead and other species. https://www.dfw.state.or.us/fish/OSCRP/CRM/reports/19_reports/2019_spring_jsr.pdf

8 Columbia River Inter-Tribal Fish Commission. 2014. Spirit of the Salmon Plan: Wy-Kan-Ush-Mi Wa-Kish-Wit. Portland, Oregon. http://plan.critfc.org/.

9 The NPT Tribal Fisheries Management Plan can be accessed at the following web location: https://nezperce.org/wp-content/uploads/2020/09/DFRM-Management-Plan-2013-2028.pdf.

10 Upper Snake River Tribes. 2018. Hells Canyon Fisheries Resource Management Plan. April 27.

in the Columbia Basin have been developed under the Mitchell Act (1938); the Lower Snake River Compensation Plan (1976); the John Day Mitigation Program (1978); Habitat Conservation Plans, Settlement Agreements, and Biological Opinions developed under the Federal Energy Regulatory Commission (FERC) re-licensing processes (e.g., Mid-Columbia Public Utility Districts [Mid-C PUDs: Grant, Douglas, and Chelan PUDs], Cowlitz, Lewis, Deschutes, Willamette programs); and the Northwest Power and Conservation Council Fish and Wildlife Program.

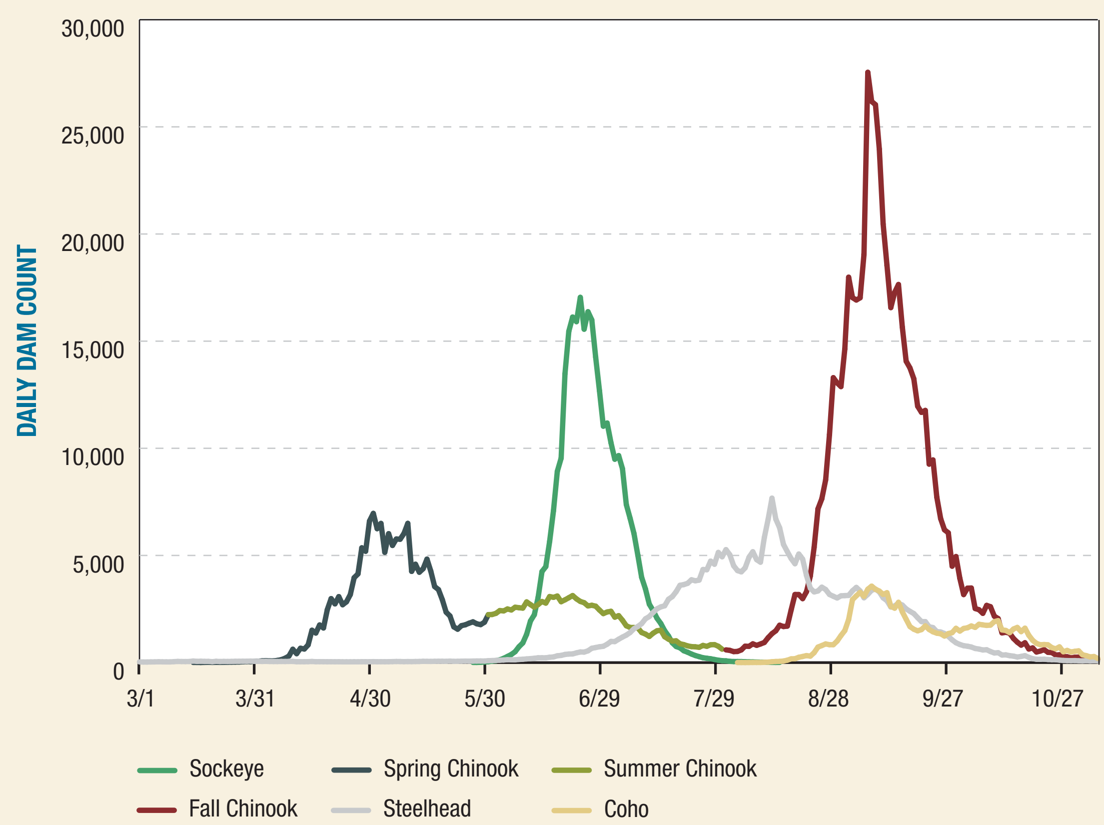
Fishery Management Plans. Fisheries for Columbia River salmon and steelhead are generally managed under four governmental/jurisdictional authorities, each of which provides policy and planning guidance related to fishery goal setting. States and tribes are responsible for fishery management in waters under their specific jurisdictions. Columbia River mainstem fisheries are co-managed by the states, some tribes, and federal government, according to a management plan developed under U.S. District Court direction in the *U.S. v. Oregon* court case.

Fisheries in marine waters under the jurisdiction of the United States (from 3 to 200 nautical miles offshore) are managed under the Pacific Fisheries Management Council process, according to authorities in the Magnuson–Stevens Fisheries Conservation and Management Act. The Pacific Salmon Treaty governs harvest of salmon that swim across United States–Canada international borders.

Columbia Basin Salmon and Steelhead Species, Stocks, and Populations

Five species of salmon and steelhead return to practically every accessible corner of the Columbia and Snake Basins in broadly overlapping runs over the course of a year (Figure 3). Groups of similar salmon and steelhead populations are typically grouped into “stocks” for status assessment and management purposes. The Partnership and its technical teams identified Quantitative Goals for different stocks of salmon and steelhead in the Columbia Basin, which were defined for Partnership purposes based on species (i.e.,

FIGURE 3. Average run timing of Columbia Basin salmon and steelhead at Bonneville Dam, 2007–2016.



Chinook, coho, sockeye, and chum salmon and steelhead), a region of origin (i.e., Lower Columbia, Willamette, Middle Columbia, Upper Columbia, or Snake), and run timing (i.e., spring, summer, fall, late-fall, and winter). The stocks include both ESA-listed and non-listed salmon and steelhead.

Quantitative Goals were identified for 27 natural-origin stocks, including 333 historical populations, some of which are extirpated (Table 5). Stocks are generally the same as the listing units defined by NOAA Fisheries for ESA purposes, except in cases where a listing unit contained multiple run timings (e.g., spring, summer, fall, winter). In these cases, the ESA listing units were split by run timing into separate stocks so that numbers could be more easily aggregated or related to fisheries by run timing in a Basinwide accounting. Hatchery numbers are also identified by the Partnership for several hatchery-only stocks.

TABLE 5. Natural-origin salmon and steelhead stocks as defined by the Columbia Basin Partnership Task Force based on region, species, and run type, and number of historical and extirpated populations in each stock.

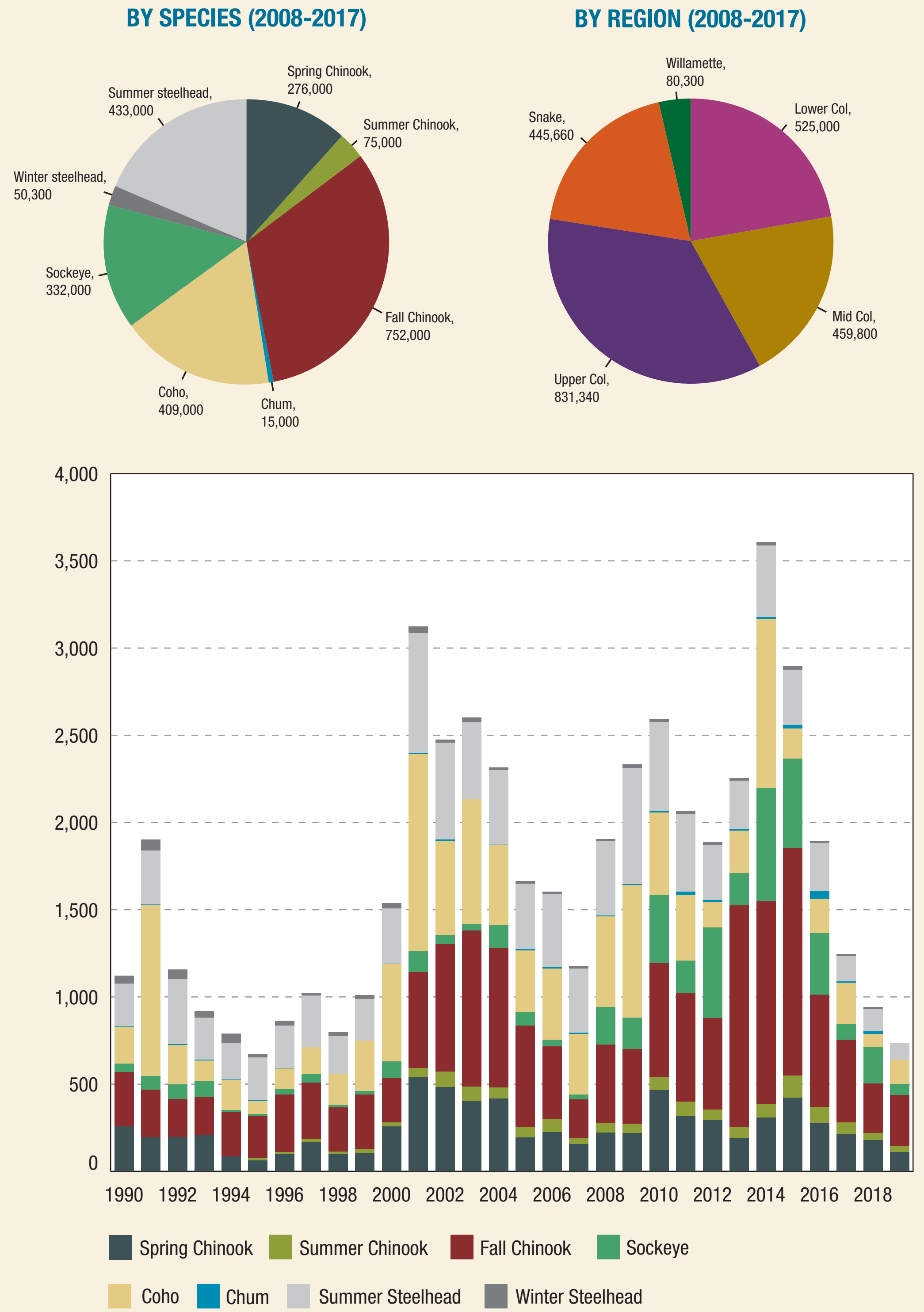
Region	Species	Run type	ESA Listed?	Evolutionarily Significant Unit or Distinct Population Segment	No. of populations: Historical	No. of populations: Extirpated[a]
Lower Columbia	Chinook	Spring	Yes	L Col R Chinook	9	0
	Chinook	Fall (tules)	Yes	L Col R Chinook	21	0
	Chinook	Fall (late brights)	Yes	L Col R Chinook	2	0
	Chinook	Fall (brights)	No	-	1	0
	Coho	Fall (early & late)	Yes	L Col R Coho	25	0
	Chum	Late Fall	Yes	Col R Chum	18	1
	Steelhead	Winter	No	SW Washington Steelhead	7	0
	Steelhead	Winter	Yes	L Col R Steelhead	17	0
	Steelhead	Summer	Yes	L Col R Steelhead	6	0
Middle Columbia	Chinook	Spring	No	M Col R Spring Chinook	14	7
	Chinook	Summer/Fall	No	M Col R Summer/Fall Chinook	1	0
	Coho	Fall	Extirpated	-	4	4
	Sockeye	Summer	Extirpated	-	2	2
	Steelhead	Summer	Yes	M Col R Steelhead	20	3
Upper Columbia	Chinook	Spring	Yes	U Col R Spring Chinook	10	7
	Chinook	Summer	No	U Col R Summer/Fall Chinook	14	7
	Chinook	Fall	No	U Col R Summer/Fall Chinook	5	1
	Coho	Fall	Extirpated	-	5	5
	Sockeye	Summer	No	Wenatchee, Okanogan Sockeye	5	3
	Steelhead	Summer	Yes	U Col R Steelhead	11	7
Snake	Chinook	Spring/Summer	Part	Snake R Spring/Summer Chinook	68	40
	Chinook	Fall (brights)	Yes	Snake R Fall Chinook	2	1
	Coho	Fall	Extirpated	-	6	6
	Sockeye	Summer	Yes	Snake R Sockeye	9	8
	Steelhead	Summer	Yes	Snake R Steelhead	40	15
Willamette	Chinook	Spring	Yes	U Willamette R Spring Chinook	7	0
	Steelhead	Winter	Yes	U Willamette R Steelhead	4	0
All	**Total**	**-**	**27**	**-**	**333**	**117**
	Listed	**-**	**17**	**-**	**202**	**-**

[a] A number of number of extirpated populations are being reintroduced.

Current and Historical Abundance

Approximately 2 million salmon and steelhead returned to the Columbia Basin on average each year from 2000 to 2019 (Figure 4). Annual numbers have varied between 0.7 and 3.6 million since 1990. Chinook salmon (spring, summer, and fall) typically comprise about half of the total return with the rest often evenly distributed among sockeye salmon, coho salmon, and steelhead. Chum salmon typically comprise less than one percent of the total return. Relative species composition and distribution currently differ from historical conditions.

FIGURE 4. Annual salmon and steelhead returns (combined hatchery and natural-origin) to the Columbia River, 1990–2019.



Hatchery-origin fish currently account for two-thirds of the average Columbia River return (Table 6). Hatchery percentages are less than 10 percent for sockeye and chum salmon, but average 80 to 90 percent for spring Chinook, summer Chinook, and coho salmon. Natural-origin fish numbers averaged approximately 800,000 annually from 2008 to 2017, when hatchery- and natural-origin composition data were available.

TABLE 6. Recent average annual return of natural- and hatchery-origin salmon and steelhead to the Columbia River, 2008–2017. Stock-specific details may be found in Appendix A.

Species	Region	Natural	Hatchery	Total	% Hatchery
Spring Chinook	Lower Columbia	3,000	17,000	20,000	85%
	Middle Columbia	14,700	47,200	61,900	76%
	Upper Columbia	3,840	19,400	23,240	83%
	Snake	27,400	85,500	112,900	76%
	Willamette	10,000	48,000	58,000	83%
	Total	58,940	217,100	276,040	79%
Summer Chinook Fall Chinook	Upper Columbia	30,000	45,000	75,000	60%
	Lower Columbia	30,500	88,500	119,000	74%
	Middle Columbia	18,600	200,500	219,100	92%
	Upper Columbia	228,800	118,100	346,900	34%
	Snake	17,900	49,200	67,100	73%
	Total	295,800	456,300	752,100	61%
Chum	Lower Columbia	14,700	300	15,000	2%
Coho	Lower Columbia	34,000	246,000	280,000	88%
	Middle Columbia	0	76,700	76,700	100%
	Upper Columbia	0	29,500	29,500	100%
	Snake	0	22,900	22,900	100%
	Total	34,000	375,100	409,100	92%
Sockeye	Middle Columbia	1,100	0	1,100	0%
	Upper Columbia	296,100	32,900	329,000	10%
	Snake	290	1,170	1,460	80%
Summer Steelhead	Lower Columbia	3,000	44,000	47,000	94%
	Middle Columbia	43,000	58,000	101,000	57%
	Upper Columbia	6,400	21,300	27,700	77%
	Snake	37,900	203,400	241,300	84%
	Willamette	0	16,000	16,000	100%
	Total	90,300	342,700	433,000	79%
Summer Steelhead	Lower Columbia	11,000	33,000	44,000	75%
	Willamette	6,300	0	6,300	0%
	Total	17,300	33,000	50,300	66%
Total	**–**	**838,530**	**1,503,570**	**2,342,100**	**64%**

The current return of naturally produced salmon and steelhead to the Columbia Basin is less than 10 percent of the historical run. While historical abundance is uncertain, various estimates developed since 1979 place the average during the pre-development period (~mid-1800s) at 8.3 million,[11] 7.5 to 8.9 million (Table 7),[12] 10 to 16 million,[13] and 5 to 9 million.[14]

Natural Production Goals

Natural production is an essential value in the long-term health and viability of salmon and steelhead. The regional technical teams identified goals for numbers of natural-origin spawners of salmon and steelhead in the U.S. portion of the Columbia Basin and its tributaries, including both listed and non-listed salmon and steelhead. Some regional technical teams also identified goals in historical production areas that are currently blocked. Goals were identified in ranges that represent a continuum of decreased extinction risk and increased ecological and societal benefits (Figure 5). Numbers were identified at the population level and aggregated by species, stock, and region.

Low-range, mid-range, and high-range goals provide abundance goals to achieve different levels of extinction risk and ecological and societal benefits for Columbia Basin natural-origin salmon and steelhead.

- ***Low-range goals*** identify minimum average abundance levels necessary to ensure the long- term survival of the population, stock, or species. For listed salmon and steelhead, the low-range natural production goals are, in most cases, consistent with ESA delisting goals. Delisting goals are generally defined as the abundance consistent with a viable population (i.e., a population with a five percent risk of extinction over a 100-year timeframe). ESA recovery plans sometimes identify abundance targets consistent with an ESA "recovery scenario" where numbers for a specific population might be higher or lower than the abundance number consistent with a viable population. In these cases, the Partnership adopted the specific recovery plan abundance target for that population. For non-listed species, low-range goals were based on the application of the same technical guidance used in ESA recovery plans to identify abundance levels consistent with a viable population. In some cases, a non-listed population is already meeting these low-range goals, and in this

TABLE 7. Historical run-size estimates of salmon and steelhead in the Columbia Basin (millions).

Species	NPPC 1986	Chapman 1986	PFMC 1979	ISAB 2015
Chinook	**5.4-9.2**	**3.75-4.34**	**3.44**	**-**
Spring	1.4-2.3	0.5-0.6	-	1.92
Summer	2.7-4.6	2.0-2.5	-	0.73
Fall	1.3-2.3	1.25	-	1.40
Chum	**0.8-1.0**	**0.45-0.75**	**0.95**	**-**
Coho	**1.0-1.8**	**0.56-0.62**	**1.20**	**-**
Sockeye	**1.5-2.6**	**2.25-2.62**	**0.65**	**-**
Steelhead	**0.8-1.4**	**0.45-0.55**	**2.04**	**-**
Winter	-	-	-	0.28
Summer	-	-	-	1.92
Total	**9.6-16.3**	**7.5-8.9**	**8.28**	**5.0-9.0**

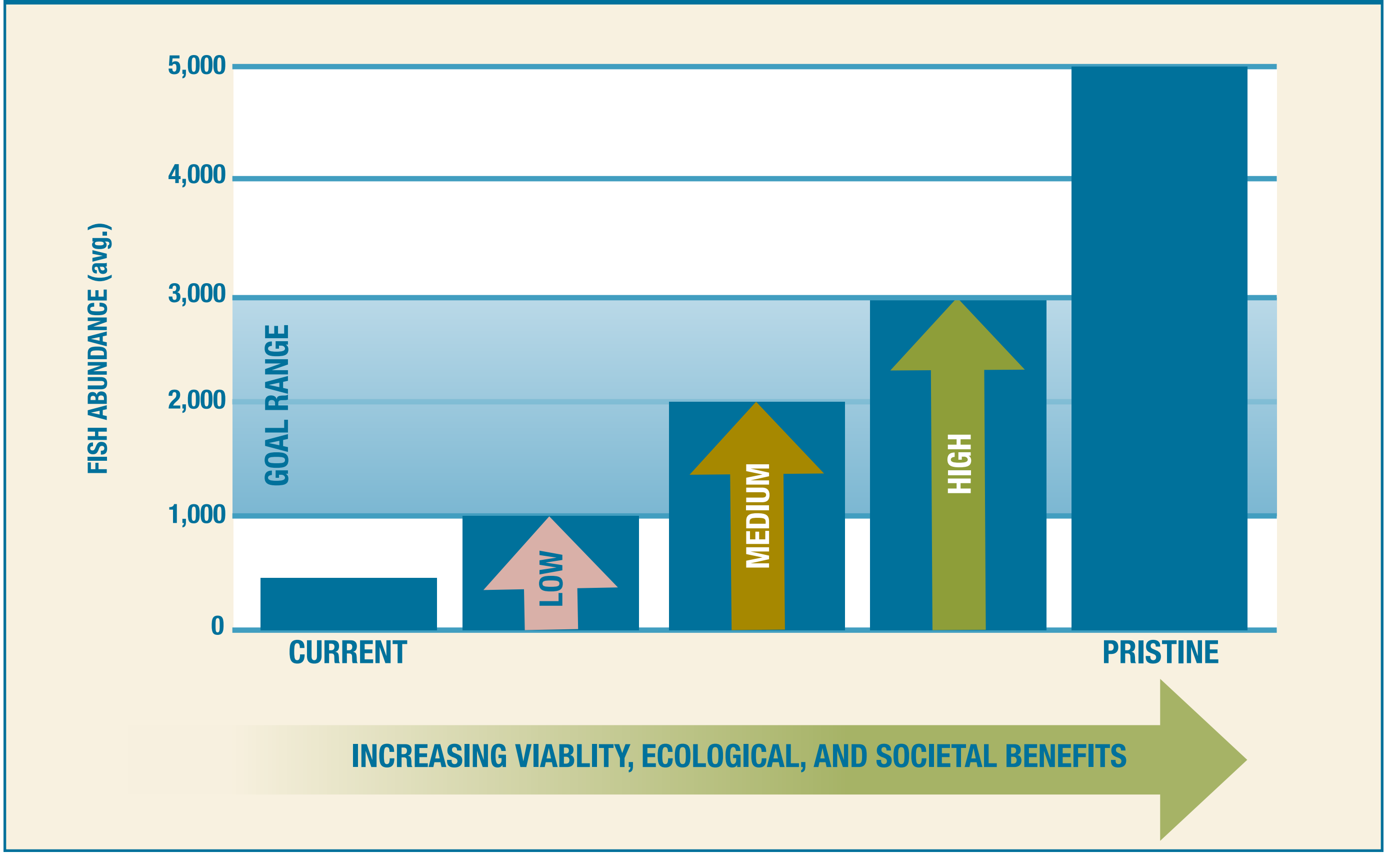
11 Pacific Fishery Management Council (PFMC). 1979. Freshwater habitat, salmon produced, and escapements for natural spawning along the Pacific coast of the U.S. Prepared by the Anadromous Salmonid Environmental Task Force of the Pacific Fishery Management Council. Portland, OR.

12 Chapman, D. W. 1986. Salmon and Steelhead Abundance in the Columbia River in the Nineteenth Century. Transactions of the American Fisheries Society 115:662-670.

13 Northwest Power Planning Council. 1986. Compilation of information on salmon and steelhead losses in the Columbia River Basin. Northwest Power and Conservation Council (formerly named Northwest Power Planning Council) Portland, OR.

14 Independent Scientific Advisory Board. 2015. Density Dependence and its Implications for Fish Management and Restoration in the Columbia River Basin. Northwest Power and Conservation Council, Portland Oregon. ISAB 2015-1. https://www.nwcouncil.org/fish-and-wildlife/fw-independent-advisory-committees/independent-scientific-advisory-board/density-dependence-and-its-implications-for-fish-management-and-restoration-in-the-columbia-river-basin-and-july-2016-addendum

FIGURE 5. Concepts for defining natural production goals.



circumstance, the low-range goal serves as a reference point rather than a management goal.

- ***Mid-range goals*** are generally halfway between the low-range goals and the high-range goals for listed stocks. For unlisted stocks, mid-range goals are generally defined as the number of natural-origin spawners that could effectively use available habitat and sustain high levels of harvest.
- ***High-range goals*** reflect “healthy and harvestable” levels that are generally three to five times greater than low-range goals and 50 percent or less than historical average abundance estimates. The Partnership recognizes that Quantitative Goals do not diminish the desire and intent of some stakeholders to achieve even higher levels of abundance.

Substantial increases in abundance will be necessary to meet even the low-range natural production goals identified by the Partnership for the majority of salmon and steelhead stocks. This is particularly true for depleted and listed stocks, whose numbers are typically far below the low-range goals, which are consistent with minimum

Salmon troller off north Oregon Coast.
Credit: NOAA Fisheries West Coast Region

Progress starts with well-intentioned people working respectfully together to achieve a common vision. I believe the Partnership will prove to be pivotal when, years from now, people look back at the history of salmon management in the Columbia Basin and realize that it was the Partnership that shifted the dominant dynamic from conflict to collaboration. Processes don't create such shifts, people do. So I want to commend all of my fellow Partners and the convening team for embracing and demonstrating the change we want (and need) to see in the Basin. There is a lot of hard work ahead to achieve the goals we have collectively set. I am hopeful that the Partnership's spirit will carry forward and enable us to do that work well and, ultimately, to succeed. — Rob Masonis, *Trout Unlimited*

viability levels or ESA recovery goals. Currently, about a third of the stocks are meeting low-range goals, a third are within 50 percent of the low-range goals, and the remaining third are far below and would require improvements of 100 percent or more to reach the low-range goals.

Low-range Quantitative Goals for natural-origin salmon and steelhead on the spawning grounds in aggregate total 437,000 fish, which is approximately 1.2 times the current mean abundance numbers. High-range Quantitative Goals total 2.8 million salmon and steelhead, which is approximately four times higher than current mean abundance numbers.

Current (2008-2017) mean abundance numbers generally fall within the target goal range but below the high goal range, which is indicative of additional scope for improvement.[15] These stocks include Lower Columbia River bright Chinook salmon, Mid-Columbia summer/fall Chinook salmon, Upper Columbia fall Chinook salmon, Upper Columbia summer Chinook salmon, and Upper Columbia River sockeye salmon. Only one stock is at or above its high-range goal: Upper Columbia fall Chinook salmon, which spawn in the Hanford Reach.

The high-range goals are typically less than estimated historical abundance levels. The goals represent a small fraction of the historical escapement level for many stocks (Table 8, Figure 6, Figure 7). For instance, the aggregate high-range goal for chum salmon is just 4 percent of the historical abundance. This low percentage reflects the severely depleted status of chum salmon and the challenges associated with improving productivity and restoring habitat. Meeting the goal will also require successful reintroduction of chum salmon into numerous areas where current habitat conditions do not support significant natural production of this species.

GOALS FOR CURRENTLY INACCESSIBLE AREAS

This report includes Quantitative Goals for natural production in historically accessible areas that are currently blocked. These include areas of the upper Columbia upstream from Grand Coulee Dam and the Snake River upstream from Hells Canyon and Dworshak Dams. Quantitative Goals are also identified for areas above tributary dams where plans for passage have been identified or are starting to be implemented through some other process (e.g., in the Cowlitz River, Lewis River, Willamette River tributaries, and Deschutes River). Quantitative Goals were not considered or identified in areas that have been historically blocked by natural barriers.

Hatchery Production

The Partnership considered hatchery production because hatcheries play an essential role in conservation, fisheries, and mitigation for Columbia Basin salmon and steelhead. The Partnership documented current and anticipated hatchery production throughout the Columbia Basin.

- ***Current hatchery production*** is identified based on juvenile production levels and corresponding adult returns under existing conservation and mitigation programs throughout the Columbia Basin.

[15] Salmon and steelhead abundance can vary considerably from year to year in response to marine and freshwater environmental conditions. Estimates of "current" abundance are based on a recent (2008-2017) 10-year average. Abundance of some stocks has been less than this average in 2018-2019.

TABLE 8. Aggregate stock-specific abundance values for natural-origin escapement under current and historical conditions, and low, medium, and high goal ranges.						
Stock	Current	Historical	Low goal	Med goal	High goal	High as % of historical
L Col R Spring Chinook	2,240	101,700	9,800	21,550	33,300	33%
L Col R Fall (tule) Chinook	12,329	169,700	28,050	54,100	82,000	48%
L Col R Late Fall (bright) Chinook	10,800	33,000	11,100	16,700	22,200	67%
L Col R Fall (bright) Chinook	11,000	0	11,000	11,000	11,000	-
L Col R Coho	31,524	301,900	67,925	129,550	191,400	63%
Col R Chum	11,762	461,300	16,500	33,000	49,500	11%
SW WA Winter Steelhead	3,252	19,100	4,650	5,850	6,950	36%
L Col R Winter Steelhead	5,989	41,900	19,000	27,900	36,400	87%
L Col R Summer Steelhead	10,594	61,200	21,100	29,800	38,100	62%
M Col R Spring Chinook	11,600	246,500	17,750	40,425	114,500	46%
M Col R Summer/Fall Chinook	11,500	17,000	4,000	13,000	16,000	94%
M Col R Coho	6,324	75,000	5,300	11,600	19,900	27%
M Col Sockeye	1,036	230,000	7,500	45,000	107,500	47%
M Col R Summer Steelhead	18,155	132,800	21,500	43,850	69,150	52%
U Col R Spring Chinook	1,430	259,450	11,500	19,840	30,135	12%
U Col R Summer Chinook	16,920	733,500	9,000	78,350	131,300	18%
U Col R Fall Chinook	92,400	680,000	9,200	62,215	87,835	13%
U Col R Coho	392	44,500	7,500	15,000	26,000	58%
U Col R Sockeye	40,850	1,800,000	31,500	580,000	1,235,000	69%
U Col R Summer Steelhead	1,480	1,121,400	7,500	31,000	47,000	4%
Snake R Spring/Summer Chinook	6,988	1,000,000	33,500	98,750	159,500	16%
Snake R Fall Chinook	8,360	500,000	4,200	10,780	23,360	5%
Snake R Coho	100	200,000	8,900	26,600	44,100	22%
Snake R Sockeye	100	84,000	5,500	15,750	26,000	31%
Snake R Summer Steelhead	28,000	600,000	22,500	75,000	131,500	22%
U Will R Spring Chinook	4,278	312,170	28,900	47,850	66,800	21%
U Will R Winter Steelhead	2,816	220,000	16,290	27,805	39,320	18%
Totals	**352,119**	**9,446,120**	**441,165**	**1,572,265**	**2,845,750**	**30%**

FIGURE 6. Goals for natural-origin spawning escapement of salmon and steelhead species and runs relative to current and historical values. Current, low goal, medium goal, and high goal pie slices are incremental relative to lower values (e.g., high goal total = medium goal + additional increment needed to reach the total identified for the high goal).

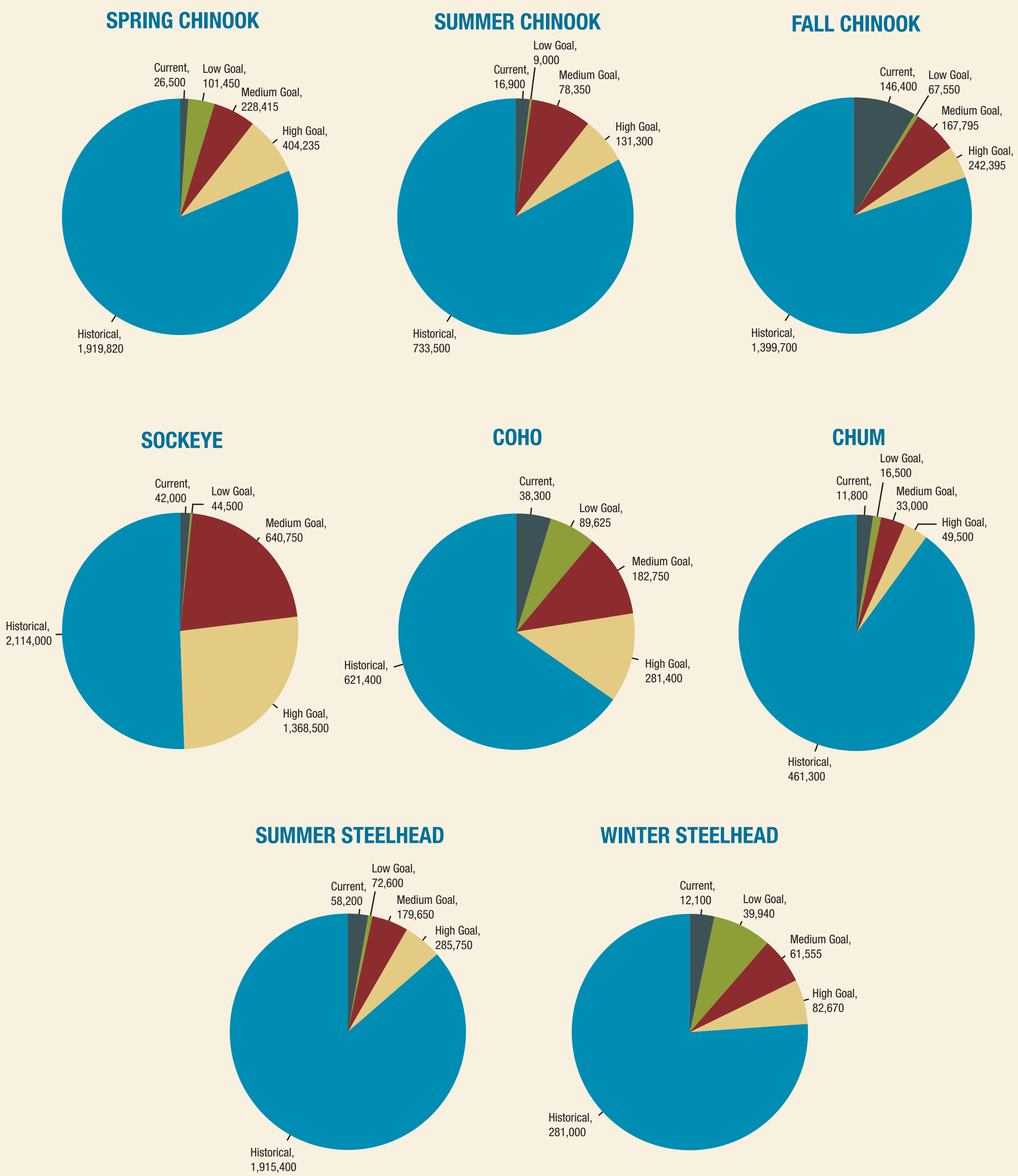
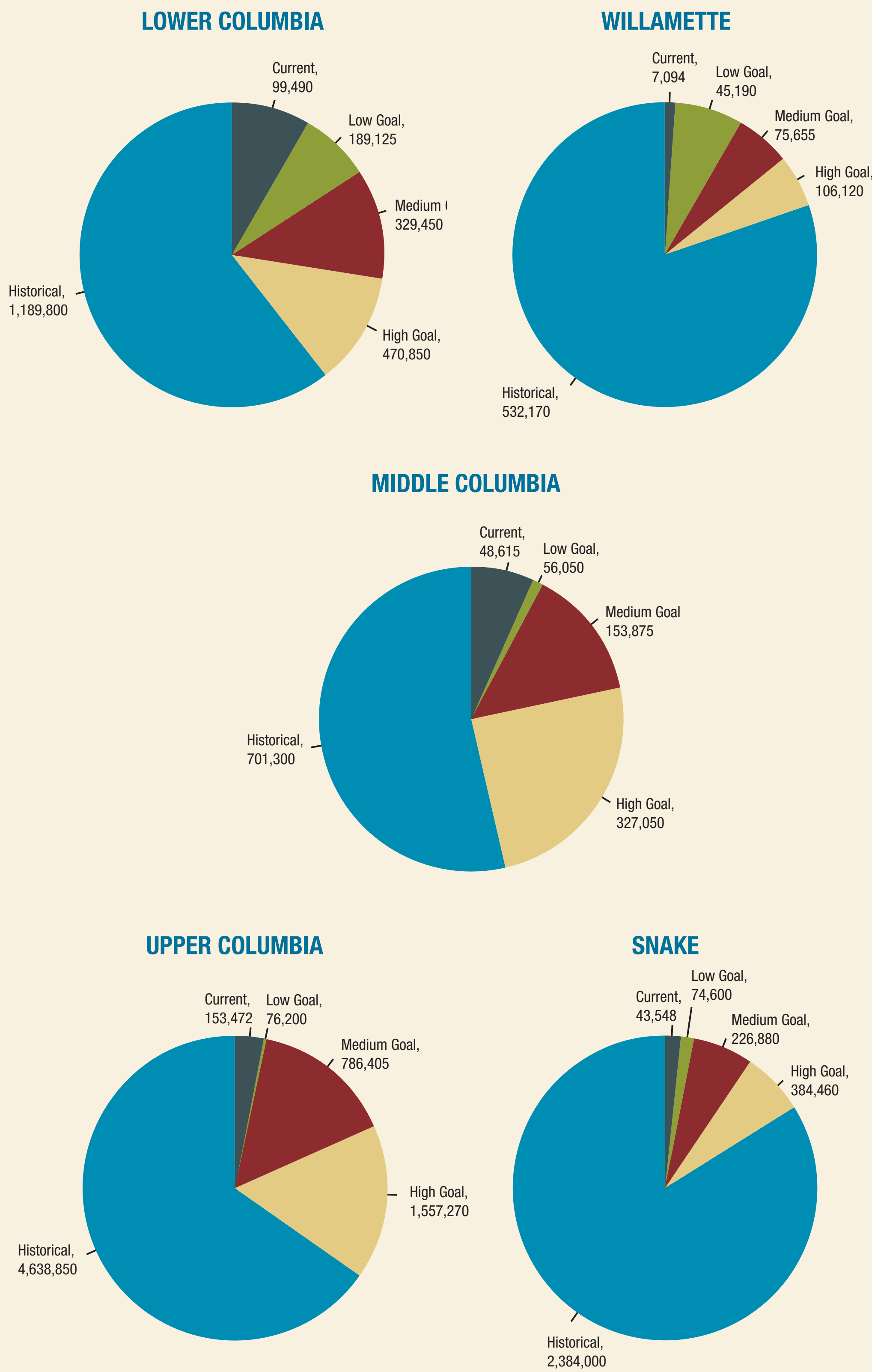


FIGURE 7. Natural production goals for combined spawning escapements by region relative to current and historical values. Current, low goal, medium goal, and high goal pie slices are incremental relative to lower values (e.g., high goal total = medium goal + additional increment needed to reach the total identified for the high goal).



- ***Anticipated hatchery production*** is also identified where defined in existing processes and plans (e.g., the John Day Mitigation Program) and where proposed by Partnership members to address specific purposes (e.g., currently blocked historical anadromous production areas). Specific hatchery programs are inevitably subject to continuing refinements under the authority and auspices of oversight, funding, and implementing entities. Anticipated future hatchery production levels identified by the Partnership are intended to describe expectations based on current information. They are not intended to supersede or undermine specific management authorities governing the implementation of any particular program, or to preclude future changes based on new information, conditions, or requirements.

Hatchery production of salmon and steelhead steadily increased in the Columbia Basin from 1950 through 1980 (Figure 8), primarily as mitigation for declining numbers of wild fish associated with increasing development throughout the Basin. Hatchery releases peaked at over 200 million juvenile fish per year but were subsequently reduced to about 140 million per year as a result of hatchery reforms to protect natural-origin fish and hatchery funding reductions. Most of this reduction in production occurred in the lower Columbia River, and hatchery production has increasingly focused on areas upstream from Bonneville Dam. Future hatchery production plans documented by the Partnership anticipate potential future increases in hatchery production to a total of about 190 million juveniles per year (Table 9).

Fall Chinook salmon comprise 45 percent of current hatchery production, followed by spring Chinook salmon (24 percent), coho salmon (12 percent), summer steelhead (11 percent), and sockeye salmon (4 percent) (Figure 9, Table 9). Chum salmon and winter steelhead each account for just 1 percent of the total. Significant hatchery production occurs throughout the Columbia and Snake Basins, with smaller programs in the Willamette Basin. Approximately two-thirds of the total hatchery production is currently released above Bonneville Dam (Figure 9). Fall Chinook and coho salmon production dominate the lower Columbia hatchery programs, while programs in the upper Columbia Basin also produce summer Chinook and sockeye salmon. Large spring Chinook salmon and summer steelhead programs dominate in the Snake River Basin. Willamette programs concentrate on spring Chinook salmon.

The Partnership estimated potential increases in hatchery production of about 30 percent relative to current levels (Table 9). Several new hatchery programs are planned or in development. The largest potential increases were proposed by the Upper Columbia River Tribes for Upper Columbia sockeye and summer Chinook salmon to support goals for reintroduction.

FIGURE 8. Hatchery juvenile production trends and current production by species of Columbia Basin salmon and steelhead.

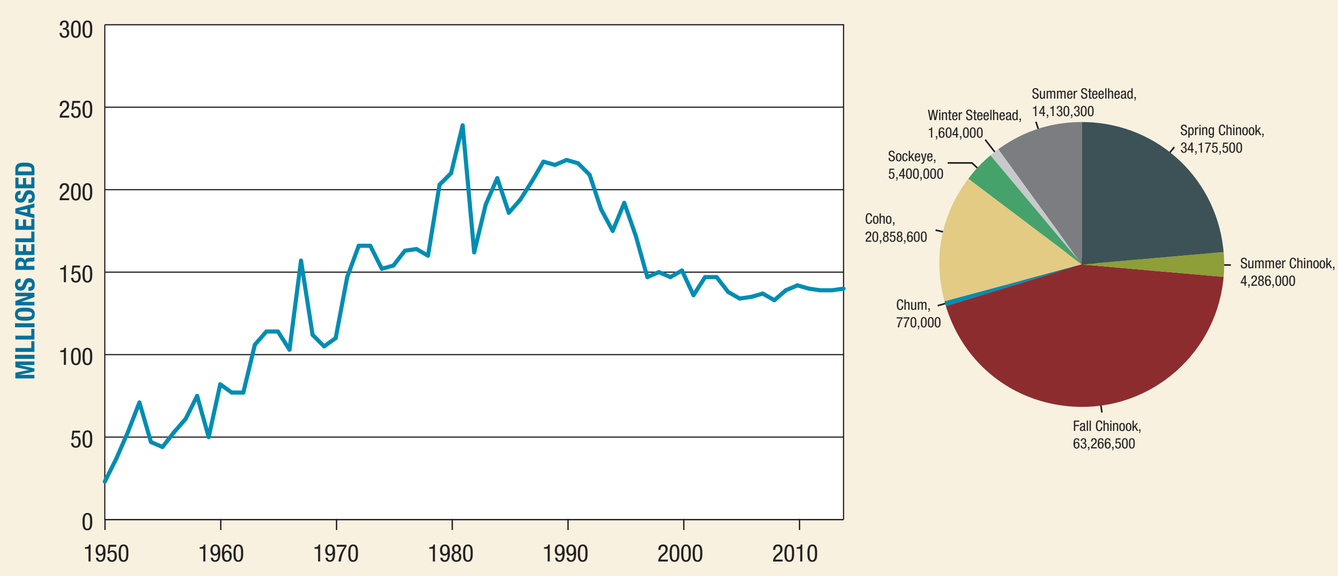
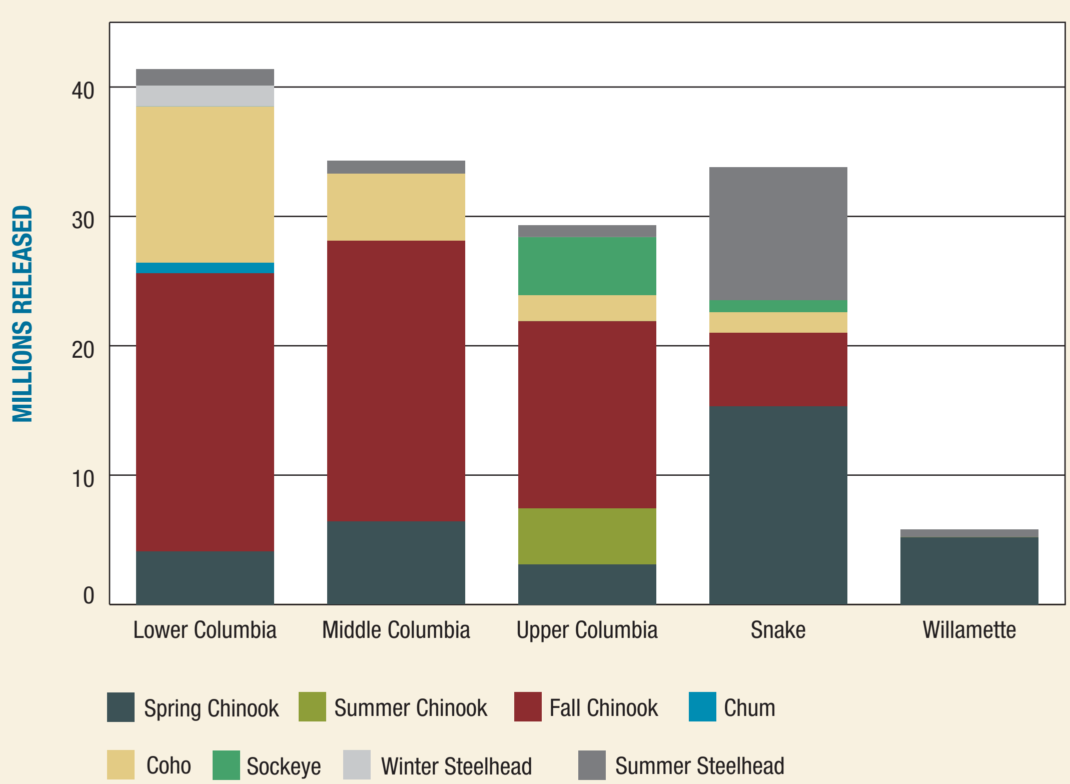


TABLE 9. Current and anticipated hatchery juvenile production and adult returns to the Columbia River of hatchery-origin salmon and steelhead.

	Current Production (Avg.)				Anticipated production	
Species	Yearlings	Subyearlings	Total	Adult returns	Total	Adult returns
Spring Chinook	31,870,500	2,055,000	33,925,500	217,100	47,402,500	301,800
Summer Chinook	3,102,000	1,184,000	4,286,000	45,000	14,400,000	140,000
Fall Chinook	900,000	62,366,500	63,266,500	456,300	73,956,500	564,300
Chum	0	770,000	770,000	300	770,000	300
Coho	20,350,000	508,600	20,858,600	374,000	21,239,000	377,600
Sockeye	900,000	4,500,000	5,400,000	34,070	15,100,000	101,300
Winter Steelhead	1,604,000	0	1,604,000	28,000	1,604,000	28,000
Summer Steel-head	12,780,300	1,350,000	14,130,300	344,700	15,645,000	365,000
Total	**71,506,800**	**72,734,100**	**144,240,900**	**1,499,470**	**190,117,000**	**1,878,300**

FIGURE 9. Current hatchery juvenile production by species/run-timing and area.



Harvest/Fisheries

The Partnership addressed harvest because of the economic, social, and cultural significance of fisheries, their interaction with natural production, and to honor tribal treaty and trust responsibilities. A full accounting of Columbia River salmon and steelhead runs requires documentation of harvest. Knowing how many, and where, fish are harvested also helps us understand fishery values and effects.

The Partnership documented the number of fish harvested and the harvest rate[16] for each stock and fishery. Numbers are estimated for current fisheries and for aspirational (potential) fishing

[16] Harvest rates are defined as the proportion of total adult salmon and steelhead that die as a result of fishing activity in a given year (including retained catch and indirect mortality, including that associated with catch-and-release fisheries).

levels that may be sustainable by healthy salmon and steelhead stocks.

- ***Current harvest*** and harvest rates are estimated by the management entities responsible for the various fisheries. For ocean fisheries, these include the Pacific Salmon Commission for Alaska and Canada fisheries; the Pacific Fishery Management Council for Oregon, Washington, and California ocean fisheries; and the states of Oregon, Washington, and Idaho and the Columbia River treaty and nontreaty tribes for freshwater fisheries. Many fisheries are managed under abundance-based fishery strategies, where harvest rates vary relative to annual abundance. Rates documented in this report are recent 10-year averages (generally 2008–2017 where available).
- ***Potential harvest*** and harvest rates identify the scope for increased harvest as natural stocks become healthier. Healthy stocks can sustain higher harvest rates than those currently in place to protect weak or listed stocks. For Partnership purposes, high-range potential harvest rates are estimated based on existing management frameworks for currently healthy stocks. For currently weak or depleted stocks, potential rates were identified by the NOAA Fisheries Project Team in consultation with regional technical team members, and based on their professional judgement and knowledge of harvest rates they believe could be sustained by healthy stocks, depending on the life-history type (i.e., spring, fall, or late-fall) and species. Corresponding harvest numbers were estimated from the product of aspirational harvest rates and run sizes corresponding to high natural production goals and anticipated hatchery production. More details on this analysis may be found in Appendix C.

Current harvest rates vary considerably from stock to stock depending on stock status and migration patterns, and in relation to the timing and distribution of salmon fisheries that occur along the coasts of Oregon, Washington, Canada, and Alaska and in freshwater. Fall Chinook, coho, and some spring Chinook salmon stocks are subject to significant harvest in both ocean and freshwater fisheries (Figure 10). Summer and fall Chinook salmon in particular are harvested in ocean fisheries from Alaska to the Columbia River mouth. Harvest for steelhead, sockeye salmon, chum salmon, and some spring Chinook salmon occurs almost entirely in freshwater.

As the status of many salmon and steelhead stocks has declined, harvest rates and corresponding harvests have been substantially reduced from historical levels. Weak or listed stocks generally are no longer targeted in fisheries but are harvested incidentally in mixed-stock fisheries focused on healthy stocks and/or hatchery-origin fish. Corresponding harvest rates for weak or depleted stocks are typically 20 percent or less (Figure 10). Historical harvest rates on many of these stocks were typically two- or three-times current levels.

Few healthy stocks currently exist in the Columbia Basin but those that do are typically harvested at rates of 40 to 60 percent (Figure 10). These include summer and bright fall Chinook salmon from the middle and upper Columbia River. Higher rates are typically observed for stocks subject to significant marine and freshwater fisheries. Current salmon fisheries are typically managed for, and constrained by, harvest limits designed to protect weak or listed stocks. Thus, healthy stocks are not typically harvested to their maximum potential.

Weak and listed stocks may have the potential to support substantially higher harvest rates if restored to levels consistent with medium- to high-range natural production goals identified by the Partnership (Table 10). Access in mixed-stock fisheries to strong natural-origin stocks and hatchery stocks is also currently constrained by harvest rate limits in place to protect weak and listed stocks. Thus, increasing the abundance of weak stocks could also provide increased harvest opportunity for strong stocks.

Columbia River salmon and steelhead currently yield a harvest of about 1.35 million fish per year (Table 10). This includes both natural- and hatchery-origin fish. Fall Chinook salmon account for half of the total. Freshwater fisheries account for 60 percent of the total harvest of all species. It is possible that total harvest could triple (based on Project Team assumptions about potential "healthy stock" harvest rates) if the high-range natural production goals were achieved, but appropriate harvest rates will need to be determined in stock-specific management plans.

FIGURE 10. Current average harvest rates of natural-origin fish by stock in ocean and freshwater fisheries, and potential increases that may be sustainable upon restoration to healthy levels consistent with high-range natural production goals.

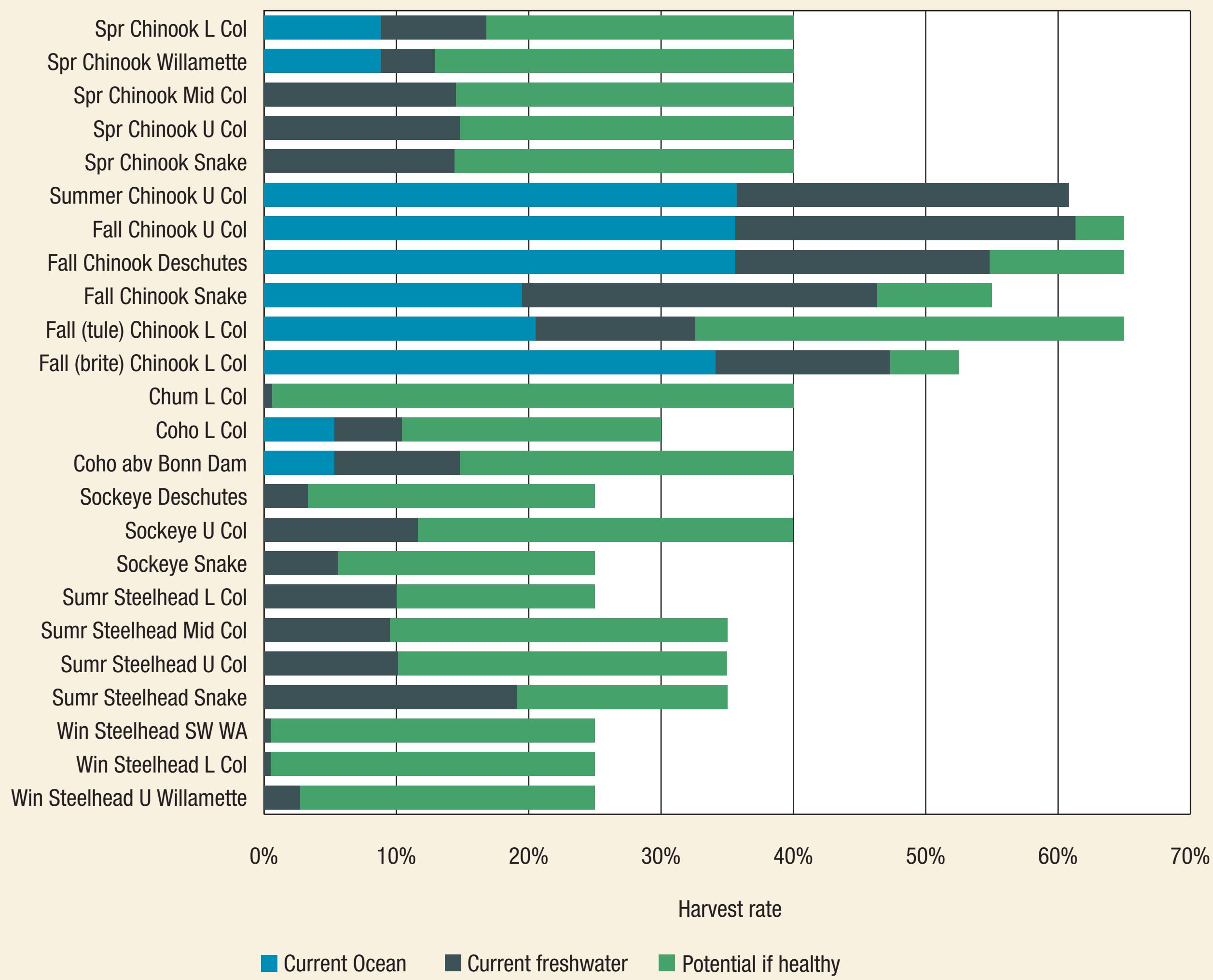


TABLE 10. Current (recent 10-year average) harvest of Columbia Basin salmon and steelhead in freshwater (Col basin) and ocean fisheries and potential harvest at high natural production goals and anticipated hatchery production levels. (See Table 9 for more detail on anticipated hatchery production levels).

	Harvest (current)			Harvest (at high goal)		
Stock	Col basin	Ocean	Total	Col basin	Ocean	Total
Chinook	**429,800**	**426,150**	**855,950**	**1,280,400**	**707,600**	**1,988,000**
Spring	88,800	7,400	96,200	619,800	34,300	654,100
Summer	31,100	41,500	72,600	153,000	207,000	360,000
Fall	309,900	377,250	687,150	507,600	466,300	973,900
Chum	**80**	**0**	**80**	**41,000**	**0**	**41,000**
Coho	**134,800**	**95,100**	**229,900**	**336,900**	**121,700**	**458,600**
Sockeye	**42,082**	**0**	**42,082**	**1,217,600**	**0**	**1,217,600**
Steelhead	**222,300**	**0**	**222,300**	**521,200**	**0**	**521,200**
Winter	19,700	0	19,700	59,000	0	59,000
Summer	202,600	0	202,600	462,200	0	462,200
Totals	**829,062**	**521,250**	**1,350,312**	**3,397,100**	**829,300**	**4,226,400**

Run Sizes

Run sizes, in terms of both total adult returns at the mouth of the Columbia River and numbers of fish returning to different regions of the Columbia Basin, provide useful references for comparison with various goals that have been established across the Basin, both by the Partnership and in other processes. Run sizes are also the basis for many fishery or mitigation-related goals.

Run sizes are reported below by species, run type, stock, and origin (hatchery or natural) (Figure 11, Table 11). Current run sizes are provided as a point of reference. Projected run sizes are also provided based on the combined total number of salmon and steelhead that would be needed to meet the Partnership's natural production goals, potential fisheries needs, and anticipated hatchery production levels.

Quantitative Goals for natural production were translated into equivalent Columbia River mouth numbers by accounting for harvest and other mortality (natural or human-caused) between the mouth and the spawning grounds. Spawning escapement is less than the total number of fish returning to the Columbia River mouth because fish are lost to harvest, other causes of mortality (e.g., dam passage mortality, high water temperatures, marine mammal predation), and straying between the river mouth and the spawning grounds. Therefore, spawning escapement and river-mouth return numbers are related but not directly comparable.

Estimated returns of approximately 2.8 million salmon and steelhead to the Columbia River mouth correspond to the low-range Quantitative Goals for natural production (Figure 11, Table 11), with approximately 2 million of the fish from stocks originating above Bonneville Dam. This includes natural-origin and hatchery-origin fish and reflects projected harvest in freshwater. Estimates corresponding to high-range Quantitative Goals for natural production are approximately 8 million fish. Of these, approximately 6 million are from stocks originating above Bonneville Dam.

Summary

Quantitative Goals identify stock-specific numbers consistent with the Partnership's Vision for the restoration of healthy and harvestable salmon and steelhead runs throughout the

FIGURE 11. Columbia River mouth run sizes for salmon and steelhead at low and high natural production goals in conjunction with anticipated hatchery production and potential harvest relative to current numbers.

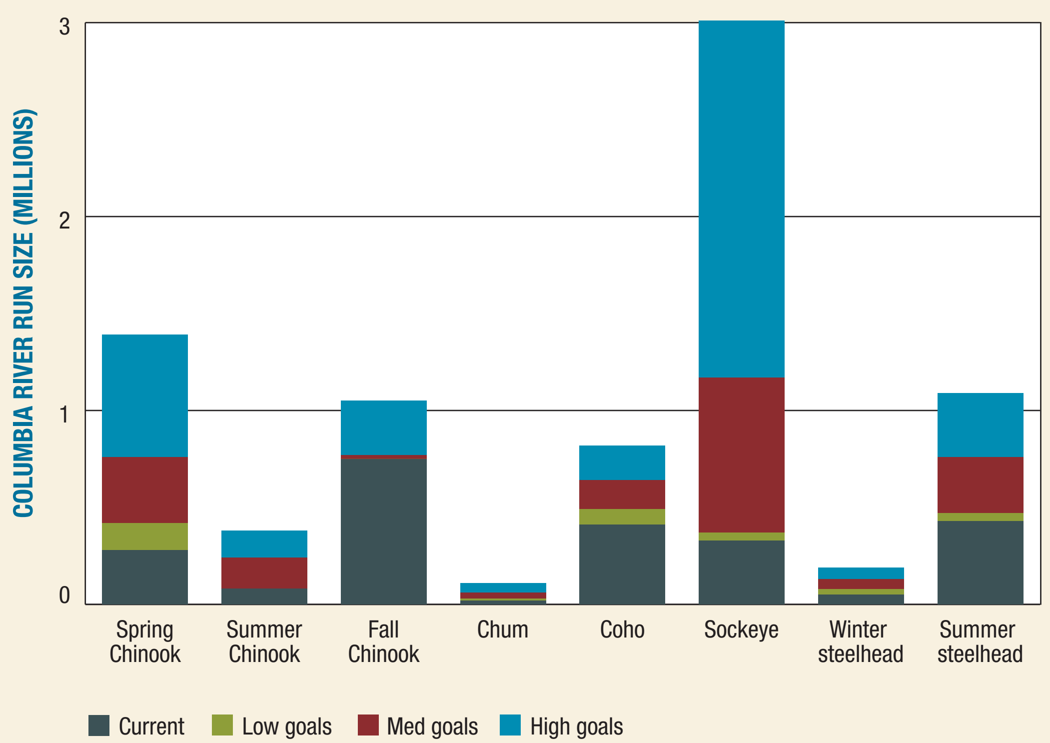


TABLE 11. Columbia River mouth run sizes for salmon and steelhead at low and high natural production goals in conjunction with anticipated hatchery production and potential harvest relative to current numbers.					
	Species	Natural origin	Hatchery origin	Total	% Hatchery
Current Run Size	**Chinook**	**384,740**	**718,400**	**1,103,140**	**65%**
	Spring	58,940	217,100	276,040	79%
	Summer	30,000	45,000	75,000	60%
	Fall	295,800	456,300	752,100	61%
	Chum	**14,700**	**300**	**15,000**	**2%**
	Coho	**34,000**	**375,100**	**409,100**	**92%**
	Sockeye	**297,490**	**34,070**	**331,560**	**10%**
	Steelhead	**107,600**	**375,700**	**483,300**	**78%**
	Winter	17,300	33,000	50,300	66%
	Summer	90,300	342,700	433,000	79%
	Total	**838,530**	**1,503,570**	**2,342,100**	**64%**
Run Size at Low Goals	**Chinook**	**536,700**	**727,700**	**1,264,400**	**58%**
	Spring	198,400	217,300	415,700	52%
	Summer	30,000	43,000	73,000	59%
	Fall	308,300	467,400	775,500	60%
	Chum	**21,000**	**0**	**21,000**	**0%**
	Coho	**116,300**	**375,100**	**491,400**	**76%**
	Sockeye	**320,100**	**53,600**	**373,700**	**14%**
	Steelhead	**187,900**	**371,400**	**559,300**	**66%**
	Winter	57,000	28,000	85,000	33%
	Summer	130,900	343,400	474,300	72%
	Total	**1,182,000**	**1,527,800**	**2,709,800**	**56%**
Run Size at High Goals	**Chinook**	**1,753,300**	**1,046,300**	**2,799,600**	**37%**
	Spring	1,042,500	342,000	1,384,500	25%
	Summer	234,000	140,000	374,000	37%
	Fall	476,800	564,300	1,041,100	54%
	Chum	**102,000**	**0**	**102,000**	**0%**
	Coho	**446,400**	**375,100**	**821,500**	**46%**
	Sockeye	**2,913,900**	**100,000**	**3,013,900**	**3%**
	Steelhead	**886,300**	**394,300**	**1,280,600**	**31%**
	Winter	163,000	28,000	191,000	15%
	Summer	723,300	366,300	1,089,600	34%
	Total	**6,101,900**	**1,915,700**	**8,017,600**	**24%**

Columbia Basin. The annual Columbia River salmon and steelhead run has declined from approximately 9 million adult fish to about 2 million on average. Only one-third of these fish are produced naturally, with the remainder coming from hatcheries. The Partnership recognized the challenge of restoring natural production of salmon and steelhead with low, medium, and high goals that describe a progression in improvements in viability and ecological and societal benefits. Combined high-range goals for all stocks total approximately 2.8 million fish on the spawning grounds, which is eight times the current numbers but less than a third of historical estimates. The Partnership also recognized the role of fisheries and hatcheries in the region by identifying current and potential future harvests and hatchery returns.

Yakama tribal fisheries near Hood River, Oregon. Credit: CRITFC

Biological Analyses

The Partnership employed a series of biological analyses to help understand the factors that limit naturally produced Columbia Basin salmon and steelhead abundance and the potential pathways for increasing abundance to achieve the quantitative natural production goals. A large volume of scientific information is available on factors affecting Columbia Basin salmon and steelhead, although critical information gaps and uncertainties remain. The analyses were intended to provide high-level summaries and synthesis of the available scientific information, and are described in more detail below.

Introduction

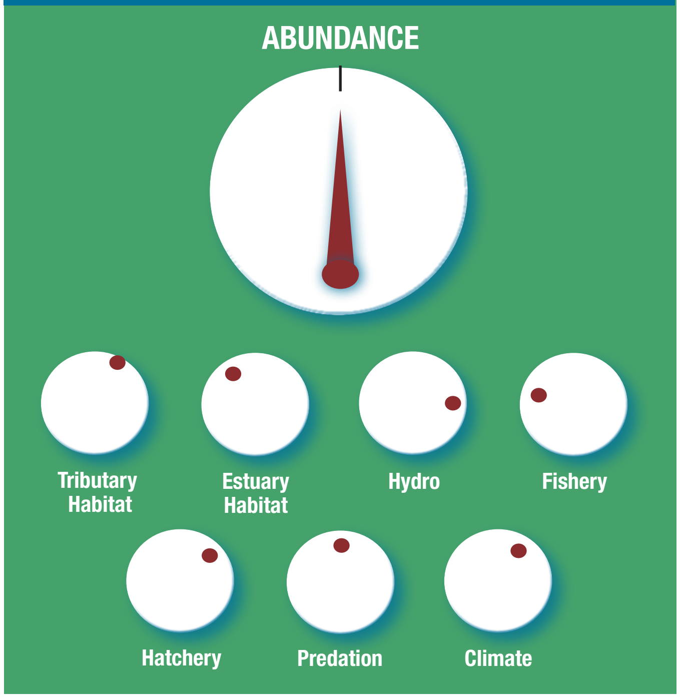
The Partnership used the concept of a "dial-turning" exercise (Figure 12) to inform the following questions:

- What dials can we turn (i.e., what impacts can we reduce) to increase salmon or steelhead abundance?
- How much do we have to turn the dials (i.e., reduce impacts) to achieve a desired improvement?
- How feasible is it to turn any particular dial (i.e., to reduce any particular impact)?
- What combinations of dial turns (i.e., reductions in multiple impacts) get us where we want to go?

Two analytical tools were used to address these questions:

- **Limiting Factors Analysis:** This analysis quantitatively estimated the impacts of human-related or potentially manageable limiting factors affecting each salmon and steelhead stock throughout its life cycle. Impacts were estimated in a common currency of adult abundance to facilitate comparisons of the relative magnitude of the various factors on each stock. The results of this analysis are displayed in a "heat map" (Figure 13) that shows the potential magnitude of each factor, estimated based on existing information.
- **Life-Cycle Analysis:** This analysis examined, at a coarse scale, the individual and combined effects of increasing or decreasing the impacts of the factors limiting adult salmon and steelhead abundance. This analysis was based on a simple life-cycle model adapted for the Partnership as a

FIGURE 12. Conceptual diagram of the "dials" that can be turned to change salmon and steelhead abundance. Turning these dials (or changing the level of impact from these factors) affects salmon and steelhead abundance.



tool for problem-solving, learning, and discovery. Analyses were facilitated by use of a "Salmon Analyzer" that connects the life-cycle model to an interface allowing users to "dial" impacts in various threat categories up or down to examine how overall abundance of stocks changes in response.

These analyses were developed to help inform Partnership considerations regarding Quantitative Goals for Columbia Basin salmon and steelhead and potential scenarios or strategies that might contribute toward achieving these Goals. The analyses were intended to serve primarily as a learning tool, allowing the Partnership to explore at a coarse scale the relative magnitude of key limiting factors; the effects of change in one or more factors on abundance of natural-origin salmon and steelhead; and the implications of alternative hypotheses for limiting factors where information is uncertain. Analyses were informative in providing context and background for developing scenarios and strategies, although the scenarios and strategies were not explicitly analyzed with these or any other analytical tools.

The results of these analyses are not intended to evaluate specific actions, management decisions, or resource allocations. Results must also be qualified by limitations in the scientific base of information, which introduce significant uncertainties in the current understanding of salmon dynamics and many limiting factors. The Partnership recommends that any results from the analyses be further validated with finer-scale analysis depending on the type of questions or management decisions being evaluated.

Limiting Factors Analysis

Estimates of limiting factor impacts were central to the biological analyses considered by the Partnership. They provided the basis for understanding the relative significance of factors limiting each Columbia River salmon and steelhead stock and highlighted the nuances of quantifying the impacts, the uncertainties involved, and the potential for reducing each factor. These impact estimates were also essential inputs in the life-cycle analysis.

Impacts are defined as a percentage reduction in abundance of spawning salmon or steelhead associated with a reduction in productivity (or survival) for each limiting factor. Limiting factor categories include tributary habitat, estuary habitat, mainstem effects (including hydropower), latent effects (related to hydropower), blocked areas, selected predators, fisheries, and hatcheries (Table 12).

TABLE 12. Definitions of limiting factor impacts quantified for Columbia Basin Partnership consideration.

Limiting Factor	Definition
Tributary Habitat	Percentage reduction in productivity of natural-origin fish due to habitat degradation in tributary production areas
Estuary Habitat	Mortality rate of juveniles during migration from Bonneville Dam to the Columbia River mouth
Mainstem[a]	Cumulative percentage mortality of juveniles and adults during migration between dams through the Columbia and Snake River mainstems ("reach mortality") and the reduction in productivity due to spawning habitat inundation
Latent	Percentage mortality due to passage through the Columbia Basin hydropower system but manifested in the estuary and ocean
Blocked Areas	Percentage loss in potential production due to dams that block access or inundate historically accessible habitat
Predation	Percentage mortality due to potentially manageable predators. These include birds (Caspian terns, double-crested cormorants, and gulls), pinnipeds (California and Steller sea lions), and fish (northern pikeminnow) where empirical estimates of mortality are available
Fisheries	Mortality occurring in or as a result of handling in fisheries
Hatchery	Percentage reduction in natural productivity due to the effects of hatchery fish on natural population diversity, productivity, and fitness, as well as effects on fish health and effects resulting from complex ecological interactions[b]

[a] Both mainstem and latent mortality factors defined in this analysis include effects of hydropower configuration. However, this analysis treated latent mortality separately in order to clearly represent the magnitude and uncertainty of this parameter relative to reach mortality which is estimated with relatively high confidence.

[b] The scale and significance of hatchery fish interactions with naturally produced fish remain a source of substantial uncertainty. Net effects include a complex of both negative and positive contributions that depend on the status of the natural populations and characteristics of the hatchery fish.

The State of Oregon greatly appreciates the collaborative and cooperative spirit of the MAFAC Partnership. The challenges facing salmon and steelhead are complex and multi-faceted. We must find solutions that ensure equity and inclusion of historically underserved communities throughout the Basin; address cultural and treaty rights of sovereign Tribes; maintain generation and distribution of low-carbon, cost-effective power; ensure a healthy and robust economy; provide recreation opportunities; and meet irrigation and flood management needs. What we have learned from the MAFAC Partnership effort is that success requires meaningful participation of all key sovereigns and stakeholders in the Basin working together towards agreed-upon goals (i.e., quantitative and qualitative goals for native salmon and steelhead). We can now take the Partnership model and build upon it to develop an implementation plan for the salmon and steelhead goals. — Jim McKenna, *Oregon Governor Brown's Natural Resource Policy Office*

To develop these estimates of impacts, the Project Team reviewed literature that would inform the development of quantified estimates of the impacts. Then technical and subject matter experts from across the Columbia Basin contributed to refining these estimates. The following discussion provides a snapshot of how each impact was defined and quantified. Appendix C discusses the analysis and findings in more detail. Quantifying any one of these impacts is a complex undertaking. In quantifying the impacts, the Project Team did not attempt to resolve key uncertainties. For several limiting factors, the analysis identifies a range of values consistent with alternative assumptions and hypotheses.

A "heat map" of impacts provides a snapshot of the relative magnitude of each category of limiting factor for each stock (Figure 13). This figure uses colors to categorize impacts based on their relative severity, and provides a way to identify, at a glance, which impacts are more or less severe. Some impacts are displayed as ranges reflecting uncertainty, where appropriate. General observations based on the heat map include the following:

- Every stock is subject to significant impacts from multiple factors.
- Large-scale habitat impacts are pervasive for most stocks throughout the Basin.
- All stocks are subject to estuary habitat impacts, which vary depending on fish life history.
- Hydro-related effects, including mainstem impacts, potential latent mortality, and lost access in blocked areas, are large wherever significant dam construction has occurred.[17]
- Predation impacts vary depending on fish life history but are significant for some stocks and often linked to habitat conditions created by hydropower system dams.
- Fishery impacts are stock-specific, with high values generally limited to relatively healthy stocks that are subject to widespread fishing in marine and freshwater.

Impact Estimates — Tributary Habitat

Large and pervasive effects resulting from a long history of development and land use activities have severely impacted the quantity and quality of tributary habitat for salmon and steelhead. Healthy stream habitat, including cool stream flows, clean gravel beds, and deep pools, is critical for sustaining these fish species. Healthy streams are also the product of healthy watershed conditions, including the riparian zone, floodplain, wetlands, and uplands. These essential habitat features have been widely affected by physical impacts such as urbanization, logging, agriculture, road building, gravel mining, channelization, and water withdrawals. In addition, biological impacts such as reductions in marine-derived nutrients also impact tributary habitat productivity. Some biological factors, such as effects of reductions in marine-derived nutrients, may be partially but not completely captured in tributary habitat impact estimates.

[17] It should also be recognized that some hydro-related effects are inextricably intertwined with other factors, such as predation, and cannot be isolated.

FIGURE 13. Heat map of impacts of limiting factors by stock and region, including ranges reflecting uncertainties where appropriate. Units are percentage reductions in equilibrium abundance (generally equivalent to mortality rates).

	Stock	Tributary Habitat	Estuary Habitat	Hydro (mainstem)	Hydro (latent)	Hydro (blocked)	Predation	Fishery	Hatchery
Lower Columbia	Spr Chinook	85	17	0	0 (0-0)	30	14	17	29 (4-54)
	Fall (tule) Chinook	70	21	0	0 (0-0)	15	11	33	25 (3-47)
	Fall (bright) Chinook	10	21	0	0 (0-0)	40	11	47	0 (0-0)
	Chum	95	50	5	0 (0-0)	0	2	1	10 (1-18)
	Coho	80	11	0	0 (0-0)	5	13	17	22 (3-42)
	Sumr Steelhead	65	28	4	0 (0-0)	40	19	5	8 (1-15)
	Win Steelhead SWW	60	28	0	0 (0-0)	0	19	5	17 (2-33)
	Win Steelhead LCR	65	28	0	0 (0-0)	10	19	5	9 (1-16)
Willamette	Spr Chinook	85	20	0	0 (0-0)	50	19	13	25 (3-46)
	Win Steelhead	80	28	0	0 (0-0)	20	32	3	2 (0-4)
Middle Columbia	Spr Chinook	85	17	23	14 (3-25)	25	25	15	24 (3-45)
	Fall Chinook	20	27	13	9 (2-17)	5	10	55	0 (0-0)
	Coho	NA	11	30	19 (5-33)	0	17	22	NA
	Sockeye	0	17	19	9 (2-17)	95	8	3	NA
	Sumr Steelhead	80	28	11	14 (3-25)	20	33	10	17 (2-33)
Upper Columbia	Spr Chinook	45	18	49	38 (9-67)	75	29	15	32 (5-59)
	Summer Chinook	50	27	49	38 (9-67)	50	13	61	27 (4-51)
	Fall Chinook	25	27	65	19 (5-33)	5	13	61	10 (1-18)
	Sockeye	50	17	38	38 (9-67)	80	24	12	10 (1-18)
	Sumr Steelhead	40	31	30	38 (9-67)	95	52	10	24 (3-45)
Snake	Spr Chinook	50	16	39	38 (9-67)	30	29	14	15 (2-28)
	Fall Chinook	25	27	62	38 (9-67)	80	13	45	NA
	Sockeye	10	17	47	38 (9-67)	70	24	6	NA
	Sumr Steelhead	45	27	30	38 (9-67)	40	43	25	24 (3-45)

<5%	5-20%	21-30%	31-50%	>50%

For the purposes of the Partnership analysis, tributary habitat impacts are defined as the percentage reduction in productivity of natural-origin fish due to habitat degradation. This includes local and cumulative effects of habitat loss and degradation in spawning, incubation, rearing, and overwintering habitats. The total impact is the aggregate effect of changes in all habitat features that affect the fish, including streamflow, water quality, channel morphology, substrate, etc. Impacts are also expressed as the aggregate for all populations within a stock. The average for each population was weighted by the size of the historical population to estimate the net habitat impact for the entire stock. Impacts include only populations returning to areas within the currently accessible range.

Estimates are derived from a variety of sources. These include habitat modeling applied in ESA recovery plans or Northwest Power and Conservation Council subbasin plans to relate salmon and steelhead production to specific habitat conditions. These relationships can then be used to infer historical fish abundance from high-quality habitat conditions assumed to be present before development and land use. Models included Ecosystem Diagnosis and Treatment (EDT) and the Conservation Assessment Tool for Anadromous Salmonids (CATAS). For some populations where model estimates were not available, values were inferred from similar populations by regional work groups with knowledge of the habitat conditions in the basin of interest. Estimates are presented as point estimates intended to represent a coarse-scale, order-of-magnitude impact but are subject to significant uncertainty.

Habitat impacts are substantial for most stocks, often exceeding 80 percent in highly developed portions of the Basin (Figure 14). Habitat impacts exceed 50 percent in 14 of the 27 stocks. Habitat impacts exceed 20 percent in 23 stocks.

FIGURE 14. Stock-specific estimate of tributary habitat impact rates.

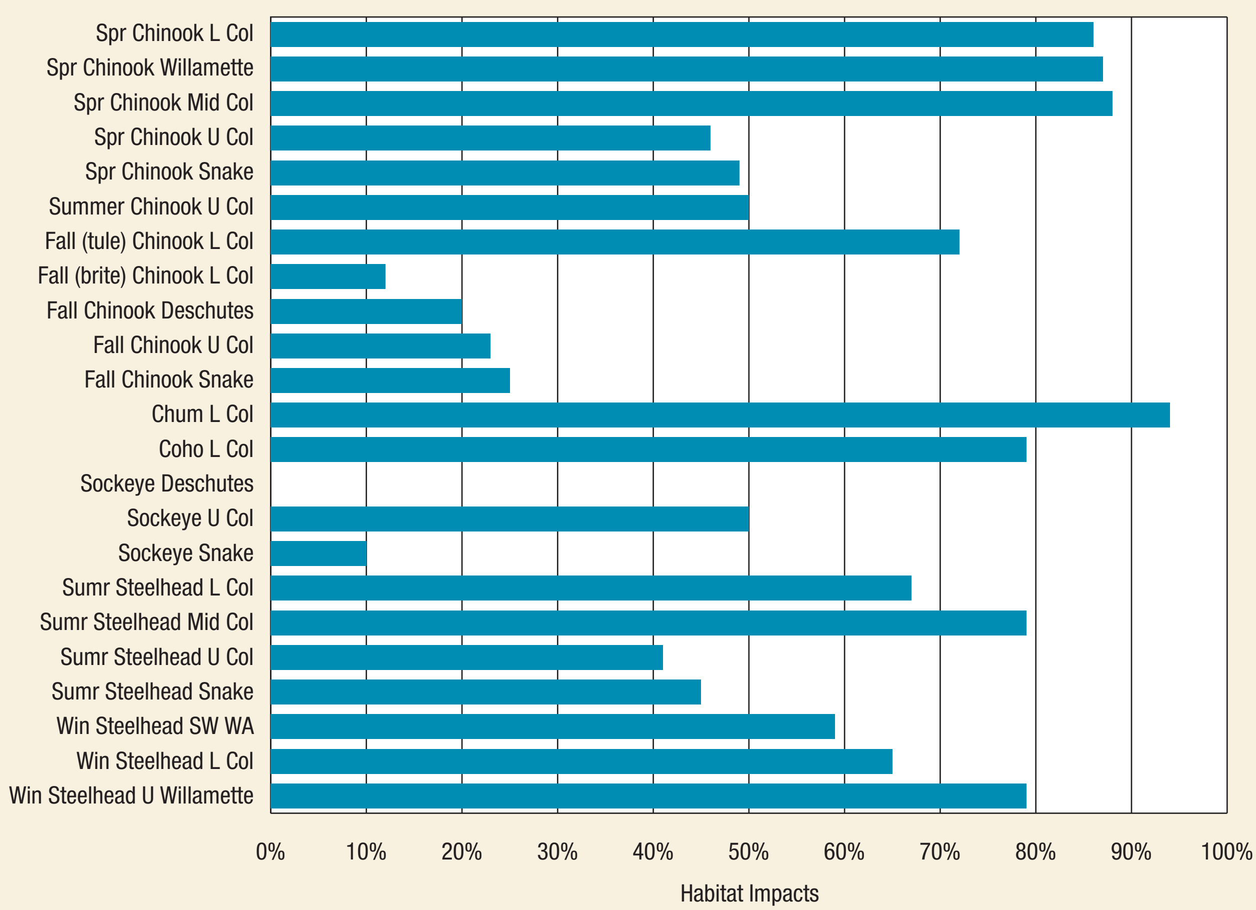
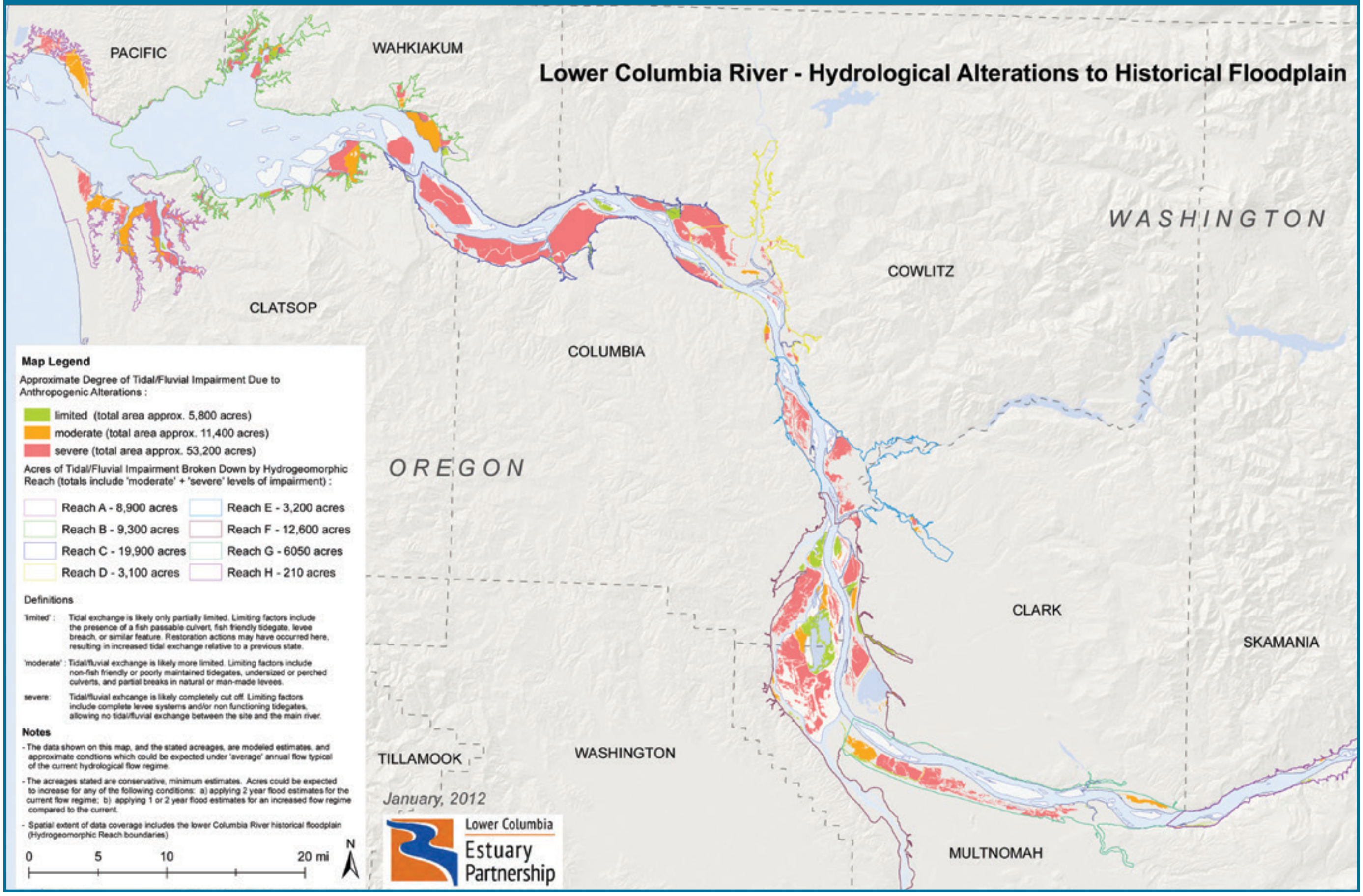


FIGURE 15. Hydrological alterations to historical floodplain in the lower Columbia River.



Impact Estimates — Estuary Habitat

The estuary provides critical migratory and rearing habitat for Columbia Basin salmon and steelhead populations.[18] Development and land use have significantly altered estuarine habitat and conditions over the last 100 years.[19,20,21] These changes have substantially reduced the quantity and quality of estuarine habitat for Columbia Basin salmon and steelhead, all of which rear in and/or migrate through these areas. Most of the marshes, wetlands, and floodplain channels that historically provided food and refuge have been diked off from the river and converted to agricultural, industrial, and urban uses (Figure 15). Dredging, filling, and channelizing have been extensive. Changes in Columbia River flow, temperature, and sediment transport as a result of reservoir storage and release operations have also substantially altered environmental conditions and habitat-forming processes. Mean river flow through the estuary has declined by about 16 percent and peak spring flows have declined by about 44 percent in the last 100 years.[22]

For the Partnership analysis, estuary impacts are defined in terms of the mortality rate of juvenile salmonids in migration through the tidally influenced 146 miles of the Columbia River from Bonneville Dam to the river's mouth. Mortality documented to result from predation through this same reach is not included in the estuary impacts.

Quantifying the impact of habitat changes in the estuary on juvenile salmon mortality is extremely difficult. Other assessments have measured changes in habitat conditions that are known to affect salmonid life history. However, translating these habitat changes into fish numbers is difficult because the relationships are complex and have not been extensively investigated. Therefore, the

[18] Natural Marine Fisheries Service. 2019. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response — Continued Operation and Maintenance of the Columbia River System. NMFS Consultation Number: WCRO-2018-00152.

[19] Natural Marine Fisheries Service. 2011. Columbia River estuary ESA recovery plan module for salmon and steelhead. Northwest Region, Portland, Oregon. https://www.fisheries.noaa.gov/resource/document/columbia-river-estuary-esa-recovery-plan-module-salmon-and-steelhead.

[20] Lower Columbia Estuary Partnership. 2017. Defining voluntary restoration targets for species survival: How much habitat is enough in the Lower Columbia River?

[21] Marcoe, K. and S. Pilson. 2017. Habitat change in the lower Columbia River Estuary. Journal of Coastal Conservation Planning and Management DOI 10.1007/s11852-017-0523-7

[22] NOAA Fisheries. 2017. ESA Recovery Plan for Snake River Fall Chinook Salmon (Oncorhynchus tshawytscha). West Coast Region, Portland Oregon.

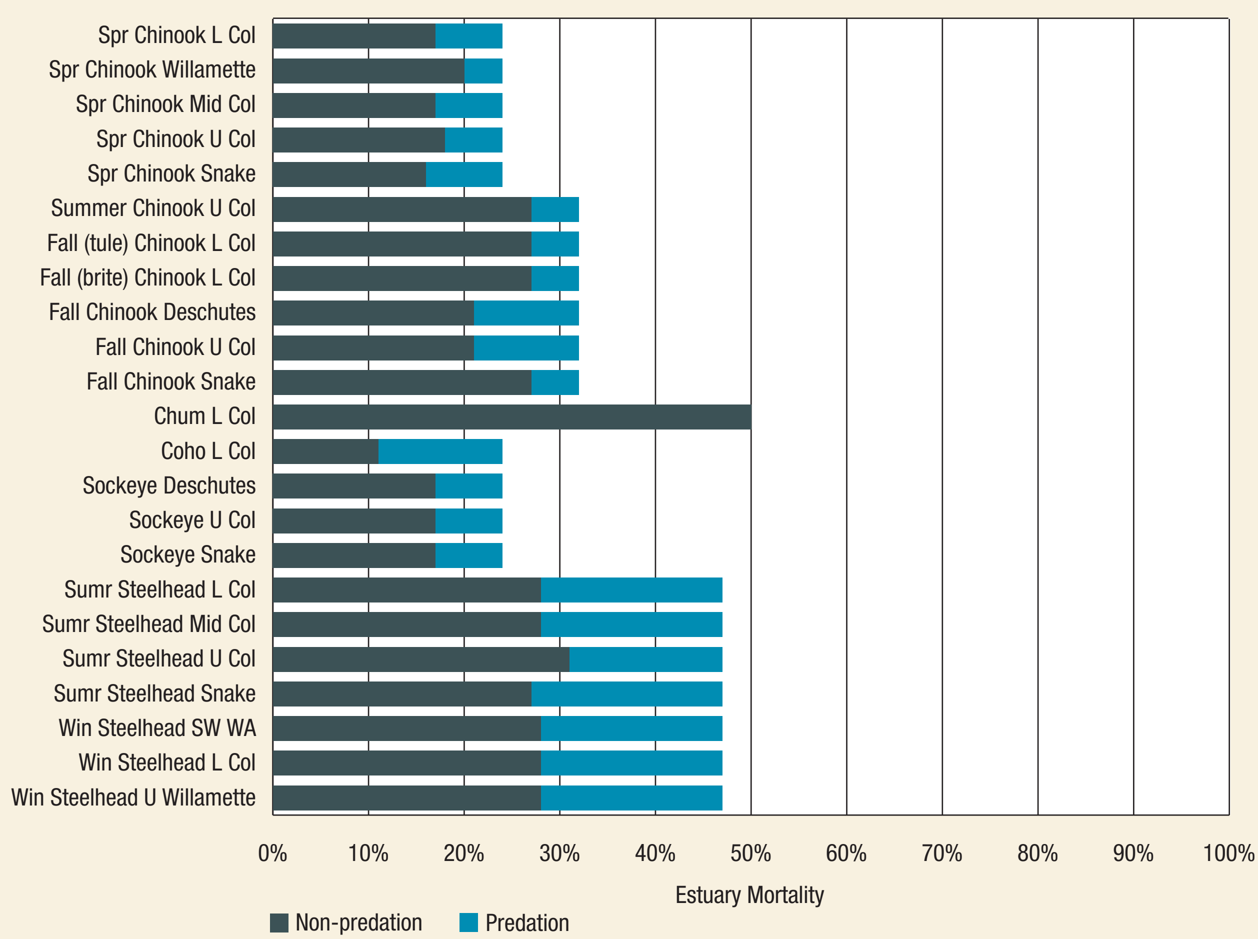
analysis is based simply on empirical estimates of estuary mortality reported by McMichael et al. (2010).[23] These values are based on average annual survival rates between the Bonneville Dam forebay and the Columbia River mouth and are a function of both natural and human-related factors. Estimates do not include assumptions for mortality that occurs in the Columbia River plume due to the lack of related empirical information. Documented predation mortality of juveniles is subtracted from the total estuary mortality because predation is treated as a separate impact for the purposes of this analysis. Estimates are presented as point estimates intended to represent a coarse-scale, order-of-magnitude impact and are subject to significant uncertainty.

Estuary mortality of juvenile salmon and steelhead ranges from 24 to 50 percent (Figure 16). Predation documented for terns, cormorants, and pikeminnow accounts for 0 to 19 percent of the totals. Non-predation-related mortality ranges from 11 to 50 percent. The rates vary with species and life history. The highest rates are assumed to occur for chum salmon, which emigrate into the estuary as fry soon after emergence and may rear there for some period. The lowest rates were estimated for spring Chinook, coho, and sockeye salmon, which typically transit the estuary relatively quickly on their way to the ocean.

Impact Estimates — Blocked Areas

Construction and operation of dozens of hydropower, flood control, and irrigation storage dams and reservoirs have severely impacted anadromous salmon and steelhead runs across the Columbia Basin. The effect of dams without fish passage is clear: fish can no longer access the upstream habitat. Large mainstem dams in the

FIGURE 16. Stock-specific estimates of estuary habitat impact rates.



[23] McMichael, G. A., R. A. Harnish, B. J. Bellgraph, J. A. Carter, K. D. Ham, P. S. Titzler, and M. S. Hughes. 2010. Survival and Migratory Behavior of Juvenile Salmonids in the Lower Columbia River Estuary in 2009. PNNL-19545, Pacific Northwest National Laboratory, Richland, Washington. https://waterpower.pnnl.gov/jsats/pdf/PNNL-19545.pdf

upper Columbia and Snake Rivers and dams in numerous tributaries completely block access to portions of the historical range (Figure 17). Dam-related impacts also include "mainstem effects," which are addressed in a separate section.

For this analysis, blocked area impacts are defined as the percentage loss in potential production due to dams that block access or inundate historically accessible habitat. Affected areas include the upper Columbia Basin (above Chief Joseph and

FIGURE 17. Map of current and historical distribution of salmon and steelhead in the Columbia Basin, including currently blocked areas.

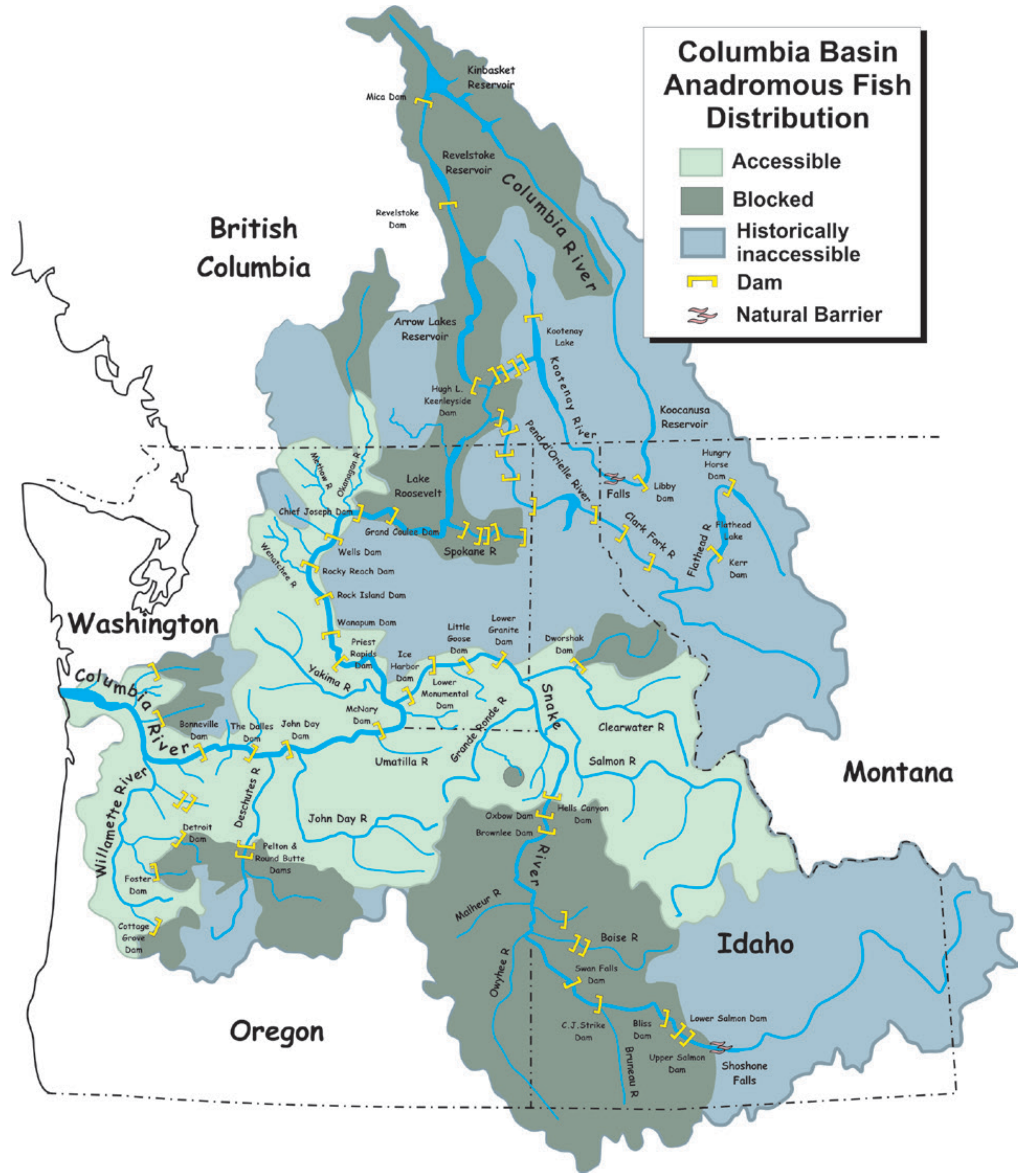
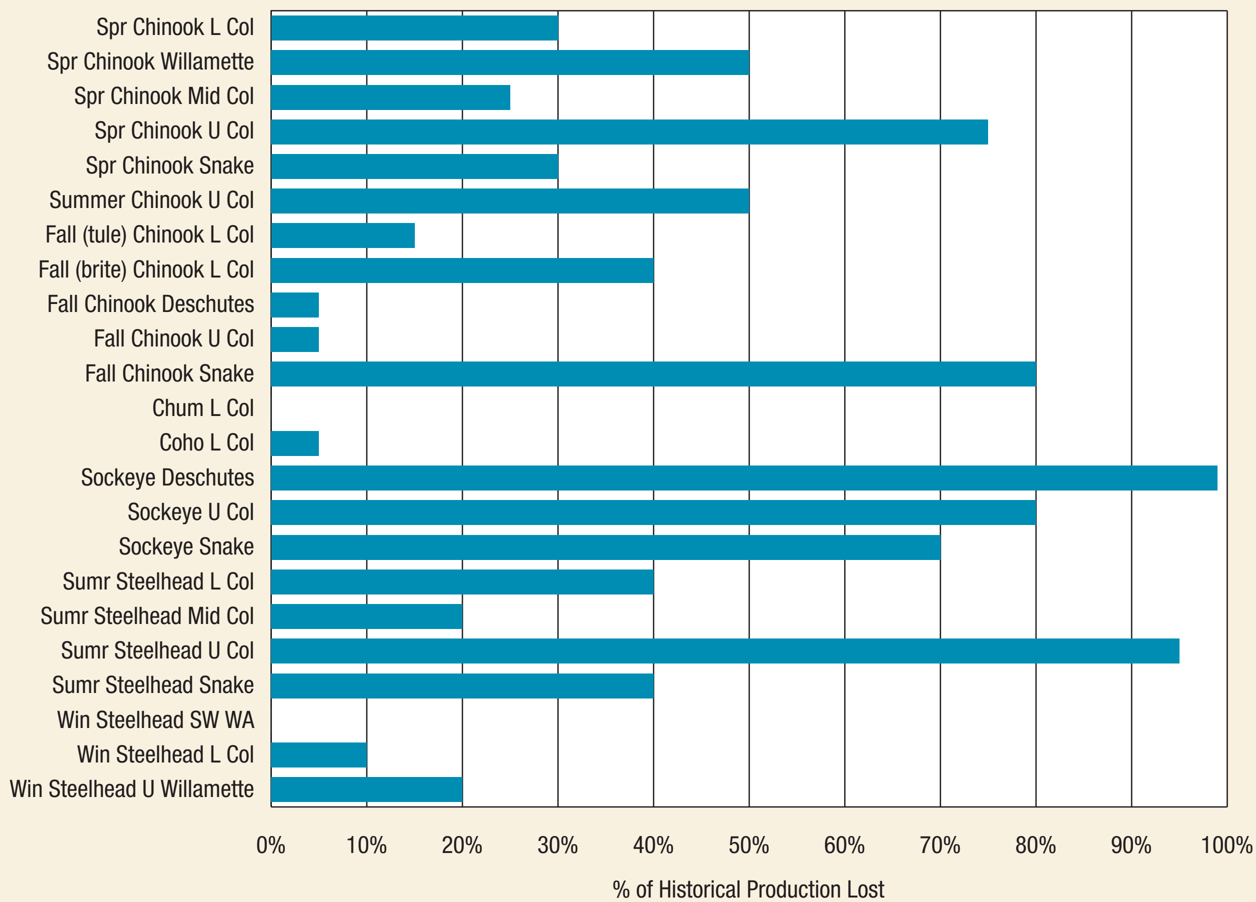


FIGURE 18. Percentages of historical salmon and steelhead production area currently blocked by dams.



Grand Coulee Dams), the upper Snake River basin (above Hells Canyon Dam), tributaries to the Willamette River (dams on the Santiam, Middle Fork Willamette, and McKenzie Rivers, tributaries to the Columbia River (dams on the Cowlitz, Lewis, Deschutes, Yakima, and Okanogan Rivers), and tributaries to the Snake River (the Wallowa and North Fork Clearwater Rivers) (Figure 18). Smaller-scale blockages due to culverts and diversion dams are incorporated under freshwater habitat impacts.

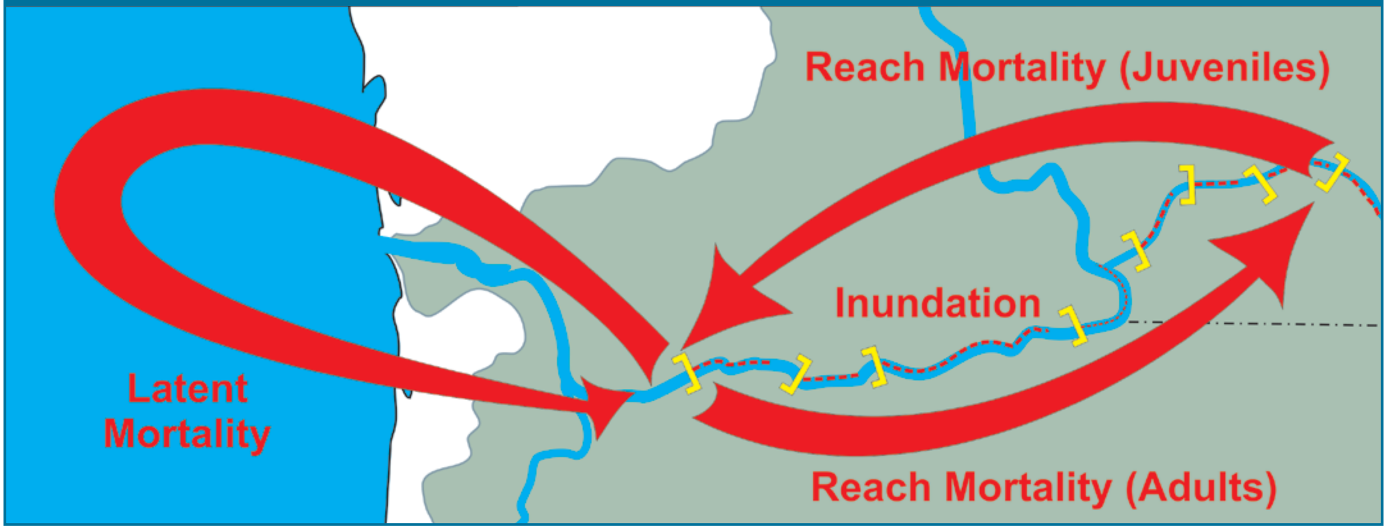
Historical abundance estimates were based on the best available information as detailed for each stock in Appendix C. "Historical" is defined as pre-European settlement, and corresponding numbers were estimated by a variety of methods including historical records, inferences from habitat models such as EDT, and relative numbers of fish population or stream miles in blocked and accessible areas.

Areas blocked by dams in Columbia mainstem and tributary rivers accounted for approximately 50 percent of the historical salmon and steelhead production in the Columbia Basin based on analyses for the Partnership. Virtually all stocks were affected to some degree, with the largest impacts in the upper Columbia and Snake Rivers, where large areas containing many tributaries and fish populations are not currently accessible.

Impact Estimates — Mainstem/Latent/ Hydropower Factors

Because of the scale and complexity of dam and hydropower effects, the Partnership analysis distinguished the impacts into several categories. Complete blockages of portions of the historical anadromous range are addressed in the previous section. Mainstem dams in accessible areas also impede passage of adults and juveniles and result in significant mortality related to passage.

FIGURE 19. Categories of mainstem Columbia and Snake River impacts considered by the Partnership: juvenile reach mortality, adult reach mortality, inundation, and latent mortality. These may include both hydropower and non-hydropower effects.



Reservoirs created by dams have flooded historical spawning areas, fundamentally altered native riverine ecosystems, and enhanced conditions for native and introduced fish predators. Operations for power generation, irrigation, and flood control have drastically altered water discharge and temperature patterns from those to which salmon and steelhead were historically adapted.

For the purposes of this analysis, mainstem impacts are defined to include passage and inundation effects of dams and reservoirs in areas of the Columbia and Snake Rivers that remain accessible to anadromous salmonids. The Partnership considered four categories of impacts related to conditions in the Columbia and Snake River mainstems (Figure 19): juvenile reach mortality, adult reach mortality, inundation, and latent mortality. These impact estimates were generally intended to capture significant mainstem hydropower dam effects but can include both hydro-related and non-hydro-related factors since hydro-related effects cannot be distinguished from other effects in reach mortality data.

Juvenile Reach Mortality

Juvenile reach mortality is the loss of fish during downstream migration between the uppermost and lowermost mainstem Columbia and Snake River dams they encounter. Mortality occurs at dams and in reservoirs and includes direct and indirect effects of the dams as well as natural losses. Injury during turbine passage is an example of a direct effect. Gas bubble disease resulting from dissolved gas supersaturation produced by high levels of spill would be an example of an indirect effect. Predation by fish and birds can be a significant source of juvenile reach mortality. Juvenile reach mortality is reported separately for: (1) juvenile predation mortality that has been documented; and (2) other sources of juvenile reach mortality, which include hydro-related and unrelated sources (e.g., predation that has not been separately documented) (Figure 20).

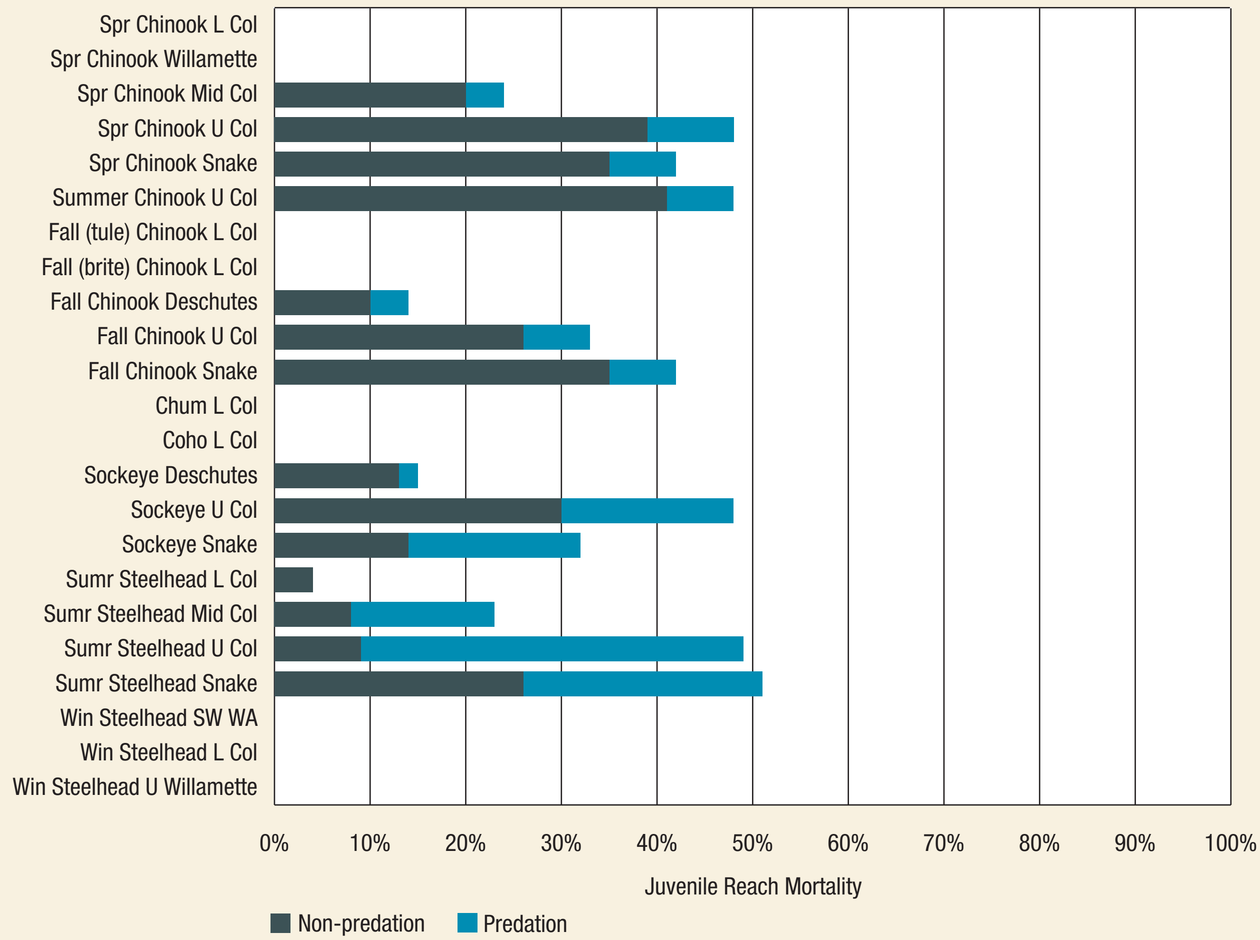
Survival of juveniles during outmigration is generally estimated based on statistical mark-recapture methods and juveniles tagged with passive integrated transponder (PIT) tags.[24,25] Naturally and hatchery-produced juveniles are PIT tagged upstream from and in juvenile collection facilities at dams. Reach survivals used in the Partnership analysis are the 2013–2018 averages reported by NMFS.[26] This time period generally represents recent conditions, including increased spill and reduced transportation of juveniles from Snake River dams to below Bonneville Dam. Because transported fish are not subject to reach mortality, estimates are weighted by the percentage of migrants that are collected and transported from Snake River dams to below

[24] Widener, D. L., J. R. Faulkner, S. G. Smith, T. M. Marsh, and R. W. Zabel. 2018. Survival estimates for the passage of spring-migrating juveniles salmonds through Snake and Columbia River dams and reservoirs. National Marine Fisheries Service.

[25] Grant County Public Utility District No. 2. 2019. Calendar Year 2018 Activities under Priest Rapids Hydroelectric Project License (FERC No. 2114).

[26] Natural Marine Fisheries Service. 2019. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response — Continued Operation and Maintenance of the Columbia River System. NMFS Consultation Number: WCRO-2018-00152. https://www.fisheries.noaa.gov/resource/document/continued-operation-and-maintenance-columbia-river-system

FIGURE 20. Stock-specific estimates of juvenile reach mortality upstream from Bonneville Dam (in-river migrants).



Bonneville Dam. Impacts for stocks without empirical estimates were inferred from similar stocks with adjustments for numbers of dams passed based on per dam averages.

Juvenile reach mortality can be as high as 50 percent for stocks migrating long distances (i.e., from the upper Columbia and Snake River Basins) (Figure 20). Lower rates are observed for stocks migrating shorter distances. Predation losses during migration can be significant, particularly for steelhead, which migrate closer to the surface, where they are more vulnerable to bird predators. Dam passage mortality likely accounts for a substantial portion of, but not all, "other" juvenile reach mortality. Conversely, the predation portion of juvenile reach mortality may also include indirect effects of dam passage and reservoir migration, which increase vulnerability to predators.

Adult Reach Mortality

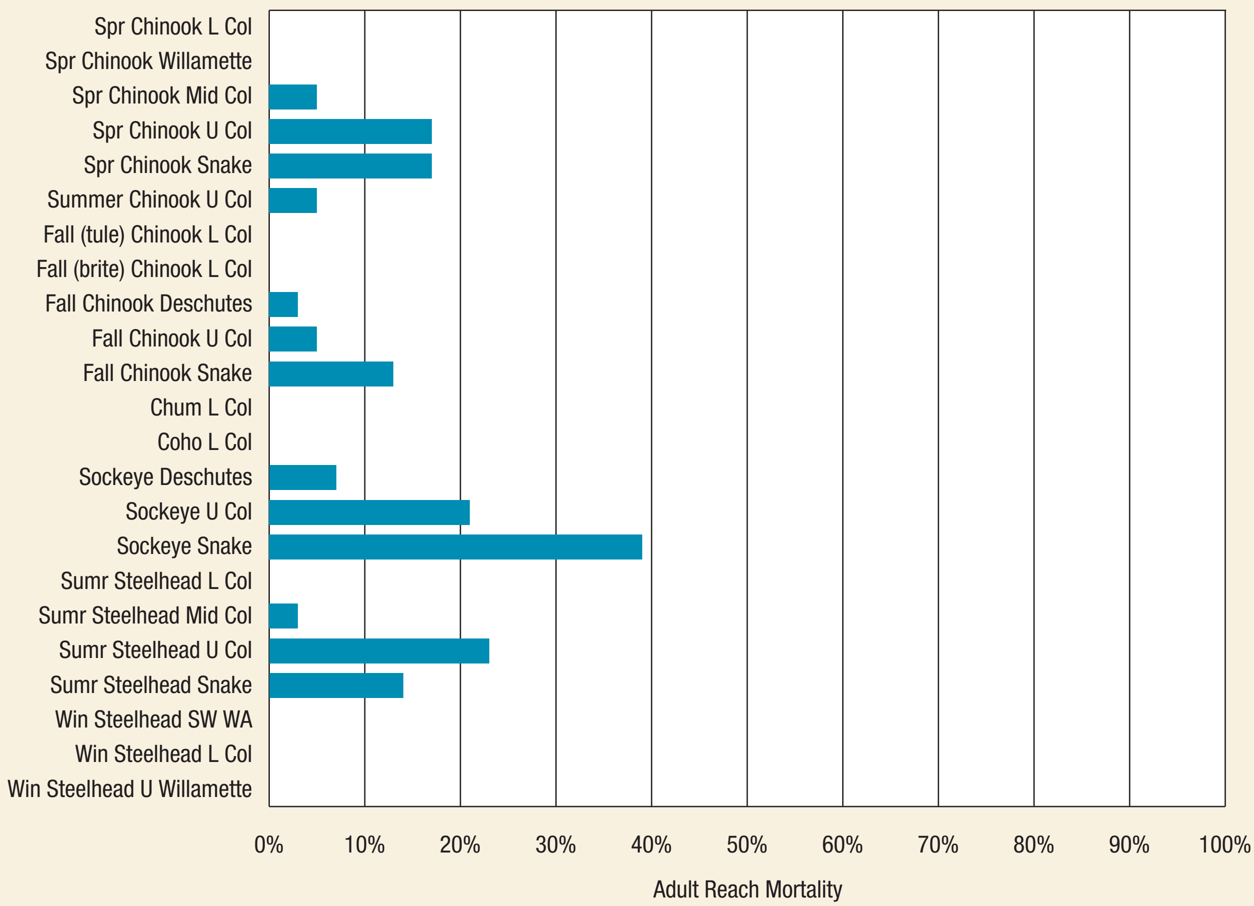
Adult reach mortality is the loss of fish during upstream migration between the lowermost and uppermost mainstem Columbia and Snake River dams they encounter. This includes federal and non-federal dams. Mortality occurs at dams and in reservoirs and includes direct and indirect effects of the dams as well as natural losses. Fishery mortality between dams is subtracted from total estimates of adult reach mortality and reported separately.

The survival of adults during upstream migration is generally estimated based on statistical mark-recapture methods and PIT tags.[27] Reach survivals used in the Partnership analysis are the 2008–2017 averages.[28] Estimates are weighted by the percentage of migrants that are collected and transported from Snake River dams and released downstream from Bonneville Dam, because transportation affects subsequent straying rates.

[27] Widener, D. L., J. R. Faulkner, S. G. Smith, T. M. Marsh, and R. W. Zabel. 2018. Survival estimates for the passage of spring-migrating juveniles salmonds through Snake and Columbia River dams and reservoirs. National Marine Fisheries Service.

[28] B. Bellerud, NOAA Fisheries, personal communication.

FIGURE 21. Stock-specific estimates of adult reach mortality upstream from Bonneville Dam, for the years 2008–2017 (adjusted for fishery harvests).



Reach mortality of adults is relatively low because effective fish ladders and associated passage systems have been developed at mainstem dams over the years. Mortality rates of adults destined for the Snake and upper Columbia Rivers are generally around 10 to 20 percent (Figure 21). Rates are lower for fish passing fewer dams. Mortality rates are high for Snake River sockeye salmon, which have been severely impacted by warm water temperatures in the migration corridor during some recent years.

Inundated Habitat

Inundated habitat refers to the loss of historical production areas due to inundation by Columbia and Snake River mainstem reservoirs within the current area of anadromy. This is not considered a mortality, but rather a reduction in the numbers of fish that could be produced in the absence of the reservoirs. Inundation of spawning grounds in the Columbia and Snake River mainstems primarily affects fall Chinook salmon, which historically spawned throughout the system but particularly in the Columbia River mainstem upstream from the current site of John Day Dam and in the Snake River upstream from the current site of Ice Harbor Dam. To a lesser extent, Bonneville Dam inundates habitat for Columbia River chum salmon. Spawning in many mainstem reaches above Bonneville Dam is now limited to dam tailraces.

For this analysis, estimates of habitat inundation are based on the proportion of historical spawning and/or rearing habitats that have been flooded by impoundment in the mainstem Columbia and Snake Rivers. Information is limited on potential production from inundated areas of the currently accessible range of stocks that spawn in the mainstem. The analysis assumed inundation impacts of 50 percent, 25 percent, and 5 percent for Upper Columbia River fall Chinook salmon, Snake River fall Chinook salmon, and Lower Columbia River chum salmon, respectively.

Net Mainstem Impact

Net mainstem impact is calculated as the product of factor-specific rates assuming that each act on progressive stages of the life cycle:

$$Impact_{net} = 1 - [(1 - Impact_{inundation})(1 - Impact_{juveniles})(1 - Impact_{adults})]$$

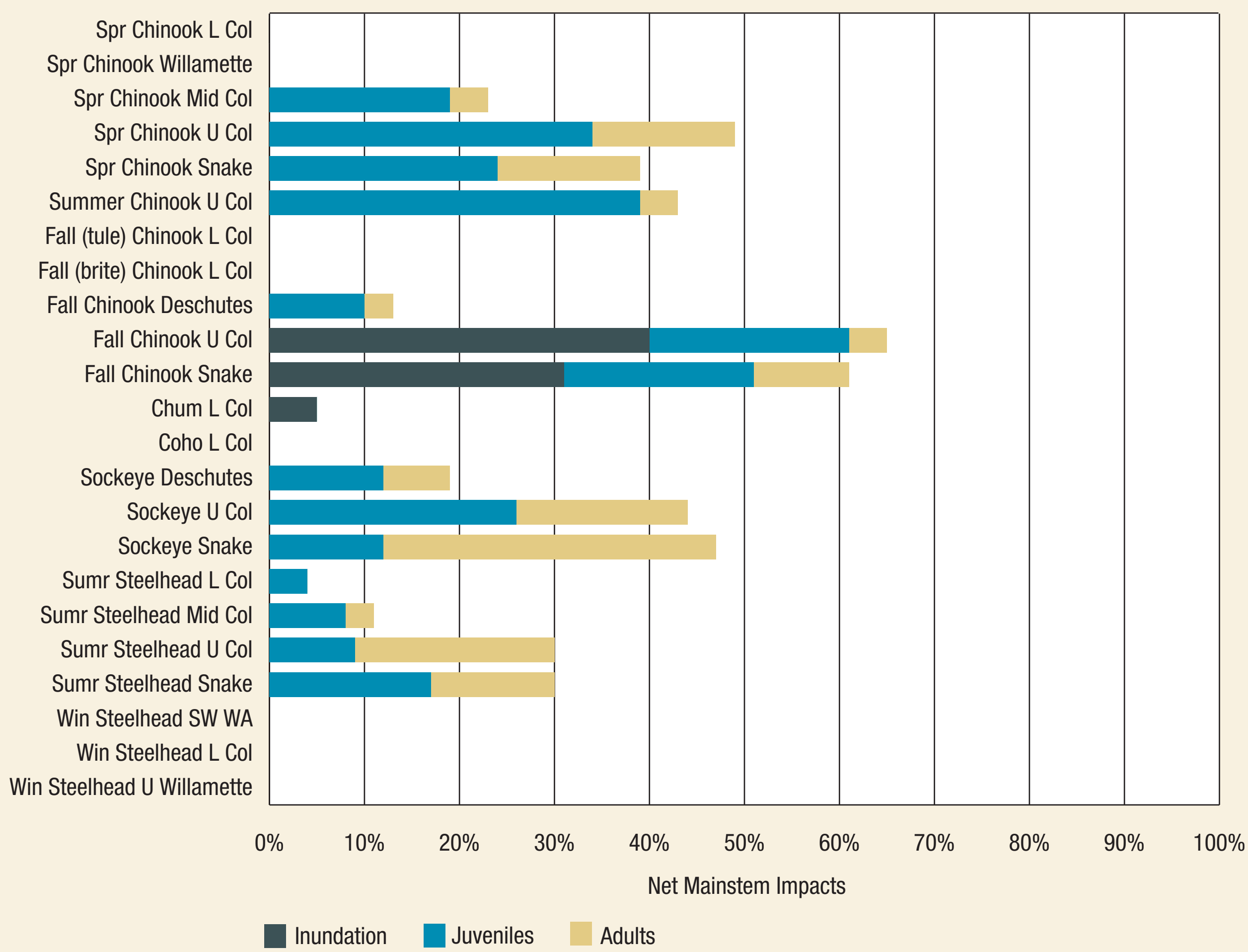
Combined mainstem impacts are substantial for many upper Columbia and Snake River stocks that migrate past multiple dams. Fall Chinook salmon stocks are most severely impacted due to a combination of inundation of spawning habitats, juvenile reach mortality, and adult reach mortality (Figure 22).

Latent Hydropower Mortality

Latent mortality occurs downstream from Bonneville Dam, either in the estuary or the ocean, as a result of delayed effects of passage through the hydropower system. Latent mortality might be caused by stress related to dam and reservoir passage, by change in ocean entry timing, or by size-selective predation mortality related to transportation.[29,30]

The magnitude of latent mortality is highly uncertain. In a comprehensive review of the issue, the Independent Scientific Advisory Board (ISAB) concluded that the hydropower system causes some fish to experience latent mortality; however, it identified no practical way to measure this quantity

FIGURE 22. Net impacts of mainstem inundation, juvenile reach mortality (accounting for documented bird predation), and adult reach mortality (accounting for estimated fishery harvests). In this figure, factor-specific impacts are scaled relative to their contribution to the combined net impact.



[29] Comparative Survival Study Oversight Committee (CSS) 2019. Comparative Survival Study of PIT-tagged Spring/Summer/Fall Chinook, Summer Steelhead, and Sockeye. 2019 Annual Report, BPA Project #19960200 Contract #78040 (12-1-2018 to 11-30-2019). Prepared by Comparative Survival Study Oversight Committee and Fish Passage Center.

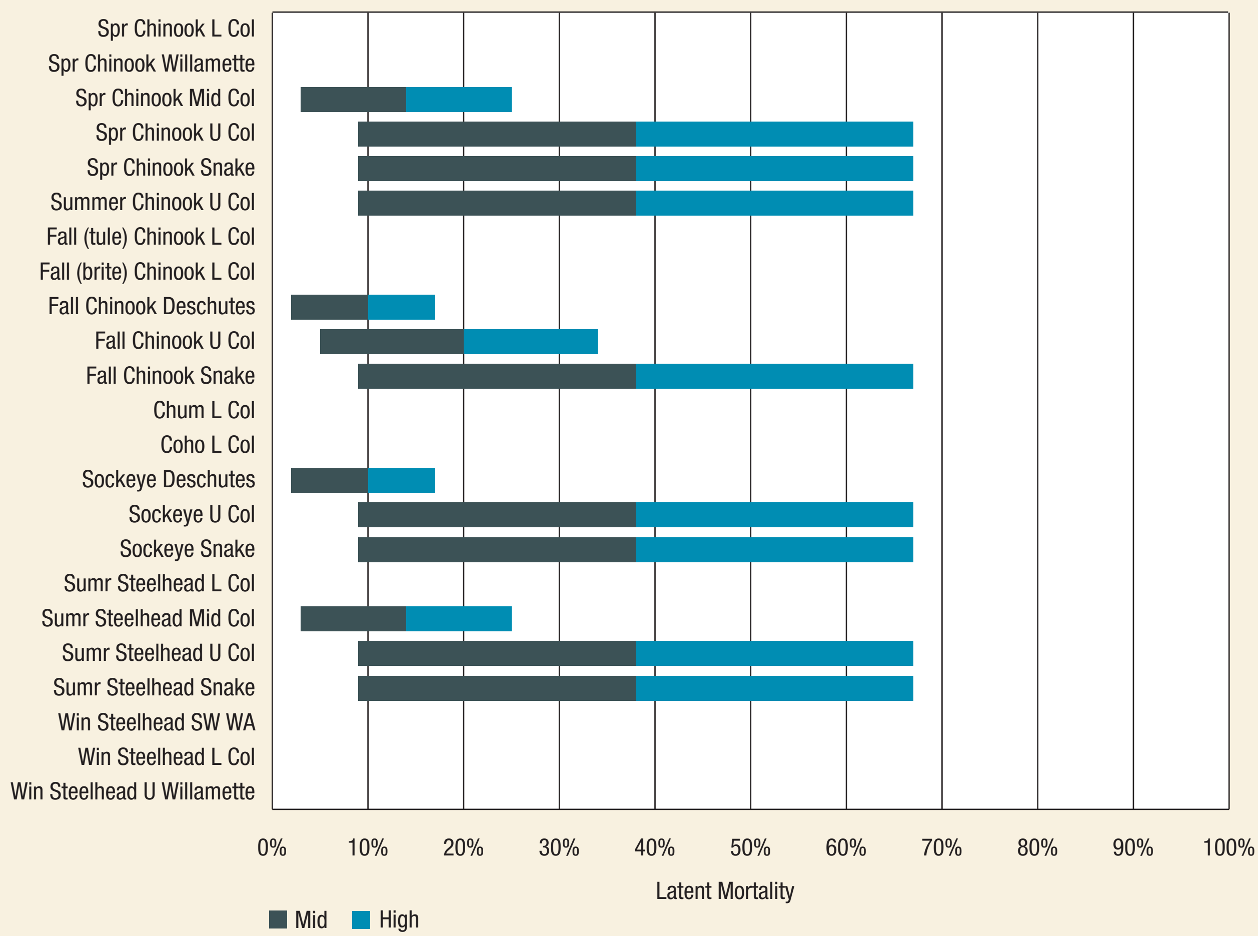
[30] Independent Scientific Advisory Board. 2019. Review of the comparative survival study (CSS) draft 2019 annual report. Northwest Power and Conservation Council, Portland Oregon. ISAB-2019-2. https://www.nwcouncil.org/sites/default/files/ISAB%202019-2%20ReviewCSSdraft2019AnnualReport17Oct.pdf

relative to mortality in an undammed river.[31] The ISAB has also noted that competing hypotheses about latent mortality have different implications for hydropower system operations and that alternative explanations should be considered and further research conducted to resolve related issues.[32]

The Salmon Analyzer does not attempt to resolve uncertainties regarding the magnitude of latent mortality but rather identifies a range of potential values generally consistent with existing information in order to explore the implications of different estimates. Because direct estimates of latent mortality are not available, the incremental improvements associated with existing analyses of spill operation scenarios for Snake River spring Chinook salmon were used as a proxy. Appendix C provides detailed descriptions of related information (summarized in Figure 23).

- At the low end, a 9 percent latent mortality value was identified consistent with the low-end value identified by a 2019 Northwest Fisheries Science Center analysis.[33,34]
- At the high end, a 67 percent latent mortality value was identified, consistent with the threefold potential for improvement. This value is consistent with high-end projections by the Comparative Survival Study (CSS) for a four-dam breach and 125 percent total dissolved gas spill operation. This value is also similar to Schaller and Petrosky's (2007)[35] estimate of a 69 percent latent mortality for 1975–1998 brood years of

FIGURE 23. Range of potential latent mortality rates identified for use in Columbia Basin Partnership analysis.



[31] Independent Scientific Advisory Board. 2007. Review of Hypotheses and Causative Factors Contributing to Latent Mortality and their Likely Relevance to the "Below Bonneville" Component of the COMPASS Model. Northwest Power and Conservation Council, Portland Oregon. ISAB-2007-1.

[32] Independent Scientific Advisory Board. 2012. Follow-up to ISAB reviews of three FPC memos and CSS annual reports regarding latent mortality of in-river migrants due to route of dam passage. Northwest Power and Conservation Council, Portland Oregon. ISAB-2012-1.

[33] Natural Marine Fisheries Service. 2019. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response - Continued Operation and Maintenance of the Columbia River System. NMFS Consultation Number: WCRO-2018-00152. https://www.fisheries.noaa.gov/resource/document/continued-operation-and-maintenance-columbia-river-system

[34] U.S. Army Corps of Engineers. 2020. Columbia River system operations draft environmental impact statement. Portland District, Portland, Oregon. https://www.nwd.usace.army.mil/CRSO/

Snake River stream-type spring Chinook salmon.

- Mid-range values (38 percent) simply split the difference between high and low numbers.
- For stocks originating in the mid and upper Columbia River basins, Snake River values were scaled proportional to the average number of dams affecting each stock.

Impact Estimates — Predation

Predation is a natural source of mortality on both juvenile and adult salmonids but has also been exacerbated by human activities such as the creation of dredge-material islands used by terns and cormorants for nesting colonies and the narrowing of adult fish passage routes to ladders at mainstem dams, which become focused foraging areas for sea lions. In the case of birds and pinnipeds, increasing rates of predation have at least partially offset the benefits of other system survival improvements.

For the Partnership analysis, predation impact is defined as the percentage of mortality due to "potentially manageable" predators. These predators include birds (Caspian terns, double-crested cormorants, and gulls), pinnipeds (California and Steller sea lions), and fish (northern pikeminnow, smallmouth bass, and walleye). Quantitative estimates of impacts are conservative because research and monitoring have tended to examine subsets of juvenile and adult salmonids, and a subset of predators, resulting in uneven coverage and a dearth of information on certain combinations of species and life histories.[36]

Piscivorous colonial water birds, especially Caspian terns, double-crested cormorants, and California and ring-billed gulls, are having a significant impact on the survival of juvenile salmonids in the Columbia River.[37,38] Predation occurs in both the Columbia River estuary and the mainstem throughout the interior Basin. Bird colonies have grown considerably since 1984, along with corresponding increases in bird predation. Various estimates of predation rates have been reported, primarily based on recoveries of PIT tags at nesting colonies.

The abundance of seals and sea lions has also increased considerably along the northwest United States coast and in the Columbia River since the Marine Mammal Protection Act (MMPA) was enacted in 1972.[39] California sea lions, Steller sea lions, and harbor seals consume adult and juvenile salmonids from the mouth of the Columbia River to Bonneville Dam and in some tributaries (e.g., Willamette River, Cowlitz River). Significant numbers of adult salmon and steelhead are being consumed by seals and sea lions, particularly near Bonneville Dam, on the Columbia River, and Willamette Falls, on the Willamette River, where fish are concentrated before upstream passage. Predation is particularly high on upriver spring Chinook salmon and Willamette River winter steelhead, which are migrating when sea lions are most abundant.[40,41,42,43,44]

Resident fish predators are a significant source of mortality of juvenile salmonids during outmigration through the Columbia and Snake River mainstems and reservoirs.[45,46] Predators include northern pikeminnow, which are native to the system, and the non-native smallmouth bass, walleye, and channel catfish. In the mainstem

[35] Schaller, H. A., and C. E. Petrosky. 2007. Assessing hydro-system influence on delayed mortality of Snake River stream-type Chinook Salmon. North American Journal of Fisheries Management 27:810-824.

[36] Independent Scientific Advisory Board. 2019. A review of predation impacts and management effectiveness for the Columbia River Basin. Northwest Power and Conservation Council. Portland, OR.

[37] Id.

[38] Natural Marine Fisheries Service. 2019. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response–Continued Operation and Maintenance of the Columbia River System. NMFS Consultation Number: WCRO-2018-00152. https://www.fisheries.noaa.gov/resource/document/continued-operation-and-maintenance-columbia-river-system

[39] Carretta, J. V., E. M. Oleson, D. W. Weller, A. R. Lang, K. A. Forney, J. Baker, B. Hanson, K. Martien, M. M. Muto, A. J. Orr, H. Huber, M. S. Lowry, J. Barlow, D. Lynch, L. Carswell, R. L. Brownell Jr., and D. K. Mattila. 2014. U.S. Pacific Marine Mammal Stock Assessments: 2013, U.S. Department of Commerce, NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-532. August 1, 2014.

[40] Sorel, M. H., A. M. Wargo-Rub, and R. W. Zabel. 2017. Population-specific migration timing affects en route survival of Chinook salmon through a variable lower-river corridor.

[41] Falcy, M. 2017. Population Viability of Willamette River Winter Steelhead. An Assessment of the effect of sea lions at Willamette Falls. ODFW.

[42] Wright, B., and T. Murtagh. 2018. Willamette Falls pinniped monitoring project, 2018. Oregon Department of Fish and Wildlife.

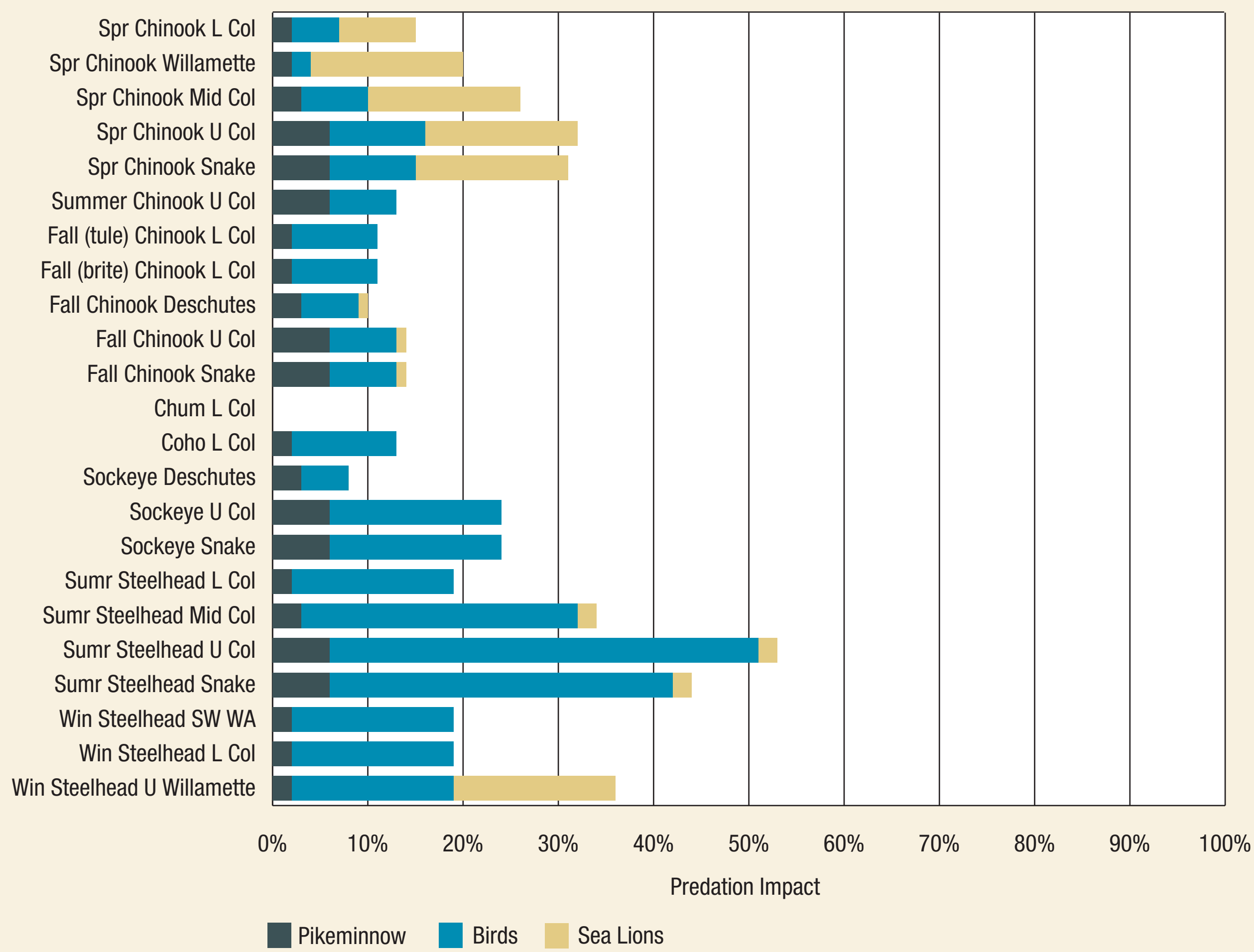
[43] Rub A. M., N. A. Som, M. J. Henderson, B. P. Sandford, D. M. Van Doornik, D. J. Teel, M. J. Tennis, O. P. Langness, B. K. van der Leeuw, and D. D. Huff. 2019. Changes in adult Chinook salmon (Oncorhynchus tshawytscha) survival within the lower Columbia River amid increasing pinniped abundance.

[44] Tidwell, K. S., B. A. Carrothers, K. N. Bayley, L. N. Magill, and B. K. van der Leeuw. 2019. Evaluation of pinniped predation on adult salmonids and other fish in the Bonneville Dam tailrace, 2018. U.S. Army Corps of Engineers, Portland District Fisheries Field Unit. Cascade Locks, OR.

[45] Independent Scientific Advisory Board. 2019. A review of predation impacts and management effectiveness for the Columbia River Basin. Northwest Power and Conservation Council. Portland, OR.

[46] Natural Marine Fisheries Service. 2019. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response–Continued Operation and Maintenance of the Columbia River System. NMFS Consultation Number: WCRO-2018-00152. https://www.fisheries.noaa.gov/resource/document/continued-operation-and-maintenance-columbia-river-system

FIGURE 24. Stock-specific estimates of current predation impacts.



Columbia and Snake Rivers, the altered habitats in reservoirs increase smolt migration travel times, create more favorable habitat conditions for fish predators, and enhance conditions for predation in reservoirs and tailraces. Predation rates are available for northern pikeminnow.[47,48,49] Information is not available to quantify the scale of predation by other fish predators, and their predation is considered a component of the reach mortality estimates.

Combined predation impacts by pikeminnow, birds, and sea lions vary by stock from near zero to about 50 percent (Figure 24).

The greatest predation impacts occur to spring Chinook salmon stocks that spawn above Bonneville Dam and to upriver steelhead. Upriver spring Chinook stocks are subject to significant pikeminnow, bird, and sea lion impacts, while upriver steelhead are vulnerable to significant bird predation in the estuary and inland.

Impact Estimates — Harvest

Fisheries provide tremendous social, cultural, and economic benefits but obviously also affect the abundance and productivity of fish stocks. For this analysis, fishery impacts are defined as mortality of natural-origin fish handled in fisheries, which ultimately reduces the number of these fish reaching the spawning grounds.

[47] Beamesderfer, R. C. P., D. L. Ward, and A. A. Nigro. 1996. Evaluation of the biological basis for a predator control program on northern pikeminnow (Ptychocheilus oregonensis) in the Columbia and Snake Rivers. Canadian Journal of Fisheries and Aquatic Sciences 53:2898-2908.

[48] Friesen, T. A. and D. L. Ward. 1999. Management of Northern Pikeminnow and Implications for Juvenile Salmonid Survival in the Lower Columbia and Snake rivers. North American Journal of Fisheries Management 19:406-420.

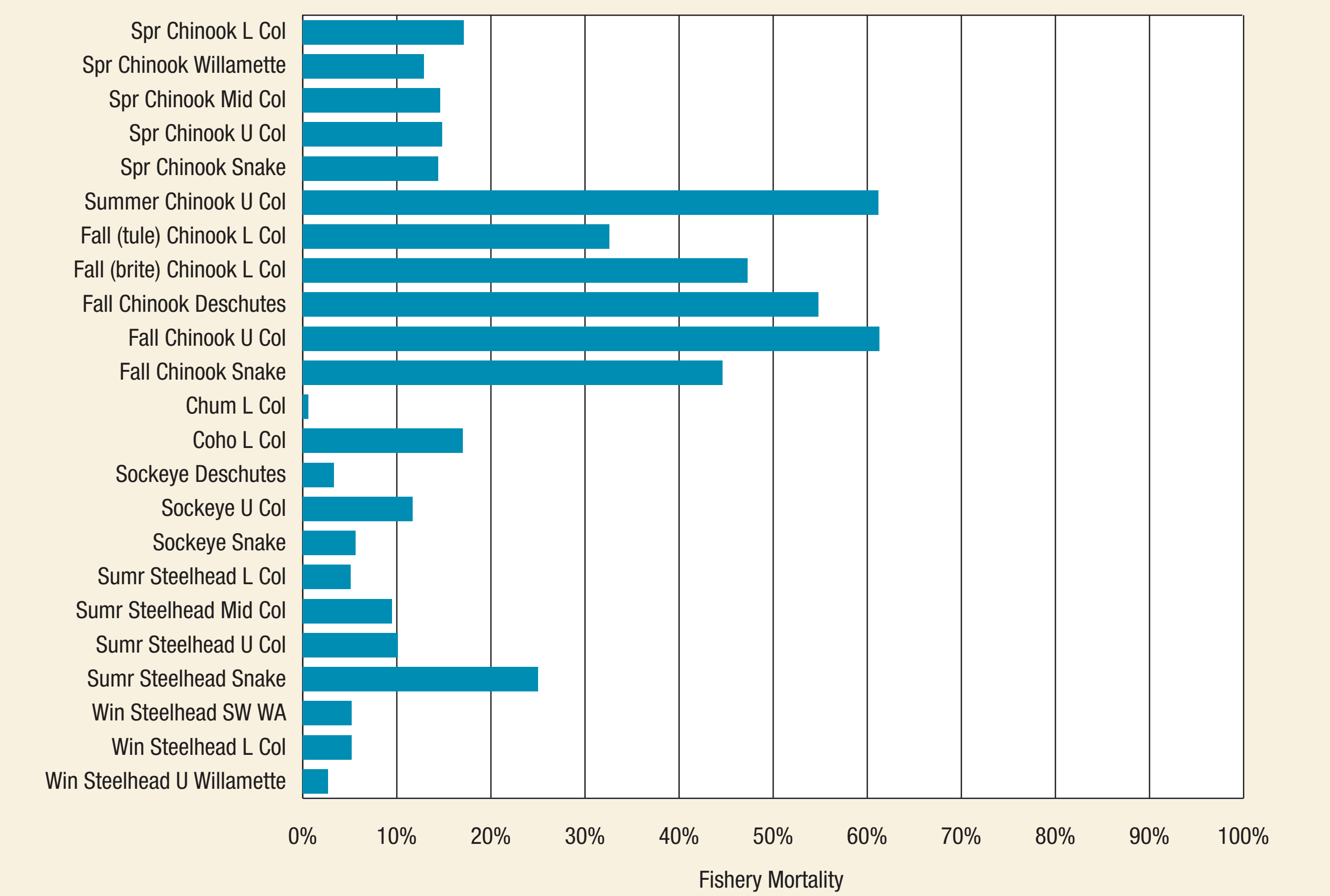
[49] Williams, S., E. Winther, C. M. Barr, and C. Miller. 2017. Report on the predation index, predator control fisheries, and program evaluation for the Columbia River basin Northern Pikeminnow Sport Reward Program. 2017 Annual report, April 1, 2017 thru March 31, 2018. Pacific States Marine Fisheries Commission, Portland, Oregon.

Fishery impacts include harvest and indirect mortalities. Harvest refers to fish that are caught and retained. Harvest is typically estimated using commercial landing records, otherwise known as fish tickets, for commercial fisheries. For recreational fisheries, harvest is typically estimated using creel surveys or angler catch record cards. Indirect mortalities are fish that are not retained but die due to handling or encounter in the fishery. Fish that die after release are often referred to as "catch and release mortalities." Indirect mortalities are estimated from the number of fish handled in a given fishery and the estimated proportion of those fish handled or encountered that subsequently die.

Columbia Basin salmon and steelhead range widely throughout the north Pacific Ocean and are subject to different fisheries and fishing rates depending on the distribution and timing of migration. Stock-specific impact estimates are available for most fisheries because they are the basis for fishery management objectives and allocation. Estimates are made by the management entities responsible for the various fisheries. For ocean fisheries, these include the Pacific Salmon Commission and Pacific Fishery Management Council.[50,51] Mainstem Columbia River fishery information is provided by the states of Oregon and Washington, and the Columbia River treaty and nontreaty tribes.[52,53] Harvest estimates in tributaries to the Columbia River are provided by the tribes and the states of Oregon, Washington, and Idaho.

Total fishery impacts in ocean and freshwater fisheries vary by stock from near zero to about 60 percent (Figure 25). Rates of up to 33 to 61 percent

FIGURE 25. Stock-specific estimates of current fishery impact rates (combined ocean and freshwater fisheries).



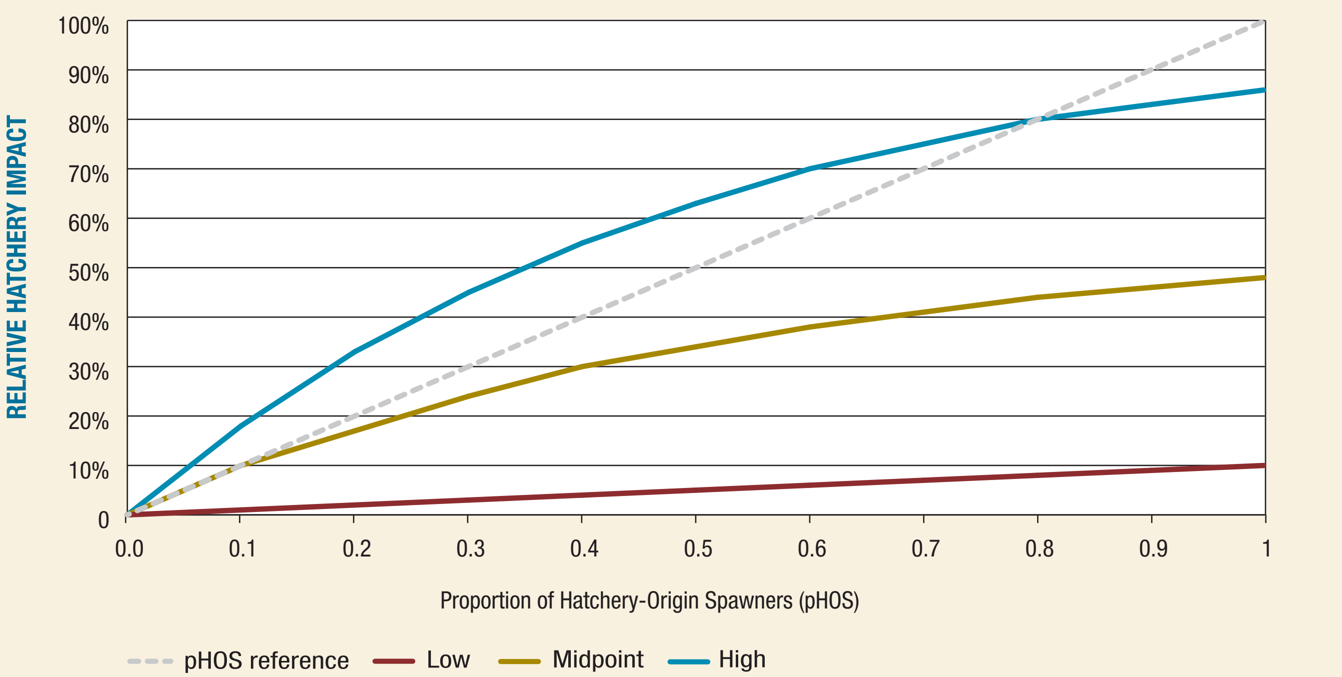
[50] Pacific Salmon Commission. 2018. 2017 Exploitation rate analysis and model calibration volume two: appendix supplement. Joint Chinook Technical Committee Report TCCHINOOK (18)-01 v.2. https://www.psc.org/download/35/chinook-technical-committee/11280/tcchinook-18-2.pdf

[51] Pacific Fishery Management Council. 2019. Review of 2018 ocean salmon fisheries – stock assessment and fishery evaluation document for the Pacific Coast salmon fishery management plan. https://www.pcouncil.org/documents/2020/02/review-of-2019-ocean-salmon-fisheries.pdf/

[52] Oregon Department of Fish and Wildlife and Washington Department of Fish and Wildlife. 2019. Joint Staff Report: Stock status and fisheries for Spring Chinook, Summer Chinook, Sockeye, Steelhead and other species. https://www.dfw.state.or.us/fish/OSCRP/CRM/reports/19_reports/2019_spring_jsr.pdf

[53] Washington Department of Fish and Wildlife and Oregon Department of Fish and Wildlife. 2019. Joint Staff Report: Stock status and fisheries for Fall Chinook Salmon, Coho Salmon, Chum Salmon, Summer Steelhead and White Sturgeon. https://www.dfw.state.or.us/fish/OSCRP/CRM/reports/19_reports/2019falljsr.pdf

FIGURE 26. Functional relationships between relative hatchery impacts on natural production and proportion hatchery spawners based on a range of assumptions.



occur for summer and fall Chinook salmon. These include many of the healthier and unlisted stocks in the Basin, and higher rates are often also associated with stocks subject to widespread ocean and freshwater fisheries. Rates are relatively low for most listed stocks due to fishery reductions implemented prior and subsequent to ESA listings.

Impact Estimates — Hatcheries

Columbia Basin hatcheries currently release about 140 million juvenile salmon and steelhead per year, primarily as mitigation for declining numbers of natural-origin fish associated with development throughout the Basin. Hatcheries account for an average annual return of about 1.5 million adults per year, or about two-thirds of the current total return.

The scale and significance of hatchery fish interactions with naturally produced fish remain a source of substantial uncertainty. Net effects include a complex of both negative and positive contributions that depend on the status of the natural populations and characteristics of the hatchery fish.

For this analysis, hatchery impacts are defined as the percentage reduction in natural productivity due to the effects of hatchery fish on natural population diversity, productivity, and fitness, as well as effects on fish health and effects resulting from complex ecological interactions. This definition is conservative from the perspective of natural production in that it captures only potential detrimental effects of hatcheries. Negative effects are the focus of this analysis because long-term Quantitative Goals are defined in terms of self-sustaining natural production.[54]

Hatchery conservation and supplementation programs have proven to be successful for increasing the number of naturally spawning, natural-origin fish, at least in the short term.[55] Benefits may outweigh risks under circumstances where demographic or short-term extinction risk to the population is greater than risks to population diversity and productivity.[56] Conversely, the long-term use of artificial propagation may pose risks to natural productivity and diversity. Demographic benefits are sustainable only if they exceed

54 Potentially negative impacts of hatcheries are outweighed by benefits in interim situations where hatchery fish are essential to conservation, reintroduction or supplementation programs necessary to address more immediate concerns.

55 National Marine Fisheries Service. 2014. Final Environmental Impact Statement to inform Columbia Bain Hatchery operations and the funding of Mitchell Act hatchery programs. Seattle WA.

56 Natural Marine Fisheries Service. 2019. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response — Continued Operation and Maintenance of the Columbia River System. NMFS Consultation Number: WCRO-2018-00152. https://www.fisheries.noaa.gov/resource/document/continued-operation-and-maintenance-columbia-river-system

the predicted reductions in the genetic viability and reproductive fitness of natural-origin fish in subsequent generations.[57] Without commensurate improvements in the condition of natural habitat or other limiting factors, the long-term success in recovering naturally spawning populations using hatcheries is difficult to demonstrate.[58]

The scientific literature has documented a number of hatchery-related risks to natural production.[59,60,61,62,63,64,65,66,67,68] Traditional approaches of hatchery programs have imposed different types of biological risks for natural-origin salmon populations, including demographic risks; genetic and evolutionary risks; risks due to behavior, health status, or physiology of hatchery fish; and ecological risks.[69] Hatchery programs can negatively affect naturally produced populations through competition (for spawning sites and food), predation effects, disease effects, genetic effects (outbreeding depression), broodstock collection, and facility effects (hatchery influenced selection).[70] The magnitude and type of the risk depend on the species, the status of affected populations, and the specific practices of the hatchery program.

The magnitude of hatchery impacts has proven difficult to quantify, and various approaches have produced a broad range of related estimates. Comparisons of the relative reproductive success (RRS) of hatchery- and natural-origin salmon and steelhead have provided some of the earliest and most direct evidence for negative impacts of hatchery production.[71,72,73] Ford (2002)[74] developed a theoretical basis for assessing relative hatchery fitness of a wild and captive population using a phenotypic model based on a suite of fitness-correlated traits (such as time of spawning, length, etc.). The Columbia Basin Hatchery Scientific Review Group (HSRG) evaluated regional hatchery program effects on the viability of natural populations based on population fitness using a similar quantitative genetic framework implemented in the "All-H Analyzer (AHA)" model.[75,76,77] Chilcote et al. (2011)[78] examined hatchery impacts with a correlative model

57 Hatchery Scientific Review Group (HSRG). 2009. Columbia River hatchery reform system-wide report. http://hatcheryreform.us/wp-content/uploads/2016/05/01_HSRG-Final-Systemwide-Report.pdf

58 National Marine Fisheries Service. 2014. Final Environmental Impact Statement to inform Columbia Bain Hatchery operations and the funding of Mitchell Act hatchery programs. Seattle WA.

59 Waples, R. S., O. W. Johnson, and R. P. Jones, Jr. 1991. Status review for Snake River sockeye salmon. U.S. Department of Commerce, NOAA Technical Memorandum. NMFS-F/NWC 195, 4/1991.

60 Busack, C. A., and K. P. Currens. 1995. Genetic risks and hazards in hatchery operations: fundamental concepts and issues. American Fisheries Society Symposium 15:71-80.

61 National Research Council. 1996. Upstream: Salmon and society in the Pacific Northwest. National Academy Press. Washington, D. C.

62 Brannon, E. L., D. F. Amend, M. A. Cronin, J. E. Lannan, S. LaPatra, W. J. McNeil, R. E. Noble, C. E. Smith, A. J. Talbot, G. A. Wedemeyer, and H. Westers. 2020. The controversy about salmon hatcheries. Fisheries 29(9):12-31.

63 Lichatowich, J. A., M. S. Powell and R. N. Williams. 2006. Artificial production and the effects of fish culture on native salmonids. Pages 417 to 464 in R. N. Williams, editor. Return to the River: Restoring salmon to the Columbia River. Elsevier, Amsterdam.

64 McClure, M. M., F. M. Utter, C. Baldwin, R, W. Carmichael, P. F. Hassemer, P. J. Howell, P. Spruell, T. D. Cooney, H. A. Schaller, and C. E. Petrosky. 2008. Evolutionary effects of alternative artificial propagation programs: implications for viability of endangered anadromous salmonids. Evolutionary Applications1:356–375.

65 Naish, K. A., J. E. Taylor III, P. S. Levin, T. P. Quinn, J. R. Winton, D. Huppert, and R. Hilborn. 2008. An evaluation of the effects of conservation and fishery enhancement hatcheries on wild populations of salmon. Advances in Marine Biology 53:61-194.

66 Kostow, K. 2009. Factors that contribute to the ecological risks of salmon and steelhead hatchery programs and some mitigating strategies. Reviews in Fish Biology and Fisheries 19:9-31.

67 Hatchery Scientific Review Group (HSRG). 2014. On the Science of Hatcheries: An updated perspective on the role of hatcheries in salmon and steelhead management in the Pacific Northwest. A. Appleby, H.L. Blankenship, D. Campton, K. Currens, T. Evelyn, D. Fast, T. Flagg, J. Gislason, P. Kline, C. Mahnken, B. Missildine, L. Mobrand, G. Nandor, P. Paquet, S. Patterson, L. Seeb, S. Smith, and K. Warheit. June 2014; revised October 2014. http://hatcheryreform.us/wp-content/uploads/2016/05/On-the-Science-of-Hatcheries_HSRG_Revised-Oct-2014.pdf

68 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.

69 National Research Council. 1996. Upstream: Salmon and society in the Pacific Northwest. National Academy Press. Washington, D. C.

70 Natural Marine Fisheries Service. 2019. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response - Continued Operation and Maintenance of the Columbia River System. NMFS Consultation Number: WCRO-2018-00152. https://www.fisheries.noaa.gov/resource/document/continued-operation-and-maintenance-columbia-river-system

71 Reisenbichler, R. R., and S. P. Rubin. 1999. Genetic changes from artificial propagation of Pacific salmon affect the productivity and viability of supplemented populations. ICES J. Mar. Sci. 56:459–466.

72 Chilcote, M. W., S. A. Leider, and J. J. Loch. 1986. Differential reproductive success of hatchery and wild summer-run steelhead under natural conditions. Transactions of the American Fisheries Society 115: 726-735.

73 Berejikian, B., and M. Ford. 2004. A review of relative fitness of hatchery and natural salmon. NOAA Technical Memorandum NMFS-NWFSC-61. Seattle WA.

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75 Mobrand, L. E., J. Barr, L. Blankenship, D. E. Campton, T. T. P. Evelyn, T. A. Flagg, C. V. M. Mahnken, L. W. Seeb, P. R. Seidel, and W. W. Smoker. 2005. Hatchery reform in Washington State Principles and emerging issues. Fisheries 30(6):11-23.

76 Hatchery Scientific Review Group (HSRG). 2009. Columbia River hatchery reform system-wide report. http://hatcheryreform.us/wp-content/uploads/2016/05/01_HSRG-Final-Systemwide-Report.pdf

77 Hatchery Scientific Review Group (HSRG). 2014. On the Science of Hatcheries: An updated perspective on the role of hatcheries in salmon and steelhead management in the Pacific Northwest. A. Appleby, H.L. Blankenship, D. Campton, K. Currens, T. Evelyn, D. Fast, T. Flagg, J. Gislason, P. Kline, C. Mahnken, B. Missildine, L. Mobrand, G. Nandor, P. Paquet, S. Patterson, L. Seeb, S. Smith, and K. Warheit. June 2014; revised October 2014. http://hatcheryreform.us/wp-content/uploads/2016/05/On-the-Science-of-Hatcheries_HSRG_Revised-Oct-2014.pdf

78 Chilcote, M. W., K. W. Goodson, M. R. Falcy. 2011. Reduced recruitment performance in natural populations of anadromous salmonids associated with hatchery-reared fish. Canadian Journal of Fisheries and Aquatic Sciences 68:511-522.

"The CBP process confirmed for me once again that we are all, including all the major stakeholders in the Columbia Basin, searching for a way out of the perpetual cycle of inaction, frustration, litigation, avoidance and denial that has caused basinwide gridlock for nearly 25 years, putting its valuable salmon runs at severe risk of extinction. What we have accomplished with the CBP is to trail-blaze a pathway out of gridlock and conflict toward mutually supportive salmon restoration goals that are both doable and which can benefit the whole region. But this 100-year salmon restoration plan will take the sustainable commitment and energy of all of the participating stakeholder groups, and their successors, to make it a reality. I look forward to helping create the framework and energy to make that happen. More than anything else, the CBP has demonstrated that the people of the Basin can set aside short-term narrow interests and conflicts, and can work together for the long-term good of providing healthy, abundant salmon runs for future generations. Publishing this Final Report formally begins that process." — Glen Spain, *Pacific Coast Federation of Fishermen's Associations*

comparing the productivity of natural populations with the percentage of hatchery-origin spawners. The Idaho Supplementation Studies measured the population effects of dedicated, intentional hatchery supplementation on the abundance and productivity of Chinook salmon during and after supplementation.[79,80] Finally, Courter et al. (2019)[81] evaluated the response of hatchery elimination on the abundance and productivity of a natural steelhead population.

For the purposes of the Partnership analysis, a broad range of potential hatchery impacts was identified for each stock to reflect uncertainties identified in the scientific literature for the potential magnitude of fitness-related and ecological effects. Impacts were assumed to be directly related to the percentage of hatchery-origin spawners (pHOS) in the naturally spawning population (Figure 26). Estimates of pHOS are generally available for many stocks based on spawning ground survey data. Hatchery fish are typically distinguished by adipose fin clips or coded-wire tags.

Low-range values assume relatively small hatchery impacts consistent with empirical results of the Idaho Supplementation Study[82,83] and the response to hatchery elimination reported by Courter et al. (2019).[84] These values were calculated as the product of pHOS and a relative reproductive success value of 10 percent. High-range values assume relatively high hatchery impacts, consistent with relationships reported by Chilcote et al. (2011).[85] Point estimates of hatchery impact for each stock were based on the midpoint between low and high values.

Observed numbers of hatchery-origin spawners in natural production areas create a potential for significant negative impacts on most Columbia Basin salmon and steelhead stocks (Figure 27) although impacts may vary considerably among populations within a stock. Wide ranges around

79 Venditti, D. A., R. N. Kinzer, K. A. Apperson, B. Barnett, M. Belnap, T. Copeland, M. P. Corsi, W. T. Gross, L. Janssen, R. Santo, K. Tardy, and A. Teton. 2015. Idaho supplementation studies. Project completion report 1991-2014. Idaho Department of Fish and Game Report 15-18.

80 Independent Scientific Review Panel. 2016. Review of the Idaho Supplementation Studies Project Completion Report 1991-2014. Northwest Power and Conservation Council ISRP 2016-9.

81 Courter, I. I., G. J. Wyatt, R. W. Perry, J. M. Plumb, F. M. Carpenter, N. K. Ackerman, R. B. Lessard, and P. F. Galbreath. 2018. A Natural-Origin Steelhead Population's Response to Exclusion of Hatchery Fish. Transactions of the American Fisheries Society 148:339-351.

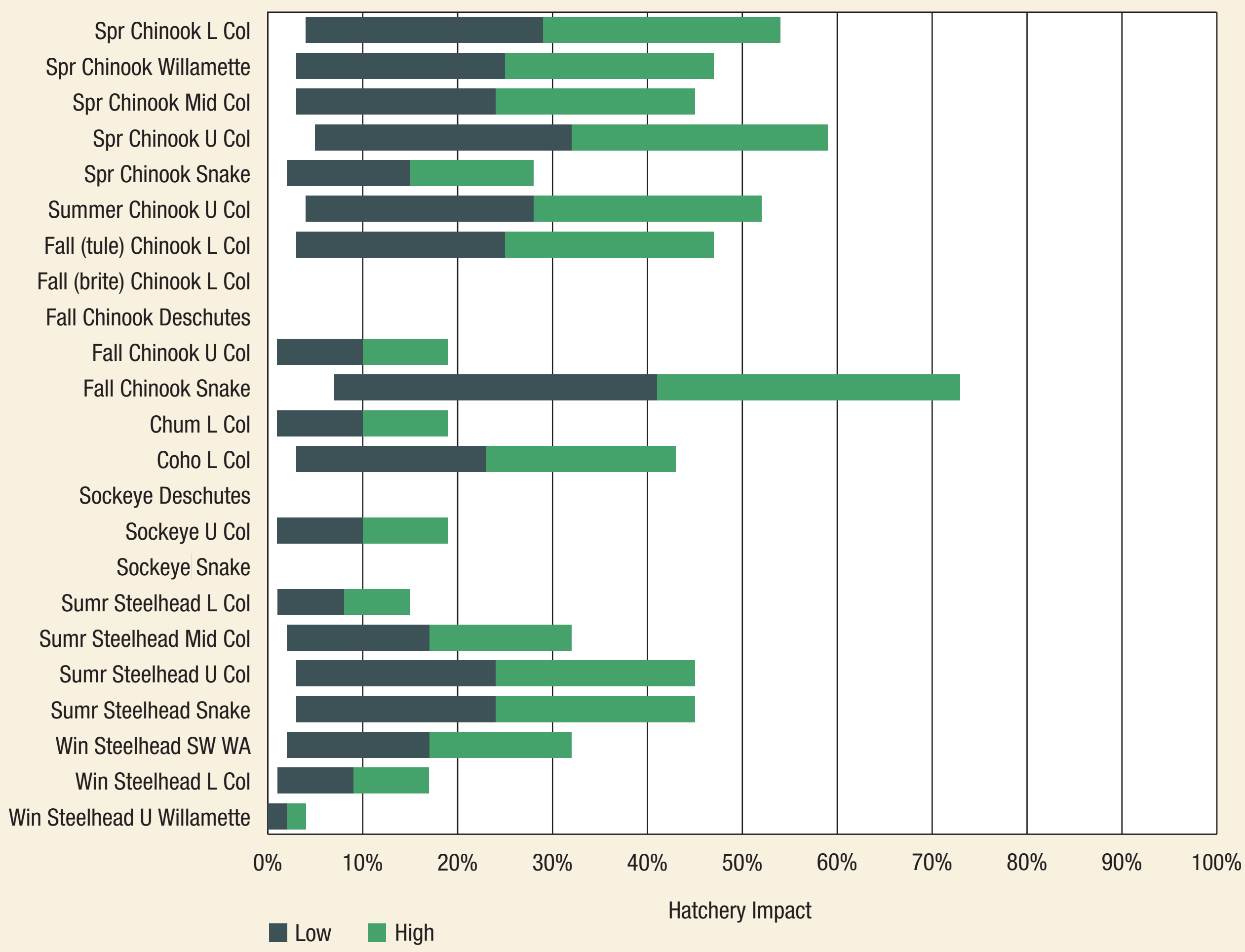
82 Venditti, D. A., R. N. Kinzer, K. A. Apperson, B. Barnett, M. Belnap, T. Copeland, M. P. Corsi, W. T. Gross, L. Janssen, R. Santo, K. Tardy, and A. Teton. 2015. Idaho supplementation studies. Project completion report 1991-2014. Idaho Department of Fish and Game Report 15-18.

83 Independent Scientific Review Panel. 2016. Review of the Idaho Supplementation Studies Project Completion Report 1991-2014. Northwest Power and Conservation Council ISRP 2016-9.

84 Courter, I. I., G. J. Wyatt, R. W. Perry, J. M. Plumb, F. M. Carpenter, N. K. Ackerman, R. B. Lessard, and P. F. Galbreath. 2018. A Natural-Origin Steelhead Population's Response to Exclusion of Hatchery Fish. Transactions of the American Fisheries Society 148:339-351.

85 Chilcote, M. W., K. W. Goodson, M. R. Falcy. 2011. Reduced recruitment performance in natural populations of anadromous salmonids associated with hatchery-reared fish. Canadian Journal of Fisheries and Aquatic Sciences 68:511-522.

FIGURE 27. Stock-specific estimates of hatchery impacts based on observed proportions of hatchery-origin spawners and a range of assumptions for the relative reproductive success of hatchery versus natural-origin fish.



point estimates reflect uncertainties regarding the potential magnitude of hatchery effects. Point estimates for most stocks are typically 30 percent or less, although high-range values are typically double the point estimates. Only a few stocks are subject to no significant hatchery influence. These include Lower Columbia River bright Chinook salmon and Mid-Columbia (Deschutes River) fall Chinook salmon. No hatchery impacts are reported for mid-Columbia River sockeye salmon, but this stock is extirpated. The highest values are associated with stocks where hatchery programs are being used in conservation or reintroduction programs to address severe declines. These include programs for Snake River fall Chinook and Snake River sockeye salmon. These are special cases where the near-term demographic benefits far exceed any negative impact on natural productivity.

Cattle at 6 Ranch, Enterprise, Oregon. Credit: 6 Ranch

Life-Cycle Analysis — The Salmon Analyzer

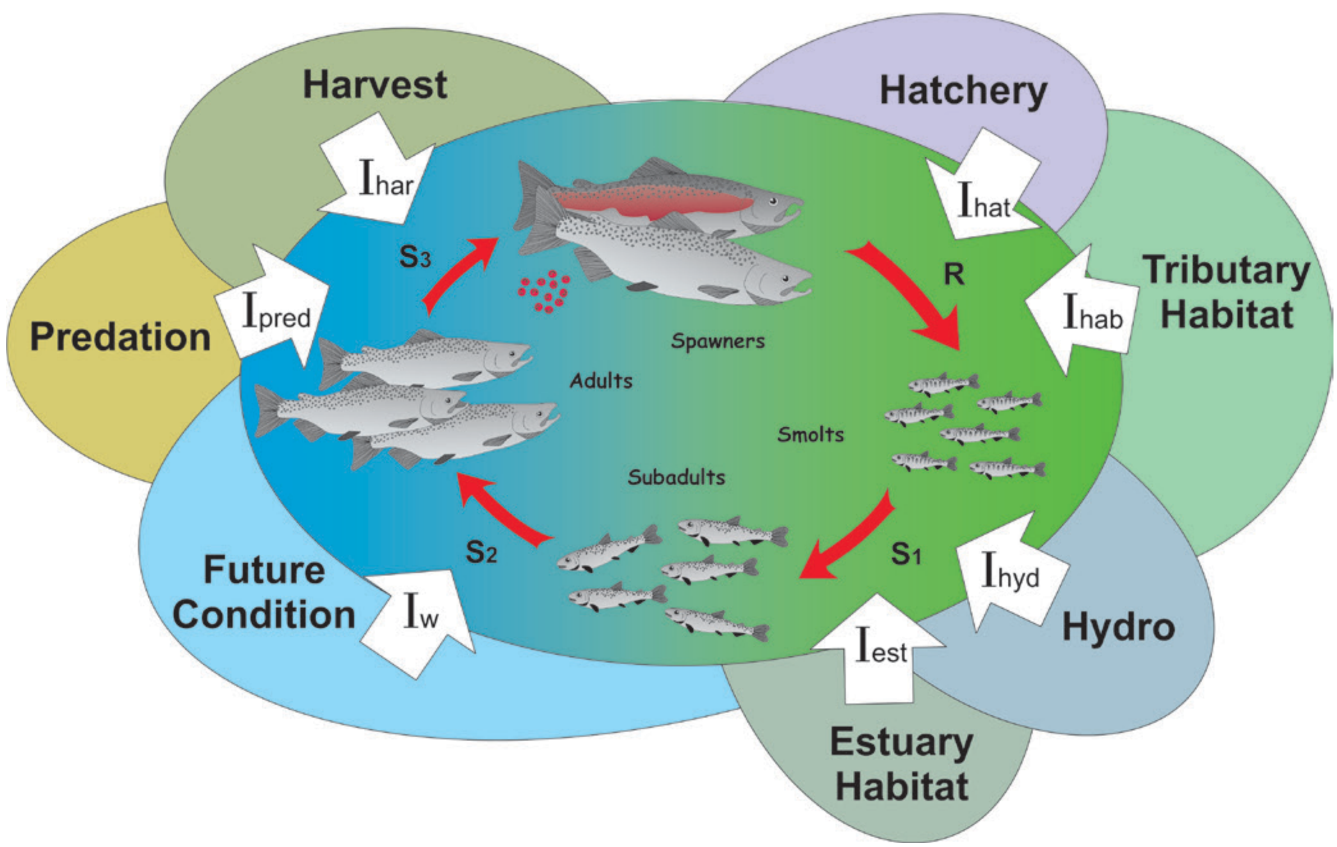
The Partnership used a life-cycle model to explore the effects of "turning the dials" for various limiting factors on fish abundance relative to the Partnership Goals. This analysis examined, at a coarse scale, the sensitivity of adult abundance to reductions in limiting factors impacts, the compounding benefits of reductions in impacts throughout the salmon and steelhead life cycle, and the levels of effort that might be required to achieve the Quantitative Goals. The analysis broadly synthesized the results of decades of research to provide a general foundation for considering pathways for salmon and steelhead restoration. These coarse-scale analyses are intended to complement, but not substitute for, the wide array of analyses and models currently employed for salmon assessments throughout the region.

Model Description

The Salmon Analyzer is a simple life-cycle model adapted to facilitate the exploration of broad hypotheses and coarse-scale strategies for increasing salmon and steelhead abundance (Figure 28). The analyzer relates adult abundance to factors that impact productivity or survival at various stages in the salmon life cycle (Figure 28). Quantifying these relationships allowed the Partnership to consider likely changes in fish abundance in response to increases or decreases in any given impact or combinations of changes in impacts.

The Salmon Analyzer is a heuristic model, meaning that its appropriate and intended application is as a tool for interactive learning and hypothesis exploration. The Salmon Analyzer is not designed to evaluate specific actions, management decisions, or resource allocations but rather to suggest general approaches (strategies) that then need finer-scale analyses to transition

FIGURE 28. Conceptual depiction of Salmon Analyzer formulation in relation to impacts (I) of factors affecting productivity or survival at stages in the salmon life cycle.



into management actions. The model is robust in this application by virtue of its simplicity and transparency. The model can be broadly applied across many species and stocks where a lack of empirical life history data does not permit finer-scale analysis.

The Salmon Analyzer is an equilibrium modeling approach that generally identifies "average" conditions corresponding to the net effect of a combination of inputs. This approach is adapted from a model previously developed for the Washington Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plan.[86] The core concept of this modeling approach is that equilibrium or average salmon abundance measured on the spawning grounds can be directly and proportionally related to changes in limiting factors. For example, doubling the quantity or quality of fish habitat, all other things being equal, can be expected to double average adult abundance. Increasing fishing mortality rates by 10 percent, decreases average adult abundance on average by 10 percent.

The basic model formulation is:

$\bar{A} = \bar{A}' [(1 - I_1)(1 - I_2) \ldots (1 - I_x)]$

Where, $\bar{A}$ = current average (equilibrium) abundance.

$\bar{A}'$ = historical average (equilibrium) abundance that would have occurred in the absence of human-related or potentially manageable impacts.

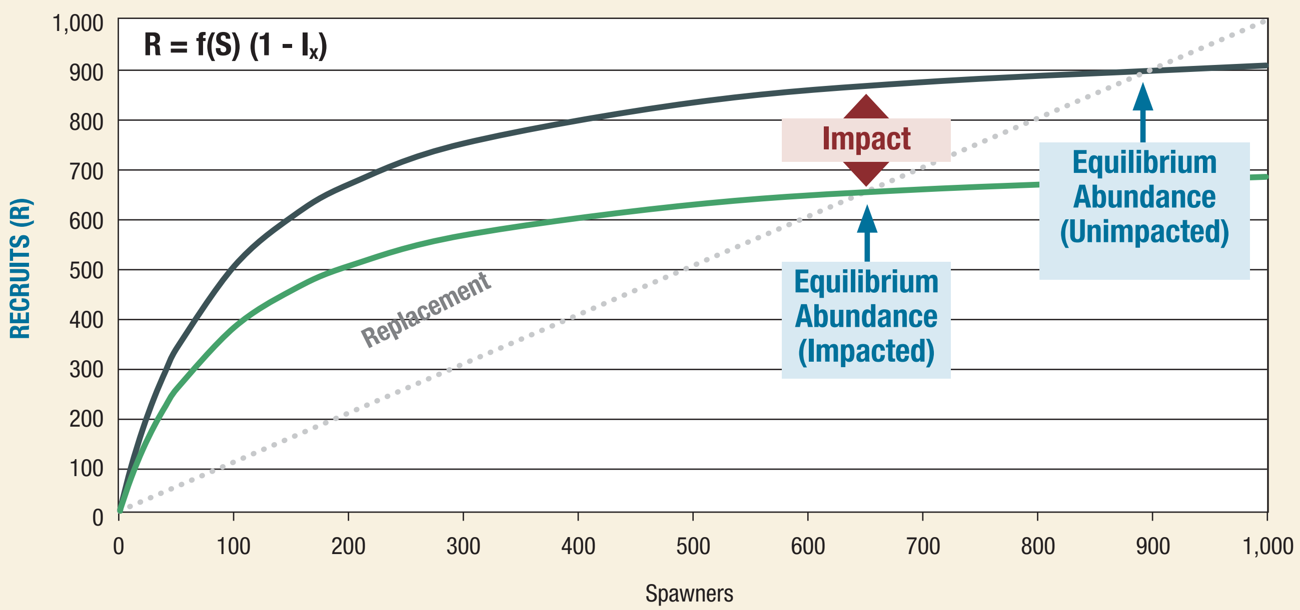
I_x = potentially manageable impacts for factor x.

The model is derived from the conventional stage-specific stock-recruitment function in wide use for life-cycle modeling of salmon (Figure 29).

Analysis inputs include:

1. Estimates of current average abundance of natural-origin spawners for 27 Columbia Basin salmon and steelhead stocks.
2. Current impact estimates of potentially manageable factors. These are the same

FIGURE 29. Graphical depiction of stage-specific salmon stock-recruitment function employed in the Partnership life-cycle analysis.



[86] Lower Columbia Fish Recovery Board. 2010. Washington Lower Columbia salmon recovery and fish and wildlife subbasin plan. https://www.lcfrb.gen.wa.us/librarysalmonrecovery

impacts described above for the limiting factors analysis (tributary habitat, estuary habitat, mainstem, latent, blocked areas, predation, fishery, hatchery).
3. Changes in impacts of potentially manageable factors (user option).
4. Columbia Basin Partnership low-, medium-, and high-range goals for natural-origin spawners of each stock, which are input for reference purposes.
5. Percentage of hatchery-origin spawners, which is also input for reference purposes so that the analysis can calculate both natural-origin and hatchery-origin abundance. Contributions of supplementation and reintroduction hatchery programs are reflected in the change in the total number of spawners on the spawning grounds.

Analysis outputs include:
1. Equilibrium abundance of natural-origin spawners produced by changes in impacts of potentially manageable factors.
2. Number of hatchery-origin spawners and percentage of hatchery-origin spawners (pHOS) resulting from changes in impacts of potentially manageable factors.[87]

The model is operated through an interface designed to facilitate analysis. The Salmon Analyzer is constructed in MS Excel with macros constructed in Visual Basic to automate certain applications. Impact assumptions may be increased or decreased relative to current reference values to examine incremental and aggregate effects on abundance.

All life-cycle models are necessarily abstractions of complex natural systems. The Salmon Analyzer employs a number of features or assumptions to provide broad and consistent applicability to all salmon and steelhead stocks throughout the region, including:
- Results are expressed at the scale of stocks, which generally consist of multiple populations.
- Impacts are assumed to act independently at various stages of the life cycle. This assumption is generally robust because density-dependent processes are typically concentrated in the freshwater rearing stage of the salmon life cycle.
- Impacts are included where values can be reasonably quantified or assumed based on scientific information. Where impacts are uncertain, a range of values is identified reflecting those uncertainties.
- Analyses do not determine the feasibility and cost of any given impact reduction.
- Where impacts are particularly uncertain as for latent hydropower and hatchery effects, estimates are presented as ranges. Other values may also be subject to significant uncertainty, but estimates are generally presented as point estimates intended to represent a coarse-scale, order-of-magnitude impact.
- The analysis does not explicitly incorporate a time component that accounts for delays between implementation of an action and the time when benefits of that action would fully accrue. The results are intended to represent equilibrium values produced by combinations of changes in impacts. In reality, achieving equilibrium abundance would occur over time, because while the benefits of some actions, such as reductions in harvest or predation on adults, would be more immediate, the benefits of some habitat treatments, such as planting trees for shade in riparian areas, may take decades to accrue.

Results
The Project Team used the Salmon Analyzer to examine the sensitivity of fish abundance to reductions in quantified impacts. These sensitivity analyses examined improvements if: (1) the impact of all factors was reduced to zero for a particular stock; (2) the impact of each individual factor was reduced to zero; and (3) impacts if all factors are reduced proportionally (e.g., 10 percent, 30 percent, 50 percent). The analyzer was also made available to all Partnership members and their technical staff, and they were encouraged to explore the effects of various reductions in impacts.

Reducing all impacts to zero is not realistic but does provide a test of consistency between impact estimates and estimates of historical abundance. Similar fish numbers for historical and “all-impacts-reduced-to-zero” conditions generally might be inferred to suggest that the net impact of all quantified factors provides a reasonable order-of-magnitude calibration for historical abundance. Allocation of impacts among the various factors may or may not be reasonable in this case. Overestimates in some factors might be offset by underestimates

87 Percentages of hatchery-origin spawners decrease in response to reductions in tributary habitat impacts which increase numbers of naturally produced fish. Reductions in hatchery impacts reduce both numbers and percentage of hatchery-origin adults.

The pathway to a sustainable Columbia River System into the next centuries is through positive and productive interactions and civil discourse between individuals with diverse points of view who have developed a common understanding of facts. The friendships, understanding, and respect that have been created between each of the CBP members involved in this process opened up the gate to this pathway that can lead to success for everything and everybody with connections to this river. — Urban Eberhart, *Kittitas Reclamation District*

in others. Where historical and "all-impacts-reduced-to-zero" values are not similar, there might be less confidence in estimates of either historical abundance or impacts or both.

Reducing the impact of each individual factor to zero is also unrealistic in many cases, but it does provide information about the scope for the potential improvement that might be gained by addressing any given limiting factor. For instance, reducing habitat impacts to zero would involve restoring pristine, pre-development conditions. In most cases, doing so would be impossible, but understanding the potential benefits from habitat restoration helps to inform about the scope of what might be possible. The actual scope for improvement will depend on the feasibility, costs, and willingness to produce any given level of impact reduction within the scope of the potential range. Those decisions are beyond the scope of the current analysis.

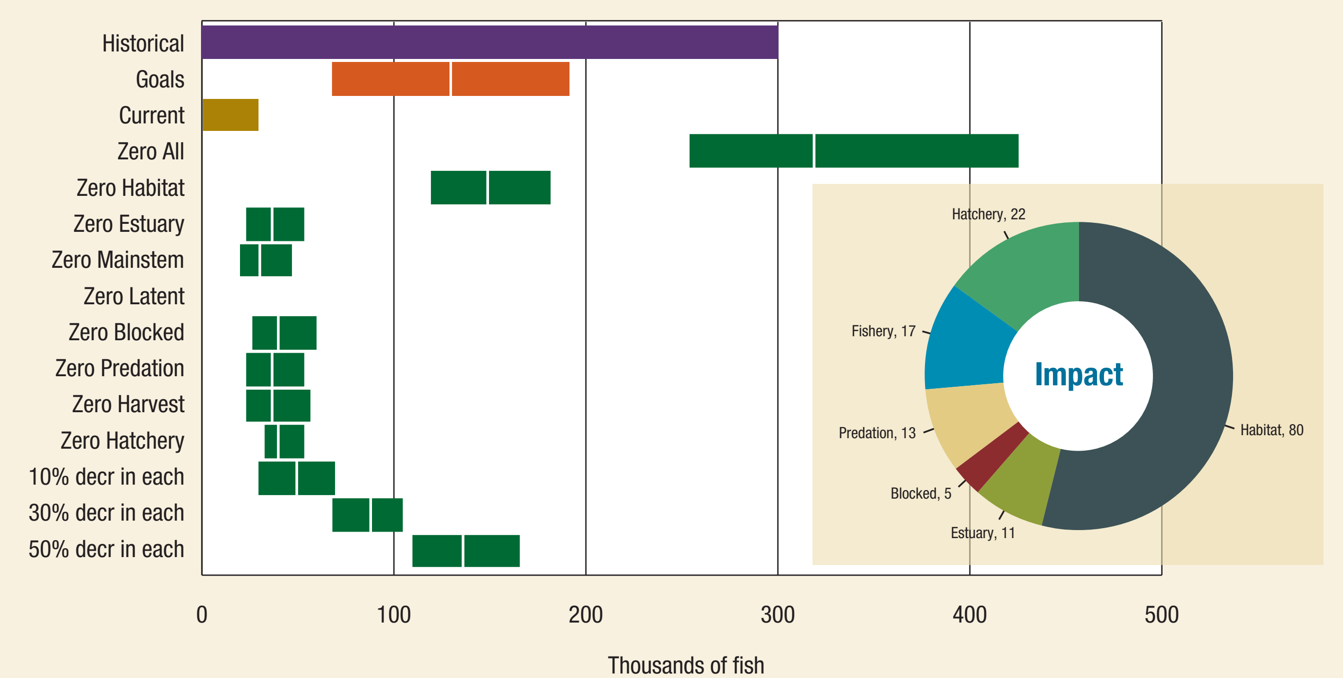
Proportional reductions illustrate the sensitivity in response to reducing multiple impacts by a given amount. These examples reduce impacts in proportion to their relative magnitude. Thus, a 50 percent reduction in a 50 percent impact produces an impact of 25 percent. A 50 percent reduction in a 10 percent impact produces an impact of 5 percent. These are an illustration of the effects of one possible way of sharing impact reductions "evenly" across impacts. They are provided merely as examples and are not meant to imply any type of judgement on the relative values or implications of reductions in any given impact.

This chapter presents the results of sensitivity analyses for four example stocks. The results are presented as ranges meant to reflect the uncertainties in the underlying estimates of impacts. For estimates of latent mortality and potential for detrimental hatchery effects, this range reflects values described earlier in this chapter. For other factors, a range of ±20 percent was assumed for illustration purposes.


Dagger Falls, Salmon River, Idaho. Credit: NOAA Fisheries West Coast Region

The stocks were selected by the Project Team as examples of different species, regions, and primary limiting factors. For instance, Lower Columbia River coho salmon are far below natural production goals and heavily impacted by habitat changes associated with land use and urbanization in the lower Columbia Basin. Mid-Columbia steelhead are relatively closer to their natural production goals and subject to a broad range of moderate impacts. Upper Columbia River summer Chinook salmon currently exceed their low-range goals but are well below their mid- to high-range goals, which were identified in part to address the loss of large areas of historical spawning and rearing habitat that are currently blocked by mainstem dams. Snake River spring/summer Chinook salmon are currently well below even low-range goals and heavily impacted by a broad range of factors including hydropower development and operation. Complete analyses of all stocks may be found in Appendix C.

FIGURE 30. Life-cycle analysis of the sensitivity of Lower Columbia River coho salmon abundance to reductions in human-related or potentially manageable impacts. (Latent mortality is not applicable because fish from this stock do not pass mainstem dams; therefore, no results are shown for zero latent mortality.) Donut chart shows mid-range impact values.



Line on goal bar indicates mid-point of goal range. Green bars depict a range based on uncertainties reported for impact estimates; the mid-line represents the likely value.

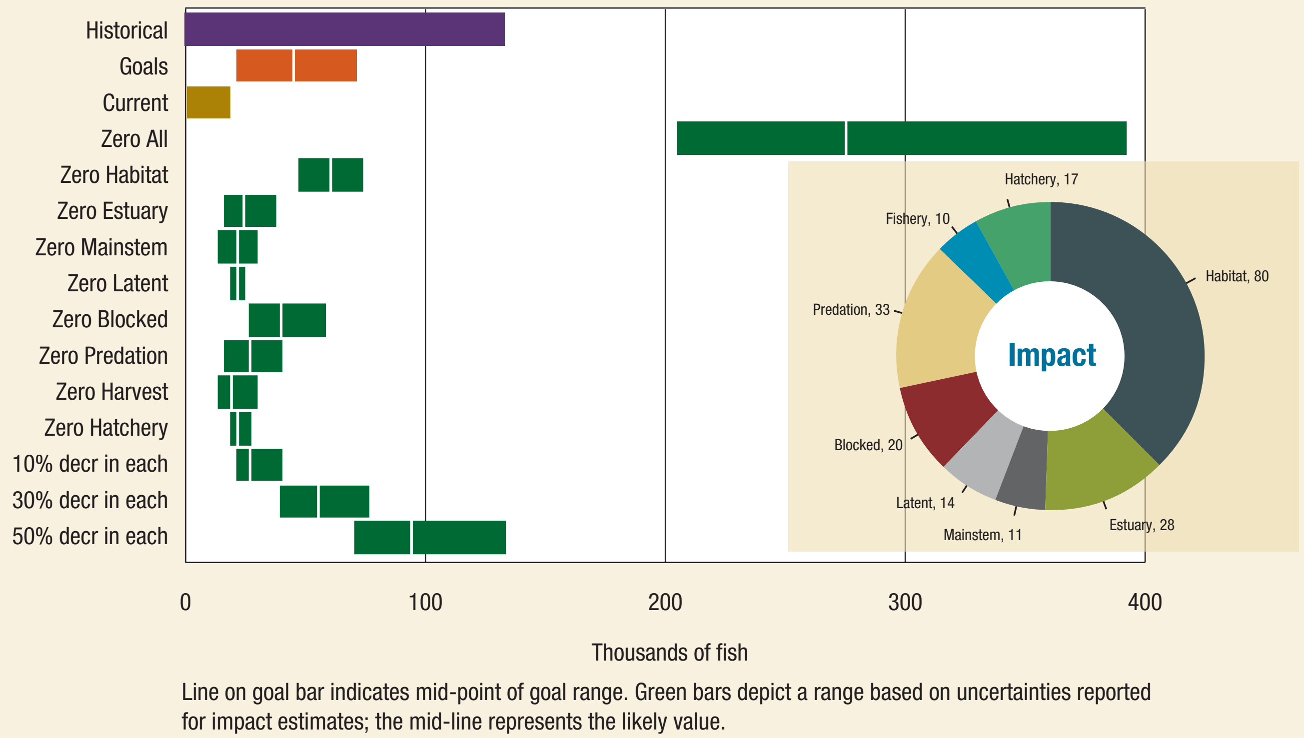
Lower Columbia River Coho Salmon

- This stock has been heavily impacted by habitat degradation. Combined impacts of other factors are also significant (Figure 30). Lower river hatcheries produce large numbers of coho salmon and straying is significant into some natural populations.
- Current abundance of natural-origin coho salmon (gold bar in Figure 30) is just 10 percent of the likely historical abundance (purple bar) and about 50 percent of the low end of the goal range identified by the Partnership (red bar).
- Zeroing all estimated impacts (green bar) produces an abundance similar to the likely historical value as depicted by the purple bar. The green bars depict a range in estimates based on uncertainties reported for impact estimates; the midline represents the likely value.
- Zeroing habitat impacts would produce an abundance within the Partnership goal range. This reflects the large scale of the habitat impacts and highlights the potential benefit of habitat improvements where practical.
- Zeroing other impacts produces incremental improvements, none of which by themselves approaches the lower goal range even under optimistic assumptions.
- Proportional reductions of 10 percent in the impact of each factor do not reach the low-range goal, but the low-range goal is reached by proportional reductions of 30 percent, and mid-range goal is reached by proportional reductions of 50 percent.

Mid-Columbia River Steelhead

- This stock has been impacted by a variety of factors (Figure 31).
- Current abundance of natural-origin steelhead (gold bar in Figure 31) is just 14 percent of the likely historical abundance (purple bar), but about 80 percent of the low end of the goal range identified by the Partnership (red bar).
- Zeroing all estimated impacts produces an abundance greater than the identified historical value as depicted by the purple bar. The green bars depict a range in estimates based on

FIGURE 31. Life-cycle analysis of the sensitivity of Mid-Columbia River steelhead abundance to reductions in human-related or potentially manageable impacts. Donut chart shows mid-range impact values.



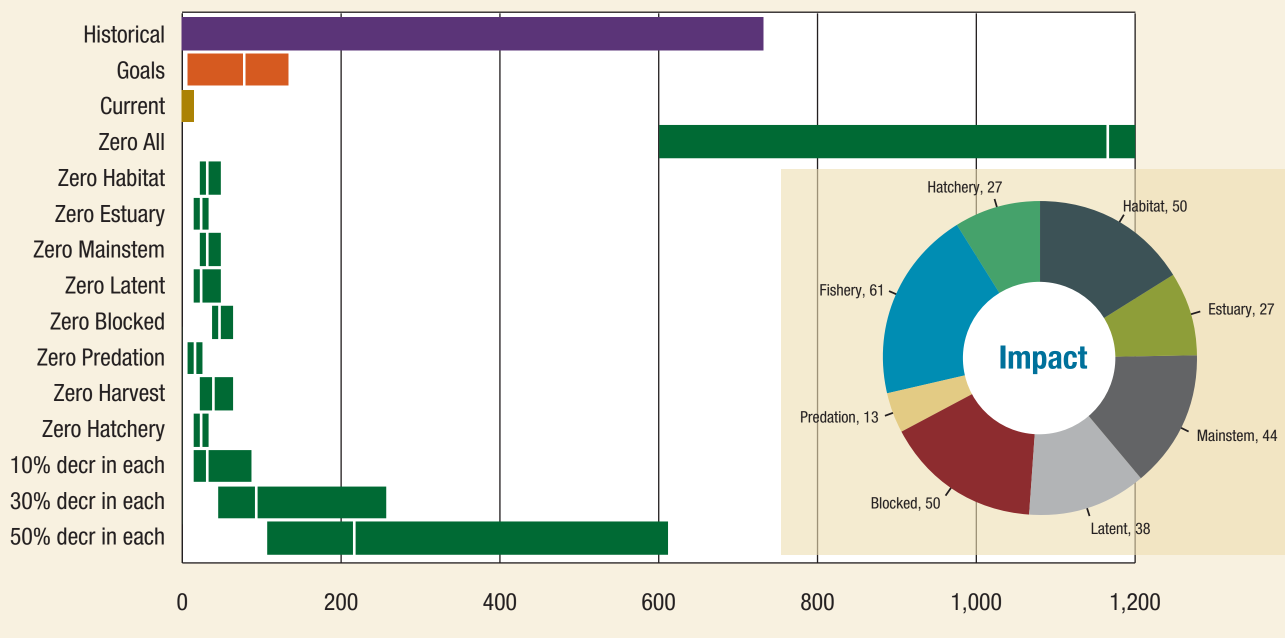
Line on goal bar indicates mid-point of goal range. Green bars depict a range based on uncertainties reported for impact estimates; the mid-line represents the likely value.

uncertainties reported for impact estimates; the midline represents the likely value. This suggests that either the historical number is an underestimate or net current impact is an overestimate.

- Zeroing habitat impacts would produce an abundance near the high-range goal identified by the Partnership goal range. This reflects the large scale of the habitat impacts and highlights the potential benefit of habitat improvements where practical.
- Zeroing other impacts produces incremental improvements, any of which reach or exceed the low-range goal.
- Proportional reductions of 10 percent in the impact of each factor reach the low-range goal. The high-range goal is approached by a proportional 30 percent reduction. This suggests that different combinations of improvements would likely increase the abundance of this stock to levels consistent with Partnership Goals.

Salmon at Adult Fish Trap, Lower Granite Dam, Washington. Credit: NOAA Fisheries West Coast Region

FIGURE 32. Life-cycle analysis of the sensitivity of Upper Columbia summer Chinook salmon abundance to reductions in human-related or potentially manageable impacts. Donut chart shows mid-range impact values.



Line on goal bar indicates mid-point of goal range. Green bars depict a range based on uncertainties reported for impact estimates; the mid-line represents the likely value.

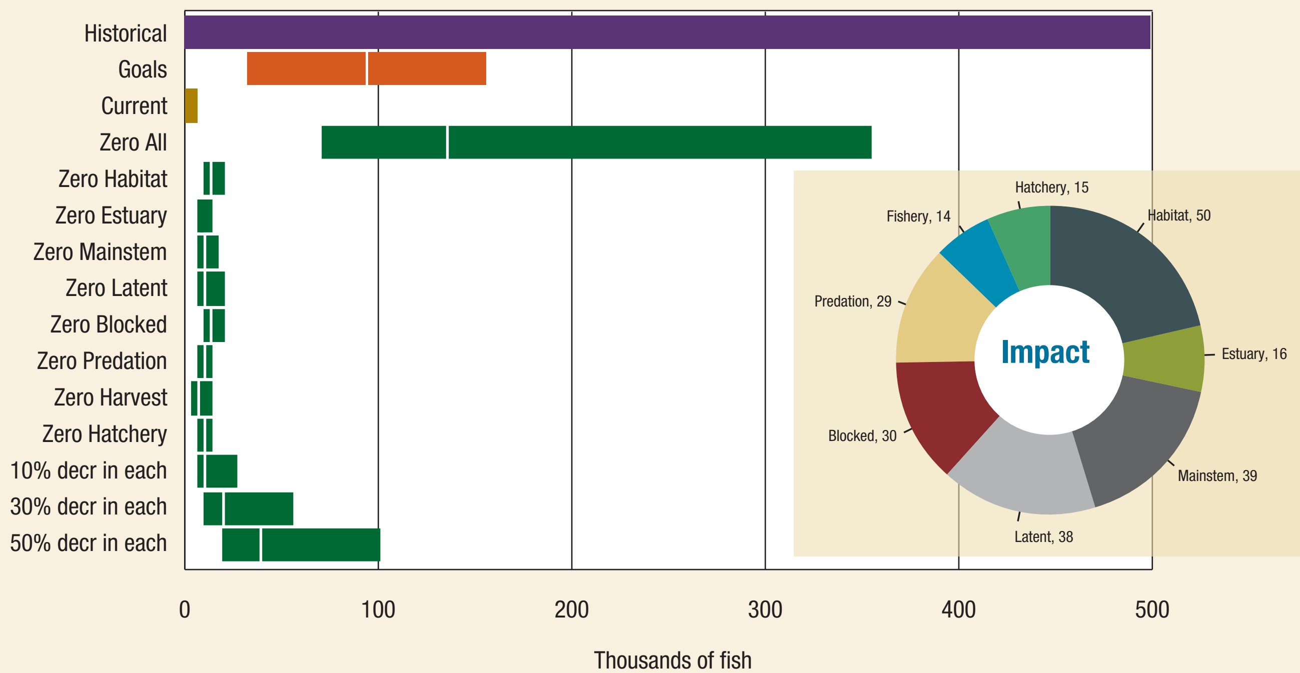
Upper Columbia Summer Chinook Salmon

- This stock has been impacted by the combined effects of a multitude of factors but remains relatively productive and sustains a high rate of fishing (Figure 32). However, impacts of habitat degradation in accessible areas and blocked access to historical production areas above Grand Coulee Dam are significant.
- Current abundance of natural-origin Upper Columbia summer Chinook salmon (gold bar in Figure 32) is less than 5 percent of the likely historical abundance (purple bar) but current abundance (gold bar) exceeds the low end of the goal range identified by the Partnership (red bar).
- Zeroing all estimated impacts produces an abundance greater than the identified historical value, as depicted by the purple bar. The green bars depict a range in estimates based on uncertainties reported for impact estimates; the midline represents the likely value. This suggests that either the historical number is an underestimate or net current impact is an overestimate.
- Zeroing individual impacts produces incremental improvements, none of which by themselves reaches the midpoint of the goal range even under optimistic assumptions.
- The low-range goal is currently being met for this stock. Proportional reductions of 30 percent in the impact of each factor reach the mid-point of the goal range and high-range goals are exceeded with proportional 50 percent reductions.

Snake River Spring/Summer Chinook Salmon

- This stock has been heavily impacted by the combined effects of a multitude of factors (Figure 33). The sensitivity analyses highlight the challenges of restoring significant levels of natural production to this stock given its current very low abundance.
- Current abundance of natural-origin spring/summer Chinook salmon (gold bar in Figure 33) is less than 1 percent of the historical abundance, which has been estimated to be as many as 1 million fish. Current abundance is about 20 percent of the low end of the goal range identified by the Partnership (red bar).
- Zeroing all estimated impacts produces an abundance that approaches the high-range goal identified by the Partnership. However, historical

FIGURE 33. Life-cycle analysis of the sensitivity of Snake River spring/summer Chinook salmon abundance to reductions in human-related or potentially manageable impacts. Donut chart shows mid-range impact values.



Line on goal bar indicates mid-point of goal range. Green bars depict a range based on uncertainties reported for impact estimates; the mid-line represents the likely value.

numbers are not approached even under assumptions of impacts at the high end of the range identified for these impacts.

- Combined hydropower impacts (mainstem and latent mortalities) are equivalent to a 62 percent reduction in natural production (or 80 percent at the high end of the range estimated for latent mortality). Zeroing these combined impacts might produce a 160 to 400 percent increase in natural production. This would meet the low-range Partnership goal only under an assumption of high latent mortality.
- Zeroing other impacts produces incremental improvements, none of which by themselves approaches the low-range goal even under optimistic assumptions.
- Sensitivity analyses suggest that proportional reductions in multiple factors, if significant, can produce substantial improvements in abundance consistent with low- to mid-range Partnership goals.

Discussion

The life-cycle analyses based on quantified estimated impacts helped inform Partnership considerations of potential opportunities for achieving Quantitative Goals for natural production. Sensitivity analyses were used to examine the potential scope for improvements associated with reductions in impacts of factors that affect Columbia Basin salmon and steelhead.

The analysis highlighted broad differences among salmon and steelhead stocks across the Basin both in terms of status relative to Partnership Goals and major limiting factors that must be addressed to reach the Goals. While a few stocks are meeting low-range goals identified by the Partnership, the majority of stocks are not achieving low-range goals, which is why most are listed under the ESA. Even greater improvements will be needed to reach mid- to high-range goals consistent with the restoration of healthy and harvestable salmon and steelhead throughout their historical range.

All stocks are impacted by a broad array of factors that are collectively responsible for large-scale declines. In some stocks, impacts are shared relatively evenly among factors, and effective strategies will require improvements that address multiple factors. Among the stock examples presented above, Mid-Columbia steelhead and Upper Columbia summer Chinook

Too often salmon are considered as an afterthought in our decision-making. The current condition of our fish populations is a reflection of how we have not prioritized the needs of salmon and steelhead. We make decisions that best suit the needs of people, and then work to reduce or "mitigate" their impacts on fish. To achieve the goals that we have collectively set, this must change. The needs of salmon and steelhead must be at the forefront of our decision-making, and a paramount consideration in how we manage our lives. — **Steve Manlow,** *Lower Columbia Fish Recovery Board*

salmon generally fall into this category. For other stocks, significant improvements will depend on the ability to address very large impacts of specific factors. In the case of Lower Columbia River coho salmon, it will be difficult to make substantial gains without addressing severe impacts of habitat loss in tributary spawning and rearing areas. For Snake River spring/summer Chinook salmon, hydro-related mortality is a substantial constraint. Both Upper Columbia summer Chinook salmon and Snake spring/summer Chinook salmon have also been significantly impacted by the loss of access to historical spawning and rearing areas that are currently blocked by large mainstem dams.

For the purposes of this analysis, each stock was considered individually. In reality, any given Basinwide or region-specific strategy should consider complementary impacts for multiple stocks affected by any given factor (e.g., effects of mainstem hydropower strategies on all stocks migrating through a given reach). This might involve identifying common assumptions for impact reductions as inputs for multiple stocks.

Sensitivity analyses also clearly demonstrate that improvements in multiple factors produce compounding benefits that can produce very large improvements from broad-based restoration strategies. The benefits of multiple improvements create synergies that far surpass the contributions of the individual factors alone. For instance, improving habitat quantity and quality will increase productivity measured in terms of juveniles produced per adult spawner, but numbers will still be limited by out-of-basin factors that limit smolt-to-adult return rates. Conversely, improving smolt-to-adult return rates by addressing out-of-basin limitations will return greater numbers of spawners, but production will still ultimately depend on the habitat conditions they find. However, improving both habitat productivity and smolt-to-adult survivals multiples the value of each. More high-quality habitat allows larger numbers of fish to survive out-of-basin factors, thus achieving much higher abundance than would have been realized with less productive habitat. Higher out-of-basin survival supports the return of more fish that are better able to use the habitats available. This is just one example. The dynamic holds for all stocks and limiting factors.

While significant improvements will be needed in key limiting factors, the life-cycle analyses demonstrate that the greatest potential for success comes from broad-based strategies that address multiple factors. Sensitivity analyses clearly demonstrate that it is rarely possible to achieve the Partnership's goals based on improvements in any single factor alone. There is no silver bullet.

Recognition of the power of compounding benefits from broad-based restoration strategies is one of the most important findings of modeling exercises like these. In modeling parlance, broad lessons such as this are called "emergent properties." These properties or behaviors emerge only when the parts interact in a wider whole. In the case of Columbia Basin salmon and steelhead, challenges of restoration are daunting due to the large scale of decline and the long list of causative factors. Multiple and severe impacts acting across the life cycle have compounded

The Partnership provided an absolutely unique opportunity to take a comprehensive look at all the factors contributing to salmon and steelhead declines across the basin and to synthesize the tremendous body of related science to inform our understanding of potential pathways for recovery.
— Ray Beamesderfer, *Fish Scientist, Project Team*

to reduce fish abundance to very low levels. However, this life-cycle analysis demonstrates that shared strategies addressing multiple factors have the potential to make substantial improvements that could not be achieved by addressing any single factor by itself.

Interpretations of analytical results must recognize that our knowledge base is not perfect, and that critical uncertainties remain. This exercise highlights the effects and implications of substantial uncertainties in the level of impact for many limiting factors. In particular, these include the magnitude of latent mortality associated with downstream migration of juveniles through the hydropower system and the tradeoffs between positive and negative effects of hatchery production on natural-origin fish. Much remains unknown, and some answers may be difficult to quantify precisely. Therefore, effective long-term salmon and steelhead restoration must continue to test, monitor, and adapt.

The life-cycle analysis was primarily a hypothesis testing and learning exercise used to examine the sensitivity of fish numbers to alternative inputs that reflect a range of uncertainty. Where concerns or disagreements on inputs exist, the modeling framework encourages users to articulate alternative assumptions, and it allows for the exploration of the related implications in a systematic fashion.

The Salmon Analyzer is broadly applicable to all species and stocks in the Basin. The tradeoff for this general applicability is that the model does not provide for mechanistic assessments of the effects of specific conditions (e.g., water temperature) or actions (e.g., hydropower configuration). More-detailed, finer-scaled models have been developed for specific factors and selected species and populations, but existing data are not adequate to develop detailed models for all stocks or all factors. Depending on the type of questions or management decisions being evaluated, it is recommended that results from the Salmon Analyzer be further validated with additional finer-scale analysis.


**New juvenile bypass at Wanapum Dam.
Credit: NOAA Fisheries West Coast Region**

Columbia River with barge. Credit: Shutterstock

Social, Cultural, Economic, and Ecological Considerations

Salmon and steelhead traverse a wide landscape during their migration to and from the ocean, weaving a common thread through a patchwork of human communities along their paths. Each of the communities they touch on their migratory path is unique and connected, even communities as far away as Alaska. This is a river system that supports salmon and steelhead, grows food, lights up homes and businesses, provides transportation, and sustains the souls of tribal people and others who are drawn to the river and salmon for spiritual, cultural, and social reasons. This chapter describes efforts by the Partnership to better understand the Basin's human landscapes. It shares the different perspectives of several Partnership members and the challenges and opportunities that need to be considered in efforts to achieve the Partnership Goals.

Overview

From the outset, the Partnership sought to integrate the "people side" of the Columbia Basin into discussions about the future of salmon. Members came together from across the Basin to share their interests and experiences, and to discuss ways to align their goals for salmon and steelhead. In Phase 1, the Partnership adopted a Qualitative Goal to "Make decisions within a broader context that reflects and considers effects to the full range of social, cultural, economic, and ecosystem values and diversity in the Columbia Basin." The Partnership engaged several approaches to help articulate those considerations. For example, individual members described their communities and constituencies in presentations in Phase 1. Also, discussions were structured to allow for inquisitive explorations and a greater understanding of the reasons behind people's positions.

In Phase 2, the Partnership delved further into these social, cultural, economic, and ecological considerations. Through small group exercises and a half-day workshop led by SERA Architects (see Appendix D), Partnership members shared their experiences from where they live and work in the Basin.

The members heard inspiring stories about farmers in eastern Washington collaborating with Yakama tribal members and non-governmental organizations to preserve water for migrating fish at critical times of the year. They heard about the difficulties in salmon-dependent communities and industries due to declines in fish abundance. They listened to stories about the tragic repercussions of the loss of salmon to tribal culture, health, and economies. They also heard about the economic benefits from the river's ability to provide cheap energy and transportation. Together, the stories highlight the complete mix of challenges and opportunities that the people of the Basin face moving forward.

These conversations were not easy. Partnership members learned new insights and had to dispense with false impressions. The respectful exchange of viewpoints and dialogue helped to create a sense of openness to change. Throughout difficult conversations, the collective interest in sustainable salmon and a healthy ecosystem into the future served as a bond to keep everyone at the table.

This chapter shares the stories of some Partnership members. The stories, like the individuals, are all authentic. Heartfelt, the stories portray the complexity of the Basin's human landscape and the needs, emotions, and values of its people. All of the stories, like the people, matter. They are provided here so the people of the Basin can learn about and from each other, and gain perspective on their collective needs. The stories capture the energy and commitment of individual Partnership members to the salmon, rivers, and landscape, and their desire to work together to create a healthy ecosystem that supports different cultures and economies. The Partnership hopes these stories will motivate others to learn from different viewpoints and work openly and passionately to achieve common goals.

The collection of perspectives from across the Basin serves as a way to change the nature of the conversation about salmon and steelhead conservation and ask how "we" as a region can meet the needs of these fish. In most contexts, the focus is on biological or engineered solutions to human-created problems. The question of how the problem came to exist in the first place, including the social, cultural, and economic values that contributed to and perpetuate the decline of salmon, is rarely discussed. By engaging in these broader conversations, people start to break down those barriers and think about a problem more comprehensively, thus providing a space for broader understanding and solutions.

The proposition of changing course is not as threatening when it is prefaced with an understanding that our current situation was created by a certain set of social, cultural, economic, and environmental values, and that those values may be combined in different ways to create better results for all. People stop thinking about a problem in terms of "winners" and "losers" and begin to explore different ways of sharing the benefits so all enjoy them.

Ultimately, these perspectives do not represent an "end" but rather the means to incorporate a more creative way to think about challenges ahead, with the hopes of moving toward a win-win solution. Meeting the needs of our diverse landscape — while leaving future generations with resilient fish and wildlife populations, and a healthy ecosystem — will take ingenuity, innovation, and teamwork. This diversity, however, is also our strength. By listening to each other and recognizing our different interests, people can pinpoint common problems, identify sustainable solutions, and join forces to address them effectively.

Sportfishing Industry Perspective

By Liz Hamilton, Northwest Sportfishing Industry Association

The Northwest Sportfishing Industry Association (NSIA) is dedicated to the preservation, restoration, and enhancement of sport fisheries and the businesses dependent on them. Our organization itself consists of about 300, mostly small, businesses serving nearly 2.2 million customers in Oregon, Washington, and Idaho. In Oregon and Washington alone, nearly 400,000 customers have purchased special fishing licenses to fish for salmon in the Columbia River annually. Not only do these millions of license holders fund conservation agencies, but the sportfishing industry also pays an excise tax on manufactured goods and boat fuel. This federal excise tax, called the Sportfish Restoration Fund, was initially introduced by the industry and brings tens of millions back to the Pacific Northwest for the betterment of fish and fisheries.

As the largest salmon-producing river in the lower 48 states, the Columbia River is vital to the industry across an entire supply chain. Chinook, sockeye, and coho salmon and steelhead returns fuel sport fisheries in the Basin across an entire calendar year. And the first salmon of the year to enter the Columbia River, spring Chinook salmon, set the table for the success of our industry for the entire year. Fishermen buy their license, the latest tackle, a new battery for their boat, maintenance for their boat, motor, and trailer, and make a dozen other purchases that support local industries. The food chain of manufacturing, wholesale, and retail that feeds these industries can take several months or even years. For example, if a local lure manufacturer is looking to be as cost-effective as possible, they may need to buy several years-worth of hooks, creating a distribution cycle that must start months or years in advance. If salmon fishing is curtailed, an overstocked inventory becomes difficult to move, impacting everyone from manufacturers to retailers and fishing guides.

The economic impacts of sportfishing are most directly felt in rural communities, acting as one of the few reliable transfers of wealth from urban to rural areas. The industry, which produces around $3 billion of economic development in the Pacific Northwest annually, is mostly operated by small, often family-run, businesses. The largest local businesses employ between 100 and 150 workers. The unique waters of the Columbia Basin lead to innovation from skilled craftsmen in the region, including aluminum boat builders and creators of geographic-specific fishing gear and the latest salmon lures.

Recent declines in salmon abundance have been extraordinarily difficult for sportfishing industries. Additionally, the ripple effect that filters through secondary businesses such as restaurants, hotels, and local tourism is often located in rural communities. The challenges the sportfishing industry faces are not easily remedied. It is difficult for these industries to adapt to other fish species — as they do not entice anglers as much as salmon do. The trend has been for struggling salmon-related businesses to close or sell to larger corporations. To illustrate this point, consider the fate of Luhr-Jensen & Sons. It was once the largest salmon lure manufacturing company in the world, starting in a garage along the Columbia River in the 1930s and then growing to become the second-largest employer in Hood River County. Recent declines in salmon abundance impacted the business so consistently that when the founder/owner retired, he sold the company. Today it is owned by a large international company based In Finland, which has moved the production and jobs offshore.

Consider the local fishing guide, an important part of Oregon's tourism infrastructure, who needs to juggle two jobs to support his young family. This young man has over $200,000 tied up in his boat, motor, trailer, truck and gear, and a loan payment to finance his equipment. Add onto that moorage, business licenses, hotels, food, ice, and other necessary trip expenditures. His family's fate is tied up in fisheries that are collapsing. When his trips are canceled or failed to be booked in the first place, local communities lose income for hotels, restaurants, rain gear, and other purchases to local shops during his customers' stay. When a fishery closes suddenly, entire trips to the Pacific Northwest are canceled, creating second thoughts for these visitors to book a trip to fish our waters for salmon and steelhead.

Importantly, fishing is more than an industry. Fishing connects people in terms of family and friends while putting sustainable food on their tables. And fishing is about hope — hope that "I" will be the lucky one to catch the next salmon and be able to take it home for dinner. One of our constituents recently said, "Well it looks like this year will be as bad as last year, but last year we had some hope." We are looking at some bad fishing seasons, compounded with the lack of hope. And yet fishing is about hope.

There is also a personal connection to fish that cannot be understated for those who live and work on the river. It is more than an economic connection. It is also spiritual. I believe we have a moral obligation to avoid their extinction.

Challenges and Opportunities

The status quo is not acceptable. We are in crisis mode. The path forward should consider what alternatives are available or might be available in the future for those river-based industries that can adapt. Salmon do not have any alternatives but to live in the river. We can find other ways to transport our goods, irrigate crops, and generate and conserve power, but fish cannot do without water.

Constructive dialogue should continue to move away from the false choices that have dominated the discussions about Columbia River salmon recovery, such as either fish or reliable power and fish or efficient transportation. These will be important conversations as we look to dam removals and re-introductions to recover, protect, and restore salmon. What does it look like to restore fish above blocked areas and what kind of productivity can we get out of that? These conversations should include questions about alternatives. How can the irrigation sector modernize and conserve water so there's enough for fish also? What kind of transportation system do we need to move farm products? Where do transportation investments help the entire region, not just agriculture? There are many examples of innovation in the energy sector, and ideas about how we can embrace conservation and renewables.

These types of questions and considerations will shape not just the future of salmon but the future economic development of the Columbia Basin. The businesses in the sportfishing industry have been put on hold for too long. We cannot start soon enough to create solutions to address these important considerations and solve these challenges.

Southern Resident Killer Whales and Ecological Perspective

By Ben Enticknap, Oceana

Columbia Basin salmon and steelhead provide a rich, seasonal food source for aquatic and terrestrial wildlife. As such, they play an integral role in establishing a functional food web, linking together the land, river, and sea. Wildlife, including bald eagles, osprey, American black bear, river otter, and whales, have a very strong, possibly co-evolutionary relationship with salmon. The importance of salmon to over 130 species of fish and wildlife across the region cannot be overlooked or understated.[88] The loss of salmon and steelhead impacts many wildlife species and weakens the overall health and functioning of the region's terrestrial and aquatic ecosystems.

For Southern Resident killer whales, the close connection between salmon and dependent wildlife could not be clearer. Perhaps the single greatest change in food availability for these whales has been the decline of Chinook salmon in the Columbia Basin.[89] Rebuilding Chinook salmon populations in the Columbia-Snake River system is a critical need for the recovery of these whales. This distinct Southern Resident killer whale population has relied on Columbia Basin Chinook salmon for thousands of years but the whales are now dangerously nearing extinction just as many Chinook salmon populations are threatened with extinction.

In November 2005, NOAA's National Marine Fisheries Service issued a final rule listing Southern Resident killer whales as endangered.[90] Primary threats to the whales' recovery include reductions in the quantity or quality of prey (principally Chinook salmon), contaminants, and sound and disturbance from vessel traffic. As of January 2020, there were only 72 whales in the population (Figure 34). The Southern Resident killer whale recovery goal of an annual average 2.3 percent growth rate over 28 years is not being met. Population-level analyses find that the whales will likely go extinct under current conditions and threats.[91] To meet the recovery goals and prey requirements for the whales, Chinook salmon abundance must increase, including Chinook salmon from the Columbia Basin, where there is significant restoration potential.

Southern Resident killer whale births and deaths have been closely linked with coastwide Chinook salmon abundance. Diet studies show that 99 percent of their diet is salmonids, with roughly 80 percent being the largest and fattiest of fish, the Chinook salmon.[92] It has been shown that with lower Chinook salmon abundance, Southern Resident killer whale fecundity decreases and mortality increases.[93] Other studies, however, suggest this relationship may be weakening, highlighting the challenges in quantifying the ecological relationships of the whale population.[94] Nevertheless, recent low Chinook salmon returns have been perilous for the whales. There were no successful Southern Resident killer whale births from 2016 to 2018 and half of the ten whales born in the 2014–2015 "baby boom" later died. Some of the whales were visibly emaciated. In 2018, a 3-year-old whale, "Scarlet" or J50, died after she became so obviously thin that she lost the fat at the base of her head — what scientists call "peanut head."

Chinook salmon from the Columbia Basin, including Lower Columbia spring, Snake River spring, Middle Columbia, and Upper Columbia summer/fall Chinook salmon, are considered among the "priority" Chinook salmon stocks for increasing abundance to help Southern Resident killer whale recovery.[95] The science confirms that the whales feed on Columbia Basin Chinook salmon, often in the late winter and early spring months when they are foraging near the

88 Cederholm, C. J., D. H. Johnson, R. E. Bilby, L. G. Dominguez, A. M. Garrett, W. H. Graeber, E. L. Greda, M. D. Kunze, B. G. Marcot, J. F. Palmisano, R. W. Plotnikoff, W. G. Pearcy, C. A. Simenstad, and P. C. Trotter. 2000. Pacific Salmon and Wildlife–Ecological Contexts, Relationships, and Implications for Management. Special Edition Technical Report, Prepared for D. H. Johnson and T. A. O'Neil, Wildlife-Habitat Relationships in Oregon and Washington. Washington Department of Fish and Wildlife, Olympia, Washington.

89 National Marine Fisheries Service. 2008. Recovery Plan for Southern Resident Killer Whales (Orcinus orca). National Marine Fisheries Service, Northwest Region, Seattle, Washington. At: II-82.

90 70 Fed. Reg. 69,903 (November 18, 2005).

91 Velez-Espino, L. A., J. K. B. Ford, H. A. Araujo, G. Ellis, C. K. Parken, and R. Sharma. 2014. Relative importance of Chinook salmon abundance on resident killer whale population growth and viability. Aquatic Conservation: Marine and Freshwater Ecosystems. 25(6): 756-780. Lacy, R. C., R. Williams, E. Ashe, K. C. Balcomb, J. N. Brent, C. W. Clark and P. C. Paquet. 2017. Evaluating anthropogenic threats to endangered killer whales to inform effective recovery plans. Scientific Reports, 7, 14119.

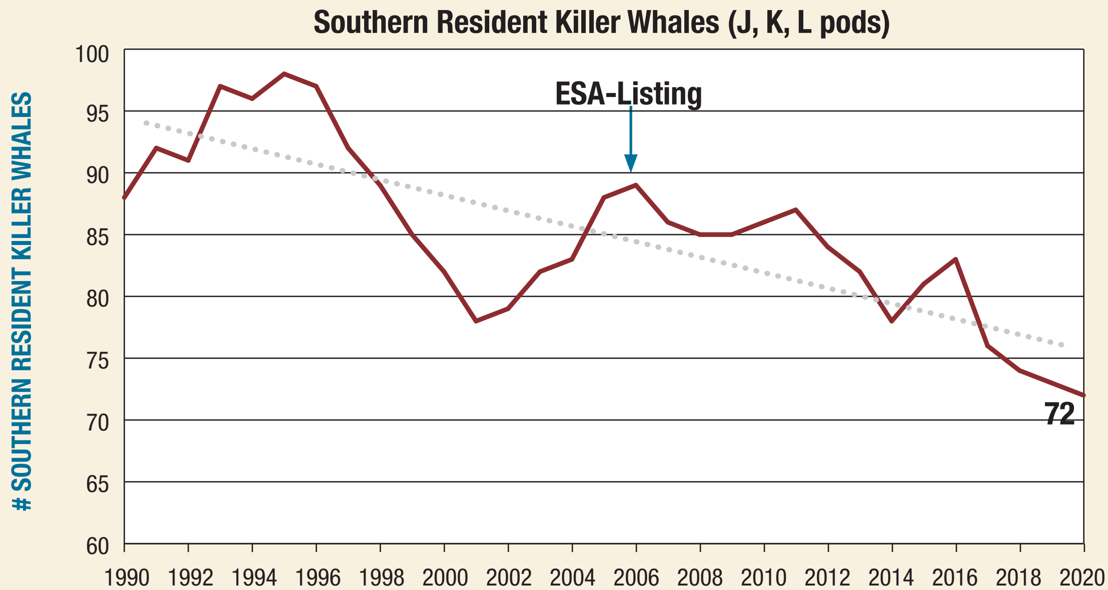
92 Ford, M. J., J. Hempelmann, M. B. Hanson, K. L. Ayres, R. W. Baird, C. K. Emmons, and L. K. Parlk. 2016. Estimation of a Killer Whale (Orcinus orca) Population's Diet Using Sequencing Analysis of DNA from Feces. PLoS ONE, 11(1), 1–14. http://doi.org/10.5061/dryad.ds6gc.

93 Ward, E. J., E. E. Holmes, and K. C. Balcomb. 2009. Quantifying the Effects of Prey Abundance on Killer Whale Reproduction. Source Journal of Applied Ecology Journal of Applied Ecology, 46(46), 632–640. https://doi.org/10.1111/j.1365-2664.2009.01647.x. Ford, J. K. B., G. M. Ellis, P. F. Olesiuk, and K. C. Balcomb. 2010. Linking killer whale survival and prey abundance: food limitation in the oceans' apex predator? Biol. Lett. (2010) 6, 139-142 http://doi.org/10.1098/rsbl.2009.0468.

94 Pacific Fishery Management Council. 2020. Salmon Fishery Management Plan Impacts to Southern Resident Killer Whales. Final Draft Risk Assessment (February 2020). Available: https://www.pcouncil.org/documents/2020/02/e-3-a-srkw-workgroup-report-1-electronic-only.pdf/.

95 NOAA Fisheries West Coast Region and Washington Department of Fish and Wildlife (NOAA and WDFW). 2018. Southern Resident Killer Whale Priority Chinook Stocks Report. Available: https://www.fisheries.noaa.gov/webdam/download/103504571.

FIGURE 34. The number of Southern Resident killer whales, 1990 to January 2020. Center for Whale Research. The dotted line shows the downward trajectory for the future at the current rate of population decline.



mouth of the Columbia River. Analysis of fish scales and whale fecal samples collected on the outer coast indicate that Chinook salmon are the primary species consumed on the outer coast and that over half the Chinook salmon consumed by the whales are from the Columbia Basin.[96]

In the face of persistent threats to salmon and Southern Resident killer whale recovery, many people are calling for bold and urgent recovery actions, including making big changes in the Columbia Basin. Many see the Columbia Basin as critical to the region's Southern Resident killer whale recovery efforts. The focus on salmon recovery in the Columbia Basin is based on two converging sets of facts: First, as described above, the science on the whale population shows the link to salmon as part of their prey requirements, foraging ecology, and major threats to their continued survival. Second, salmon restoration potential exists in the Columbia Basin.

Challenges and Opportunities

By implementing bold actions like restoring the lower Snake River and increasing spill, establishing passage above currently blocked areas, and providing salmon access to high-quality habitat in the upper reaches of the Columbia Basin, we can expect to see substantially more Chinook salmon returning to the Basin on average than under current conditions (Figure 35). We expect many of these results could be seen quickly with tremendous benefits for Southern Resident killer whales and people.

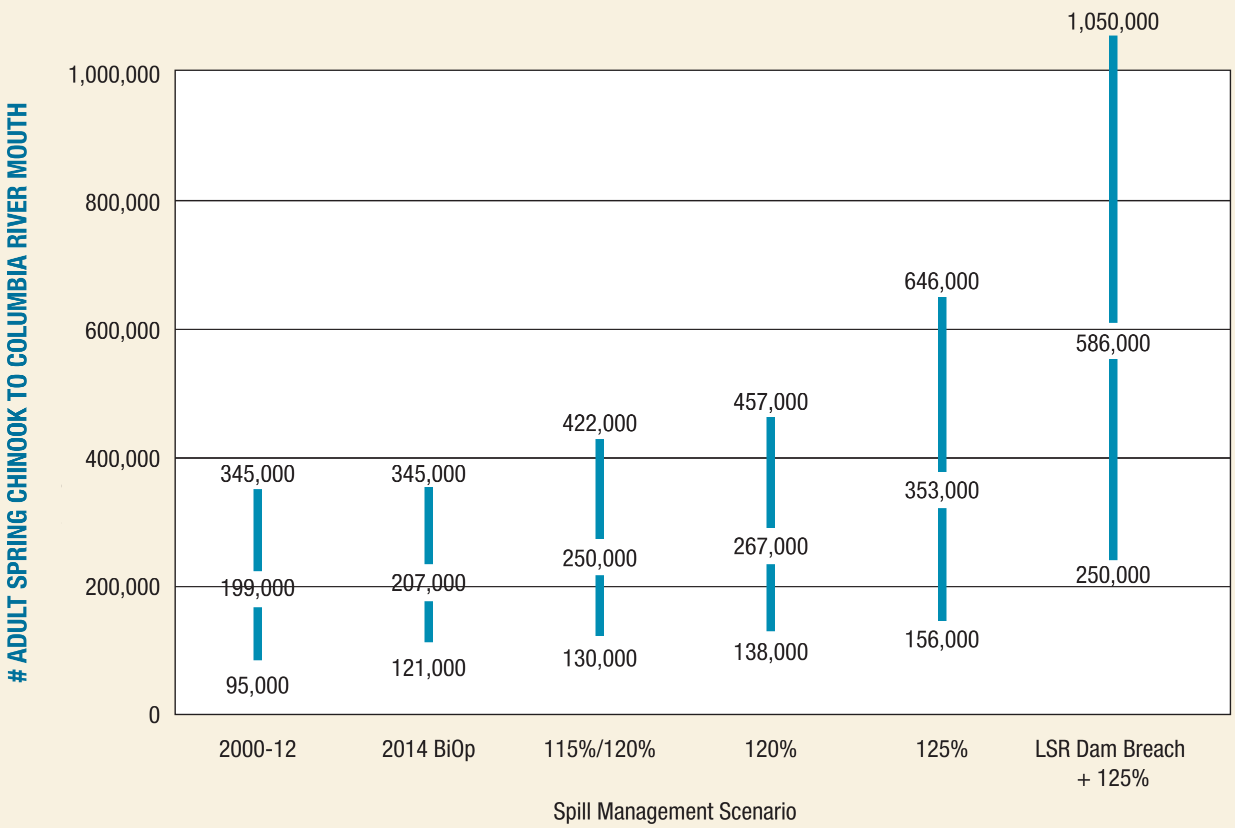
The extinction of Southern Resident killer whales is an unfathomable proposition for people throughout the region, including scientists, conservationists, non-governmental organizations, whale watchers, and many others. But without the urgent implementation of bold actions to recover Columbia Basin salmon, quickly stopping the decline of the endangered whales, and beginning to achieve recovery goals, it is an all too likely scenario. The sense of urgency is only heightened by climate change, which will result in further loss of salmon habitat, alteration of river flows and temperatures, and increased frequency of marine heatwaves and ocean acidification.[97]

Southern Resident killer whales and salmon are important to our region's cultural identity, fishing economy, and tourism industry. Southern Resident killer whales are deeply respected by many people, including Coast Salish Tribes and First Nations.

96 National Marine Fisheries Service. 2019. Proposed Revision of the Critical Habitat Designation for Southern Resident Killer Whales Draft Biological Report. Available: https://www.fisheries.noaa.gov/action/critical-habitat-southern-resident-killer-whale.

97 Northwest Fisheries Science Center. 2014. Impacts of Climate Change on Columbia River Salmon. Fish Ecology Division Northwest Fisheries Science Center National Marine Fisheries Service, NOAA; IPCC, 2019: Special Report on the Ocean and Cryosphere in a Changing Climate [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)].

FIGURE 35. Spring Chinook salmon returns and expected spring Chinook salmon returns to the mouth of the Columbia River under the 2014 federal Columbia River hydropower system spill management framework and revised spill and lower Snake River dam breach management scenarios (Adapted from, M. DeHart 2018).[a]



[a] Breaching the four lower Snake River dams and increasing spill to 125 percent total dissolved gas (TDG) is expected to result in average returns of 586,000 adult spring Chinook to the mouth of the Columbia (all runs, originating above Bonneville Dam, hatchery and wild) with higher (1,050,000) and lower (250,000) adult spring Chinook return estimates based on variable environmental conditions (M. DeHart, Fish Passage Center). As presented in: lower Snake River dam panel discussion and webinar to the Washington Orca Task Force (September 27, 2018). Based on CSS (Comparative Survival Study) 2017. Comparative Survival Study of PIT-tagged Spring/Summer/Fall Chinook, Summer Steelhead, and Sockeye. December 2017. 834 p.

Killer whales, for example, are considered culturally and spiritually significant for the Lummi people of Washington's northernmost coast and southern British Columbia. The Lummi name for killer whales, *qw'e lh'ol' me chen*, means "our relations who live under the water."[98] Southern Resident killer whales are also an important economic driver in Washington. One study of the economic contribution of whale watching in the state projects annual losses of $34 million in economic activity, $2.2 million in state and local tax revenue, and 330 jobs if the whale population were to go extinct.[99]

While the big, bold changes for salmon and Southern Resident killer whale recovery being called for will not be easy, they will be effective. It is well understood that actions like lower Snake River dam removal will require that we also address other related important issues, like clean power generation, energy efficiency, irrigation, and transportation. These are complex issues that the region must address. With this great challenge, however, there is an opportunity for collaborative approaches that could help move these ideas forward in ways that address the urgent needs of Southern Resident killer whales and the needs of people throughout the Columbia Basin. Ultimately, for salmon, dependent wildlife, and people, we need to see real, meaningful change. It is encouraging that people throughout the Basin are willing to come together to find a path forward that benefits killer whales, salmon, people, and the overall health of the region's ecosystem.

[98] Julius, J. 2018. Tokitae's return is part of their larger vision to protect and restore the Salish Sea. The Bellingham Herald, op-ed, Jay Julius, Lummi Nation. Available: https://www.bellinghamherald.com/opinion/op-ed/article210826344.html.

[99] Van Deren, M., J. Mojica, J. Martin, C. Armistead, and C. Koefod. 2019. The Whales in Our Waters: The Economic Benefits of Whale Watching in San Juan County. Earth Economics. Tacoma, WA.

Ranching and River Restoration in Eastern Oregon, "It's not just all about the fish"

By Liza Jane McAlister, 6 Ranch

James W. McAlister first saw Wallowa County as a boy on a hunting trip in 1876 and he was forever enamored, vowing to come back and raise his family there, which he did. Along with his hardy wife, Belle, he settled on a piece of land with rich soil, diverse wildlife, and a winding river. Six generations later, we are still striving to be the best stewards of the land, river, and animals that sustain us. We raise Corriente cattle, quarter horses, cow dogs, bees, chickens, gardens, and do our best to preserve traditions, restore ecosystems, and produce healthy food.

My experience with restoration began about 28 years ago when I was fishing with my 8-year-old son on the stretch of the Wallowa River that runs through our family ranch. A half-century before us, the river had been moved, straightened and channelized to accommodate agriculture, and protect the railroad and highway. The winding, historical riverbed was still evident in the riparian pasture, and we both wondered how we could "put it back" the way it used to be. My son was thinking about creating better fishing, I was looking to restore balance. We initiated a project with ODFW to divert the river, but it rapidly became very expensive, bogged down in bureaucracy, and out of our reach. However, a neighbor downstream with similar values and greater tenacity picked up where we left off and completed a successful restoration project in his stretch of the Wallowa River. Often it takes a trailblazer to cut the path so we can all see how to get where we want to go, and 18 years after we started the process, we moved the river back into its old bed.

The resiliency of Nature is miraculous. Within two weeks of moving the river into its new channel, we had macroinvertebrates making homes under rocks, and in less than a month, Chinook salmon were found spawning for the first time in over 30 years. The abundance of bugs, birds, and streamside vegetation was inspiring, and the water table for the valley improved to help sub-irrigate our pastures. One good thing leads to another, so we purchased the land adjacent to ours that included another mile of river and set out to restore its meanders and floodplains too.

Just as everything is connected, nothing happens in isolation. The restoration work on our ranch could not have happened for us without partnering with government and non-profit agencies. In the ranching community, it is a widely held belief that collaborating with the government is akin to the death penalty. This belief is based on the reality of power imbalance and an unintended message of discredited knowledge and lack of trust. I think of my great-grandparents who homesteaded our ranch in 1884. It is hard to imagine their urban neighbors or government agencies restricting their decisions on their land because they believed they were more knowledgeable about managing natural resources than my family that worked on the land, but that is the reality today. Many people in my community believe that if the government is allowed to get one step inside the gate, they will eventually take our land and livelihood. There is a historical record to provide a basis for those fears.

Trust can be built when respect for knowledge is present in relationships and will be what is necessary to continue to restore the health of watersheds for fish and wildlife, specifically on private working lands. An example of a shift in trust and respect is the second phase of the Wallowa River restoration project on our ranch. It's one of the first projects in our region where cattle will actually be considered as a restoration tool, helping to graze invasive reed canary grass in the riparian areas. In addition, our government partners understood that the restoration work we accomplished could not be at the expense of our ability to remain an economically viable operation. Agriculture, restoration, and recreation can all fit onto the same landscape when approached holistically.

A good story can go a long way. I hope that we can keep finding those stories about all the good work and successes that we are having on the land that will help us reach our goals to support the return of salmon and steelhead to our rivers.

Working with Ranchers

By Mike Edmondson, Idaho Governor's Office of Species Conservation, and Merrill Beveler, Beveler Ranches, Leadore, Idaho

In the interior Columbia Basin, agricultural and ranching lands are often adjacent to the spawning areas of spring/summer Chinook salmon. This is no coincidence, as the broad floodplains created by western rivers and their rich soils were idyllic to settlers looking to sustain themselves. These same broad river valleys are the habitat in which Chinook salmon complete their life cycle, carrying loads of marine-derived nutrients inland, spawning, dying, and thus contributing to these same floodplain ecosystems. The Chinook salmon's progeny rear in these same areas in preparation for their journey to the ocean to mature to adults and complete the cycle.

As pioneers settled the west, populated these valleys, and the overall population increased, often the riverine habitat and adjacent floodplain were altered to suit their growing needs. This often meant channelizing, de-snagging, and moving rivers, as well as diverting water for growing crops. The changes, while practical and necessary for human needs, often were detrimental to the habitats that supported these salmon and that these salmon, in turn, sustained. No one action, no one government program, no one segment of our culture intended to diminish salmon populations. Rather, a myriad of actions and government programs worked to change the landscape to prioritize meeting human needs. The unintended consequences of our growth have been highly detrimental to salmon populations. Floodplains that were once tangled riparian forests that flooded seasonally have become pastoral landscapes disconnected from the water tables. They now contain single-thread river systems instead of multi-channel river systems. These single-thread systems, lacking beaver, de-snagged, disconnected from their floodplain, and often diked or leveed, have become efficient drainage networks and conveyances of irrigation water rather than the vibrant aquatic/riparian habitats that once supported a keystone species, the salmon, a cultural icon and for some, a sacred creature.

Fast forward to today, we see that in the interior Columbia Basin we have upwards of 9 ESA-listed salmon and steelhead species. In Idaho, we have four ESA-listed stocks: spring/summer Chinook, fall Chinook, and sockeye salmon and steelhead. In the upper Salmon Basin, the settlement patterns and conversion of floodplains to agriculture have played out in the same manner they have Basinwide. The Idaho Legislature created the Governor's Office of Species Conservation (OSC) in 2000 and charged the agency with all matters pertaining to ESA issues and federal-state coordination. In concert with the Idaho Department of Fish and Game and many other state and non-governmental organizations, we are working to implement ESA recovery plans for listed stocks of anadromous fish in Idaho. A key approach is to improve or rehabilitate the freshwater habitat to increase the carrying capacity of the riparian/riverine ecosystem, which will, in turn, increase the productivity, abundance, survival, and overall health of our ESA-listed stocks. The challenge is to do it in such a way that it provides a win-win situation for all parties involved. The guiding principle in Idaho is to recover species while maintaining Idaho's vibrant economy.

On the scale of a river reach that should support anadromous reproduction and rearing, we work with private landowners to improve the capacity of the landscape for salmon while keeping agricultural operations whole or providing a net benefit through increased efficiency of irrigation or a net increase in production. Ranchers and other landowners want to see anadromous fish recovered for a variety of reasons, including reducing the burden of the ESA, the intrinsic value of salmon, and often the nostalgia of remembering catching salmon on their ranches or hearing the stories of their fathers or grandfathers catching salmon. Whatever the reason, they are all valuable, meaningful, and motivational.

As a fish biologist working with ranchers and other landowners, I believe the best thing we can do is listen. Landowners observe changes through time and seasons and know their land best. They can be exceedingly good stewards of their land and come to us to improve their land for anadromous fish. To do so, we need to understand landowners' daily lives, their operations, seasonal patterns, and challenges. We need to respect their experience, observations, and knowledge. Relationships have to be built. Often times this occurs over morning coffee, supper with the ranch crew, and even branding calves in the spring. Relationships become partnerships in conservation and often turn into lifelong friendships. Changes to the river system negatively impacting anadromous fish often came from improvements to make living and ranching next to the river more viable. Flooding was often problematic once infrastructure was built so rivers were confined in single channels or even moved over to one side of a valley to avoid the need for a bridge or a long drive to access a pasture on the other side of the river. Levees were built after flood events, and rip-rap was placed to "repair" banks and was often a pragmatic approach for a single landowner with limited personal funds.

In this era of river restoration, the public and user groups, such as electricity ratepayers, are providing funding to rebuild rivers either for regulatory compliance or for mitigation responsibilities. Since the habitats that need improvement are often on private lands, it is only through a voluntary model that these actions can occur and, due to their nature, they can only occur through shared-cost models. While there are incentives for landowners, often they are not the right fit for a family or individual and most participate because they want to see the outcome of increased fish abundance. Other times, conservation easements or water transactions are the vehicles that facilitate the ability to restore riparian/riverine systems on private lands. In the end, it is the willingness of a landowner, the relationships that have been cultivated, and the availability of funding that need to come together to move the needle toward ESA recovery and eventually to anadromous fish abundance.

Challenges and Opportunities — The Little Spring Creek Project Story

"I love it when a plan comes together," said Colonel Hannibal Smith in The A-Team, an American television series. The restoration and reconnecting of Little Spring Creek to the Lemhi River and the cold-water refugia it now provides reminds me of episodes from the A Team. So, with this in mind what are some of the elements necessary for a plan not only to come together, but to begin? The rancher's methodology, patterned after Lenard Snart's as portrayed in The Flash, may play a role. It consists of making a plan, expecting the plan to work, seeing the plan go off the rails and throwing the plan away. In the case of Little Spring Creek, it took at least 20 unravelling plans with their accompanying disasters. One disaster was so significant, that it found a rancher standing knee-high in water at the bottom of a ditch now 20 feet deep watching the Lemhi River being displaced to Highway 28. After sorting through a complete list of all the words commonly connected to such times, and with hands on his hips, he shook his head and declared, "Well crap. What are we going to do now, and who are we going to call?"

Yes, almost all projects are landowner initiated, not all of them out of distress, but without a support group the only thing to do is to find a bigger Cat that can push more, knowing it will have to be done again, and again.

The Little Spring Creek Project was born out of frustration and a need to find a better way. One of the frustrations with Little Spring Creek was that it accommodated two diversions from the Lemhi River, which traversed an alkali field carrying huge sediment loads down Little Spring Creek. This water was re-diverted out of Little Spring Creek along the steep hillside for seven miles, creating another frustration, the risk for potential washouts. There is clear evidence of 20 plus such events. Little Spring Creek itself was diverted four times and was a dry channel during the irrigation season. With the construction of Highway 28, the lower end of Little Spring Creek had been straightened and channelized.

The four ranchers associated with Little Spring Creek began looking for a better answer. They turned to The Upper Salmon Basin Watershed Program, under the direction of the Idaho Governor's Office of Species Conservation, for help. From these conversations, the Little Spring Creek Project took shape. With a host of partners to do the lifting, this project moved to completion.

Today, Little Spring Creek is a different picture.

- There are no diversions from the Lemhi River being dumped into Little Spring Creek.
- There are no diversions of water from Little Spring Creek.
- The hillside ditches have been eliminated along with the risks of washouts.
- Colder water from Little Spring Creek now enters the Lemhi River.
- More efficient and dependable irrigation systems using warmer river water now occupy these ranchlands.
- The section of Little Spring Creek that was channelized next to Highway 28 has been restored with sinuosity, complexity, and a cold-water refugia that attracts fish (Figure 36).
- For all of these changes to occur, funding was required along with hands on the ground. This in turn has built and diversified our local rural economy.

FIGURE 36. Little Spring Creek, a tributary to the Lemhi River in Idaho after restoration projects completed.

Today's image of Little Spring Creek is a vast improvement over standing knee-high in water 20 feet from the top of the bank, watching the Lemhi River heading for Highway 28 and wondering "What are we going to do now?"

Our valley, our ranchlands, and our community are better positioned, thanks to the following Partners in Conservation:

- Upper Salmon Basin Watershed Program
- Idaho Department of Fish and Game
- Idaho Office of Species Conservation
- Idaho Department of Water Resources
- U.S. Bureau of Reclamation
- U.S. Bureau of Land Management
- U.S. Fish and Wildlife Service
- U.S. Forest Service
- Columbia Basin Water Transactions Program
- The Nature Conservancy
- Trout Unlimited
- Idaho Water Resource Board
- Shoshone Bannock Tribes
- Lemhi Regional Land Trust
- Idaho Power
- Bonneville Power Administration

Hydroelectric Power Perspective

By Tom Dresser, Grant County PUD; Mike Edmondson, Idaho Governor's Office of Species Conservation; Joe Lukas, Western Montana Electric Generating and Transmission Cooperative; Kurt Miller, Northwest RiverPartners; and Glen Spain, Pacific Coast Federation of Fishermen's Associations

The Columbia Basin contains more than 400 dams,[100] over half of them dedicated (fully or partly) to generating power. Together these dams serve as the region's primary source of electricity. Fully 40 percent of the electricity used in the Northwest is generated by 33 federal dams that comprise the Federal Columbia River Power System (CRS). This rises with contributions from non-federal dams in the Columbia Basin, and again with the addition of electricity from dams in the Canadian portion of the Columbia Basin. It is the largest hydroelectric system in the United States, accounting for 40 percent of all hydroelectric production in the nation. Nearly 60 percent of the energy produced in Washington, Oregon, Idaho, and Montana is generated by hydropower dams on the Columbia and Snake Rivers. Most of the hydroelectricity in

[100] Northwest Power Conservation Council. However, no universally agreed upon census of dams in the Columbia Basin seems to exist.

the region is marketed by the Bonneville Power Administration to not-for-profit, community-owned utilities across the Northwest. Fish passage at these and other dams has been a major concern for nearly as long as dams have existed in the Basin.

Ultimately, the key interest of the hydroelectric sector is to cleanly, efficiently, and reliably generate and deliver affordable energy to customers throughout the Pacific Northwest in the most cost-effective manner to support carbon-reduction goals and enhance economic development throughout the region. Additionally, the hydroelectric sector wants to produce electricity in a manner that reduces the impact on fish with regulatory and budget certainty.

In return for certain social benefits that dams provide, those who made the original decision to build any particular dam chose to accept various negative impacts on society that can also be caused by dams, such as partial or complete blockage of salmon migration routes, reduced water quality and quantity, loss of natural river functions such as sediment recruitment and seasonal flushing flows that support healthy riverine ecosystems, channeling of rivers that reduce the natural meander of rivers over time, and reduced river ecosystem functions generally. In today's world, our views as a society of these tradeoffs are changing.

Mid-Columbia Public Utility Districts

In central-eastern Washington State, the Mid-Columbia Public Utility Districts (Mid-C PUDs; Chelan, Douglas, and Grant PUDs) provide a combined peak generating capacity of 4,928 megawatts. This electricity supports regional needs but more importantly drives the local economies of Chelan, Douglas, and Grant counties for irrigated farming, food processing, manufacturing, local governments, retail trade, health services, data centers, and other industries.

The above-mentioned sectors accounted for over 98,000 individual payrolls within these three Washington State counties with a total wage income of $3.54 billion.[101] The importance of this low-cost power generated by the Mid-C PUD's is further highlighted by the fact that Grant County farms annually produced crops and livestock valued at $1.19 billion, while crops processed within the county create a $364 million industry.[102]

Challenges and Opportunities

Salmon, water, and the hydroelectric system play an integral role in the Pacific Northwest culture. Focusing on a single interest/sector will not achieve the Quantitative Goals developed during Phase 1 meetings of the Partnership. Instead, a comprehensive approach including all interests/sectors must be developed from the federal to the state and local levels. This comprehensive approach needs to be well defined with costs and benefits clearly documented and articulated, so the citizens of the Pacific Northwest can fully understand the shared cost(s) across society.

Scenarios for salmon recovery calling for normative river conditions, dam breaching, or year-round spill at one or more hydroelectric facilities on the Snake or Columbia Rivers could severely and negatively impact the reliability and affordability of electricity from the Pacific Northwest power system. This impact would likely be severely felt by customers, especially low-income customers in central-eastern Washington and other rural areas in the Pacific Northwest that rely on access to affordable energy. For example, in rural counties, like Grant County in Washington State, the inflation-adjusted per capita personal income is $38,308, which is less than the average in the rest of the state ($57,896) and the nation ($51,640).[103] Income in other rural counties is much lower. With a per capita income of only $11,597, Glacier County, Montana depends on low-cost power from the CRS to serve customers in one of the most severe climates in the United States.

Major changes in power production (such as dam breaching) could also have a chilling effect on the region's ability to draw new businesses or support existing agricultural jobs in central-eastern Washington, where agriculture is the top job-providing sector. Agricultural jobs accounted for 23.5 to 25.3 percent of the total employment for Chelan and Douglas counties, respectively, followed by local government (14.5 to 17.1 percent for Douglas and Grant counties) and health services (14.1 percent for Chelan County).[104] Any redesign of the Northwest's hydropower system would have to minimize negative impacts to agricultural industries and other important economic sectors.

While there will always be great debate over the costs and benefits of specific dam removal

[101] Merseck. 2020. Washington State Employment Security Department labor market county profiles. http://esd.wa.gov/labormarketinfo/county-profiles.
[102] Id.
[103] Id.
[104] Id.

proposals, the potential negative impacts of dam removal are further illustrated in the 2020 draft environmental impact statement for the removal of the lower Snake River dams, which reported that breaching would cost $1 billion per year for 20 year,[105] raise residential utility bills by 25 percent or more (if the hydropower is replaced with a carbon-free portfolio, such as wind, solar, and batteries), and cost $457 million in social welfare due to the loss of irrigation and jobs for farm laborers. But other studies, based on different assumptions and methodologies, come up with very different numbers, so there is as yet little agreement on either the costs or benefits of dam removals in the Basin.

Still, future technological innovations will likely provide opportunities to optimize hydropower generation while minimizing environmental impacts. This is well documented at the Mid-C PUD hydroelectric projects, which have been designed and constructed with top-spill bypasses (at Priest and Wanapum Dams), juvenile fish bypass systems (at Rocky Reach Dam), and "fish friendly" advanced turbine systems (at Wanapum Dam), and incorporated biological criteria into turbine upgrades (at Priest Rapids and Rocky Reach Dams). They also now operate a hydro-combine (at Wells Dam), implement specific operational criteria, such as "fish mode" during the juvenile salmonid and steelhead migration (at Wanapum and Priest Rapids Dams), a flow protection programs (the Hanford Reach Fall Chinook Protection Program), and a flow management tool (in the Okanogan River).

To move the region towards achieving the Partnership's Quantitative Goals, hydroelectric operators will need to evaluate whether proven technologies/innovations implemented at other dams are reasonable and feasible at their facilities.

Finally, we must keep in mind that dams are human-engineered structures designed and built to last certain lifespans and to provide a combination of benefits to society, including hydropower, river transportation, flood control, and irrigation. Over time, and often related to changes in technology, we have seen the mix and value of benefits that dams provide change. Additionally, according to the U.S. Army Corps of Engineers, the average age of the 90,580 dams in the U.S. is about 56 years, with many of them approaching or exceeding their designed lifespans,[106] including in the Columbia Basin. Thus, during the 100-year salmon restoration time frame that we contemplate in this report, there may be many opportunities to rethink, redesign, and reconstruct the Pacific Northwest's hydropower system in ways that both enhance salmon restoration and also better protect vitally important river ecosystems.

Port Perspective

By David Doeringsfeld, Port of Lewiston

Along the Columba and Snake Rivers, there are 27 inland and coastal ports that serve as important job creation centers for rural communities. To foster job creation, ports primarily focus efforts in three areas: intermodal transportation, economic development, and international trade. A port's role in intermodal transportation includes river, rail, roads, and runways. A port must be competitive in each of these areas in today's global economy.

Ports provide dependable, cost-effective transportation for agriculture exports. Northcentral Idaho and eastern Washington have primarily natural resource-based economies in timber and agriculture. Due to the multi-use benefits of the Columbia and Snake River system, both timber and agriculture have developed niche export markets. Farmers in the region, for example, produce soft white wheat and pulses (peas, lentils, and garbanzo beans). These are niche agriculture products of which approximately 90 percent is exported overseas.

The ports allow tug and barge companies to efficiently transport millions of bushels of grain throughout the year from inland grain elevators at terminals along the Columbia and Snake Rivers to coastal export terminals. One tug normally transports four barges in a tow, with each barge capable of carrying 100,000 to 120,000 bushels. The volume of grain in one tow is equal to approximately 536 semi-trucks or 140 rail cars. This ability to efficiently transport 400,000 bushels of grain in one tow allows U.S. farmers to compete in world export markets. Demonstrating the efficiency of the river system, wheat harvested on Monday

105 Northwest RiverPartners. This value is very consistent with a recent analysis performed by EnergyGPS.

106 See for instance the American Society of Civil Engineers (ASCE) 2017 Infrastructure Report on the nation's dams at: https://www.infrastructurereportcard.org/cat-item/dams. According to an inventory maintained by American Rivers, 1,384 dams have been removed in the U.S. from 1912 through 2016 (www.americanrivers.org/DamRemovalDatabase). Dam removal is thus not a radical or new idea, and there are often sound reasons to remove particular dams, but we must also remember that each dam presents unique situations, benefits and opportunities that must be carefully thought through on a case-by-case basis. See also Maclin E. and Sicchio M. (1999), Dam Removal Success Stories: Restoring rivers through selective removal of dams that don't make sense. American Rivers, Friends of the Earth, & Trout Unlimited, December 1999. https://www.michigan.gov/documents/dnr/damsuccess_513764_7.pdf.

in north-central Idaho, can be loaded onto a river barge on Tuesday and by Saturday, the wheat will be on an ocean vessel sailing out the mouth of the Columbia River. Along with agricultural products, port facilities ship petroleum products, fertilizer, solid waste, logs, and wood chips.

Ports provide the region with reliable, low-cost transportation while keeping carbon emissions low. It is far less expensive to transport containers by barge to Portland than it is to transport them by truck to Seattle or Tacoma. Additionally, exporters have fewer problems with damaged cargo when they can load their export containers for barge shipment instead of having a warehouse load the container in Seattle. They are also able to better schedule containers for steamship sailings.

Ports are foundational to communities along the Columbia and Snake Rivers and have recently become central players in enhancing local tourism. Cruise ship visitations are growing steadily throughout the Columbia and Snake River system, including to the Lewiston-Clarkston Valley. In 2018, cruise boat passengers touring on the Columbia and Snake Rivers outsold the Mississippi River for the first time. In 2019, five cruise lines with over 24,000 passengers visited Lewiston, Idaho and Clarkston, Washington. Passengers can disembark at several communities along the waterway and spend their dollars visiting local attractions. New cruise boats are being constructed and are scheduled for Columbia and Snake River excursions in 2020.

Reservoirs behind the four dams on the mainstem lower Columbia River and four dams on the lower Snake River provide numerous recreational opportunities. Each of the reservoirs offers a river/lake environment for residents and tourists to participate in a variety of water activities. Boating, sailing, windsurfing, fishing, water skiing, paddle boarding, and jet skis are just a few of the waterway activities.

Port activities can impact salmon and steelhead recovery in several ways. For example, driving piles for a new dock expansion, developing property for a new manufacturing plant, handling stormwater runoff at a facility so it does not pollute a nearby stream, or otherwise maintaining port facilities can have important consequences to fish recovery. Columbia Basin ports constantly work with stakeholders and agencies toward salmon recovery goals and incorporate a variety of measures into port projects to further recovery efforts.

Challenges and Opportunities

Ports recognize their role in mitigating for their impacts on salmon and in being good partners. Ports utilize a diverse array of measures to avoid, minimize, and mitigate impacts to ESA-listed fish and fish habitat, and to provide benefits to multiple other species. Port mitigation activities include:

- Enhancing existing wetlands and riparian areas with streams and shrubs;
- Creating wetlands;
- Reconnecting riverine areas to associated wetlands and floodplain;
- Creating and/or purchasing credits in habitat conservation banks;
- Installing engineered log jams to create and diversify fish habitat;
- Preserving and enhancing floodplain areas with trees and shrubs;
- Incorporating sound attenuation measures during pile installation activities, including the use of bubble curtains and/or use of a pile cushion during pile driving to reduce sound impacts to fish;
- Conducting in-water work during windows when listed fish are least likely to be present;
- Designing docks to mitigate impacts to fish and fish habitat by ensuring the docks are constructed in deep water, streamline design, and minimize overwater shading;
- Monitoring fish species during projects to collect data on potential effects; and
- Collaborating with fish enhancement groups to provide matching funds on fish enhancement projects.

One significant challenge for ports is obtaining permits to maintain port facilities. Port development projects require permits and coordination with local, state, and federal agencies, and the agencies coordinate with the tribes. On the lower Columbia River, these agencies include city or county jurisdictions, state fish and wildlife agencies, and the state departments of Ecology or Environmental Quality. Projects that entail in-water work, such as dock repairs or construction, require the ports to obtain multiple permits to conduct work along shorelines and in- or over-water. For example, in Washington State, a port would need to obtain 8 to 12 permits for an over-water project. These permitting processes are typically lengthy and complex. Unfortunately, they can also become adversarial given the conflicts around salmon in the Columba Basin and a litigious environment.

Ports must maintain their business viability along with operating in a strict regulatory environment. Most recently, regulatory changes in the application of the ESA require additional mitigation for existing and new structures and a more formal process of consultation. This has significantly increased the time and expense necessary to maintain existing facilities.

The Pacific Northwest has wrestled with proposals to breach the four lower Snake dams as a means of salmon and steelhead recovery for over 30 years. Breaching dams on the lower Snake River would end all barge shipments from Snake River ports. Similarly, should breaching be considered for Columbia River dams, ports on the Columbia River would suffer. A recent study for the Pacific Northwest Waterways Association by FCS Group found that the vast majority of farmers in north-central Idaho and southeast Washington could be forced into bankruptcy if the lower Snake River dams were breached and barge transportation was lost. This would have significant impacts on Columbia Basin agriculture and industries' because there are no cost-effective alternatives for shipping by barge at this time. Private rail companies would need to spend hundreds of millions of dollars to develop the needed capacity to handle the volume of grain currently shipped on the river system. Trucking grain to coastal export ports is also not economically feasible. Even the consideration of dam breaching has a negative impact on potential investments in expanding or locating port businesses. This is especially apparent in the developing inland cruise industry. For example, the Port of Lewiston is planning to construct a new cruise boat dock to assist in the berthing of new ships. Dam-breaching proposals loom heavily over this fledgling industry.

Another example of a potentially negative impact of dam breaching is specific to the Port of Lewiston. The Port of Lewiston has shipped numerous pieces of oversized equipment from the port to the interior of the U.S. and Canada. Currently, the Columbia/Snake River corridor and U.S. Highway 12 provide a unique transportation route because there are no height restrictions. U.S. Highway 12 has no overpasses and similarly, there are highway routes in Montana that have no height restrictions. There are no alternative west coast rail or highway routes that offer transport of cargo without height restrictions into the interior of U.S. Dam breaching would eliminate utilization of the Columbia and Snake Rivers and U.S. Highways 12 and 95 as shipping routes to Canada and the interior of the U.S.

In summary, it has been said many times that "there is no silver bullet in restoring fish runs." We all must work together to achieve abundant salmon and steelhead runs. Ports, along with other sectors, have both opportunities to contribute

PORT PARTNERSHIP IN KALAMA RIVER SALMON ENHANCEMENT

An exciting project on the Kalama River exemplifies how ports are working with various organizations to improve fish runs. Recently, the Port of Kalama provided matching funds and collaborated with the Lower Columbia Fish Enhancement Group utilizing funds from the Salmon Recovery Funding Board to further local efforts to restore and enhance habitat for salmon and steelhead on the Kalama River, a key tributary of the lower Columbia River. The project constructed wood structures along the shoreline of the Kalama River to provide shelter and safe feeding areas for juvenile salmon. The project goal is to maximize the function of the lower Kalama River as a thermal refuge habitat to benefit multiple in-basin and out-of-basin salmon stocks including Chinook, coho, sockeye, and chum salmon and steelhead. A second goal is to increase the productivity of in-basin stocks and to decrease predation of all salmonids by increasing habitat complexity and diversity.

Collaboration between the Port of Kalama and its partners resulted in positive outcomes to support salmon. The project:

- Installed 30 multi-log structures along 7,000 feet of mainstem shoreline and 970 feet of side-channel shoreline;
- Enhanced 2 million cubic feet of existing juvenile rearing and adult holding cover habitat;
- Increased riffle/ pool frequency from 1 pool in every 6,500 feet to 1 pool in every 170 feet;
- Reduced width-to-depth ratio from 150:3 to 125:5;
- Added 700,000 cubic feet of juvenile rearing and adult holding cover by increasing depth of existing deep-water habitat and creating a minimum of 20 new pools; and
- Increased sediment sorting to create a minimum of 2,000 square feet of spawning habitat.

to salmon recovery and challenges that must be addressed. We cannot pit one stakeholder against another. This will only ensure continued litigation.

The Partnership has demonstrated that diverse interests can reach consensus and make a positive impact. By respecting our diverse interests and developing shared goals, we can identify the strategic investments necessary to recover our iconic salmon and steelhead runs.

Idaho Irrigation Perspective

By Paul Arrington, Idaho Water Users Association

It is hard to believe that early European settlers to southern Idaho considered that it would ever be a thriving agricultural oasis. The sagebrush-covered desert stretched as far as the eye could see. Yet, through this land stretched the magnificent Snake River. Beginning near Yellowstone Park, the Snake River crosses southern Idaho in a winding path, collecting water along the way from the Big Wood, Boise, Payette, Weiser, and other river tributaries.

Over time, forward-thinking settlers, like I.B. Perrine, recognized this desert land could be developed into prime agricultural land. Beginning in the early 1900s, canals and ditches were dug throughout the landscape. Homesteads were granted by the federal government and reservoirs were built along rivers. Water delivery entities were formed to manage systems that would take the water from the river to the fields. It did not take long for the desert to bloom. Now, instead of sagebrush, Idaho's farmers grow potatoes, corn, beans, sugar beets, wheat, barley, and other commodities. What once was a sagebrush desert is now prime farmland used, quite literally, to feed the world. Water not needed by the crops fills underground aquifers and returns to the river system through spring discharges that fuel groundwater-fed irrigation. Thus, the spring flows benefit the river and an aquaculture industry that is second-to-none in the world.

Development of Idaho's river systems for water storage, hydropower, recreation, flood prevention, and other purposes has resulted in a thriving agricultural economy — none of which would be possible without storage reservoirs. Today, millions of acres are farmed throughout southern Idaho. In 2019, cash receipts from the sales of crops and livestock in Idaho totaled $8.3 billion[107] and net farm income was $2.7 billion.[108] Irrigated agriculture is responsible for over 112,000 Idaho jobs, about 12 percent of the total workforce.[109] The Bureau of Reclamation (Reclamation) estimates that projects along the Snake River and its tributaries have contributed billions of dollars to Idaho's economy (Table 13).

Reclamation and Idaho irrigators continue to work hard to balance the development and management of Idaho's river systems, including for fish and wildlife. Besides managing for irrigation, flood control, hydropower generation, and recreation, many of Idaho's reservoirs incorporate operations for fish and wildlife benefits. This includes an annual release of up to 487,000 acre-feet of Idaho water for downstream flow augmentation.

TABLE 13. Estimated economic contributions from the Boise, Minidoka, Owyhee, and Palisade hydroelectric projects in the Snake River basin.[a]

	Boise Project	Minidoka Project	Owyhee Project	Palisades Project
Crops	$624,575,000	$704,104,000	$155,250,000	$650,900,000
Livestock	$645,000,000	$387,144,000	$93,150,000	$355,448,000
Power Generation	$13,975,000	$6,339,200	$0	$31,413,000
Flood Prevention	$183,287,500	$9,961,600	$755,550	$20,942,000
Recreation	$33,002,500	$28,300,000	$4,830,000	$16,640,400
TOTAL	**$1,499,840,000**	**$1,135,848,800**	**$253,985,550**	**$1,075,343,400**

[a] Bureau of Reclamation (2017). The Story of the Boise Project. http://www.usbr.gov/projects/pdf.php?id=226. The Story of the Minidota Project. http://www.usbr.gov/projects/pdf.php?id=216. The Story of the Owyhee Project. http://www.usbr.gov/projects/pdf.php?id=217. The Story of the Palisades Project. http://www.usbr.gov/projects/pdf.php?id=218.

107 The Financial Condition of Idaho Agriculture: 2019 (Eborn & Taylor) (2020).
108 Id.
109 Taylor, Garth, The Contribution of Irrigated Agriculture to the Idaho Economy (2017).

SNAKE RIVER WATER RIGHTS AGREEMENT

In 2004, the State of Idaho, Nez Perce Tribe, and other water users entered the Snake River Water Rights Agreement, which was ratified and adopted by Congress in the Snake River Water Rights Act of 2004. That agreement resolved disputed tribal claims for the Snake River and its tributaries. As part of the agreement, Tribal water rights were quantified in the Snake River Basin Adjudication (SRBA), and trust funds were established for water and fisheries resources. The agreement also established a flow augmentation program, whereby up to 487,000 acre-feet of Idaho water is leased from willing parties and is passed through the Upper Snake River system (including its tributaries) to assist with downriver migration of juvenile salmon and steelhead. This water, which comes from the federal government, state of Idaho and irrigators, could otherwise be used for agricultural or other uses but is left in the river. As part of this flow augmentation agreement, a 30-year biological opinion for the Upper Snake River was adopted, with an option to review for an additional 30-years upon mutual agreement. This agreement provides water users with certainty and predictability — allowing them to manage their systems, grow their crops and support their families and communities without the fear of increased regulation or litigation. In particular:

- The United States and the tribe waived and released all claims for water rights within the Snake River Basin in Idaho.
- The United States agreed to pay a set price for the rental of storage water for flow augmentation.
- The United States agreed that flow augmentation would only be conducted in compliance with Idaho state law, water bank rules, and local rental pool procedures.
- The agreement contains Endangered Species Act and Clean Water Act assurances.

Challenges and Opportunities

Changing the management of Idaho's rivers, either through mandating additional flow augmentation, breaching dams, or reintroducing ESA-listed salmon and steelhead could have significant impacts on Idaho irrigation communities and other stakeholders. These impacts (i.e., loss of annual crop production, hydropower generation, and recreational opportunities) could have both economic and non-economic consequences[110] and include:

- Lower reservoir refill probability and reduced allocation for irrigation, hydropower, recreation, fish and wildlife flows and other uses;
- Reduce reservoir head for hydropower generation during the summer/fall;
- Lost hydropower generation opportunities when augmented flows to increase flood control space exceed generation capacity;
- Altered access for boating recreation, Idaho State parks, wildlife refuge/conservation areas, etc.;
- Increased reservoir water temperatures, resulting from drafting below minimum pool elevations, encouraging greater aquatic growth, which may negatively impact fish productivity in the reservoir and downstream and may cause reservoirs to draft below minimum pool requirements implemented to protect ESA-threatened species as outlined in existing biological opinions;
- Reduced reliability of water supplies for future projects, including recharge operations; and
- Reduced summer/early fall flows to support barge transportation in the lower Snake River.

Finally, a determination (whether express or implied) that dam removal is the solution for fish recovery could place all river development at risk and work to undermine the significant efforts of stakeholders throughout Idaho to balance the management of Idaho's river system for multiple purpose and benefits. A consequence that could strain the friendly working relationships that now exist between agencies and stakeholders.

Idaho water users firmly believe that dams and fish can coexist and that collaborative effort can generate long-term, successful solutions that achieve the interests of many stakeholders. For Idaho water users, these efforts can result in the improved and more efficient management of this resource. The use of water supplies can be optimized to achieve multiple results, benefit all stakeholders and tribes, and create a system that is more resilient and responsive to the effects of climate change. The river system can be utilized in a manner that does not create "winners" and "loser" but, instead, benefits all users.

[110] The present-day economic impact of altered river management were last studied in 1998 by Reclamation. That study, which analyzed the impacts of removing an additional 1 million acre feet from the Snake River system concluded that loss of annual production could range from $90 million to over $240 million, loss of annual income could range from $46 million to over $80 million, loss of annual hydropower generation could exceeding $2 million and loss of annual recreational value could range from $4 million to over $13 million (1998 dollars).

Ocean Commercial Fishing Perspective

By Joel Kawahara, Coastal Trollers Association and Glen Spain, Pacific Coast Federation of Fishermen's Associations

Ocean commercial fisheries extend along the U.S. west coast and southeast coast of Alaska. Most U.S. salmon fishers participate in the troll sector, a hook and line method for catching salmon. Ocean salmon fisheries also occur along British Columbia and intertwine with U.S. fisheries because of the migratory nature of salmon. Conservation is managed coastwide through the joint U.S.-Canada Pacific Salmon Commission. Ocean salmon fisheries are, by nature, mixed-stock fisheries, with the Columbia Basin — which is still home to the largest salmon runs in the continental U.S. — contributing significant portions of the ocean harvest far up and down the coastline.

The ocean salmon troll fishery sector is composed of relatively small boats usually employing at most one crew member. Many operators do not take crew. On the U.S. west coast, Chinook salmon comprise the majority of the harvest; in Alaska, Chinook, coho, and chum salmon are the primary harvest. In agricultural terms, the trollers would be very small farms, basically backyard plots generating very sparse revenue. Until their severe decline in recent decades, salmon had always been the pillar of the ocean commercial fisheries. Today, many trollers also harvest a variety of other species, including albacore tuna, groundfish, halibut, and Dungeness crab, and have otherwise diversified to survive as the salmon numbers plummeted.

Estimates of economic value in an industry that harvests fish from multiple sources and with different methods in differing jurisdictions are necessarily gross estimates. In the sense that a given economic value is a measure of community benefit, one can quote the values produced in a study of the "Economic Impact of Pacific Salmon Fisheries" by the Pacific Salmon Commission.[111] This study analyzes a value chain that includes economic impacts from harvesting through to retail use of the product. The scope of impacts extends U.S.-wide and, separately, Canada-wide.

One can also use the similar Pacific Salmon Commission study because of the way Columbia Basin salmon are intertwined with the coastwide harvest of salmon overseen by the Commission. Changes to the status of Columbia Basin salmon affect the economic values of the fisheries, most directly to troll fisheries, less so to other fisheries where Chinook salmon contribute a smaller portion of the economic value of the harvest. These numbers include fisheries within the Columbia Basin as they are within the Pacific Salmon Commission jurisdiction.

Given those qualifications, the values of the Pacific salmon fishery, coastwide for Alaska, British Columbia, Washington, and Oregon, during the years 2012 to 2015 averaged $2,428 million/year. However, these values were for salmon runs that had already been greatly damaged and diminished by decades of habitat loss and migration blockages throughout their range. The total true potential value of these salmon runs, once restored, would be considerably greater.

Challenges and Opportunities

The ocean salmon fishery, at least the troll sector, is directly dependent on the number of Columbia Basin Chinook and coho salmon that survive to become harvestable adults. This connection reflects the ocean migration habits of the various subbasins' salmon. In general, upper Basin salmon migrate farther into the Gulf of Alaska than lower Basin salmon. Snake River fall Chinook salmon are exceptional in that they are present in virtually all areas within the Pacific Salmon Commission jurisdiction and in Oregon and California ocean fisheries.

Challenges in the context of Columbia Basin salmon restoration are all related to the abundance of the various stocks of salmon originating in the Basin. The reduction in salmon resources throughout the Basin has led to ESA incidental take restrictions on ocean salmon fisheries to protect Snake River fall Chinook salmon, lower river natural spawning tule fall Chinook salmon, and lower river natural spawning coho salmon. Pre-ESA conservation restrictions on ocean fisheries prohibited ocean harvest of Columbia Basin spring Chinook salmon by delaying the ocean season until spring Chinook salmon have entered the Columbia River.

[111] Gislason, G., E. Lam, G. Knapp, and M. Guettabi. 2017. Economic Impacts of Pacific Salmon Fisheries. Prepared for the Pacific Salmon Commission, Vancouver Canada. Prepared by G. S. Gislason & Associates Ltd and the Institute of Social and Economic Research, University of Alaska Anchorage.

While the Washington ocean fishery is also "mixed stock," the predominant salmon stocks are Lower River hatchery fall Chinook (tule) salmon from the Bonneville Fish Hatchery (below Bonneville Dam), Cowlitz Salmon Hatchery, and Spring Creek National Fish Hatchery. The ESA harvest control rule on Lower River natural tule stock limits the total fisheries exploitation rate to between 30 percent and 41 percent of harvestable surplus fish (i.e., mature fish not needed as spawners), depending on the abundance of natural tules. Thus, the challenge every year is to plan a season that meets conservation requirements for natural tules and to wring the most economic benefit out of the few fish available.

For the Southeast Alaska salmon troll fishery, the harvest is managed under the Pacific Salmon Treaty where ESA restrictions and harvest allocations are embedded in a single yearly calculated harvest quota. The ESA-listed Snake River fall Chinook salmon is the most important Columbia-origin restriction on those fisheries. Lower river natural tules are also harvested in Southeast Alaska but account for only a minor part of the harvest of that stock group.

The most challenging part of the web of stocks, restrictions, and allocations is that the fishery cannot significantly increase the harvest of Chinook salmon until coastwide recovery is achieved. Simultaneously, the mix of stocks helps maintain harvest by providing a portfolio where at least some stocks are providing fair amounts of harvestable surplus each year. However, as more and more inland watershed salmon spawning and rearing habitat is blocked, destroyed, or damaged, meeting those minimum conservation needs becomes increasingly more difficult.

The restoration of Columbia Basin salmon has the potential to be an opportunity for the ocean salmon troll fisheries to regain stability as both an industry and as an important local food production system. As this is being written in the summer of 2020, the COVID-19 pandemic is entering its seventh month. Issues in the food supply system in the United States have fortunately not led to drastic nutritional shortages, but have certainly demonstrated weaknesses related to industrial practices in the meat and poultry industry.

Columbia Basin salmon fisheries in general, treaty and non-treaty, in-river and ocean fisheries, have the opportunity to be part of a larger food production system. Apples irrigated in Wenatchee, Washington rely on water that also supports salmon; barges carrying drylands wheat float over the backs of salmon coming and going to Idaho. We all need the rivers to grow or move our business products.

Business, however, connotes competition. Salmon have been viewed as competing for resources necessary for other food production. Water allocations between agricultural districts and cities are adjudicated by the same process as water reserved for fish and wildlife, fostering an alienation between all water users. Dams converting the potential energy of water compete with juvenile salmon using that potential energy for an easy ride to the estuary. The opportunity is to look at the Basin as a network of interconnected food producers, within a framework of energy production.

This may be the only way forward for salmon. The emotional appeal of salmon as a great natural spectacle has failed to motivate society to keep them alive. The modern environmental movement, for the most part, recognizes intrinsic values more than economic values of the environment and ultimately as competition for resources. Salmon are calories, dollars, nutrition, they are a hybrid of an environmental spectacle and a food product. Can the region recognize salmon as both food and money?

Business likes to think it stands on its own two legs. Rather than picking on this notion, it is more productive to look for ways to make policy support equivalent across food producers, including salmon. This task is obviously beyond the scope of this paragraph but is an opportunity to make the Basin's food production more diverse than traditional agricultural products that face global competition by recognizing a unique local food source, salmon, of the Basin.

It is completely unfair to compare the economic output from salmon to other food producers in the Basin under current conditions. Salmon were put in a subordinate economic position when the dams went in. Using relative values from recent years to determine who deserves to exist or from whom the greatest contributions to salmon conservation should come is a non-starter. It is our hope that the output from the Partnership is that salmon are seen as an engine of future economic redevelopment and that the current unfortunate and destructive competition for resources is converted into recognition of interdependence and the need for mutual and regional support.

Lower Columbia Community Perspective

By Steve Fick, Fishhawk Fisheries

Today, the piling that served as the foundation of the Kinney Cannery, once the largest salmon cannery in the world, now is the fir flooring in my home. Boulders from piles of ship ballast dropped along the Astoria shoreline before loading canned salmon now serve as my living room fireplace. In 1883, 630,000 cases of canned salmon (the equivalent of 43 million pounds) from 39 canneries shipped from the Columbia River destined to markets throughout the world. Before the inundation of European settlers to North America, the estimated annual consumption of salmon by Native Americans stood between 4 and 6 million fish. In the decade from 1930 to 1940, the lower Columbia River community of Chinook, Washington, was the wealthiest community per capita in the United States due to salmon. Once between 6 and 11 million salmon passed by Astoria annually into the 259,000 square mile Basin.

As fisheries expanded in the late 1870s, the lower Columbia River community realized catches were declining. Seasons were established to control fisheries to sustainable harvest levels. Other factors started playing into the downturn of salmon and steelhead, such as mining, logging, water pollution, overfishing by recreational users, and tributary dams. Organization of advocacy groups, such as the Columbia River Fisherman's Protective Union, and creation of the 1918 Columbia River Compact between Oregon and Washington, which created co-management between Oregon and Washington, helped partially recover some stocks. But the construction of mainstream dams continued. Grand Coulee Dam was built without fish passage. Fish ladders could have helped mitigate the loss of 2 million Chinook salmon (June Hogs) destined for the upper reaches of the Columbia River in British Columbia. These fish, which weighed over seventy-pounds, became extinct with the completion of Grand Coulee Dam, affecting not only lower river communities but also Native American nations the entire length of the river. With the continued insistence of the Columbia River Fisherman's Protective Union, fish ladders were installed during the construction of Bonneville Dam and, later, on six other mainstream hydropower projects.

Challenges and Opportunities

Today, with the eight previous decades of continued downturns in salmon stocks due to irresponsible and negligent development of the Columbia River watershed, Astoria and surrounding communities want and need vibrant salmon populations. For my area, salmon create opportunities and life choices. Working in a salmon plant, serving fish in a restaurant, fishing on a boat, or at a related marine business creates family-wage jobs. Philanthropic opportunities in rural Oregon are created through our sustainable natural resource-based industries, such as fisheries, timber, and agriculture. In Astoria, salmon mean scholarships for students, little league sponsors, food bank support, and libraries, just to name a few of the benefits these fish provide. Seasonal jobs create meaningful dollars for our youth to invest in their futures, including college and trade schools. Doctors, teachers, tradespeople, architects, and biologists all have touched my life by working or fishing for my salmon company.

Our social fabric is tied to salmon. Local community festivals, the annual Astoria Regatta, suicide levels, and mental health problems are all directly associated with the health of our salmon. If we are to sustain and recover salmon, a connection must continue to exist with those affected by their existence and expand to the rest of society. We all need to understand the indirect connection healthy ecosystems bring to us all.

Yakima Basin Irrigation Perspective

By Urban Eberhart, Kittitas Reclamation District, and Lisa Pelly, Trout Unlimited

A partnership between the Kittitas Reclamation District (KRD), Trout Unlimited, U.S. Bureau of Reclamation (Reclamation), Yakama Nation, farmers, and other Yakima Basin Integrated Plan (YBIP) members applies innovative conservation practices to achieve integrated water solutions in the Yakima Basin. The partnership provides an example of a successful collaborative approach in dealing with complicated resource-related issues.

Under the umbrella of the Yakima River Basin Integrated Water Resource Management Plan (YBIP), the partners — KRD, Reclamation, Yakama Nation, farmers, cities, counties, state agencies, environmental interests, and others — work together in a commonsense approach to solving

THE YAKIMA BASIN

The Yakima Basin has a population of nearly 400,000 people and supports the federal Bureau of Reclamation's large Yakima Irrigation Project, local irrigation districts and some of the state's earliest water rights for individuals and cities. Apples, cherries, wine grapes, hops, corn, and hay are top crops produced in the watershed, supporting a $4.5 billion agriculture growing and processing industry.

The watershed is the ancestral home to the Yakama Nation, whose rights memorialized in the Treaty of 1855 recognize inherent fishing, hunting, and migration rights, including those supporting important salmon species. The river hosts a variety of endangered and threatened fish species and offers some of the best opportunities for sockeye reintroduction and habitat restoration in the state.

The region has experienced numerous droughts, including an unprecedented snowpack drought in 2015. And climate change predictions forecast the valley's precipitation will change from snow to rain.

decades of water conflicts in the Yakima Basin. YBIP offers a 30-year vision for responding to drought and changing climate, assuring water is clean and ample, and lands are both protected and productive for growing communities and the natural environment.

YBIP's innovative initiative has been hailed as a model for making progress on Western water issues. By developing a plan and building unusually broad stakeholder support, this new approach for water resource management sets aside historic clashes over water, helping people to work together and respond during times of drought and to continue to prepare for a changing climate. It applies collaborative and integrated approaches to solving classic Western water, fisheries, and habitat concerns. Concentrated in one basin are the thorny issues of drought, climate change, growth, maintaining a robust agricultural economy, tribal rights, and restoring fisheries.

The plan builds on decades of work to achieve water security that began in the 1980s through the federal Yakima River Basin Water Enhancement Project. After years of litigation and successive droughts, we were able to bring irrigation districts, environmental organizations, the Yakama Nation, and federal, state, county, and city governments to the table to form the Yakima River Basin workgroup to develop the plan. In 2013, the Washington State legislature recognized the need to find sustainable water solutions that meet both instream and out-of-stream benefits in the region and authorized funding for the initial development phase of the Yakima Basin Integrated Plan.

The goals of the 30-year water resiliency plan are to protect and enhance fish and natural resources, improve water availability and reliability, establish more efficient water markets, manage the variability of water supplies, and prepare for the uncertainties of climate change through operational and structural changes.

One of the highlights of YBIP is KRD's streamflow enhancement project where they are working collaboratively with Trout Unlimited, Reclamation, and the other YBIP partners to implement water conservation practices on their system that produce water for streamflow restoration in upper Yakima River tributaries that provide critical habitat for ESA-listed fish. KRD is improving instream flow in key upper Yakima River tributaries by implementing water conservation practices (e.g. lateral piping or main canal lining) in the leakiest sections of its 330+ miles of irrigation distribution system in Kittitas County, Washington.

KRD identifies areas of the distribution system that are leaking water and provides cost-effective means of eliminating water loss. KRD then completes the necessary site-specific steps to conserve the water and improve the reliability of irrigation water delivery for its customers and provide conserved water for instream flow. These steps include the design, permitting, and construction necessary to complete the conservation practice.

The technical aspects of the water allocation, management, and protection are designed to provide benefits for fish, wildlife, and the environment during times of impaired stream flows in upper Yakima River tributaries — especially during drought periods. KRD accomplishes this through a three-party agreement between KRD, Reclamation, and the Washington Department of Ecology (Ecology) that specifies KRD uses the conserved water to supplement instream flows in upper Yakima River tributaries that are flow impaired and provide habitat for ESA-listed and unlisted species. The water is then delivered to improve stream flows in any of six streams, including Manastash Creek, where KRD has existing infrastructure at the creek-canal intersection to deliver a measured amount of conserved water to help restore flows.

KRD uses a committee made of local Yakima Basin fisheries and water professionals to identify which tributaries most need instream flow help on an annual basis. The committee recommends the stream for supplementation to mimic natural flows. KRD then delivers the water into the stream for ecosystem benefits. The state Department of Ecology administers the protection of this water.

Challenges and Opportunities

The streamflow enhancement project described above is one example of the ongoing efforts by KRD, Ecology, Trout Unlimited, and basin partners to find innovative ways to conserve water for instream flows. Traditional methods of acquiring water rights to restore flows can be more challenging and, even when the most senior water is acquired, may not be sufficient to maintain flows in a stream during drought conditions. In addition to providing guaranteed water during drought years, this project also provides water during non-drought years so the environment is resilient to drought conditions. Given that "drought is a period of abnormally dry weather that persists long enough to produce a serious hydrologic imbalance," the over-appropriated streams in the upper Yakima Basin may be viewed as having an annual drought due to unnaturally dry conditions due to surface water diversions and groundwater withdrawals. Using innovative approaches to adjust the timing of water storage and deliveries, the project demonstrates that there are ways to meet the needs of both irrigators and fish.

The project improves conditions for coho and Chinook salmon, steelhead, and bull trout, which historically had access to, and likely migrated and reared in, the lower reaches of upper Yakima River tributaries. Today, two of these species, Mid-Columbia steelhead and bull trout, are listed as federally threatened on the ESA list. Groundwater withdrawals impact all fish species by impairing already over-appropriated stream flows to the point that conditions (e.g., no water instream) are unsuitable for fish passage or occupancy. These withdrawals also impact the salmon and steelhead by restricting their access to cool headwaters essential for spawning and rearing. Inadequate flows impair stream functions and reduce the habitat's suitability for bull trout. Bull trout may use lower reaches of the Yakima River tributaries for feeding, migration, and overwintering when conditions are suitable. Both fish species are subject to plans for recovery and conservation within the Yakima Basin.

The streamflow enhancement project helps reduce the impacts of drought and groundwater withdrawals by providing continuous flow in tributaries that provide habitat for adult and juvenile fish. Increased instream flows, expected at 6.93 cfs and 2,476 acre-feet per year, benefit multiple species:

- increased habitat and migratory passage for anadromous Mid-Columbia steelhead and coho and Chinook salmon;
- increased feeding-migratory-overwintering habitat for bull trout;
- increased habitat and passage for resident Westslope cutthroat and redband rainbow trout; and
- improved ecosystem functions throughout the stream corridors.

Over the next 10 years, KRD plans to implement over 168,000 feet of conservation practices to conserve over 10,000 acre-feet per year of water for instream flow in any of at least eight upper Yakima River tributaries that are vital to the restoration of anadromous fish — the same fish fed upon by Southern Resident killer whales in Puget Sound — in the Yakima Basin.

Challenges ahead include funding support for continuing collaborative discussions and for implementing continuing long-term infrastructure improvements. The good news is with strong relationships among YBIP members and collaboration there is a lot of optimism for continuing to work together to overcome any and all obstacles.

Tribal Perspectives

The First People of the Columbia Basin: A Tribal Perspective on Developing Shared Goals

Note: Tribal members on the Partnership shared the following perspective during Phase 1 on the development of salmon and steelhead recovery goals for the Columbia Basin. It is provided again here upon their request.

More Than a Tradition

The tribal delegates to the Columbia Basin Partnership Task Force represent a contingent of diverse sovereign nations that have existed in the Columbia Basin since time immemorial. The rivers and tributaries of the Columbia and Snake Basins have always provided for our people's needs. We are of this land, and as Indian people, we are distinct in our connection to it. Anadromous and native fish, including the five species of Pacific salmon, steelhead, Pacific lamprey, white sturgeon, and eulachon, are part of our identity. They are our relatives, and we participate on this Task Force as part of our sacred responsibility to speak for those who cannot. These fish and the Columbia Basin ecosystem are central to tribal culture, ceremony, and subsistence. They have always been a fundamental component of our tribal economies and trade. The rivers and the fish have taught us many lessons. We are honored and take seriously the opportunity to share our ways and to teach these lessons to those who will listen. We accept that compromise is necessary to bring about a better environment and a better future for the fish, but we cannot compromise our identity, and we must never be asked to stop being Indians.

While the participating tribes of the Columbia Basin Partnership Task Force share different relationships and agreements with the United States federal government and one another, we are aligned in the perspective that salmon and steelhead are more than a vibrant cultural or spiritual tradition. The participating tribes of the Task Force agree that we have a sacred duty to salmon — indeed all the natural resources in the Columbia Basin. We believe that if you take care of the resources, the resources will take care of you. A common tribal perspective is that we are borrowing these resources from future generations.

Our participation on this Task Force is contingent on honoring of tribal treaty and trust responsibilities/obligations and the Task Force's continued engagement to help restore and care for what has been diminished, conceded, or lost. To this end, the participating tribal delegates want to be forthright in our perspective of how the Columbia Basin moves forward to achieve the Goals presented in this report.

No False Equivalencies in Achieving Recovery

Participants of this Task Force have developed "broad sense" recovery goals to address long-term conservation, harvest, and mitigation needs for Columbia Basin salmon and steelhead. It has been clear to us that no members of the Task Force want to see Columbia Basin salmon go extinct or live in an endless cycle of adversarial litigation.

To accomplish the broad sense goals, we must identify the factors that are within our control to improve salmon and steelhead survival. This requires change, collaboration, and compromise. For tribal nations, the inherent challenge with being in a working group like this Task Force is the overarching principle of fair play and compromise. While it is certainly true that all members of the Task Force need to be open minded and willing to compromise, the tribal perspective is unique, in that our history has been one of a continuous and unabated loss of resources. Conversely, other sovereign and stakeholder participants' histories show significant, measurable resource gains, even if they can identify a period of decline in their recent histories or if their constituents are frustrated or fatigued by salmon mitigation that is perceived to have demonstrated little in the way of recovery.

Over the last 200 years, tribal resource losses, including reduced availability of salmon and steelhead, are a direct consequence of the resource gains of others in the Columbia Basin. It is a false equivalency to propose that all parties on this Task Force should be willing to give up equally, because historical gain/loss balances weight heavily against tribes. This is especially true for the many tribal nations that no longer have anadromous fish returning to their homelands.

As we move toward testing these broad sense goals, we are looking for zero-loss compromises and win-win collaborations. The tribal nations are not willing to accept the normalization of the status quo and do not concede our long-term tribal goals for salmon and steelhead restoration, including restoring passage to blocked regions of the Columbia River Basin that historically supported anadromous fish. We will continue to look for the shared responsibility and accountability for this resource into the future.

Moving Baselines and the Future

The pristine potential of the Columbia Basin is the basis for long-term tribal goals for salmon and steelhead restoration, however it is important to articulate that the tribes are looking to the future, not striving to return the Columbia Basin to 19th century conditions. We now live in a society that relies heavily on hydropower production and economies associated with it, but the salmon and steelhead are showing us that the balance of this relationship is skewed. The people of the Pacific Northwest, including British Columbia and Alaska, ask a lot of these fish. This Task Force can change this conversation and determine what we can do to help these fish recover.

The participating tribes of the Task Force have been sensitive to the establishment of goals with concern that some escapement objectives may reset baselines to levels of already degraded conditions. However, for tribal nations that no longer have returning salmon and steelhead, they have everything to gain from this process. We view the Task Force Goals as a step in the right direction and in-line with long-term tribal recovery goals.

Moving Forward

We are encouraged by the relationships that have been built, and the respectful dialogue that has ensued between the sovereigns and stakeholders of this Task Force. It is promising that the members of this Task Force are not just focused on the status quo or merely achieving ESA-delisting goals, but rather focused on the future potential of the entirety of the Columbia Basin.

With or without the Task Force, the tribes will continue their work to return fish to rivers and heal the Columbia Basin ecosystem. Achieving the Goals set forth in this report however, will require coordinated long-term commitment and investment by sovereigns and stakeholders alike. With respect to salmon and steelhead recovery, we recognize that there are many things outside of our control, including ocean conditions and climate change. However, there are undoubtedly many things on the landscape that are within our control, and we must evaluate and implement the critical actions that can move us toward achieving these broad sense goals.

As has been our agreement since the beginning, we will continue to speak on behalf of the fish and the ecosystem we have always been in partnership with. We offer this perspective to invite readers of this document to view the Columbia Basin from the tribal lens. Like the salmon and steelhead, tribes have adapted to the challenges of the last 200 years and have persisted. As measures are implemented to achieve provisional goals, we are sensitive to the reality that Task Force members and their constituents will experience similar challenges to the ones that tribes have faced. We respect and honor your willingness to face those challenges. We look forward to continued collaboration and partnership with this Task Force.

Columbia River Treaty Tribal Perspective

by Zachary L. Penney, Ph.D., Columbia River Inter-Tribal Fish Commission

In 1805, Lewis and Clark were in the midst of an adventure going horribly wrong in the Bitterroot Mountains. Nimiipuu (Nez Perce) people discovered them lost and starving. The Nez Perce and other Columbia River tribes shared their knowledge of the land and river and guided the Corps of Discovery on their way to ultimate success. Tribal knowledge and connection to the river and the salmon run deep, and as it did in the time of exploration and settlement, its guidance can serve us now to find our way toward a prosperous shared future with a healthy river and plentiful salmon.

The Columbia River and its many renowned tributaries, like the Snake, John Day, Salmon, Klickitat, Deschutes, Clearwater, Grande Ronde, and Yakima, once supported the stronghold for nacó’x (Chinook salmon) and Héyey (steelhead trout)[112] production in the northeast Pacific. The Columbia River also historically supported abundant populations of other anadromous and resident Pacific salmonids, including islam (Bull trout), hésu (Pacific lamprey), qilex (White sturgeon), and assorted resident fish species. Today, these populations are a small fraction of what they were when Lewis and Clark first canoed down the Columbia, and in many cases, populations have been lost or deliberately extirpated.

[112] Ernest L. Brannon et al. 2004. Population Structure of Columbia River Basin Chinook Salmon and Steelhead Trout. Reviews in Fisheries Science, 12:99-232.

The people that comprise the Nez Perce Tribe, Confederated Tribes of the Umatilla Reservation, Confederated Tribes of the Warm Springs Reservation of Oregon, and the Confederated Tribes and Bands of the Yakama Nation, hereafter collectively referred to as Columbia River Treaty Tribes, have been part of the Columbia River ecosystem since time immemorial. Even by western science standards, tribal occupation of the Columbia Basin is among the oldest on record in North America for humans (~16,000 years).[113] These four tribes have coevolved with salmon and they remain interdependent with one another today.

Columbia River tribal nations have always viewed the Columbia River, and the fish in it, as "a great table where all the Indians came to partake."[114] The river's bounty was the lifeblood of an economy that allowed tribes to sustain a dependable trade network, with goods and products reaching as far away as Alaska and the Great Plains.[115] More than just food for subsistence and trade, salmon also formed a cultural keystone to the four tribes.[116] As noted by the late Horace Axtell, a Nez Perce elder, *"According to our spiritual way of life, everything is based on nature. Anything that grows or lives is part of our spiritual way of life. The most important element we have in way of life is water. The next most important element is the fish because the fish comes from water."*[117] Without question, this unique relationship and interdependence between tribal people and salmon is the focal point and crux of the 1855 treaty negotiations that allowed non-tribal settlement in the Columbia Basin.

Treaties are the supreme law of the land under the United States Constitution and take precedence over any conflicting state laws. The United States entered the 1855 treaties with the four tribes to acquire land on a government-to-government level. As succinctly stated in United States v. Winans, the treaties were "not a grant of rights to the Indians, but a grant of right from them — a reservation of those not granted."[118] Treaty rights can often be misinterpreted as special rights belonging to a specific race or class of people (i.e., Native Americans) creating a false impression of inequality, which is incorrect. The Columbia River Treaty Tribes are, and always have been, sovereign nations long before the states of Washington, Oregon, and Idaho existed.

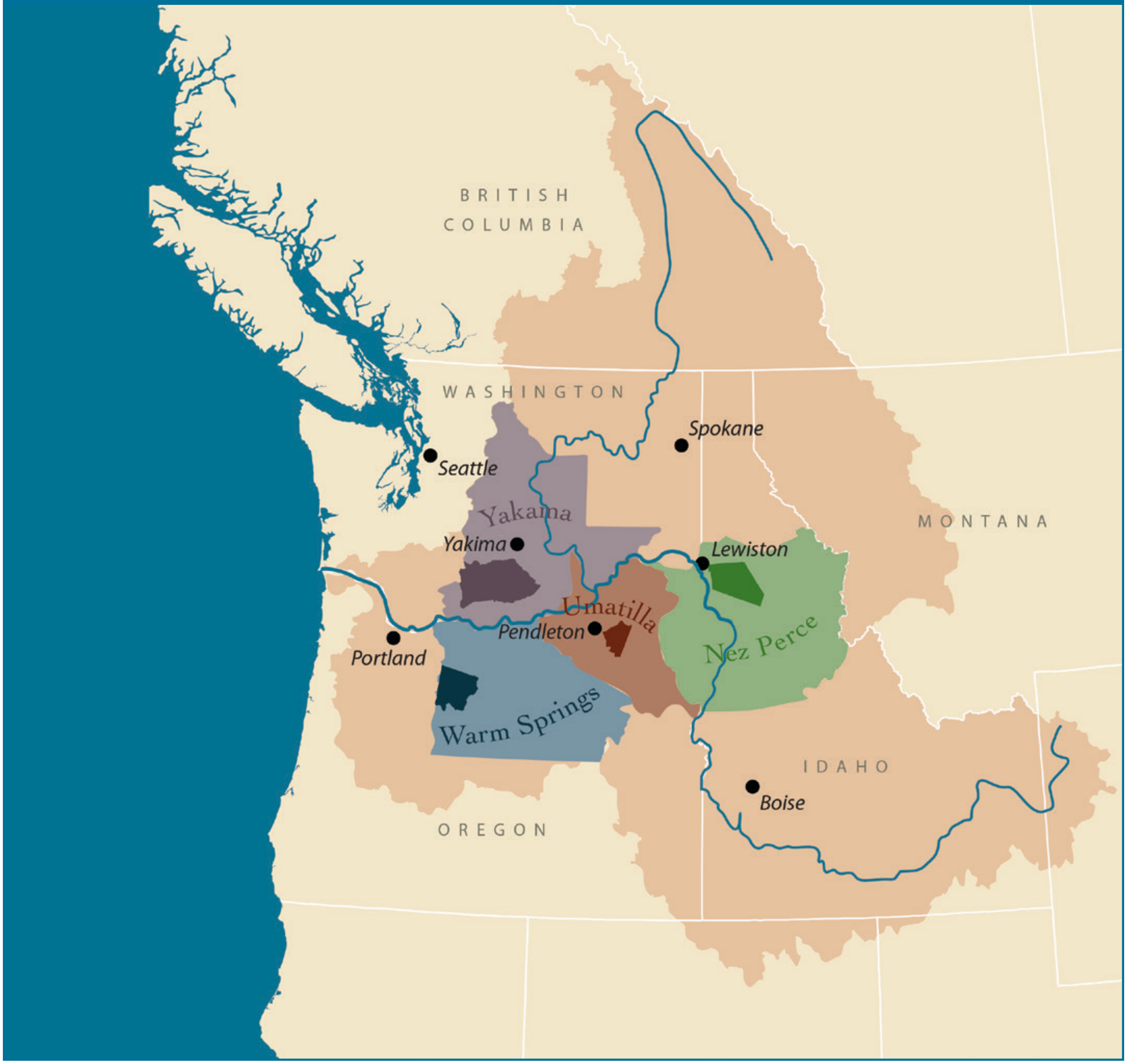
In the treaty language, the four tribes exclusively retained "the right of taking fish at all usual and accustomed [places]…." which included reservation and ceded areas. These ceded lands account for more than 25 percent of the entire Columbia Basin (66,591 square miles) and currently account for approximately 84 percent of the rivers and streams above Bonneville Dam that are still accessible (not fully blocked by dams) to salmon and steelhead (Figure 37).

Now, more than a century after the Columbia River treaties were signed, the Columbia River and its tributaries have largely been subordinated to energy production and other non-Indian water development. While the current state of salmon and steelhead abundance is often rationalized as death by a thousand cuts, history tells us that settlers and regional authorities were fully aware of how salmon were being impacted by the decisions being made.[119,120] While the duty to consult the Columbia River Treaty Tribes has not been historically honored, the tribes have always been vocal against actions (past and present) that could impact the fundamental components of tribal existence: subsistence, ceremony, economy, and identity.

Throughout all of the progress to develop the Columbia River (e.g., logging, irrigation, power development, transportation), promises were consistently made to mitigate the impacts of these actions, yet when it came time to share the benefits of development and pay for the losses to salmon, the costs were considered too expensive and funding could not be found. When we finally obtained levels of mitigation that may finally improve the salmon runs, regional "salmon funding fatigue" and frustration about the lack of success given the scale of current mitigation is omnipresent. It is not so much that all current mitigation measures are out-of-sync and outdated, but rather most were never enough or implemented fast enough for salmon in the first place. The many sectors of our economy that now

113 Loren G. Davis et al. 2019. Late Upper Paleolithic occupation at Cooper's Ferry, Idaho, USA, ~16,000 years ago. Science 365 (6456): 891-897; doi: 10.1126/science.aax9830.
114 Seufert Brothers Co. v. United States, 249 U.S. 194, 197 (1919).
115 Columbia River Inter-Tribal Fish Commission (CRITFC). "Celilo Falls," Website. http://www.critfc.org/salmon-culture/tribal-salmon-culture/celilo-falls/ Accessed February 14, 2016.
116 Benedict J. Columbi. 2012. Salmon and the Adaptive Capacity of Nimiipuu (Nez Perce) Culture to Cope with Change. American Indian Quarterly. Vol 36, No.1: pp75-97.
117 Horace Axtell, "Water and Fish," Nez Perce Language Discussion List, September 2008.
118 United States v. Winans, 198 U.S. 371, 381 (1905).
119 Bakke, Bill. Chronology of salmon decline in the Columbia River 1779 to the present. http://www.millenniumbulkeiswa.gov/Comments/MBTL-SEPA-DEIS-0003004-100990.pdf.
120 Lang, William. "1949: Year of the Decision on the Columbia River." Columbia Magazine. 19.1 (Spring 2005): 8-15. Date accessed https://www.washingtonhistory.org/wp-content/uploads/2020/04/1949-1.pdf.

FIGURE 37. Map of the Columbia Basin with the ceded territories and current reservation boundaries of the Yakama Nation, Warm Springs, Umatilla, and Nez Perce Columbia Basin Treaty Tribes.



enjoy the benefits of the developed Columbia River are not willing to return a larger portion of those benefits for the purposes of restoring the very salmon that were sacrificed on their behalf.

While the timeline and detailed legal history upholding Columbia River tribal treaties is beyond the scope of this perspective, and better described elsewhere,[121,122,123] it is important that readers understand that beyond the right to take fish, right to access, and right to a fair share, there has always been an inherent understanding by the tribes that there would *actually be fish* for the taking. In the recent *U.S. v. Washington* "Culverts Case," the United States Supreme Court affirmed a decision by the Ninth Circuit of Appeals that determined that the Columbia River tribes' treaties guarantee the right of

[121] Meyer Resources, Inc., Tribal Circumstances and Impacts of the Lower Snake River Project on Nez Perce, Yakama, Umatilla, Warm Springs and Shoshone Bannock Tribes (April 1999). https://www.critfc.org/wp-content/uploads/2014/11/circum.pdf.

[122] Charles F. Wilkinson, Indian Tribal Rights and the National Forests: The Case of the Aboriginal Lands of the Nez Perce Tribe, 34 Idaho L. Rev. 435 (1998), available at http://scholar.law.colorado.edu/articles/650.

[123] Michael C. Blumm & Jane G. Steadman, Indian Treaty Fishing Rights and Habitat Protection: The Martinez Decision Supplies a Resounding Judicial Reaffirmation, 49 Nat. Resources J. 653 (2009). Available at: http://digitalrepository.unm.edu/nrj/vol49/iss3/4.

an actual abundance of fish to take, i.e., that it is not sufficient for the tribes to merely dip their nets into the empty waters devoid of salmon.

For over a century, choices have been made over Columbia River salmon and, in some regions of the Basin, anadromous fish have been totally exchanged for something else. These choices, whether deliberate or made in ignorance, are responsible for what we have today. Columbia River salmon runs have been diminished and some have been destroyed.

Historical and legal context is critical to understanding the tribal perspective and expectations at this juncture in the Basin. The development of the Columbia Basin has converted wealth derived from salmon to wealth in other forms, but the loss of salmon wealth has brought little in return to the tribes. Columbia and Snake River dams increased the wealth of non-Indians through enhanced production of electricity, agricultural products, transportation services, flood control, and other associated benefits. The tribes did not receive a commensurate share of the wealth increase, nor did the tribes receive commensurate benefits from the resulting fisheries mitigation. In fact, the burdens of dams and failed mitigation fell disproportionately on tribal fisheries (e.g., Mitchell Act),[124] and the tribes have shouldered the bulk of the conservation burden created by dams and other non-Indian water development.

So now what?

The Columbia River Treaty Tribes are still here and are still committed to the same ancient covenant with salmon. We will continue to speak for those that cannot. Columbia River Treaty Tribes have been fighting for the rights and perpetuation of Columbia River salmon since 1855 and will always hold the government, and those that settled here, accountable to the intent of the treaties that were signed. Although seemingly at odds, tribal treaty rights have likely protected the opportunity of non-tribal fishers to continue to catch salmon and steelhead in the Columbia Basin, as have the tribal supplementation hatcheries aimed at putting fish back in the rivers. Indeed, without the fight to uphold tribal treaty rights, it is possible that salmon and steelhead would not have persisted into the 21st century.

The treaty tribal baseline for tribal salmon restoration and harvest remains 1855. This entitlement is a fair share of the salmon harvest from all streams in their ceded areas — measured at the fully functioning production levels observed in the mid-1800s. This was the tribal entitlement at the time of treaty signing. It is still so today, and into the future. To that end, tribal harvest is not to be viewed as a "new" action that incrementally increases the survival gaps of diminished Columbia and Snake River runs, but rather as a baseline that the fish runs have always encountered and that the United States secured by treaty.[125]

Notwithstanding, it is recognized that there is a large gap between current conditions and the tribal baseline. The declines in salmon productivity due to subsequent human action have not changed this entitlement. To that end, the Columbia River Treaty Tribes remain committed to guiding and working with the region to get salmon and steelhead populations pointed back in the right direction.

A deal is a deal.

Challenges and Opportunities

At the start, this Partnership came together with the Vision to work towards "a healthy Columbia Basin ecosystem with thriving salmon and steelhead that are indicators of clean and abundant water, reliable clean energy, a robust regional economy, and vibrant spiritual traditions, all interdependent and existing in harmony."[126] We are not going to achieve this goal simply by doing better fishery management or removing dams. The greatest opportunity and strength of the Partnership is our ability to teach the interest groups and industries to adapt to the needs of salmon rather than expecting the salmon to adapt to them.

As previously stated in the broad tribal perspective, the tribal nations in this Partnership are not willing to accept the normalization of the status quo and do not concede our long-term tribal goals for salmon and steelhead restoration, including restoring passage to blocked regions of the Columbia Basin that historically supported anadromous fish. It has been apparent that other Partnership members also do not accept the status quo. Although we currently have different thoughts about how to get back to "healthy and

[124] Allen, Cain, Replacing Salmon: Columbia River Indian Fishing Rights and the Geography of Fisheries Mitigation in Oregon Historical Quarterly, Vol. 104 No. 2, pp. 196-227 at 215 (Summer 2003) www.jstor.org/stable/20615319 [hereinafter Replacing Salmon].

[125] Nez Perce Tribe Department of Fisheries Management, Management Plan 2013-2028 at 45 (July 17, 2013), https://nezperce.org/wp-content/uploads/2020/09/DFRM-Management-Plan-2013-2028.pdf.

[126] A Vision for Salmon and Steelhead: Goals to Restore Thriving Salmon and Steelhead to the Columbia River Basin: Phase 1 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

harvestable" runs, as observed in the Scenarios published within this report, there is a collaborative and respectful determination to figure this out together. This is a huge opportunity, but time is limited.

As a start, this Partnership has found common priorities and actions we can take right now. These common priorities, as synthesized from the scenarios, indicate the Partnership broadly agrees on an immediate emphasis to act on stream habitat, estuary habitat, mainstem migration, blocked areas, predation, hatchery reform, harvest, climate change mitigation, and funding. As sovereigns and stakeholders, we can take these aligned priorities back to our constituencies with the understanding that there is agreement within the Partnership, and that these are the clearest steps to take in the near-term. However, it is also crucial to understand that the strategies presented in the Scenarios are not an exhaustive list to achieve the Quantitative Goals. Further innovation and adaptation by the region are necessary and critical.

A key challenge for the Columbia Basin is that salmon have, to a degree, become a surrogate measure for river health and subterfuge to the repurposing of river discharge. While regional worries often focus on the number of fish, or lack thereof, returning for harvest, recreational opportunity, meeting broodstock goals, or rebuilding "wild" populations, more focus and attention needs to be placed on balancing the water needs of our society and industry. This is not just water flowing down the river. It is about the condition of that water (e.g., temperature), what that water is turned into (e.g., electricity, agriculture), how we hold that water, when we release that water, and if we can adequately replenish other water we are taking (e.g., groundwater). With respect to the regional emphasis on supporting a broader global economy, we should also consider where we are sending Columbia Basin water and what it leaves us with. Sacrificing the health of the river ecosystem and salmon, under the guise of a robust economy, leaves us all environmentally destitute.

Rather than debating how many salmon we need to meet everyone's needs, we should also ask how many apples the river reasonably needs to produce. How many potatoes do we need? How many cows do we need? And to what cost are we willing, as a society, to pay in the currency of salmon for the various economies the region now supports. To date, most can only demonstrate their anxiety by the money they will lose and how it will hurt them, you, or me right now. Few have talked about their own ability for adaptation and change.

Another opportunity, albeit equally challenging, is to promote a greater sense of place to all residents of the Columbia Basin. The United States socioeconomic balance is based on growth and mobility and relies heavily on resource extraction. Tribal society is based more on the connection to land over time. Most Euro-Americans do not know the places where their ancestors lived in 1855. The tribes know exactly where theirs did.[127] The veritable incompatibility of these cultures over the last century, as described earlier, has done more to divide than to unite us. With respect to salmon, the region needs to promote its own salmon culture as a place-based people. Cultural appropriation is rarely viewed as acceptable but appropriating tribal salmon culture may be exactly what is needed right now. In a recent article in the *Salmon and Steelhead Journal*, a journal dedicated to sportfishing, an author suggests the appropriation of three tribal philosophies: (1) Centering one's self in reverence and gratitude for these fish, (2) Identity of place, the place is the people, and (3) Wealth that is not measured by dollars, but in the land and fish that provide for you.[128] This sport fisher gets it, and yes, this may be something the Columbia River Treaty Tribes would be willing to appropriate, to a reasonable degree.

The tribes, salmon, and steelhead have had to adapt and evolve with the incredible changes, advancements, and damages done to the Columbia River ecosystem for over 150 years. The tribes have always been progressive people, as our very survival and resilience for the past 15,000 years has depended on it. For the tribes, survival is not about trying to sustain some condition from a changing state; rather, survival is about constant adaptation to the changing needs of our own society and culture as a dynamic system.[129] We have evolved through periods of multiple pandemics, armed conflict, attempted cultural terminations, litigation, destruction of salmon runs, and into what is hopefully now a new era of partnership and collaboration.

127 Charles F. Wilkinson, Indian Tribal Rights and the National Forests: The Case of the Aboriginal Lands of the Nez Perce Tribe, 34 Idaho L. Rev. 435 (1998), available at http://scholar.law.colorado.edu/articles/650.

128 Salmon and Steelhead Journal Volume 16, Issue 6: pp22-23.

129 Columbi, B. J. 2012. Salmon and the Adaptive Capacity of Nimiipuu (Nez Perce) Culture to Cope with Change. American Indian Quarterly. Vol 36, No.1: pp75-97.

We are asking too much of Columbia River salmon. The salmon are telling us this. There is no other river for these fish and there is no alternative water to bring to it. The opportunity and challenge for us going forward is whether the region can socially and economically innovate for the salmon. It is our hope that readers 20 years from now can review the words of this Partnership and identify this as the turning point for the return of healthy and abundant salmon and steelhead to the Columbia River.

Confederated Tribes of the Colville Reservation's Perspective

For tribes of the upper Columbia River, the total loss of anadromous fish runs removed the linchpin of tribal culture. Language, ceremonies, rituals, traditional teachings, religion, legends, settlement and subsistence patterns, and many other intangible things are a product and shape the beliefs, of a living community and the history of that community. They are essential to maintaining the continuing cultural identity of the tribes. The impacts of the loss or diminution of these cultural ways are identifiable and can be documented historically, quantitatively, and qualitatively. The effects are far-reaching, ongoing, and cumulative over time.

The focus of this assessment is on Grand Coulee Dam but also applies to Chief Joseph Dam and all other dams in the Columbia Basin. Detrimental effects of dams may be the single most devastating factor in the loss of traditional lifeways among the affected tribes. Settlement patterns centered on river shores were disrupted as Indian towns (like Old Inchelium), individual homes, archaeological villages, and ancestral cemeteries were inundated. Salmon, the staple food and major trade item for Columbia River tribes, were abruptly blocked from many areas, while in other areas, the annual runs were decimated. Gathering areas for traditional cultural plants have been compromised by the effects of irrigation, inundation, and agriculture. Traditional transportation routes across the Columbia and Snake Rivers became impassable without seasonal low water conducive to fording the rivers. Productive riparian habitat was drowned. Tribal members who successfully transitioned to a commercial agricultural-based economy lost their fields beneath the rising waters of reservoirs, as well as the family gardens used to augment the yearly food supply and supplement traditional hunting, gathering, and fishing. Religious, ceremonial, ritual, sacred, and burial sites were lost. Indian cemeteries were flooded.

Population displacement was compounded when many tribal members moved to dam construction sites and associated boomtowns. Almost everything about life in boomtowns was damaging to traditional ways.[130] Native language was lost, a cash economy upset traditional social roles, and alcoholism and prostitution were prevalent in these non-native communities. Gone were many of the traditional family and leadership roles. Increasing civil authority and abandonment of Indian villages undermined the influence of tribal elders and tribal leadership. Key cultural roles, like that of the Salmon Chief, which was once a powerful and prestigious position, were no longer needed where the salmon no longer ran.

On June 12, 2018, at a meeting on the National Environmental Policy Act process underway to develop an Environmental Impact Statement for the Columbia River System, Dr. Michael Marchand, then Chairman of the Colville Business Council, summarized the enormity of the dams' impacts and the loss of the salmon. He stated that a once powerful and independent people, rich in heritage, culture, and the natural resources to sustain themselves, became a Fourth World Nation as the resources upon which they relied were destroyed.

The creation of Kettle Falls as told by Lakes Indian Eneas Seymour to Mrs. Goldie Putnam:[131] *I am Coyote, the Transformer, and have been sent by Great Mystery, the creator and arranger of the world. Great Mystery has said that all people should have an equal right in everything and that all should share alike. As long as the sun sets in the west this will be a land of peace. This is the commandment I gave to my people, and they have obeyed me.*

My people are the Skoyelpi and Snaitceskt Indians, who lived near the Kettle Falls on the Columbia River. I gave them that Falls to provide them with fish all their days. It was called Ilthkoyape, which means "falls of boiling baskets," but the name was shortened to Skoyelpi. The Falls was surrounded by potholes which resembled the boiling baskets in which my people cooked their food…

[130] Ortolano and Cushing 2000; Ray 1977.
[131] Lakin 1976-V-VI.

Many generations ago my people were hungry and starving. They did not have a good place to catch their fish. One day while I was out walking I came upon a poor man and his three daughters. They were thin from hunger because they could not get salmon. I promised the old man I would make him a dam across the river to enable him to catch fish, if he would give me his youngest daughter as my wife. The old man agreed to this and I built him a fine falls where he could fish at low water. But when I went to claim the daughter the old man explained that it was customary to give away the eldest daughter first. So I took the oldest daughter and once again promised the man I would build him a medium dam so he could fish at medium water if I could have the youngest daughter. The old man explained again that the middle daughter must be married before the youngest, so I claimed his middle daughter and built him a fine falls where he could fish at medium water.

Shortly after the father came to me and said he was in need of a high dam where he could fish at high water. He promised me his youngest daughter if I would build this. So I built him a third and highest dam where he could fish at high water. And then I claimed the long-awaited youngest daughter as my wife.

And now, because I had built the Falls in three levels, my people could fish at low, medium and high water. I had become responsible for my people, and I saw that the fish must jump up the falls in one certain area where the water flowed over a deep depression. I appointed the old man as Salmon Chief, and he and his descendants were to rule over the Falls and see that all people shared in the fish caught there. All people must live there in peace, and no one should leave there unprovided. Indians and white men from hundreds of miles away have gathered during the salmon runs at my falls, and they have all lived in peace sharing together.

The construction of the Grand Coulee Dam destroyed the Kettle Falls Fishery. The falls were submerged beneath the waters of Lake Roosevelt and the salmon were stopped at the base of the Grand Coulee Dam and, later, Chief Joseph Dam. Now those who visit Kettle Falls will not be able to catch salmon and will leave "unprovided." Not only has the Kettle Falls economy been ruined, but the moral lessons embedded in the site have been debased. The Columbia River is not simply a tool for subsistence and travel, but an integral part of the cosmology of Columbia Plateau tribes. Figure 38 shows the Kettle Falls area before inundation.

Upper Snake River Tribes' Perspective

The Upper Snake River Tribes (USRT) Foundation is composed of four Indian tribes of the upper Snake River region in Idaho, Nevada, and Oregon: the Burns Paiute Tribe, Fort McDermitt Paiute-Shoshone Tribe, Shoshone-Bannock Tribes of the Fort Hall Reservation, and Shoshone-Paiute Tribes of the Duck Valley Reservation (USRT member tribes). In 1997, USRT's member tribes recognized that there were common issues that affect the tribes and it would be beneficial that they unite to strengthen their respective voices. As such, the USRT Motherhood Document was developed and established the Compact of USRT. The USRT Charter, approved in 2007, was developed in accordance with the 1997 Motherhood Document to facilitate, coordinate, and assist the implementation of USRT's policies and principles. USRT's mission is further guided by the 2015 USRT Policy for Management of Columbia and Snake River Basin Resources:

> *The USRT will pursue, promote, and where necessary, initiate efforts to restore the Columbia River and Snake River systems and affected unoccupied lands to a functioning ecosystem. This includes the restoration of component resources to conditions which most closely represents the ecological features associated with ecosystem-based function. In addition, the USRT will work to ensure the protection, preservation, and the enhancement of rights and interests reserved by treaty, federal laws, mandates, and executive orders, and any inherent aboriginal rights.*

Since time immemorial, USRT member tribes harvested salmon, steelhead, lamprey, and trout throughout the Columbia Basin for subsistence. Annual salmon and steelhead runs in what are now Idaho, Nevada, Oregon, and Washington provided harvest opportunities throughout the year. Archeological records indicate that the USRT member tribe's cultures are at least 10,000 years old in their aboriginal range. Research shows salmon was a significant primary resource along with terrestrial wildlife, resident fish, roots, berries, and other botanical resources. A renowned ethnographer and linguist described the tribal connection to anadromous fish in the mid-1900s

FIGURE 38. Kettle Falls on the Columbia River before inundation by Grand Coulee Dam.

Montana has been historically blocked to salmon and steelhead as a result of geography, so we do not have the relevant stocks in our region. However, we are committed to helping achieve the Partnership goals by supporting efforts in the "four H's" and continuing to work collaboratively with others. We will reach out to stakeholders in our area (primarily Bonneville customers through their Western Montana electric cooperatives) and help them understand the work of the Partnership, the importance of regional collaboration, and the need to be creative when it comes to solutions. Two areas of concern for our electric cooperatives have been (1) reintroduction in blocked areas and (2) Snake River dam removal. This is an opportunity to talk with them about those issues, how they fit with the work of the Partnership, and how their concerns might be addressed in the future. — Jennifer Anders, *Northwest Power and Conservation Council, Montana, Salish-Kootenai Tribes and Kootenai Tribe of Idaho* by noting a "culture existence is dependent on the continuity of interconnected knowledge, beliefs, conventional behavior, and technical practices." The traditional cultural practices, including the use of riverine resources, are the foundation on which the USRT member tribes built sustainable communities across their homelands for millennia.

Based on the USRT member tribes' unique Traditional Ecological Knowledge, gathered over generations as stewards of the Snake River, is a desire to move toward more normative river conditions. Historically, an estimated 5-9 million anadromous fishes returned annually to the Columbia Basin. Watersheds across the Basin were filled with an abundance we can scarcely comprehend in our current management paradigm. In one contemporary reconstruction of fish consumption, it was estimated that members of the Shoshone-Bannock Tribes ate as much as 800 pounds of fish per year, the equivalent of 1,000 grams of fish per day. Historic fish consumption estimations for the Northern Paiute vary widely from as little as 143 pounds per year (178 grams/day) to 700 pounds per year (871 grams/day). Contemporary harvest rates provide less than one pound of anadromous fish per member, per year; resulting in a catastrophic loss of this indigenous food resource for USRT member tribes.

During the nineteenth century, increasing numbers of immigrant fur trappers, miners, ranchers, and non-Indian settlers occupied the lands within the Snake River Basin. The fierce competition for resources by a growing population required USRT member tribes to travel further for wildlife resources now absent from the Snake River Basin, which increased the importance of anadromous fisheries for basic survival. USRT member tribes endured decades of conflict with encroaching settlers onto traditional gathering areas and witnessed the once sustainable resources disappearing from the landscape. Tragically, the encroachment of European settlers led to USRT member tribes being displaced from their historic use areas and isolated on reservations. The forcible removal of USRT member tribes from their homelands is unquestionably one of the most horrific periods in U.S. history.

When USRT member tribes were aggressively pushed to reservations in the Snake Basin, they were promised many things by the U.S. government. One of those promises was that they would always have unfettered access to plentiful anadromous fish. That promise was short-lived with the construction of Bruneau Dam in 1890, which was followed by the construction of a series of dams and impoundments over the next several decades. Rapidly, the Snake Basin was blocked from what was once productive anadromous runs and USRT member tribes' source of sustenance, and more importantly, spiritual and cultural practices were robbed from them. The final and most impactful blockage in the upper Snake Basin was the construction of the privately-owned three-dam Hells Canyon Complex in the mid-20th century, which entirely blocks anadromy to three of USRT's four member tribes.

The anthropogenic impacts of industrialized development in the Basin have dramatically reduced anadromous fish abundance to near-extinction, and as co-managers, USRT member tribes are seeing a growing acceptance of the new levels of decreased abundance. Access to anadromous fish for subsistence and ceremonial purposes has been eliminated from much of the upper Snake Basin following the construction of dams along the Columbia and Snake Rivers. Once a mainstay of the tribal diet, anadromous fish have been absent from waters within, or near, tribal reservations for nearly a century, effectively preventing three generations of tribal members from practicing their cultural practices and traditions.

Prior to the precipitous decline of anadromy in the Columbia Basin, the salmon trade was a pillar of the Shoshone-Bannock Tribes' culture and trade in the mid-19th century. However, declining salmon numbers, coupled with the forcible removal from their homelands, caused salmon to become solely a subsistence food source; similar to the procurement of big game for the Shoshone-Bannock. Under the current Shoshone-Bannock tribal game code, it is illegal to "sell or give away fish or game to non-members of the tribe."

The Shoshone-Bannock Tribes continue to harvest anadromous fish under rights reserved by Article IV of the Fort Bridger Treaty of 1868. Tribal fishing methods include all contemporary methods as well as the culturally important technique where tribal fishers hunt Chinook salmon in streams using spears. Maintaining this type of fishery is a high priority for the Shoshone-Bannock Tribes and it complements existing fisheries management in the Salmon Basin by allowing carefully controlled, population-specific harvest impacts.

While the Burns Paiute, Fort McDermitt Shoshone Paiute, and Shoshone-Paiute Tribes entered into several treaties with the U.S. government, none were ratified by the U.S. Senate. Yet, they still retain rights in their traditional homelands as they fight for the realization of those rights promised to them by the U.S. government. This right also includes a habitat component that others should not engage in habitat-damaging activities that would diminish the abundance of salmon, which provides sustenance and cultural and spiritual practices. Regrettably, this has not been the case for salmon or the tribes.

The Burns Paiute and Shoshone-Paiute Tribes have in the last five years implemented ceremonial fishery programs to begin restoring fishing culture to tribal members. These efforts have taken place in coordination with the Idaho Department of Fish and Game and Oregon Department of Fish and Wildlife. Ceremonial fisheries are included in a long-term plan developed by the USRT member tribes that leads to sustainable and harvestable populations of spring/summer Chinook salmon, fall Chinook salmon, and steelhead in the upper Snake Basin.

The Snake River Fisheries Management Program seeks to restore fishing opportunities through anadromous and resident fish management programs in the Snake River and significant tributaries including the Bruneau/Jarbidge, Owyhee, Malheur, Boise, Payette, and Weiser Rivers. Restoration of these subsistence fisheries would be accomplished in a manner intended to complement the ongoing recovery efforts of anadromous and resident fish in the Salmon Basin.

Lower Columbia and Estuary Perspective

By Debrah Marriott, Lower Columbia Estuary Partnership, a National Estuary Program

Historically, lower Columbia River fish and wildlife used a wide variety of habitats for shelter, food, rearing areas, and other functions during their life. However, in the last 100 years, more than 114,000 acres of lower river floodplain were converted to agricultural, urban, or other uses — a habitat loss in excess of 50 percent. Dikes, tide gates, and flood control devices kept the Columbia River from inundating riparian areas, radically changed the landscape and restricted fish and wildlife access to once important habitats. Reconnecting the river's tidal influence to these areas improves water quality, restores a more natural food web for salmon and allows a wide variety of species access to a broad range of formerly inaccessible habitats.

Every migratory salmon in the entire Columbia River depends on the lower river and estuary twice during their life cycle — for rearing, refuge, and feeding, as juveniles traveling to the ocean and as adults returning to spawn. Salmon need a complex mix of habitat conditions to thrive: food sources such as terrestrial and aquatic insects; cool water with appropriate levels of oxygen, clarity, and salinity; shallow off-channel habitats for resting, feeding, and refuge; spawning gravel at the appropriate depth; and the right channel contours and current velocities.

The ecosystem's stability and health come from its complexity. In the estuary, fresh river water mixes with saltwater from the Pacific Ocean in a unique environment. This transition zone with islands, mud flats, and salt marshes, gathers and holds an abundance of life-giving nutrients from the land and from the sea. This ecosystem contains more life per square inch than the richest farmland and provides for all wildlife. The estuary maintains water quality, attenuates floods, and provides recreation and aesthetic opportunities. The greater number of distinct habitats within an ecosystem, the more species it supports, the more ecological processes and functions it provides, and the better it withstands disturbances. This wide range of complex, diverse habitats is now greatly diminished in the lower Columbia River and estuary. The thirteen salmonid species listed as threatened or endangered symbolize the consequences of habitat degradation and loss and they are not alone; many other species native to this ecosystem are now listed as threatened or endangered including other fishes, native plants, birds, and mammals. The plight of the salmon is an indicator of the condition of the ecosystem as a whole.

Habitat restoration. Since 2000, over 100 partners have protected or restored 28,387 acres of habitat in the lower Columbia River estuary. These efforts encompass a wide range of projects including acquisition, tide gate replacement, culvert enhancement or replacement, riparian planting, and other techniques. Most projects have immediate benefits; the greatest benefit is the creation of a self-sustaining and stable ecological process to enhance and maintain the desired habitat conditions over time. Projects may take from 10 to 40 years to reach their full ecological benefit and in some cases, external or internal conditions may affect and alter a project's outcome.

Challenges and Opportunities

1. How Much Is Enough: Habitat Coverage Targets

Despite the investment in habitat restoration and protection, the number of threatened or endangered species that use the lower Columbia continues to grow — from 24 species in 2004, to 32 species in 2010, and 40 species in 2015. The difficult questions are "how much habitat is enough?" and "where and what types of habitat?" The Estuary Partnership identified priority habitats by comparing historical habitat coverage (late 1870s) to 2009 habitat coverage. Habitats that suffered the most significant decreases in coverage were identified as a priority for restoration and protection to recover historical native habitat diversity. Other considerations were: ensuring representation of priority habitats across the lower Columbia, ensuring there are multiple locations of the priority habitats across the lower Columbia, ensuring the resiliency of these habitats through the protection of multiple large patches of these habitats, and where practical, focusing restoration of native habitats in locations where they used to exist. In 2016 we finalized ecologically based voluntary habitat coverage targets. Meeting these targets will bring us to an average of 60 percent native habitat coverage by 2050. That means protecting existing habitat and restoring 3,300 acres every five years, an increase over the rate of the past decade.

2. Funding and Effective Monitoring

Funding and regulatory requirements do not have flexibility in types of restoration or working on private lands. Most funding is directed at a subset of threatened and endangered species. Competition with mitigation banks or other for-profit restoration organizations increases pressure and competition for existing sites and funding resources. Funders often want to fund the shovel-ready components of projects but not project development and design, long-term maintenance, or effectiveness monitoring.

3. Toxic Contaminants

There still is no sustained monitoring (funding) for toxic contaminants in the mainstem Columbia River. The one-time studies, monitoring, and evaluation that have been done are conclusive and support the need to identify sources, measure contaminants and levels, assess transport of contaminants in the system, evaluate impacts on species and humans, and define opportunities to reduce or remove contaminants. The states of Oregon and Washington both focus on monitoring and assessments within the tributaries to the lower Columbia but there is little to no monitoring within the lower Columbia mainstem itself. There is no funding to remove toxic hotspots identified over 25 years ago and no funding of consequence to remove and reduce those toxics that we know are here. The more we learn, the worse the news about the impacts to species, including human health. Over the past 60 years, we have introduced thousands of toxins into the environment, from products we use — pharmaceuticals, personal care products, plastics, fertilizers — and from our farming and manufacturing practices. Toxics settle on roofs and pavement and rainwater washes them into our rivers and streams.

Contaminants Impact Economic Viability. Plastic waste causes over $13 billion in damage to marine ecosystem tourism and fisheries industries each year. Contaminated dredged materials threaten port and marina operations. Contaminated lands cannot be developed until they undergo costly cleanup. Contaminated water negatively impacts the fishing industry. Commercial salmon fishing provided personal income of $41 million from 1976–1980; by 1998 it was $4 million.

Contaminants Impact Fish and Wildlife. Polychlorinated biphenyls (PCBs) affect thyroid function and metabolism of juvenile salmonids, alter hormonal balance in fish and other species, prevent detection of predators, and cause male fish to grow female eggs, reducing reproduction. DDT persists, despite its 1972 ban, thinning the eggshells of eagles and osprey and disrupting the reproductive systems of river otters. Contaminants in flame retardants (Polybrominated diphenyl ethers or PBDEs), personal care products, and pharmaceuticals affect salmon's ability to reproduce, avoid predators, and resist disease. Fish are not surviving, even where habitat is restored. For example, millions of dollars were invested in habitat restoration at Seattle's

Longfellow Creek and Grover's Creek Hatchery in North Kitsap, but work by NOAA Fisheries indicates that when the fish returned, they died from toxins in runoff.[132]

Contaminants Impact Human Health. About 60 to 80 percent of our marine debris is plastic. Humans ingest thousands of bits of microplastics each year, harming our immune systems and causing cancer. Humans are exposed to mercury by consuming contaminated fish; mercury affects the developing brains of children, altering behavior and learning capacity. DDT causes cancer and liver disease in humans and disrupts our hormones. Flame-retardants (PBDEs) found in building materials, electronics, furniture, plastics, and even in children's clothes are linked to infertility, birth defects, cancer, and learning disabilities in children.

4. Cultural Social Impact

Environmental and land use practices and policies unequally harm people of color, Indigenous people, and low-income people. People of color, Indigenous peoples, and low-income people are exposed to higher levels of contaminated air, soil, and water and are more vulnerable to the impacts of climate change. As a result, people of color, Indigenous people, and low-income people have higher rates of cancer, neurological disorders, infertility, learning disabilities, and other negative health outcomes. We have a responsibility to include all communities in who we are and what we do.

Those of us who are working in this field need to change who is involved, who has the decision-making power, and who is represented in our work. We need to rethink restoration and what it could look like when we incorporate other ecological, economic, and community priorities. Right now, a large proportion of that funding is mitigation for the hydropower system. That is critical. Salmon and steelhead and other species have been impacted by that system and other land use and environmental decisions, often made by white people. Funds are limited: if we incorporate multiple needs into our restoration projects or incorporate restoration into other community priorities by working more collaboratively and holistically, and with more voices sharing the decision-making power, we will be more effective and efficient in our results. In developing and designing habitat restoration projects, most of what happens in the Columbia Basin focuses on the priorities of the funder.

5. Economic Impact

There is significant data about the impact of habitat restoration on local economies. The Oregon Watershed Enhancement Board collaborated with the University of Oregon in 2010 to complete a thorough analysis that found on average for every $1,000,000 invested in habitat restoration 20 jobs were created and another $900,000 is generated from the economic multiplier.[133] The economic benefits start with the construction jobs themselves, and the products needed to complete the construction, and then the paychecks of those workers buying gas, paying mortgages and rents, and buying food. Since 2000, the Estuary Partnership alone has raised funds that have created over 1,800 local jobs: jobs that cannot be exported and that support the local communities directly. Where and how we spend the dollars, and the impacts on the communities they sustain, need to be part of the consideration in how and where we do the restoration.

6. Climate Change

Changes to lower river conditions as a result of climate change need to be further assessed. We are still focusing much of our present protection, restoration, and species recovery efforts on areas that will greatly change with shifts in climate and sea levels. As a result, we risk further decimation of our ecosystem that provides essential habitats and ecosystem services to the region as well as the long-term success of our restoration and species recovery actions.

Warming water temperatures and changing precipitation patterns are projected to reduce the availability of habitat in the Columbia Basin for cold-water species by 20-40 percent by 2090. Water temperatures in the 19-22°C range that routinely occur in the Columbia River mainstem can cause behavioral changes and a variety of sub-lethal effects on physiology, disease susceptibility, reproduction, survival, and fitness. We need to protect cold water sources and locations (e.g., protecting baseflow, removing diversions that dewater downstream areas, and

[132] Stormwater and Salmon: Risks and Remedies. Presentation to Science to Policy Summit by Nat Scholz, Ecotoxicology Program Manager, NOAA Fisheries. June 13, 2014. http://www.estuarypartnership.org/sites/default/files/Scholz%20Ecotoxicology.pdf. Completed by University of Oregon with funding from OWEB. http://Scholarsbank.uoregon.edu/xmlui/bitstream/handle/1794/10776/WP 24.pdf?sequence=1

[133] Economic and Employment Impacts of Forest and Watershed Restoration in Oregon. Ecosystem Workforce Program Working Paper, Number 24, Spring 2010. Authors: Max Nielsen-Pincus and Cassandra Moseley.

providing shade to protect cold-water refugia for cold-water species). Due to this altered thermal regime, juvenile and adult salmon migrating through the lower Columbia River during summer months seek out pockets of cool water to rest and feed. Restoration and protection of sources and locations of cold water will be key for the protection of these refuges for the future. The Estuary Partnership mapped cold-water refuge along the lower Columbia River and identified several tributaries that provide refuge habitat, but found no cold-water refuges suitable for use by returning salmon and steelhead in the reach between the Lewis River and Eagle Creek, a distance of 57 miles. The Estuary Partnership is designing a pilot project for one potential restoration technique to increase cold-water refugia.

Sea Level Rise. In 2018 the Estuary Partnership mapped areas where wetlands may be lost due to excessive inundation, migrate upslope to higher elevations that become inundated, or remain intact. Results from the first model iteration suggest that sea-level rise may overtop portions of the widespread network of existing levees in the lower Columbia floodplain. This could result in significant tidal wetland habitat loss in the lower Columbia River. The next step is to fund further flood risk assessments to identify areas where increased flooding will occur and to work with stakeholders to develop new engineering standards and best practices for integrating climate adaptation measures into our restoration projects. This could include designing and applying living shoreline techniques, moving levees back from present-day locations to allow inland migration of wetlands, increasing bankfull width for culvert replacements, and adapting our approach to restoration and land use decisions.

Increased hypoxia events within the estuary and acidification are also concerns. Along the west coast, scientists are finding that hypoxic conditions and reduced pH levels associated with coastal upwelling events are moving into the estuaries, including the Columbia, with tidal exchange. Low dissolved oxygen levels, increasing acidification and increasing water temperatures that accompany climate change have the potential to alter fish behavior and survival (via suffocation or avoidance of areas affected) and have significant deleterious impacts on the estuarine food web.

The Steigerwald Habitat Restoration and Floodplain Protection Project: Melding Multiple Priorities.

The Steigerwald Lake National Wildlife Refuge is a beloved natural area within the Columbia River Gorge National Scenic Area and home to an abundance of wildlife. Over 90,000 people visit the refuge each year. Parking is inadequate and the result is congestion and unsafe parking along Highway 14.

In the 1950s, the natural levee along the Columbia River was built up about 10 feet to protect the area from flooding. It did a good job at that, but it cut the Columbia River off from its historic floodplain and blocked Gibbons Creek from naturally draining into the Columbia River. This has left the community, including the Port of Camas-Washougal and a mobile home park experiencing regular annual flooding from Gibbins Creek, at a cost of over $60,000 annually just in electrical costs to pump out the Port's land to keep the industrial park operational. There is a failing diversion structure that was about to cost the U.S. Fish and Wildlife Service over $5 million to replace; and a fish ladder that is not regularly accessible for fish use.

In 2000, the Estuary Partnership got together with the Port, local community members, landowners, and the refuge to see how we could both reduce flood impacts to the community and create fish access to the refuge. It took nine years of collaboration, working extensively with multiple landowners to meet their needs, many of whom did not have fish recovery as their first priority.

We broke ground on the project this year. So far, we have anchored 84 large wood habitat structures in the refuge's historic floodplain and a contractor, Aquatic Contracting, has treated invasive species and reforested 53 acres of the alluvial fan. Over the next few years, other contractors, Rotchsy Construction and their partner LKE Construction, will build the new setback levees and lower the levee along the Columbia River to open up the fish access and reduce internal flooding.

This is a $25 million project. All invested locally. In total, the completed project will create 560 local family-wage jobs; provide opportunities for 2,000 local students and community members to plant trees to contribute to the project; expand the refuge's recreation trail system for the local tourism economy, which in turn benefits Washougal's small businesses; remove the Port land and mobile home and Highway 14 from flooding, reducing those costs; negate the need for the diversion structure replacement; and open 965 acres of floodplain habitat to juvenile salmon, helping fill a huge gap in habitat for migrating species.

This is the power of collaboration: local landowners, the community, U.S. Fish and Wildlife Service, Bonneville Power Administration, Washington Department of Ecology, Washington Department of Transportation, Bonneville Environmental Fund/OneTreePlanted, Port of Camas-Washougal, City of Washougal, Columbia Gorge Refuge Stewards, BNSF Railroad, and Friends of the Columbia Gorge working together.

The Next Generation Perspective

As part of the Partnership process, members developed a Student Engagement Survey to solicit the next generation's views on how to achieve the long-term Vision and Goals for the Columbia Basin and its salmon over the next 100 years. They sent the survey to 245 university and college programs throughout the Pacific Northwest. Partnership members also visited several college classrooms and explained the Columbia Basin Partnership Goals and work, answered questions, and heard different perspectives.

The survey asked several key questions that addressed Partnership Goals:

- How do you view the Columbia Basin Partnership Vision and (Qualitative and Quantitative) Goals for Columbia Basin salmon and steelhead in the Phase 1 Report?
- What sort of Columbia Basin do you want to see in the next 10 to 30 years regarding salmon and related social, cultural, economic, or ecological considerations across the entire Columbia Basin?
- What suggestions do you have for the Columbia Basin Partnership Task Force to make our work meaningful, implementable, and achievable?

In response to the survey, the Partnership heard from 60 students, representing six different universities and colleges. All of the students responded favorably to the Partnership's efforts and voiced support for its Vision and Goals for Columbia Basin salmon and steelhead. Overall, the students felt the Partnership's Qualitative and Quantitative Goals for Columbia Basin salmon and steelhead were achievable. However, many of them — while recognizing the importance of addressing the needs of different people — stressed the need to act with urgency to ensure clean rivers and healthy salmon into the future.

As representatives of the next generation, the students provided valuable feedback about their hopes and dreams for the future of the Columbia Basin. They also shared numerous suggestions to help frame future Partnership efforts. This feedback from the student survey is summarized below.

What sort of Columbia Basin do you want to see in the next 10 to 30 years?

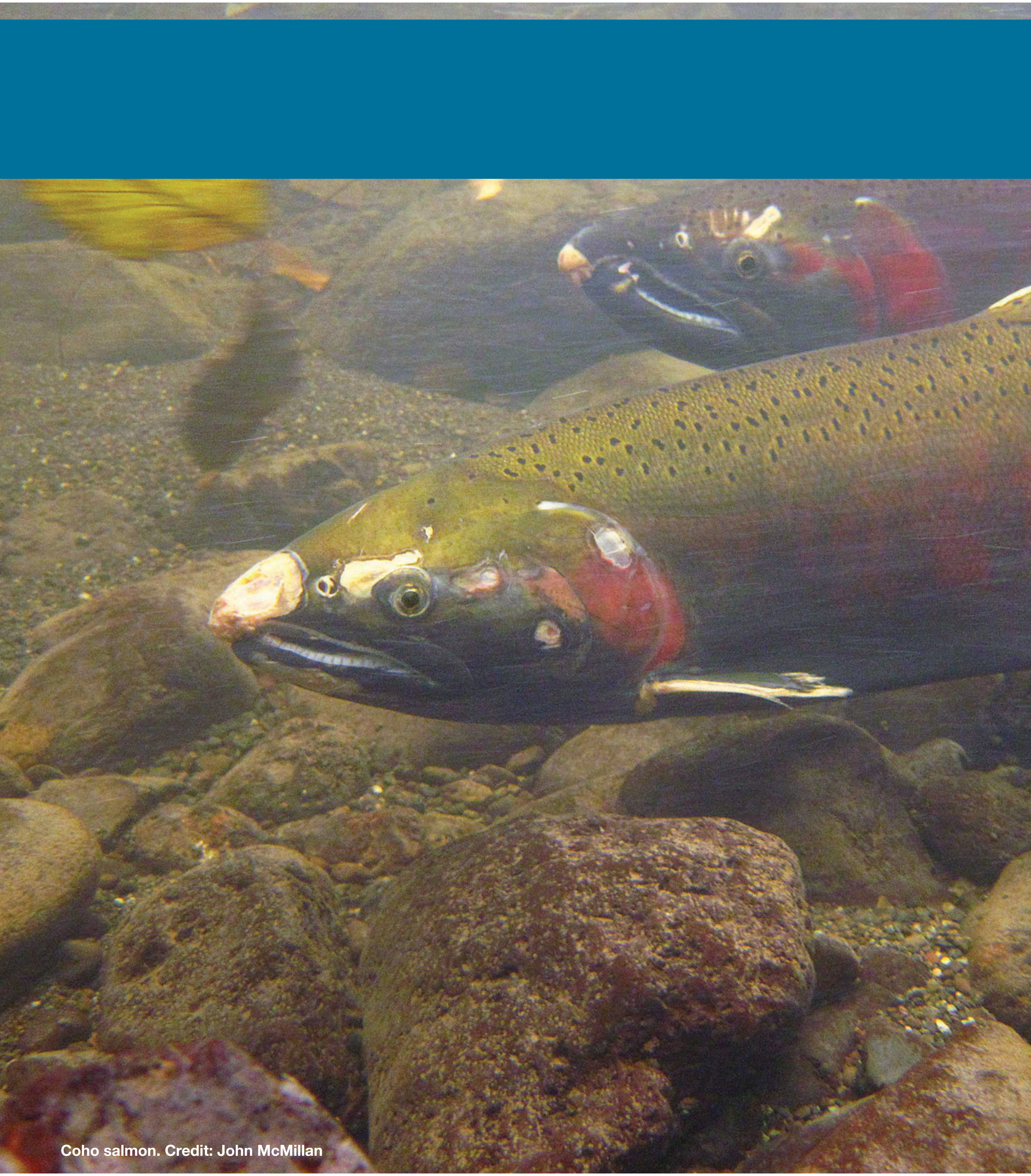
- Salmon and steelhead thriving, flourishing; high salmon populations across the region, healthy and sustainable at levels that meet different social and cultural needs.
- People coming together to a collaborative understanding of the river, the role that hydropower does/can/should play as a low-emission energy source but also as a barrier to fish.
- Increased salmon and steelhead runs while not significantly harming the economy of the region.
- A restored Basin capable of supporting native, abundant salmon and steelhead populations. A Basin full of salmon swimming home in the summer to bring back the “king fish” lifestyle that salmon were once able to sustain. To see the tribes of the Pacific Northwest not lose one of the most important species within their communities.
- The use of all tools available to help fish; innovative.
- A region with a green power grid.
- Removal of all or most dams so fish can access historical habitats, possibly into British Columbia and Montana. A return of salmon and steelhead, and fisheries, to some or all blocked areas.
- Passage for fish to get through all dams for purposes of spawning; some dams with fish ladders.
- A plan in place for responsible, realistic management to help prevent and mitigate even more damage from happening in the Columbia Basin because of inevitable anthropogenic changes. A plan or plans that identifies actions so that people make sustainable choices to reduce impacts from climate change, pollution, and growing populations.


Fall Chinook Spawning Habitat, Hells Canyon, Idaho.
Credit: NOAA Fisheries West Coast Region

- A region where killer whales are thriving again, and where bear, eagle, and more than 100 other species can depend on salmon as a food source.
- Fisheries that give tribes the first rights to fish; where commercial fisheries bear a larger burden for ESA-delisting.
- A Basin where land use practices, such as agricultural practices, support surrounding ecosystems; where hatcheries are no longer necessary; and where fishing is practiced responsibly for the long-term sustainability of the resource and industry.
- More protection for salmon and steelhead habitats along streams and rivers, less urban development in floodplains.
- A Basin that celebrates our natural and cultural resources; joins people of all histories; honors indigenous people; upholds treaties. A Basin that is fertile and abundant; supports all who live in it and does not destroy local communities or take advantage of resources to profit unduly.
- More knowledge about the diversity of salmon and steelhead populations and ecosystems in different locations of the Columbia Basin.

What suggestions do you have for the Partnership?

- Increase efforts to get the word out by using social media, guest lecturing, enlisting volunteers, etc. Develop a condensed version of the Partnership report for the public.
- Increase education efforts across the Columbia Basin and identify what people, students, and communities can do to help the fish. Share successes, make them visible to communities.
- Work with individual city and county governments and identify ways to join efforts to meet larger Basin goals.
- Keep transparency with communities; listen to and include different stakeholders in conversations; use respectful discourse to discuss difficult subjects and find solutions.
- Since it will take a lot of effort and time to achieve the Goals, identify shorter “check-in” times to track progress and make corrections.
- All parties on the Partnership should look at their negative impacts on the environment, cultural, social, and economic harms and identify what they can do differently.
- Act with urgency, increase efforts. Always do a little bit extra and strive to do a little bit more.
- Keep listening to and working closely with tribal people.
- Identify ways to help people and communities who are tied financially to the dams. Provide financial incentives for innovations that aid salmon.
- Provide financial support for hatcheries to help them supplement wild populations by improving breeding techniques to prevent inbreeding depression in populations.


Coho salmon. Credit: John McMillan

Scenarios

The Partnership adopted the concept of scenarios as a means to explore alternative pathways to achieving the Goals. The Partnership's concept of scenarios and their utility evolved over time. The primary components of most scenarios considered by the Partnership were biological strategies for achieving the Goals, but some scenarios also included other components, such as proposals for new regulatory and funding mechanisms. Analytical tools (see Biological Analyses) and social, cultural, economic, and ecological considerations provided context for the Partnership's development, understanding, and consideration of scenarios.

Initially, the Partnership envisioned developing a relatively small set of scenarios and doing coarse-scale biological analysis and evaluation of the social, cultural, economic, and ecological implications of the different scenarios. Eventually, the Partnership decided that rather than building scenarios that included strategies that could be analyzed using the tools described in the Biological Analyses chapter, it was more valuable to put forward a number of scenarios that represented a range of options or viewpoints. The limiting factors analysis and life-cycle model were used by some Partnership members and the Project Team as exploratory tools (e.g., in the sensitivity analysis and in regional meetings to discuss the "level of effort" scenarios described below). While these tools provided context and background for all of the scenarios, they were not used for evaluation of the scenarios, nor did the Partnership have extensive discussions of the implications of the alternative scenarios put forward. The Partnership recommends further exploration of scenario components going forward.

Overall the scenarios proved useful to facilitate discussion and explore various viewpoints. They provide an opportunity for Partnership members and others to

- Begin consideration of the biological strategies and levels of effort that might be required to achieve the Goals.
- Evaluate qualitatively the likelihood of achieving the Goals or the length of time it might take to achieve the Goals.
- Conduct discussions with regional technical experts to explore outcomes for specific stocks and areas.
- Consider alternative themes or approaches to achieving the Goals, including:
- What the implications might be of a new approach to funding and governing salmon recovery efforts.
- What the potential strategies might be under different scenarios for future climate change and population growth.
- What applying maximum efforts to achieve the Goals might look like.

The following sections provide background on how the Partnership defined and developed the scenarios, briefly summarize the intent of each scenario, and discuss some of the key learnings the Partnership gleaned while considering scenarios and how it recommends the scenarios be used going forward. The following chapter describes the strategies that became the primary components of most of the scenarios. The full scenarios are included in this report as Appendix B.

Definition and Components of Scenarios

At the end of its Phase 1 process, the Partnership began to conceptualize how it might use scenarios as it moved into Phase 2. The Partnership brainstormed various potential approaches to developing and using scenarios. These included "scenario planning" as it has been used in community/urban planning, corporate strategic planning, and, to some extent, by resource managers, and "management strategy evaluation," an adaptation of scenario planning used in the fishery community.[134]

Ultimately, given the nature of the questions being evaluated (i.e., what alternative approaches might there be to achieving the Goals and what are the implications of those different approaches?) and the time, resources, and analytical tools available, the Partnership defined a scenario as a combination of one or more strategies, sets of assumed future conditions, and other components or approaches intended to achieve the salmon and steelhead Goals.

All scenarios were intended to make substantive progress toward the Goals, and ideally, all would achieve the high-range goals, although some might achieve them sooner than others, or have a higher certainty of achieving them. Some scenarios focused primarily on achieving the natural production goals, while others incorporated consideration of additional Qualitative Goals. Having a variety of scenarios helped to highlight different strategic approaches or different implications related to interests and values across the Basin.

Strategies, the fundamental building blocks of scenarios, were defined as a broad approach to improving salmon and steelhead abundance by reducing the impact of a specific threat category (i.e., tributary habitat, estuary habitat, hydro, harvest, hatcheries, predation, future conditions). In its simplest form, a strategy could be expressed as a reduction in the current impacts of a particular threat category (e.g., reducing impacts of habitat degradation by increasing capacity and/or productivity of habitat, reducing impacts of hydropower and dams by improving passage survival, reducing negative impacts of hatchery fish on natural productivity, reducing fishing mortality). In the final set of scenarios, strategies were articulated as general approaches that would be implemented through one or more specific actions.

In addition to strategies, the Partnership envisioned that scenarios could contain additional components. For example, several scenarios incorporated the concept of benchmarks, wherein implementation would proceed along a particular path for a certain time period, and at the end of that time, if identified benchmarks were not met, additional actions would be triggered. Other potential components of scenarios included critical uncertainties and research needs; regional considerations (e.g., how might appropriate strategies differ by region or stock); innovative approaches; experimental management; strategic choices (e.g., sequencing considerations, identification of strongholds); and considerations related to climate change and population growth. The scenarios also reflected the different social, cultural, economic, and ecological perspectives.

Approach to Developing Scenarios

The scenarios included in this report evolved through a multi-step process over Phase 2, as summarized below:

- In April 2019, the Partnership brainstormed strategies for potential inclusion in scenarios and considered how to organize the strategies into common groupings or themes.
- In September 2019, the Partnership participated in facilitated small-group discussions to suggest themes for scenarios and to consider how sets of strategies might fit within those themes. They also participated in a Social, Cultural, Economic, and Ecosystem Considerations Mapping Exercise facilitated by SERA Architects.
- Concurrently, the Partnership and Project Team used a limiting factors analysis and simple life-cycle model to explore basic scenarios and how changes in one or more impact categories might contribute to achieving the Quantitative Goals.
- Next, based on these discussions, the Project Team began to develop a suite of potential scenario themes, which it discussed with the Integration Team and the full Partnership. Eventually, through input from the Integration Team and the Partnership, the suite of potential themes was narrowed to exploring scenarios related to "levels of effort" (e.g., levels of

[134] See, e.g., Bentham, Jeremy. 2014. The scenario approach to possible futures for oil and natural gas. Energy Policy 64: 87-92, https://doi.org/10.1016/j.enpol.2013.08.019; International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean. 2019. "Report for the First North Pacific Albacore Management Strategy Evaluation." 19th Meeting of the International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean. Taipei, Taiwan. July 11-15, 2019.


Bull Run Watershed, Oregon. Credit: NOAA Fisheries West Coast Region

funding and levels of scale, intensity, and pace of implementation of strategies and actions).

- The Project Team developed three level-of-effort scenarios: (1) baseline effort (i.e., continuing existing levels of effort and strategies), (2) moderate increase in effort (i.e., assuming substantially more funding, increased intensity of strategy implementation, and addition of new strategies), and (3) maximum effort (i.e., assuming even greater increase in funding, intensity of strategy implementation, and addition of new strategies).
- Concurrently, the Partnership and Project Team developed a menu of strategies. This menu represented a comprehensive collection of strategies put forward by the Partnership and organized by threat category (e.g., tributary habitat, harvest, hatcheries, hydropower, predation) and level of effort. One intended use of this menu was to provide a basis for mixing and matching strategies that might be most appropriate for specific stocks or locations.
- In January 2020, the Project Team conducted regional meetings in the Willamette/Lower Columbia, Middle Columbia, Upper Columbia, and Snake River basins. Partnership members and technical staff attended these meetings to explore in more detail what each of the three "level of effort" scenarios might look like in each region. These regional meetings made the scenarios more specific and tangible, and provided a forum for productive discussion of alternative strategies, their potential outcomes, and the level of effort that might be needed to achieve the Goals.
- At its February 2020 meeting, the Partnership decided to remove the baseline effort scenario from consideration, because it did not appear that the scenario would achieve the high-range goals. The Partnership noted, however, the importance of exploring the potential outcomes of continuing on the current path.
- At the February 2020 meeting, a key breakthrough occurred. A Partnership member introduced the "Salmon First" scenario as an addition to the range of scenarios the Partnership might consider. Several Partnership members were inspired by that scenario and the possibility to develop their own scenarios for achieving the Goals, and this led to the development of the additional scenarios summarized below and included in their entirety in Appendix B.

Scenarios

The scenarios, developed by Partnership members and the Project Team, describe alternative pathways to achieve the Goals. These alternative pathways reflect the different perspectives and social, cultural, economic, and ecological values among sovereigns and stakeholders. However, the scenarios are not rooted in an intensive analytical framework or peer-reviewed process. Overall the scenarios represent a broad range of views, and yet they have much in common. Perhaps foremost among the commonalities is the view that the current path is not one that will lead to achieving the Goals. Change is needed.

This section briefly describes the main themes of the different scenarios developed by Partnership members and the Project Team (not in any particular order). Appendix B provides the full scenarios.

All in for Salmon Scenario, Idaho Stakeholders

This scenario was submitted by Idaho stakeholders in an effort to spark conversation about making the hard decisions necessary to achieve the Partnership's Vision. The scenario maximizes predator control, eliminates harvest, removes dams on the Lower Columbia and Snake Rivers, maximizes hatchery production, and expands flow augmentation. The goal of this scenario is to push the comfort level of Partnership members, including the Idaho stakeholders, to foster "out of the box" dialogue on meaningful solutions. The goal is for swift and comprehensive action focused on restoring rivers and their flow to pre-industrial conditions, as much as possible, and for the sole purpose of restoring salmon. To fund such actions, a "salmon tax" will be imposed on all residents of Oregon, Washington, Montana, and Idaho; a "salmon surcharge" will be imposed on all recreational fishing, watercraft, and guide permits and licenses, and on existing flood control districts throughout the region; and members of Congress will be lobbied to increase federal funding for salmon and steelhead recovery.

Total Salmon Scenario, Idaho Stakeholders

The theme of this scenario is that the value of the river system to the region cannot be overstated and that it is the backbone of the social, cultural, and economic well-being of tribes and state and local communities across the Pacific Northwest. Unfortunately, historical management practices, overharvest, the construction of dams, the effects of variable climate and ocean conditions, and other impacts resulted in dramatic declines to salmon and steelhead populations throughout the region from the mid-1800s until the early 1990s when many populations were listed under the ESA. Improvements occurred, but recent adverse ocean conditions due to climate change have caused fish returns to decline, and more must be done to reverse this trend. This scenario focuses on working together; it calls for an "all hands on deck" approach, where all tribes and stakeholders work together to create the future desired by all. Its strategies focus on maximizing restoration efforts, in measured steps and with adaptive management.

Salmon First Scenario, Zach Penney

This scenario changes the conversation from "how do we get enough salmon to meet everyone's needs?" to "what can we do to meet the needs of salmon?" It focuses on achieving the fastest possible response to declining populations of salmon and steelhead and avoids normalizing the status quo or perpetuating the "false equivalencies" among sovereigns and stakeholders on "remaining whole." The baseline for tribes is the conditions and abundances that existed in 1855. In treaties that facilitated non-tribal settlement, tribes retained the right to fish at usual and accustomed places, yet this has not been achieved, even though tribal dependence on salmon and other fish to meet dietary, spiritual, cultural, economic and basic subsistence needs is still a prevailing necessity of tribal culture and society.

The long-term goal is to have salmon and steelhead in all places that they historically inhabited. This requires returning the river to a more normative state, especially to avoid climate change exacerbations on the current inhospitable conditions. This scenario will maximize effort in the near term on all fronts toward achieving goals as soon as possible, consistent with fair allocation of the conservation burden and treaty/trust obligations the federal government has to tribes. The scenario recognizes regional and subbasin differences in stock composition, population status, management efforts, and jurisdictional boundaries; encourages better integration of salmon recovery into all local decision-making; and recommends strategic choices in light of related risks, with the goal of restoring all fish in all places, including blocked areas that were historically accessible to anadromous fish.

Southern Resident killer whales; J50 and her pod.
Credit: NOAA Fisheries West Coast Region

Fish Forever Scenario, Ben Enticknap and Liz Hamilton

This scenario recognizes the urgency for salmonid recovery to support both people and dependent wildlife and acknowledges the inadequacies and challenges of current efforts, particularly in light of pending climate change impacts. It recognizes that preventing future impacts requires implementing strategies that improve resilience for salmon and steelhead, their habitat, and related ecosystems, and that this demands bold steps now to protect, restore, and increase connectivity of habitat to help recover wild salmon and steelhead populations and maximize their genetic diversity. Achieving these critical outcomes will enable salmon and steelhead to adapt and thrive as the climate changes. This scenario highlights ecosystem benefits — including benefits that recovering Columbia Basin Chinook salmon will provide for endangered Southern Resident killer whales and other fish and wildlife species — and the social, cultural, and economic benefits that recovering salmon and steelhead will provide for people throughout the Basin and beyond.

Stronghold-Anchored and Diversified Portfolio Scenario, Rob Masonis

This scenario acknowledges the reality that the ability to produce abundant, fishable populations of naturally produced salmon and steelhead is highly variable based on habitat quality, quantity, and connectivity, particularly because extensive habitat alteration and degradation of some areas severely limit their fish production potential. Some parts of the Basin have high-quality, connected habitat with substantial natural production potential, while other parts contain areas where habitat improvements can improve natural production and help achieve the Quantitative Goals. The scenario places an emphasis on specific management strategies to match this variability — manage subbasins with the highest natural production as strongholds,

Westport boats. Credit: NOAA Fisheries West Coast Region

and focus on hatchery production in those with low potential to serve harvest fisheries without jeopardizing wild stocks.

The scenario also calls for the river governance structure to be changed and improved to integrate and align salmon recovery policies and management actions (e.g., habitat, hatcheries, harvest, predation, etc.), which will increase transparency, accountability, and public confidence in salmon recovery efforts. It also calls for sequencing and stacking actions to capitalize on synergistic effects.

Shared Sacrifices Scenario, Joe Lukas

The "Shared Sacrifice" scenario is based on all parties acknowledging that a paradigm shift away from divisive, expensive past conflicts is needed. The scenario calls for the region to come together to craft lasting, durable solutions that form a "Community Response" to meet the Quantitative Goals for salmon and steelhead recovery envisioned in this process. All parties must modify their past approaches, set aside past thinking, and come together to identify contributions they are willing to make — every citizen must contribute something meaningful to this effort. This scenario also takes a bold stance on reforming existing governance and funding structures, specifically describing new governance proposals to replace the failing governance strategy currently in place.

The scenario will require a comprehensive, multi-lateral agreement highlighting reforms in: (1) governance; (2) funding; (3) hydropower system operation and configuration; (4) habitat measures; (5) ocean conditions considerations; (6) harvest and weak stock management; and (7) hatchery mitigation, anchored in federal legislation that will provide stability and certainty for the region's citizens. Current laws and regulations are geared towards efforts to reverse declines or avoid jeopardy of protected species but do not focus on recovering salmon and steelhead to the abundance goals established by the Partnership. Thus, this scenario proposes exempting salmon and steelhead from ESA requirements and replacing their recovery and management with new legislation: the Northwest Salmon Act. This will also bolster the fish and wildlife provisions that were an afterthought in the Northwest Power Act. Strategies under this scenario also call for the creation of a new funding mechanism for salmon and steelhead recovery based on both the kilowatt hour sales of BPA "preference customers" and a portion of the Residential Exchange payments under the Northwest Power Act.

Full Recovery Plan Implementation Scenario, Steve Manlow and Washington's Columbia Basin Recovery Organizations

The state of Washington's response to the ESA listings in the late 1990s was a bottom-up approach that relied on regionally based salmon recovery organizations to coordinate the efforts of local professionals, volunteers, scientists, and policymakers. Regional salmon and steelhead recovery plans were developed and implemented. Nearly 20 years later, the efforts have instrumentally helped some species turn the corner toward recovery and slowed the decline or prevented extinction of other species, but not yet helped all species. Unfortunately, the collective and full integration of salmon recovery needs into existing local, state, and federal management programs has not yet been achieved or fully funded.

The theme of this scenario is that lack of progress toward recovery goals is related less to inadequacies in existing plans than to a lack of social, political, and economic engagement in salmon and steelhead recovery at a scale necessary to achieve the goals. Stronger policy support across various management sectors is needed to meaningfully increase progress toward achieving the goals across the Columbia Basin.

Level-of-Effort Scenarios, Project Team

The Partnership and Project Team developed an "a la carte" menu of strategies organized by threat category (e.g., tributary habitat, harvest, hatcheries, hydropower, predation) and level of effort to allow mixing and matching of strategies that might be appropriate for specific stocks or locations. Pairing this with discussions and input from regional meetings and Partnership meetings provided the framework for fleshing out potential scenarios under the "moderate increase" and "maximum increase" levels of effort.

The two scenarios — a Moderate-Increase-in-Effort scenario and a Maximum-Increase-in-Effort scenario — include strategies that reflect how effort would be frontloaded for the first 25 years. Both scenarios also incorporate a concept that a set of benchmarks would be developed to evaluate progress, and that if those benchmarks were not met, additional actions would be triggered (though the details of these benchmarks and additional actions have not yet been developed). Both also incorporate the concept of identifying critical uncertainties, innovative approaches, and strategic choices that might drive implementation; these aspects require additional development. In addition, the strategies identified are general and would need further refinement to be implemented.

Climate Change Scenario, Kevin Scribner

This scenario starts with a different premise and approach than the others. It incorporates potential responses by both fish and people to future changes in climate by posing an array of "plausible futures" and exploring how the Partnership recovery goals for salmon and steelhead could be achieved under each. Over the past decade, many organizations have used this type of scenario planning to prepare for the uncertainties associated with climate change. The scenario proposes a methodology that could be used in the future to explore potential responses by fish and people to climate changes.

The scenario describes eight plausible futures (four for fish and four for people) that serve as examples of this approach:

> For fish, it explores the response to new hydrological conditions and the ability for fish to adapt to physiological changes to individuals within a population that translate to intergenerational evolutionary changes. It proposes four plausible futures for salmon: (1) There is Time — for humans to help salmon adapt; (2) Challenging Times — humans hinder and help salmon adapt; (3) Sirens Sound — all hands on deck to help salmon adapt; and (4) The Bell tolls for Triage — help is haphazard, some salmon go extinct.
>
> For people, the scenario looks at the response in adjustments to behaviors that are influenced by attitude, especially the willingness to change. It presents four plausible futures for people: (1) Readiness is All — time is on our side; (2) Tick Tock — banking on slow change; (3) Time is Nigh — surfing waves of change together; and (4) Torrents of Change — time for triage.

The scenario identifies sample prospective actions for each plausible future as examples of potential salmon recovery approaches that could be expanded into full-blown salmon recovery scenarios.

Discussion

The scenarios collectively represent a range of potential approaches to achieving the Goals. Partnership members agreed that it was important to capture and preserve these approaches for future discussion and development. While not every Partnership member supported the implementation of every scenario or strategy, they did concur in moving forward the set of scenarios included here. In addition, each Partnership member agreed that they could see their interests represented in at least one of the scenarios.

The scenario themes, and the strategies within scenarios, range from step-wise, cautious approaches with relatively proven, known outcomes, to radical changes in any number of arenas, including some approaches that are experimental. While time and resources did not permit either an extensive discussion of the implications of the various scenarios or a more detailed analysis of their biological outcomes, the Partnership did find it useful to consider what was common among the scenarios, what unique viewpoints were represented, and what the points of difference were.

Common Themes among Scenarios

The scenarios have several common themes, including support for actions that address multiple threat categories — primarily habitat, harvest, hatcheries, and hydropower, but also generally predation and reintroduction into blocked areas. Also common among all scenarios was the concept of sacrifice. It is not surprising that these themes recur, as they are the classic themes throughout the history of salmon recovery and restoration. Perhaps the most common theme among scenarios was the conclusion that current approaches will not achieve the Goals, and that major changes are needed, in addition to increases in the level of financial investment in recovery actions. There was also overall agreement that large reduction of impacts in all threat categories (habitat, hatchery, harvest, hydropower, predation) is needed to achieve the Goals, that improved planning for climate change adaptation and resilience is needed, and that some level of change in governance is needed.

The following are common themes among all the scenarios.

Habitat Investments

Partnership members recognized that salmon have well-defined habitat needs, particularly in freshwater. There is a huge volume of study of salmon freshwater habitat and their restoration needs. There is strong support for increasing habitat investments for both tributary and estuary habitat restoration, and for being more strategic with those investments to maximize benefits. Some scenarios suggest focusing on a specific type of action (e.g., actions to improve floodplain connectivity or actions in areas least vulnerable to climate change). Some emphasize the need to ensure that actions are implemented in areas with the highest potential to support natural production, and that they focus on restoring natural processes. Some point out the need to ensure that new development does not threaten existing habitat. There is also interest in evaluating which habitat improvements are most beneficial to fish through monitoring and evaluation.

Hydropower Operations and Dam Breaching

While the topic of dam breaching or removal is controversial as it relates to the lower Snake River dams, this idea has been applied nationwide in fish recovery strategies, including in the Pacific Northwest. While not all scenarios include dam removal or breaching as a strategy, it is recognized in most as an available tool. Most Partnership members agree that hydropower operations need to benefit fish as well as humans, particularly in the face of climate change and the need to transition away from coal and gas. There is interest in exploring breaching of one or more dams in the Columbia River system, not limited to the lower Snake River dams. Some consider this exercise as urgent, while others consider it a measure of last resort and argue for evaluation of additional changes in hydropower operations before moving toward breaching. Some scenarios also include strategies to consider the removal of other smaller dams on a case-by-case basis. The range of approaches is consistent with the moderate and maximum effort strategies that the Partnership as a whole explored in the "level of effort" scenarios.

Harvest

Many of the scenarios propose harvest restrictions in varying degrees, whether through the continuation of abundance-based management approaches or more draconian decreases in harvest or moratoriums on harvest for a certain period of time. These scenarios recognize that harvest can be a limiting factor that interferes with Partnership Goals for natural production, but the majority of scenarios highlight the importance of respecting tribal treaty and trust rights and ensuring tribal ceremonial and subsistence harvest.

Predation/Invasive Species

Most scenarios call for enhanced actions to address predation and invasive species, and several call for removing harvest quotas on predator fish, implementing population-scale removal of non-native predator fish, and enhancing efforts to remove and discourage marine mammal and avian predators. The impact of predation, particularly from birds and marine mammals, has become obvious as studies have shown significant impacts to both juveniles and adults. Predators have increased in number as a result of human activities and regulations that protect native predator species.

Reintroduction into Blocked Areas

Reintroduction has been used as a tool in salmon restoration in the Columbia Basin and is a strategy identified in multiple recovery plans. For example, coho salmon have been reintroduced into previously occupied habitats within their historical range in the Columbia and Snake Rivers upstream from Bonneville Dam. There is overall support for a continued effort toward reintroduction/mitigation efforts in blocked areas. A path forward has been identified in the upper Columbia Basin that is different from the path forward in the Snake Basin. The scenarios respect these paths and urge them to continue, although some highlight this issue more than others, and some call for increased funding and expedited efforts.

Hatcheries

There is general agreement that hatcheries are an important component of recovery and conservation (especially for very high-risk stocks and for reintroduction), that they are useful in providing harvest opportunities, and that they should be operated to ensure consistency with the Partnership Goals. Hatchery production is also used to meet mitigation responsibilities. In addition, some Partnership members feel that increasing hatchery production is urgent to support dependent species, such as Southern Resident killer whales; others view hatchery production as important to enhance abundance of natural stocks; and others recognize the significance of hatchery releases to meet mitigation responsibilities and support sportfishing, commercial fishing, tribal fishing, dependent industries, dependent communities, and food production. Those who have strong concerns about adverse influences of hatchery fish on natural populations advocate for the strongest hatchery reforms. The degrees of hatchery reform are outlined in the “level of effort” scenarios and reflected in the Range of Strategies Chapter.

Public Engagement and Education

There is broad support by Partnership members for public engagement and education to ensure that there is long-term, sustained support for salmon and steelhead objectives.

Shared Sacrifice

The concept of shared sacrifice is another theme common to all the scenarios, although debate remains about what “equitable” sharing would look like. The Salmon First scenario articulates the concept of historical loss of salmon resources, dating back to 1855, as a sacrifice to be regained. The Fish Forever scenario points out that humans share salmon with hundreds of other species, including Southern Resident killer whales, none of which can “contribute” to restoration but to whom humans owe a debt.

Unique Elements of Scenarios

Despite their common themes, scenarios also advanced unique perspectives or elements to promote Partnership Goals. These include:

- Several scenarios call for shifts in perspective, so that rather than starting from human needs, people ask what they can do for the salmon. Others envision a reorganization of the regional economy. Some highlight the need for more integrated, coordinated planning and decision making and overcoming the “silos” that have separated management of some aspects of salmon and steelhead recovery.
- Several scenarios advocate for new funding sources and opportunities (e.g., a “salmon tax” on kilowatt hours of electricity consumed; a “salmon surcharge” on recreational fishing, watercraft, and guide permits and licenses, as well as on flood control districts; and targeted

lobbying of Congress to increase federal funding for salmon and steelhead recovery).
- One scenario proposes new legislation that would exempt salmon and steelhead from ESA requirements and focus on recovery rather than avoiding jeopardy, while also providing more stability and certainty for the region's citizens.
- One scenario notes that there are existing ESA recovery plans for Columbia Basin salmon and steelhead and suggests that lack of progress toward recovery is related less to inadequacies in existing plans than to a lack of social, political, and economic engagement at a scale necessary to achieve the Goals. This scenario advocates collective and full integration of salmon recovery needs into existing local, state, and federal management programs. It also highlights some specific and local priorities from entities implementing existing recovery plans.
- One scenario suggests applying scenario planning as it has been used by organizations to prepare for uncertainties related to climate change. As an example of an approach that could be further developed in a structured workshop, it gamed out "plausible futures." Included in these plausible futures was a vision for a new economic structure and a "Salmon Culture" in the Pacific Northwest.
- Several scenarios highlight the need to move beyond traditional views of habitat restoration and propose that to achieve the Goals it will be necessary to upgrade state land use, development, and environmental laws and regulations and, ultimately, to remove existing development in some places to restore adequate habitat.
- Other scenarios suggest that other types of extreme actions might be necessary, such as breaching all dams in the Basin, shutting down harvest or hatchery production in at least some areas for some period of time, or ramping down and decommissioning hatcheries as natural populations rebound.
- A few scenarios expand hydropower strategies beyond the federal Columbia and Snake River dams, and either suggest strategies for FERC-licensed dams or a strategic prioritization Basinwide of opportunities to address blocked areas/dams in tributary habitat through dam removal or passage improvement.
- Some scenarios include innovative approaches for decreasing hydropower and habitat impacts, either through innovation in technology, or funding and incentives, or both. Some recommend that the region more fully explore innovative approaches to reduce impacts in all threat categories, or that it considers large-scale experimental management approaches to explore critical uncertainties.
- Some scenarios identify critical uncertainties and highlight the importance of structured approaches to explore these uncertainties, or call for more strategic approaches to moving toward recovery.

Points of Difference

There are several areas where views expressed in the scenarios are divergent. These points of difference may reflect the areas of most scientific uncertainty, or they may reflect areas where social, cultural, economic, and ecological considerations are strongest. Some are longstanding points of divergence, and some are relatively new to discussions at the Basinwide level. These points of divergence may present fruitful ground for future Partnership engagement, although that engagement should be based on an understanding of whether the disagreement can be adequately resolved to advance Partnership Goals. Primary points of divergence were:

- Who should bear the economic, cultural, and social burdens of change? How should the burden of recovery be allocated so everyone shares responsibility? Some in the Basin advocate that the burden should be shared equitably, proportionate to relative contribution to impact. Others believe that those who have benefitted the most from the anthropomorphic changes should bear the greatest burden. Another view is that there is a need to avoid normalizing the status quo and shift the conversation entirely, from focusing on how to make salmon meet our needs to how we can meet the needs of the salmon. These questions highlight the relevance of the social, cultural, economic, and ecological impacts and the need to consider them in exploring issues and making decisions.
- What is the value of the current governance structure? Some scenarios question whether the current legal and governance structures are consistent with the Partnership Goals. Others assume that existing governance structures are valid and do not impede achieving the Goals. Suggestions in scenarios ranged from improving coordination in decision making to full-scale

Partnership members at work. Credit: Kearns and West

change in the legal, funding, and governance frameworks for managing salmon and steelhead recovery in the Basin.

- What is the appropriate path for reducing hydropower threats? While all scenarios recognized dam removal as a tool, they differed in terms of the perceived urgency of the issue and the extent to which it should be explored. Scientific questions related to this discussion include the impact of enhanced spill operations versus dam breaching and what dams should be considered for breaching, and when. There are also significant social, cultural, economic, and ecological components to this question. Changing dam removal as a threat to some entities into something that might be an opportunity is an important challenge.
- Some scenarios reflected divergent views and values about hatcheries and harvest. Should harvest continue to be managed as it has in the recent past (e.g., through the use of abundance-based harvest management frameworks and weak stock protections) or are changes required? If changes are required, can they be achieved through incremental approaches, or are more draconian measures required, such as temporary moratoriums on some or all fisheries? What impacts do hatchery fish have on natural populations and what is the best way to manage those impacts?

Partnership Recommendations on Scenarios Going Forward

All Partnership members support the Quantitative Goals, and although the scenarios reflect a diversity of views about how to achieve them, there are also many broad points of agreement. The scenarios collectively reflect a range of views from Partnership members on how to achieve the Goals, and the Partnership agreed that it was important to capture and preserve these approaches for future discussion and development. The suite of strategies from the scenarios, and the various approaches represented in the scenarios, should help set the stage for the next set of conversations about how to move forward. That conversation should include consideration of the social, cultural, economic, and ecological considerations, as well as of scientific uncertainties, and exploration of tools to help further analyze the outcomes of various scenarios. Scenarios should not be used as a platform for positional arguments or for advocating one scenario versus another. Rather, they should be used as a basis from which to understand underlying values, the range of possible approaches, and outcomes, and as a means for creating greater understanding and moving to agreement.

Habitat restoration near Leadore, Idaho. The project increased channel complexity, reactivated side channels, and increased floodplain connectivity to benefit spring Chinook salmon. Credit: Photo by Daniel Bertram, Idaho

Range of Strategies for Regional Consideration

The Partnership identified a range of potential strategies to address each of the categories of factors limiting salmon and steelhead (tributary habitat, estuary habitat, hydropower, blocked areas, predation/invasive species, fisheries, hatcheries, climate). Strategies are the building blocks of the scenarios described in the previous chapter. Each scenario includes suites of strategies that combine to chart a pathway toward the salmon and steelhead Goals. Each strategy in turn may be implemented through one or more specific activities or actions.

The strategies summarized here are intended to provide a menu of potential choices on how to achieve salmon and steelhead Goals. They are not an exhaustive list, but rather represent a range of ideas reflected in the scenarios in the previous chapter. They are intended to provide a starting point to inform future discussions and considerations.

Different strategies have different likely biological outcomes and different implications for related social, cultural, and economic interests and values. Many are already being implemented. All are expected to contribute to achieving the Qualitative and Quantitative Goals.

Strategies were identified through a series of scenario development discussions and exercises by the Partnership as a whole and by individual Partnership members. The strategies identified for each limiting factor category may or may not be mutually exclusive alternatives. In some cases, strategies might be combined to achieve synergistic effects. In other cases, different strategies might represent competing decisions. Different strategies may also be pursued in different regions or for specific stocks, depending on local or stock-specific conditions, and the most appropriate mix of strategies may differ for each stock.

Tributary Habitat Strategies

Tributary habitat strategies aim to protect and restore tributary habitat quantity and quality in rivers and streams where salmon and steelhead spawn and rear. Current conditions reflect more than one hundred years of human activities that have degraded habitat. While significant habitat restoration efforts have been implemented for salmon and steelhead throughout the Columbia Basin, large-scale, concerted effort is needed to restore sufficient habitat to support healthy, harvestable populations of salmon and steelhead. At the same time, habitat continues to be adversely affected by ongoing development. Current land and water use regulations may not prioritize habitat protection at the same level as other social and economic considerations. The effects of climate change also have implications for the ability of tributary habitat to support healthy, harvestable populations. Significant improvements will require sufficient effort to address past impacts and offset continuing declines.

1. **Implement opportunistic restoration and protection projects targeting key limiting factors in high value or high potential salmon habitats.**

   This strategy addresses tributary passage issues for adults and juveniles, and implements opportunistic habitat restoration projects at selected sites. Examples include culvert replacement, riparian restoration, stream structure enhancement, and screening of irrigation diversions. Projects are opportunistic in the sense that they are identified and prioritized based on a basic but possibly incomplete understanding of limiting factors, capitalize on available resources and willing partners, and are relatively small in scale and straightforward in implementation. This strategy describes many of the habitat restoration activities to date in much of the Columbia Basin. Most of these "low-hanging fruit" projects have been completed. Funding levels have been generally stable, but not increasing, and maintaining the current level of investment might result in merely maintaining the status quo due to ongoing development and degradation from other activities.

2. **Increase investments and focus on large-scale, process-based restoration projects and protection of habitat function sufficient to demonstrably improve abundance and productivity of key populations.**
This strategy prioritizes larger and increasingly complex projects with a shift in focus from specific stream reaches to larger reaches or areas of the watershed (e.g., floodplains). Costs can increase substantially as projects become more complex and the available pool of opportunities gets smaller. Project implementers have noted that some funding entities may consider these more complex projects risky and be hesitant to fund them. Some funding systems may need to adapt to provide the flexibility to implement such projects. For example, there may be a need to shift from traditional project metrics (e.g., numbers, acres) to more complex ways of predicting and evaluating benefits. Under this strategy, watershed assessments provide focus on areas with the high intrinsic productivity and potential for improvement. Project effectiveness monitoring is used to guide strategic decisions on further investments. There is potential to significantly expand and build upon current efforts in both currently degraded and in less-developed areas. Effective implementation of this strategy will require significant expansion of implementation infrastructure, supporting assessment information, coordination, capacity and capital, design and development, and monitoring. Significant effort is needed to reduce or mitigate the impacts of continuing land development, particularly in floodplains.

3. **Implement watershed-level, process-based restoration and protection of habitat sufficient to demonstrably and significantly improve abundance and productivity for multiple salmon or steelhead populations.**
Stream habitat conditions for salmon and steelhead are ultimately a function of watershed processes across the landscape. Therefore, significant watershed-level restoration will require implementing actions with broad impacts across large areas. This will involve not just large-scale, process-based restoration but also comprehensive efforts to work with local governments and other land and water managers to integrate recovery needs into land use and water use planning. Additional actions would include reconnecting large areas of floodplain, restoring more natural hydrography, protecting and restoring uplands, managing stormwater, and reducing toxic pollutants. Opportunities are more constrained in watersheds with higher levels of existing development and these areas will require different approaches depending on land use. Long-term success will also require incorporating considerations related to protection of habitats least vulnerable to climate change or most likely to improve climate resilience. Significant improvements in land use planning will be necessary to slow the impact of development and achieve the full benefit of habitat restoration activities. Protection of watershed functions that benefit salmon and steelhead, in addition to other species, would need to receive significantly higher priority in land use planning forums to achieve desired improvements in abundance and productivity.

4. **Reconfigure significant infrastructure in areas critical to salmon and steelhead production.**
Opportunities for significant habitat improvements are limited in some areas where development is extensive. These include many urban, residential, and agricultural areas where conditions have been substantially altered by infrastructure structure development (e.g., roads, railways, dikes, channelization, diversions, floodplain development). In these cases, large-scale improvements will require a willingness to implement changes to remove and reduce constraints from infrastructure. Significant progress on this strategy will require a willingness to purchase private land and implement actions such as removing imperious surfaces and relocating structures, with appropriate consideration of social, cultural, and economic factors.

Estuary Habitat Strategies

The Columbia River estuary includes the tidally influenced area from the river mouth upstream to Bonneville Dam and in the Willamette upstream to Willamette Falls. Estuary habitat strategies aim to protect and restore the quantity, quality, and function of estuary habitats critical to salmon and steelhead. All stocks utilize estuary habitats to a greater or lesser degree during outmigration as juveniles and as returning adults. Estuary habitats are particularly important to ocean-rearing stocks such as summer and fall Chinook and chum salmon, because they pause to feed and grow in the estuary.

Estuary habitat protection and restoration provides significant benefits for salmon, migrating waterfowl, and other wildlife. Restoration projects can also protect nearby landowners from flooding, sequester carbon to mitigate climate change effects, and improve recreation opportunities. Current conditions reflect more than one hundred years of human activities that have degraded estuarine habitat. While significant habitat restoration efforts have been implemented for salmon and steelhead in the Columbia River estuary, large-scale, concerted effort is needed to restore sufficient habitat to support healthy, harvestable populations. Restoring sufficient habitat will require large-scale, concerted efforts. At the same time, habitat continues to be adversely affected by ongoing development. Current land use regulations may not prioritize habitat protection at the same level as other social and economic considerations. The effects of climate change, including predicted sea-level rise, will have serious implications for estuary habitat. Significant improvements will require sufficient effort to address past impacts and offset continuing declines.

1. **Implement site-specific restoration and protection projects that address key limiting factors in high value or high potential salmon habitats.**

This strategy describes many of the habitat restoration activities to date in the estuary. Example projects include site-specific actions such as dike removal, tide-gate repair, culvert repair, riparian restoration, native revegetation, and land protection through purchases, easements, or development rights. Selected projects often capitalize on available resources and willing partners. Much of the work to date has been focused on public lands. These efforts have been significant. For instance, from 2000 through 2019, the Lower Columbia Estuary Partnership and 100 partners completed 199 projects restoring or protecting 28,387 acres of the approximately 114,050 acres of historical native habitats lost since the late 1800s to agriculture, industry, and urban development. However, more effort is needed to meet the needs of salmon and steelhead and other species.

2. **Increase investments and focus on large-scale, process-based restoration projects and protection of habitat function sufficient to demonstrably improve abundance and productivity of key populations.**

This strategy involves implementation of projects with increased complexity and cost, often requiring some impact to existing infrastructure (e.g., dike removal to restore tidal marsh habitat and floodplain connectivity). Larger-scale projects (similar to the Steigerwald project discussed earlier in this report) will strategically target species and habitat limiting factors to increase habitat to a high level of fish function in selected priority areas while also benefiting ecosystem function for a variety of species. This strategy requires substantial increases in the level of effort, opportunities on private lands, and flexibility in project approval and funding processes. Broadening the funding base will allow for more diverse applications beyond salmon and steelhead and provide for more opportunities in riparian planting, stormwater management, addressing toxic pollutants, reducing impervious surfaces, etc. Project implementers have noted that some funding entities may consider these more complex projects risky and be hesitant to fund them. Some funding systems may need to adapt to provide the flexibility to implement such projects. For example, there may be a need to shift from traditional project metrics (e.g., numbers, acres) to more complex ways of predicting and evaluating benefits.

3. **Watershed-level, process-based restoration and protection of habitat function sufficient to demonstrably and significantly improve abundance and productivity for multiple salmon or steelhead populations.**

Habitat conditions for salmon and steelhead are ultimately a function of watershed processes. Therefore, significant watershed-level restoration will require measures with broad impacts across large areas involving wetlands, floodplains, riparian areas, and uplands. This will involve not just large-scale, process-based restoration but also comprehensive efforts to work with local governments and other land and water managers to integrate salmon restoration needs into land and water-use planning and regulatory programs.

Additional actions would include reconnecting large areas of floodplain, restoring more natural Columbia River hydrography, protecting and restoring uplands, managing stormwater, and reducing toxic pollutants. High priority is assigned to increasing and improving floodplain habitat and protecting floodplain habitat from future industry expansion. Significant improvements in land use planning will be necessary to slow the impact of development and achieve the full benefit of habitat restoration activities. Protection of watershed functions that benefit salmon and steelhead, in additional to other species, would need to receive significantly higher priority in land use planning forums to achieve desired improvements in abundance and productivity.

4. **Reconfigure significant infrastructure in areas critical to salmon and steelhead production.**

Opportunities for significant habitat improvements are limited in some areas where development is extensive. These include many urban, residential, and agricultural areas where conditions have been substantially altered by infrastructure development (roads, dikes, channelization, diversions, flood plain development, etc.). In these cases, large-scale improvements will require a willingness to implement changes to constraining infrastructure. Significant progress in this strategy will require a willingness to purchase private land, remove impervious surfaces, relocate structures, etc., with appropriate consideration of social, cultural, and economic factors.

Hydropower: Mainstem and Tributary Dam Strategies

Hydropower projects on the Columbia and lower Snake River mainstems and in tributaries are a significant source of mortality of juvenile and adult salmon and steelhead. This section includes strategies related to upstream and downstream passage at hydropower projects in the Basin that provide access for anadromous fish (primarily the federal lower Columbia and lower Snake River dams and the Mid-C PUD dams but also a few tributary dams — for example, in the Clackamas River subbasin — that have effective passage facilities). Strategies for areas blocked by dams are addressed separately in a following section. Strategies are applicable to projects owned and operated by the federal government, public utility districts, and private power companies.

Passage impacts are manifested during migration through dams and reservoirs, and afterward as a consequence of the migration experience. Direct effects include injury during passage through spillbays, turbines, or fish bypass systems. Indirect effects include things like increased vulnerability to predation or disease due to stress or delayed migration. The region has dedicated tremendous energy to the identification and implementation of effective remedies for dam impacts. These investments have clearly produced substantial improvements in fish survival in many areas, but impacts remain significant, and the region is grappling with the challenge of balancing competing demands for fish, power, water, navigation, and flood control in the Columbia and Snake River system. Water management operations of the federal hydropower system in the Columbia Basin are also complex, involving coordinated management of storage projects in four states and Canada.

1. **Provide fish passage and transportation to reduce dam-related mortality consistent with competing demands for power, navigation, flood control, etc.**

Extensive effort has been dedicated to systems and operations for passing salmon and steelhead at dams. Fish ladders or trap and haul programs can address the most obvious problem of allowing adults to pass upstream.[135] Fishway systems, including multiple ladder entries, attraction flows, channels, ladders, and exits, have been engineered over decades to optimize adult passage, and they are generally effective. Trap and haul systems have proven effective at some tributary dams that are too high for effective ladder passage. Juvenile passage has proven to be more challenging. Mortality of juveniles passing through turbines can be substantial, particularly where compounded through multiple dams. To avoid turbines, a variety of bypass systems have been developed over the years to collect juveniles and route them around turbines. To avoid dams entirely, fish are collected at upper dams and loaded onto barges or trucks for transportation to the lower river (although reliance on fish transportation has declined in recent years as the focus has shifted to improving in-river survival conditions). Juvenile bypass systems have been continually

[135] There are no trap and haul programs associated with the mainstem Columbia and lower Snake River dams. Trap and haul programs are in use at some dams in tributaries to the Columbia River.

refined to improve safety and effectiveness. Spill programs, surface bypass routes, bypass system outfalls, and predator management programs have been developed to move fish more quickly and effectively through dam forebays and bypass systems. Effective passage requires both routing juveniles through the dams and delivering them through a complex of dams and reservoirs in good health and in a manner that supports their life-history strategies. Therefore, the opportunity for additional engineering improvements in juvenile bypass systems may be limited. More recent passage efforts are focused on more-holistic improvements of in-river passage conditions.

2. **Implement dedicated efforts to substantially improve fish passage and survival through significant modifications of hydropower system operation and configuration.**

A dedicated spill program is currently in place with a goal to further improve juvenile survival rates through eight federal Columbia and lower Snake River dams and/or to increase salmon and steelhead smolt-to-adult returns. Surface passage routes, followed by spillways, are the most effective route of passage past the dams, and high levels of spill and associated river flows have been positively correlated with improvements in system survival by some researchers. Juvenile fish that pass through spillways (including surface passage structures) on the lower Snake and Columbia Rivers generally have higher smolt-to-adult return rates than those that pass through turbines or through juvenile bypass systems. Fish that pass through spillways also have higher first-year estuary and ocean survival.[136]

Water spilled over dams cannot be used for power generation. Therefore, spill programs require changes in water management throughout the system and incur significant costs in terms of foregone power generation. Spill operations for salmon and steelhead have been in place at the Columbia and lower Snake River dams since 1993. Spill program requirements have expanded over time. The most recent expansion of spill requirements for salmon and steelhead began in 2019 with the advent of the "flexible" spring spill program. This program increases spill for fish migration during certain times of the day, with lesser amounts spilled in the hours when hydropower production is needed most. The program is designed to provide additional fish benefits, manage power system costs, preserve hydropower system flexibility, and retain operational feasibility.

Dedicated efforts for improving in-river migration conditions also include a variety of other measures. These include water temperature management operations of upstream storage reservoirs (e.g., at Dworshak Dam in Idaho's Clearwater River). In addition, offsite mitigation actions, such as predator management and tributary and estuary habitat improvement programs, have been implemented for over a decade. Mainstem dams operated by non-federal public utility districts in the mid-Columbia River (Douglas and Chelan PUDs) are implementing Habitat Conservation Plans (HCPs) consistent with Federal licensing requirements. These HCPs commit the PUDs to a 50-year program to meet hydropower project survival targets and compensation programs that in combination produce no net impact on mid-Columbia salmon and steelhead runs. The Grant PUD's Priest Rapids Project dams (Wanapum and Priest Rapids Dams) are not covered by an HCP but implement a similar program for their upper Columbia River mainstem dams.

3. **Expanded measures to improve system survival within the large-scale limitations of current system configuration.**

Additional hydropower alternatives are available for the benefit of salmon and steelhead within the constraints imposed by the system of dams and reservoirs currently in place. All of these alternatives come with greater costs and constraints on other land and water uses and values. For example, spill programs could be expanded to 24 hours per day rather than the 16 hours per day implemented as part of the 125 percent total dissolved gas flexible spring spill operation implemented beginning in 2020. Spring-migrating juveniles might be afforded higher priorities in the management of upstream storage reservoirs relative to flood risk management, power generation, irrigation, navigation, and the needs of Columbia River chum and resident fish species. Higher flow levels and water management could

[136] While these observations hold true, there is substantial scientific disagreement about the underlying mechanisms causing these differences. See: (1) Independent Scientific Advisory Board. 2007. Latent mortality report: review of hypotheses and causative factors contributing to latent mortality and their likely relevance to the "below Bonneville" component of the COMPASS model. Northwest Power and Conservation Council, Portland, Oregon; and (2) Independent Scientific Advisory Board. 2012. Follow-up to ISAB reviews of three FPC memos and CSS annual reports regarding latent mortality of in-river migrants due to route of dam passage. ISAB 2012-1. Independent Science Advisory Board for the Northwest Power and Conservation Council. January 3.

be used to a greater extent to provide cold water for migrating adults during summer, but doing so would increase the risk of not refilling the next year. Non-federal projects might look beyond FERC license agreements and corresponding biological opinions or, in the case of the Mid-C PUD dams, the HCPs, to find additional operational measures that might improve survival if implemented. For example, attendees at a regional meeting to discuss scenarios in the upper Columbia region mentioned exploring year-round bypass operations, alternative spill regimes, adult passage technologies, year-round fish passage, additional turbine restrictions, and more fish-friendly turbines.

4. **Targeted restoration of more natural river conditions and function.**

It is not practical to return the Columbia River system to a completely natural state, but improvements to more natural habitat conditions may be necessary to achieve salmon and steelhead restoration goals, according to some experts.[137] Natural conditions include unimpeded passage to and from spawning and rearing sites; flow and temperature regimes produced by local and regional climates, unencumbered by regulation; riverine habitats formed and maintained by natural processes through the interactions between flowing water and the surrounding landscape; and community interactions dominated by species with which salmonids co-evolved. Corresponding fish and ecosystem benefits of these natural conditions would include naturally spawning populations capable of maintaining themselves; sufficient numbers to repopulate favorable but currently underutilized habitats; and sufficient marine-derived nutrients to maintain aquatic and riparian productivity.

Within the constraints of current hydropower system configuration, more natural seasonal flow patterns might be achieved by significantly altering flood risk management operations at upper Basin storage projects.[138] This approach might also require a coordinated effort to reconfigure flood control structures in downstream areas and reopen floodplain habitat.

In the case of mainstem hydropower projects, dam breaching would likely be one of the most powerful means of restoring natural conditions in selected reaches. Several interest groups in the region have advocated breaching of one or more of the four lower Snake River dams for the benefit of salmon. Survival rates generally decline in relation to the number of dams a population must pass. Breaching would have significant social, cultural, economic, and ecological implications. Breaching even one lower Snake River dam would preclude barge transportation to and from Lewiston, Idaho. Dam breaching would also reduce hydropower system generation capabilities and affect irrigated agriculture fed by withdrawals from lower Snake River reservoirs. In addition, dam breaching would require shoring up regional rail and highway infrastructure to compensate for lost river transportation capacity. At the same time, corresponding improvements in salmon and steelhead numbers may be difficult to achieve with other measures. Mainstem dam breaching remains a source of much discussion, with no clear consensus yet achieved by the broad range of interested parties.

Blocked Area Strategies

Blocked areas strategies address the large portions of the Basin that were once accessible to salmon and steelhead but are now blocked by dams. These include the upper Columbia River upstream of Chief Joseph and Grand Coulee Dams, the Snake River and its tributaries upstream of the Hells Canyon Dam complex, and a number of large tributaries throughout the Basin (e.g., the Cowlitz, Lewis, North Fork Santiam, Middle Fork Willamette, Deschutes, and Clearwater Rivers). Many tributary dams were built without fish passage structures, or with passage structures that proved to be ineffective, due primarily to inherent difficulties in passing adults and juveniles at high dams and through large reservoirs. In several cases, passage was attempted after the dams were constructed but subsequently abandoned. Passage efforts have more recently been reinitiated in selected tributaries including the Cowlitz, Lewis, Deschutes, and Yakima Rivers but their effectiveness remains to be determined.

The Upper Columbia United Tribes (UCUT) have developed a phased approach to fish passage and reintroduction in the upper Columbia River above Chief Joseph and Grand Coulee Dams. In May 2019, the UCUT completed Phase 1 of their phased approach and issued a report confirming

137 Williams, R. N., J. A. Stanford, J. A. Lichatowich, W. L. Liss, C. C. Coutant, W. E. McConnaha, R. R. Whitney, P. R. Mundy, P. A. Bisson, and M. S. Powell. 2006. Return to the river: strategies for salmon restoration in the Columbia River basin. Pages 629 to 666 in R. N. Williams, editor. Return to the river: restoring salmon to the Columbia River. Elsevier, Amsterdam.

138 This action would require Congressional authorization.

that the reintroduction of salmon to the U.S. portion of the upper Columbia River upstream of Chief Joseph Dam is likely to achieve identified tribal goals given current dam operations, riverine and reservoir habitat condition, donor stock availability, reintroduction risk to native species, and effectiveness of state-of-the-art juvenile and adult passage technology.[139] The Upper Snake River Tribes have also developed a plan to reestablish fisheries on unlisted, hatchery-origin spring, summer, and fall Chinook salmon and/or steelhead in select tributaries to provide subsistence, cultural, and recreational harvest opportunities upstream of the Hells Canyon Complex; to restore naturally reproducing unlisted populations of salmon and steelhead within select tributaries upstream of the Hells Canyon Complex to meet harvest, cultural, and ecological needs; and to restore fall Chinook salmon in the mainstem Snake River as a long-term goal dependent, in part, upon restoration of mainstem water quality and effectiveness of mainstem collection measures.[140]

1. **Enhance resident fish production as partial mitigation in areas of the historical anadromous distribution that are not currently accessible.**

In many blocked areas, efforts have been undertaken to enhance resident fish production to provide increased fishing opportunity where anadromous production has been blocked. For instance, the Fish and Wildlife Program of the Northwest Power and Conservation Council includes use of resident fish as one of its strategies to address losses of anadromous fish production in blocked areas. Resident fish, however, are generally not regarded as an appropriate substitute for anadromous fish, especially by tribes that have experienced a complete loss of their way of life with the extirpation of salmon and steelhead in blocked areas.

2. **Release limited numbers of adult salmon and steelhead in currently blocked historical production areas to provide cultural needs and fishing opportunities, and assess the natural production potential of current habitats.**

Limited releases of adult salmon and steelhead into historical habitats of blocked areas have been used in the upper Columbia and Snake Rivers in recognition of the importance of salmon and steelhead to tribal cultures, provide limited fishing opportunities, and investigate current habitat availability, suitability, and salmon survival potential. Typically, hatchery adults are collected at hatcheries, dams, or weirs in accessible areas and transported into blocked areas. The hatchery fish used might be surplus broodstock from existing programs or require the development of new programs dedicated to the specific reintroduction need. This strategy is not expected to produce significant adult returns from natural production because avenues for downstream passage of juveniles are typically limited. Depending on the area, some juveniles might survive to return as adults, but survival rates would be too low to sustain a significant adult population even where returning adults were collected and transported into natural production areas. This strategy might be an interim step toward a long-term goal of restoring natural production or it might be the ending point itself.

3. **Experimental reintroduction with interim hatchery supplementation concurrent with evaluation of passage potential.**

This strategy involves concerted efforts to reestablish effective passage systems for adults and juveniles through existing dams and reservoirs into historically blocked areas. The strategy describes current reintroduction efforts in the Cowlitz, Lewis, and Deschutes Rivers. High storage dams in those rivers make it difficult to construct effective fish ladders for adult passage. However, adults can be readily trapped at the base of dams and transported into upstream production areas. Juvenile passage has proven to be a more daunting challenge. Juveniles must transit large reservoirs and pass the dams through turbines, over spillways, or through collection and bypass systems. Each of these passage routes presents difficulties that are exacerbated by the height of these dams (relative to shorter run-of-river dams). Juvenile collection systems have been developed for reintroduction efforts in some tributary projects, but these efforts have met with varying degrees of success. Collection systems must ensure that a significant percentage of migrating juveniles pass downstream of the dam to produce self-sustaining natural populations or hatchery supplemented populations. In most areas, successful juvenile passage systems at high dams remain a work in progress. Therefore, strategies for restoring

[139] Upper Columbia United Tribes. 2019. Fish Passage and Reintroduction Phase 1 Report: Investigations Upstream of Chief Joseph and Grand Coulee Dams. May 2.
[140] Upper Snake River Tribes. 2018. Hells Canyon Complex Fisheries Resource Management Plan. April 27.

self-sustaining natural production in blocked areas almost inevitably include hatchery supplementation and experimental evaluation of passage on a path to a goal of reintroduction.

4. **Restore effective adult and juvenile passage consistent with high levels of self-sustaining natural abundance and production throughout historical ranges.**

This strategy aims to restore healthy, self-sustaining natural production in historical production areas that are currently blocked. Successful implementation of this strategy would require spawning, rearing, and migration corridor habitats capable of sustaining salmon throughout their life cycle and effective adult and juvenile passage to and from natural production areas. Passage might be accomplished by removal of barriers or development of effective passage systems. Several examples of this strategy exist in the Columbia Basin. For instance, the removal of Condit Dam, on the White Salmon River, in 2011 restored anadromous salmon and steelhead access to this river, and these populations are naturally recolonizing it. Following the removal of the Lewiston Dam, on the Clearwater River in 1973, spring Chinook salmon were reintroduced, and natural production has become reestablished. Significant progress has been made in reintroduction of natural coho salmon and winter steelhead into the upper Cowlitz River Basin by construction of effective juvenile collection facilities. A number of potential passage restoration opportunities are currently being considered or explored in the upper Columbia River, upper Snake River, and several tributary systems (e.g., the Okanogan, Wallowa, and Crooked Rivers). Depending on the stock, it is likely that the continuing effects of climate change, especially in the marine environment, will substantially influence the potential for success using this strategy, more than those strategies relying at least in part, on some form of hatchery supplementation.

Predation and Invasive Species Strategies

Predation is a natural mortality factor for salmon and steelhead throughout their life-cycle, but predation has also been exacerbated in many areas by human activities and development. As a result, salmon and steelhead restoration efforts have included a variety of strategies for predator management or control. These efforts have addressed predaceous fishes, birds, seals, and sea lions. Native northern pikeminnow and introduced walleye and smallmouth bass are significant predators of juvenile salmon and steelhead during outmigration through Columbia and Snake River reservoirs. The impact of predation by colonizing seabirds (Caspian terns, cormorants, and gulls) on juvenile salmon and steelhead is significant in the Columbia River estuary and certain upriver areas. Increasing numbers of California and Steller sea lions are consuming large numbers of adult salmon and steelhead in the Columbia River downstream from Bonneville Dam and in the Willamette River downstream from Willamette Falls. Columbia Basin salmon are also a prey species for Southern Resident killer whales during winter and spring, but these predators are themselves an endangered species and can be expected to benefit from increased numbers of salmon that may result from management or control of competing predators.

Non-native and invasive species imperil native species in the Pacific Northwest's ecosystems through predation, competition for food, interbreeding, disease transmission, food web disruption, and physical habitat alteration.[141] A variety of invasive species have already colonized the Basin, with significant impacts on native species and ecosystems. In many cases, these invasive species have capitalized on habitat alterations accompanying widespread land and water development. These have included fish (walleye, northern pike, smallmouth bass, and American shad) and a variety of invertebrates (snails, clams, shrimp, crayfish, zooplankton). The greatest known threat in the Columbia Basin from aquatic invasive species is the potential introduction of zebra or quagga mussels. Other aquatic threats include hydrilla, silver carp, flowering rush, and Eurasian milfoil.

1. **Allow extant conditions to regulate predator populations, independent of directed management actions by humans.**

This is, in effect, a no-action strategy. It may not be feasible or cost-effective to implement predation reduction strategies in every case. Competing values, priorities, and federal, state, and local laws may also limit options. For instance, the Migratory Bird Treaty Act and Marine Mammal Protection Act protect seabirds and pinnipeds.

[141] Northwest Power and Conservation Council. 2014. Fish and Wildlife Program.

2. Implement nonlethal measures designed to discourage predation by key predators in focal problem areas.

Nonlethal actions have been the initial focus of many predator management efforts in the Columbia Basin. For sea lions gathering to feed on vulnerable concentrations of salmon and steelhead below Bonneville Dam or Willamette Falls, these have included construction of grates or other exclusion devices to prevent pinniped entry to fishways and hazing from small boats to discourage pinnipeds from entering tailwater areas. Sea lions have also been trapped from the Bonneville Dam tailrace and relocated to the ocean. For northern pikeminnow, dam bypass outfalls have been reconstructed to discharge juvenile salmon and steelhead into higher-velocity areas where they are less vulnerable to predation. Measures to control fish predators have also included modification or removals of artificial instream structure such as docks and pilings that might exacerbate predation. For seabirds, habitat on estuary islands where nesting occurs has been modified to encourage birds to redistribute to areas where salmon predation is less significant. Wires have also been strung across dam tailraces to discourage birds from preying on juvenile salmon and steelhead that are disoriented and vulnerable after passing a dam. These efforts have provided a level of benefit in some cases, but predation remains significant in many areas. Such efforts could be expanded, for instance, by extending bird redistribution and management programs into reservoir areas upstream from the estuary.

3. Undertake lethal but limited removal of problem animals of key predators in specific areas or as part of redistribution efforts.

This strategy is intended to reduce predation by lethally removing a portion of the predator populations responsible for significant salmon and steelhead impacts. The goal of this strategy is not to substantially reduce numbers of predators by removing a large proportion of the population but rather to remove a smaller number that are disproportionately responsible for the problem. For instance, small numbers of problem sea lions are being removed from the Bonneville Dam tailrace and below Willamette Falls. These individuals are habitually present in areas where salmon and steelhead are concentrated below fishways. Several thousand cormorants were removed and nests destroyed in the estuary in 2015 through 2017 to reduce predation and encourage redistribution. These types of ecological management efforts can have mixed effects. Sea lion removals partially reduced predation, particularly on steelhead below Willamette Falls. However, cormorant removals resulted in relocation of the nesting colony upstream to the Astoria-Megler Bridge, where predation might increasingly be focused on juvenile salmon and steelhead.

4. Undertake lethal predator removals that substantially reduce numbers and corresponding predation impacts.

The most aggressive predator management strategies would involve lethal removal of a significant proportion of a predator population. One such example is the northern pikeminnow removal program in the Columbia and lower Snake Rivers. This program pays sport anglers for pikeminnow they catch to incentivize removal of significant numbers of this predator. Northern pikeminnow eat millions of salmon and steelhead juveniles each year in the Columbia and Snake River systems. The goal of the program is not to eliminate northern pikeminnow but rather to reduce the average size and curtail the number of larger, older fish, which are responsible for much of the predation. Another example is the removal of angler bag limits on nonnative sport fish species such as walleye and smallmouth bass in order to increase exploitation rates in waters that contain, or connect to waters that contain, anadromous salmon and steelhead.

5. Implement aggressive measures to prevent introduction of invasive species and to remove them where invasions occur.

Preventing the introduction of invasive species is a high priority, especially since management actions have shown little success in removing or controlling invasive non-native species once they become established. Current efforts include watercraft inspection and permitting programs, early detection monitoring, and containment planning. Chemical treatments have been used in limited areas to control plant species. Removal programs have been implemented for predatory species in several cases (e.g., northern pike removal in Lake Roosevelt). Opportunities exist for increased funding of federal, state, and tribal enforcement to reduce illegal or intentional introductions. Elimination of non-native species is often not feasible. Therefore, programs typically focus on limiting increases in abundance or expansion of geographic range to reduce adverse impacts to salmon and steelhead and the habitats on which they depend.

6. **Reduce predation by changing the environmental conditions that enable predator populations to thrive and make salmon and steelhead more susceptible.**
   In many cases, predation has been exacerbated by habitat alterations or other activities that have increased predator numbers or made salmon and steelhead more vulnerable to predation. For instance, mainstem dams have created reservoirs that are favorable habitats for both native (northern pikeminnow) and introduced (walleye, smallmouth bass) fish predators. Juvenile salmon and steelhead smolts are also particularly vulnerable to predation by fish and birds in dam tailraces where normal migration patterns are disrupted. Sea lions have been observed to concentrate downstream from Bonneville Dam to feed on adult salmon and steelhead staging for upstream passage through fish ladders. In addition, some people have hypothesized that predation levels have been exacerbated by large numbers of hatchery salmon and steelhead currently being released into the system. Thus, effective measures might include restoring more-natural or free-flowing river conditions or reducing concentrations of hatchery fish.

Fishery Strategies

Salmon and steelhead support significant ceremonial, subsistence, recreational, and commercial harvest and fishery opportunity throughout the Columbia Basin and in marine fisheries from Oregon to Alaska. These fisheries currently produce harvests of over 1 million Columbia Basin salmon and steelhead per year. The Partnership has identified Qualitative Goals for both natural production and fisheries of Columbia Basin salmon and steelhead. Fisheries provide essential cultural, social, and economic values but can also affect the abundance and natural production of Columbia Basin salmon and steelhead. The fishery strategies described below do not address allocation of harvest or impacts among fishery sectors; allocation decisions fall within the purview of the management authorities and processes for each fishery.

1. **Harvest healthy natural stocks consistent with maximum and/or optimum sustained yields and fair allocation among users.**
   Although there are relatively few healthy salmon and steelhead stocks in the Columbia Basin at present, this strategy is consistent with the long-term Partnership Qualitative Goal of optimizing sustainable salmon harvest and fishing opportunity as healthy stocks are restored. Healthy stocks can sustain high levels of harvest and are typically managed for maximum or optimum yields. Maximum sustained yield is the greatest average annual harvest that can be supported by a stock. Optimum yield can include biological and allocative factors other than harvest. Fisheries for Columbia Basin salmon and steelhead were historically managed to maximize harvest of healthy natural stocks and hatchery stocks intended for harvest. However, in mixed-stock fisheries that are managed to maximize harvest of hatchery stocks and healthy natural stocks, weak stocks that are included in the mixed stock may be substantially overharvested. Therefore, current fisheries have been substantially reduced by restrictions to protect weak and listed stocks. The Partnership's long-term Qualitative Goals call for expansion of future fishery opportunity concurrent with progress toward ESA delisting and natural production goals.

2. **Manage fisheries to optimize harvest of healthy natural stocks within constraints of reduced exploitation rates on weak or less abundant natural stocks to ensure that harvest does not impede recovery.**
   This is the primary strategy currently in place for Columbia Basin salmon and steelhead fisheries. Conservative fishery management strategies are employed to allow depleted stocks to capitalize on the benefits of other rebuilding measures. Fishery opportunities for hatchery fish and strong natural stocks are provided where consistent with conservation needs, although harvest limits established to protect weak stocks preclude access to harvestable surpluses of these fish in many years. Weak stock protections have resulted in substantial reductions in harvest relative to historical levels. In addition, several stocks are now managed using abundance-based management frameworks, under which allowable harvest varies

from year to year based on abundance. For other stocks, pre-determined harvest limits are in effect. Fishery impacts on natural-origin fish in many non-tribal fisheries have been reduced by limiting harvest to marked (adipose fin-clipped) hatchery fish. Fishery limits and objectives may be re-evaluated in the future based on progress toward natural production and mitigation goals.

3. **Curtail or eliminate fisheries targeting weak natural stocks, and in mixed-stock fisheries, further limit incidental impacts to natural stocks that are not exhibiting healthy self-sustaining abundance levels.**

This strategy would enact additional reductions in fisheries to maximize natural production. Directed fisheries targeting natural Columbia River stocks have already been substantially limited or closed in many areas. However, natural stocks continue to be subject to harvest or incidental impacts in some mixed-stock fisheries. Mixed-stock fishery impacts can be significant for some fall Chinook and coho salmon stocks subject to fishing across wide areas of the ocean and freshwater. Further closures might be considered, particularly at times of critical low abundance. Fishery impacts can also be reduced by expanding use of in-river refuges and non-consumptive uses (e.g., catch and release) to protect migrating adults in the face of warming trends in the Columbia and Snake River mainstems.

4. **Develop and expand use of new and innovative approaches to fishery management.**

Gear restrictions, area closures, and innovative management techniques, such as periodic, temporary “fallowing” of rivers, are management tools used to maintain quality fisheries that can be sustained year-in and year-out. Sportfishing may be managed to control impacts and to promote fishing opportunity and equitable distribution of opportunity throughout the basin. Selective gear is used in commercial fisheries to minimize take of non-target stocks. Enforcement of fishing regulations is robust and there is a strong self-enforcement ethic among fishers because fishing opportunity is dependent on good stewardship. Longer, consistent seasons allow fishing dependent businesses to sustain themselves and is better than the status quo.

5. **Close or severely limit all harvest to maximize natural spawning escapement as an interim measure to restore natural diversity, distribution, and productivity.**

This strategy would involve complete closures or very low limits for significant fisheries to maximize natural spawning escapement. Current fishery strategies accept some level of impact of natural production to support cultural, social, and economic values of fisheries, just as impacts of land and water use on salmon are accepted to support related values. Under this strategy, fishery values would effectively be afforded a much lower priority than natural production and other competing land and water uses that impact fish.

Hatchery Strategies

Hatchery production serves a critical function in the Basin, primarily as fishery mitigation for systemic declines in natural production but also as an effective tool for conservation. Juveniles released by hatcheries provide clear benefits in the form of increasing total returns of salmon and steelhead to the Columbia Basin. In fact, hatchery-origin fish currently account for two-thirds of the total return of adults to the Columbia Basin. Hatchery fish also comprise the majority of the harvest of Columbia Basin salmon and steelhead. Conservation hatchery programs have saved certain stocks or populations from extinction (e.g., Snake River sockeye salmon). Hatchery fish have been used to reintroduce salmon or steelhead into areas where they were previously extirpated (e.g., upper Cowlitz, upper Deschutes, and Clearwater Rivers). Hatchery fish are also being used in some areas to increase natural production by supplementing spawning by natural-origin fish in the wild.[142]

At the same time, hatchery fish can also depress natural production. Hatchery fish can compete with natural fish for spawning and rearing habitat and reduce the productivity of natural fish by interbreeding. Interbreeding is an issue where fitness of hatchery fish has been reduced by hatchery selection or domestication or when hatchery fish stray into natural streams to which they are not well adapted. Additionally, hatchery fish can ecologically impact natural populations through competition for food and habitat, boosting predator populations, direct predation, and disease transmission.

[142] Natural production is typically defined to include all fish that were spawned and reared in the wild regardless of whether their parents were of natural or hatchery origin.

The relative benefits and risks of hatchery fish are a source of uncertainty and debate across the region. There is, however, general recognition that historical hatchery practices, which did not fully appreciate the potential for adverse genetic and ecological impacts, adversely affected natural production in many areas. As a result, the region has undergone an extensive review of hatchery practices and has begun implementing reforms to reduce those risks. Disagreements remain about the appropriate role of hatchery fish and the appropriate strategies to use in certain areas.

Benefits and risks ultimately depend upon specific circumstances. Hatchery fish can be an effective tool for providing fisheries, reintroduction, conservation, and enhancing abundance of depressed stocks in the short term. However, the long-term use of hatcheries may reduce natural productivity and diversity. The magnitude and type of impact depends on the status of affected populations, habitat conditions, and practices in the specific hatchery program. There is not currently a regional consensus among all interests on the relative benefits and risks of hatchery programs and the appropriate level of use across the Basin.

Additional information and data are necessary to explore and inform uncertainties related to the benefits and risks of hatchery fish. Monitoring programs collect data on the abundance and distribution of spawning adults, and some collect data regarding composition of the spawning populations (natural/hatchery). However, these data are generally not adequate to determine the impact of hatchery programs on natural-origin populations. Significant improvements in monitoring programs will be required to operate hatcheries in a manner that supports both fishery and natural-production goals.

This section identifies a range of hatchery strategies. These strategies are not mutually exclusive. Each strategy might be employed either in concert with or to the exclusion of other strategies. All of these strategies are currently being implemented to some degree in various areas of the Basin.

1. Use large-scale hatchery production to support fisheries as mitigation for lost natural production.

Columbia Basin hatcheries currently release over 140 million salmon and steelhead per year, the large majority of which are produced for the primary purpose of supporting tribal and nontribal, ceremonial, subsistence, commercial, and recreational fisheries. Many hatchery programs address mitigation purposes as a result of specific impacts, particularly the construction and operation of dams (e.g., the Lower Snake River Compensation Program). Other programs address more generalized declines (e.g., programs funded by the Mitchell Act). A number of hatchery programs with a mitigation responsibility are not currently funded at levels sufficient to meet needs or obligations.

Almost 1 million Columbia Basin hatchery salmon and steelhead are harvested per year in marine fisheries from Alaska to Oregon and in freshwater fisheries across Washington, Oregon, and Idaho. Hatchery production can be a particularly effective mitigation tool in areas that currently do not support self-sustaining populations. However, increased use of hatcheries for fishery mitigation also increases the potential risk of detrimental impacts on natural populations. Partnership Qualitative Goals identify the need for strategic alignment of hatchery production for fishery mitigation purposes with natural production goals.

2. Employ hatcheries for conservation and reintroduction to protect and restore the native diversity and distribution.

Hatcheries are capable of producing large numbers of fish from a relatively small number of parents. This makes them an effective tool for restoring or bolstering natural production in certain cases. Hatcheries can be a viable source of salmon or steelhead for reintroduction into areas where populations have been extirpated, for instance where historical barriers have been removed or effective passage has been restored (e.g., blocked areas), assuming that appropriate donor stock can be identified. Hatcheries have also been utilized as an emergency measure where a population or stock has declined to very low levels and extinction is imminent. This was the situation for Snake River sockeye salmon, where the few remaining adults were captured and spawned in the hatchery for captive rearing in order to improve survival. Dedicated hatchery programs may be developed where appropriate to support expanded fishery or reintroduction efforts in currently blocked areas. Hatchery programs and infrastructure also play a critical role in buffering against fluctuating environments and stochastic climate events.

3. Expand hatchery supplementation efforts to bolster harvest and natural production.

Hatchery fish may also be used to supplement natural production and adult returns with dedicated releases into natural production areas. Supplementation programs are currently being implemented in a number of areas where restoration and mitigation goals have not been met, particularly where habitat is not being fully utilized by natural returns. For instance, supplementation of the Snake River fall Chinook salmon population has been effective in restoring significant natural production between Lower Granite and Hells Canyon Dams. Supplementation is generally intended to be used as an interim measure until habitat or out-of-basin limitations can be addressed.

Supplementation programs provide clear demographic benefits of increasing total abundance of fish returning to spawning areas, but they also pose some risk if the hatchery fish reduce the genetic fitness of the natural stock or compete with the natural stock for limited food and habitat. In this case, demographic benefits of more total spawners, including hatchery-origin fish, may be offset by increased competition and reduced productivity of natural-origin fish. Therefore, these kinds of programs require clearly defined goals, monitoring, and management (e.g., of broodstock source, program size, proportion of natural-origin fish used in the broodstock (pNOB), and proportion of hatchery-origin fish spawning naturally (pHOS) to ensure that expected benefits to natural populations are realized.[143] In these programs it is especially important to properly balance the benefits of increased production with fitness and diversity risk. As abundance of the natural population increases, so should the use of natural-origin fish in the broodstock, but the size of the program may decrease to allow the natural population to grow and adapt to unique habitat conditions in the watershed.

4. Reduce or reform hatchery programs to limit impacts or risks to natural production.

Hatchery program reductions and reforms are being implemented in multiple areas of the Basin to protect and promote natural productivity, diversity, and function.

Some hatchery programs have been reduced or eliminated, particularly where were mismatched with local stocks. Since peak production levels around 1990, Columbia Basin releases of hatchery salmon and steelhead have been reduced by 35 percent, due to a combination of native stock concerns and budget cuts. Several lower Columbia River summer and winter steelhead programs were eliminated or reprogrammed where these fish were being released into subbasins where they were mismatched with the native stock. Lower Columbia River tule fall Chinook salmon production has also been substantially reduced, in part due to concerns for the incidence of straying into natural populations.

Hatchery reforms generally seek to modify hatchery practices to limit the incidence of hatchery strays in natural spawning grounds and/or to improve the quality of hatchery fish to more closely resemble that of natural-origin fish in order to reduce detrimental impacts of natural spawning by hatchery fish where it occurs. Associated actions have included: (1) clearly defining the objectives of each hatchery program; (2) marking hatchery fish in order to increase harvest with mark-selective fisheries; (3) operating weirs downstream from spawning grounds in order to collect and remove marked hatchery fishery (reducing pHOS); (4) modifying release locations to reduce straying; (5) modifying release number and time to minimize ecological impacts; (6) developing local hatchery brood stock by incorporating natural-origin adults (increasing pNOB) in order to reduce the impact of straying where it occurs; (7) modifying spawning and rearing protocols in the hatchery to avoid selection or domestication; and (8) establishing natural population reserves protected from significant hatchery influence as native gene banks.

Effective monitoring programs are necessary to evaluate the effectiveness of these hatchery reform actions and the response of the natural-origin population. The majority of current monitoring programs are not adequately funded to collect the data necessary to assess the impact of current hatchery programs or responses of natural populations to hatchery reform actions. Well-designed monitoring programs will collect the data to direct adjustments to hatchery programs that will benefit natural populations.

[143] Impacts of hatchery-origin fish spawning in natural production areas are often described based on the proportionate natural impact (PNI). PNI is a function of the percentage of hatchery-origin spawners (pHOS) and the proportion of natural-origin fish in the hatchery broodstock (pNOB).


Salmon backsplash. Credit: NOAA Fisheries West Coast Region

5. **Prioritize and reconfigure hatchery production in significant portions of the Basin based on natural production potential.**

A number of populations are currently managed as natural reserves in which no hatchery fish are released. Further reconfiguration or reductions in hatchery production might be pursued to emphasize natural production in additional portions of the Basin. Hatchery releases might be eliminated in additional areas where quantity and quality of freshwater spawning and rearing habitat is sufficient to sustain diverse and productive natural populations. Subbasins with the highest natural production potential could be managed as strongholds to maximize that potential. Subbasins with low natural production potential could be managed for hatchery production that serves fisheries in a way that minimizes risks to natural stocks. Other rivers could have mixed management, with both natural production and hatchery operations. Sliding-scale protocols for reducing hatchery production may also be implemented as natural abundance increases and proves resilient.

Systemic Strategies

A number of the scenarios developed by the Partnership members (see previous chapter and Appendix B) included "systemic strategies" or strategies that identify general approaches that could be globally applicable across the Columbia Basin.

1. **Develop and implement experimental and adaptive management strategies.**

Some scenarios advocated for the use of large-scale experimental management to resolve key uncertainties and identify effective restoration strategies. For instance, the Stronghold and Portfolio Scenario called for using treatment and control rivers to get more clarity on issues including, but not limited to: the ecological and genetic impacts of hatchery fish on naturally produced fish; the benefits of different types of fishing, harvest, and predation management strategies; the effect of large increases in escapement to the spawning grounds on productivity and spatial distribution; and the resilience of salmon and steelhead to thermal and hydrologic changes caused by a warming climate. The Shared Sacrifice Scenario called for construction and testing of new dam spillway structures over a ten-year period followed by implementation of more aggressive actions if required. The Climate Change Scenario highlighted the need to be able to respond effectively to dramatic surprises as well as new opportunities that may arise in the future. Some scenarios also advocated exploring new and innovative approaches, such as innovative strategies for cooling tributary water, preserving/restoring floodplain function, preventing land use conversion, and evaluating restoration opportunities.

2. **Consider new governance structures.**

Several scenarios proposed new governance structures to achieve comprehensive and coordinated implementation of an effective salmon and steelhead restoration program. For instance, the Stronghold and Portfolio Scenario suggested that the current river governance structure is outdated and must be improved to ensure that management actions and policies are integrated and aligned to increase transparency and accountability, and to improve public confidence. The Shared Sacrifice Scenario also suggested that the current approach to governance of salmon and steelhead recovery is fragmented, ineffective, and must be changed.

3. **Provide funding levels adequate to restore salmon and steelhead to healthy and harvestable levels consistent with Partnership Goals.**

Many scenarios identified the need for additional funding to achieve the Partnership Goals. The Shared Sacrifice Scenario noted that the best biological strategies possible would fail without the political will to fund and implement them in a timely manner. This scenario recommended an alternative funding structure in the form of a salmon tax to increase funding levels and to share costs more broadly. The Full Recovery Plan Implementation Scenario identified a critical need for additional, stable funding. The All-in-for-Salmon Scenario identified potential new funding sources such as a “salmon tax” on all residents of Oregon, Washington, Montana, and Idaho; a “salmon surcharge” on all recreational permits and licenses; increased federal funding for fish recovery; and a surcharge on flood control districts in the region. The Level-of-Effort scenarios explored what strategies might be implemented under moderate and maximum increases in effort, including consideration of moderate and maximum increased funding.

4. **Develop new legislation to foster an effective salmon and steelhead restoration program.**

The Shared Sacrifice Scenario noted that there are no clear statutory requirements to recover salmon and steelhead to the level of abundance envisioned in the Partnership’s Quantitative Goals. This scenario suggested that recovery of salmon and steelhead requires its own legislation separate and distinct from the power focus of the Northwest Power Act. This scenario recommended that salmon and steelhead be exempted from the requirements of the Endangered Species Act and instead, their recovery and management would be governed by replacement legislation: The Northwest Salmon Act.

5. **Conduct education and outreach to the public and decision makers to foster an understanding of the value of, and a commitment to, the need for salmon and steelhead restoration.**

The Shared Sacrifice Scenario suggested that success would require asking each citizen to contribute something toward salmon and steelhead recovery and make this a community effort. The Salmon First Scenario recommended conducting outreach and education to: (1) hydropower customers on the historic and current impacts of declining salmon and steelhead runs to tribal communities, the benefits of salmon runs in the Pacific Northwest, and the costs and benefits of maintaining the hydropower system relative to alternative forms of energy; and (2) local and state land and water management boards and committees on integrating salmon recovery into local decision making.

6. **Expand monitoring and assessment efforts to assess status and progress toward salmon and steelhead recovery.**

The Full Recovery Plan Implementation Scenario noted that Washington salmon recovery regions and their partners (management entities throughout the Columbia Basin) currently lack the capacity and tools to adequately track, monitor, and report on the progress of salmon recovery across the threat categories (habitat, hatcheries, harvest, hydro, and predation). The scenario highlighted the need for ensuring that fish population monitoring is sufficient for ESA recovery and broader purposes, expanding the ability to monitor and assess habitat status and trends and restoration action effectiveness in a coordinated manner across the Columbia Basin, and focusing monitoring and research on critical uncertainties.

Summary

The strategies provided in this chapter present a range of potential choices on how to achieve the salmon and steelhead Goals. They represent a range of ideas that are reflected in the scenarios in the previous chapter. The intention of providing the strategies was not to provide recommendations. Instead, the Partnership hopes that the range of strategies presented here will serve as a starting point to inform future discussions and considerations.

Headgate diversion and canal, Snake River, Idaho. Credit: Paul Arrington

Path Forward Recommendations

Much more work needs to be done on how best to achieve the Partnership's Goals. To keep this effort moving forward efficiently and effectively, there will need to be agreement on strategies and actions. Continued collaboration would create an opportunity to increase transparency and public confidence in salmon-rebuilding efforts and investments by creating a sense of collective ownership.

Value Proposition

The region would benefit from greater integration and accountability across the various management entities in the Columbia Basin. Information about salmon science, critical information gaps, critical points of disagreement, and new technological advances from a holistic, Basinwide perspective will be necessary to actualize opportunities and address challenges.

The future collaboration described below provides a place where: (1) there is a Basinwide, holistic perspective that brings together all of the salmon impacts or "H's" and; (2) stakeholders and management entities interact with an equal voice.

Continued collaboration would provide a meaningful venue for addressing complex social factors necessary to support bold actions. The positive relationships and enhanced understanding gained from the Partnership provide a powerful foundation for this critical path forward.

It is the intent of this proposal to add value to the Basin and advance achievement of the Qualitative and Quantitative Goals. There is a desire to enhance regional alignment without adding a layer of bureaucracy.

Proposed Membership and Organization of Future Collaboration

The Partnership recommends retaining the current representation of the existing Partnership across geography and interests, and to include tribes, agencies, and stakeholders. Criteria for representation could be useful to identify potential new members and to consider roles and responsibilities moving forward. Consideration should also be given to the overall size of the group.

- *Federal Agencies* — In addition to NOAA Fisheries, other federal agencies with management authorities should be involved. There are various ways to accomplish this, such as a formal seat at the table, as a resource, by participating in specific workgroups or issue discussions, or through a federal caucus. Potential federal agencies include Bonneville Power Administration, U.S. Fish and Wildlife Service, Bureau of Reclamation, U.S. Army Corps of Engineers, Forest Service, Natural Resources Conservation Service, Environmental Protection Agency, Bureau of Land Management, and others. Additionally, continued coordination with the Northwest Power and Conservation Council is recommended for technical and regional planning expertise.
- *States* — Oregon, Washington, Montana, Idaho.
- *Federally recognized Columbia Basin Treaty Tribes.*
- *Stakeholders* — broad representation across diverse interests including agriculture (ranching, irrigation), commercial fishing, recreational fishing, conservation groups, hydropower utilities (BPA customers and others), local watershed groups, and river users/ports.

Chum salmon spawning in Hamilton Creek, Washington.
Credit: Bonneville Power Administration

The collaboration should seek consensus, but if consensus cannot be obtained, the majority and minority views should be transparent.

We also suggest carrying forward the Guiding Principles to continue the spirit, interests, and momentum of the Partnership.

We encourage the use of an independent, neutral facilitator to manage complex, difficult conversations respectfully and inclusively.

Consideration should be given to establishing rotating chair and vice-chair positions to assist in administration and organization, and/or a small governing body of members elected by members.

Roles and Functions of Future Collaboration

1. ***Implementation:*** Forge agreement on strategies and actions to advance towards the Qualitative and Quantitative Goals.

- Explore opportunities, including innovative approaches; the feasibility of specific actions; and challenges to achieving success.
- Surface and seek to resolve critical disagreements with transparency and credibility.
- Develop recommendations for federal, state, tribal, and local governments to promote policies that advance achieving Partnership Goals. Examples include model "codes" for various jurisdictions to protect salmon and steelhead habitat.
- Communicate and coordinate with existing salmon management and recovery-focused forums and processes to achieve Partnership Goals. Leverage existing efforts and build on the momentum and regional successes for local and Basin-specific efforts.
- Promote social equity and advance a better future for both people and fish in the Columbia Basin.
- Develop partnerships among various entities for achieving Columbia Basin Partnership Goals.
- Identify and advocate for new funding sources in other venues.

2. ***Accountability and Adaptive Management:*** Provide accountability and continuity for progress towards Goals.

- Develop a salmon report card/ annual report to: (1) track salmon and steelhead abundance at the stock and population scales; (2) reflect on implementation progress across the Basin what is working, what is not working, and why; and (3) recognize when shifts in response are required and make recommendations to federal, state, tribal, and local governments for adaptive management.
- Develop benchmarks for achieving the Goals over time for accountability.
- Consider future scenarios and trends in climate, energy, transportation, food production, and other relevant topics.

3. ***Salmon Culture and Social Capital:*** Advance integration across sectors and interests.

- Promote information exchange regarding success stories and lessons learned at the subbasin and Basinwide levels.
- Mobilize and motivate people across the Basin to support salmon rebuilding and achieve the Goals. This could be accomplished through outreach and education efforts.
- Maintain communication with communities and constituencies to promote vertical and horizontal integration across the landscape. This can be accomplished in different ways.
- Utilize social media and innovative platforms to enhance outreach, including to students and younger generations.

Potential Components of Collaboration

Elements of a Basinwide collaborative effort could include these components:

- A plenary group of Basinwide representatives that meets quarterly.
- Topic-specific working teams that are convened by the plenary, meet regularly to address key issues and report recommendations to the plenary.
- Working teams that address specific topics, with structure, participation, and work plan tailored to the specific issue, and to bring together scientific, technical, and other experts throughout the Basin to inform the deliberations.
  - Examples of topics for in-depth discussion include: opportunities and challenges in the energy and transportation sectors, dam breaching, and food production, among others. Working teams could also have a specific basin or sub-region focus.
  - Exploring opportunities and challenges in addressing effects of hydropower, habitat, hatcheries, harvest, predation, and blocked areas.
  - Geographic-based working teams focused on implementation. Topics could include stock-specific actions; pilot programs; community outreach; and social, cultural, economic, and ecological interests.
  - Organize Basinwide tracking and reporting information for effective adaptive management.

Options for Future Collaboration Authority

Among the many options and permutations for future collaborations, five options stand out:

- A federal agency could convene the collaboration and form a new FACA committee.
- Federal legislation could be passed for a federal agency to convene a new committee, and to articulate the structure and function (likely with FACA exemption).
- A new or existing non-profit organization with a board of directors could be utilized. This option could also be combined with a quasi-governmental agency, below.
- A quasi-governmental agency could be established to also allow the entity to accept and distribute funds.
- A state or several states could convene the collaboration. A memorandum of agreement could be signed by various parties to participate in the collaboration.

The positive relationships and enhanced understanding gained from the Partnership provide a powerful foundation for this critical path forward.

Appendices

For assistance with accessibility for these Appendices, please contact NOAA Fisheries West Coast Region at (503) 230-5400 or visit https://www.fisheries.noaa.gov/west-coast/partners/columbia-basin-partnership-task-force.

Appendix A. Quantitative Goals for Columbia Basin Salmon and Steelhead Stocks

List of Acronyms and Abbreviations

AK	Alaska
BON	Bonneville Dam
Can	Canada
CJD	Chief Joseph Dam
Council	Northwest Power and Conservation Council
CR	Columbia River
Crk	Creek
DPS	Distinct Population Segment
EDT	Ecosystem Diagnosis and Treatment
EF	East Fork
ER	Exploitation Rate
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
Hat	Hatchery
ICTRT	Interior Columbia Technical Recovery Team
ID	Idaho
IDFG	Idaho Department of Fish and Game
IHR	Ice Harbor Dam
LCR	Lower Columbia River
LGR	Lower Granite Dam
LRH	Lower River Hatchery (fall Chinook stock)
LRW	Lower River Wild (fall Chinook stock)
MAT	Minimum Abundance Threshold
MCN	McNary Dam
MCR	Middle Columbia River
MPG	Major Population Group
Natl	Natural
NF	North Fork
NMFS	National Marine Fisheries Service
NPCC	Northwest Power and Conservation Council
Ocn	Ocean
ODFW	Oregon Department of Fish and Wildlife
OR	Oregon
PFC	Properly Function Conditions (freshwater habitat)
PRD	Priest Rapids Dam
R	River
SAB	Select Area Bright (fall Chinook stock)
SF	South Fork
TDA	The Dalles Dam
UCR	Upper Columbia River
URB	Upriver Bright (fall Chinook stock)
WA	Washington
WDFW	Washington Department of Fish and Wildlife
WLCTRT	Willamette Lower Columbia Technical Recovery Team
YN	Yakama Nation

Approach & Summary

Quantitative goals are measured in numbers of adult salmon and steelhead that translate qualitative goals described by the Task Force into measurable and specific conditions. Below we describe the approach and methods used to develop and summarize the quantitative goals identified by the Task Force.

Goal Definitions

The Task Force identified numbers for natural production, anticipated hatchery production, and potential harvest. These categories address specific purposes and provide a comprehensive accounting of how many salmon and steelhead are needed to meet goals in the Columbia Basin consistent with the vision and qualitative goals identified by the Task Force.

Natural Production. Natural production is the essential value in the long-term health and viability of Columbia Basin salmon and steelhead. Natural production goals are defined by abundance of natural-origin spawners for each salmon and steelhead population. Natural-origin fish are those that were spawned and reared in the wild.[1] Abundance is one of the four parameters (along with productivity, spatial structure, and diversity) commonly used to evaluate the biological health of salmon and steelhead, and upon which the long-term viability of salmon and steelhead depends. Abundance goals are based on 10-year geometric means for consistency with ESA recovery objectives.[2]

Harvest and Fishery Opportunity. Harvest is addressed because of the economic, social, cultural, and legal (treaty rights) sigificance of fisheries and their interaction with natural production. Columbia River salmon and steelhead are harvested in tribal and nontribal commercial, sport, subsistence, and ceremonial fisheries in the ocean as far north as Canada and Alaska, in the Columbia River mainstem, and in some tributaries. Related metrics can include quantity (number of fish harvested), quality or opportunity (e.g., fishing effort, catch per effort, fish size and condition, open seasons), or related economic values. In this report, the Task Force has identified potential harvest and fishery opportunity under several scenarios and in terms of both numbers of fish harvested and exploitation rates (which are defined as the percentage of total abundance harvested in one or more fisheries).

Hatchery/Mitigation. Hatchery production is addressed because of the essential role of hatcheries in conservation, fisheries, and mitigation for Columbia Basin salmon and steelhead. Current and anticipated hatchery production and mitigation levels are expressed in terms of numbers of juveniles released and the corresponding return of adult salmon and steelhead. Hatchery-origin salmon and steelhead play important roles in supporting harvest and fishery opportunities, and in contributing to conservation of natural populations across the Basin. Large-scale hatchery programs are operated throughout the Columbia River Basin to provide fish as mitigation for historical losses of natural production as a result of development and other human activities. In some cases, these hatchery programs are tied to specific mitigation programs (e.g., the Lower Snake River Compensation Plan). In other cases, hatchery production is more loosely related to a general need to mitigate for production lost as a result of human impacts. In addition to providing fish to enhance fisheries, hatchery production also serves conservation purposes — for example, to supplement abundance of naturally spawning fish, reintroduce fish into areas where fish have been extirpated, avoid extinction (through measures such as captive broodstock programs), and

[1] Natural production goals identified by the Task Force do not distinguish the parentage (natural or hatchery) of natural-origin adults. This definition is consistent with that used by NOAA Fisheries for ESA Recovery Plan purposes. Natural spawning by hatchery fish may be intentional or undesirable depending on specific circumstances.

[2] The geometric mean is 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 can inflate simple averages relative to typical population values. The 10-year period was selected to represent an interval of sustained abundance across multiple generational cycles.

provide ecological benefits to wildlife including Southern Resident killer whales.

Run Size. Run sizes are the combined total of natural production, harvest, and hatchery numbers. Run sizes may be calculated for specific stocks, but also may be calculated across wider regions and multiple species, for instance for the entire Columbia River return. Run-size estimates are useful for evaluating status and goals relative to a variety of needs across the Basin.

Goal Metrics

The quantitative goals are defined in terms of abundance of adult salmon and steelhead.[3] Numbers of adult fish are an essential measure of fish status, fishery value, and mitigation. Abundance also provides an objective measure applicable to each of the purposes identified in the qualitative goals.

Abundance is not the sole measure of conservation status, but it is strongly associated with a variety of other metrics of interest. For instance, long-term biological viability and long-term resilience of salmon and steelhead populations have been related to abundance, productivity, spatial structure, and diversity (McElhany et al. 2000). Population-level biological viability criteria identified in ESA recovery plans are typically based on a combination of these parameters. Therefore, the Task Force abundance goals should be considered in the context of the other parameters related to long-term viability. In practice, abundance is positively correlated with and strongly influenced by productivity, spatial structure, and diversity. Because of this relationship, it is difficult to achieve high levels of abundance without simultaneous increases in other parameters (although there are exceptions).

Other metrics related to population life-cycle dynamics are also considered in some contexts. For instance, smolt-to-adult survival rates (SAR) describe a portion of the life cycle encompassing outmigration from natal streams to the point of freshwater return at adulthood. The Northwest Power and Conservation Council (Council) included SAR goals in its 2014 Fish and Wildlife Program. SARs are a measure of population productivity over a portion of the life cycle outside of the freshwater spawning and rearing stages. They can be used to distinguish the influences of local freshwater habitat and environmental conditions in natal streams from nonlocal influences in the migration corridor and ocean. However, SARs are also influenced by survival in marine waters, which varies considerably from year to year.

In each category, the quantitative goals are identified as ranges rather than single-point estimates. Ranges reflect a continuum of aspiration for progressive improvements. Goal ranges also reflect the increasing benefits that more fish will provide, including higher viability of fish species, increased fishing opportunities, and enhanced social, cultural, economic, legal (treaty rights) and ecological benefits. In many cases, goal ranges incorporate values identified in other plans and processes to address a variety of purposes. For instance, goals to meet ESA delisting requirements are identified as increments to achieving higher numbers that support higher viability, fishery opportunity, and ecological benefits.

Regional Technical Teams

NOAA Fisheries convened regional technical teams to assist the Task Force in developing quantitative goals and provide other technical input. Teams were convened for the Upper Columbia, Snake, Middle Columbia, Lower Columbia, and Willamette River Basins. Initially, the technical teams focused on one stock per region, which served as prototypes to test concepts and better define information needs. The teams then expanded their efforts to address all stocks occurring in each region.

NOAA Fisheries and the Task Force asked the regional technical teams to:

1. Review and refine stock definitions, including subject populations, hatchery production programs, and fisheries.
2. Summarize reference information for each stock, including current spawning escapements, historical production potential, numbers of hatchery fish produced, harvest rates, and run-size estimates.
3. Review and summarize existing natural escapement goals, hatchery production levels, harvest rates, and run sizes.
4. Develop options for integrating differing goals identified by various entities or for identifying additional quantitative goals where they had not been otherwise identified.

[3] For consistency with NOAA Fisheries' Technical Recovery Team guidance and fishery stock assessment convention, abundance goals do not include jacks. Jacks are generally males returning to freshwater one year earlier than most mature salmon. Jacks typically comprise a small proportion (<10%) of the total return of natural-origin fish (although hatchery programs may produce higher percentages).

5. Provide technical documentation for the sources of existing goals and the basis of any new goals identified.

The technical teams operated under the Guiding Principles set by the Task Force, including the requirement to rely on best available science. The teams also considered consistency between quantitative goals and the qualitative goals identified by the Task Force. All technical team products were developed for consideration by the Task Force.

To facilitate review of existing information and development of quantitative goals for each stock, NOAA Fisheries developed a three-page template for use by the work groups. The template includes bulleted text describing key information about the stock; a map showing the geographic distribution of the stock; graphs summarizing current trends in abundance; pie charts showing the distribution of harvest among various fisheries and the distribution of hatchery releases among various programs; and a table summarizing aggregate run sizes at the mouth of the Columbia River, Bonneville Dam, and point of tributary entry, and the numbers of fish harvested in the Columbia River mainstem. The template also includes tables showing existing natural-origin production, hatchery production, fishery exploitation and harvest, and run sizes. For each stock, a notes page summarizes the basis for specific numbers. Additional documentation is available upon request (see contact information on p. 158).

Salmon and Steelhead Stocks and Populations

Quantitative goals are identified for stocks defined, for the purposes of the Task Force, based on species (i.e., Chinook, coho, sockeye, and chum salmon, and steelhead), region of origin (i.e., Lower Columbia, Middle Columbia, Upper Columbia, Snake, or Willamette), and run timing (i.e., spring, summer, fall, or late-fall). Stocks include both listed (under the U.S. Endangered Species Act) and unlisted salmon and steelhead. Twenty-seven stocks including 333 historical populations, some of which are extirpated, were identified (Table A-1).

Stocks are generally the same as listing units defined by NOAA Fisheries for ESA purposes.[4] One exception is in cases where a listing unit contained multiple run-types (e.g., spring, summer, fall, winter). In these cases, the listing units were split by run type into separate stocks so that abundance numbers could be more easily aggregated by run type (i.e., by stock) in a Basinwide accounting and aligned more closely to fishery management units. For instance, the lower Columbia River Chinook salmon ESU was split into three stocks: Lower Columbia spring Chinook, Lower Columbia fall Chinook, and Lower Columbia late-fall Chinook. Similar splits were made for the Lower Columbia River steelhead DPS (stocks separated into winter and summer runs) and Upper Columbia River summer/fall Chinook ESU (stocks separated into summer and fall runs).

NOAA Fisheries has not identified ESUs or DPSs for some unlisted or extirpated stocks, particularly including blocked areas within the historical range where salmon and steelhead no longer have access. In these cases, stocks were identified based on the available scientific information.

Each stock (and each ESU or DPS) contains a number of independent populations. An independent population is defined as a group of fish of the same species that spawns in a particular locality at a particular season and does not interbreed substantially with fish from any other group. Independent populations spawning naturally, and groups of such populations (major population groups), are the essential building blocks of an ESU or DPS (Figure A-1). For listed ESUs or DPSs, NOAA Fisheries' technical recovery teams (TRTs) — teams of scientists convened to provide guidance for recovery planning — used this concept to define independent populations and those definitions were incorporated into ESA recovery plans. For unlisted stocks, population delineations are sometimes less formal, particularly where they have been extirpated (e.g., coho upstream from Bonneville Dam). Where NOAA Fisheries had not identified populations, populations were identified by regional technical teams for each stock based on the best available information. Populations were identified for every stock regardless of whether they were listed, unlisted, extant, or extirpated.

For information purposes, stocks were also cross-referenced with Fishery Management Units (FMUs) which are defined as stocks or groups of

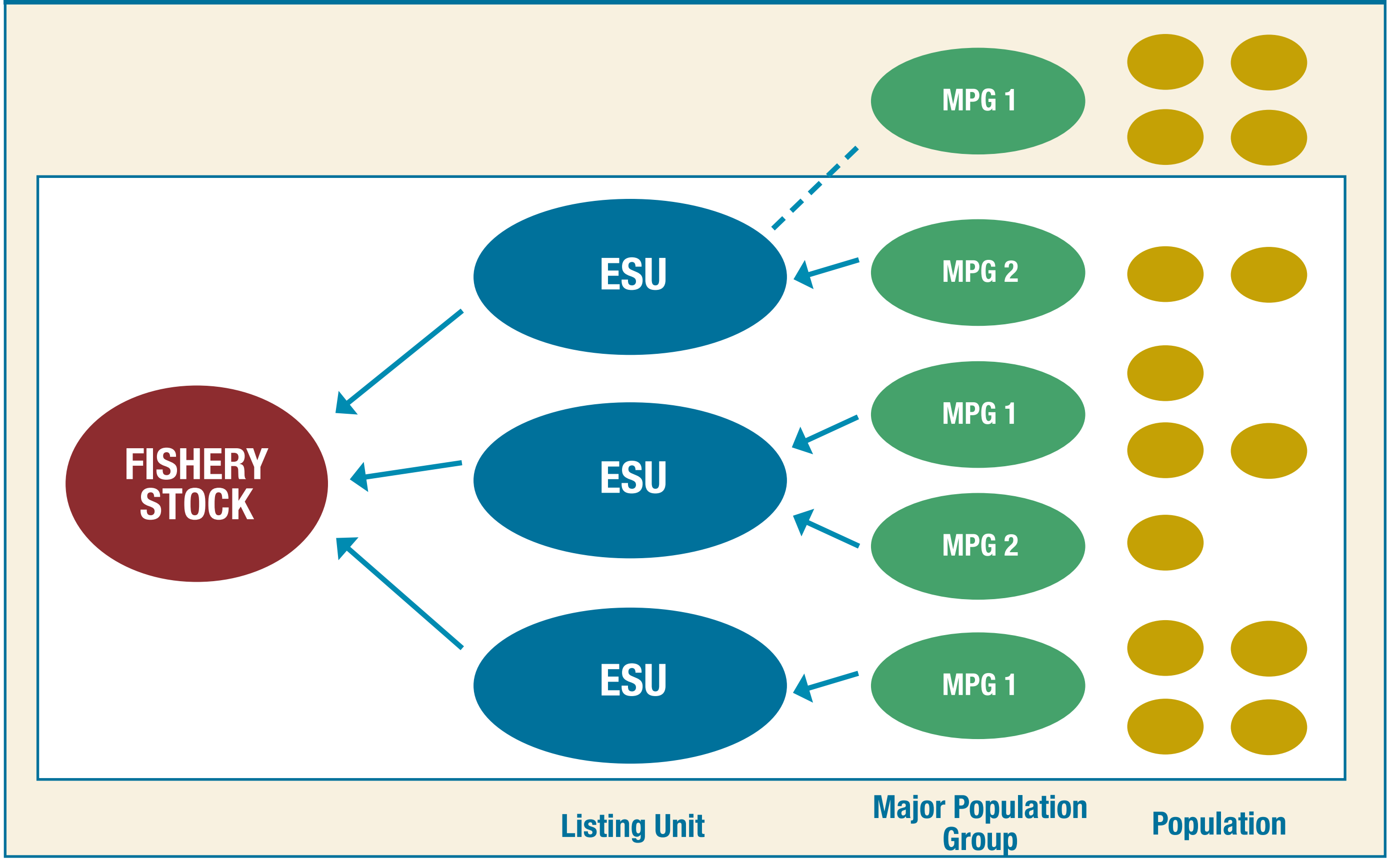
[4] The ESA allows listing decisions at the level of a species, subspecies, or distinct population segment. Listing units are designated by NOAA Fisheries as ESUs or DPSs. For salmon, NOAA Fisheries applies its ESU policy and treats ESUs as distinct population segments. An ESU is a group of Pacific salmon that is (1) substantially reproductively isolated from other conspecific units and (2) represents an important component of the evolutionary legacy of the species. For steelhead, NOAA applies the DPS policy. A DPS is a population or group of populations that is discrete from and significant to the remainder of its species based on factors such as physical, behavioral, or genetic characteristics, because it occupies an unusual or unique ecological setting, or because its loss would represent a significant gap in the species' range. A DPS is defined based on discreteness in behavioral, physiological, and morphological characteristics, whereas the definition of an ESU emphasizes genetic and reproductive isolation.

TABLE A-1. Natural-origin Columbia Basin salmon and steelhead stocks defined for Columbia Basin Partnership Task Force based on listing unit and run type.

Region	Species	Run type	ESA listed?	CBP Stock	
Lower Columbia	Chinook	Spring	Yes	L Col R Spring Chinook	
	Chinook	Fall (tules)	Yes	L Col R Fall (tule) Chinook	
	Chinook	Fall (late brights)	Yes	L Col R Late Fall (bright) Chinook	
	Chinook	Fall (brights)	No	L Col R Fall (bright) Chinook	
	Coho	Fall (early & late)	Yes	L Col R Coho	
	Chum	Late Fall	Yes	Col R Chum	
	Steelhead	Winter	No	SW WA Winter Steelhead	
	Steelhead	Winter	Yes	L Col R Winter Steelhead	
	Steelhead	Summer	Yes	L Col R Summer Steelhead	
Middle Columbia	Chinook	Spring	No	M Col R Spring Chinook	
	Chinook	Summer/Fall	No	M Col R Summer/Fall Chinook	
	Coho	Fall	Extirpated	M Col R Coho	
	Sockeye	Summer	Extirpated	M Col Sockeye	
	Steelhead	Summer	Yes	M Col R Summer Steelhead	
Upper Columbia	Chinook	Spring	Yes	U Col R Spring Chinook	
	Chinook	Summer	No	U Col R Summer Chinook	
	Chinook	Fall	No	U Col R Fall Chinook	
	Coho	Fall	Extirpated	U Col R Coho	
	Sockeye	Summer	No	U Col R Sockeye	
	Steelhead	Summer	Yes	U Col R Summer Steelhead	
Snake	Chinook	Spring/Summer	Part	Snake R Spring/Summer Chinook	
	Chinook	Fall (brights)	Yes	Snake R Fall Chinook	
	Coho	Fall	Extirpated	Snake R Coho	
	Sockeye	Summer	Yes	Snake R Sockeye	
	Steelhead	Summer	Yes	Snake R Summer Steelhead	
Willamette	Chinook	Spring	Yes	U Will R Spring Chinook	
	Steelhead	Winter	Yes	U Will R Winter Steelhead	
All	Total	including extirpated	27	NA	
	Listed	NA	17	NA	

			Number of Populations			
Evolutionarily Significant Unit or Distinct Population Segment	Fishery Management Unit	Major Pop Groups	Total	Extant	Extirpated	Reintroduced
L Col R Chinook L Col R Chinook L Col R Chinook -	L River Spring L River Hatchery (LRH, BPH) L River Wild (LRW) L River Bright (LRB)	2 3 1 1	9 21 2 1	9 21 2 1	0 0 0 0	0 0 0 1
L Col R Coho	Col R Coho	4	25	25	0	1
Col R Chum	Col R Chum	4	18	17	1	0
SW Washington Steelhead L Col R Steelhead L Col R Steelhead	Winter run Winter run L Col R Summer	1 2 2	7 17 6	7 17 6	0 0 0	0 0 0
M Col R Spring Chinook M Col R Summer/Fall Chinook	Upriver Spring Upriver Summer, Bright (URB	4 1	14 1	14 1	7 0	7 0
-	Upriver Coho	1	4	3	4	3
-	Col R Sockeye	2	2	2	2	2
M Col R Steelhead	Upriver Summer	4	20	19	3	2
U Col R Spring Chinook U Col R Summer/Fall Chinook U Col R Summer/Fall Chinook	Upriver Spring U Col Summer Upriver Bright Fall Chinook (URB)	4 3 1	10 14 5	4 7 4	7 7 1	1 2 0
-	Upriver Coho	1	5	2	5	2
Wenatchee, Okanogan Sockeye	Col R Sockeye	3	5	2	3	0
U Col R Steelhead	Upriver Summer	3	11	4	7	0
Snake R Spring/Summer Chinook Snake R Fall Chinook	Upriver Spring Upriver Bright / Snake R Bright	12 1	68 2	28 1	40 1	6 0
-	Upriver Coho	1	6	3	6	3
Snake R Sockeye	Snake R Sockeye	4	9	1	8	0
Snake R Steelhead	Upriver Summer (A & B runs)	9	40	25	15	0
U Willamette R Spring Chinook	Will Spring	1	7	7	0	0
U Willamette R Steelhead	Winter run	1	4	4	0	0
NA NA	NA NA	76 57	333 202	236 187	117 NA	30 NA

FIGURE A-1. Relationship of fishery management units to hierarchy of listing units, major population groups (MPG), and populations. A fishery management unit and an ESU/DPS can include one or more Columbia Basin Partnership stocks.



stocks that are subject to similar management strategies and objectives. FMUs are primarily determined by run type and return timing in relation to Columbia River mainstem fisheries, which account for the largest share of salmon and steelhead harvest. One FMU may include several listing units of similar run type (Figure A-1). For example, fishery managers identify an upriver spring Chinook management unit, which includes all spring Chinook destined for areas upstream from Bonneville Dam (Mid-Columbia, Upper Columbia, and Snake ESUs). Listing units may sometimes be split among different fishery management units when the listing units include different run types.

Foundation of Goals in Existing Plans

The quantitative goals are based on the various conservation, recovery, management, and mitigation plans developed throughout the region to address various purposes and programs. In some cases, these plans contain different numerical goals identified by different entities for different purposes. The Task Force considered these different goals and integrated or reconciled them based on input from its regional technical teams. There were also instances where quantitative goals had not yet been identified for specific stocks or outcomes. In these cases, the Task Force identified appropriate values based on input from its regional technical teams.

Key sources of existing goals include:

ESA Recovery Plans. NOAA Fisheries has adopted ESA recovery plans for all listed salmon and steelhead in the Columbia River Basin (UCRSB 2007; NMFS 2009, 2013, 2015, 2017a, 2017b; ODFW and NMFS 2011). These plans were developed with local partners. The plans include objective, measurable criteria for delisting threatened or endangered salmon ESUs and steelhead DPSs. Delisting criteria include both biological criteria (for evaluating a species' demographic risk status) and threats criteria (for evaluating whether the threats to a species have been addressed). The biological criteria include criteria at the ESU/DPS, major population group (MPG),[5] and population levels. Population-level criteria include specific numerical goals for abundance, as well as goals for productivity, spatial structure, and diversity. Quantitative goals for natural production are consistent with ESA delisting goals (with a few noted exceptions). In some cases, ESA recovery plans also include "broad sense recovery goals." These goals are generally defined by co-managers (state and tribal entities) or stakeholders and go beyond the requirements for ESA delisting to achieve even lower extinction risk and/or to address, for example, other legislative mandates or social, economic, and ecological values.[6]

Northwest Power and Conservation Council Fish and Wildlife Program. The Council was established pursuant to the Pacific Northwest Electric Power Planning and Conservation Act of 1980. The Act authorizes the Council to serve as a comprehensive planning agency for energy, fish, and wildlife policy, and citizen involvement in the Columbia River Basin. Council members include the states of Idaho, Montana, Oregon, and Washington. The Council's Fish and Wildlife Program is intended to protect, mitigate, and enhance fish and wildlife affected by the development and operation of the hydroelectric dams in the Columbia River Basin. The majority of the program is funded by the Bonneville Power Administration.

The program includes qualitative goal statements and quantitative objectives. The quantitative objectives include increasing total adult salmon and steelhead abundance to an average of 5 million fish annually by 2025 in a manner that emphasizes the populations that originate above Bonneville Dam. More specific objectives are identified for some populations in subbasin plans prepared by local groups for the Fish and Wildlife Program. The Council is currently considering adopting a comprehensive suite of quantitative objectives into the program. In support of this consideration, Council staff have compiled a comprehensive inventory of existing abundance goals at the population and aggregate levels, which is available in a web-accessible database at https://www.nwcouncil.org/fish-objectives-query. This database was a key reference for goals incorporated into the Task Force recommendations.

Tribal Plans. Tribal plans include the Spirit of the Salmon Plan (Wy-Kan-Ush-Mi Wa-Kish-Wit) as well as local plans developed by individual tribes. Wy-Kan-Ush-Mi Wa-Kish-Wit is a regional fish restoration plan adopted in 1995 and updated in 2014 by the Nez Perce, Umatilla, Warm Springs, and Yakama Tribes (CRITFC 2014). The plan includes several goals and objectives, including an objective to increase the total adult salmon and steelhead returns above Bonneville Dam to four million annually (by 2020), and in a manner that sustains natural production to support tribal commercial as well as ceremonial and subsistence harvests. In addition, the plan establishes a long-term objective to "restore anadromous fish to historical abundance in perpetuity."

A Nez Perce tribal fisheries managment plan (NPT 2014)[7] identifies specific abundance objectives and thresholds at the species and population levels for salmon and steelhead within Nez Perce tribal usual and accustomed fishing areas of the Snake River Basin, and corresponding hatchery and harvest strategies. The plan identifies viable, sustainable, and ecological escapement objectives for salmon and steelhead populations in the Snake River Basin. The viable abundance objectives are considered the minimum size at which a population maintains essential genetic diversity. They generally align with NOAA Fisheries' minimum abundance thresholds (and with the Task Force low-range quantitative goals for natural producion). Sustainable escapement objectives describe the numbers of returning adults that would annually sustain spawning, as well as harvest for tribal and non-tribal fisheries. Sustainable objectives generally align with the Task Force high-range quantitative goals for natural production. Ecological escapement objectives refer to the escapement level at which sustainable spawning abundance for a population is maximized, the full utilization of available spawning and rearing habitat is promoted, and ecosystem-level processes (e.g., nutrient

5 Major population groups (MPG) are aggregates of independent populations within an ESU or DPS that share similar genetic and spatial characteristic and are important components of ESA delisting criteria and species status.

6 In ESA recovery plans, NOAA Fisheries has stated our support for these broad sense goals, and our commitment, upon delisting, to work with co-managers and local stakeholders, using our non-ESA authorities, to pursue broad sense recovery goals while continuing to maintain robust natural populations. In some situations, it is also appropriate to consider broad sense goals in designing ESA recovery strategies and scenarios.

7 The NPT Tribal Fisheries Management Plan can be accessed at the following web location: https://nezperce.org/wp-content/uploads/2020/09/DFRM-Management-Plan-2013-2028.pdf.

redistribution) for multiple species are fostered. Ecological escapement objectives describe future desired conditions that extend Task Force high-range quantitative goals. Ecological escapement objectives are referenced in this report for contextual purposes only.

The Upper Snake River Tribes (USRT) — comprised of the Burns Paiute Tribe, Fort McDermitt Paiute and Shoshone Tribe, Shoshone–Bannock Tribes of the Fort Hall Reservation, and the Shoshone-Paiute Tribes of the Duck Valley Reservation — developed the Hells Canyon Complex Fisheries Resource Management Plan (USRT 2018).[9] This plan seeks to restore fishing opportunities through anadromous and resident fish management programs conducted in a phased approach in the Snake River and in significant tributaries (including the Bruneau/ Jarbidge, Owyhee, Malheur, Boise, Payette, and Weiser Rivers). Restoration of these conservation and subsistence fisheries would be accomplished in a manner intended to complement the ongoing recovery efforts of anadromous and resident fish in the Upper Salmon River Basin.The USRT Plan's tribal goals for numbers of adult fish, including Snake River spring/summer Chinook salmon, steelhead, and, eventually, fall Chinook salmon, anticipated in the watersheds above the Hells Canyon Complex, are long-term goals.

Consensus goals for natural production and harvest of salmon and steelhead in the Snake River upstream from Hells Canyon dams were not previously identified by the regional interests. However, a working group of policy and technical representatives from the states of Idaho and Oregon, Upper Snake River Tribes, and the Nez Perce Tribe developed numbers for Task Force purposes. The parties also provided detailed policy guidance regarding the interpretation and application of these numbers.

Quantitative goals for natural abundance were also identified for Task Force purposes for salmon and steelhead in the Columbia River upstream of Chief Joseph and Grand Coulee Dams, which currently block access to portions of the historical range of anadromous fish. The intent of these goals is to restore meaningful fishing opportunities in areas of historical use by the Colville and Spokane Tribes. The goals were developed by the Upper Columbia regional technical team, including staff from the Colville and Spokane Tribes. The goals were informed by estimates of numbers of fish historically available to tribal fisheries, including fish originating in both U.S. and Canadian waters. However, the goals do not apportion production into specific populations or geographic areas, nor do they make any assumptions, either explicit or implicit, regarding any future salmon or steelhead production in the Canadian portion of the Columbia River Basin. The goals represent only a fraction of the estimated historical production, and additional analysis would be needed to apportion production to different populations or geographic areas.

State Plans. The states of Washington, Oregon, and Idaho have identified salmon and steelhead goals and related policies in a variety of forums. Task Force goals were intended to be consistent with related guidance in state plans and policies.

Washington established a series of regional salmon recovery boards that worked as partners to develop regional recovery plans in the Columbia Basin in conjunction with the Northwest Power and Conservation Council's subbasin planning process. These plans have been incorporated into NOAA Fisheries' ESA recovery plans. Guidance is also available in other state programs, plans, and policies. For instance, statewide policies have been developed by the Washington Department of Fish and Wildlife for some species, such as steelhead, and for hatchery operations and fisheries.

In Oregon, the Oregon Department of Fish and Wildlife led development of an overarching statewide conservation strategy to provide priorities for fish and wildlife. Oregon has also developed a number of conservation and recovery plans for specific regions. All of these plans have been incorporated into NOAA Fisheries' ESA recovery plans. Oregon's efforts are guided by statewide policies that have been adopted into regulation (e.g., the Native Fish Conservation Policy, OAR 635-007-0502, and the Fish Hatchery Management Policy, OAR 635-007-0542). Oregon is supporting recovery with a variety of related activities. The Oregon Watershed Enhancement Board is the state agency charged with directing funds for habitat activities supporting recovery. Oregon's statewide goals and strategies call for recovery across species ranges — and NOAA Fisheries' recovery plans for Snake River fall Chinook, spring/summer Chinook, and steelhead recommend exploring the feasibility of reintroduction above blocked areas to minimize extinction risk and support broad sense recovery goals but have not explicitly adopted quantitative

[8] The USRT Plan can be accessed at the following web location: https://uppersnakerivertribes.org/projects/hells-canyon-complex-fisheries-resource-management-plan/

goals for populations upstream from Hells Canyon.

Idaho participated with NOAA Fisheries and other federal agencies; the states of Washington and Oregon; the Nez Perce, Shoshone–Bannock, and Shoshone-Paiute Tribes; and other entities to develop ESA recovery plans for Snake River spring Chinook salmon, fall Chinook salmon, and steelhead. Idaho and other partners also worked with NOAA Fisheries to develop the ESA recovery plan for Snake River sockeye salmon. Policy and strategic guidance regarding state management of fish and fisheries is provided in multi-year management plans prepared by the Idaho Department of Fish and Game. In addition, the Idaho Legislature has created an Office of Species Conservation within the Office of the Governor to provide coordination, cooperation, and consultation among the state and federal agencies with ESA responsibilities in Idaho.

Hatchery/Mitigation Plans and Policies. A variety of plans and policies define goals and govern operation of the more than 80 hatchery facilities operated by federal and state agencies, tribes, and private interests to produce salmon and steelhead in the Columbia River Basin. While some hatcheries are operated for conservation purposes, others are operated for fisheries enhancement and many have dual purposes. Most hatcheries in the Columbia River Basin were initiated as mitigation to offset natural production losses caused by human development and activities. Major hatchery programs in the Columbia Basin have been developed under the Mitchell Act (1938); the Lower Snake River Compensation Plan (1976); the John Day Mitigation Program (1978); the Mid-Columbia Public Utility Districts (PUD) Habitat Conservation Plans, Settlement Agreements, and Biological Opinions; and the Northwest Power and Conservation Council Fish and Wildlife Program.

Fishery Management Plans. Fisheries for Columbia River salmon and steelhead are generally managed under four governmental/jurisdictional authorities, each of which provides some policy and planning guidance related to fishery goal setting. States and tribes are responsible for fishery management in waters under their specific jurisdictions. Columbia River mainstem fisheries are co-managed by the states, tribes, and the federal government, according to a management plan developed under U.S. District Federal Court direction in the *U.S. v. Oregon* court case. Fisheries in marine waters under the jurisdiction of the United States (from 3 miles to 200 nautical miles offshore) are managed under the Pacific Fisheries Management Council (PFMC) process, according to authorities in the Magnuson–Stevens Fisheries Conservation and Management Act. The Pacific Salmon Treaty governs harvest of salmon that swim across the United States–Canada border.

Natural Production Goals

Qualitative goal 1 calls for restoration of Columbia Basin salmon and steelhead to healthy and harvestable/fishable levels. Achieving this goal will require substantial improvements in natural production of these species.

Approach

Natural production goals are expressed in terms of natural-origin adults spawning naturally and are identified in three ranges — low, medium, and high. These ranges represent a continuum of decreased extinction risk and increased ecological and societal benefits. Table A-2 summarizes how the regional technical teams identified the low-, medium-, and high-range quantitative goals for natural production. To place the goals into context, estimates of current and historical abundance were also developed.

Estimates of the current abundance of natural-origin spawners for each extant salmon and steelhead population provided a point of reference for identifying natural production goals. For consistency with metrics that NOAA Fisheries uses in ESA status assessments and delisting goals, abundance of natural-origin adults in each population is expressed using a 10-year geometric mean. The geometric mean values are based on the most recent 10 years of data available. Because of a one- to two-year lag time in derivation and reporting of abundance numbers for some populations, year ranges vary slightly among populations.

Historical abundance estimates for salmon and steelhead were also compiled wherever possible to place goals in the context of the production that could be realized under historical, or pristine, conditions. Historical is defined as pre-development, and corresponding numbers were estimated by various means. Many of these estimates were based on Ecosystem Diagnosis and Treatment (EDT) modelling. EDT modeling can be used to evaluate and compare salmon and steelhead production under current conditions, historical/pristine conditions, and various habitat

TABLE A-2. Rule set for quantifying low-, medium-, and high-range goals for natural production. Rules are numbered in priority of application.	
Low	1. Delisting abundance goal consistent with recovery scenario as specified in ESA recovery plan. (Not every population is required to achieve high level of viability.) 2. Minimum abundance threshold (equivalent to a viable population with ≤5% risk of extinction in 100 years) inferred from rule set developed and applied by the Technical Recovery Teams to similar populations by species. (Applicable where population-specific viability goals were not otherwise identified.)
Medium	1. From existing plans, where identified. 2. Mid-way between low- and high-range goals for listed populations where not otherwise identified in existing plans. 3. Yield-based escapement goals where defined for unlisted populations based on stock-recruitment analyses. 4. Based on current abundance where yield-based goals have not been identified for unlisted populations.
High	1. Based on broad sense goals identified in existing plans where consistent with qualitative goals identified by the Columbia Basin Partnership. 2. Equivalent to empirical estimates of abundance under conditions when populations were previously considered to be reasonably healthy. 3. Based on habitat-model inferences of abundance that would result from reasonably feasible habitat restoration actions and/or favorable habitat conditions. 4. Default value (generally three times the low-range value) were used where historical or model-derived values were not available (not to exceed the estimated pre-development habitat potential).

restoration scenarios. Most of the EDT results used by the Task Force were developed during the 2005 subbasin planning process overseen by the Council. The regional technical teams reviewed these results, and the NOAA Fisheries project team compared the EDT-based historical estimates to pre-development run sizes identified by the Council (1986) and recently reviewed by the Independent Scientific Advisory Board (ISAB 2015). Regional technical teams sometimes also considered other habitat models. Habitat restoration assumptions embedded in these models took a variety of forms. Some were based on a specific suite of improvements determined by recovery and subbasin planners to be reasonably feasible. Others were based on more general assumptions regarding restoration of habitat conditions favorable for salmonids (e.g., Properly Functioning Conditions: NMFS 1996).

Low-range goals for natural production for listed populations are defined as the natural-origin adult spawner abundance consistent with ESA delisting goals in NOAA Fisheries' recovery plans. These goals are based on recommendations developed by the TRTs to provide guidance for recovery planning. The goals generally represent a viable population, which is considered a population not threatened with a risk of extinction (i.e., a population with a 5 percent risk of extinction over a 100-year timeframe).

The TRTs generally derived these abundance goals from population viability analyses using stochastic life-cycle models. These models project the probability of abundance falling to critically low levels (i.e., a quasi-extinction threshold) based on population productivity and normal variation in abundance due to environmental factors. Viability curves used by TRTs to identify abundance goals for delisting also sometimes incorporated minimum abundance thresholds (MATs) to address genetic and spatial structure components in general abundance and productivity objectives.[9] In cases where recovery plans targeted populations for high levels of viability, delisting goals are often equivalent to the MAT.

For ESA delisting, not every population is required to achieve viable status. The TRTs noted that as long as a sufficient number of populations representing the historical productivity, diversity, and spatial distributions of the species are restored to viable levels, other populations could be maintained at lower levels of viability. In some recovery plans, abundance goals consistent with these lower levels of viability are identified, consistent with TRT guidance on how many and which populations need to be at various levels of viability of an ESU or DPS to be

9 For more information on ESA delisting goals and their derivation, see ICTRT 2007; UCRSB 2007; NMFS 2013, 2015, 2017a, 2017b; ODFW and NMFS 2011; WLCTRT and ODFW 2006.

considered viable. In these cases, the Task Force recommendations for low-range quantitative goals for natural production are generally consistent with those lower numbers.[10] Similarly, recovery plans sometimes identify quantitative goals for some populations to be restored to levels of very high viability. In these cases, the Task Force generally incorporated these goals as the low-range quantitative goals for natural production. Exceptions are noted in specific stock summaries.

For unlisted stocks, there are no ESA recovery plans or delisting goals. For these stocks, the regional technical teams used MATs as the low-range natural production abundance goals. Both the Interior Columbia and Willamette/Lower Columbia TRTs identified species-specific MATs based on the size and spatial complexity of the historical population distribution (ICTRT 2007; McElhany et al. 2007; LCFRB 2010). Current abundance in unlisted populations typically far exceeds these minimum abundance thresholds. Since the low-range goals have been achieved in these cases, management efforts will now focus on the medium-range and high-range goals, and the low-range goals represent a biological reference point rather than a future goal.

Medium-range goals define an intermediate step between low-range goals and high-range goals. For some stocks, ESA recovery, subbasin, or other management plans have previously identified a range of goals including values intermediate between delisting and higher, longer-term values. Medium-range goals identified in other plans were used where consistent with other low- and high-range goals developed by the Task Force. For populations in listed ESUs or DPSs where medium-range goals were not identified in other plans, the regional technical teams simply derived medium-range goals as the midpoint between low-range and high-range goal values.

For unlisted populations, where current abundance is substantially greater than the low-range goal, the regional technical teams applied one of two goals: (1) medium-range goals are equal to yield-based goals where identified from stock-recruit analyses for relatively healthy populations (e.g., Hanford bright fall Chinook, Lewis River wild fall Chinook); or (2) where yield-based goals have not been derived for relatively healthy populations, medium-range goals are simply defined as equivalent to current abundance.

High-range goals are intended to represent "healthy and harvestable" abundance levels that would sustain very high levels of species viability, significant fishery opportunities and harvest, and a fuller range of ecological values. These goals reflect potential future habitat conditions (i.e., restored habitats) but are still typically just a fraction of historical numbers before development.

Regional technical teams identified high-range goals based on the information available for each stock. In some cases, existing plans identified goals or reference values consistent with the high-range definition. In these cases, the existing goals are incorporated into the Task Force goals. For instance, ESA recovery plans (and the locally developed plans they were based on) sometimes quantified "broad sense" goals in addition to delisting goals.[11] In other cases, these plans identified qualitative broad sense goals and reported modeling results consistent with those goals, but did not adopt actual quantitative broad sense goals. Other management plans also occasionally identified goals with broad sense purposes. For most stocks, however, numbers consistent with the high-range category were not available. Thus, most high-range quantitative goals were derived by the regional technical teams.

Where possible, high-range goals are intended to provide a sound measure of what might meaningfully be expected with reduced constraints. For instance, the state of Idaho surveyed spring Chinook salmon in many natural production areas during the 1950s and 1960s, when fish numbers were substantially higher. In other cases, historical dam counts provide solid reference points upon which to base high-range goals.

Where such empirical data were lacking, high-range goals were generally based on inferences from modeling of habitat productive potential. A variety of models relate fish abundance and other population parameters to habitat conditions (i.e., stream size, gradient, morphology, substrate, riparian conditions). These models can be used

[10] One exception is in the ESA recovery plan for Lower Columbia River salmon and steelhead. In that plan, the recovery scenario did not identify abundance goals for all populations designated as "stabilizing." The stabilizing designation signifies that under the recovery scenario, the goal is to maintain these populations at their current risk status and not to improve their status. Where more recent monitoring information is available regarding current abundance of such populations than was available during recovery plan development, the current abundance estimates are incorporated into the CBP Task Force recommendations as the low-range natural production abundance goal. Those targets are not included in the ESA recovery plan, and do not represent delisting abundance targets. We have noted this and other specific instances where the low-range goals differ from this general rule in the methodology summaries that accompany the stock summaries included in this report.

[11] Broad sense recovery is defined outside of the ESA recovery planning process, generally by fisheries managers (state and tribal entities) or stakeholders, and goes beyond the requirements for ESA delisting to achieve even lower extinction risk and/or to address, for example, other legislative mandates or social, economic, and ecological values.

to project changes in abundance based on improvement in habitat conditions and other life-cycle limitations. Estimates based on these habitat models of fish abundance under scenarios with significant habitat restoration were documented in many sub-basin plans or ESA recovery plans. For instance, many subbasin plans incorporated EDT-based estimates of fish numbers that might be expected with habitat improvements that subbasin planners deemed to be realistically feasible or otherwise desirable.[12] These were the source of many of the high-range goals identified by the Task Force for populations where empirical historical estimates were not available.

In some cases, neither empirical nor model-based numbers were available for use in deriving high-range goals. In this event, regional technical teams identified high-range goals that were three times the abundance identified in the low-range goal for the population. The threefold difference was generally similar to the interval observed for populations where both low- and high-range goals were otherwise documented. High-range values were limited to estimated levels of pre-development habitat potential when three times the low-range value exceeded that value.

While the quantitative goals were developed using a generally consistent approach, to some extent, they also reflect local approaches and perspectives. Therefore, they are not intended to direct resource allocation or funding decisions among regions within the Basin.

Natural-origin spawning escapement was estimated independent of numbers of hatchery-origin fish returning to natural spawning areas. Thus, total spawning escapement was greater than natural-origin spawning escapement when hatchery fish were also present. Spawning escapements were also estimated independent of any harvest that might occur locally or downstream. Thus, total production of natural-origin fish would include both spawning escapement and downstream harvest.

Natural production goals take into account density dependence and carrying capacity of the existing spawning and rearing habitats for salmon and steelhead. The ISAB (2015) reviewed the status of Columbia River salmonid populations in the context of density dependence, which they defined as changes in one or more vital rates (birth, death, immigration, or emigration) in response to changing population density. Most common is compensatory density dependence (also termed compensation) in which a population's growth rate is highest at low density and decreases as density increases. Compensation is typically caused by competition for limited resources, such as food or habitat. The ISAB found that understanding density dependence in salmon and steelhead populations is important in evaluating responses to recovery actions and for setting spawning escapement goals that will be sustainable.

Results

Stock-specific natural production goals are identified in Table A-3 relative to current and historical numbers. Figure A-2 shows low- and high-goal ranges in relation to current abundance. Values are normalized so that ranges for more or less abundant stocks can be illustrated on the same graph. The gap between current abundance (value of 1) and the low end of the goal range shows the proportional increase in abundance needed to reach the minimum goal. Current values overlap the goal range for stocks that are relatively abundance.

Current numbers fall below target low-range goals for most stocks (Figure A-2). Numbers below low-range goals are indicative of stocks that do not achieve minimum viability levels or ESA recovery goals. Numbers falling within the target goal range are indicative of relatively healthy stocks with additional scope for improvement. Current mean numbers are sometimes greater than the target goal range — that is the case for Upper Columbia fall Chinook where recent returns have benefited from a period of favorable marine environmental conditions which are not likely to be representative of a long-term average future condition.

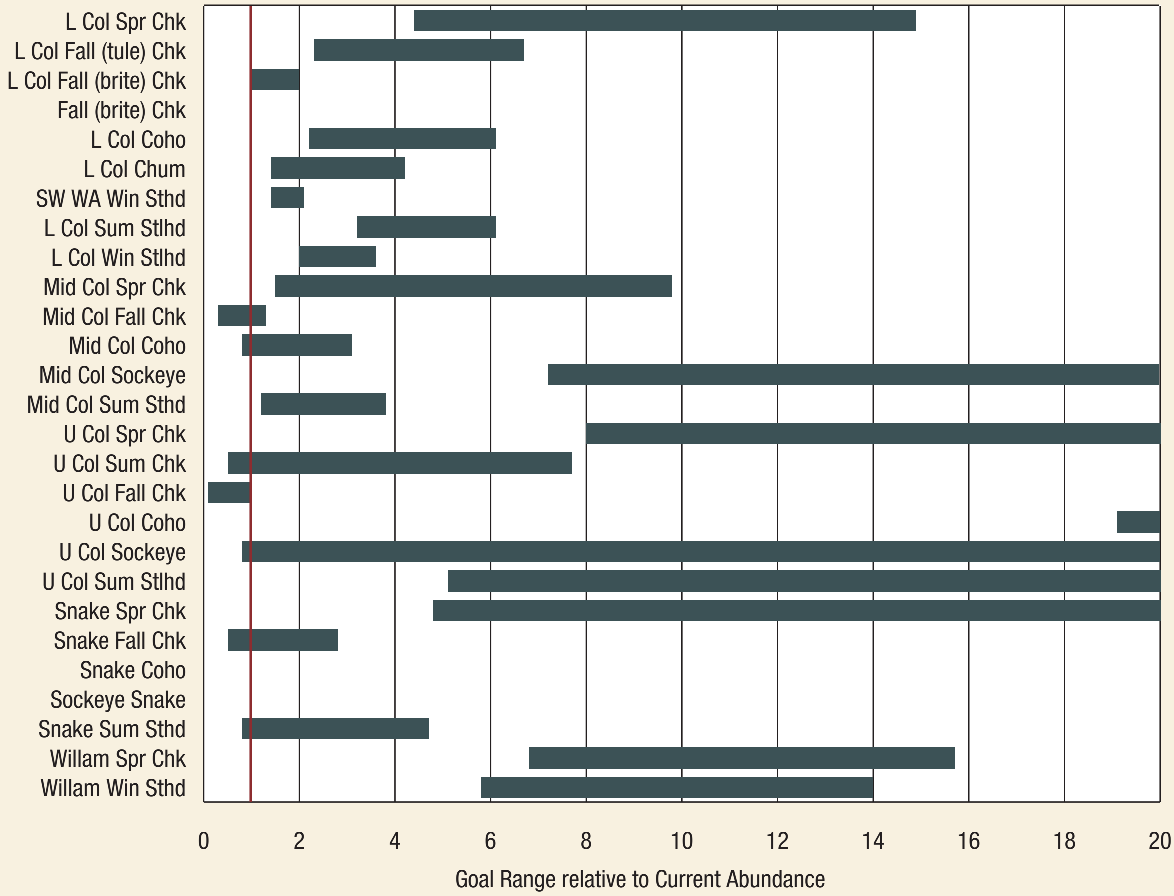
High goals are typically less than estimated historical abundance before development (Table A-3). These differences recoginize the difficultly of approaching historical abundance without restoration of pristine conditions. In some cases, goals are a small fraction of the historical number. For instance, the aggregate high-range goal for chum salmon is just four percent of the historical abundance. This low percentage reflects the severely depleted status of chum salmon and the ambitious nature of the Task Force goals which will require successful reintroduction into numerous areas where current habitat conditions do not support significant natural production of this species.

[12] For additional discussion of EDT modeling, see above. Examples of goals based on restoration scenarios may be found in YBFWRB (2009), ODFW (2010), and ODFW and NMFS (2011).

TABLE A-3. Aggregate abundance values for natural-origin escapements under current, historical, and low, medium, and high escapement goal ranges.

Stock	Current	Historical	Low goal	Med goal	High goal	High as % of historical
L Col R Spring Chinook	2,240	101,700	9,800	21,550	33,300	33%
L Col R Fall (tule) Chinook	12,329	169,700	28,050	54,100	82,000	48%
L Col R Late Fall (bright) Chinook	10,800	33,000	11,100	16,700	22,200	67%
L Col R Fall (bright) Chinook	11,000	0	11,000	11,000	11,000	–
L Col R Coho	31,524	301,900	67,925	129,550	191,400	63%
Col R Chum	11,762	461,300	16,500	33,000	49,500	11%
SW WA Winter Steelhead	3,252	19,100	4,650	5,850	6,950	36%
L Col R Winter Steelhead	5,989	41,900	19,000	27,900	36,400	87%
L Col R Summer Steelhead	10,594	61,200	21,100	29,800	38,100	62%
M Col R Spring Chinook	11,600	246,500	17,750	40,425	114,500	46%
M Col R Summer/Fall Chinook	11,500	17,000	4,000	13,000	16,000	94%
M Col R Coho	6,324	75,000	5,300	11,600	19,900	27%
M Col Sockeye	1,036	230,000	7,500	45,000	107,500	47%
M Col R Summer Steelhead	18,155	132,800	21,500	43,850	69,150	52%
U Col R Spring Chinook	1,430	259,450	11,500	19,840	30,135	12%
U Col R Summer Chinook	16,920	733,500	9,000	78,350	131,300	18%
U Col R Fall Chinook	92,400	680,000	9,200	62,215	87,835	13%
U Col R Coho	392	44,500	7,500	15,000	26,000	58%
U Col R Sockeye	40,850	1,800,000	31,500	580,000	1,235,000	69%
U Col R Summer Steelhead	1,480	1,121,400	7,500	31,000	47,000	4%
Snake R Spring/Summer Chinook	6,988	1,000,000	33,500	98,750	159,500	16%
Snake R Fall Chinook	8,360	500,000	4,200	10,780	23,360	5%
Snake R Coho	100	200,000	8,900	26,600	44,100	22%
Snake R Sockeye	100	84,000	5,500	15,750	26,000	31%
Snake R Summer Steelhead	28,000	600,000	22,500	75,000	131,500	22%
U Will R Spring Chinook	4,278	312,170	28,900	47,850	66,800	21%
U Will R Winter Steelhead	2,816	220,000	16,290	27,805	39,320	18%
Totals	**352,119**	**9,446,120**	**441,165**	**1,572,265**	**2,845,750**	**30%**
Chinook	**189,845**	**4,053,020**	**178,000**	**474,560**	**777,930**	**19%**
Spring	26,536	1,919,820	101,450	228,415	404,235	21%
Summer	16,920	733,500	9,000	78,350	131,300	18%
Fall	146,389	1,399,700	67,550	167,795	242,395	17%
Chum	**11,762**	**461,300**	**16,500**	**33,000**	**49,500**	**11%**
Coho	**38,340**	**621,400**	**89,625**	**182,750**	**281,400**	**45%**
Sockeye	**41,986**	**2,114,000**	**44,500**	**640,750**	**1,368,500**	**65%**
Steelhead	**70,286**	**2,196,400**	**112,540**	**241,205**	**368,420**	**17%**
Winter	12,057	281,000	39,940	61,555	82,670	29%
Summer	58,229	1,915,400	72,600	179,650	285,750	15%
Lower Columbia River	**99,490**	**1,189,800**	**189,125**	**329,450**	**470,850**	**40%**
Mid Columbia River	**48,615**	**701,300**	**56,050**	**153,875**	**327,050**	**47%**
Upper Columbia River	**153,472**	**4,638,850**	**76,200**	**786,405**	**1,557,270**	**34%**
Snake River	**43,548**	**2,384,000**	**74,600**	**226,880**	**384,460**	**16%**
Willamette	**7,094**	**532,170**	**45,190**	**75,655**	**106,120**	**20%**

FIGURE A-2. Natural production goal range relative to current numbers. Relative goal ranges are calculated by dividing the low and high goal values by the current abundance. The reference line identifies the current mean number in relation to the goal range.



Current & Anticipated Hatchery Production

The qualitative goals call for producing hatchery salmon and steelhead to support conservation, mitigate for lost natural production, and support fisheries in a manner consistent with achieving natural production goals.

Approach

The Task Force documented current and anticipated hatchery production throughout the Columbia Basin. Table A-4 shows the rule set for documenting these numbers.

Existing hatchery production levels are defined in different ways for programs throughout the Basin. Some programs define production levels in terms of adult returns, but many programs focus solely on juvenile production. For Task Force purposes regional technical teams documented current hatchery production levels (i.e., juvenile production) for each stock by hatchery program, and estimated corresponding numbers of adults by stock. Adult return expectations were identified where available.

Anticipated future hatchery production is identified based on available information. In most cases, future production is anticipated to be similar to current production (status quo). In some cases, planned changes or additions are identified. For instance, existing programs may be undergoing modifications based on new information or direction (e.g., Mitchell Act program revisions). Several new hatchery programs are also currently under development are likely to be implemented (e.g., John Day Mitigation, Yakama Coho Hatchery, Walla Walla Spring Chinook Hatchery). Mid-Columbia PUD hatchery mitigation production requirements change with periodic survival studies, and are recalculated every 10 years to adjust for changes in fish abundance and survival. It should not be expected that future recalculated numbers

TABLE A-4. Rule set for quantifying current and anticipated hatchery production.		
Current		1. Juvenile production levels of existing programs. (Juveniles provide a common currency for all programs including those where adult return goals are not specifically identified.) 2. Adult returns from current programs to the Columbia River and regional production areas (Lower Columbia, Willamette, Middle Columbia, Upper Columbia, and Snake) are identified by stock based on recent average numbers.
Future production	Status quo	1. Juvenile production continues at current levels (barring refinements of programs based on performance or new information). 2. Corresponding adult returns as defined or inferred from current program return rates.
	Planned adjustments	3. Identify additional juvenile production in development where defined in existing processes and plans (e.g., John Day Mitigation). 4. Corresponding adult returns as defined or inferred from current program return rates.
	Additional needs	5. Identify any additional or reduced juvenile production needs to address specific purposes identified by Columbia Basin Partnership (e.g., reintroduction of extirpated populations or production for currently blocked historical anadromous production areas). 6. Corresponding to adult returns as defined or inferred from current program return rates.

for PUD programs will be the same as current mitigation numbers; however, because it is not clear what the future numbers will be, current numbers are used as interim estimates. Finally, some Task Force members highlighted a desire for additional new programs to support other needs, for example to reintroduce salmon and steelhead into blocked areas within their historical range, and to increase Chinook salmon prey for Southern Resident killer whales while others have expressed concern that current production levels may be impeding recovery of naturally reproducing populations.

Specific hatchery programs are inevitably subject to continuing refinements under the authority and auspices of oversight, funding, and implementing entities. Anticipated future hatchery production identified by the Task Force is intended to describe expectations based on current information. They are not intended to supersede or undermine specific management authorities governing implementation of any particular program, or to preclude future changes based on new information, conditions, or requirements. For example, hatchery mitigation production requirements for the Mid-Columbia PUDs will change following scheduled project survival-verification studies, and every 10 years with scheduled recalculations as described above, and these changes will be developed and approved by hatchery oversight committees authorized and required as part of each PUD's federal operating license issued by the Federal Energy Regulatory Commission (FERC).

Results

Current and anticipated hatchery production and adult returns by stock are shown in Figure A-3 and Table A-5. Current hatchery production is approximately 145 million.

Anticipated future production increases to about 190 million, with much of the increase contingent on use of hatchery fish to to support programs in currently inaccessible areas of the upper Columbia. Potential increases outside of this area are relatively modest.

Hatchery programs currently return about 1.5 million adult salmon and steelhead to the Columbia River mouth on average. This does not include the fish harvested in marine fisheries. Potential future increases in hatchery production were projected to increase the average return to about 1.9 million assuming hatchery survival rates similar to current.

Potential Harvest & Fishery Opportunity

The qualitative goals call for providing "diverse, productive, and dependable tribal and non-tribal harvest and fishing opportunities for Columbia Basin salmon and steelhead." Achieving this goal would reflect a substantial improvement from the current state of these fisheries. Qualitative goals also call for managing harvest and fisheries at levels consistent with conserving natural salmon and steelhead populations.

Approach

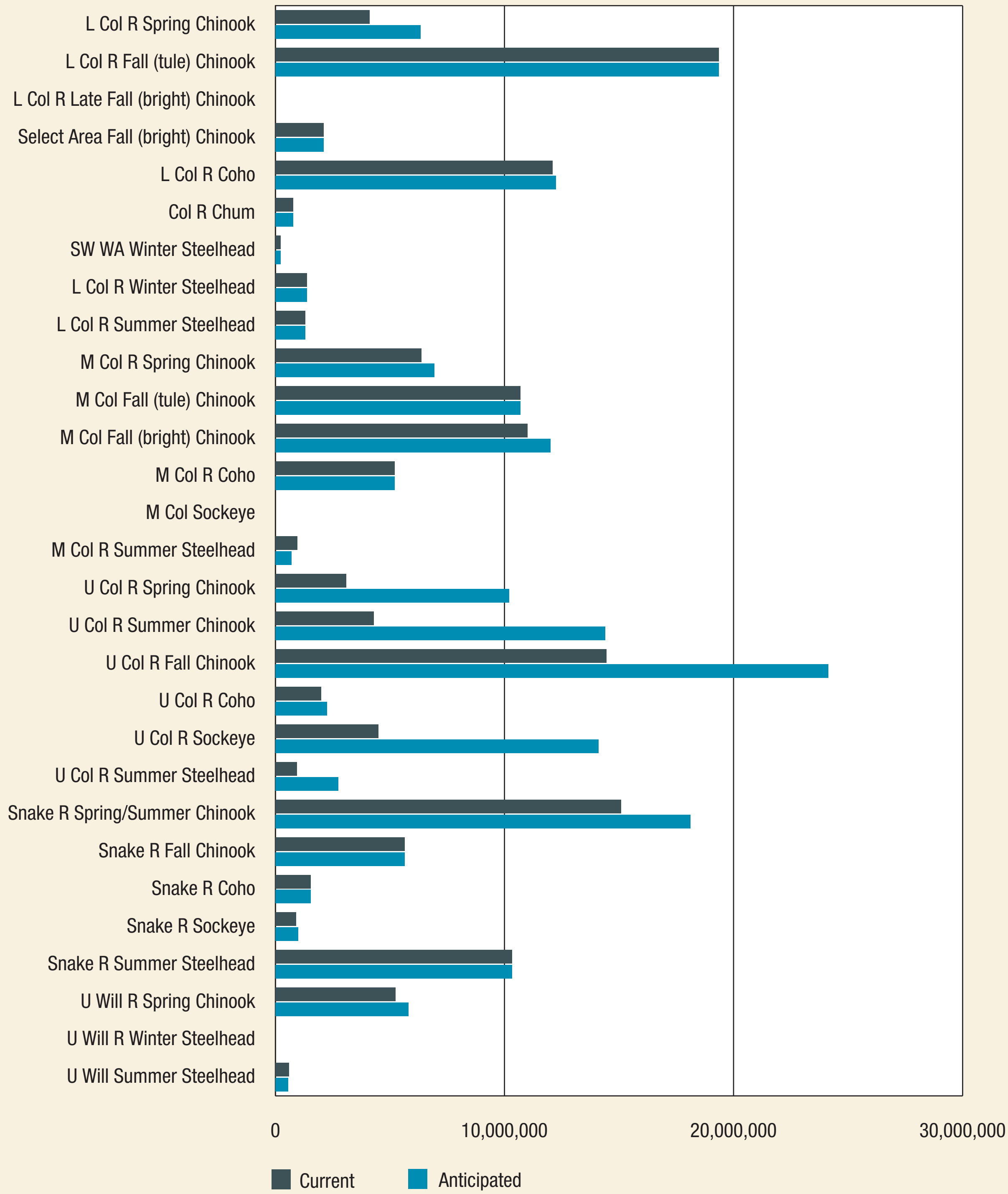
To provide baseline information, the NOAA Fisheries project team documented current

TABLE A-5. Current and anticipated hatchery production and approximate adult returns to the Columbia River mouth for Columbia Basin salmon and steelhead stocks.

	Current production (avg.)				Anticipated production	
Stock	Yearlings	Other	Total	Col R adults	Total	Col R adults
L Col R Spring Chinook	3,720,000	400,000	4,120,000	17,000	6,340,000	19,000
L Col R Fall (tule) Chinook	0	19,366,500	19,366,500	76,000	19,366,500	76,000
L Col R Late Fall (bright) Chinook	0	0	0	0	0	0
Select Area Fall (bright) Chinook*	0	2,100,000	2,100,000	12,500	2,100,000	12,500
L Col R Coho	12,100,000	8,600	12,108,600	246,000	12,239,000	246,000
Col R Chum	0	770,000	770,000	300	770,000	300
SW WA Winter Steelhead	223,000	0	223,000	3,900	223,000	3,900
L Col R Winter Steelhead	1,381,000	0	1,381,000	24,100	1,381,000	24,100
L Col R Summer Steelhead	1,307,000	0	1,307,000	46,000	1,307,000	46,000
M Col R Spring Chinook	5,950,000	430,000	6,380,000	47,200	6,930,000	55,800
M Col Fall (tule) Chinook*	0	10,700,000	10,700,000	87,000	10,700,000	87,000
M Col Fall (bright) Chinook*	0	11,000,000	11,000,000	113,500	12,000,000	123,800
M Col R Coho	4,700,000	500,000	5,200,000	76,000	5,200,000	76,000
M Col Sockeye	0	0	0	0	0	0
M Col R Summer Steelhead	610,000	350,000	960,000	58,000	710,000	42,900
U Col R Spring Chinook	3,094,000	0	3,094,000	19,400	10,200,000	64,000
U Col R Summer Chinook	3,102,000	1,184,000	4,286,000	45,000	14,400,000	140,000
U Col R Fall Chinook	450,000	14,000,000	14,450,000	118,100	24,140,000	215,800
U Col R Coho	2,000,000	0	2,000,000	29,000	2,250,000	32,600
U Col R Sockeye	0	4,500,000	4,500,000	32,900	14,100,000	100,000
U Col R Summer Steelhead	935,300	0	935,300	21,300	2,750,000	58,000
Snake R Spring/Summer Chinook	13,865,500	1,225,000	15,090,500	85,500	18,115,500	110,000
Snake R Fall Chinook	450,000	5,200,000	5,650,000	49,200	5,650,000	49,200
Snake R Coho	1,550,000	0	1,550,000	23,000	1,550,000	23,000
Snake R Sockeye	900,000	0	900,000	1,170	1,000,000	1,300
Snake R Summer Steelhead	9,328,000	1,000,000	10,328,000	203,400	10,328,000	203,400
U Will R Spring Chinook	5,241,000	0	5,241,000	48,000	5,817,000	53,000
U Will R Winter Steelhead	0	0	0	0	0	0
U Will Summer Steelhead*	600,000	0	600,000	16,000	550,000	14,700
TOTALS	**71,506,800**	**72,734,100**	**144,240,900**	**1,499,470**	**190,117,000**	**1,878,300**
Spring Chinook	**31,870,500**	**2,055,000**	**33,925,500**	**217,100**	**47,402,500**	**301,800**
Summer Chinook	**3,102,000**	**1,184,000**	**4,286,000**	**45,000**	**14,400,000**	**140,000**
Fall Chinook	**900,000**	**62,366,500**	**63,266,500**	**456,300**	**73,956,500**	**564,300**
Chum	**0**	**770,000**	**770,000**	**300**	**770,000**	**300**
Coho	**20,350,000**	**508,600**	**20,858,600**	**374,000**	**21,239,000**	**377,600**
Sockeye	**900,000**	**4,500,000**	**5,400,000**	**34,070**	**15,100,000**	**101,300**
Winter Steelhead	**1,604,000**	**0**	**1,604,000**	**28,000**	**1,604,000**	**28,000**
Summer Chinook	**12,780,300**	**1,350,000**	**14,130,300**	**344,700**	**15,645,000**	**365,000**
Lower Columbia River	**18,731,000**	**22,645,100**	**41,376,100**	**425,800**	**43,726,500**	**427,800**
Mid Columbia River	**11,260,000**	**22,980,000**	**34,240,000**	**381,700**	**35,540,000**	**385,500**
Upper Columbia River	**9,581,300**	**19,684,000**	**29,265,300**	**265,700**	**67,840,000**	**610,400**
Snake River	**26,093,500**	**7,425,000**	**33,518,500**	**362,270**	**36,643,500**	**386,900**
Willamette	**5,841,000**	**0**	**5,841,000**	**64,000**	**6,367,000**	**67,700**

* Hatchery-only

FIGURE A-3. Current and anticipated hatchery production for Columbia Basin salmon and steelhead stocks.



harvest rates for all Columbia Basin salmon and steelhead. Current fisheries are generally managed under harvest rate limits prescribed through a complex of management plans, agreements, and processes (e.g., *U.S. v. Oregon*, the Pacific Fishery Management Council process, and the Pacific Salmon Treaty), and include a combination of abundance-based, escapement-based, and harvest-rate-based goals for specific stocks. These current harvest rates do not represent fishery goals, per se, but rather allowable harvest under frameworks designed to protect weak and listed stocks. The weak stock constraints in these existing frameworks also limit access to harvestable surpluses of strong natural and hatchery stocks in many fisheries.

Many stocks are currently managed under abundance-based management frameworks. These frameworks were developed to guide fisheries in response to annual variability in run size. They allow higher harvest rates in years of greater abundance and reduce harvest rates to protect escapements in years of lower abundance. One practical effect is that, for recovering stocks whose average abundance improves over time, harvest rates in general are also higher on average. This means that, as an outcome of the existing fishery management structure, benefits of higher abundance are shared between increased numbers of natural-origin spawners and increased harvest. For reference purposes, the regional technical teams estimated approximate increases in harvest rates that would occur under existing management frameworks if abundance increased consistent with the Task Force natural production goals.

Healthy stocks can typically support substantially higher harvest rates than are currently identified in existing management frameworks, which are designed to protect weak and listed stocks. Therefore, the Task Force also identifies potential harvest rates and numbers that would be sustainable by abundant and productive salmon and steelhead stocks. These potential harvest rates and numbers are identified in conjunction with the low-, medium-, and high-range natural production goals. As described in Table A-6, the low-range potential harvest is based on the assumption that existing management frameworks (designed to protect weak stocks) will still be in place; therefore, there is no change from the estimated harvest rates under existing frameworks for low-range natural production goals.

The high-range potential harvest rates are based on existing management frameworks for stocks that are currently relative abundant (i.e., Upper Columbia River (UCR) spring Chinook, UCR fall Chinook, Deschutes fall Chinook, and Lower Columbia River (LCR) bright fall Chinook). For currently weak or depleted stocks, the high-range potential rates were identified by the NOAA Fisheries project team, in consultation with regional technical team members, and based on their professional judgement and knowledge of harvest rates typically sustained by healthy stocks, depending on life-history type (i.e., spring, fall, or late-fall) and species. The high-range potential harvest rates were also calibrated down slightly for stocks that would be harvested in mixed-stock fisheries, due to the need to protect weaker stocks in such fisheries. These potential harvest levels are generally conservative relative to historical harvest rates and those sustained by salmon and steelhead stocks in more pristine areas of the North Pacific.

Potential harvest rate estimates do not attempt to allocate fishery opportunities among specific fisheries. It is assumed that opportunities for

TABLE A-6. Approach to identifying potential harvest and fishery opportunity consistent with quantitative goals for natural production identified by the Columbia Basin Partnership Task Force.

Harvest under Existing Management Plans	1. Harvests by stock are projected with increased natural-origin abundance and incremental increases according to existing abundance-based harvest management frameworks. 2. If there is currently no abundance-based management framework, current harvest rate limits were used for all natural production goal ranges.
Low-range potential harvest	1. For weak stocks, assume that existing management frameworks remain in place. 2. For currently healthy stocks (i.e., UCR spring Chinook, UCR fall Chinook, Deschutes fall Chinook, and LCR bright fall Chinook), based on existing management frameworks. 3. Ranges reflect annual variation in harvest rates based on abundance in order to meet natural-origin spawning escapement goals and access higher numbers during large run years.
Mid-range potential harvest	1. Based on existing management frameworks for currently healthy stocks (i.e., UCR spring Chinook, UCR fall Chinook, Deschutes fall Chinook, and LCR bright fall Chinook). 2. Intermediate between low- and high-range goals for currently weak or depleted stocks.
High-range potential harvest	1. Based on existing management frameworks for currently healthy stocks (i.e., UCR spring Chinook, UCR fall Chinook, Deschutes fall Chinook, and LCR bright fall Chinook). 2. For currently weak or depleted stocks, based on reasonably realistic harvest rates expected to be sustainable by healthy natural-origin stocks. 3. Prescribed rates were also consistent with needs to provide significant access to wild and hatchery fish in mixed-stock fisheries across the range of harvest including ocean, Columbia River mainstem, and tributary fisheries.

additional harvest will be distributed among fisheries through existing management authorities and processes, and that harvest managers will continue to constrain harvest (or set harvest rates) consistent with achieving escapement goals for naturally produced fish. Mid- to high-range fishing levels are assumed to occur at the same time that mid- to high-range natural production goals for spawning escapement are achieved.

Results

Incremental increases in average harvest rates likely to occur with increasing natural production in relation to current management frameworks are shown in Figure A-4. Corresponding exploitation rate numbers are identified in Table A-7. Increases occur only for stocks where the harvest is regulated according to an abundance-based framework. For stocks currently managed under a fixed harvest rate, it is assumed for the purposes of this exercise that future harvest rates would be the same as current (although harvest numbers would be expected to increase due to a higher abundance of fish available to the fishery). These projections make no assumptions at this point regarding the ability to access allowable rates due to other stock limits in mixed-stock fisheries. Figure A-5 shows abundance-based harvest/impact rates that reflect aspirational fishery objectives beyond incremental increases projected under existing management frameworks consistent with increases in fish abundance identified in quantitative goals for natural production.

FIGURE A-4. Current average fishery harvest/impact rates of natural-origin fish and range of increases consistent with Task Force quantitative goals for natural production under current management frameworks in combined marine and freshwater fisheries for Columbia Basin salmon and steelhead stocks.

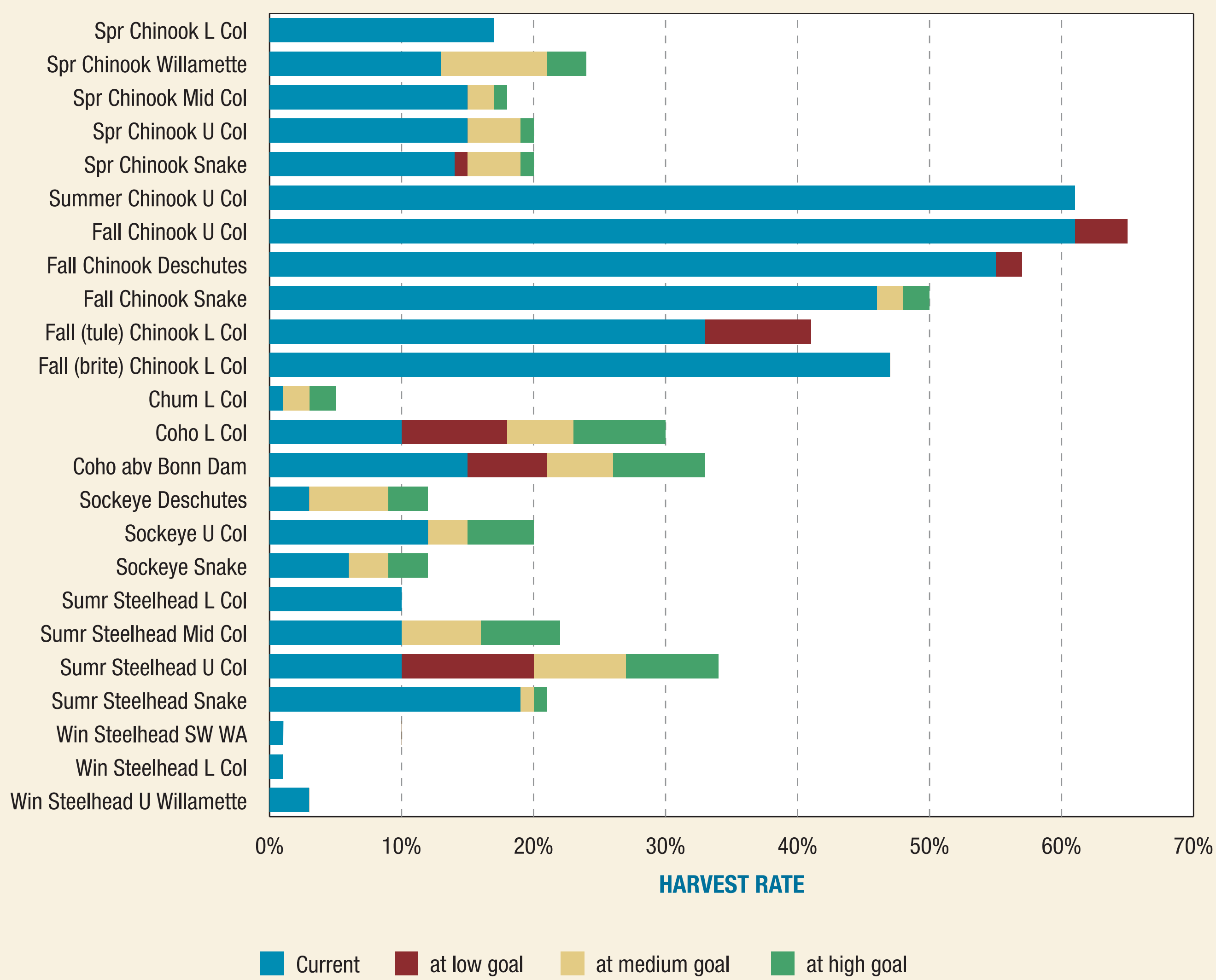


TABLE A-7. Current fishery harvest/impact rates, range of increases under current management frameworks, and low, medium, and high goals for natural-origin fish in combined marine and freshwater fisheries for Columbia Basin salmon and steelhead stocks.

	Current Exploitation Rates (natural-origin)			Current Management Framework		
Stock	Ocean	Fresh Water	Total (avg)	Range	Related guidance	Guidance includes
Spr Chinook L Col	9%	8%	17%	10-40%	–	–
Spr Chinook Willamette	9%	4%	13%	8-25%	<15%/<12%	Fresh/Ocean
Spr Chinook Mid Col	–	15%	15%	5.5-17%	5.5-17%	Freshwater
Spr Chinook U Col	–	15%	15%	7.5-23%	7.5-23%	Freshwater
Spr Chinook Snake	–	14%	14%	7.5-23%	7.5-23%	Freshwater
Summer Chinook U Col	36%	25%	61%	40-80%	5.2-50%	Freshwater
Fall Chinook U Col	36%	26%	61%	40-80%	21.5-45%	Freshwater
Fall Chinook Deschutes	36%	19%	55%	30-70%	21.5-45%	Freshwater
Fall Chinook Snake	20%	27%	46%	30-70%	21.5-45%	Freshwater
Fall (tule) Chinook L Col	21%	12%	33%	30-41%	30-41%	All
Fall (brite) Chinook L Col	34%	13%	47%	35-70%	–	–
Chum L Col	–	1%	1%	<5%	<5%	Freshwater
Coho L Col	5%	5%	10%	<10-30%	<10-30%	All
Coho abv Bonn Dam	5%	10%	15%	<10-35%	<10-30%	All < BON
Sockeye Deschutes	–	3%	3%	3-11%	6-8+%	Freshwater
Sockeye U Col	–	12%	12%	6-19%	6-26+%	Freshwater
Sockeye Snake	–	6%	6%	6-11%	6-8+%	Freshwater
Sumr Steelhead L Col	–	<10%	10%	<10%	<10%	Freshwater
Sumr Steelhead Mid Col	–	10%	10%	8-22%	15-22%	Freshwater
Sumr Steelhead U Col	–	10%	10%	20-34%	20-34%	Freshwater
Sumr Steelhead Snake	–	19%	19%	15-22%	15-22%	Freshwater
Win Steelhead SW WA	–	1%	1%	<10%	<10%	Freshwater
Win Steelhead L Col	–	1%	1%	<10%	<10%	Freshwater
Win Steelhead U Will	–	3%	3%	<20%	<20%	Freshwater

Rates under existing plans			Potential rates with production improvements					
@ low natl	@ med natl	@ high natl	@ low natl Avg.	@ low natl Range	@ med natl Avg.	@ med natl Range	@ high natl Avg	@ high natl Range
17%	17%	17%	17%	10-40%	28%	15-45%	40%	20-60%
13%	21%	24%	13%	8-25%	26%	15-45%	40%	20-60%
15%	16%	17%	15%	5.5-17%	27%	20-35%	40%	20-60%
15%	19%	20%	15%	7.5-23%	28%	20-40%	40%	20-60%
15%	19%	20%	15%	7.5-23%	28%	20-40%	40%	20-60%
61%	61%	61%	61%	40-80%	61%	40-80%	61%	40-80%
65%	65%	65%	65%	40-80%	65%	40-80%	65%	40-80%
57%	57%	57%	57%	30-70%	61%	30-70%	65%	30-80%
46%	48%	50%	46%	30-70%	51%	30-75%	55%	30-80%
41%	41%	41%	41%	30-41%	53%	30-55%	65%	30-80%
47%	47%	47%	47%	35-70%	50%	35-70%	53%	35-70%
1%	2.8%	5%	1%	<5%	20%	5-30%	40%	20-60%
18%	23%	30%	18%	<10-30%	24%	10-40%	30%	10-50%
21%	26%	33%	21%	<10-40%	30%	10-50%	40%	20-60%
3%	9%	12%	3%	3-11%	15%	10-30%	25%	10-40%
12%	15%	20%	12%	6-19%	25%	10-40%	40%	20-60%
6%	9%	12%	6%	6-11%	15%	10-30%	25%	10-40%
10%	10%	10%	10%	<10%	18%	10-25%	25%	10-40%
10%	15.8%	22%	10%	8-22%	22%	15-30%	35%	20-50%
20%	27%	34%	20%	20-34%	28%	20-40%	35%	20-50%
19%	20.6%	22%	19%	15-22%	27%	20-40%	35%	20-50%
1%	1%	1%	1%	<10%	13%	10-30%	25%	10-40%
1%	1%	1%	1%	<10%	13%	10-30%	25%	10-40%
3%	3%	3%	3%	<20%	14%	10-30%	25%	10-40%

FIGURE A-5. Potential harvest/impact rates under abundance-based management frameworks at low, medium, and high natural production (assuming corresponding changes in fishery management frameworks). Average values are depicted by vertical lines within colored bars.

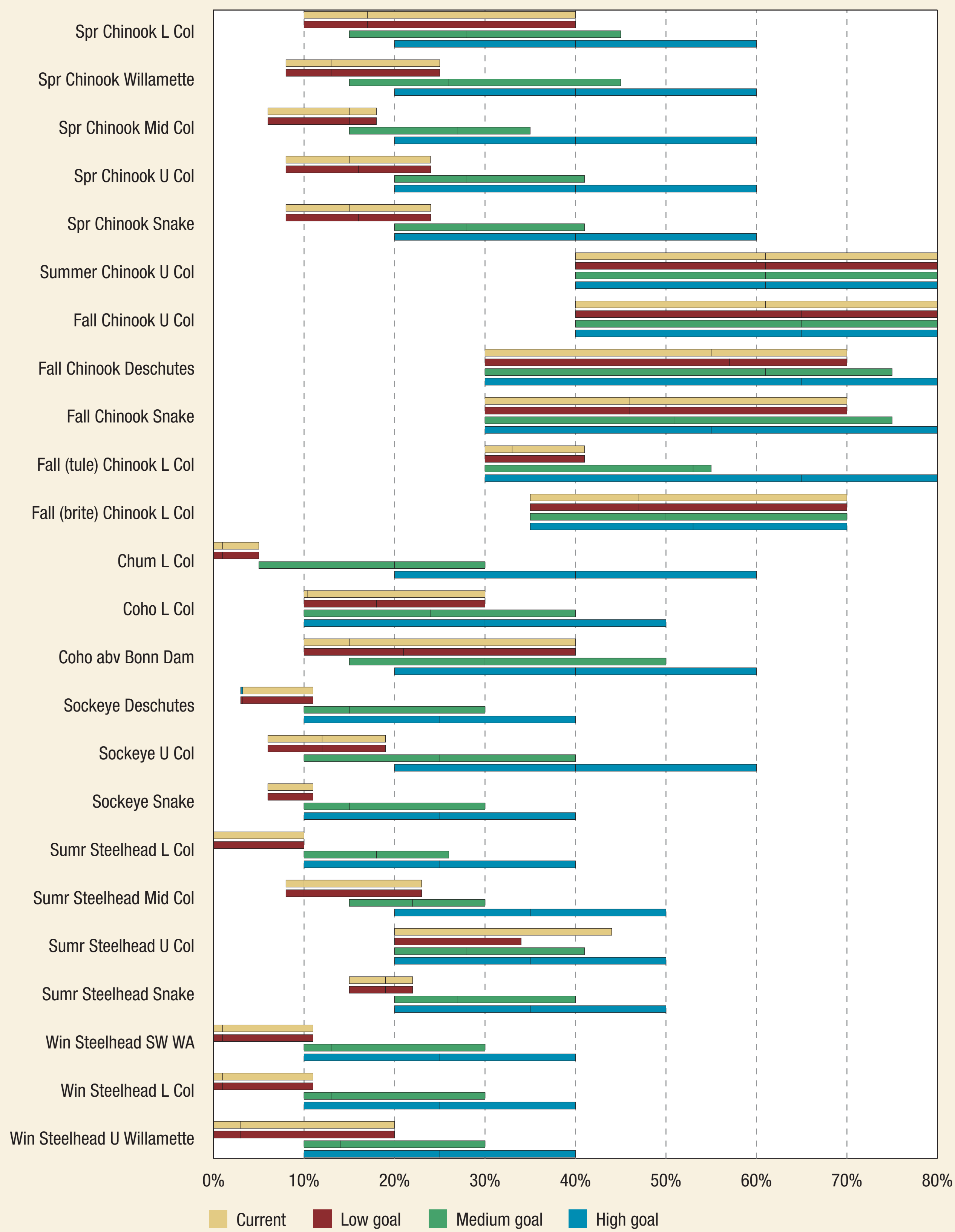


TABLE A-8. Current (2008-2017 average) and potential harvest of Columbia River salmon and steelhead in combined ocean and freshwater fisheries projected at high natural production goal, anticipated hatchery production and potential fishing levels.

	Harvest (current)			Harvest (at high goal)		
Stock	Col basin	Ocean	Total	Col basin	Ocean	Total
L Col R Spring Chinook	6,200	1,200	7,400	34,000	8,000	42,000
L Col R Fall (tule) Chinook	21,000	33,000	54,000	170,000	73,000	243,000
L Col R Late Fall (bright) Chinook	2,800	7,500	10,300	9,600	17,300	26,900
Select Area Fall (bright) Chinook	10,100	NA	10,100	10,100	NA	10,100
L Col R Coho	108,000	63,000	171,000	262,000	57,000	319,000
Col R Chum	80	0	80	41,000	0	41,000
SWW/LCR WA Winter Steelhead	19,500	0	19,500	31,000	0	31,000
L Col R Summer Steelhead	24,200	0	24,200	35,000	0	35,000
M Col R Spring Chinook	13,600	0	13,600	120,700	0	120,700
M Col Fall (tule) Chinook	52,000	34,000	86,000	52,000	34,000	86,000
M Col R Summer/Fall Chinook	5,600	10,300	15,900	15,400	18,600	34,000
M Col Fall (bright) Chinook	60,000	84,450	144,450	65,400	92,100	157,500
M Col R Coho	16,000	19,000	35,000	26,600	26,200	52,800
M Col Sockeye	100	0	100	71,700	0	71,700
M Col R Summer Steelhead	26,800	0	26,800	110,100	0	110,100
U Col R Spring Chinook	5,970	0	5,970	119,400	0	119,400
U Col R Summer Chinook	31,100	41,500	72,600	153,000	207,000	360,000
U Col R Fall Chinook	136,200	191,700	327,900	153,200	211,100	364,300
U Col R Coho	6,100	7,400	13,500	20,000	16,800	36,800
U Col R Sockeye	41,900	0	41,900	1,122,200	0	1,122,200
U Col R Summer Steelhead	9,700	0	9,700	126,000	0	126,000
Snake R Spring/Summer Chinook	44,230	0	44,230	235,000	0	228,000
Snake R Fall Chinook	22,200	16,300	38,500	31,900	20,200	52,100
Snake R Coho	4,700	5,700	10,400	28,300	21,700	50,000
Snake R Sockeye	82	0	82	23,700	0	23,700
Snake R Summer Steelhead	133,900	0	133,900	183,100	0	180,800
U Will R Spring Chinook	18,800	6,200	25,000	110,700	26,300	137,000
U Will R Winter Steelhead	200	0	200	28,000	0	28,000
U Will Summer Steelhead	8,000	0	8,000	8,000	0	8,000
Totals	**829,062**	**521,250**	**1,350,312**	**3,397,800**	**829,300**	**4,226,400**
Chinook	**429,800**	**426,150**	**855,950**	**1,280,400**	**707,600**	**1,988,000**
Spring	88,800	7,400	96,200	619,800	34,300	654,100
Summer	31,100	41,500	72,600	153,000	207,000	360,000
Fall	309,900	377,250	687,150	507,600	466,300	973,900
Chum	**80**	**0**	**80**	**41,000**	**0**	**41,000**
Coho	**134,800**	**95,100**	**229,900**	**336,900**	**121,700**	**458,600**
Sockeye	**42,082**	**0**	**42,082**	**1,217,600**	**0**	**1,217,600**
Steelhead	**222,300**	**0**	**222,300**	**521,200**	**0**	**521,200**
Winter	19,700	0	19,700	59,000	0	59,000
Summer	202,600	0	202,600	462,200	0	462,200
Lower Columbia River	**191,880**	**104,700**	**296,580**	**592,700**	**155,300**	**748,000**
Mid Columbia River	**174,100**	**147,750**	**321,850**	**461,900**	**170,900**	**632,800**
Upper Columbia River	**230,970**	**240,600**	**471,570**	**1,693,800**	**434,900**	**2,128,700**
Snake River	**205,112**	**22,000**	**227,112**	**502,000**	**41,900**	**543,900**
Willamette	**27,000**	**6,200**	**33,200**	**146,700**	**26,300**	**173,000**

Table A-8 shows corresponding harvest numbers in ocean and freshwater fisheries, including current levels and projected numbers sustainable at high-range natural production goals, anticipated hatchery production, and exploitation rates likely to be sustainable by healthy natural-origin stocks.

Columbia River Run Sizes

Approach

The regional technical teams also developed aggregate abundance numbers for natural production, fisheries, and hatchery production at Basin and species scales. "Run size" is defined as the combined total number of salmon and steelhead that would be needed to meet natural production, fisheries, and anticipated hatchery production levels. Run sizes are identified at Basin, species, and stock scales and used for evaluating status and goals relative to a variety of needs across the Basin. Numbers are reported for total adult returns at the mouth of the Columbia River, and for numbers of fish returning to different regions of the Basin. These numbers are useful references for comparison with various goals that have been established across the Basin, and are also the basis for many fishery or mitigation-related goals.

Spawning escapement is less than the total number of fish returning to the Columbia River mouth because fish are lost to harvest, other causes of mortality (e.g., dam passage mortality, high temperature effects, marine mammal predation), and straying between the river mouth and the spawning grounds. Therefore, spawning escapement and river mouth return numbers are related but not directly comparable.

FIGURE A-6. Columbia River run size by salmon and steelhead stock (2008-2017 average and number projected at high natural production goal, anticipated hatchery production, and potential fishing levels).

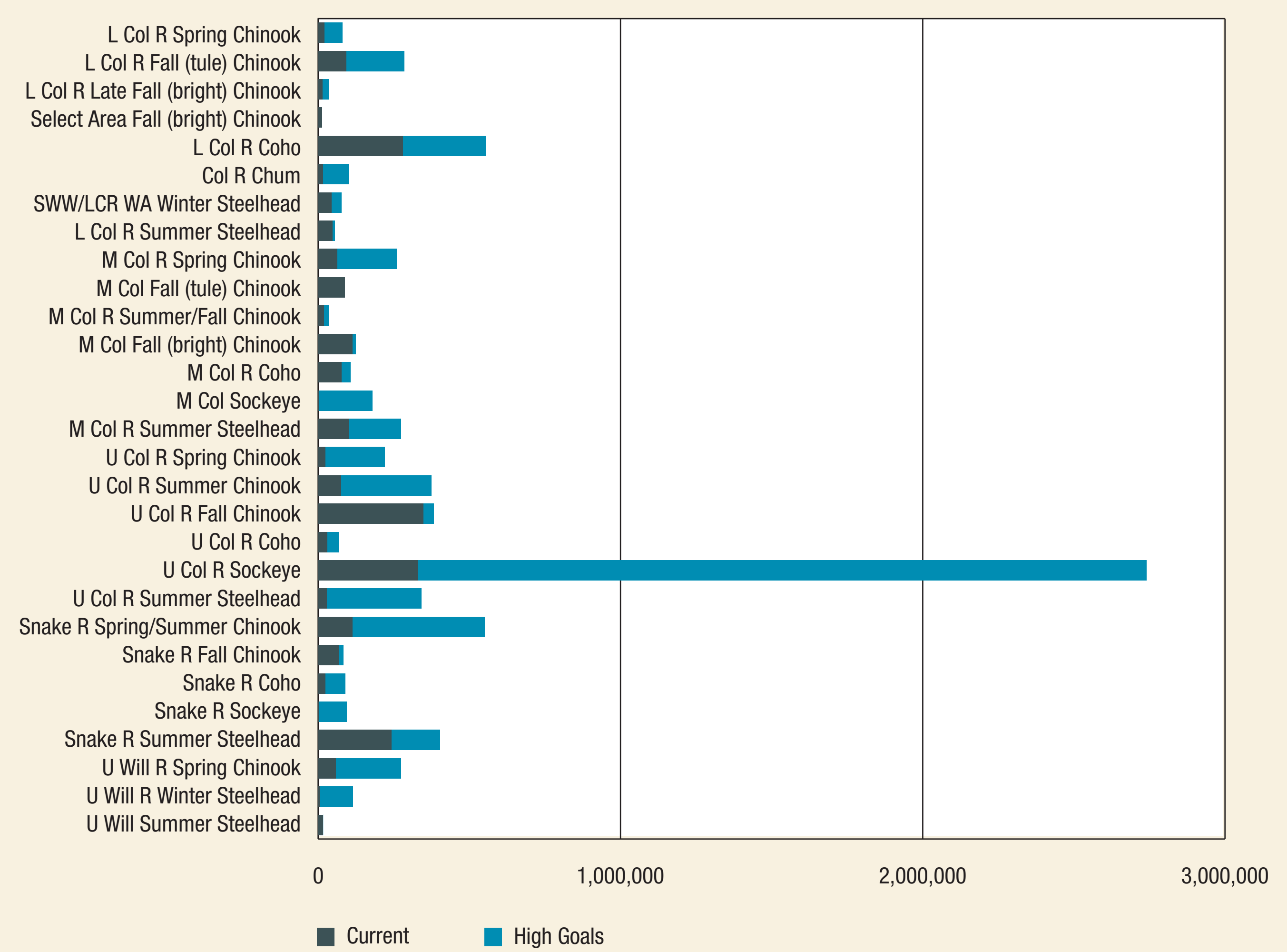


TABLE A-9. Columbia River run size and hatchery/wild composition by salmon and steelhead stock (2008-2017 average and number projected at high natural production goal, anticipated hatchery production, and potential fishing levels).

	Columbia River Mouth (current)				Columbia River Mouth (at high goal)			
Stock	Natural	Hatchery	Total	% Hat	Natural	Hatchery	Total	% Hat
L Col R Spring Chinook	3,000	17,000	20,000	85%	61,000	19,000	80,000	24%
L Col R Fall (tule) Chinook	16,000	76,000	92,000	83%	209,000	76,000	285,000	27%
L Col R Late Fall (bright) Chinook	14,500	0	14,500	0%	33,500	0	33,500	0%
Select Area Fall (bright) Chinook	0	12,500	12,500	100%	0	12,500	12,500	100%
L Col R Coho	34,000	246,000	280,000	88%	309,000	246,000	555,000	44%
Col R Chum	14,700	300	15,000	2%	102,000	0	102,000	0%
SWW/LCR Winter Steelhead	11,000	33,000	44,000	75%	49,000	28,000	77,000	36%
L Col R Summer Steelhead	3,000	44,000	47,000	94%	9,000	46,000	55,000	84%
M Col R Spring Chinook	14,700	47,200	61,900	76%	204,200	55,800	260,000	21%
M Col Fall (tule) Chinook	0	87,000	87,000	100%	0	87,000	87,000	100%
M Col R Summer/Fall Chinook	18,600	0	18,600	0%	33,700	0	33,700	0%
M Col Fall (bright) Chinook	0	113,500	113,500	100%	0	123,800	123,800	100%
M Col R Coho	0	76,700	76,700	100%	30,500	76,700	107,200	72%
M Col Sockeye	1,100	0	1,100	0%	179,000	0	179,000	0%
M Col R Summer Steelhead	43,000	58,000	101,000	57%	231,000	42,900	273,900	16%
U Col R Spring Chinook	3,840	19,400	23,240	83%	116,300	104,200	220,500	47%
U Col R Summer Chinook	30,000	45,000	75,000	60%	234,000	140,000	374,000	37%
U Col R Fall Chinook	228,800	118,100	346,900	34%	166,400	215,800	382,200	56%
U Col R Coho	0	29,500	29,500	100%	39,900	29,500	69,400	43%
U Col R Sockeye	296,100	32,900	329,000	10%	2,640,000	100,000	2,740,000	4%
U Col R Summer Steelhead	6,400	21,300	27,700	77%	284,000	58,000	342,000	17%
Snake R Spring/Summer Chinook	27,400	85,500	112,900	76%	441,000	110,000	551,000	20%
Snake R Fall Chinook	17,900	49,200	67,100	73%	34,200	49,200	83,400	59%
Snake R Coho	0	22,900	22,900	100%	67,000	22,900	89,900	25%
Snake R Sockeye	290	1,170	1,460	80%	94,900	0	94,900	0%
Snake R Summer Steelhead	37,900	203,400	241,300	84%	199,300	203,400	402,700	51%
U Will R Spring Chinook	10,000	48,000	58,000	83%	220,000	53,000	273,000	19%
U Will R Winter Steelhead	6,300	0	6,300	0%	114,000	0	114,000	0%
U Will Summer Steelhead*	0	16,000	16,000	100%	0	16,000	16,000	100%
Totals	**838,530**	**1,503,570**	**2,342,100**	**64%**	**6,101,900**	**1,915,700**	**8,017,600**	**24%**
Chinook	**384,740**	**718,400**	**1,103,140**	**65%**	**1,753,300**	**1,046,300**	**2,799,600**	**37%**
Spring	58,940	217,100	276,040	79%	1,042,500	342,000	1,384,500	25%
Summer	30,000	45,000	75,000	60%	234,000	140,000	374,000	37%
Fall	295,800	456,300	752,100	61%	476,800	564,300	1,041,100	54%
Chum	**14,700**	**300**	**15,000**	**2%**	**102,000**	**0**	**102,000**	**0%**
Coho	**34,000**	**375,100**	**409,100**	**92%**	**446,400**	**375,100**	**821,500**	**46%**
Sockeye	**297,490**	**34,070**	**331,560**	**10%**	**2,913,900**	**100,000**	**3,013,900**	**3%**
Steelhead	**107,600**	**375,700**	**483,300**	**78%**	**886,300**	**394,300**	**1,280,600**	**31%**
Winter	17,300	33,000	50,300	66%	163,000	28,000	191,000	15%
Summer	90,300	342,700	433,000	79%	723,300	366,300	1,089,500	34%
Lower Columbia River	**96,200**	**428,800**	**525,000**	**82%**	**772,500**	**427,500**	**1,200,000**	**36%**
Mid Columbia River	**77,400**	**382,400**	**459,800**	**83%**	**678,400**	**386,200**	**1,064,600**	**36%**
Upper Columbia River	**565,140**	**266,200**	**831,340**	**32%**	**3,480,600**	**647,500**	**4,128,100**	**16%**
Snake River	**83,490**	**362,170**	**445,660**	**81%**	**836,400**	**385,500**	**1,221,900**	**32%**
Willamette	**16,300**	**64,000**	**80,300**	**80%**	**334,000**	**69,000**	**403,000**	**17%**

Results

Recent (2008-2017) salmon and steelhead runs to the Columbia River have averaged approximately 2.3 million per year (Figure A-6 and Table A-9). Natural-origin fish account for approximately 800,000 or one third of the total.

Results of our analysis show projected run size increasing to 8 million adult salmon and steelhead at the high-range natural production goals, of which 6 million (about three-quarters) would be natural-origin fish. Results of the analysis also showed that at the high-range goal, total harvest (freshwater and ocean) would increase from 1.3 to 4.2 million, as productive natural populations are assumed to sustain substantial increases in exploitation rates of both natural and hatchery-orgin fish.

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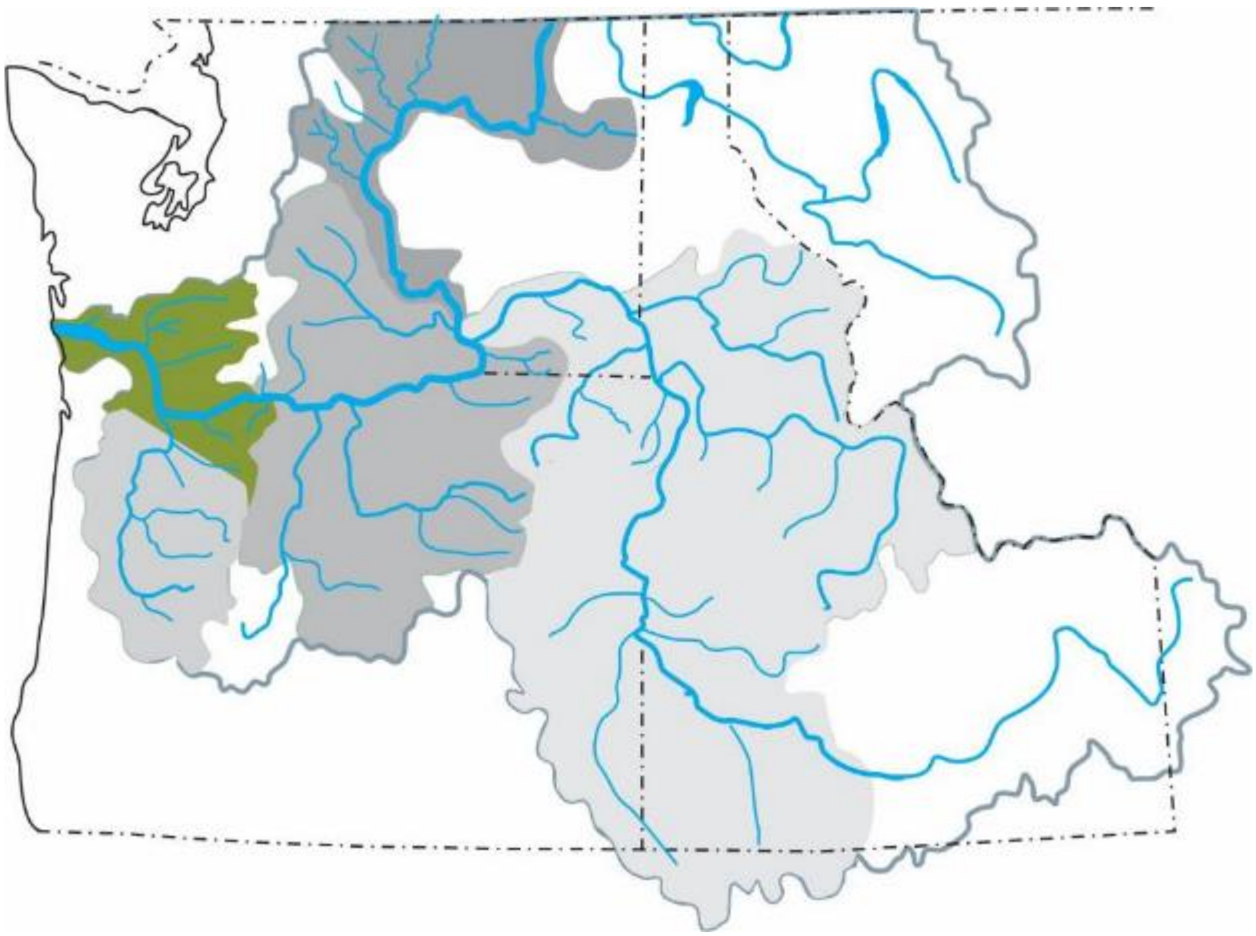
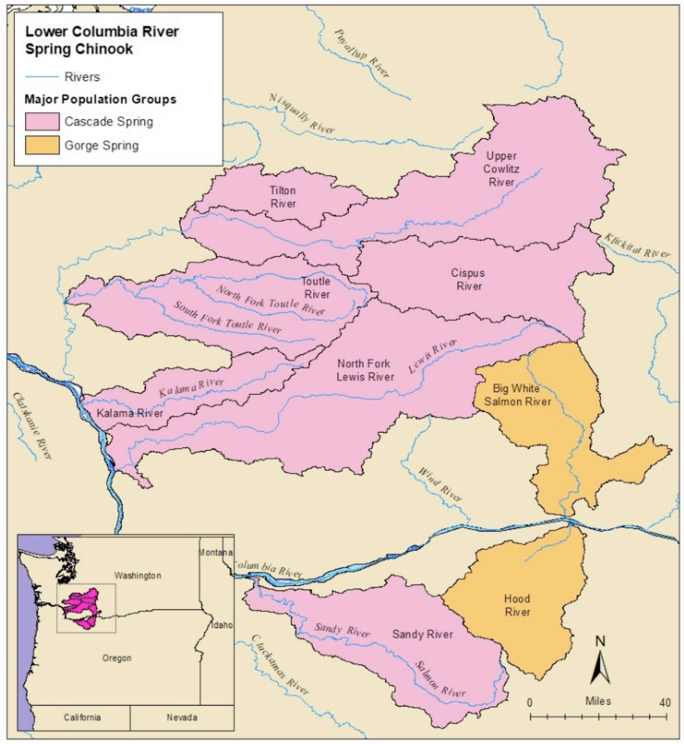
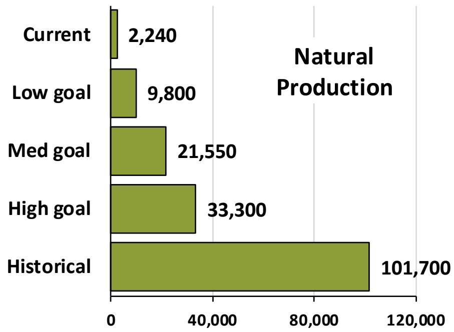
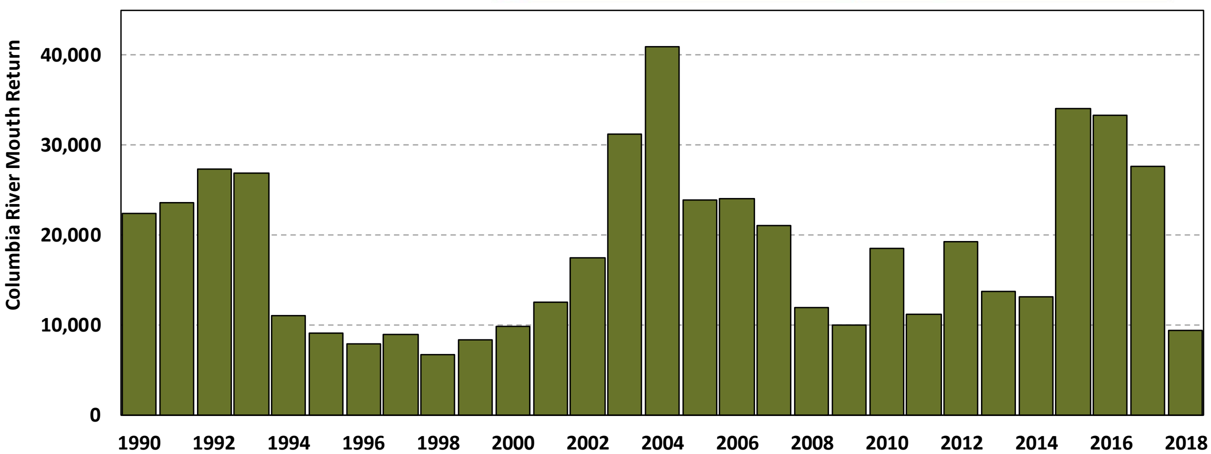
LOWER COLUMBIA



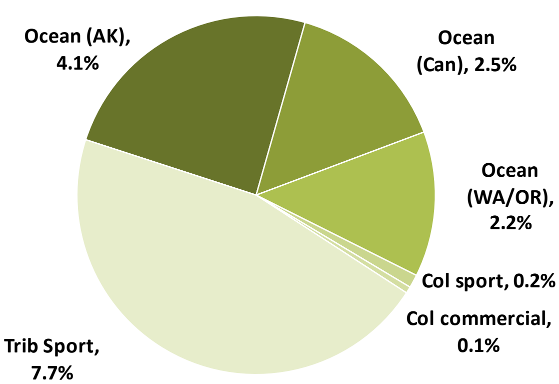
- Return to mid to upper reaches of Cascade tributaries in the Lower Columbia and Columbia River Gorge.
- Significant historical production areas in the upper Cowlitz and Lewis Rivers were blocked but are currently the focus of reintroduction efforts.
- Hatchery programs are currently operated in many areas to mitigate for lost production.





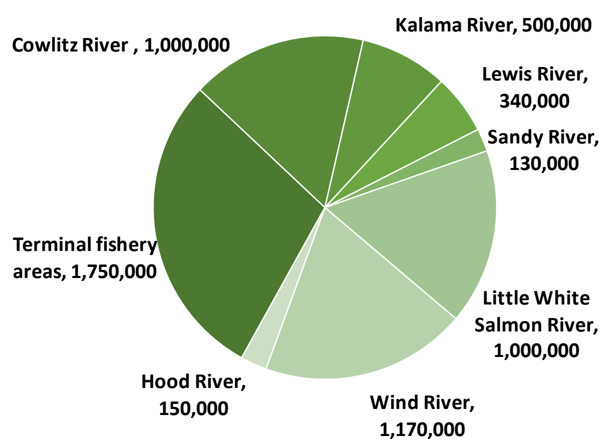


Harvest Distribution (Wild/Natural Exploitation Rate)



Total 16.8%

Current Hatchery Production (smolts)



Total 6.0 million

Natural Production		Abundance		Potential Goal Range		
MPG	**Population**	**Recent**	**Historical**	**Low**	**Med**	**High**
Cascade	Upper Cowlitz (WA)	150	22,000	1,800	4,100	6,400
	Cispus (WA)		7,800	1,800	1,800	1,800
	Tilton (WA)	0	5,400	100	1,650	3,200
	Toutle (WA)	100	3,100	1,100	1,900	2,700
	Kalama (WA)	160	4,900	300	550	800
	NF Lewis (WA)	150	15,700	1,500	2,300	3,100
	Sandy (OR)	1,560	26,900	1,200	4,550	7,900
Gorge	White Salmon (WA)	50	900	500	700	900
	Hood (OR)	70	15,000	1,500	4,000	6,500
	Totals	**2,240**	**101,700**	**9,800**	**21,550**	**33,300**

Artificial Production		Current Production			Return	Anticipated
Location (Program)		**Brood**	**Yearling**	**Subyearling**	**Goal**	**production**
Below BON Dam	Terminal fishery areas		1,750,000			3,450,000
	Cowlitz River		1,000,000	400,000		1,800,000
	Kalama River		500,000			500,000
	Lewis River		340,000			340,000
	Sandy River		130,000			250,000
Subtotal			**3,720,000**	**400,000**		**6,340,000**
Abv BON	Little White Salmon River		1,000,000			1,000,000
	Wind River		1,170,000			1,170,000
	Hood River		150,000			250,000
Subtotal			**2,320,000**	**0**		**2,420,000**
Total			**6,040,000**	**400,000**		**8,760,000**

Fisheries / Harvest		Exploitation rate				Harvest *	
	Location	**Avg (v ocn)**	**Avg (v CR)**	**Limits**	**Potential**	**Recent**	**Potential**
Natural	Ocean (AK)	4.1%	--	10-40%	20-50%	109	6,000
	Ocean (Can)	2.5%	--			60	
	Ocean (WA/OR)	2.2%	--			63	
	Col sport	0.2%	0.3%			7	21,000
	Col commercial	0.1%	0.1%			2	
	Trib Sport	7.7%	8.4%			191	
	Total	**16.8%**	**8.8%**	***10-40%***	***20-50%***	**433**	**27,000**
Hatchery	Ocean (AK)	4.1%	--	≤ 70%	≤ 70%	736	2,000
	Ocean (Can)	2.5%	--			373	
	Ocean (WA/OR)	2.2%	--			495	
	Col sport	2.2%	2.4%			436	13,000
	Col commercial	0.8%	0.9%			159	
	Trib Sport	22.1%	24.2%			5,095	
	Total	**33.9%**	**27.6%**	***≤ 70%***	***≤ 70%***	**7,294**	**15,000**
Select Area	Col Sport	--	7.8%			10,100	21,883
	Col Commercial	--	91.1%			1,000	
	Total		***98.9%***			**11,100**	**21,883**
Bonn Tribs	Treaty	--	19.7%			4,200	10,400
	Sport	--	34.6%			6,200	
	Total	***0.0%***	***54.3%***			**10,400**	**10,400**

** Columbia River sport and commercial fisheries are mark selective*

Total Return		Recent avg. (2008-2017)	@ Goals Low	Med	High
@ Columbia R Mouth		**20,000**	**26,000**	**49,000**	**80,000**
	Natural	3,000	13,000	33,000	61,000
	Hatchery	17,000	13,000	16,000	19,000
	% hatchery	85%	50%	33%	24%
Escapement		**14,000**	**22,000**	**35,000**	**46,000**
	Natural	3,000	12,000	26,000	40,000
	Hatchery	11,000	10,000	9,000	6,000
	% hatchery	79%	45%	26%	13%
Harvest (Col basin)		**6,200**	**5,000**	**15,000**	**34,000**
	Natural	200	1,000	7,000	21,000
	Hatchery	6,000	4,000	8,000	13,000
	% hatchery	97%	80%	53%	38%
Harvest (Total)		**7,400**	**7,000**	**19,000**	**42,000**
	Natural	400	2,000	10,000	27,000
	Hatchery	7,000	5,000	9,000	15,000
	% hatchery	95%	71%	47%	36%

Notes - Natural Production

Historical populations returned to Cascade tributaries in the Lower Columbia and the Columbia River Gorge. Spawning occurred in mid to upper reaches of streams. Significant historical production areas in the Upper Cowlitz and Lewis Rivers were historically blocked but are currently the focus of reintroduction efforts. Hatchery programs are currently operated in many areas to mitigate for lost production. This stock is not subject to significant harvest in the ocean due to run timing and distribution.

Distribution: LCR spring Chinook salmon historically spawned in large tributaries in the western Cascade and Gorge ecoregions. The Willamette/Lower Columbia Technical Recovery Team (WLCTRT) identified a total of 32 historical populations in 6 MPGs in this ESU. While all identified historical populations are extant, access to historical spawning habitat in the Cowlitz and Lewis populations has been limited by tributary dams.

Historical abundance: Estimates from LCR recovery plan. For WA populations, historical abundance is estimated based on EDT modeling using estimated historical habitat conditions. For OR populations, ODFW developed estimates using information from NMFS status reviews and the WLCTRT. (NMFS estimates of historical kilometers of habitat for each species and population were used to apportion the ESU abundance estimate between all populations.)

Current abundance: Estimated from spawning ground surveys and/or tributary dam counts. In Toutle and White Salmon abundance estimates not available; therefore, used baseline abundance from WA and OR LCR recovery plans, respectively.

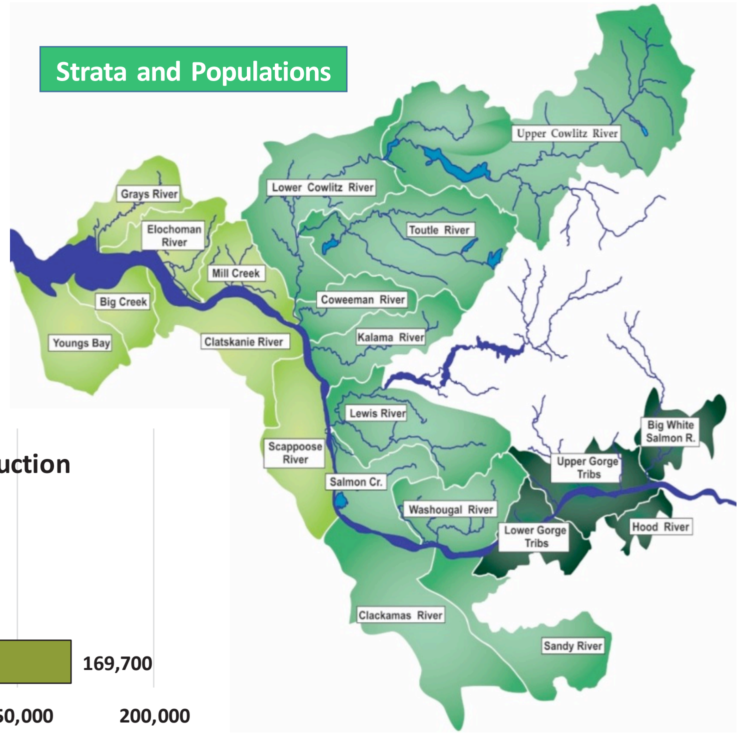
Goals:

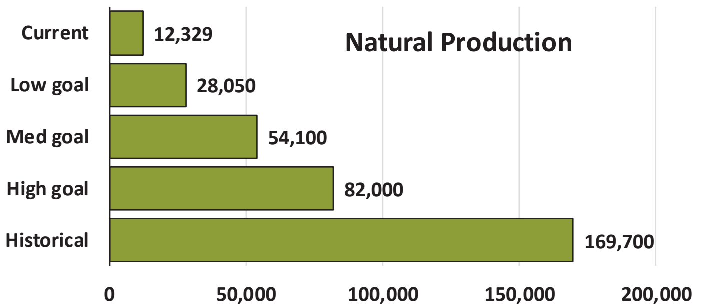
- *Low range*: Population-specific delisting abundance target from ESA recovery plan. In Tilton no delisting goal established; therefore, low goal is set equal to baseline abundance estimate from WA LCR recovery plan.
- *Medium range:* Mid-point between low and high goals.
- *High range*: For WA populations, based on EDT modeling of tributary habitat restored to properly functioning condition that is incorporated into recovery plan. (In White Salmon, high-range goal is based on EDT historical estimate because no modeling of PFC conditions is available.) For OR populations (Hood and Sandy), based on broad sense recovery goals developed by ODFW and incorporated into OR LCR recovery plan, table 10-1.

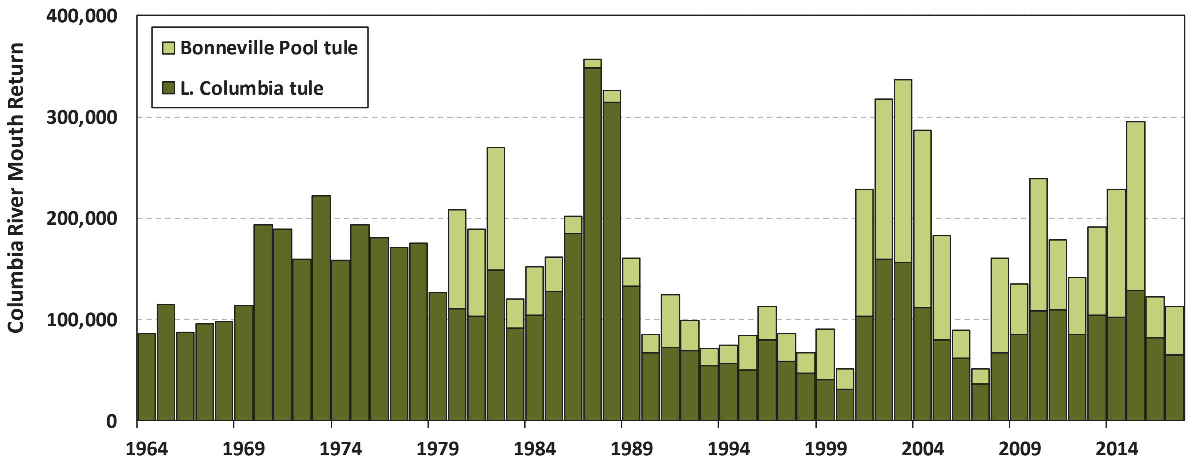
Notes - Hatchery Production

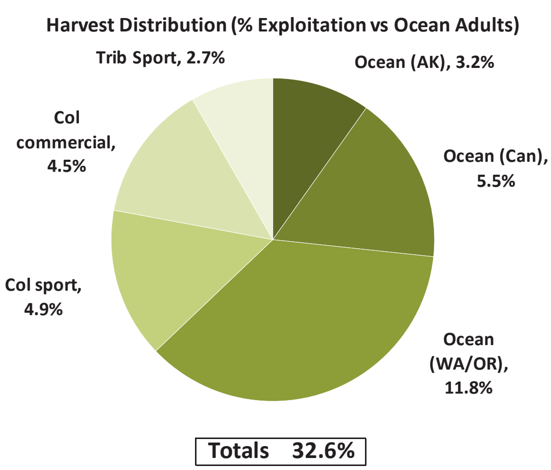
Recent hatchery reforms have reduced current production from the recent 10-year average. Hatchery run size estimates are based on production downstream from Bonneville Dam, not including terminal fisheries areas.

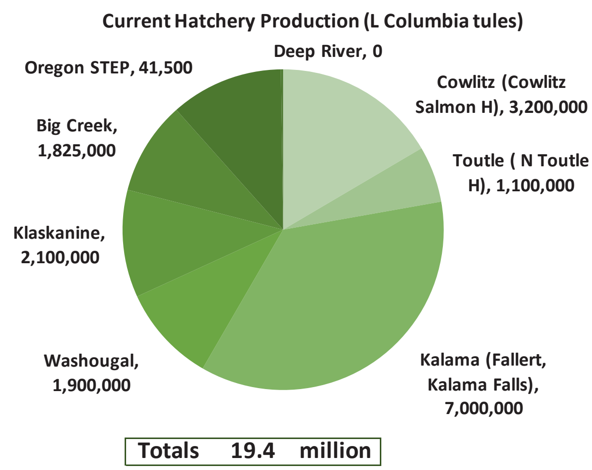
- One of three stocks, along with a spring run and a late "bright" fall stock, in the lower Columbia River Chinook ESU.
- The "tule" stock is distinguished by their dark skin coloration and advanced stage of maturation at freshwater entry.
- Spawned historically in the mainstem & large tributaries up to the Klickitat River.
- Ocean range is primarily along Washington and British Columbia coasts.
- Predominately hatchery fish at this time.











Natural Production		Abundance		Potential Goal Range		
MPG	**Population**	**Recent**	**Historical**	**Low**	**Med**	**High**
Coast Fall	Grays/Chinook	106	800	1,000	1,000	1,000
	Elochoman/Skamokawa	100	3,000	1,500	2,200	2,900
	Mill/Abernathy/Germany	71	2,500	900	1,500	2,100
	Youngs Bay	219	15,100	500	1,000	1,500
	Big Creek	24	8,800	600	1,100	1,500
	Clatskanie	5	14,400	1,300	1,500	1,700
	Scappoose	0	12,500	1,200	1,800	2,300
Cascade Fall	Lower Cowlitz	2,810	24,000	3,000	12,000	20,900
	Upper Cowlitz	2,585	28,000	2,800	5,600	11,000
	Toutle	337	11,000	4,000	6,600	9,100
	Coweeman	784	3,500	900	1,900	2,900
	Kalama	934	2,700	500	1,500	2,400
	Lewis	2,738	2,600	1,400	1,800	2,200
	Salmon	na	400	50	200	400
	Washougal	712	2,600	1,200	2,000	2,800
	Clackamas	152	22,600	1,600	3,000	4,400
	Sandy	89	6,200	1,000	1,300	1,500
Gorge Fall	Lower Gorge	124	3,200	1,600	3,400	5,100
	Upper Gorge	201	3,400	1,300	2,600	3,900
	White Salmon	300	1,000	500	700	900
	Hood	39	1,400	1,200	1,400	1,500
Totals		**12,329**	**169,700**	**28,050**	**54,100**	**82,000**

Hatchery Production				Current Production		Anticipated
Location (Program)		**Stock**	**Brood**	**No.**	**Goal**	**production**
WA tules	Deep River	LRH		0		0
	Cowlitz (Cowlitz Salmon H)	LRH		3,200,000		3,200,000
	Toutle (N Toutle H)	LRH		1,100,000		1,100,000
	Kalama (Fallert, Kalama Falls)	LRH		7,000,000		7,000,000
	Washougal	LRH		1,900,000		1,900,000
OR tules	Klaskanine	LRH		2,100,000		2,100,000
	Big Creek	LRH		1,825,000		1,825,000
	Bonneville	LRH		2,200,000	25,000	2,200,000
	Oregon STEP	LRH		41,500		41,500
	Subtotal	LRH		**19,366,500**		**19,366,500**
Tules	Bonneville Pool H (Spring Crk)	BPH	**7,000**	**10,700,000**		**10,700,000**
Brights*	Youngs R	SAB		900,000		900,000
	Klaskanine R	SAB		1,200,000		1,200,000
	Total	SAB		**2,100,000**		**2,100,000**

**Non-ESU hatchery production of fall Chinook in the lower Columbia region.*

Fisheries / Harvest		Exploitation Rate				Harvest	
	Location	**Avg (v ocn)**	**Avg (v CR)**	**Limits**	**Potential**	**10-yr avg**	**Potential**
Natural Tules (LRH)	Ocean (AK)	3.2%	--			700	
	Ocean (Can)	5.5%	--			1,200	117,000
	Ocean (WA/OR)	11.8%	--	30-41%	30-80%	2,600	
	Col sport	4.9%	6.2%			1,000	
	Col commercial	4.5%	5.7%			900	54,000
	Trib Sport	2.7%	3.4%			600	
	Total	***32.6%***	***15.3%***	***30-41%***	***30-80%***	**7,000**	171,000
Hatchery tules (LRH)	Ocean (AK)	3.2%	--			3,800	
	Ocean (Can)	5.5%	--			5,500	53,000
	Ocean (WA/OR)	11.8%	--	≤75%	≤75%	12,700	
	Col sport	5.9%	7.4%			6,800	
	Col commercial	10.1%	12.7%			11,800	20,000
	Trib Sport	6.3%	7.9%			6,300	
	Total	***42.8%***	***28.0%***	***≤75%***	***≤75%***	**46,900**	72,000
Select brights	Col sport	--	19.5%	≤75%	≤75%	2,200	2,200
	Col commercial	--	60.3%			7,700	7,700
	Total		***79.8%***	***≤75%***	***≤75%***	**9,900**	**9,900**
Bonneville Pool Hatchery	Ocean (AK)	0.0%	--			0	
	Ocean (Can)	10.0%	--			13,000	35,000
	Ocean (WA/OR)	18.2%	--			21,700	
	Col sport	3.0%	4.2%	≤75%	≤75%	3,400	
	Col commercial	10.1%	14.0%			11,900	
	Col treaty	29.2%	40.5%			35,800	52,000
	Trib Sport	0.5%	0.7%			500	
	Total	***71.0%***	***59.4%***	***≤75%***	***≤75%***	**86,300**	**87,000**

Total Return (LRH)	Recent avg. (2008-2017)	@ Goals Low	@ Goals Med	@ Goals High
@ Columbia R Mouth	**92,000**	**113,000**	**170,000**	**285,000**
Natural	16,000	37,000	94,000	209,000
Hatchery	76,000	76,000	76,000	76,000
% hatchery	83%	67%	45%	27%
Escapement	**71,000**	**82,000**	**94,000**	**109,000**
Natural	13,000	30,000	57,000	87,000
Hatchery	58,000	52,000	37,000	22,000
% hatchery	82%	63%	39%	20%
Harvest (Col basin)	**21,000**	**27,000**	**71,000**	**170,000**
Natural	2,000	6,000	34,000	117,000
Hatchery	19,000	21,000	37,000	53,000
% hatchery	91%	78%	52%	31%
Harvest (Total)	**54,000**	**56,000**	**115,000**	**243,000**
Natural	7,000	15,000	58,000	171,000
Hatchery	47,000	41,000	57,000	72,000
% hatchery	87%	73%	50%	30%

Total Return (BPH)	Recent avg. (2008-2017)	@ Goals Low	@ Goals Med	@ Goals High
@ Columbia R Mouth	**87,000**	**87,000**	**87,000**	**87,000**
Natural	0	0	0	0
Hatchery	87,000	87,000	87,000	87,000
% hatchery	100%	100%	100%	100%
Bonneville Dam	**67,000**	**67,000**	**67,000**	**67,000**
Natural	0	0	0	0
Hatchery	67,000	67,000	67,000	67,000
% hatchery	100%	100%	100%	100%
Escapement	**32,000**	**32,000**	**32,000**	**32,000**
Natural	0	0	0	0
Hatchery	32,000	32,000	32,000	32,000
% hatchery	100%	100%	100%	100%
Harvest (Col basin)	**52,000**	**52,000**	**52,000**	**52,000**
Natural	0	0	0	0
Hatchery	52,000	52,000	52,000	52,000
% hatchery	100%	100%	100%	100%
Harvest (Total)	**86,000**	**86,000**	**86,000**	**86,000**
Natural	0	0	0	0
Hatchery	86,000	86,000	86,000	86,000
% hatchery	100%	100%	100%	100%

Notes - Natural Production

One of three stocks, along with a spring run and a late "bright" fall stock, in the Lower Columbia River Chinook ESU. The "tule" stock is distinguished from lower river and upriver bright fall Chinook stocks by their dark skin coloration and advanced stage of maturation at freshwater entry. The Lower Columbia River tule run is typically distinguished for management purposes into a lower river hatchery (LRH) and Bonneville Pool Hatchery (BPH) stocks. The LRH stock includes both hatchery and natural origin fish - current returns and natural spawning escapments are dominated by hatchery-origin fish. Tules spawned historically in the mainstem and large tributaries up to the Klickitat River. The ocean range is primarily along Washington and British Columbia coasts. Status has been severely reduced by habitat degradation in spawning streams.

Distribution: Historically distributed in Coast, Cascade, and Gorge tributaries east to Hood and White Salmon Rivers. The WLCTRT identified 21 historical populations in 3 MPGs. All identified historical populations are extant, although a number have been reduced to very low levels.

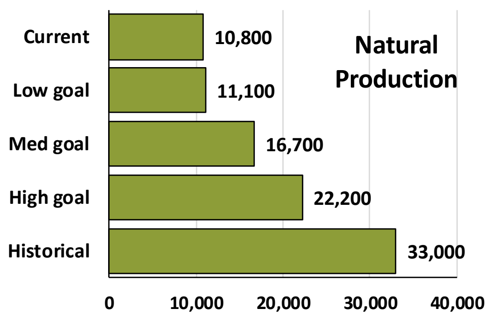
Historical abundance: Estimates from LCR recovery plan. For WA populations, historical abundance is estimated based on EDT modeling using estimated historical habitat conditions. For OR populations, ODFW developed estimates using information from NMFS status reviews and the WLCTRT. (NMFS estimates of historical kilometers of habitat for each species and population were used to apportion the ESU abundance estimate between all populations.)

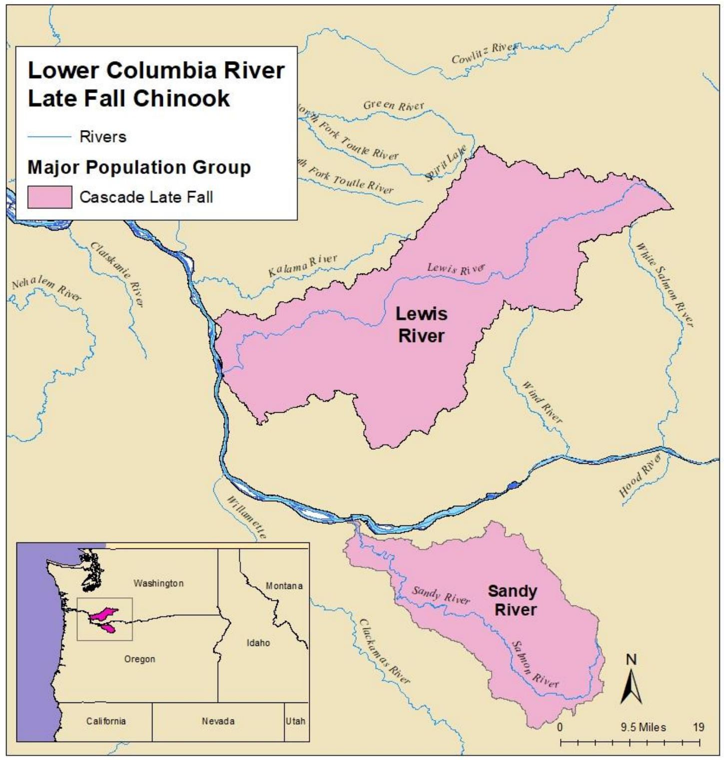
Current abundance: Based on spawning ground surveys. For Upper Cowlitz population based on natural fish trucked upstream of Cowlitz Falls Dam. For Scappoose, Lower Gorge and Salmon Creek no estimates of current abundance is available; therefore, used baseline abundance estimates from OR LCR recovery plans as current abundance.

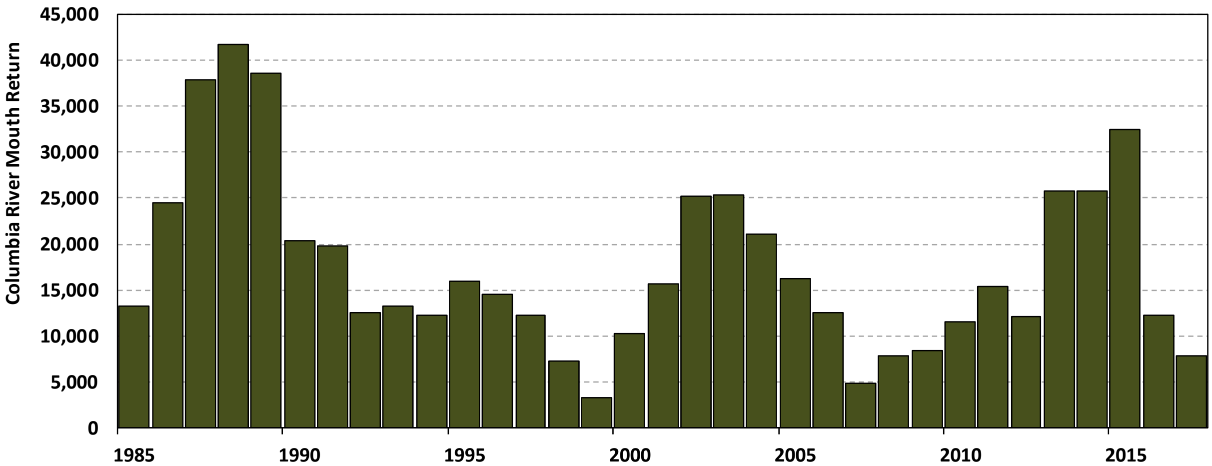
Goals:

- *Low range:* Population-specific delisting abundance target from ESA recovery plan. For Upper Cowlitz and Salmon Creek no delisting goals were established; therefore, used current abundance estimates for low goal.
- *Medium range:* Mid-point between low and high goals.
- *High range:* For WA populations, based on EDT modeling of tributary habitat restored to properly functioning condition that is incorporated into recovery plan. (In White Salmon, high-range goal is based on EDT historical estimate because no modeling of PFC conditions is available). For OR populations (Hood and Sandy), based on broad sense recovery goals developed by ODFW and incorporated into OR LCR recovery plan, table 10-1. For Upper Cowlitz high goal is three times low goal because no EDT modeling is available for this population.

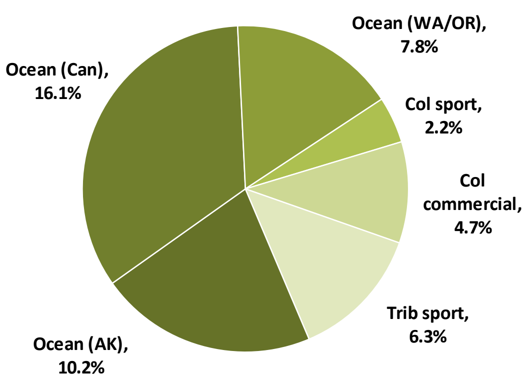
- This "bright" stock is one of three types, along with a spring run and a "tule" Fall stock, in the listed lower Columbia River Chinook ESU.
- The "late fall" stock is distinguished from the lower river tule stock by a later run timing and earlier stage of maturation at freshwater entry.
- Returns are entirely wild-origin, for this reason the stock is also referred to as Lower River Wild or LRW.







Harvest Distribution
(% Exploitation vs Ocean Adults)



Totals 47.3%

No Current Hatchery Production

Totals 0

Natural Production		Abundance		Potential Goal Range		
MPG	Population	Recent	Historical	Low	Med	High
Late Fall	North Fork Lewis	9,700	23,000	7,300	11,000	14,600
	Sandy	1,100	10,000	3,800	5,700	7,600
Totals		**10,800**	**33,000**	**11,100**	**16,700**	**22,200**

Hatchery Production		Current Production			Return	Anticipated
Location (Program)		Brood	Smolts	Fry	Goal	production
None		0	0	0	0	0
Totals		**0**	**0**	**0**	**0**	**0**

Fisheries / Harvest		Exploitation rate				Harvest	
	Location	Avg (v ocn)	Avg (v CR)	Limits	Potential	Recent	Potential
Wild/Natural	Ocean (AK)	10.2%	--	35-70%	35-70%	2,100	17,300
	Ocean (Can)	16.1%	--			3,400	
	Ocean (WA/OR)	7.8%	--			2,000	
	Col sport	2.2%	3.3%			600	9,600
	Col commercial	4.7%	7.2%			900	
	Trib sport	6.3%	9.5%			1,300	
	Total	***47.3%***	***20.0%***	***35-70%***	***35-70%***	**10,300**	**26,900**

Total Return		Recent avg (2008-2017)	@ Goals Low	Med	High
@ Columbia R Mouth		**14,500**	**14,900**	**23,700**	**33,500**
	Natural	14,500	14,900	23,700	33,500
	Hatchery	0	0	0	0
	% hatchery	0%	0%	0%	0%
Escapement		**11,700**	**12,000**	**18,100**	**24,100**
	Natural	11,700	12,000	18,100	24,100
	Hatchery	0	0	0	0
	% hatchery	0%	0%	0%	0%
Harvest (Col basin)		**2,800**	**3,000**	**5,800**	**9,600**
	Natural	2,800	3,000	5,800	9,600
	Hatchery	0	0	0	0
	% hatchery	0%	0%	0%	0%
Harvest (Total)		**10,300**	**10,700**	**18,100**	**26,900**
	Natural	10,300	10,700	18,100	26,900
	Hatchery	0	0	0	0
	% hatchery	0%	0%	0%	0%

Notes - Natural Production

This "bright" stock is one of three types, along with a spring run and a "tule" fall stock, in the listed Lower Columbia River Chinook ESU. The "late fall" stock is distinguished from the lower river tule stock by a later run timing and earlier stage of maturation at freshwater entry. In the ocean this stock is subject to harvest from Southeast Alaska south to the Columbia River. The Lewis River population is among the most productive Chinook stocks in the Columbia Basin. Returns are entirely wild-origin - for this reason the stock is also referred to as "Lower River Wild or LRW".

Distribution: The WLCTRT identified two historical populations – the Sandy River Basin in Oregon and the Lewis River Basin in Washington. Both populations are extant.

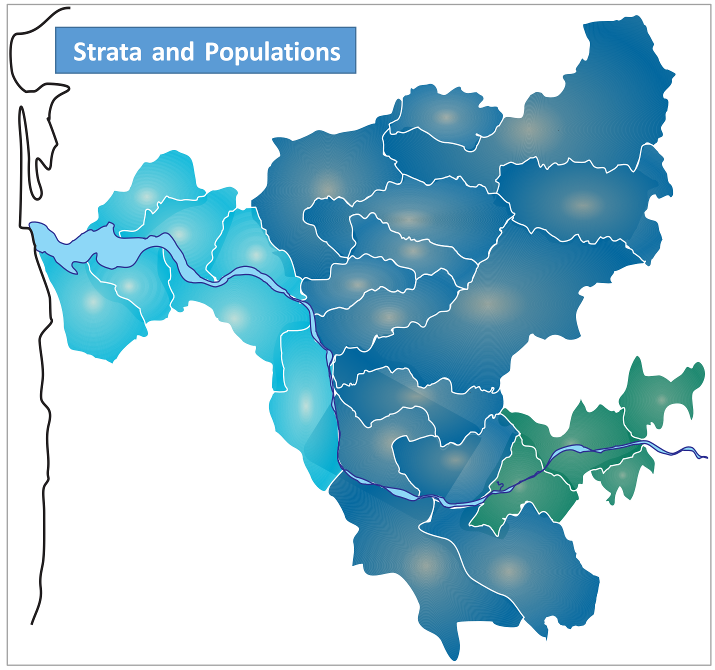
Historical abundance: For the Washington population (Lewis River), the estimate of historical abundance is based on EDT modeling using estimated historical habitat conditions. For the Oregon population (Sandy River), ODFW developed estimates using information from NMFS status reviews and the WLCTRT. (NMFS estimates of historical kilometers of habitat for each species and population were used to apportion the ESU abundance estimate between all populations.)

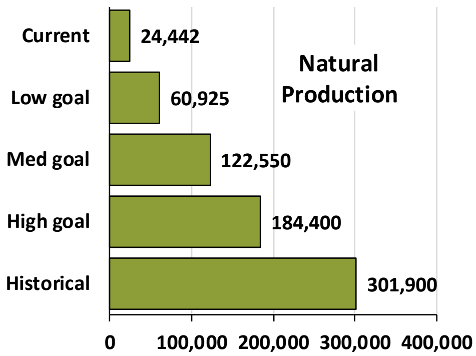
Current abundance: Based on spawning ground surveys for both populations.

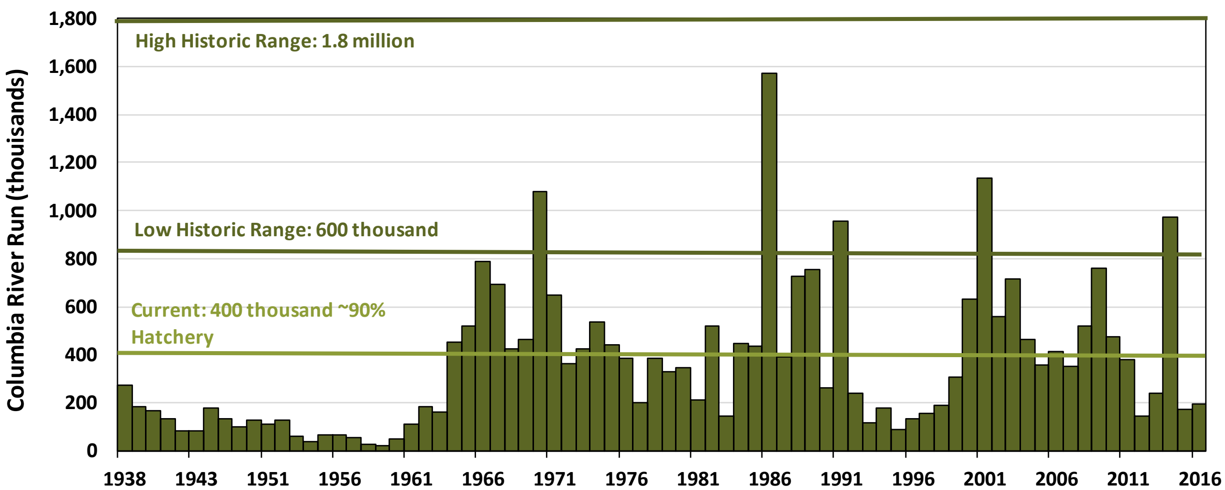
Goals:

- *Low range*: Population-specific delisting abundance target from ESA recovery plan.
- *Medium range*: Midpoint between low-range and high-range goals for both populations.
- *High range*: For Sandy, 4000 (which is rounded up from BROAD SENSE RECOVERY GOAL identified in ODFW recovery plan). For both populations, doubled low goal as a placeholder.

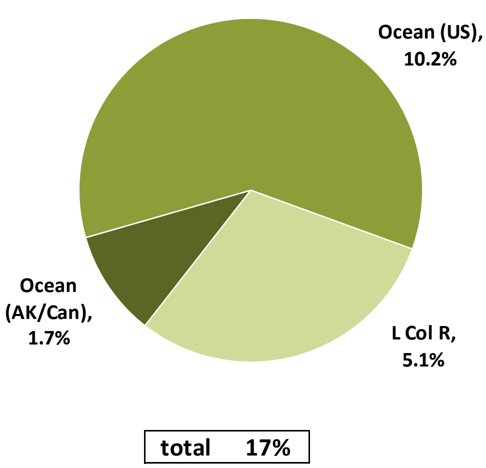
- Currently inhabits low to moderate elevation streams throughout accessible portions of the lower Columbia.
- ESA-listed coho occur from the Columbia River Gorge downstream.
- Current runs are mostly hatchery origin.
- Significant natural populations occur in some streams.



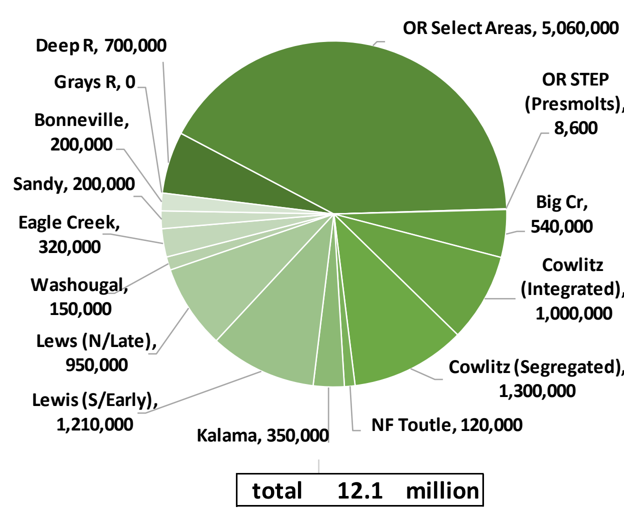




Current Fishery Distribution
(Wild/Natural Exploitation Rate)



Hatchery Releases



Natural Production		Abundance		Potential Goal Range		
MPG	Population	Recent	Historical	Low	Med	High
Coast	Grays	399	3,800	2,400	3,100	3,800
	Eloch/Skam	439	6,500	2,400	4,100	5,800
	Mill/Aber/Germ	605	2,800	1,800	2,400	3,000
	Youngs	79	18,600	75	6,000	11,900
	Big	349	10,800	350	3,300	6,300
	Clatskanie	867	16,800	3,200	6,400	9,600
	Scappoose	629	22,200	3,200	3,700	4,200
Cascade	L. Cowlitz	4,423	18,000	3,700	9,700	15,700
	Coweeman	2,046	5,000	1,200	3,700	6,200
	SF Toutle	1,792	27,000	1,900	3,000	4,100
	NF Toutle	1,483		1,900	3,000	4,100
	U Cowlitz	867	18,000	2,000	12,800	23,600
	Cispus		8,000	2,000	3,700	5,400
	Tilton	2,228	5,600	2,200	2,700	3,200
	Kalama	18	800	500	750	1,000
	NF Lewis	917	40,000	500	10,750	21,000
	EF Lewis	912	3,000	2,000	2,650	3,300
	Salmon	1,244	5,300	1,200	2,900	4,600
	Washougal	331	3,000	1,500	2,450	3,400
	Sandy	1,393	19,600	5,700	6,100	6,500
	Clackamas	3,023	52,600	11,200	14,450	17,700
Gorge	L. Gorge	259	4,700	2,900	5,800	8,800
	U. Gorge	140	9,800	7,100	9,100	11,200
	Hood					
	Subtotal	**24,442**	**301,900**	**60,925**	**122,550**	**184,400**
Other	Willamette*	7,082	0	7,000	7,000	7,000
Total		**31,524**	**301,900**	**67,925**	**129,550**	**191,400**

** Not part of Listed ESU*

Fisheries / Harvest		Exploitation rate				Harvest	
	Location	Avg (v ocn)	Ave (v CR)	Limits	Potential	10-yr avg	Potential
Natural	Ocean (AK/Can)	1.7%	--	<10-30%	<10-50%	500	32,000
	Ocean (US)	10.2%	--			3,000	
	L Col R	5.1%	5.7%			2,000	70,000
	Total	***17.0%***	***5.7%***	***<10-30%***	***<10-50%***	***39,110***	***102,000***
Hatchery	Ocean (AK/Can)	0.7%	--	≤70%	≤70%	2,000	25,000
	Ocean (US)	18.4%	--			58,000	
	L Col R	34.1%	42.7%			106,000	192,000
	Total	***53.2%***	***42.7%***	***≤70%***	***≤70%***	**166,000**	***217,000***

Hatchery Production	Current Production		Return	Anticipated
Location (Program)	Brood	Yearlings	goal	production
Grays R		0		0
Deep R		700,000		700,000
Elochoman		0		150,000
OR Select Areas		5,060,000		5,060,000
OR STEP (Presmolts)		8,600		9,000
Big Cr		540,000		700,000
Cowlitz (Integrated)		1,000,000		1,000,000
Cowlitz (Segregated)		1,300,000		1,200,000
NF Toutle		120,000		120,000
Kalama		350,000		350,000
Lewis (S/Early)		1,210,000		1,100,000
Lews (N/Late)		950,000		900,000
Washougal		150,000		100,000
Eagle Creek		320,000		350,000
Sandy		200,000		300,000
Bonneville		200,000		200,000
Subtotal (Yearlings)		**12,100,000**		**12,230,000**
Subtotal (Presmolts)		**8,600**		**9,000**

Total Return		Abundance	@ Goals		
		recent	Low	Med	High
@ Columbia R Mouth		**408,000**	**457,000**	**586,000**	**806,000**
	Natural	34,000	83,000	212,000	432,000
	Hatchery	374,000	374,000	374,000	374,000
	% hatchery	92%	81.8%	0.0%	46.4%
Harvest (Total)		**230,000**	**259,000**	**360,000**	**562,000**
	Natural	5,000	13,000	75,000	238,000
	Hatchery	225,000	246,000	285,000	324,000
	% hatchery	98%	95%	79%	58%

L Col stock		Abundance	@ Goals		
		recent	Low	Med	High
@ Columbia R Mouth		**280,000**	**329,000**	**431,000**	**555,000**
	Natural	34,000	83,000	185,000	309,000
	Hatchery	246,000	246,000	246,000	246,000
	% hatchery	88%	75%	57%	44%
Escapement		**172,000**	**206,000**	**249,000**	**292,000**
	Natural	32,000	79,000	158,000	238,000
	Hatchery	140,000	127,000	91,000	54,000
	% hatchery	81%	62%	37%	18%
Harvest (L Col basin)		**108,000**	**124,000**	**182,000**	**262,000**
	Natural	2,000	5,000	26,000	70,000
	Hatchery	106,000	119,000	156,000	192,000
	% hatchery	98%	96%	86%	73%
Harvest (Total)		**171,000**	**157,000**	**226,000**	**319,000**
	Natural	5,000	13,000	45,000	102,000
	Hatchery	166,000	144,000	181,000	217,000
	% hatchery	97%	92%	80%	68%

Notes - Natural Production

Currently inhabit low to moderate elevation streams throughout the accessible portion of the Lower Columbia. ESA-listed Coho occur from the Columbia River Gorge downstream - most populations are at very low viability. Coho were largely extirpated upstream from The Dalles Dam but has since been reintroduced. Ocean distribution is mainly Oregon and Washington coasts where they are subject to variable marine upwelling influences and local fisheries. Current runs are predominately hatchery origin.

Distribution: Listed LCR coho ESU historically spawned in Coast, Cascade, and Gorge ecoregions. All 24 identified historical populations are extant. (Also historically returned to tributaries throughout Middle Columbia, Upper Columbia, and Snake. These populations have been largely extirpated. Reintroduction efforts are underway, and they are treated here as a separate stock – see Upriver Coho). Coho salmon did not historically occur upstream from Willamette Falls. Hatchery fish were historically planted upstream but plants have been discontinued. A natural-producing population has became established because the fish ladder at Willamette Falls now provides passage. This population is not administratively considered part of the listed ESU because it is outside the historical range.

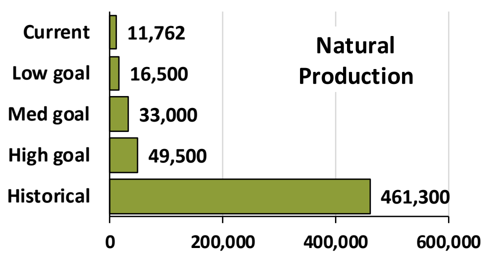
Historical abundance: For all WA populations, historical abundance is estimated based on EDT modeling of estimated historical habitat conditions. For OR populations, historical abundance came from ODFW recovery plan. Historical estimates not available for some populations.

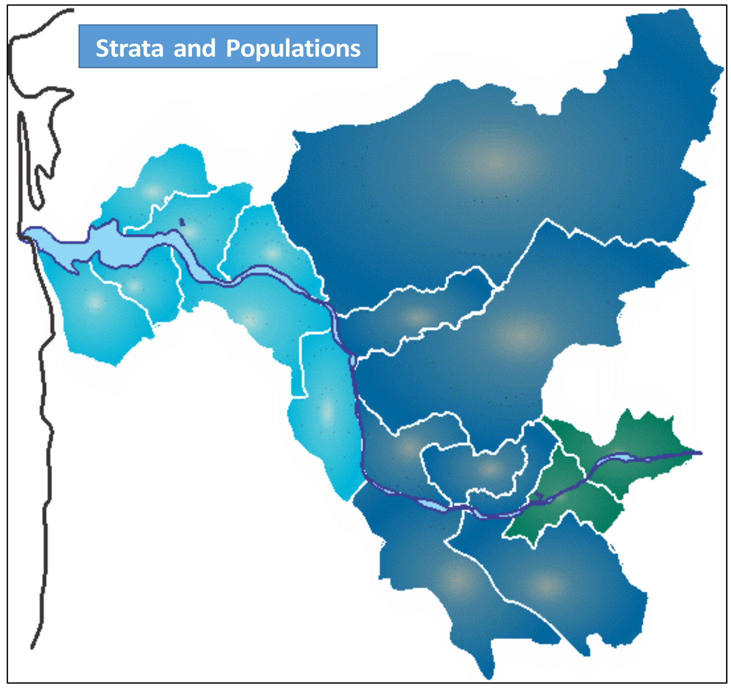
Current abundance: Based on spawning ground surveys and/or tributary dam counts.

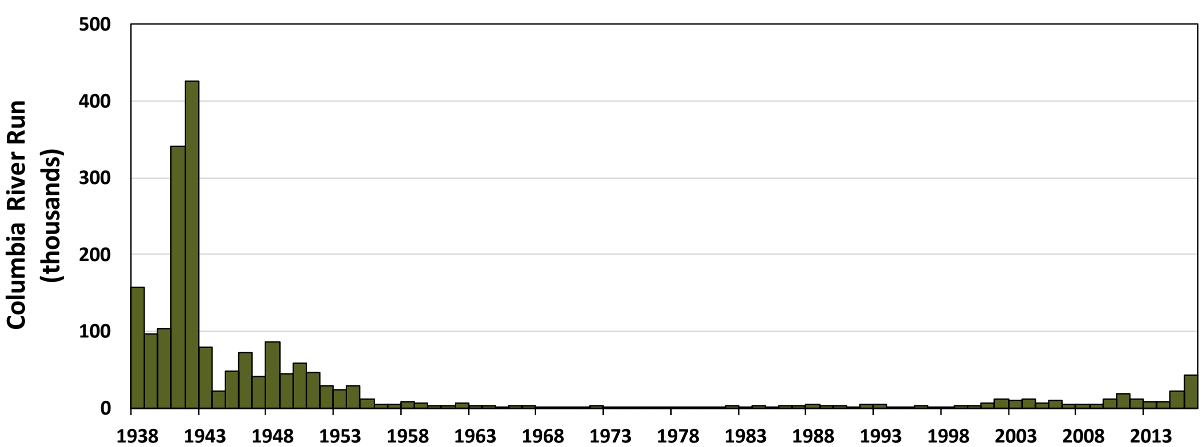
Goals:

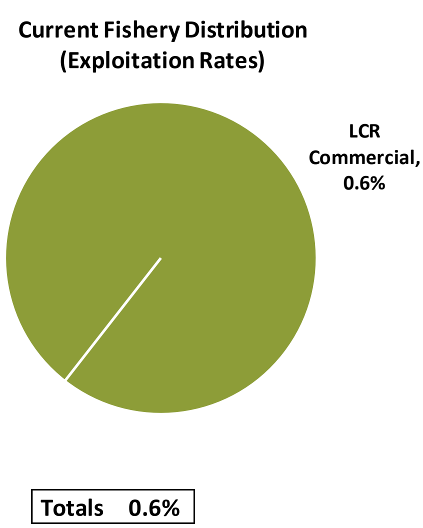
- *Low range*: Population-specific delisting abundance target from ESA recovery plan. For Youngs Bay, Big Creek, Tilton River and Salmon Creek populations, at the time of completion of the OR and WA recovery plans abundance estimates did not exist or significantly underestimated actual abundance. Subsequently, additional data have become available, and for the purpose of the CBP this data have been used to establish the low goals for these four populations. Low goals are based on current abundance estimates developed using spawning ground survey methodology. The recovery scenario did not identify abundance goals for WA LCR coho populations designated as "stabilizing." The stabilizing designation signifies that under the recovery scenario, the goal is to maintain these populations at their current risk status and not to improve their status. Where more recent monitoring information is available regarding current abundance of these stabilizing populations than was available during recovery plan development, the current abundance estimates are incorporated into the CBP Task Force recommendations as the low-range natural production abundance goal. Those targets are not included in the ESA recovery plan, and do not represent delisting abundance targets.
- *Medium range*: Mid-point between low and high goals.
- *High range*: For WA populations, based on EDT modeling of tributary habitat restored to properly functioning condition. For OR populations, based on OR LCR recovery plan BROAD SENSE RECOVERY GOALs, table 10-1. For Tilton River and Salmon Creek populations high goal is three times low goal because EDT modeling is not available for this population. For the Clatskanie population tripled lo goal as a placeholder, because broad sense goal in OR recovery plan showed no improvement from delisting goal.

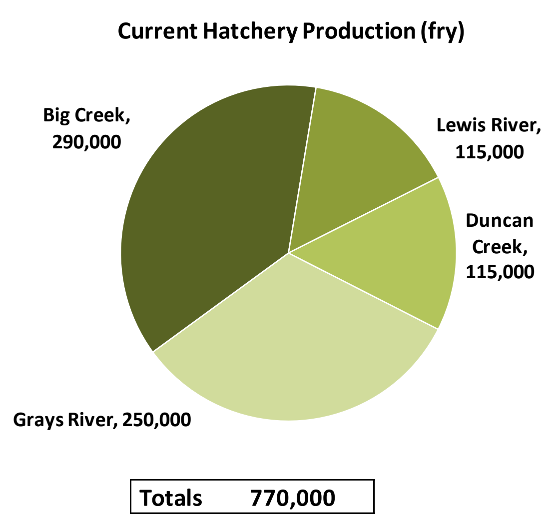
- Historically spawned in lower reaches of streams and the mainstem downstream from Celilo Falls.
- Juveniles migrate seaward as fry soon after emergence from the gravel in late winter and early spring.
- Chum have declined to very low levels consisting of a few small remnant populations.
- Hatchery production is limited to small-scale supplementation efforts.











Natural Production		Abundance		Potential Goal Range		
MPG	Population	Recent	Historical	Low	Med	High
Coast	Grays	6,766	10,000	1,600	3,200	4,800
	Eloch/Skam	200	16,000	1,300	2,600	3,900
	Mill/Aber/Germ	100	7,000	1,300	2,600	3,900
	Youngs	15	9,000	2,500	5,000	7,500
	Big	299	5,000			
	Clatskanie	3	6,000			
	Scappoose	0	500			
Cascade	Cowlitz	300	195,000	1,800	3,600	5,400
	Kalama	100	21,000	900	1,800	2,700
	Lewis	100	125,000	1,300	2,600	3,900
	Salmon	100	4,000	100	200	300
	Washougal / I205	1,911	18,000	1,300	2,600	3,900
	Clackamas	0	12,000	500	1,000	1,500
	Sandy	0	14,000	1,000	2,000	3,000
Gorge	Lower gorge	1,787	7,800	2,000	4,000	6,000
	Upper gorge	81	11,000	900	1,800	2,700
Totals		**11,762**	**461,300**	**16,500**	**33,000**	**49,500**

Artificial Production	Current Production			Return	Anticipated
Location (Program)	Brood	Smolts	Fry	Goal	production
Grays River	178	0	250,000		250,000
Big Creek	--	0	290,000		290,000
Lewis River	88	0	115,000		115,000
Duncan Creek	54	0	115,000		115,000
Totals	**320**	**0**	**770,000**		**770,000**

Fisheries / Harvest		Exploitation rate			Harvest	
	Location	Avg.	Limits	Potential	Recent	Potential
Natural	Ocean	--	--	--	--	--
	Freshwater	0.6%	<5%	10-30%	80	40%
	Total	***0.6%***	***<5%***	***10-30%***	***--***	***40%***

Total Return		Recent avg. (2008-2017)	@ Goals Low	Med	High
@ Columbia R Mouth		**15,000**	**21,000**	**51,000**	**102,000**
	Wild/Natural				
	Hatchery				
	% hatchery				
To Mid Col R (BON)		**100**	**140**	**340**	**680**
	Wild/Natural				
	Hatchery				
	% hatchery				
Escapement		**15,000**	**20,000**	**41,000**	**61,000**
	Wild/Natural				
	Hatchery				
	% hatchery				
Harvest (Col mainstem)		**80**	**100**	**10,000**	**41,000**
	Wild/Natural				
	Hatchery				
	% hatchery				

Notes - Natural Production

Historically spawned in lower reaches of streams and the mainstem downstream from Celilo Falls. Chum need clean gravel beds and intergravel flow or upwelling for successful spawning and incubation. Juveniles migrate seaward as fry soon after emergence from the gravel in late winter and early spring. Chum have declined to very low levels consisting of a few small remnant populations. Causes are loss of critical stream habitats due to watershed and stream alteration. Hatchery production is limited to small-scale supplementation efforts.

Distribution: The WLCTRT identified 17 historical populations spawning in Coast, Cascade, and Gorge tributaries up to the White Salmon River in WA and the Hood River in OR, but anecdotal information indicates historical distribution up to Celilo Falls. Most identified historical populations are extirpated or nearly so, with most natural production at present occurring in the Grays/Chinook and Lower Gorge populations.

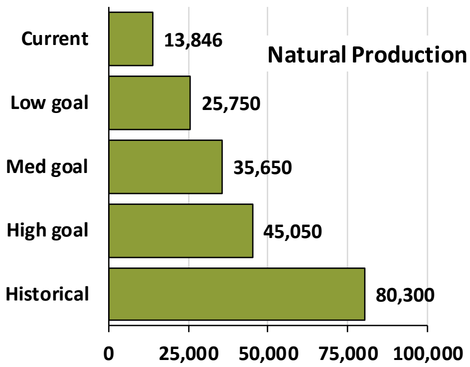
Historical abundance: A total estimate, based on fishery landings, of 900,000 has been reported by the NPCC. Population-specific estimates of historical abundance are available only for WA populations, and are based on EDT modeling of estimated historical habitat conditions. For OR population, historical estimates not available.

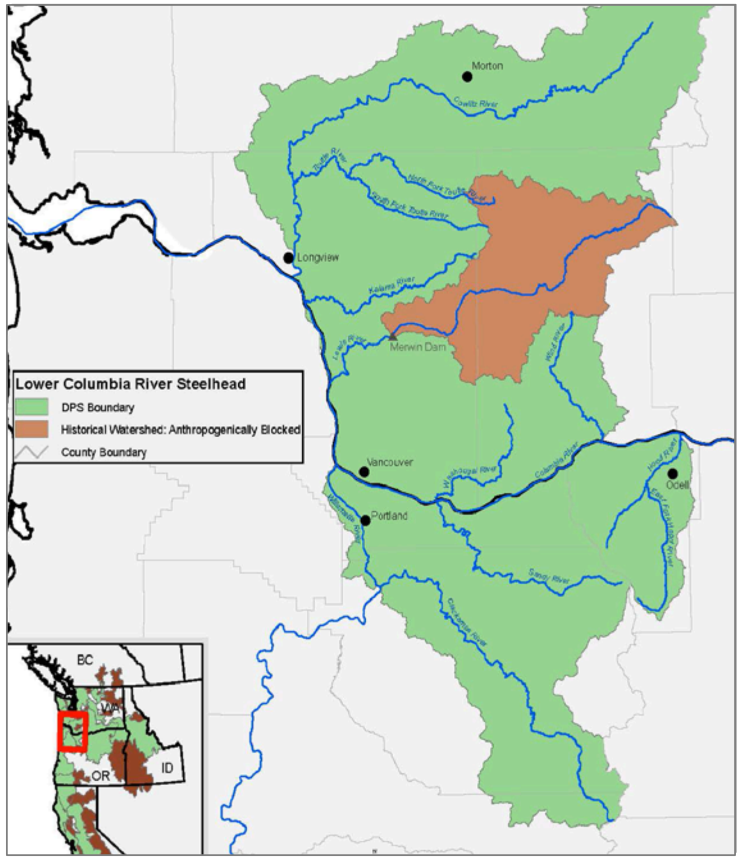
Current abundance: Based on spawning ground surveys (targeted spawning surveys take place on the Grays, Lower Lewis, Mainstem Columbia above I205, and Lower Gorge tributaries); in other tributaries, chum would be observed during fall Chinook surveys.

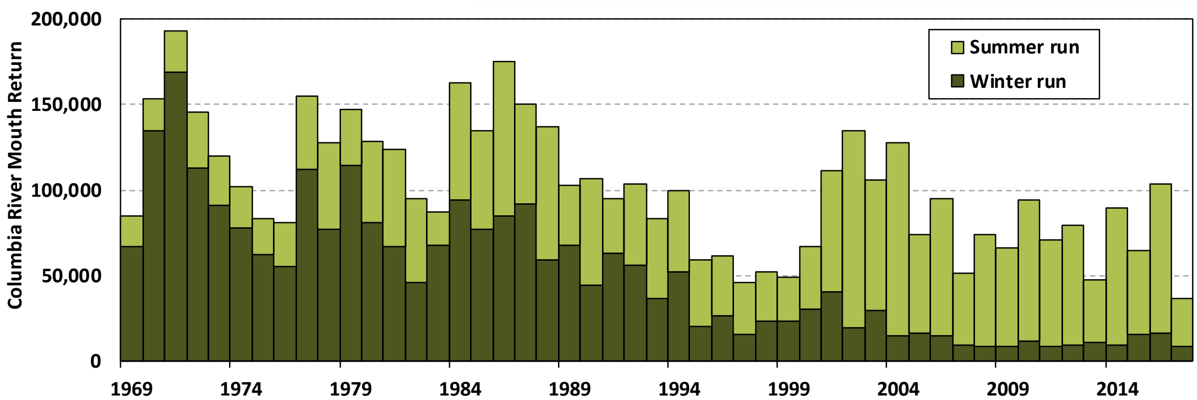
Goals:

- *Low range*: Population-specific delisting abundance target from ESA recovery plan. (Note: ODFW did not identify abundance goals for OR chum populations in its LCR recovery plan, but NOAA Fisheries did in the ESU-level plan, based on McElhany et al. ICTRT). For Salmon Creek population no delisting goal is established; therefore, the baseline abundance from the WA recovery plan is used as the low goal.
- *Medium range*: Midpoint between low and high goals.
- *High range*: White paper on high-range goals for chum salmon (developed for CBP process by Lower Columbia regional technical team members).

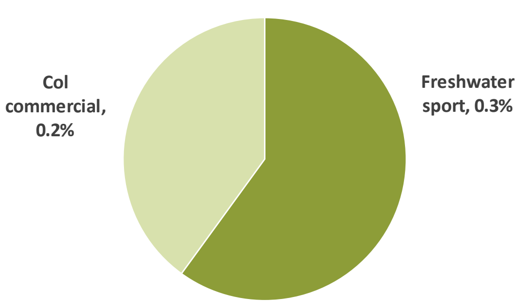
- Spawns in tributaries of the Cascades from the Cowlitz to the Hood River.
- Oregon and Washington populations (all winter run) in downstream tributaries are in a different ESU (Southwest Washington).
- Extirpated from the upper Cowlitz and Lewis Rivers where they are being reintroduced.
- Sport fisheries focus on marked hatchery fish in tributary streams. No directed commercial harvest.





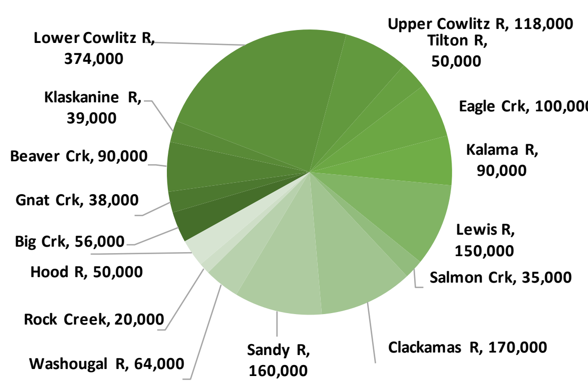


Harvest Distribution (Wild/Natural Exploitation Rate



Totals 0.5%

Current Hatchery Production (Winter Run)



Totals 1.4 million

LOWER COLUMBIA Steelhead ▪ ESA: Threatened ▪ Life History: Winter/Summer run, Stream rearing

Natural Production			Abundance		Potential Goal Range		
MPG	Population	State	Recent	Historical	Low	Med	High
Coast Winter (SW WA ESU)	Grays/Chinook	WA	609	1,600	800	1,400	1,900
	Elochoman/Skamokawa	WA	552	1,100	600	900	1,100
	Mill/Abernathy/Germany	WA	357	900	500	900	1,200
	Youngs Bay	OR	2,500	10,400	4,700	6,100	7,400
	Big Creek	OR	1,100	6,100	3,200	4,800	6,400
	Clatskanie	OR	769	9,400	4,000	6,000	8,000
	Scappoose	OR	102	12,400	5,200	7,800	10,400
SW WA ESU total			**5,989**	**41,900**	**19,000**	**27,900**	**36,400**
Cascade Winter	Lower Cowlitz	WA	350	1,400	400	900	1,400
	Upper Cowlitz	WA	268	1,400	500	1,000	1,400
	Cispus	WA		1,500	500	800	1,000
	Tilton	WA	222	1,700	200	700	1,100
	Toutle SF	WA	542	3,600	600	3,000	4,800
	Toutle NF	WA	628		600		
	Coweeman	WA	532	900	500	800	1,000
	Kalama	WA	911	800	600	800	1,000
	Lewis NF	WA	150	8,300	400	1,700	3,000
	Lewis EF	WA	504	900	500	800	1,100
	Salmon	WA	50	500	50	100	200
	Clackamas	OR	2,314	21,200	10,700	12,200	13,600
	Sandy	OR	2,160	11,700	1,500	1,800	2,100
	Washougal	WA	443	800	350	600	900
Gorge Winter	L Gorge	OR-WA	750	2,100	1,200	1,600	2,000
	U Gorge	OR-WA	351	600	400	500	600
	Hood	OR	419	3,800	2,100	2,500	2,900
Cascade Summer	Kalama	WA	513	1,000	500	800	1,000
	Lewis NF	WA	150	6,500	150	300	450
	Lewis EF	WA	762	600	500	550	600
	Washougal	WA	684	2,200	500	700	900
Gorge Summer	Wind	WA	724	5,000	1,000	1,200	1,400
	Hood	OR	419	3,800	2,000	2,300	2,600
LCR ESU	**Winter**		**10,594**	**61,200**	**21,100**	**29,800**	**38,100**
	Summer		**3,252**	**19,100**	**4,650**	**5,850**	**6,950**
	All		**13,846**	**80,300**	**25,750**	**35,650**	**45,050**

Fisheries / Harvest		Exploitation rate				Harvest	
	Location	Avg (v ocn)	Avg (v CR)	Goal	Potential	Recent	Potential
LCR Winter (natural)	Ocean	0.0%	--	--	--	--	--
	Freshwater sport	0.3%	0.3%	<2.0%	10-40%	30	35,000
	Col commercial	0.2%	0.2%			24	
	Total	***0.5%***	***0.5%***	***<2.0%***	***10-40%***	**54**	35,000
LCR Winter (hatchery)	Ocean	0.0%	--	--	--	--	--
	Freshwater sport	58.0%	**58.0%**	≤70%	≤70%	820	53,000
	Col commercial	**0.2%**	**0.2%**			0	
	Total	***58.2%***	***58.2%***	***≤70%***	***≤70%***	**820**	**53,000**
LCR Summer (natural)	Ocean	0.0%	--	--	--	--	--
	Freshwater sport	0.4%	0.4%	<2.0%	10-40%	11	3,000
	Col commercial	0.1%	0.1%			4	
	Total	***0.5%***	***0.5%***	***<2.0%***	***10-40%***	**15**	**3,000**
LCR Summer (hatchery)	Ocean	0.0%	--	--	--	--	--
	Freshwater sport	**55.0%**	**55.0%**	≤70%	≤70%	2,060	31,000
	Col commercial	0.1%	0.1%			40	
	Total	***55.1%***	***55.1%***	***≤70%***	***≤70%***	**2,100**	**31,000**

Artificial Production		Current Production			Return	Anticipated
Location (Program)		Brood	Smolts	Fry	Goal	production
Winter (SWW)	Big Crk		56,000			56,000
	Gnat Crk		38,000			38,000
	Beaver Crk		90,000			90,000
	MAG		0			0
	Klaskanine R		39,000			39,000
	Subtotal		**223,000**			**223,000**
Winter run (LCR)	Coweeman R		0			0
	Lower Cowlitz R		374,000			374,000
	Upper Cowlitz R		118,000			118,000
	Tilton R		50,000			50,000
	Eagle Crk		100,000			100,000
	Kalama R		90,000			90,000
	Lewis R		150,000			150,000
	Salmon Crk		35,000			35,000
	Clackamas R		170,000			170,000
	Sandy R		160,000			160,000
	Washougal R		64,000			64,000
	Bonneville Res.		0			0
	Rock Creek		20,000			20,000
	Hood R		50,000			50,000
	Subtotal		**1,381,000**			**1,381,000**
Summer run (LCR)	Clackamas R		160,000			160,000
	Cowlitz R		640,000			640,000
	Beaver Crk		31,000			31,000
	Kalama R		83,000			83,000
	Lewis R		235,000			235,000
	Sandy R		75,000			75,000
	Toutle		20,000			20,000
	Washougal R		63,000			63,000
	L White Salmon		0			0
	Hood		0			0
	Subtotal		**1,307,000**			**1,307,000**

Total Return		Abundance	@ Goals		
		Recent	Low	Med	High
LCR / SWW Winter	**@ Columbia R Mouth**	**44,000**	**49,000**	**62,000**	**77,000**
	Natural	11,000	21,000	34,000	49,000
	Hatchery	33,000	28,000	28,000	28,000
	% hatchery	75%	57%	45%	36%
	Escapement	**24,000**	**32,000**	**39,000**	**44,000**
	Natural	10,000	20,000	29,000	36,000
	Hatchery	14,000	12,000	10,000	8,000
	% hatchery	58%	38%	26%	18%
	Harvest (Col basin)	**19,500**	**17,000**	**23,000**	**31,000**
	Natural	500	1,000	5,000	12,000
	Hatchery	19,000	16,000	18,000	19,000
	% hatchery	97%	94%	78%	61%
LCR Summer	**@ Columbia R Mouth**	**47,000**	**50,000**	**52,000**	**55,000**
	Natural	3,000	4,000	6,000	9,000
	Hatchery	44,000	46,000	46,000	46,000
	% hatchery	94%	92%	89%	84%
	Escapement	**23,000**	**25,000**	**22,000**	**20,000**
	Natural	3,000	4,000	5,000	6,000
	Hatchery	20,000	21,000	17,000	14,000
	% hatchery	87%	84%	77%	70%
	Harvest (Col basin)	**24,200**	**25,250**	**30,000**	**35,000**
	Natural	200	250	1,000	3,000
	Hatchery	24,000	25,000	29,000	32,000
	% hatchery	99%	99%	97%	91%

Notes - Natural Production

Winter Steelhead

This stock spawns throughout Columbia River tributaries of the Cascades from the Cowlitz to the Hood River. Oregon and Washington populations (all winter run) in dowmstream tributaries are in a different ESU (Southwest Washington). Wide distribution in the high seas of the North Pacific Ocean where they are are seldom caught in marine fisheries. Limited sport fisheries in freshwater, primarily focused on marked hatchery fish in tribtary streams. No directed commercial harvest (small incidental impacts only). Populations in the Upper Cowlitz and Lewis Rivers, where they were extirpated by dams, are being reintroduced.

Distribution: This stock includes the 17 winter-run populations in the LCR Steelhead DPS plus the Columbia Basin portion of the unlisted the Southwest Washington DPS. The populations in the LCR DPS historically spawned in tributaries in the Cascade and Gorge ecoregions. While all identified historical populations are extant, access to historical spawning habitat in the Cowlitz and Lewis populations has been limited by tributary dams. The unlisted SW Washington DPS includes populations spawning in Columbia Basin tributaries downstream of the Cowlitz River – those populations are extant.

Historical abundance: For all WA populations (listed and listed), historical abundance is estimated based on EDT modeling of estimated historical habitat conditions. For OR populations, historical abundance estimates came from the ODFW recovery plan. Historical estimates not available for some populations.

Current abundance: Based on spawning ground surveys and/or tributary dam counts for most Washington populations. Oregon populations plus Colwitz, Salmon Creek, Lower Gorge and Upper Gorge populations are based on baseline abundance estimates identified in the Oregon and Washington recovery plans. (current average abundances are from ESA recovery plan and will be updated).

Goals:

- *Low range*: For listed populations, population-specific delisting abundance target from ESA recovery plan. For unlisted WA populations, the Lower Columbia Fish Recovery Board plan for SW Washington plan identifies minimum viability goals. For unlisted OR populations, low-range goals are based on Delisting Abundance estimates produced by the Scenario Analysis utilized in the OR recovery plan. For Salmon Creek population no delisting goal is established; therefore, the baseline abundance from the WA recovery plan is used as the low goal.
- *Medium range*: Mid-point between low and high goals.
- *High range*: For WA populations, based on EDT modeling of tributary habitat restored to properly functioning condition. For OR populations, based on OR LCR recovery plan broad sense recovery goals, table 10-1. For Youngs Bay, Big Creek, Clatskanie and Scappoose populations doubled low goal as a placeholder, because broad sense goal in OR recovery plan showed no improvement from delisting goal. For Salmon Creek population low goal is four times low goal because not EDT modeling is available for this population.

Summer Steelhead

Distribution: This stock includes 6 historical populations that spawned in tributaries in the Cascade and Gorge ecoregions. While all identified historical populations are extant, access to historical spawning habitat in the Lewis population has been limited by tributary dams.

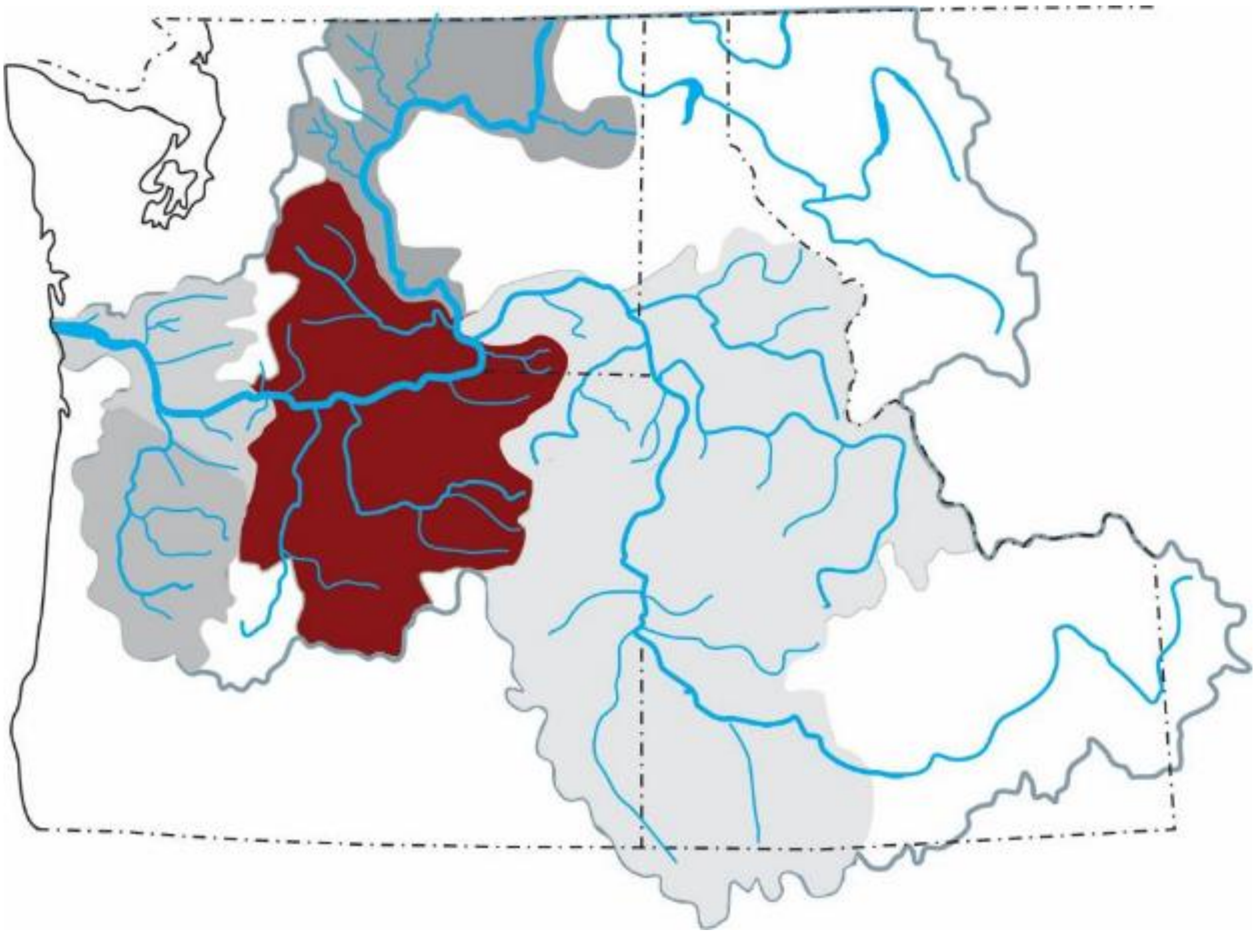
Historical abundance: For all WA populations, historical abundance is estimated based on EDT modeling of estimated historical habitat conditions. For OR populations, historical abundance came from ODFW recovery plan. Historical estimates not available for some populations.

Current abundance: Based on spawning ground surveys, tributary dam counts, and mark-recapture methods (current average abundances are from ESA recovery plan and will be updated). Current abundance data are not available for Hood and North Fork Lewis populations; therefore, abundance estimates from the OR (current abundance) and WA (baseline abundance) estimates were used.

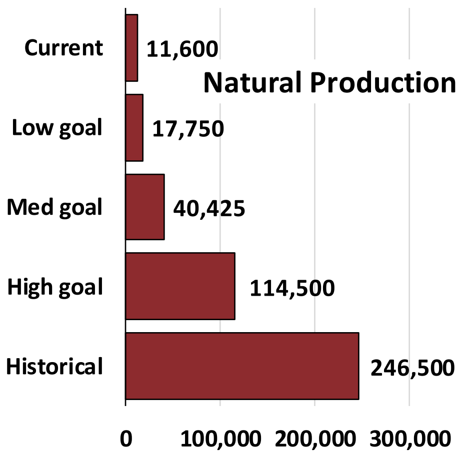
Goals:

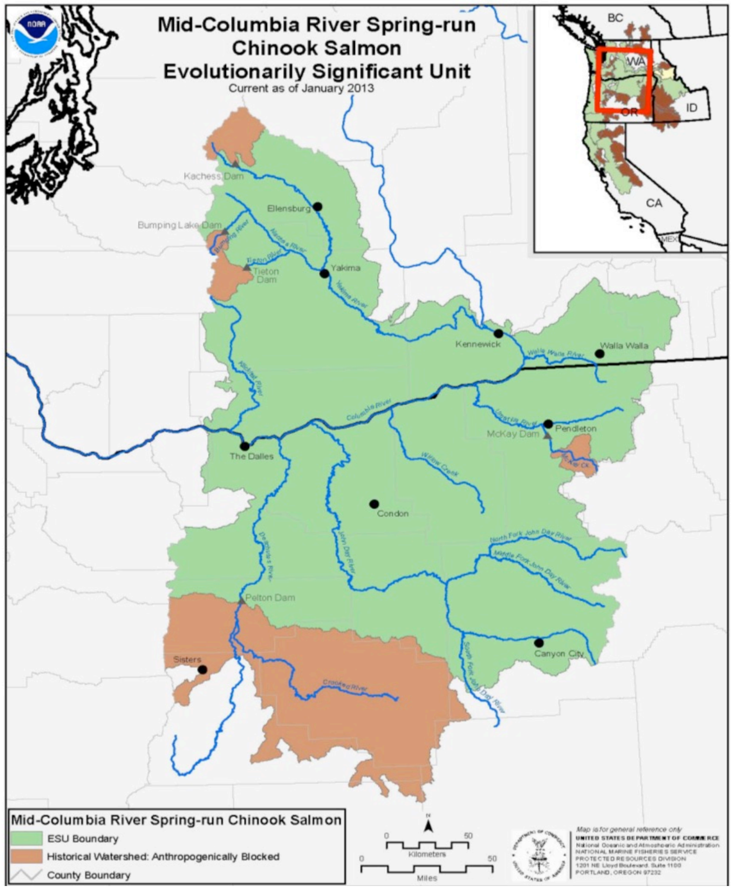
- *Low range*: Population-specific delisting abundance target from ESA recovery plan. No delisting goal is established for North Fork Lewis population; therefore, baseline abundance estimate from WA recovery plan is used as the low goal.
- *Medium range*: Mid-point between low and high goals.
- *High range*: For WA populations, based on EDT modeling of tributary habitat restored to properly functioning condition. For OR populations, based on OR LCR recovery plan broad sense recovery goals, table 10-1. For North Fork Lewis high goal is three times low goal.

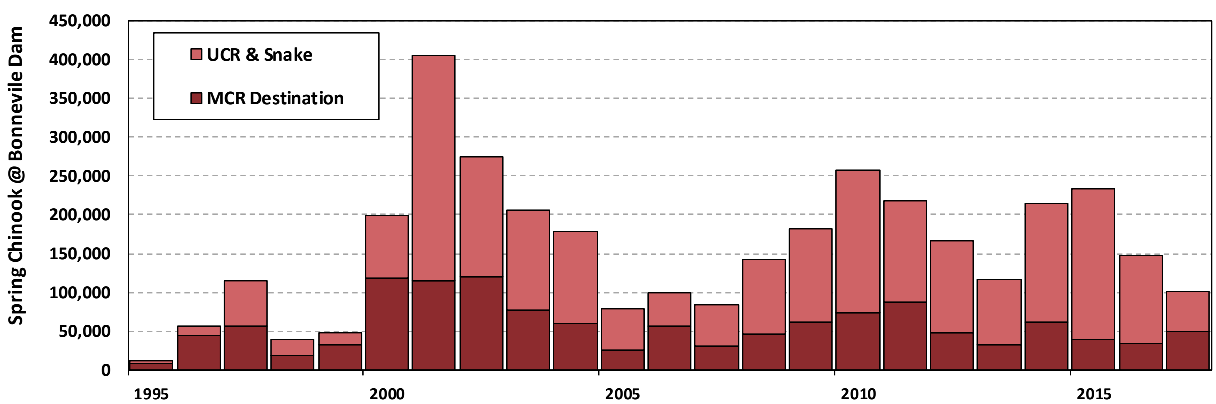
MID-COLUMBIA



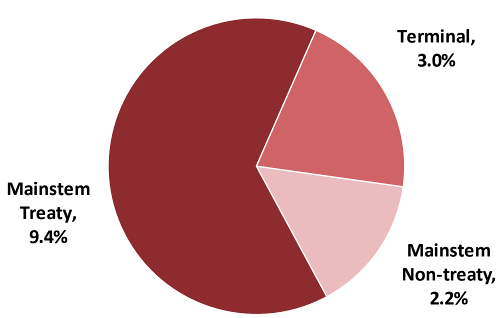
- Inhabits mid to high elevation streams draining the eastern Cascades and west Blue Mountains.
- One ofthe healthiest spring Chinooks in the basin with several viable or moderately viable populations.
- Limited hatchery production.
- Several populations that were historically extirpated by tributary dams are being reintroduced.





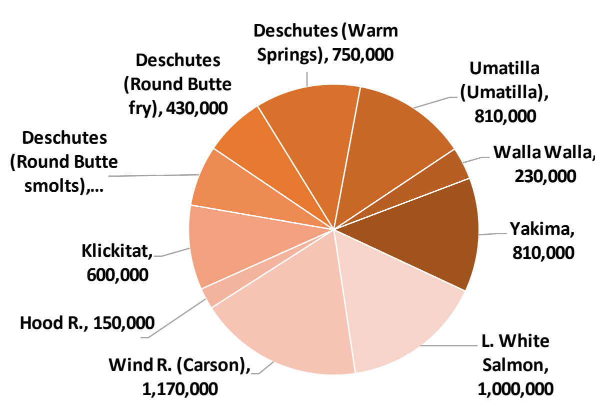


Current Harvest Distribution (Natural Exploitation Rates)



Totals 14.5%

Current Hatchery Production



Total smolts: 3,630,000 fry: 430,000

Natural Production		Abundance		Potential Goal Range		
MPG	Population	Recent	Historical	Low	Med	High
East Cascade	Klickitat R.	500	2,500	750	975	1,200
	Warm Springs	1,000	5,700	1,000	2,100	3,200
	Metolius R.	100	1,300	750	1,075	1,400
	U Deschutes		3,800	750	1,025	1,300
John Day	U. mainstem	1,400	1,800	1,000	2,000	3,000
	North Fork	1,400	7,300	2,000	4,000	6,000
	Middle Fork	700	2,200	1,000	2,000	3,000
Blue Mountains	Umatilla R.	300	5,000	1,000	1,350	1,700
	Walla Walla upper	200	4,900	1,000	1,800	2,600
	Walla Walla-Mill Cr		2,700	750	975	1,200
	Walla Walla S Fk		1,900	750	875	1,000
	Touchet		8,400	1,000	2,750	4,500
Yakima	U. mainstem	4,000	124,500	4,000	12,870	55,700
	Naches/American	2,000	74,500	2,000	6,630	28,700
Totals		**11,600**	**246,500**	**17,750**	**40,425**	**114,500**

Artificial Production		Current Production			Return	Anticipated
Location (Program)		Brood	Smolts	Fry	Goal	production
Mid Columbia ESU	Klickitat	500	600,000	--	549	800,000
	Deschutes (Round Butte)		430,000	430,000	1,200	860,000
	Deschutes (Warm Springs)		750,000	--		750,000
	Umatilla (Umatilla)		810,000	--		810,000
	Walla Walla		230,000	--		480,000
	Yakima		810,000	--		810,000
Totals			**3,630,000**	**430,000**		**4,510,000**
LCR ESU	L. White Salmon*		1,000,000	--		1,000,000
	Wind R. (Carson)*		1,170,000	--		1,170,000
	Hood R.*		150,000	--		250,000
Totals			**2,320,000**	**0**		**2,420,000**

Fisheries / Harvest		Exploitation rate (v Col R)			Harvest	
	Location	Avg.	Limits	Potential	Recent	Potential
Wild/Natural	Ocean	0%	--	--	0	0
	Mainstem Non-treaty	2.2%	5.5-17%	20-60%	300	81,600
	Mainstem Treaty	9.4%			1,400	
	Terminal	3.0%			400	
	Total	***14.5%***	***5.5-17%***	***20-60%***	***2,100***	***81,600***
Hatchery	Ocean	0%	--	~70%	0	0
	Mainstem Non-treaty	10.3%	--		4,800	39,100
	Mainstem Treaty	9.4%	--		4,400	
	Terminal	5.0%	--		2,400	
	Total	***24.6%***	***--***	***~70%***	***11,600***	***39,100***

Total Return		Recent avg. (2008-2013)	@ Goals Low	Med	High
@ Columbia R Mouth		**61,900**	**73,900**	**113,500**	**260,000**
	Wild/Natural	14,700	22,500	59,900	204,200
	Hatchery	47,200	51,400	53,600	55,800
	% hatchery	76%	70%	47%	21%
To Mid Col R (BON)		**53,400**	**68,600**	**100,200**	**228,600**
	Wild/Natural	14,400	22,000	57,500	192,200
	Hatchery	42,800	46,600	42,700	36,400
	% hatchery	80%	68%	43%	16%
Escapement		**45,400**	**54,600**	**67,100**	**130,200**
	Wild/Natural	11,600	17,800	40,400	114,500
	Hatchery	33,800	36,800	26,700	15,700
	% hatchery	74%	67%	40%	12%
Harvest (Columbia Basin)		**13,600**	**16,100**	**42,000**	**120,700**
	Wild/Natural	2,100	3,600	16,700	81,600
	Hatchery	11,500	12,500	25,300	39,100
	% hatchery	85%	78%	60%	32%

Notes - Natural Production

Distribution: Populations within this unlisted ESU historically spawned throughout Mid-Columbia tributaries, including in the Deschutes, Klickitat, Warm Springs, Umatilla, Walla Walla, John Day, Yakama subbasins. Mid-Columbia spring Chinook salmon are extirpated above Pelton Round Butte Dam (Upper Deschutes, Metolius subbasins) and extirpated or nearly so in the Blue Mountain and Yakima MPGs. The John Day and Warm Springs MPGs still have extant populations.

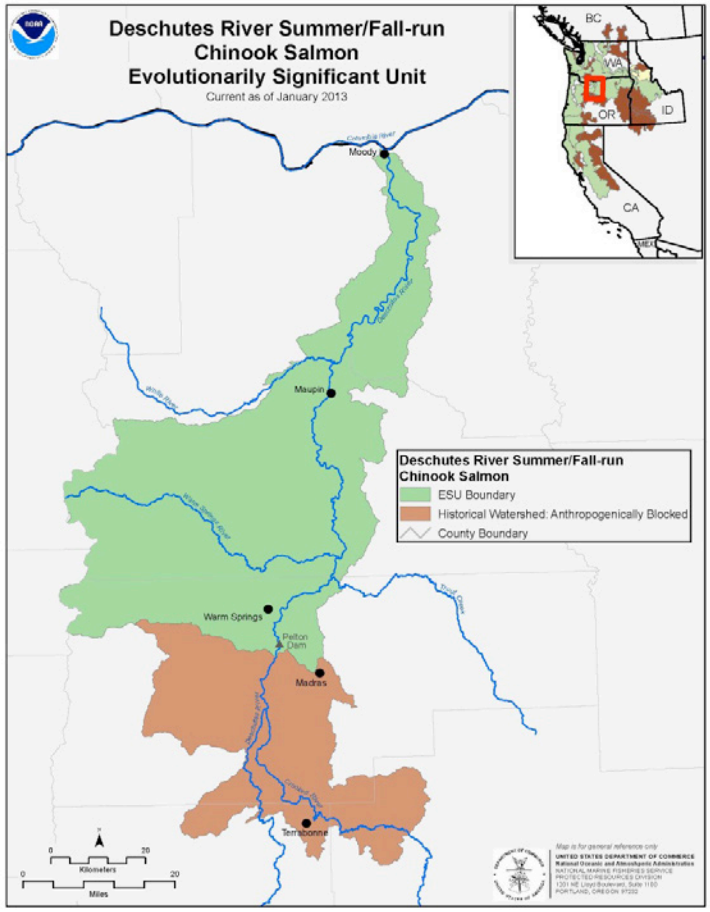
Historical abundance: Historical abundance is estimated based on EDT modeling of estimated historical habitat conditions (from the 2005 sub-basin plan), except for the Klickitat population, which is estimated based on historical documents (by the Yakama Nation).

Current abundance: Based on spawning ground surveys, weir counts, tributary dam counts, and mark/recapture.

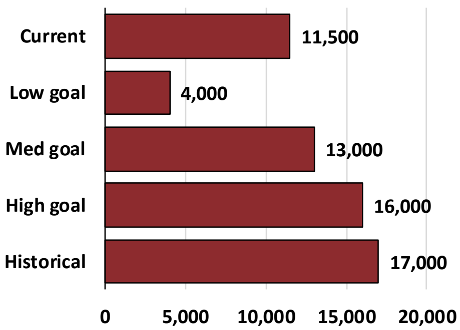
Goals:

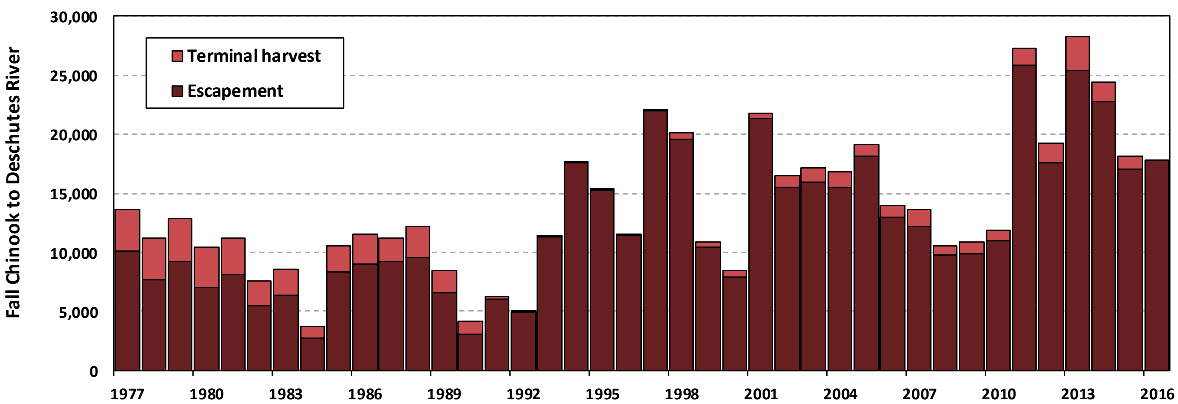
- *Low range*: Based on ICTRT MATs, using professional judgement to determine historical population size category.
- *Medium range*: Mid-point between low and high goals.
- *High range*: Mix of approaches. Many NPCC subbasin plans identify potential production under moderate habitat restoration scenarios (based on EDT analysis of restoration scenario) – e.g., in the Deschutes, Blue Mountains, and Yakama. Where that is not available (i.e., John Day), high end goals are three times MAT.

- Includes a healthy population in the Deschutes River.
- Upriver bright stock similar to the productive Hanford population returning to the upper Columbia.
- Most of historical spawning habitat in the mainstem Deschutes remains accessible. Distribution may have been slightly truncated by Pelton and Round Butte Dams.
- No hatchery production of this stock occurs in the Deschutes River. Fall Chinook are released in a number of mainstem hatcheries in the mid-Columbia.
- Ranges widely in the ocean and is harvested from the Pacific Northwest to Canada and Alaska.

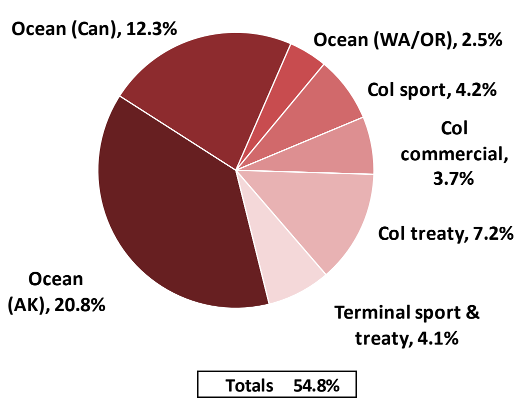


Natural Production

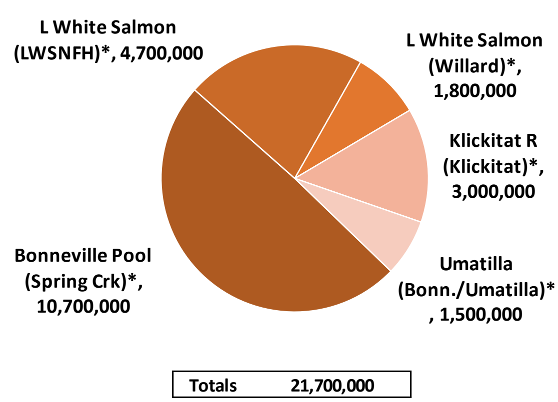




Current Fishery Distribution (Natural ER)



Mid-C Hatchery Fall Chinook Production



Natural Production		Abundance		Potential Goal Range		
MPG	Population	Recent	Historical	Low	Med	High
Mid-C	Deschutes River	11,500	17,000	4,000	13,000	16,000
	Totals	**11,500**	**17,000**	**4,000**	**13,000**	**16,000**

Hatchery Production	Current Production			Return	Anticipated
Location (Program)	Stock	Brood	Subyearlings	goal	production
Bonneville Pool (Spring Crk)*	tule		10,700,000		10,700,000
Deschutes R	--	0	0	0	0
L White Salmon (LWSNFH)*	bright		4,700,000		4,700,000
L White Salmon (Willard)*	bright		1,800,000		1,800,000
Klickitat R (Klickitat)*	bright	2,600	3,000,000		4,000,000
Umatilla (Bonn./Umatilla)*	bright		1,500,000		1,500,000
Total	**bright**	**2,600**	**11,000,000**		**12,000,000**

** Non-ESU hatchery production of Fall Chinook in the mid-Columbia region*

Fisheries / Harvest		Exploitation rate				Harvest	
	Location	Avg (v ocn)	Avg (v CR)	Limits	Potential	Recent	Potential
Wild/Natural	Ocean (AK)	20.8%	--	--	40-80%	6,000	18,600
	Ocean (Can)	12.3%	--	--		3,600	
	Ocean (WA/OR)	2.5%	--	--		700	
	Col sport	4.2%	6.5%	21.5-45%		1,200	15,400
	Col commercial	3.7%	5.8%			1,100	
	Col treaty	7.2%	11.2%			2,100	
	Terminal sport & treaty	4.1%	6.3%			1,200	
	Total	***54.8%***	***29.8%***	***30-70%***	***40-80%***	***15,900***	***34,000***

Total Return		Recent avg. (2008-2017)	@ Goals Low	Med	High
@ Columbia R Mouth		**18,600**	**6,500**	**21,200**	**33,700**
	Wild/Natural	18,600	6,500	21,200	33,700
	Hatchery	0	0	0	0
	% hatchery	0%	0%	0%	0%
To Mid Col R (BON)		**16,300**	**5,700**	**18,700**	**27,100**
	Wild/Natural	16,300	5,700	18,700	27,100
	Hatchery	0	0	0	0
	% hatchery	0%	0%	0%	0%
Escape (Spawners)		**13,800**	**4,400**	**14,400**	**17,700**
	Wild/Natural	13,800	4,400	14,400	17,700
	Hatchery	0	0	0	0
	% hatchery	0%	0%	0%	0%
Harvest (Col basin)		**5,600**	**2,000**	**6,400**	**15,400**
	Wild/Natural	5,600	2,000	6,400	15,400
	Hatchery	0	0	0	0
	% hatchery	0%	0%	0%	0%
Harvest (Total)		**15,900**	**5,600**	**18,100**	**34,000**
	Wild/Natural	15,900	5,600	18,100	34,000
	Hatchery	0	0	0	0
	% hatchery	0%	0%	0%	0%

Notes - Natural Production

Distribution: The unlisted Mid C summer/fall Chinook ESU includes a single population – the Deschutes. This population is extant, and robust.

Historical abundance: Historical abundance is estimated based on EDT modeling of estimated historical habitat conditions (from 2005 subbasin planning process).

Current abundance: Based on mark/recapture estimate and trap count at Sherars Falls.

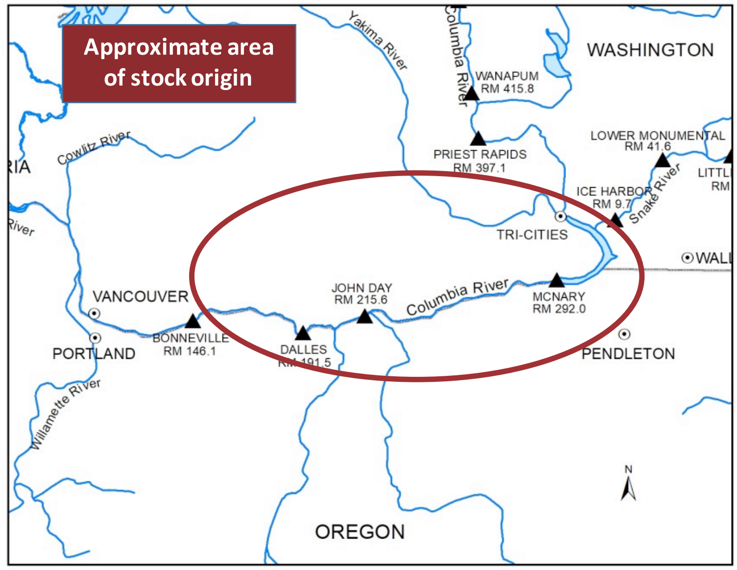
Goals:

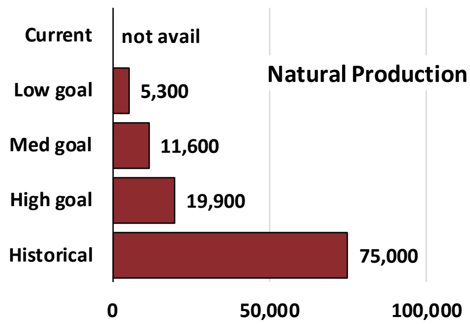
- *Low-range*: Based on the SR fall Chinook recovery plan goal (because that ESU also is a single-population fall Chinook salmon ESU). The goals is also equivalent to the ODFW minimum escapement goal.
- *Medium-range*: Deschutes subbasin plan.
- *High-range*: Deschutes subbasin (EDT-derived).

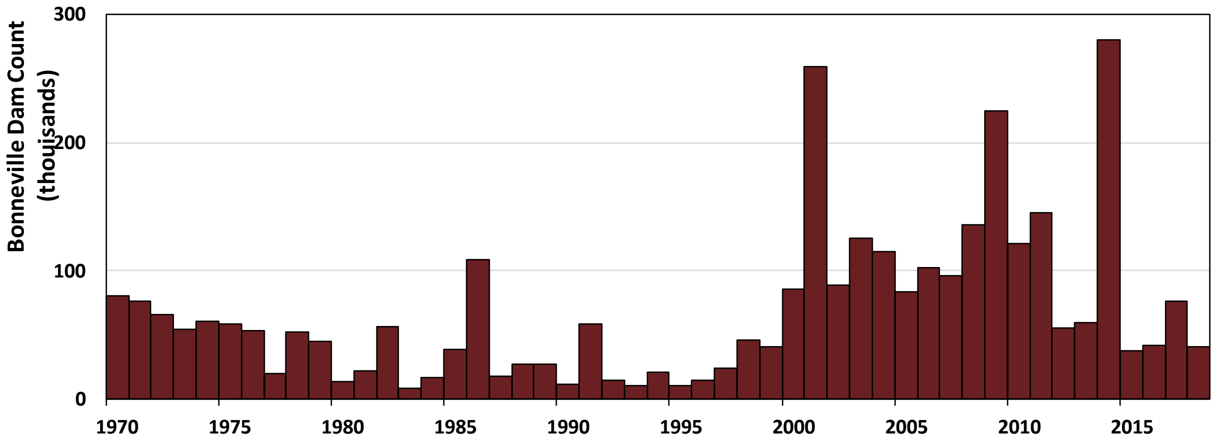
Notes - Hatchery Production

Tule fall Chinook are produced from Spring Creek Hatchery located in Bonneville Pool - this stock comprises the Bonneville Pool Hatchery fishery management unit. Bright fall Chinook are also produced from a number of hatcheries throughout the mid-Columbia. These fish are part of the upriver bright fishery management unit which also includes fall Chinook spawning in Columbia River mainstem in the Hanford reach. Mainstem spawners were also historically abundant in portions of the mid-Columbia particularly in areas currently inundated by John Day pool. The mid-Columbia hatchery fish comprise the mid-Columbia bright fishery management unit.

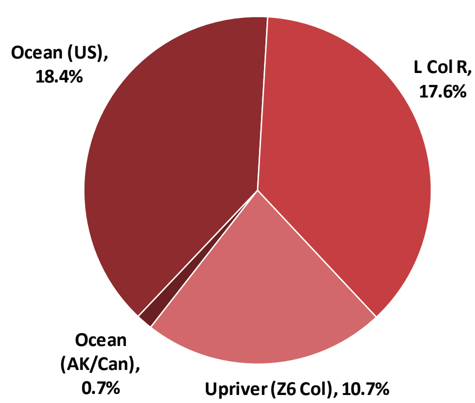
- "Upriver" Coho include fish returning to areas upstream from Bonneville Dam (including middle Columbia, upper Columbia and Snake Rivers).
- Gorge populations are part of the lower Columbia ESU.
- Historically extirpated upstream from The Dalles Dam but subsequently reintroduced.
- Current run is predominately hatchery origin.





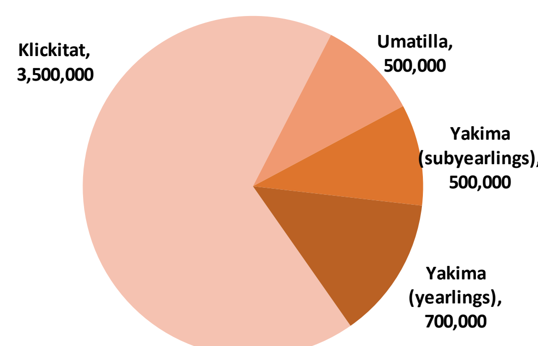


Current Fishery Distribution (Total Harvest)



Total	47%

Hatchery releases (smolts)



Total	5,200,000

Natural Production	Abundance		Potential Goal Range		
Population	Recent	Historical	Low	Med	High
Klickitat	485	0	0	0	0
John Day	na	na	1,100	2,200	3,300
Umatilla	5,039	na	1,100	2,200	3,300
Walla Walla	na	na	1,100	2,200	3,300
Yakima	800	75,000	2,000	5,000	10,000
	6,324	**75,000**	**5,300**	**11,600**	**19,900**

Hatchery Production		Current Production		Return	Anticipated
Location (Program)		Subyearlings	Yearlings	goal	production
Klickitat			3,500,000	11,799	3,500,000
Umatilla			500,000	5,377	500,000
Yakima		500,000	700,000	15,000	1,200,000
Subtotal (Upriver)		**500,000**	**4,700,000**	**32,176**	**5,200,000**

Fisheries / Harvest	Exploitation rate (combined hatchery & natural)			Harvest	
Location	avg (v ocn)	avg (v CR)	Potential	10-yr avg	Potential
Ocean (AK/Can)	0.7%	--	≤70%	1,000	26,200
Ocean (US)	18.4%	--		18,000	
L Col R	17.6%	22.0%		6,000	26,600
Upriver (Z6 Col)	10.7%	12.9%		10,000	
Total	***47.3%***	***34.9%***	***≤70%***	**35,000**	***52,800***

Total Return		Abundance	@ Goals		
		recent	Low	Med	High
@ Columbia R Mouth		**76,700**	**84,800**	**94,500**	**107,200**
	Wild/Natural		8,100	17,800	30,500
	Hatchery	76,700	76,700	76,700	76,700
	% hatchery	100%	90%	81%	72%
To Mid Col R (BON)		**70,100**	**76,400**	**84,000**	**93,900**
	Wild/Natural		6,300	13,900	23,800
	Hatchery	70,100	70,100	70,100	70,100
	% hatchery	100%	92%	83%	75%
Escapement		**60,000**	**65,300**	**71,600**	**79,900**
	Wild/Natural		5,300	11,600	19,900
	Hatchery	60,000	60,000	60,000	60,000
	% hatchery	100%	92%	84%	75%
Harvest (Col basin)		**16,000**	**18,800**	**22,200**	**26,600**
	Wild/Natural	0	2,800	6,200	10,600
	Hatchery	16,000	16,000	16,000	16,000
	% hatchery	100%	85%	72%	60%
Harvest (total)		**35,000**	**39,700**	**45,400**	**52,800**
	Wild/Natural	0	4,700	10,400	17,800
	Hatchery	35,000	35,000	35,000	35,000
	% hatchery	100%	88%	77%	66%

Notes - Natural Production

Upriver coho are generally defined to include fish returning upstream from Bonneville Dam destined for areas of the middle Columbia, Upper Columbia and Snake.

Small numbers of coho returning to stream in Columbia River Gorge tributaries below and above Bonneville Dam are part of the listed Lower Columbia River coho ESU. Population-specific data for these listed Coho may be found in the Lower Columbia coho stock summary. For ease of calculation, small numbers of listed Lower Columbia River coho are included in the run reconstruction for upriver coho stock.

Distribution: Coho historically returned to tributaries throughout the Middle Columbia, Upper Columbia, and Snake River basins. NOAA Fisheries' project team and regional technical team members tentatively identified at least 15 historical populations. These populations have been largely extirpated. Reintroduction efforts are underway utilizing hatchery fish. ESUs or MPGs were not formally identified by technical recovery teams for these upriver coho populations – therefore the project team inferred ESUs and MPGs based on similar delineations in the Lower Columbia River.

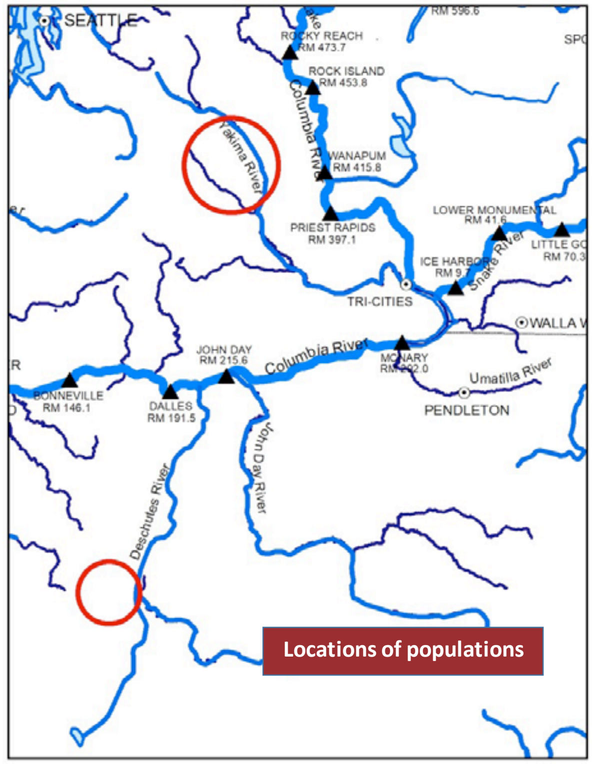
Historical abundance: Information on historical abundance is limited. Estimates for individual populations are based on a mix of EDT results and expert judgement.

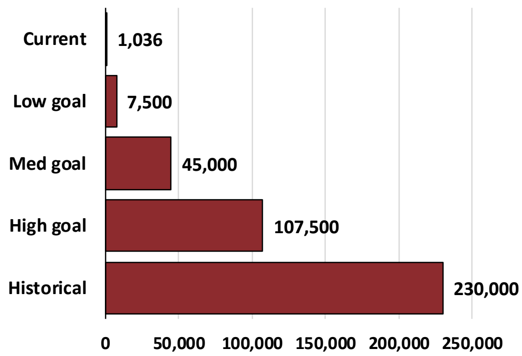
Current abundance: Generally based on tributary dam counts in Umatilla and Yakima. For Wentachee and Methow based on spawning ground surveys occurring as part of the ongoing reintroduction monitoring program.

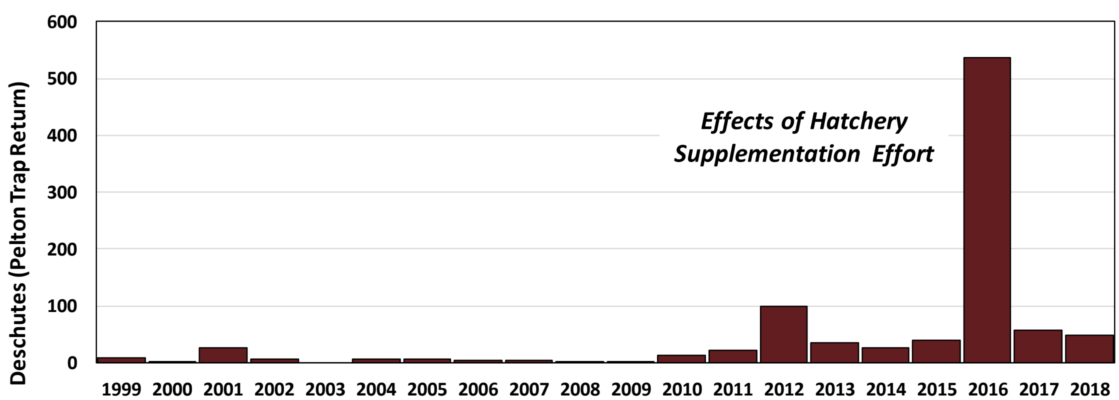
Goals:

- *Low-range*: Based on ICTRT MATs. No goals are identified for the Klickitat River where coho did not historically occur due to a falls near the mouth.
- *Medium-range*: Mid-point between low and high goals.
- *High-range*: Generally, three to four times low goal as placeholders.

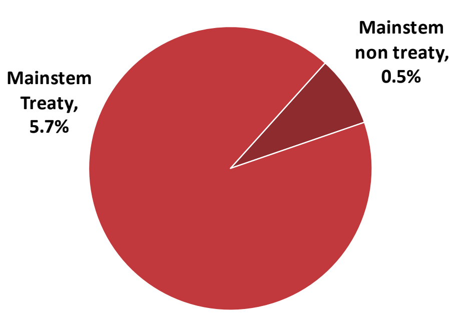
- Historical populations in the Deschutes and Yakima Rivers were extirpated.
- Construction of a barrier at Suttle Lake outlet in 1900s and the later completion of Pelton Round Butte Dam complex in 1960s blocked anadromous passage to the of the Deschutes population.
- In the Deschutes, a naturally spawning population of kokanee (land-locked sockeye) exists in Suttle Lake and Link Creek as well as in Lake Billy Chinook.
- Reintroduction of sockeye using hatchery supplementation is being explored under FERC licensing agreement for Pelton Round Butte.
- Reintroduction efforts are underway in the upper Yakima basin based on adult outplants.







Harvest Distribution (Exploitation rates)



Totals	6.2%

Natural Production		Abundance (mean)		Potential Goal Range		
MPG	Population	Recent	Historical	Low	Med	High
Mid-Col	Deschutes	36	30,000	2,500	5,000	7,500
	Yakima	1,000	200,000	5,000	40,000	100,000
Totals		**1,036**	**230,000**	**7,500**	**45,000**	**107,500**

Hatchery Production	Current Production			Return	Anticipated
Location (Program)	Brood	Smolts	Fry	goal	production
Round Butte	limited			--	--
Yakima (transplants)	1,000-10,000	--		--	--

Fisheries / Harvest		Exploitation rate			Harvest	
	Location	Avg.	Limits	Potential	10-yr avg	Potential
All	Ocean	0	--	--	--	--
	Mainstem non treaty	0.5%	6-8%	20-60%	5	0
	Mainstem Treaty	5.7%			61	
	Terminal	0	--		--	
	Total	***6.2%***	***6-8%***	***20-60%***	**66**	***0***

Total Return		Recent avg (2009-2018)	@ Goals Low	Med	High
@ Columbia R Mouth		**1,100**	**8,000**	**81,100**	**179,200**
	Wild/Natural				
	Hatchery				
	% hatchery				
Tributary return		**1,000**	**7,500**	**45,000**	**107,500**
	Wild/Natural				
	Hatchery				
	% hatchery				
Harvest (Col mainstem)		**100**	**500**	**36,100**	**71,700**
	Wild/Natural				
	Hatchery				
	% hatchery				

Notes - Natural Production

Distribution: Sockeye historically returned to Suttle Lake in upper Metolius River of the Deschutes basin. The anadromous portion of population was severely impacted by barriers on Lake Creek in the 1930s and officially extirpated in 1966 with the failure of downstream passage facilities at the newly constructed Round Butte Dam. A remnant kokanee population (land-locked sockeye) still exists in Lake Billy Chinook and Suttle Lake. Small numbers of adult Sockeye continue to return to the Pelton fish trap. These fish originate from juvenile outmigrants produced by the resident kokanee population. The 2004 settlement agreement for relicensing of the Pelton-Round Butte Project identifies a goal of re-establishing a self-sustaining, harvestable, anadromous sockeye run into the upper Deschutes. This effort utilizes smolt-sized fish attempting to emigrate from the system.

Sockeye historically returned to areas of the upper Yakima basin including Cle Elum Lake. Sockeye were extirpated from the system following dam construction in 1933. Reintroduction efforts began in 2009 by outplanting Upper Columbia River adults into areas of suitable spawning habitat.

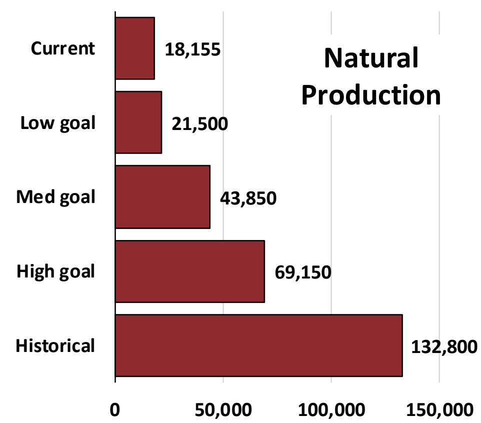
Historical abundance: Deschutes number is based on similar-sized populations in other areas of the basin. Yakima number was provided by the Yakima Nation.

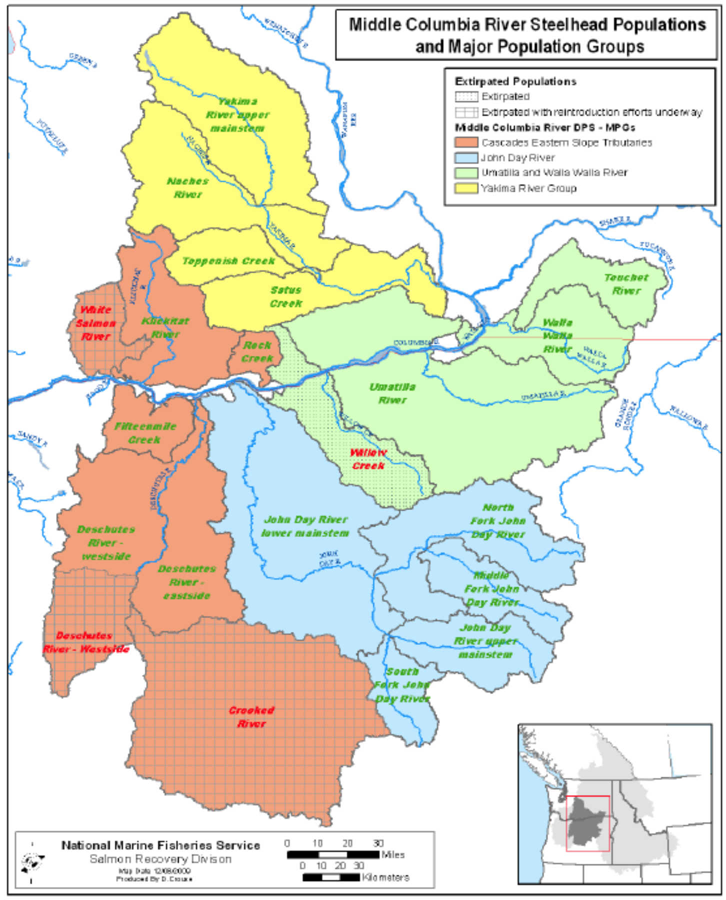
Current abundance: Deschutes number based on sockeye returns to Pelton Round Butte trap (some kokanee smolt, migrate to the ocean, and return). Yakima number based on sockeye returns to Prosser Dam.

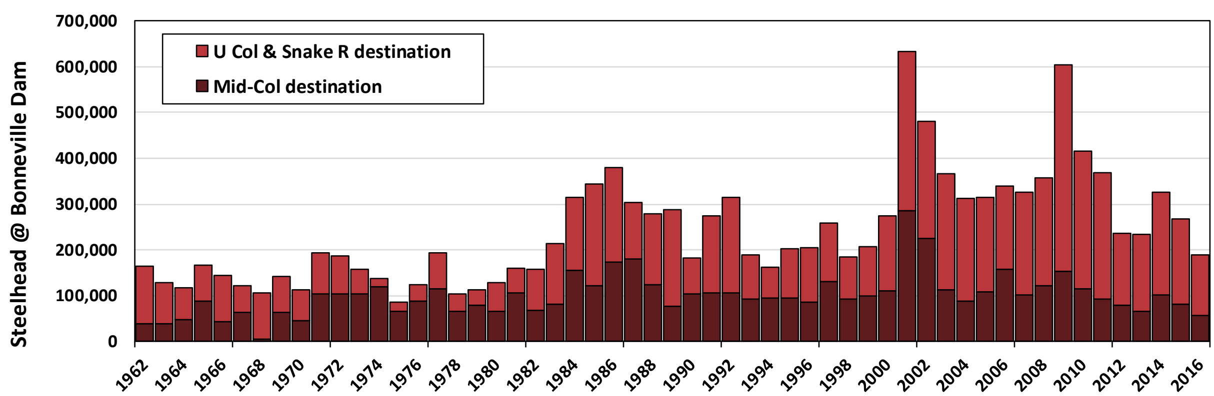
Goals:

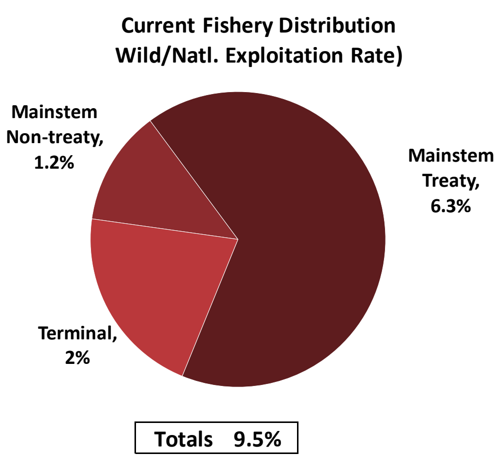
- *Low range*: Based on Snake River sockeye goal identified in the recovery plan for the aggregate of Stanley Basin.
- *Medium range*: Intermediate between high and low values. Deschutes goal is equivalent to the Warm Springs tribal goal identified in Deschutes Subbasin Plan.
- *High range*: Default rule three times low goal for the Descutes. Yakima number identified by the Yakama Nation.

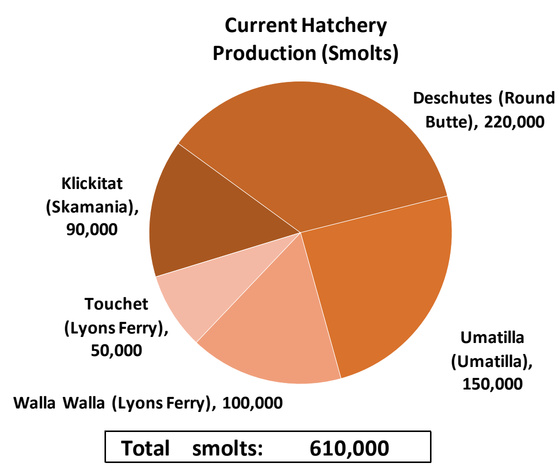
- Inhabitats low to mid-elevation streams draining the eastern Cascades and west Blue Mountains.
- Includes viable and moderately viable populations and is among the listed species that are closest to recovery.
- Hatchery production is limited to a few systems.
- Several populations that were historically extirpated by tributary dams are being reintroduced.











Natural Production		Abundance		Potential Goal Range		
MPG	Population	Recent	Historical	Low	Med	High
Cascade E Slope	White Salmon R.	200	1,100	500	750	1,100
	Klickitat R.	1,500	3,500	1,000	2,000	3,000
	Fifteenmile Cr.	400	2,000	500	1,000	1,500
	Deschutes R. east	1,700	14,700	1,000	2,000	3,400
	Deschutes R. west	600	6,900	1,500	3,000	2,800
	Crooked R.	0	14,800	2,250	4,500	4,900
	Rock Cr.	455	600	500	550	600
John Day	L. mainstem	1,600	10,100	2,250	4,500	6,750
	North Fork	2,000	14,700	1,500	3,000	4,500
	Middle Fork	1,700	5,900	1,000	2,100	3,900
	South Fork	800	2,900	500	1000	1500
	U. mainstem	700	5,900	1,000	2,000	3,000
Umatilla - Walla Walla	Willow Cr.	0	--	1,000	2,000	3,000
	Umatilla R.	2,400	7,000	1,500	4,000	7,000
	Walla Walla R.	900	16,500	1,000	2,000	3,400
	Touchet R.	200		1,000	2,000	2,200
Yakima	Satus Cr.	1,100	4,000	1,000	1,500	2,000
	Toppenish Cr.	500	3,400	500	1,000	1,500
	Naches R.	1,200	8,400	1,500	3,450	5,400
	U. mainstem	200	10,400	500	1,500	7,700
Totals		18,155	132,800	21,500	43,850	69,150

Artificial Production	Current Production			Return	Anticipated
Location (Program)	Brood	Smolts	Fry	goal	production
Bonneville/L White Salmon*		0	0		0
Hood*		0	0		0
Klickitat (Skamania)	144	90,000	0	4,000	90,000
Deschutes (Round Butte)	1,100	220,000	350,000	4,300	220,000
Umatilla (Umatilla)	110	150,000	0	750	150,000
Walla Walla (Lyons Ferry)	35	100,000	0	1,200	100,000
Touchet (Lyons Ferry)	88	50,000	0	1,800	150,000
Yakima	0	0	0	0	0
Totals	**1,477**	**610,000**	**350,000**	**12,050**	**710,000**

** Lower Columbia River ESU (counted in Bonneville Dam return)*

Fisheries / Harvest		Exploitation rate			Harvest	
	Location	Avg.	Limits	Potential	10 yr avg	Potential
Wild/Natural	Ocean	0	--	--	--	--
	Mainstem Non-treaty	1.2%	15-22%	20-50%	700	80,400
	Mainstem Treaty	6.3%			2,800	
	Terminal	2%			800	
	Total	***9.5%***			***4,300***	***80,400***
Hatchery	Ocean	0	--	--	--	--
	Mainstem Non-treaty	13%	~70%	~70%	7,100	29,700
	Mainstem Treaty	6%			3,300	
	Terminal	20%			12,100	
	Total	***39%***	***~70%***	***~70%***	***22,500***	***29,700***

Total Return	Abundance recent	@ Goals Low	@ Goals Med	@ Goals High
@ Columbia R Mouth	**101,000**	**110,000**	**173,400**	**273,900**
Wild/Natural	43,000	52,000	123,000	231,000
Hatchery	58,000	58,000	50,400	42,900
% hatchery	57%	53%	29%	16%
To Mid Col R (BON)	**97,000**	**105,000**	**159,900**	**242,300**
Wild/Natural	43,000	51,000	116,000	208,000
Hatchery	54,000	54,000	43,900	34,300
% hatchery	56%	51%	27%	14%
Local return (tributary entry)	**83,000**	**90,000**	**126,100**	**171,800**
Wild/Natural	38,000	45,000	95,000	149,000
Hatchery	45,000	45,000	31,100	22,800
% hatchery	54%	50%	25%	13%
Harvest (Col basin)	**26,800**	**27,400**	**55,000**	**110,100**
Wild/Natural	4,300	4,900	27,200	80,400
Hatchery	22,500	22,500	27,800	29,700
% hatchery	84%	82%	51%	27%

Notes - Natural Production

Distribution: The ICTRT identified 4 MPGs and 20 historical populations in the Mid-Columbia River steelhead DPS: Cascades Eastern Slope Tributaries (7 historical populations), Yakima Basin (4 historical populations), John Day Basin (5 historical populations), and Umatilla/Walla Walla (4 historical populations). Seventeen of these populations are extant. Three are extirpated: White Salmon River and Deschutes Crooked River (above Pelton Dam) in the Cascades Eastern Slope MPG and Willow Creek in the Umatilla/Walla Walla MPG). The populations are mostly summer run (Fifteenmile Creek is winter run).

The MCR steelhead DPS includes all naturally spawned anadromous steelhead originating below natural and manmade impassable barriers from the Columbia River and its tributaries upstream of the Wind and Hood Rivers (exclusive) to and including the Yakima River. The DPS comprises 20 historical populations (three of which are extirpated) grouped into four MPGs. This DPS does not include steelhead in the upper Deschutes River basin, which are designated as part of an experimental population (79 FR 20802; 76 FR 28715).

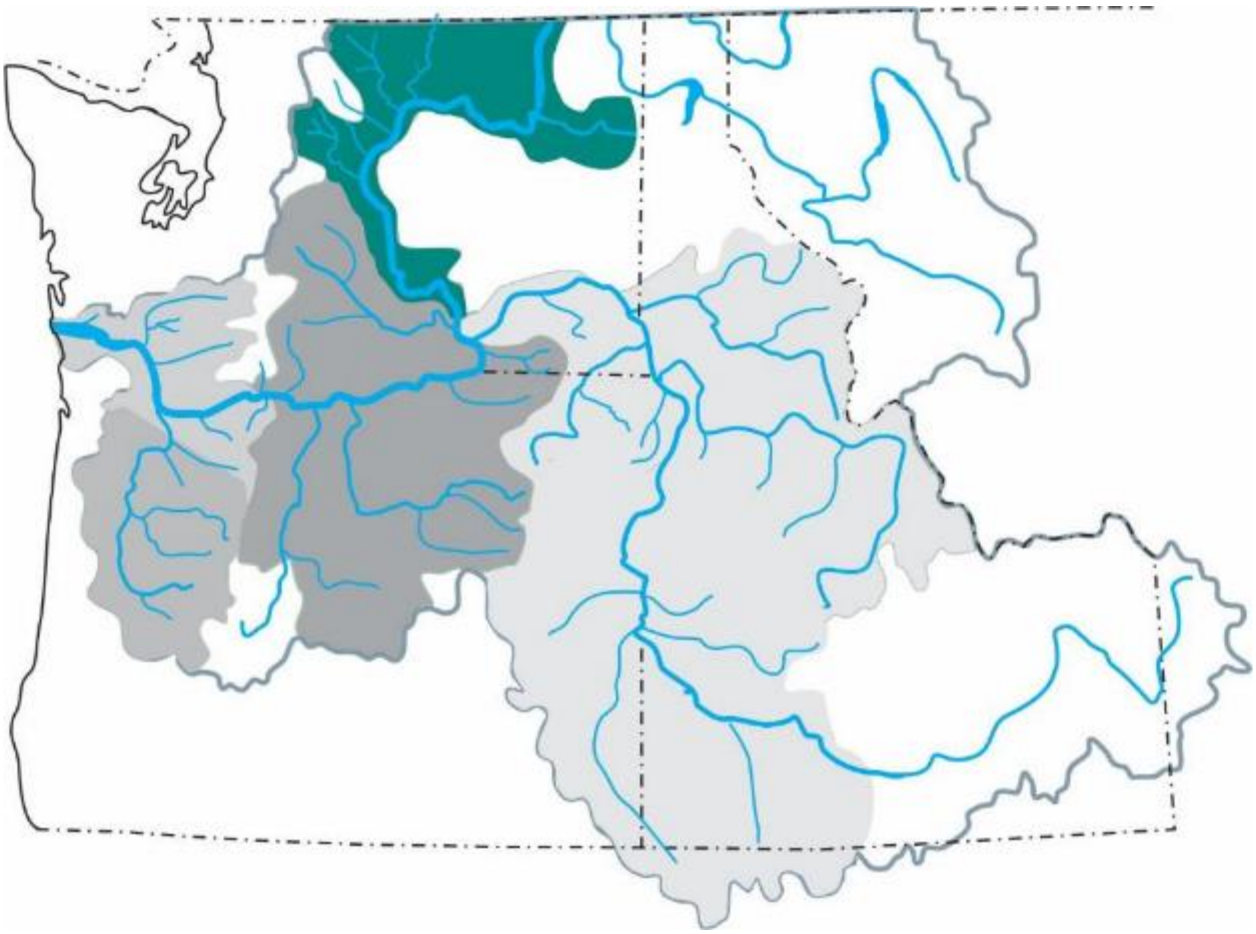
Historical abundance: Historical abundance is estimated based on EDT modeling reported in the 2005 NPCC Subbasin Plan or in EDT modeling by the Yakima tribe. Where EDT estimates were not available, values reported in the subbasin plans and based on historical information were used.

Current abundance: Based on spawning surveys, mark/recapture estimate, and tributary dam counts.

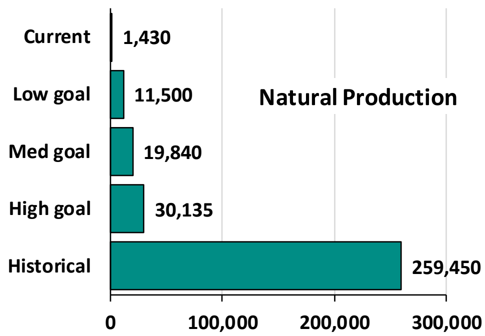
Goals:

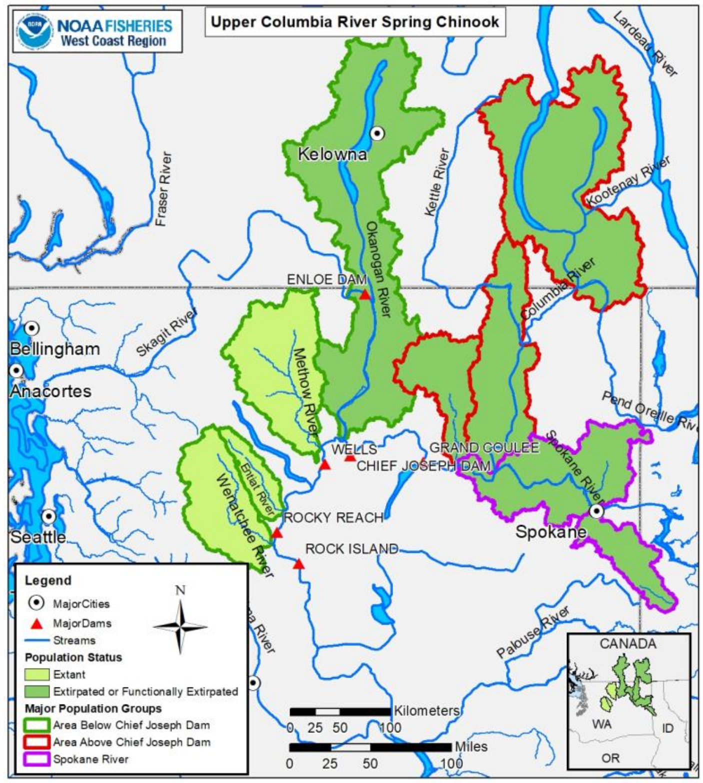
- *Low range*: Based on ESA recovery plan population-level abundance goals (ICTRT MAT).
- *Medium range*: Midpoint between low and high goals.
- *High range*: Some from EDT estimates based on moderate habitat improvement (from SBPs); for some populations high is limited to historical estimate because model-derived exceeded historical; for some no estimate is available so the three times MAT default is used.

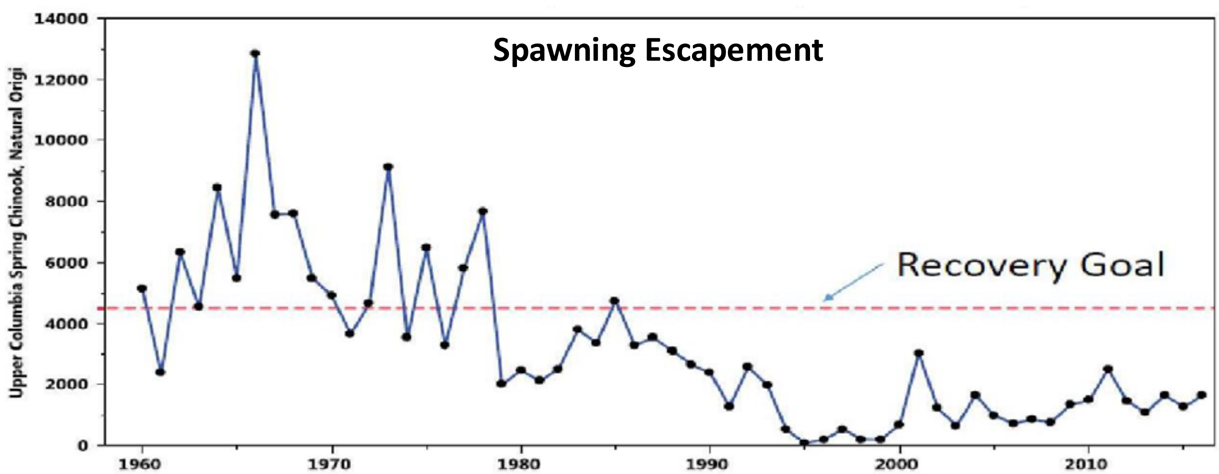
UPPER COLUMBIA



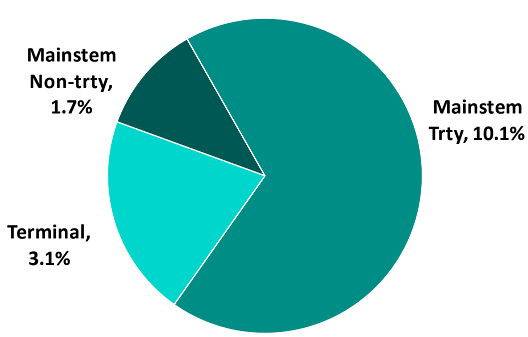
- Currently inhabits large tributaries upstream from Priest Rapids Dam.
- Spawning occurs in mid to high elevation reaches
- A portion of the historical habitat upstream from Chief Joseph and Grand Coulee Dams is not currently accessible under current management.
- This stock ranges widely in the ocean along the Pacific Coast where it is not subject to fisheries.





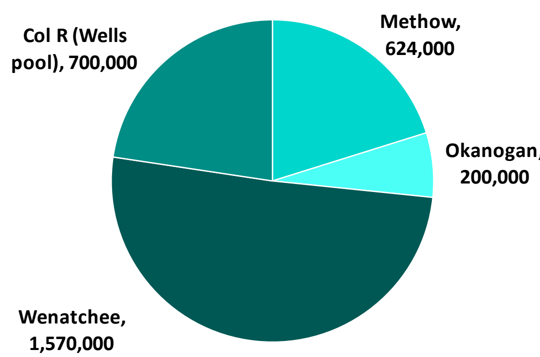


Current Fishery Distribution of Wild/Natural Impacts (v Col R)



Totals 14.8%

Current Hatchery Production (smolts)



Totals 3.0 million

UPPER COLUMBIA Spring Chinook ▪ ESA: Endangered ▪ Life History: Stream rearing

Natural Production		Abundance		Potential Goal Range		
MPG	**Population**	**Recent**	**Historical**	**Low**	**Med**	**High**
N Cascades	Methow	430	24,000	2,000	2,700	4,050
	Wenatchee	680	20,650	2,000	2,710	4,065
	Entiat	220	3,400	500	680	1,020
	Okanogan (US)	100	14,100	500	750	1,500
Blocked area		0	197,300	6,500	13,000	19,500
Totals		**1,430**	**259,450**	**11,500**	**19,840**	**30,135**

Hatchery Production	Current Production		Return	Anticipated
Location (Program)	**Brood**	**Yearlings**	**goal**	**production**
Methow	340	624,000		624,000
Okanogan	140	200,000		200,000
Wenatchee	1,087	1,570,000		1,570,000
Col R (Wells pool)	486	700,000		700,000
New (blocked area)	0	0		0.7 - 13.5 million
Subtotal	**2,053**	**3,094,000**		**3.8-16.6 million**

Fisheries / Harvest			Exploitation rate (v Col R)			Harvest	
	Location		**Avg.**	**Limits**	**Potential**	**10-yr avg**	**Potential**
Wild/Natural	Ocean	--	0%	--	--	--	--
	Mainstem Non-trty	v Col R.	1.7%	5.5-17%	20-60%	60	46,500
	Mainstem Trty	v Col R.	10.1%			390	
	Terminal	v PRD	4.0%	2-6%		120	
	Blocked area		0%	--		--	
	Total	v Col R.	***14.8%***	***7.5-23%***	***20-60%***	***570***	***46,500***
Hatchery	Ocean	--	0	--	--	--	--
	Mainstem Non-trty	v Col R.	12.1%	--	≤70%	2,350	72,900
	Mainstem Trty	v Col R.	10.1%	--		1,750	
	Terminal	v PRD	10.0%	--		1,340	
	Blocked area		0%	--		0	
	Total	v Col R.	***32.2%***		***≤70%***	***5,440***	***72,900***

Total Return		Recent avg (2008-2017)	@ Goals		
			Low	**Med**	**High**
@ Columbia R Mouth		**23,240**	**50,300**	**87,300**	**220,500**
	Wild/Natural	3,840	30,900	63,400	116,300
	Hatchery	19,400	19,400	23,900	104,200
	% hatchery	**83%**	39%	27%	47%
To Bonneville Dam		**20,880**	**47,500**	**79,600**	**174,800**
	Wild/Natural	3,780	30,400	61,400	110,700
	Hatchery	17,100	17,100	18,200	64,100
	% hatchery	**82%**	36%	23%	37%
To Upper Col R (PRD)		**16,360**	**37,200**	**55,500**	**105,500**
	Wild/Natural	2,960	23,800	42,800	67,800
	Hatchery	13,400	13,400	12,700	37,700
	% hatchery	**82%**	36%	23%	36%
Escapement		**7,530**	**17,600**	**24,900**	**43,100**
	Wild/Natural	1,430	11,500	19,800	30,100
	Hatchery	6,100	6,100	5,100	13,000
	% hatchery	81%	35%	20%	30%
Harvest (Col Basin)		**5,970**	**10,000**	**29,600**	**119,400**
	Wild/Natural	570	4,600	17,800	46,500
	Hatchery	5,400	5,400	11,800	72,900
	% hatchery	90%	54%	40%	61%

Notes - Natural Production

Distribution: Historically distributed in Wenatchee, Entiat, Methow, and Okanogan subbasins as well as currently blocked areas upstream from Chief Joseph and Grand Coulee Dams. The Okanogan population was historically extirpated; the other three populations are extant. At least 3 populations were historically assumed to occur upstream from Chief Joseph Dam (Spokane, Hangman, Sanpoil, Kettle/Colville, Kootenay and headwaters).

The UCR spring-run Chinook salmon ESU includes all naturally spawned spring-run Chinook salmon originating from Columbia River tributaries upstream of the Rock Island Dam and downstream of Chief Joseph Dam (excluding the Okanogan River). The ESU comprises three extant independent populations, which are grouped into one MPG (historically, a population also spawned in the Okanogan and would also have been part of this MPG, but it is extirpated and not required for ESA recovery). On July 11, 2014, NMFS designated the Okanogan River population as a “nonessential experimental population” of UCR spring-run Chinook salmon (79 FR 40004).

Historical abundance: Based on combination of harvest/consumption-based estimates by Upper Columbia River tribes and EDT-based estimates under assumed historical conditions.

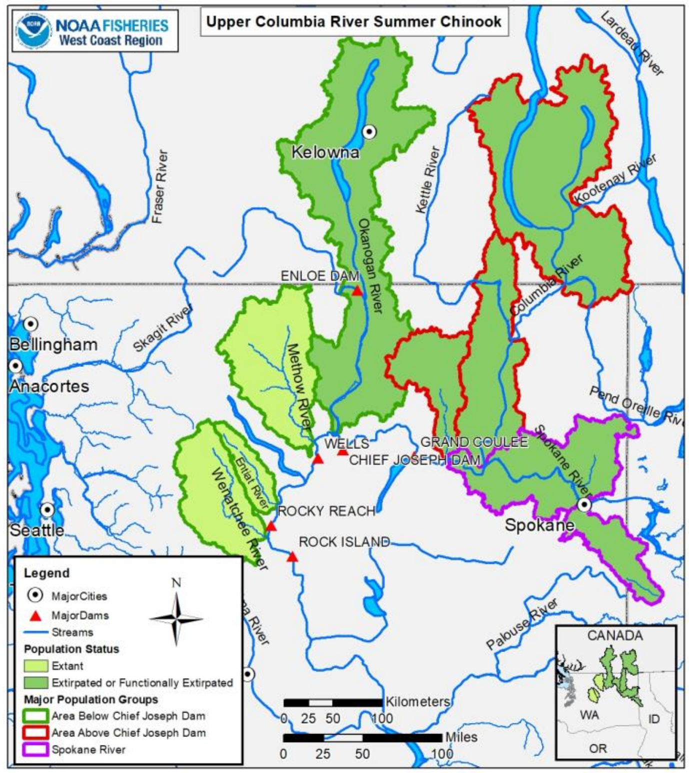
Current abundance: Based on spawning surveys.

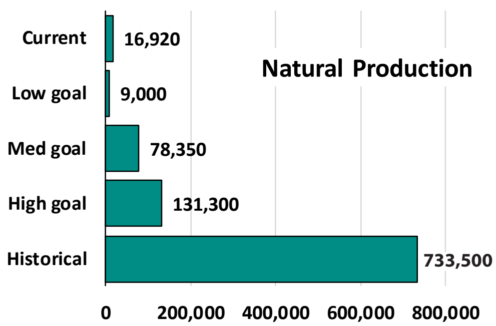
Goals:

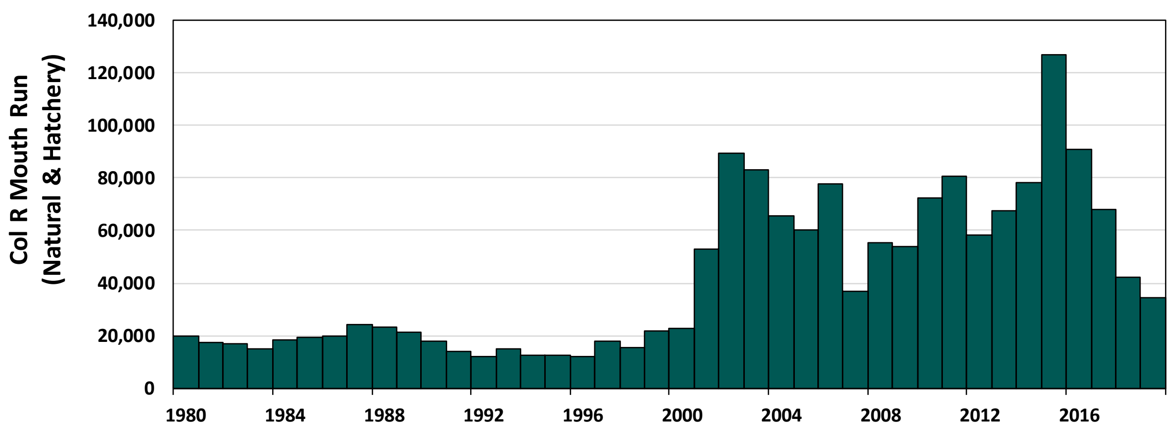
- Low: Based on recovery plan goals. In some cases, modeled abundance identified by the recovery plan is less than the minimum abundance threshold (MAT) identified by the Interior Columbia Technical Recovery Team – in these cases, the modeled abundance is used. Value for blocked areas is equal to the minimum abundance threshold for six assumed historical populations upstream from Chief Joseph Dam – this number is intended to represent numbers of fish that would be available to Colville and Spokane Tribes in historical fishing areas under conditions equivalent to minimum viability of historical populations.
- Medium: Based on modeled equilibrium abundance using EDT model assuming implementation of a suite of habitat restoration actions as reported in the recovery plan appendix. Value for blocked areas is intermediate between low and high values.
- High: Generally based on 1.5 times medium goal. Okanogan value is default three times low goal. Value for blocked areas is default three times low goal.

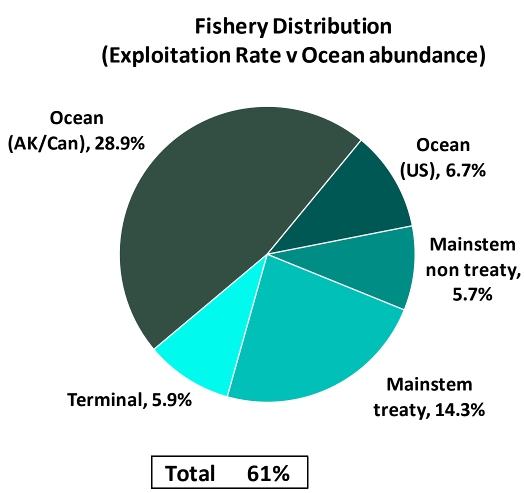
Goals are identified for salmon and steelhead returning to the Columbia River upstream of Chief Joseph and Grand Coulee Dams. The intent of these goals is to restore meaningful fishing opportunities in areas of historical use by the Colville and Spokane tribes. Goals represent only returns to areas upstream from Chief Joseph and Grand Coulee Dams and do not apportion production into specific populations or geographic areas.

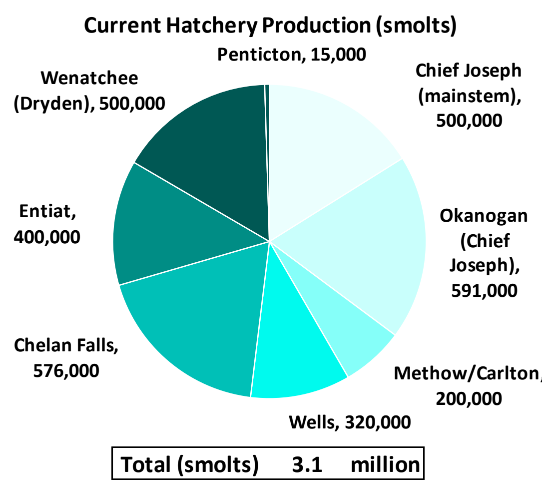
- Currently inhabits mainstem and large tributaries upstream of Priest Rapids Dam.
- Historical habitat upstream from Chief Joseph and Grand Coulee Dams is not accessible under current management.
- Historical population structure assumed similar to that of spring Chinook.
- Part of the unlisted upper Columbia summer/fall Chinook ESU, which also includes Hanford bright fall Chinook.
- Ranges widely in the ocean along the Pacific Coast where they are subject to fisheries from the Pacific Northwest to Canada and Alaska.











Natural Production		Abundance		Potential Goal Range		
MPG	Population	Recent	Historical	Low	Med	High
Cascades	Methow	1,400	12,000	1,000	2,900	4,400
	Wenatchee	5,950	21,000	1,000	5,700	8,600
	Entiat	240	0	--	--	--
	Okanogan (US)	5,150	44,000	2,000	6,000	17,400
	Chelan	880	0	500	1,350	2,000
	Mainstem Columbia	3,200	0	500	1,900	3,900
Yakima	Yakima	100	89,500	1,000	3,500	10,000
Blocked area		0	567,000	3,000	57,000	85,000
	Totals	**16,920**	**733,500**	**9,000**	**78,350**	**131,300**

Hatchery Production	Current Production				Anticipated
Location (Program)	Brood	Yearlings	Subyearlings	Goal	Production
Chief Joseph (mainstem)	503	500,000	400,000		900,000
Okanogan (Chief Joseph)	616	591,000	300,000		591,000
Methow/Carlton	118	200,000	0		200,000
Wells	494	320,000	484,000		804,000
Chelan Falls	358	576,000	0		576,000
Entiat	210	400,000	0		400,000
Wenatchee (Dryden)	262	500,000	0		500,000
Penticton	6	15,000	0		15,000
Yakima (Prosser/Marion Drain)		0	0		1,000,000
New (blocked area)	0	0	0	20-35 thou	0.9 - 18 mil
Subtotal	**2,567**	**3,102,000**	**1,184,000**	**-**	**5.9-23.0 mil**

Fisheries / Harvest		Exploitation rate				Harvest	
	Location	Avg (v ocn)	Avg (v CR)	Limit	Potential	Now	Potential
Combined Natural/Hatchery	Ocean (AK/Can)	28.9%	--	--		33,700	207,000
	Ocean (US)	6.7%	--	--		7,800	
	Mainstem non treaty	5.7%	8.8%	5.2-50%	40-80%	6,700	
	Mainstem treaty	14.3%	22.2%			17,400	153,000
	Terminal	5.9%	9.1%			7,000	
	Blocked area	0.0%	0%	--		--	
	Total	**61%**	**40%**		***40-80%***	***72,600***	***360,000***

Total Return		Current avg (2008-2017)	@ Goals Low	Med	High
@ Columbia R Mouth		**75,000**	**59,000**	**231,000**	**374,000**
	Wild/Natural	30,000	16,000	139,000	234,000
	Hatchery	45,000	43,000	92,000	140,000
	% hatchery	60%	73%	40%	37%
To Bonneville Dam		**69,000**	**54,000**	**212,000**	**343,000**
	Wild/Natural	27,600	15,000	128,000	214,000
	Hatchery	41,400	39,000	84,000	129,000
	% hatchery	60%	72%	40%	38%
To Upper Col R (PRD)		**50,400**	**40,000**	**156,000**	**251,000**
	Wild/Natural	20,160	11,000	94,000	157,000
	Hatchery	30,240	29,000	62,000	94,000
	% hatchery	60%	73%	40%	37%
Escapement		**36,300**	**27,000**	**106,000**	**171,000**
	Wild/Natural	14,500	7,000	64,000	107,000
	Hatchery	21,800	20,000	42,000	64,000
	% hatchery	60%	74%	40%	37%
Harvest (Col Basin)		**31,100**	**25,000**	**94,000**	**153,000**
	Wild/Natural	12,400	7,000	57,000	96,000
	Hatchery	18,700	18,000	37,000	57,000
	% hatchery	60%	72%	39%	37%
Harvest (Total)		**72,600**	**56,000**	**222,000**	**360,000**
	Wild/Natural	29,000	15,000	134,000	225,000
	Hatchery	43,600	41,000	88,000	135,000
	% hatchery	60%	73%	40%	38%

Notes - Natural Production

Distribution: This stock is part of the Upper Columbia summer/fall Chinook ESU which also includes Hanford bright fall Chinook. Summer and fall Chinook were treated as separate CBP stocks due to their different life history and distribution. Major population groups and demographically independent populations are not formally designated under the ESA for this listed population. For the purposes of this exercise, historical population structure is assumed similar to that of spring Chinook For the purposes of this exercise, the regional technical team identified seven extant populations in the Columbia River and tributaries between the Yakima River and Chief Joseph Dam. Three of these "populations" were not historically significant (Entiat, Chelan and the mainstem Columbia between Rock Island and Chief Joseph Dams. Summer Chinook also historically migrated into currently blocked areas upstream from Chief Joseph and Grand Coulee Dams.

Historical abundance: Based on combination of harvest/consumption-based estimates by Upper Columbia River tribes and EDT-based estimates under assumed historical conditions.

Current abundance: Based on spawning surveys and dam counts.

Goals:

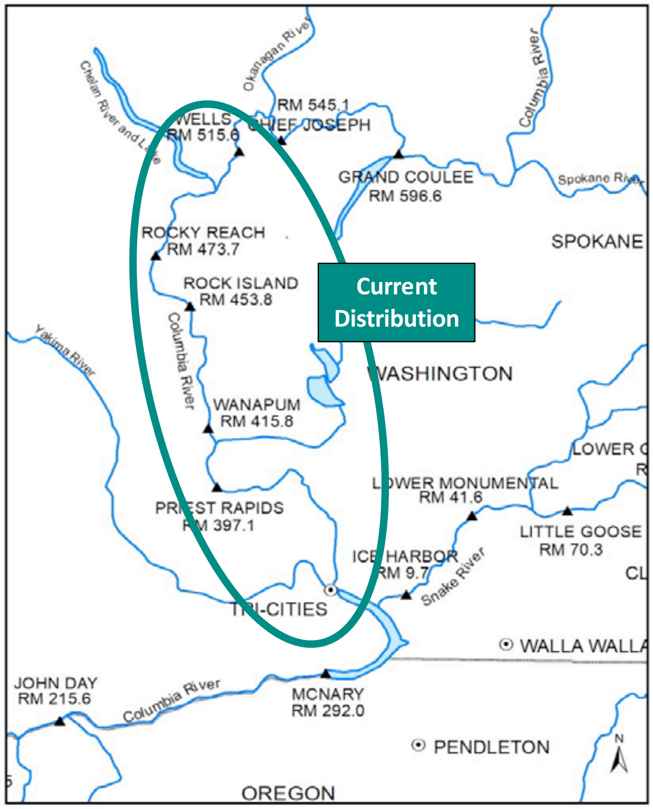
- *Low range:* Based on minimum abundance threshold values identified by the Interior Columbia Technical Recovery Team for similar-sized Spring Chinook populations. As current numbers are substantially greater this these minimal levels, the low-range numbers function primarily as biological reference points rather than goals for current management purposes. No goal is identified for the Entiat system which is not a historical population and is currently being managed for Spring Chinook. Value for blocked areas is equal to the minimum abundance threshold for five assumed historical populations upstream from Chief Joseph Dam – this number is intended to represent numbers of fish that would be available to Colville and Spokane Tribes in historical fishing areas under conditions equivalent to minimum viability of historical populations.

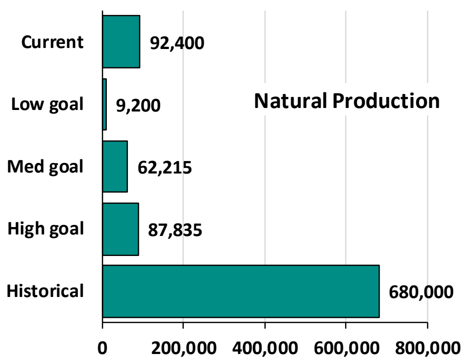
- *Medium range:* Current capacity/production-based optimum escapement levels for these healthy populations. Wenatchee value is based on stock-recruitment analysis. Okanogan value is based on EDT analysis under patient condition. Value for blocked areas is based on various models of habitat potential – this number is intended to represent numbers of fish that would be available to Colville and Spokane Tribes in historical fishing areas with restoration of significant production in the blocked area.

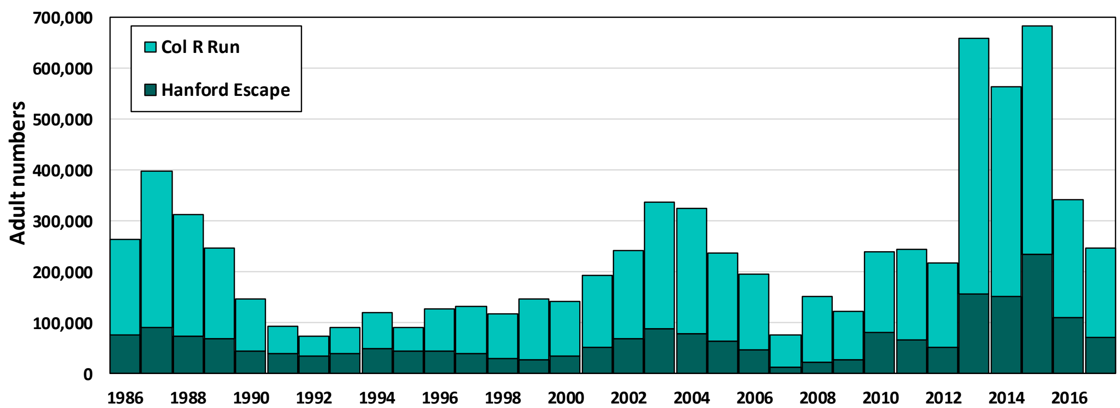
- *High range:* Values generally based on 1.5 times medium range goal reflecting potential improvements hypothesized by the Upper Columbia River technical team. The estimate for the Okanogan is based on EDT analysis.

Goals are identified for salmon and steelhead returning to the Columbia River upstream of Chief Joseph and Grand Coulee Dams. The intent of these goals is to restore meaningful fishing opportunities in areas of historical use by the Colville and Spokane tribes. Goals represent only returns to areas upstream from Chief Joseph and Grand Coulee dams and do not apportion production into specific populations or geographic areas.

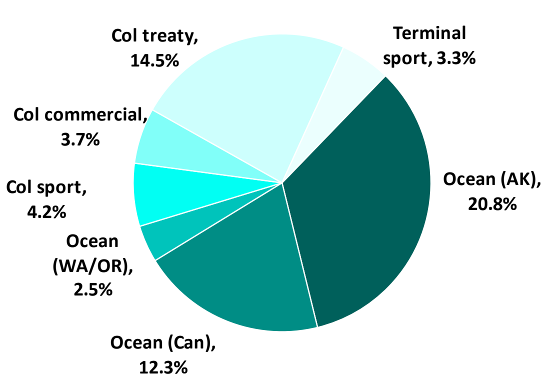
- Includes Hanford Bright fall Chinook, which are among the most abundant and most productive salmon stocks remaining in the Columbia Basin.
- This stock spawns in the unimpounded Columbia River mainstem between Richland, WA and Chief Joseph Dam.
- Fish also spawned in currently inaccessible portions of the river upstream from Chief Joseph Dam.
- This stock ranges widely in the ocean along the Pacific Coast where they are subject to fisheries from the Pacific Northwest to Canada and Alaska.





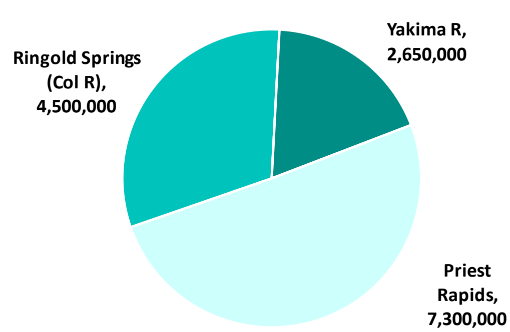


Harvest Distribution
(Exploitation rate vs. Ocean Adults)



Total 61.3%

Current Hatchery Production



Total 14,450,000

UPPER COLUMBIA Fall Chinook ▪ ESA: Not Listed ▪ Life History: Ocean rearing

Natural Production		Abundance		Potential Goal Range		
MPG	Population	Recent	Historical	Low	Med	High
UCR Fall	Hanford	70,400	500,000	4,200	40,950	51,188
	Yakima R	1,000	150,000	2,000	3,500	10,000
	PRD-CJD	21,000		1000	2,000	3,000
	Blocked area	0	30,000	2,000	15,765	23,648
	Totals	**92,400**	**680,000**	**9,200**	**62,215**	**87,835**

Hatchery Production	Current Production				Anticipated
Location (Program)	Brood	Yearlings	Subyearlings	Goal	production
Priest Rapids	7,376	0	7,300,000	54,000	7,300,000
Ringold Springs (Col R)		0	4,500,000		4,500,000
Yakima R		450,000	2,200,000		2,650,000
New (John Day Mitigation)	--	--	--	45,000	6,850,000
Blocked area	--	--	--	54,126	0.27-0.54 mil
Subtotal	**7,376**	**450,000**	**14,000,000**	**153,126**	**21.6-26.7 mil**

Fisheries / Harvest		Exploitation rate				Harvest	
	Location	Avg (v ocn)	Avg (v CR)	Limit	Potential	10-yr avg	Potential
Combined Hatch / Natl	Ocean (AK)	20.8%	--	--	40-80%	112,000	211,100
	Ocean (Can)	12.3%	--	--		66,300	
	Ocean (WA/OR)	2.5%	--	--		13,300	
	Col sport	4.2%	6.5%	21.5-45%		21,700	153,200
	Col commercial	3.7%	5.8%			20,900	
	Col treaty	14.5%	22.5%			75,900	
	Terminal sport	3.3%	5.2%			17,800	
	Blocked area	--	--	--		--	
	Total	***61.3%***	***39.9%***	***40-80%***	***40-80%***	***327,900***	***364,300***

Total Return		Recent avg (2008-2017)	@ Goals Low	@ Goals Med	@ Goals High
@ Columbia R Mouth		**346,900**	**142,800**	**262,300**	**382,200**
	Wild/Natural	228,800	13,600	133,100	166,400
	Hatchery	118,100	129,200	129,200	215,800
	% hatchery	34%	90%	49%	56%
@ Bonneville Dam		**305,600**	**125,800**	**231,000**	**336,600**
	Wild/Natural	201,600	12,000	117,200	146,500
	Hatchery	104,000	113,800	113,800	190,100
	% hatchery	34%	90%	49%	56%
To Upper Col R (MCN)		**231,500**	**93,100**	**170,900**	**249,100**
	Wild/Natural	152,700	8,900	86,700	108,400
	Hatchery	78,800	84,200	84,200	140,700
	% hatchery	34%	90%	49%	56%
Escape (MCN-PRD)		**133,000**	**54,700**	**100,500**	**146,300**
	Wild/Natural	87,600	5,200	51,000	63,700
	Hatchery	45,400	49,500	49,500	82,600
	% hatchery	34%	90%	49%	56%
Harvest (Col Basin)		**136,200**	**57,300**	**105,100**	**153,200**
	Wild/Natural	89,800	5,500	53,300	66,700
	Hatchery	46,400	51,800	51,800	86,500
	% hatchery	34%	90%	49%	56%
Harvest (Total)		**327,900**	**136,100**	**250,000**	**364,300**
	Wild/Natural	216,300	13,000	126,900	158,600
	Hatchery	111,600	123,100	123,100	205,700
	% hatchery	34%	90%	49%	56%

Notes - Natural Production

Distribution: This stock includes the large Hanford Reach population of bright fall Chinook which is currently one of the robust salmon runs in the Columbia Basin. Smaller numbers of fall Chinook also return to the lower Yakima River and mainstem Columbia between Priest Rapids and Chief Joseph Dams. This was historically likely one contiguous metapopulation but populations are identified here for accounting purposes. Major population groups and demographically independent populations are not formally designated under the ESA for this listed population. Fall Chinook also historically migrated into currently blocked areas upstream from Chief Joseph and Grand Coulee Dams.

Historical abundance: Generally based on assumed habitat availability, historical Columbia River runs and tribal utilization.

Current abundance: Based on spawning ground surveys and dam counts.

Goals:

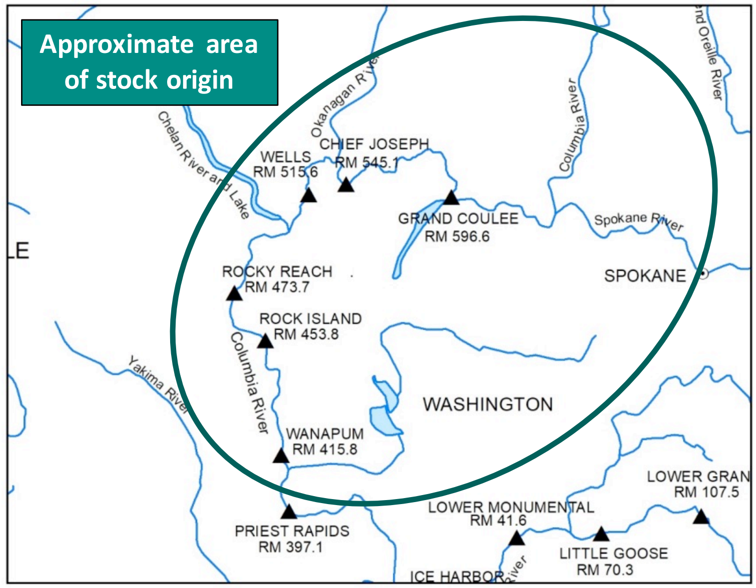
- *Low range:* Minimum abundance levels consistent with high viability are based on Snake River fall Chinook values defined in their recovery plan. As current numbers are substantially greater this these minimal levels, the low-range numbers function primarily as biological reference points rather than goals for current management purposes. Value for blocked areas is equal to the minimum abundance threshold for three assumed historical populations upstream from Chief Joseph Dam – this number is intended to represent numbers of fish that would be available to Colville and Spokane Tribes in historical fishing areas under conditions equivalent to minimum viability of historical populations.

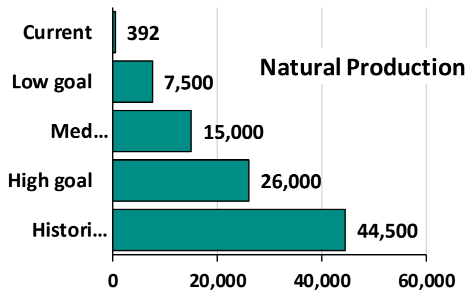
- *Medium range:* For the healthy Hanford Reach population, this goal is the current capacity/production-based optimum escapement level. The goal is based on stock-recruitment analysis of empirical data. Goals for the Yakima and PRD-CJD mainstem populations reflect modest improvement which might result from reasonable improvements in habitat and migration conditions. The value for the blocked area is based on various models of habitat potential – this number is intended to represent numbers of fish that would be available to Colville and Spokane Tribes in historical fishing areas with restoration of significant production in the blocked area.

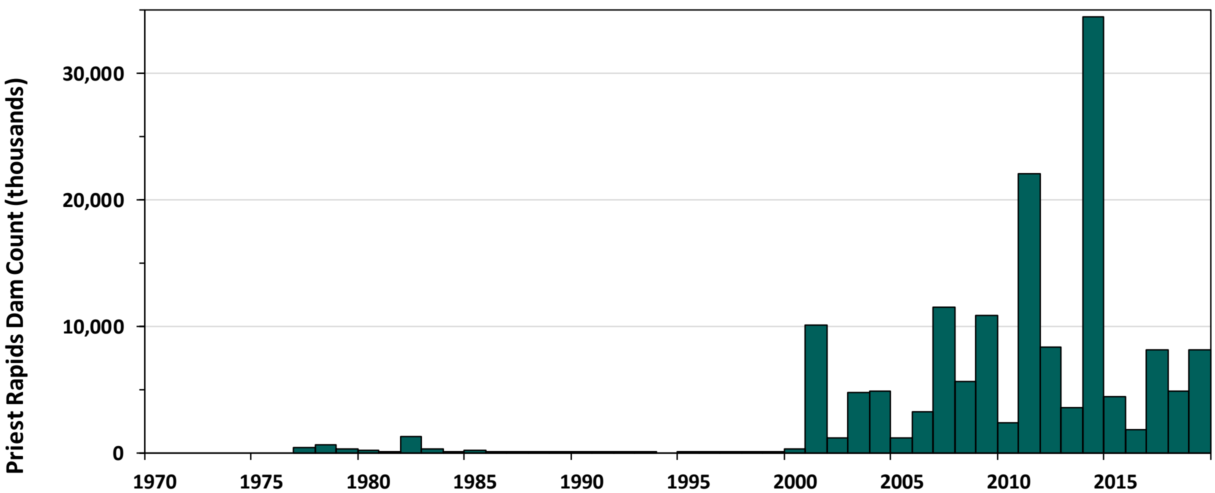
- *High range:* For the healthy Hanford Reach population, this goal is based on the potential improvements due to predator, habitat and migration condition management. The Yakima goal is identified by the Yakama Nation. The PRD-CJD mainstem population goal is the default of three times the low-range value. The value for the blocked area is based on 1.5 times the medium-range goal reflecting potential improvements hypothesized by the Upper Columbia River technical team.

Goals are identified for salmon and steelhead returning to the Columbia River upstream of Chief Joseph and Grand Coulee Dams. The intent of these goals is to restore meaningful fishing opportunities in areas of historical use by the Colville and Spokane tribes. Goals represent only returns to areas upstream from Chief Joseph and Grand Coulee Dams and do not apportion production into specific populations or geographic areas.

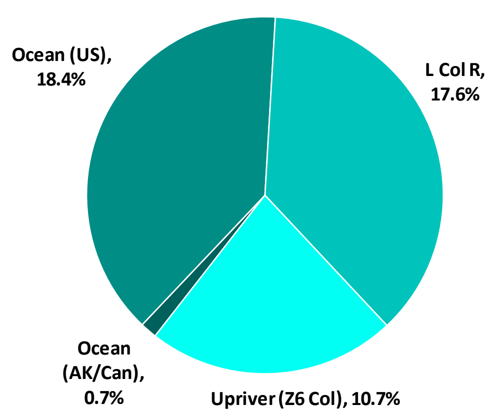
- "Upriver" Coho include fish returning to areas upstream from Bonneville Dam (including middle Columbia, upper Columbia and Snake Rivers).
- Coho were historically extirpated upstream from The Dalles Dam but have subsequently been reintroduced.
- Current run is predominately of hatchery origin but natural production is becoming re-established.





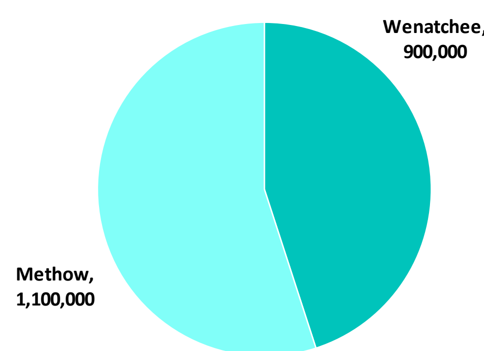


Current Fishery Distribution (Total Harvest)



Total 47%

Hatchery releases (smolts)



Total 2.0 million

Natural Production		Abundance		Potential Goal Range		
MPG	Population	Recent	Historical	Low	Med	High
Upper Columbia	Wenatchee	367	6,500	1,500	3,000	6,000
	Entiat	na	11,000	500	1,000	2,000
	Methow	25	27,000	1,500	3,000	6,000
	Okanogan	na	na	500	1,000	1,500
	Abv. Coulee	0	na	3,500	7,000	10,500
Total		**392**	**44,500**	**7,500**	**15,000**	**26,000**

Hatchery Production	Current Production		Return	Anticipated
Location (Program)	Subyearlings	Yearlings	goal	production
Wenatchee		900,000	5,374	900,000
Methow		1,100,000	1,399	1,100,000
Ringold Springs		0		250,000
Subtotal (Upriver)	**0**	**2,000,000**	**6,773**	**2,250,000**

Fisheries / Harvest		Exploitation rate			Harvest	
	Location	avg (v ocn)	avg (v CR)	Potential	10-yr avg	Potential
Hatchery / Natural	Ocean (AK/Can)	0.7%	--	≤70%	300	16,800
	Ocean (US)	18.4%	--		7,100	
	L Col R	17.6%	22.0%		2,300	20,000
	Upriver (Z6 Col)	10.7%	12.9%		3,800	
	Total	***47.3%***	***34.9%***	***≤70%***	**13,500**	***36,800***

Total Return		Abundance	@ Goals		
		recent	Low	Med	High
@ Columbia R Mouth		**29,500**	**41,000**	**52,500**	**69,400**
	Wild/Natural		11,500	23,000	39,900
	Hatchery	29,500	29,500	29,500	29,500
	% hatchery	100%	72%	56%	43%
To Mid Col R (BON)		**27,000**	**36,000**	**44,900**	**58,100**
	Wild/Natural		9,000	17,900	31,100
	Hatchery	27,000	27,000	27,000	27,000
	% hatchery	100%	75%	60%	46%
Escapement		**23,100**	**30,600**	**38,100**	**49,100**
	Wild/Natural		7,500	15,000	26,000
	Hatchery	23,100	23,100	23,100	23,100
	% hatchery	100%	75%	61%	47%
Harvest (Col basin)		**6,100**	**10,100**	**14,100**	**20,000**
	Wild/Natural	0	4,000	8,000	13,900
	Hatchery	6,100	6,100	6,100	6,100
	% hatchery	100%	60%	43%	31%
Harvest (total)		**13,500**	**20,200**	**27,000**	**36,800**
	Wild/Natural	0	6,700	13,500	23,300
	Hatchery	13,500	13,500	13,500	13,500
	% hatchery	100%	67%	50%	37%

Notes - Natural Production

Upriver coho are generally defined to include fish returning upstream from Bonneville Dam destined for areas of the middle Columbia, Upper Columbia and Snake.

Small numbers of coho returning to stream in Columbia River Gorge tributaries below and above Bonneville Dam are part of the listed Lower Columbia River coho ESU. Population-specific data for these listed Coho may be found in the Lower Columbia coho stock summary. For ease of calculation, small numbers of listed Lower Columbia River coho are included in the run reconstruction for upriver coho stock.

Distribution: Upriver coho historically returned to tributaries throughout the Middle Columbia, Upper Columbia, and Snake River basins. NOAA Fisheries' project team and regional technical team members tentatively identified at least 15 historical populations. These populations have been largely extirpated. Reintroduction efforts are underway. ESUs or MPGs were not formally identified by technical recovery teams for these upriver coho populations – therefore the project team inferred ESUs and MPGs based on similar delineations in the Lower Columbia River.

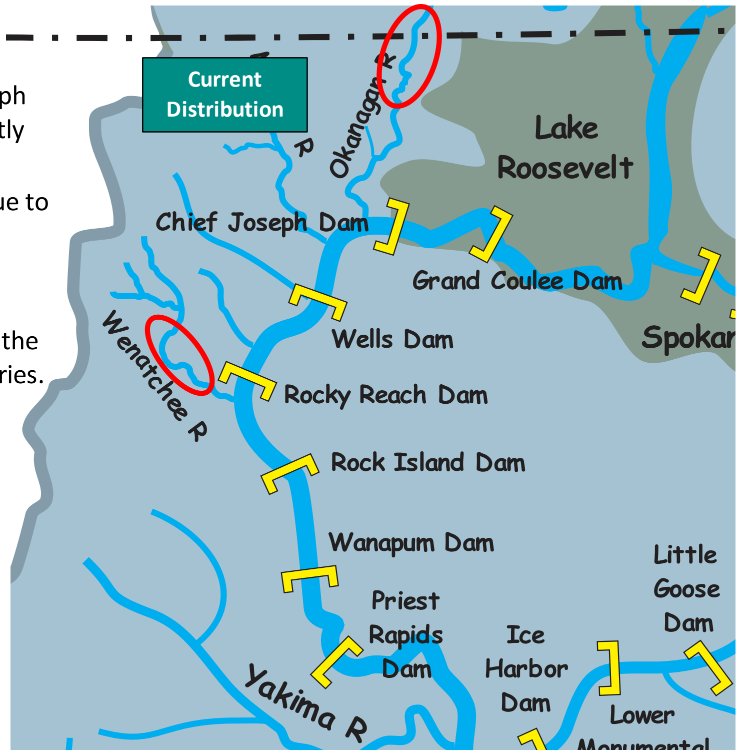
Historical abundance: Information on historical abundance is limited. Estimates for individual populations are based on a mix of EDT results and expert judgement.

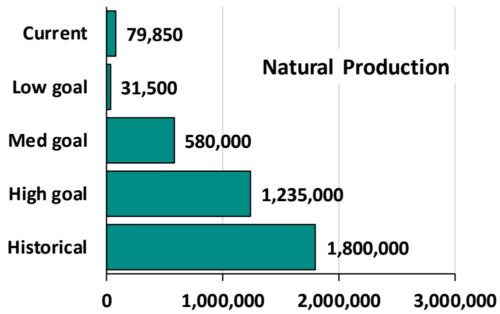
Current abundance: For Wentachee and Methow based on spawning ground surveys occurring as part of the ongoing reintroduction monitoring program.

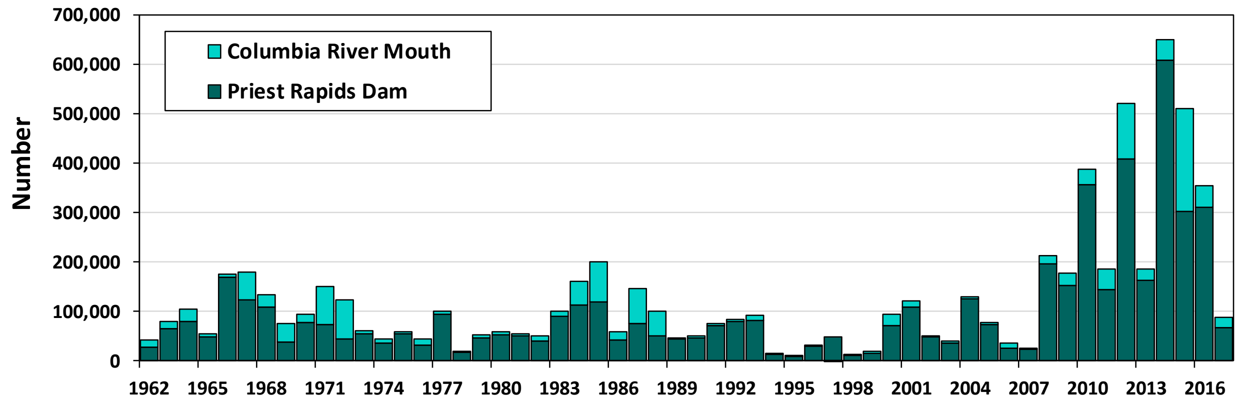
Goals:

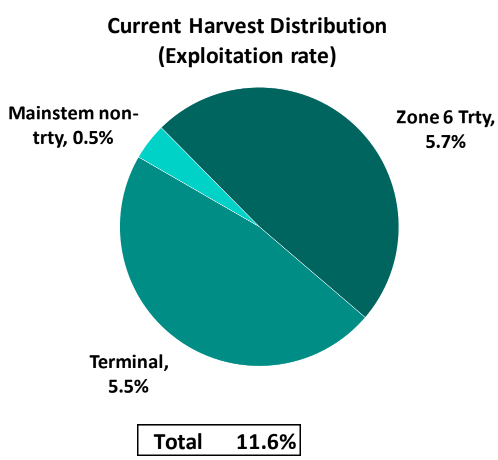
- *Low-range*: Based on ICTRT MATs.
- *Medium-range*: Mid-point between low and high goals.
- *High-range*: Generally, three to four times low goal as placeholders.

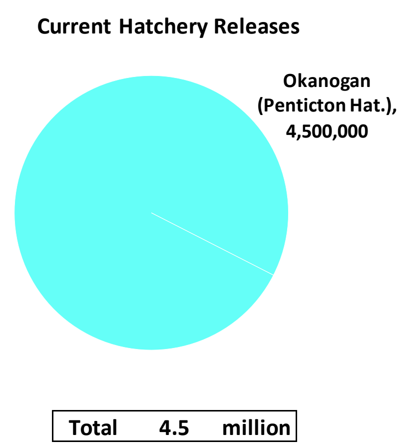
- Historically produced in large natural lakes where juvenile sockeye rear.
- Historical habitat upstream from Chief Joseph Dam and the upper Okanogan is not currently accessible under current management.
- Abundance has increased in recent years due to tributary passage and water management improvements in the Okanogan system and favorable marine survival.
- This stock ranges widely in the ocean along the Pacific Coast where it is not subject to fisheries. Columbia River fisheries are limited as well.











Natural Production	Abundance (mean)		Potential Goal Range		
Population	**Recent**	**Historical**	**Low**	**Med**	**High**
Wenatchee	21,850	35,000	3,500	23,000	35,000
Okanogan	19,000	500,000	10,500	207,000	500,000
Blocked area	0	1,265,000	17,500	350,000	700,000
Totals	**40,850**	**1,800,000**	**31,500**	**580,000**	**1,235,000**

Hatchery Production	Current Production		Return	Anticipated
Location (Program)	**Brood**	**Subyearlings**	**Goal**	**production**
Okanogan (Penticton Hat.)	3,000	4,500,000	250,000	5,000,000
Blocked Area	0	0	360,000	9,100,000
Subtotal	**3,000**	**4,500,000**	**610,000**	**14,100,000**

Fisheries / Harvest		Exploitation rate				Harvest	
	Location		**Avg.**	**Limits**	**Potential**	**10 yr avg**	**Potential**
Combined Hatchery/Natural	Ocean	--	0	--	--	--	--
	Mainstem non-trty	v Col R	0.5%	6-8+%	20-60%	1,600	1,000,000
	Zone 6 Trty	v Col R	5.7%			19,300	
	Terminal	v Col R	5.4%	<18%		21,000	
	Blocked area		0.0%			0	
	Total	**v Col R**	***11.6%***	***6-26+%***	***20-60%***	***41,900***	***1,000,000***

Total Return		Recent avg (2008-2017)	@ Goals		
			Low	**Med**	**High**
@ Columbia R Mouth		**329,000**	**262,900**	**1,042,900**	**2,740,000**
	Wild/Natural	296,100	230,000	1,010,000	2,640,000
	Hatchery	32,900	32,900	32,900	100,000
	% hatchery	10%	13%	3%	4%
@ Bonneville Dam		**322,000**	**263,000**	**1,033,000**	**2,660,000**
	Wild/Natural	289,800	230,000	1,000,000	2,560,000
	Hatchery	32,200	33,000	33,000	100,000
	% hatchery	10%	13%	3%	4%
To Upper Col R (PRD)		**271,000**	**217,000**	**805,000**	**1,444,000**
	Wild/Natural	243,900	190,000	780,000	1,390,000
	Hatchery	27,100	27,000	25,000	54,000
	% hatchery	10%	12%	3%	4%
Escapement		**221,800**	**172,000**	**599,000**	**1,265,000**
	Wild/Natural	199,620	150,000	580,000	1,240,000
	Hatchery	22,180	22,000	19,000	25,000
	% hatchery	10%	13%	3%	2%
Harvest (Col Basin)		**41,900**	**33,500**	**1,011,800**	**1,122,200**
	Wild/Natural	37,700	29,300	1,003,500	1,054,100
	Hatchery	4,200	4,200	8,300	68,100
	% hatchery	10%	13%	1%	6%

Notes - Natural Production

Distribution: This stock includes the Wenatchee and Okanogan populations, both of which are relatively healthy. Sockeye also historically occurred in the Yakima system where they are currently being introduced. Large populations were present in Canadian Lakes upstream from current passage barriers at Chief Joseph, Grand Coulee, Keenleyside, and Revelstoke Dams.

Historical abundance: Based on historical river mouth returns inferred from Lower Columbia River harvests and relative amounts of habitat available to individual populations. The value for the blocked area is based on various models of habitat potential – this number is intended to represent numbers of fish that would be available to Colville and Spokane Tribes in historical fishing areas with restoration of significant production in the blocked area.

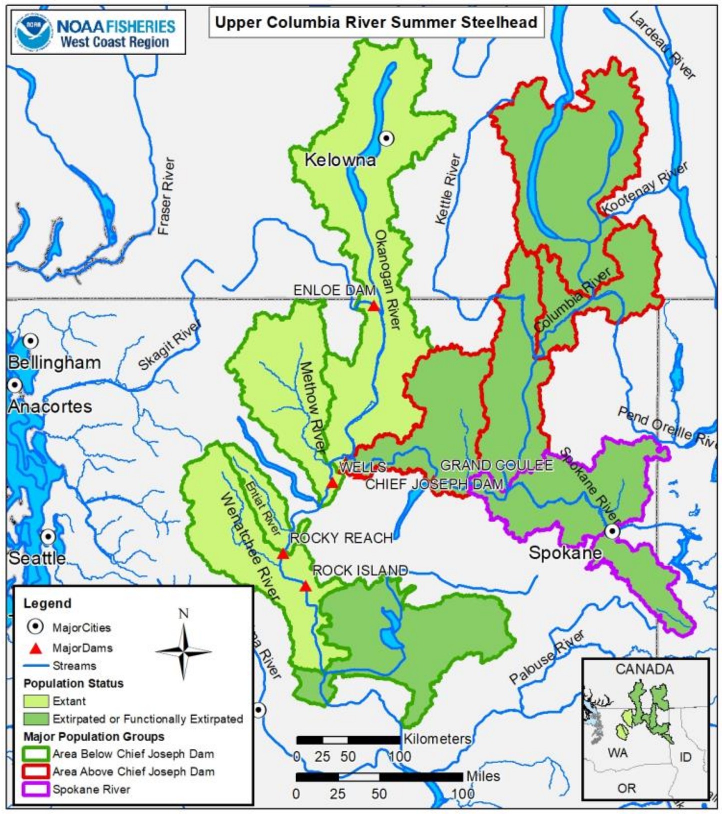
Current abundance: Based on spawning ground surveys and dam counts.

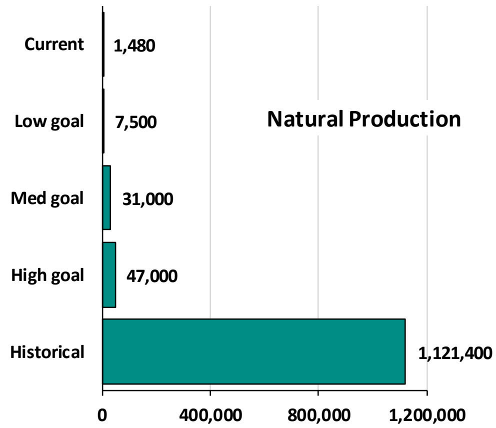
Goals:

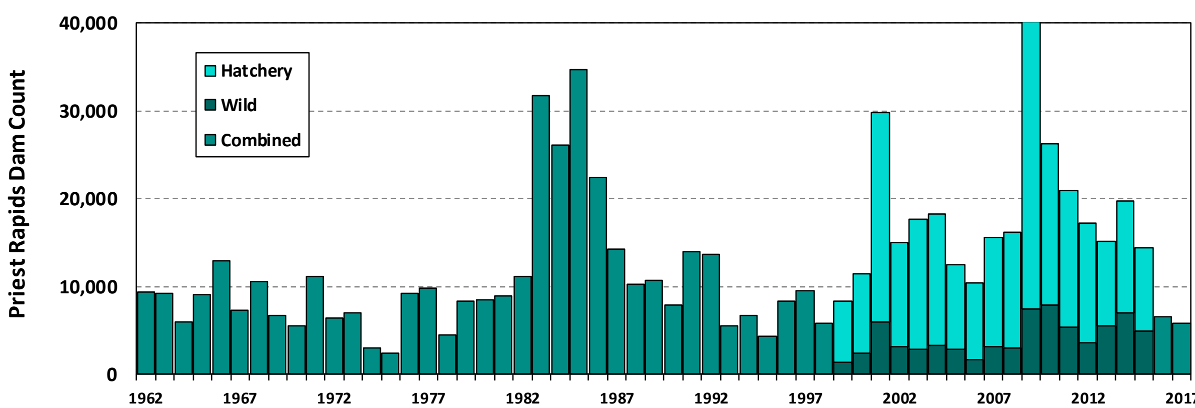
- *Low range:* Based on values identified for Snake River populations. As current numbers in the Okanogan and Wenatchee are substantially greater than this these minimal levels, the low range numbers function primarily as biological reference points rather than goals for current management purposes. The value for blocked areas is equal to the minimum abundance threshold for five assumed historical populations upstream from Chief Joseph Dam – this number is intended to represent numbers of fish that would be available to Colville and Spokane Tribes in historical fishing areas under conditions equivalent to minimum viability of historical populations.
- *Medium range:* For the healthy Wenatchee and Okanogan populations, goals are current capacity/production-based optimum escapement levels. The Wenatchee goal is based on empirical return data. The Okanogan goal is based on current habitat availability in accessible areas (not including Okanogan Lake in Canada which was historically a large producer of Sockeye). Values for the Yakima were provided by the YN and assume reintroduced levels of 8,000 fish for each of five populations.
- *High range:* For the Wenatchee and Okanogan populations, goals are based on production potential with continuing habitat improvements. Values for the Yakima were provided by the YN. Numbers for both the Yakima and the areas upstream from Chief Joseph and Grand Coulee Dams assume substantial improvements in production potential for sockeye due to increased rearing habitat provided by reservoirs.

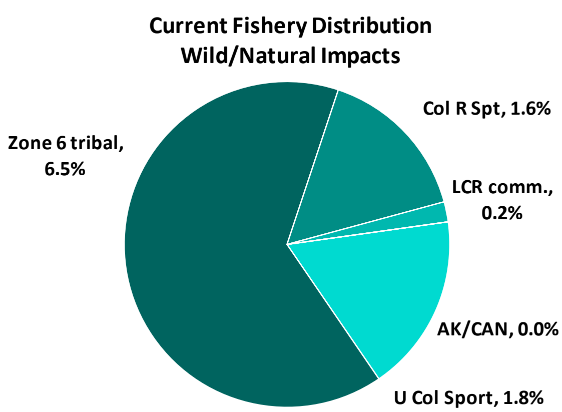
Goals are identified for salmon and steelhead returning to the Columbia River in currently blocked areas upstream of Chief Joseph and Grand Coulee Dams. The intent of these goals is to restore meaningful fishing opportunities in areas of historical use by the Colville and Spokane tribes. Goals represent only returns to areas upstream from Chief Joseph and Grand Coulee Dams and do not apportion production into specific populations or geographic areas.

- Currently inhabits large tributaries upstream from Priest Rapids Dam.
- A large portion of the historical habitat upstream from Chief Joseph and Grand Coulee Dams is no longer accessible under current management.
- This stock ranges widely in the ocean along the Pacific Coast where it is not subject to fisheries.
- Hatchery production is significant.

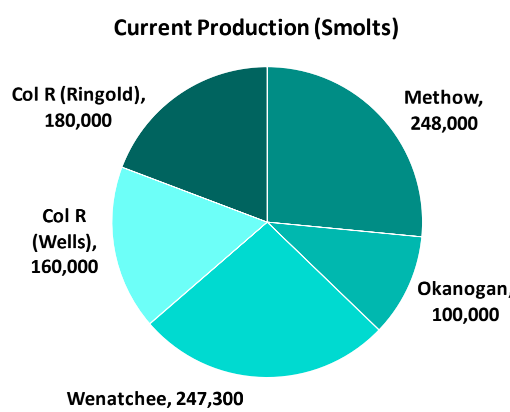








Total 10.1%



Total 935,300

Natural Production		Abundance		Potential Goal Range		
MPG	**Population**	**Recent**	**Historical**	**Low**	**Med**	**High**
N Cascades	Crab	na	0	--	--	--
	Entiat	140	500	500	1,000	1,500
	Methow	790	3,600	1,000	1,100	1,650
	Okanogan	240	10,000	500	1,900	2,850
	Wenatchee	310	7,300	1,000	2,000	3,000
Blocked area		0	1,100,000	4,500	25,000	38,000
Totals		**1,480**	**1,121,400**	**7,500**	**31,000**	**47,000**

Hatchery Production	Current Production		Return	Anticipated
Location (Program)	**Brood**	**Yearlings**	**Goal**	**production**
Methow	202	248,000		348,000
Okanogan	58	100,000		100,000
Wenatchee	140	247,300		247,300
Col R (Wells)	108	160,000		160,000
Col R (Ringold)		180,000		180,000
New (blocked area)	0	0		50,000 - 3 mil
Subtotal	**508**	**935,300**		**1.0 - 4.1 mil**

Fisheries / Harvest		Exploitation rate (v Col R)			Harvest	
	Location	**Avg.**	**Limits**	**Potential**	**10-yr avg**	**Potential**
Wild/Natural	Ocean	0	--	--	0	--
	Mainstem Non-treaty	1.8%	15-22%	20-50%	100	99,000
	Mainstem Treaty	6.5%			400	
	Terminal (>PRD)	1.8%	5-12%		100	
	Blocked area	0.0%			0	
	Total	***10.1%***	**20-34%**	**20-50%**	***600***	
Hatchery	Ocean	0	--	--	0	--
	Mainstem Non-treaty	12.0%	--	<70%	2,500	27,000
	Mainstem Treaty	6.1%	--		1,300	
	Terminal (>PRD)	24.9%	--		5,300	
	Blocked area	--	--		--	
	Total	***43.0%***	***--***	***<70%***	***9,100***	

Total Return		Recent avg (2006-2015)	@ Goals Low	Med	High
@ Columbia R Mouth		**27,700**	**57,000**	**210,000**	**342,000**
	Wild/Natural	6,400	37,000	171,000	284,000
	Hatchery	21,300	20,000	39,000	58,000
	% hatchery	77%	35%	19%	17%
@ Bonneville Fam		**26,700**	**55,000**	**202,000**	**327,000**
	Wild/Natural	6,400	36,000	165,000	272,000
	Hatchery	20,300	19,000	37,000	55,000
	% hatchery	76%	35%	18%	17%
To Upper Col R (PRD)		**19,600**	**40,000**	**137,000**	**211,000**
	Wild/Natural	5,000	26,000	110,000	170,000
	Hatchery	14,600	14,000	27,000	41,000
	% hatchery	74%	35%	20%	19%
Escapement					
	Wild/Natural	1,500	8,000	31,000	48,000
	Hatchery				
	% hatchery				
Harvest (Col Basin)		**9,700**	**16,000**	**68,000**	**126,000**
	Wild/Natural	600	7,000	50,000	99,000
	Hatchery	9,100	9,000	18,000	27,000
	% hatchery	94%	56%	26%	21%
Harvest (total)		**9,700**	**16,000**	**68,000**	**126,000**
	Wild/Natural	600	7,000	50,000	99,000
	Hatchery	9,100	9,000	18,000	27,000
	% hatchery	94%	56%	26%	21%

Notes - Natural Production

Distribution: Historically distributed in Wenatchee, Entiat, Methow, and Okanogan subbasins as well as currently blocked areas upstream from Chief Joseph and Grand Coulee Dams. At least 7 populations were historically assumed to occur upstream from Chief Joseph Dam (Spokane, Hangman, Sanpoil, Kettle/Colville, Kootenay, Pend Oreille, and headwaters). Summer steelhead also currently occur in Crab Creek where summer flows have been substantially increased from historical levels due to irrigation return flows.

The UCR steelhead DPS includes all naturally spawned anadromous O. mykiss (steelhead) populations below natural and artificial impassable barriers in streams within the Columbia River Basin, upstream from the Yakima River, Washington, to the U.S./Canada border. The DPS comprises four independent populations, which are grouped into one MPG. Historically, there were likely three MPGs. Two additional steelhead MPGs likely spawned above Grand Coulee and Chief Joseph Dams, but these MPGs are extirpated, and reintroduction is not required for recovery as defined in the ESA recovery plan.

Historical abundance: Based on harvest/consumption-based estimates by Upper Columbia River tribes.

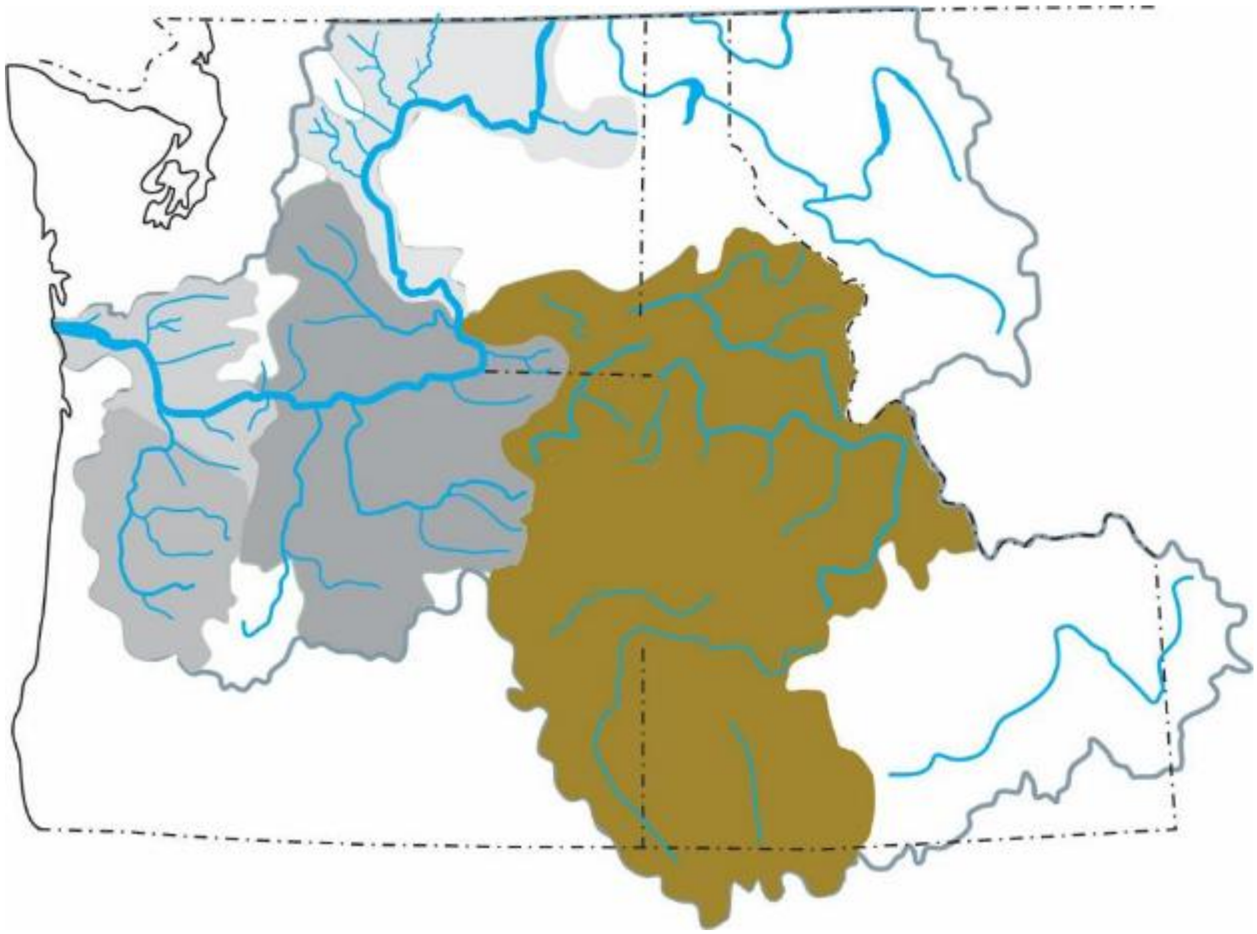
Current abundance: Based on spawning ground surveys.

Goals:

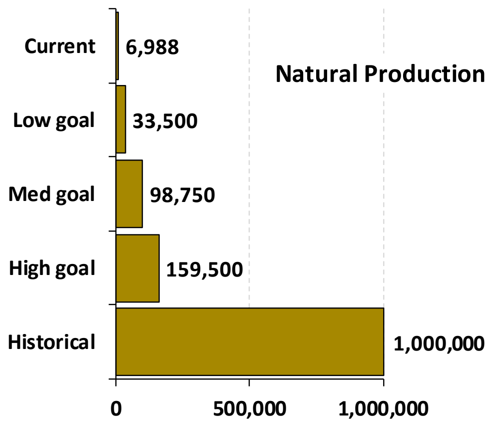
- *Low range:* Based on recovery plan goals in the currentlyaccessible area. Value for blocked areas is equal to the minimum abundance threshold for seven assumed historical populations upstream from Chief Joseph Dam – this number is intended to represent numbers of fish that would be available to Colville and Spokane Tribes in historical fishing areas under conditions equivalent to minimum viability of historical populations.
- Medium: Based on modeled equilibrium abundance using EDT model assuming implementation of a suite of habitat restoration actions as reported in the recovery plan appendix. Value for blocked areas is intermediate between low and high values.
- *High range:* Values generally based on 1.5 times the medium-range goal reflecting potential improvements hypothesized by the Upper Columbia River technical team.

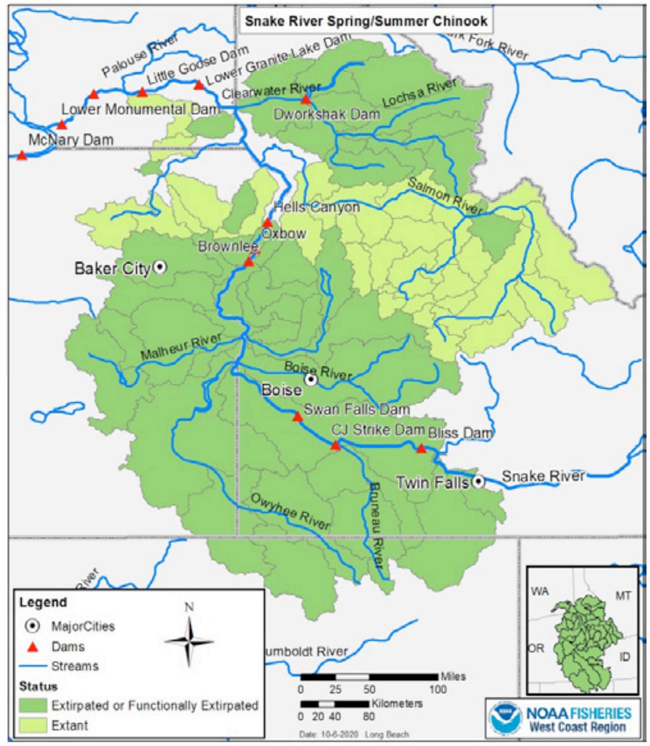
Goals are identified for salmon and steelhead returning to the Columbia River upstream of Chief Joseph and Grand Coulee Dams. The intent of these goals is to restore meaningful fishing opportunities in areas of historical use by the Colville and Spokane tribes. Goals represent only returns to areas upstream from Chief Joseph and Grand Coulee Dams and do not apportion production into specific populations or geographic areas.

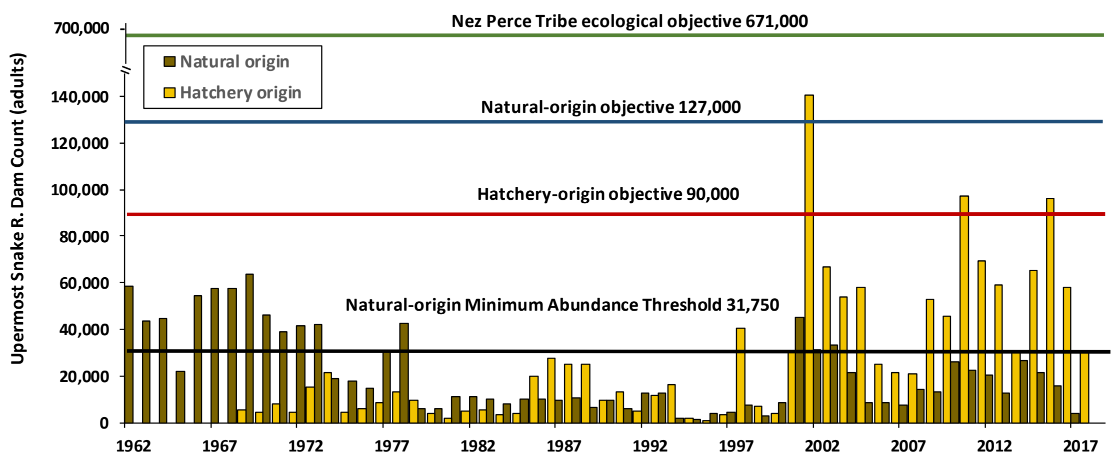
SNAKE



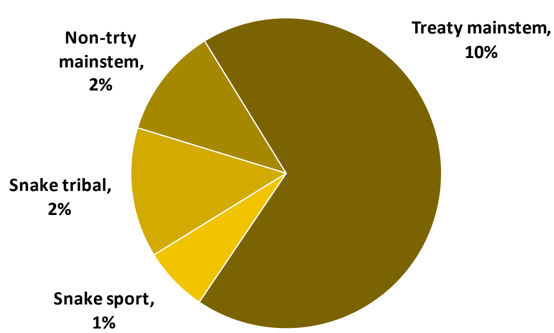
- Inhabits moderate to high elevation areas of major tributaries.
- Historically exceeded one million fish annually in the late 1800s according to the ESA recovery plan.
- Areas upstream from the Hells Canyon Dam complex are not currently accessible.
- Harvest occurs entirely in freshwater and is much reduced from historical levels.
- Hatchery production is significant.





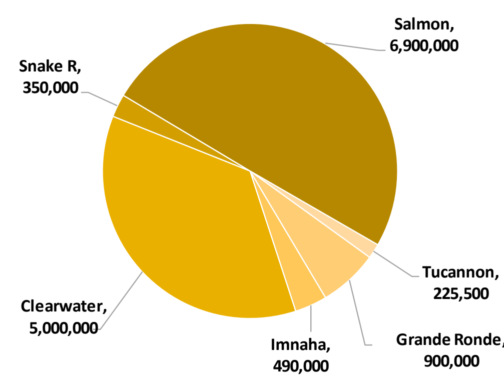


Fishery Distribution Natural-origin 2007-2016 avg.



Total 14.4%

Hatchery Production by release area (smolts)



Total 13.9 million

Natural Production			Abundance (mean)		NPT ecological	Potential Goal Range		
	MPG	Population	Recent	1950s	goal	Low	Med	High
Downstream from Hells Canyon Dam	L. Snake	Tucannon	240	na	22,000	750	1,875	3,000
		Asotin*	10	0	10,000	500	1,250	2,000
	Dry Clearwater	Potlatch*	0	0		500	1,250	2,000
		Lapwai/Big Canyon*	0	0	15,000	750	1,875	3,000
		Lawyer*	0	0	13,000	500	1,250	2,000
		Upper South Fork*	na	0	22,000	1,000	2,500	4,000
	Wet Clearwater	N Fk Lower mainstem*	0	0		1,000	2,500	4,000
		N Fk Upper mainstem*	0	0		750	1,875	3,000
		Lolo*	na	0	15,000	500	1,250	2,000
		Lochsa*	na	0	24,000	1,000	2,500	4,000
		Meadow*	na	0	8,000	500	1,250	2,000
		Moose*	na	0	12,000	750	1,875	3,000
		Upper Selway*	na	0	18,000	1,000	2,500	4,000
	Grande Ronde / Imnaha	Wenaha	420	820	13,000	750	1,875	3,000
		Minam	530	1,276	14,000	750	1,875	3,000
		Catherine	190	969	22,000	750	1,875	3,000
		Lookingglass*	na	na	3,000	500	1,250	2,000
		Lostine/Wallowa	635	926	36,000	1,000	2,500	4,000
		U Grande Ronde	70	111	31,000	1,000	2,500	4,000
		Imnaha	410	2,340	38,000	750	1,875	3,000
		Big Sheep*	na	na		500	1,250	2,000
	South Fork Salmon	Little Salmon	na		14,000	500	1,250	2,000
		Secesh	na	828	15,000	750	1,875	3,000
		South Fork Salmon	510	3,270	24,000	1,000	5,000	8,000
		East Fork South Fork	na	537	19,000	1,000	2,500	4,000
	Middle Fork Salmon	Chamberlain	840	780	11,000	500	1,250	2,000
		Big	200	620	19,000	1,000	2,500	4,000
		Lower Middle Fork	10	60	6,000	500	1,250	2,000
		Camas	40	240	8,000	500	1,250	2,000
		Loon	60	540	9,000	500	1,250	2,000
		Upper Middle Fork Salmon	80	560	17,000	750	1,875	3,000
		Sulphur	90	280	4,000	500	1,250	2,000
		Bear Valley	510	1,540	16,000	750	1,875	3,000
		Marsh	400	510	7,000	500	1,250	2,000
	Upper Salmon	North Fork Salmon	100	290	6,000	500	1,250	2,000
		Lemhi	200	1,160	43,000	2,000	5,000	8,000
		Lower Mainstem Salmon	90	1,210	46,000	2,000	5,000	8,000
		Pahsimeroi	270		35,000	1,000	2,500	4,000
		East Fork Salmon	440	1,320	18,000	1,000	2,500	4,000
		Yankee Fork Salmon River	90	220	7,000	500	1,250	2,000
		Valley	150	450	9,000	500	1,250	2,000
		Upper Mainstem Salmon	390	1,350	22,000	1,000	2,500	4,000
		Panther*	13	0	na	750	1,875	3,000
Subtotal			**6,988**	**22,207**	**671,000**	**33,500**	**86,250**	**138,000**

Natural Production			Abundance (mean)		USRT near-term	Potential Goal Range***		
	MPG	Population	Recent	Historical	harvest goal**	Low	Med	High
Upstream from Hells Canyon Dam	Middle Snake (Pine to Weiser)	Pine Creek	0	na	--	--	500	1,000
		Wildhorse Creek	0	na	--	--	500	500
		Eagle Creek	0	na	--	--	500	500
		Powder River	0	na	--	--	500	1,000
		Burnt River	0	na	--	--	500	750
		Crane Creek/Lower Weiser	0	na		--	500	750
		Little Weiser	0	na	500-2,000**	--	500	750
		Upper Weiser	0	na		--	500	750
	Payette/ Boise	Big/Little Willow Creeks	0	na	--	--	500	750
		Squaw Creek	0	na	--	--	500	750
		North Fork Payette	0	na	2000**	--	500	1,000
		South Fork Payette	0	na		--	500	1,000
		Boise River	0	na	500**	--	500	1,000
	Malheur	Willow Creek/Lower Malheur	0	na		--	500	1,000
		North Fork Malheur	0	na	2,000-3,000**	--	500	1,000
		Upper Malheur	0	na		--	500	1,000
	Owyhee	Lower Owyhee	0	na	500-1,000**	--	500	1,000
		Little Owyhee	0	na	--	--	500	1,000
		South Fork Owyhee	0	na	--	--	500	1,000
		Upper Owyhee	0	na	3,000-4,000**	--	500	1,000
	Upper Snake	Canyon Creek	0	na	--	--	500	1,000
		Lower Bruneau	0	na	1,000**	--	500	750
		Upper Bruneau	0	na		--	500	750
		Salmon Falls	0	na	--	--	500	1,000
		Rock Creek (Upper Salmon)	0	na	--	--	500	500
Subtotal			**0**	**na**	**9.500-13,500****	**--**	**12,500**	**21,500**
Total			**6,988**	**1,000,000**	**--**	**33,500**	**98,750**	**159,500**

** Functionally extirpated (some of which are being reintroduced).*

*** Upper Snake River Tribes near-term harvest goal identified for outplanting of unlisted hatchery-origin adults.*

****Until delisting occurs, these numbers represent outplanting of unlisted hatchery-origin adults. Upon delisting, the medium and high range goals represent natural production goals.*

Hatchery Production Location (Program)	Release	Type	Brood	Current Production Smolts	Subyearlings	Return Goal	Anticipated production
McCall Hatchery	Johnson Cr	Summer	100	150,000		8,000	same
	S Fk Salmon	Summer	648	1,000,000			same
	Curtis/Cabin Cr.	Summer	175		300,000		same
Pahsimeroi Hatchery	Pahsimeroi	Summer	648	1,000,000		8,000	same
TBD	Panther Cr	Summer					TBD
Tucannon/Lyons Ferry	Tucannon	Spring	150	225,500		1,152	same
TBD	Asotin Cr	Spring					TBD
Lookingglass Hatchery	Catherine Cr	Spring	100	150,000		5,820	same
	U Grande Ronde	Spring	165	250,000			same
	Lostine	Spring	165	250,000			same
	lookingglass Cr	Spring	165	250,000			same
	Imnaha	Spring	320	490,000		3,210	same
Rapid River Hatchery	Rapid	Spring	1,621	2,500,000		24,000	same
	Little Salmon	Spring	100	150,000			same
	Hells Cyn Snake R	Spring	230	350,000			same
Sawtooth Hatchery	Salmon R	Spring	972	1,800,000		19,445	same
Crystal Spr/Sawtooth	Yankee Fk Salmon	Spring	200	300,000			same
Nez Perce Tribal Hat.	Meadow (Selway)	Spring	285		400,000	9,135	same
	Lolo Cr	Spring	106		150,000		same
	Newsome Cr	Spring	55		75,000		same
NPTH / Dworshak NFH	Clearwater R	Spring	130	200,000			same
Dworshak NFH	U Selway R	Spring	215		300,000		same
	NF Clearwater R	Spring	690	1,050,000			same
Kooskia Hatchery	Clear Cr	Spring	425	650,000			same
Clearwater Hatchery	Other locations	Spring	260	1,000,000		11,915	same
	Clear Cr	Spring	415	900,000			same
	Red River	Spring	715	1,200,000			same
TBD	Upper Snake	Spring	--	0			4,000,000
Subtotal			***12,000***	***13,865,500***	***1,225,000***	***90,677***	***17,865,500***

Fisheries / Harvest	Location		Exploitation rates Avg.	Limits	Potential	Harvest 10 yr avg	Potential
Natural	Ocean	--	0%	--	--	--	--
	Mainstem Non-trty	v Col R.	1.7%	5.5-17%	20-60%	450	155,000
	Mainstem Trty	v Col R.	10.1%			2,900	
	Snake R Sport	v L Gr	3.5%	0-4%		600	
	Snake R Tribes	v L Gr					
	Total	v Col R.	***14.4%***	***5.5-19%***	***20-60%***	***3,950***	***155,000***
Hatchery	Ocean	--	0%	--	--	--	--
	Mainstem Non-trty	v Col R.	12.1%	--	≤70%	10,300	78,000
	Mainstem Treaty	v Col R.	10.1%	--		8,200	
	Snake R Sport	v L Gr	18.0%	--		10,900	
	Snake R Tribes	v L Gr	18.0%	--		10,900	
	Total	v Col R.	***47.1%***		***≤70%***	***40,300***	***78,000***

Total Return (averages)		Recent (2008-2017)	@ goals Low	Med	High
@ Columbia R Mouth		**112,900**	**152,500**	**328,000**	**549,000**
	Natural	27,400	67,000	232,000	441,000
	Hatchery	85,500	85,500	96,000	108,000
	% hatchery	76%	56%	29%	20%
@ Bonneville Dam		**100,700**	**140,200**	**302,400**	**487,600**
	Natural	26,900	66,400	220,700	401,000
	Hatchery	73,800	73,800	81,700	86,600
	% hatchery	73%	53%	27%	18%
Lower Granite Dam		**78,100**	**103,500**	**212,250**	**325,000**
	Natural	17,600	43,000	137,000	235,000
	Hatchery	60,500	60,500	75,250	90,000
	% hatchery	77%	58%	35%	28%
Tributary return		**48,400**	**68,300**	**124,800**	**183,500**
	Natural	13,600	33,500	98,800	159,500
	Hatchery	34,800	34,800	26,000	24,000
	% hatchery	72%	51%	21%	13%
Harvest (Columbia basin)		**44,230**	**50,300**	**122,000**	**233,000**
	Natural	3,930	10,000	58,000	155,000
	Hatchery	40,300	40,300	64,000	78,000
	% hatchery	91%	80%	52%	33%

Notes - Natural Production

Distribution: The ESU includes all naturally spawned populations of spring/summer-run Chinook salmon in the mainstem Snake River and the Tucannon River, Grande Ronde River, Imnaha River, and Salmon River subbasins. The ICTRT identified 5 MPGs, containing 28 extant populations, 3 functionally extirpated populations, and 1 extirpated population, in the Snake River spring/summer Chinook salmon ESU: (1) Upper Salmon River MPG (8 extant populations and 1 extirpated population); (2) Middle Fork Salmon River MPG (9 extant populations); (3) South Fork Salmon River MPG (4 extant populations); (4) Grande Ronde/Imnaha River MPG (6 extant populations and 2 functionally extirpated populations); (5) Lower Snake River MPG (1 extant population and 1 functionally extirpated population). The South Fork and Middle Fork Salmon Rivers currently support most of the natural spring/summer Chinook salmon production in the Snake River drainage. Historically, Snake River spring/summer Chinook salmon also spawned and reared in areas above the Hells Canyon dams on the Snake River and in the North Fork Clearwater River.

Historical abundance: Historical abundance during the 1950s is documented where available based on stream survey information. However, Information or inferences for historical abundance prior to to development is not available for most populations. Estimates of production potential identified by the Nez Perce Tribe as ecological goals were included instead for reference purposes.

Current abundance: Current spawning escapement is estimated for most extant populations based on annual ground surveys, which count fish redds in representative portions of the spawning grounds. Spawning ground surveys have been conducted in many areas since the 1950s.

Goals:

- *Low range:* Minimum Abundance Thresholds (MAT) were identified by the Interior Columbia Technical Recovery Team for currently accessible areas downstream from Hells Canyon Dam. Low-range goals were not identified for natural production in currently blocked areas upstream from Hells Canyon Dam recognizing near-term agreements and challenges in habitat conditions and passage. Near-term objectives recognize needs and opportunities for adult outplants in selected areas to support harvest and assessment.
- *Medium range:* Mid-point between low and high-range goals for currently accessible areas downstream from Hells Canyon Dam for currently accessible areas downstream from Hells Canyon Dam. Mid-range goals for natural production in currently blocked areas upstream from Hells Canyon Dam identify basic (minimum) viability levels for all populations.
- *High range*: High-range goals are four times the low-range goal (i.e., four times MAT) for currentlyaccessible areas downstream from Hells Canyon Dam. This multiplier is based on estimates of historical spawning escapements during the 1950s, which were deemed by the CBP Snake River regional technical group to be a reasonable representation of the potential production capacity of existing habitats. High-range goals or natural production in currently-blocked areas upstream from Hells Canyon Dam are based on minimum abundance thresholds inferred from rule set developed and applied by the Technical Recovery Teams

to similar populations by species (equivalent to a viable population with low extinction risk (≤5% risk of extinction in 100 years).[13]

Related Policy Statements Regarding Potential Fish Restoration in Blocked Areas

Upper Snake River Tribes:

The USRT have developed a plan seeking to restore anadromous fishing opportunities in currently inaccessible areas. Harvest goals of the USRT reflect an immediate need and urgency to restoring tribal fisheries to tributaries upstream of the Hells Canyon Complex to prevent further loss of cultural practices. Due to the risk of further cultural loss, the USRT view progress towards both fisheries and natural production goals as achievable in the near term with subsistence-based harvest programs and cumulative efforts to restore sustainable populations in the long-term. An increase in the geographic scale and magnitude of tribal fisheries in blocked area tributaries can occur immediately, whereas achievement of natural production goals will require a basin-wide approach to juvenile capture and transport. However, achieving both set of goals will not meet the total subsistence need of the USRT member tribes. The total subsistence need can only be met through a dramatic increase in abundance throughout the Columbia River Basin in tandem with restoration of volitional passage to the Snake River. The fisheries goals are therefore calibrated by a current view of feasibility, based on near-term increases in hatchery production and long-term improvements in mainstem survival. Accordingly, tributaries are prioritized based on tribal and public accessibility, importance to the tribes, and by areas of currently suitable habitat at the reach-level. Goals reflect release sizes appropriate for the extent of suitable habitat, in combination with target catch rates.

Fisheries releases initially rely on increased hatchery production, transitioning to a reliance on natural origin returns as reintroduction objectives are met using transport or volitional passage of both juveniles and adults through or around the Hells Canyon Complex based on manager agreement. On-going hatchery supplementation will be necessary through this transition over a twenty-five-year timeframe. The Hells Canyon Complex Fisheries Resource Management Plan (USRT, 2018), the source of the USRT' fisheries goals, outlines in detail the multi-faceted approach to restoring both fisheries and natural production to the Snake River and tributaries upstream of the Hells Canyon Complex. Several principles inform this approach and provide critical context to the fisheries goals: 1) a basin-wide scale of planning and management is necessary to the success of tributary-level releases; 2) fisheries releases require the use of unlisted, hatchery fish; 3) fisheries releases provide opportunities to obtain the empirical information necessary to inform and meet reintroduction objectives; 4) fisheries must transition from a reliance on hatchery production to natural production to sustain fisheries long-term; and 5) while suitable habitat exists in many tributaries, habitat restoration is necessary in many areas including in the mainstem Snake River for volitional passage to occur.

Although other co-managers in the Upper Snake River, including the states of Oregon and Idaho and the Nez Perce and Umatilla Tribes, are aware of USRT goals, they have not formally come to agreement on these at this time.

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[13] The NPT has identified ecological goals which are higher than high-range goals currently identified by the Columbia Basin Partnership. The CBP recognizes that goals do not diminish the long-term desire and intent of some Fish and Wildlife Manager's to achieve higher levels of abundance.

Nez Perce Tribe:

Reestablishing and recovering fish to healthy and harvestable levels throughout the Nez Perce Tribe's aboriginal and usual and accustomed territory, including areas upstream of the Hells Canyon Complex, Dworshak, and Wallowa Lake dams, is a goal of the Nez Perce Tribe and an expectation consistent with the Nez Perce Tribe's 1855 Treaty. Dworshak Dam is located within the Nez Perce Tribe's Reservation. The Hells Canyon Complex and Wallowa Lake dams are situated on lands that the Indian Claims Commission adjudicated to have been exclusively occupied by the Nez Perce Tribe, and as such, their construction and operation has had a distinct, significant and unmitigated impact on the Nez Perce way of life and resources.

The Nez Perce Tribe, as a co-manager of its resources, must be involved in and consulted with, on any restoration effort on rivers and streams within or running through its historical lands. In establishing abundance goals for populations of anadromous fish in blocked areas, the Nez Perce Tribe supports using the same methods used to generate goals for currently extant populations. With respect to immediate efforts to restore fish populations in blocked areas, the Nez Perce Tribe believes that due to the extremely limited fisheries it has had in recent times, the efforts must not impact the Tribe's harvest share from extant fish populations, without its consent.

Idaho Governor's Office:

1) The Task Force is advised that no reintroduction of ESA-listed fish to historical habitat upstream of the Hells Canyon Complex is supported by the State of Idaho.
2) The Task Force is advised that reintroduction of non-ESA-listed fish to historical habitat upstream of the Hells Canyon Complex needs to be consistent with Idaho state statutes (§ 67-302 and 67-818(5)), which requires approval by both legislative (§67-6302) and executive branches of Idaho government (§67-818(5) and is otherwise prohibited.
3) The Task Force is advised that reintroduction of non-ESA-listed fish to historical habitat upstream has to be consistent with Idaho's and Oregon's commitments in the 401 Water Quality Certification Settlement Agreement with Idaho Power Company pertaining to the FERC Application for Hells Canyon Complex Re-licensing (2019 Settlement Agreement).
4) Idaho will continue to focus the following funding sources to ESA-listed fish recovery and achieving mitigation objectives in connected areas: BPA's Fish and Wildlife Program, Idaho Fish Accord, NOAA's PCSRF Program, USFW's Lower Snake River Compensation Plan (LSRCP), and/or other federal funding sources intended to implement the 2019 FCRPS BiOp or subsequent FCRPS BiOps. The intent is to ensure recovery of stocks and to meet LSRCP mitigation objectives in connected areas with the above referenced funding sources and not diminish these efforts by diverting from the above referenced funding sources to implement put and take fisheries in historical habitat above Hells Canyon Complex.
5) So long as the above conditions are met, Idaho supports put and take fisheries in historical habitat upstream of the Hells Canyon with the following provisions:
    a. A non-ESA listed hatchery stock must be identified and agreed upon among the parties intending to stock fish in historical habitat upstream of the Hells Canyon Complex with state fisheries managers.
    b. Locations and timing for stocking of non-ESA listed fish must be identified and agreed upon by the parties intending to stock fish in historical habitat upstream of the Hells Canyon Complex with state fisheries managers.

c. Idaho does not support the collection or transport of any juvenile fish that may be produced by adult outplants intended for harvest in the agreed upon put and take fisheries.

State of Oregon Recommendations:

Low-range goals were not identified for natural production recognizing near-term agreements and challenges in habitat conditions and passage. Oregon does not support reintroductions of ESA listed spring Chinook or summer steelhead into currently inaccessible areas upstream of Hell's Canyon Dam during the first 20-years of a new FERC license as a condition of that license; however, Oregon does support species recovery in the full extent of their current and historic ranges. The two decades post-relicensing will provide the time needed for research to inform the important data needs and critical uncertainties that need to be addressed prior to reintroductions. Near-term objectives recognize needs and opportunities for adult outplants in selected areas to support harvest and assessment.

Mid-range goals for natural production identify basic (minimum) viability levels for all populations within 50-years.

High-range goals are based on minimum abundance thresholds inferred from rule set developed and applied by the Technical Recovery Teams to similar populations by species (equivalent to a viable population with low extinction risk (≤5% risk of extinction in 100 years).

Confederated Tribes of the Umatilla Indian Reservation:

Policy on Fish Restoration above Blocked Areas in the Snake River Basin
for Purposes of the Columbia Basin Partnership Phase 2 Report

Reestablishing and recovering fish to healthy and harvestable levels throughout the CTUIR's aboriginal range of travels and usual and accustomed territory is a goal of the CTUIR and an expectation consistent with the CTUIR's Treaty of 1855, 12 Stat. 945. The Hells Canyon Complex and Wallowa Lake dams are situated in locations that are usual and accustomed areas of the CTUIR, and have direct effects on lands, streams and watersheds ceded by the CTUIR in its Treaty of 1855.

CTUIR Anadromous Fish Reintroduction Assessments completed in 2017 for the Burnt, Powder and Malheur Basins include historical background, current limiting factors, fish production potential and near and long-term actions that reflect the CTUIR's policy for these basins, and all basins above the Hells Canyon Complex that the CTUIR has an interest in. The first recommended action is to reach agreement on a reintroduction approach among fish co-managers. The assessments may be found at: ftp://ftp.services.ctuir.org Username: ctuir; Password: public; Folder: CTUIR Anadromous Fish Reintroduction Assessments for Burnt, Powder, Malheur. The files can be copied or dragged and dropped.

Shoshone-Bannock Tribes:

THE POLICY OF THE SHOSHONE-BANNOCK TRIBES
FOR MANAGEMENT OF SNAKE RIVER BASIN RESOURCES

November 1994
Resolution # GAME-94-1049

ISSUE DEFINITION - Beginning in 1989 and continuing through 2008, many non-Federal hydroelectric projects (Projects) within the Snake River Basin (Basin) will be reviewed under the

Federal Energy Regulatory Commission relicensing process. In addition, subsequent to the listing of various salmon and snail species under the Endangered Species Act as well as the initiation of other conservation efforts, the Basin is being viewed, as never before, as a valuable resource contributing to the overall Pacific Northwest regional conservation framework. The Shoshone-Bannock Tribes support efforts to conserve, protect, and enhance natural and cultural resources within the Basin and therefore establish this policy to re-emphasize previous policy statements and provide new direction with regards to recently initiated Basin actions.

BACKGROUND AND INTRODUCTION - Since time immemorial, the Snake River Basin has provided substantial resources that sustain the diverse uses of the native Indian Tribes including the Shoshone-Bannock. The significance of these uses is partially reflected in the contemporary values associated with the many culturally sensitive species and geographic areas within the Basin. Various land management practices, such as the construction and operation of hydroelectric projects have contributed extensively to the loss of these crucial resources and reduced the productive capabilities of many resource systems. These losses have never been comprehensively identified or addressed as is the desire of the Shoshone-Bannock Tribes.

The Shoshone-Bannock Tribes reserved guaranteed continuous use Rights to utilize resources within the region that encompasses and includes lands of the Snake River basin. The Fort Hall Business Council has recognized the contemporary importance of these Rights and resources by advocating certain resource protection and restoration programs and by preserving a harvest opportunity on culturally significant resources necessary to fulfill inherent, contemporary and traditional Treaty Rights. However, certain resource utilization activities including the operation of federal and non-federal hydroelectric projects effect these resources and consequently, Tribal reserved Rights.

It has always been the intent and action of the Shoshone-bannock Tribes to promote the conservation, protection, restoration, and enhancement of natural resources during the processes that consider the operation and management of Federal projects and during the land management activities of other entities.

This policy re-emphasizes the Tribes previous policies with regards to these processes and activities. However, the formal relicensing process for non-federal projects (Projects) as well as other recent undertakings that will consider the overall management of the Basin represent previously unavailable opportunities to comprehensively identify and address impacts to and losses of, resources affected by these Projects.

The importance of considering Tribal goals and objectives for effected resources is specifically recognized in the regulations outlining the federal relicensing process. The Fort Hall Business Council has established the following policy for the Basin in order to provide guidance in determining these goals and objectives. This direction is intended to be consistent with existing Tribal policy for participating in processes dealing with other land and water management activities.

STATEMENT OF POLICY - The Shoshone Bannock Tribes (Tribes) will pursue, promote, and where necessary, initiate efforts to restore the Snake River systems and affected unoccupied lands to a natural condition. This includes the restoration of component resources to conditions which most closely represents the ecological features associated with a natural riverine ecosystem. In addition, the Tribes will work to ensure the protection, preservation, and where appropriate-the enhancement of Rights reserved by the Tribes under the Fort Bridger Treaty of 1868 (Treaty) and any inherent aboriginal rights.

CONCLUSION - In addition to the ongoing efforts of the Tribes and its cooperating agencies, the relicensing process as well as recently initiated Basin recovery efforts provide a firm basis for striving to meet Tribal needs regarding resource conservation, protection, and enhancement. This policy will provide direction to Tribal staff for participating in regional processes as well as for the future development of resource and process specific Tribal plans and guidelines.

Tribal participation in the Project relicensing efforts will be used to identify the direct, indirect, and cumulative effects attributable to the construction, operation, and any proposed modifications of Project facilities. The Tribes expect the license applicant(s) and the Federal Energy Regulatory Commission, in consultation with the Tribes and agencies during the relicensing process, to identify alternative management strategies and develop mitigation measures to reduce or eliminate the identified impacts consistent with this Policy.

In combination with existing policy and direction, other natural and cultural resource management activities (typically those undertaken by the Tribes cooperating agencies) will be utilized to identify additional land management impacts within the Snake River Basin and will similarly identify alternative management strategies and apply mitigation measures consistent with this Policy.

All cooperating agencies will be expected to utilize all available means, consistent with their respective trust responsibility mandates, to protect Treaty rights and Tribal interests consistent with this Policy.

Burns Paiute Tribe:

Malheur River Basin Broad Sense Recovery Goals

Large runs of Snake River Spring/Summer Chinook Salmon (Oncorhynchus tshawytscha) and Steelhead (Oncorhynchus mykiss) historically spawned in Oregon's Malheur River Basin. The mainstem tributaries of the Upper Malheur and North Fork Malheur were blocked from anadromous fish passage by the construction of Bureau of Reclamation's (BOR) Warm Springs Dam in 1919 and Agency Valley Dam in 1934, respectively. The construction of Bonneville Dam in 1938, operated by Bonneville Power Administration (BPA), and the subsequent upstream construction of dams on the Federal Columbia River Power System (FCRPS) added to the cumulative annual loss of returning migratory individuals. Construction of Brownlee Dam in 1958, part of Idaho Power's Hells Canyon Complex, completely prohibited future migration of anadromous fish from the entire Upper Snake River Basin which includes the Malheur River system.

Anadromous extirpations to localized subbasin populations in the blocked area above Hells Canyon have pushed the species' Evolutionary Significant Units (FSU) in the Snake River precariously close to extinction. The Snake River Spring/Summer Chinook ESU was listed as a threatened species under the Endangered Species Act in 1992. The Snake River Steelhead ESU was listed as threatened under the Endangered Species Act in 1997. Repopulating historic habitat could only stand to benefit each ESU.

For thousands of years, salmon fishing was a way of life and important part of the seasonal round for ancestors of Burns Paiute Tribe (BPT). Tribal descendents recognize their native rights to salmon subsistence in aboriginal territories and former reservation lands of the Malheur Basin. Loss of returning salmon equates to a loss of the Tribe's inherent right to practice salmon subsistence activities, as well as the deterioration of cultural knowledge of traditional fishing grounds, harvest techniques, preparation methods, and tribal ceremonies associated with salmon procurement. A notable decline in the health of the tribal membership is likewise linked to the disappearance of salmon as a traditional mainstay food source. Access to local runs is necessary for the maintenance and revitalization of the Northern Paiute culture. Restoration of anadromous runs will restore tribal subsistence fishing, traditional fishing knowledge, and cultural ties between the basin and the fish to the first people. BPT recovery goals specifically address the restoration of anadromous Chinook and steelhead runs to the Malheur River.

BPT considers BOR, BPA, Idaho Power and FCRPS liable for the cumulative annual losses of Chinook and steelhead stemming from reservoir operations, which resulted in reduced run sizes and the eventual extirpation of anadromous fish in the Malheur.

Recovery begins with the release of adult spring Chinook and steelhead to selected reaches of the Malheur Basin. BPT's recovery efforts will be anchored by four Guiding Principles:

1.) Recovery efforts shall evolve through a "Reintroduction Fishery" that provides tribal and public harvest opportunities in areas where released adults also have access to surrounding habitats capable of supporting various life stage needs.

2.) Recovery decisions shall be grounded by scientific findings and based on the best available data. BPT shall utilize the best available data in decision making as a precautionary approach to avoid negative, unintended biological and ecological effects.

3.) Recovery of salmon shall provide a net benefit to the regional economy. Efforts will proceed in a way that minimizes economic hardship to rural livelihoods and avoids threatening the survivability of current land use industries. The Tribe will collaborate with interested parties wherever possible and/or appropriate and will work to maintain a functional relationship with private landowners through outreach meetings, sharing of data, and incorporation of public concerns and feedback.

4.) BPT, with assistance from appropriate regulatory and land management agencies, shall lead coordinated Research, Monitoring and Evaluation (RM&E) efforts in the Malheur Basin. BPT views the reintroduced salmon as a right inherent to the Tribe as Indigenous descendents of the Northern Paiute, and therefore views the Tribe's leadership role as stewards to reintroduced Malheur salmon. Stewardship extends to the research and management of anadromous populations at all life stages as they are restored as a permanent iconic fixture to the Malheur landscape. RM&E efforts will facilitate periodic assessments of implementation effectiveness, population status, and habitat status and will advise the need, if any, to modify future management actions.

Adhering to the four Guiding Principles, BPT will take a tiered approach in the implementation of the Reintroduction Fishery.

Tier 1: Baseline Data Collection

Pathogen Testing - Testing for the known fish pathogens of the Columbia Basin is needed before a Reintroduction Fishery is initiated. Pathogen testing will minimize the threat of exposure to native salmonids in the blocked area, especially the federally threatened bull trout (Salvelinus confluentus) and state sensitive redband trout (Oncorhynchus mykiss). Samples of native salmonids shall be collected throughout the Malheur Subbasin, with special focus on areas where reintroduction may occur.

Delineating suitable habitat - Historic, potential and available habitat shall be analyzed using a watershed approach. In-stream habitat, water quality and flow will be measured in the field, and connectivity, barriers, diversions and land proprietorship in arrival areas will be mapped.

Tier 2: Release of Surplus Adults

Tribal subsistence fishery - An interim tribal fishery shall be established to return subsistence fishing and cultural ties to the resource. The tribal fishery will likely be composed of surplus returns, and the fish shall be released in an area of suitable, connected habitat. BPT Tribal Council shall determine allowable harvest methods for tribal members. A tribal subsistence fishery is the upmost priority of restoring anadromous species to the Malheur Basin, and shall be viewed as the recovery's cornerstone in future initiatives.

Natural reproduction of arriving salmon - Reintroduced salmon shall have access to historical and currently available spawning habitat upstream of the arrival location. Natural reproduction shall be the driver in establishing a self-sustaining population of Chinook and steelhead. Harvest levels should be set to reflect the desire by the Tribe to promote natural reproduction. Natural reproduction will require adequate spawning habitat with suitable overwintering conditions for incubation, sufficient pools and cover for adult pre-spawn holding, and proximate cool water tributaries for seasonal use of emergent fry.

Public harvest opportunities - BPT recognizes that, much like the Tribe, the greater community has historical ties and a present day interest in anadromous runs, and the Tribe believes that reintroduced populations represent a significant cultural, ecological and economic resource to the subbasin. Every reasonable effort shall be made to expedite the initiation of a public fishery to supplement tribal harvest. Tribal harvest will receive top priority in release efforts. Any public fishery shall be administered by Oregon Department of Fish and Wildlife (ODFW) and shall be contingent on an overabundance of surplus releases after annual considerations for tribal allowances are made.

Tier 3: Restoring the Resource

Volitional upstream passage to Malheur spawning grounds - Reintroduced populations of salmon shall pass volitionally to Malheur spawning grounds from their arrival location. If volitional passage is impossible due to low flow conditions, poor water quality, or an unacceptable level of unscreened diversions and impassable barriers at the time of arrival, a Trap and Haul program shall be implemented to aid migration through areas of concern. Areas of concern include reaches that present thermal, flow, chemical or physical barriers to migration. Areas of concern shall not be considered static; rather Trap and Haul decisions shall be made based on temporal and seasonal variations to the quality of the migratory corridor. Furthermore, BPT expects that concern areas will demonstrate continual improvements towards favorable habitat conditions as reintroduction activities progress. Trap and Haul shall be considered a short-term solution while fish passageways are constructed, diversions are screened and habitat restoration measures are initiated.

Volitional downstream passage of outmigrating smolts - Smolts moving downstream from Malheur spawning grounds shall pass volitionally to the sea. If volitional passage is impossible due to low flow conditions, poor water quality, or an unacceptable level of unscreened diversions and impassable barriers at the time of downstream migration, a Trap and Haul program shall be implemented to aid migration through areas of concern. Areas of concern include reaches that present thermal, flow, chemical or physical barriers to migration. Areas of concern shall not be considered static; rather Trap and Haul decisions shall be made based on temporal and seasonal variations to the quality of the migratory corridor. Furthermore, BPT expects that concern areas will demonstrate continual improvements towards favorable habitat conditions as reintroduction activities progress. Trap and Haul shall be considered a short-term solution while fish passageways are constructed, diversions are screened and habitat restoration measures are initiated. Biologically stable smolt - adult returns will be projected based on production estimates for the basin.

Habitat improvements to aid anadromous movements and improve carrying capacity
Restoration of migration, holding, spawning and rearing areas shall occur continually to foster habitat back to favorable condition. Habitat projects shall be based on a strategic priority framework that recognizes the importance of protection, enhancement and restoration throughout the life cycle of the species. Collaborative management processes and approaches,

including regulatory, non-regulatory, and incentive-based programs, shall be utilized to encourage restoration projects. Riparian and in-stream habitat projects should focus on improving water quality (i.e. dissolved oxygen, turbidity, temperature, total maximum daily loads), connectivity, passage, available substrate, shade, protective cover and flow. Screening projects to prevent fish loss at diversions should be a priority improvement measure. Private land acquisitions or the repatriation of former reservation lands in federal holding to tribal trust should also be considered a viable restoration tool.

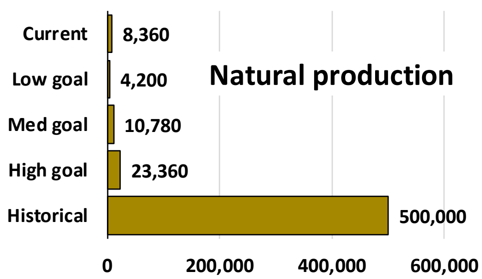
Tier 4: Reestablishment of Self-sustaining Populations

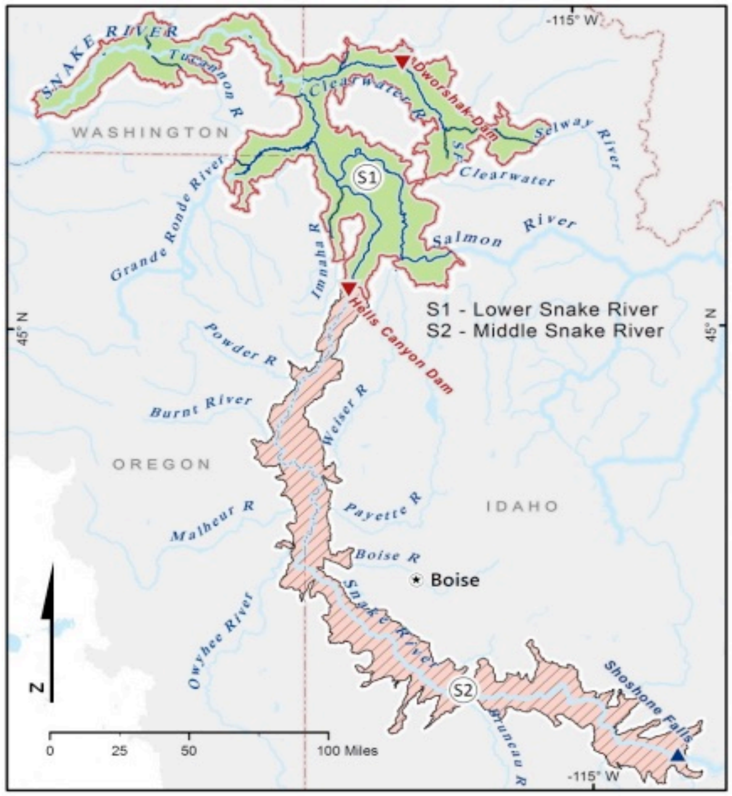
Overarching goal - The long-term goal of the reintroduction program is to demonstrate a highly viable salmonid population capable of supporting tribal and public harvest opportunities. A highly viable salmonid population shall be defined as an independent, naturally producing population that has less than a one percent risk of extinction over a 100-year period due to threats from demographic variation, local environmental variation, and genetic diversity changes. BPT recognizes that significant progress needs to occur to reach this endpoint. BPT also recognizes that release of surplus returns and hatchery supplementation will likely be required for decades to reach the carrying capacity identified for the Malheur Basin.

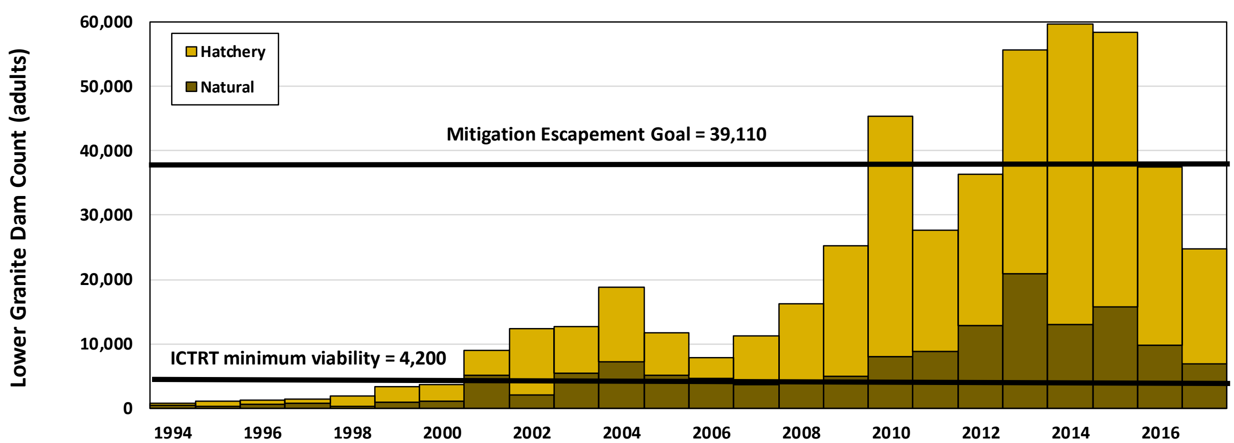
Idaho Water Users:

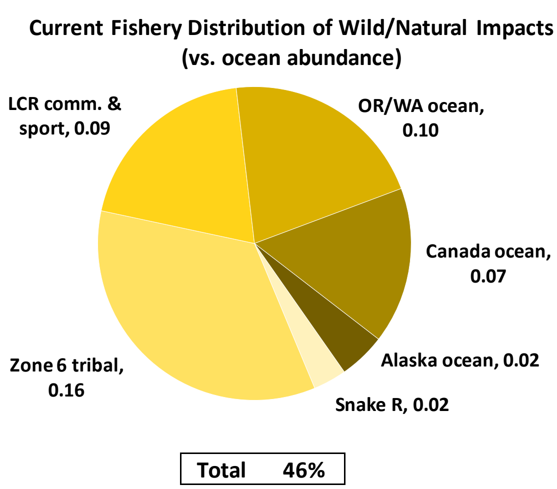
Any introduction of anadromous fish species in presently blocked areas must not (1) be inconsistent with, or alter, the provisions, commitments and protections included in the Snake River Water Rights Agreement, which was ratified and adopted by Congress in the Snake River Water Rights Act of 2004; (2) cause further actions or regulations which interfere with the authority or ability to deliver, divert, or use state based water rights; or (3) be inconsistent with Idaho Law and current policy listed in this document.

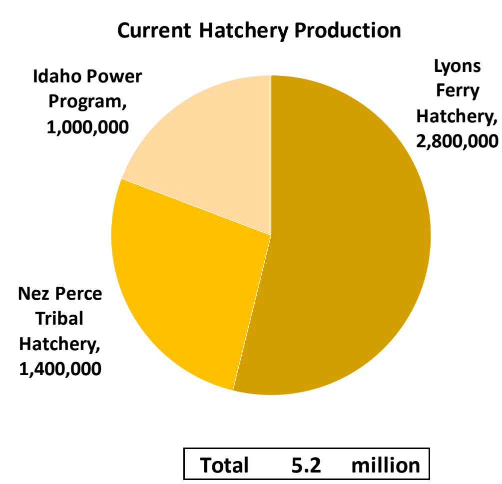
- Currently produced in the Snake River between Lewiston and Hells Canyon Dam and portions of major tribtuaries.
- Most historical habitat was located upstream from the Hells Canyon Dam complex and is not currently accessible.
- Classified in fishery management as upriver bright fall Chinook along with the healthy Hanford Reach stock.
- Harvest of this stock is significant in the ocean and in freshwater.
- Hatchery production has rebuilt a significant natural return and continues to produce a high proportion of the run.











Natural Production		Abundance (mean)		Potential Goal Range		
MPG	Population	Recent	Historical	Low	Med	High
Snake	Lower Snake R	8,360	500,000	4,200	9,280	14,360
	Middle Snake R	0		--	1,500	9,000
Totals		**8,360**	**500,000**	**4,200**	**10,780**	**23,360**

Artificial Production	Current Production			Return	Anticipated
Location (Program)	Brood	Age 0	Age 1	goal	production
Lyons Ferry Hatchery	2,700	2,800,000	450,000		3,250,000
Nez Perce Tribal Hatchery		1,400,000	0		1,400,000
Idaho Power Program		1,000,000	0		1,000,000
Subtotal		**5,200,000**	**450,000**	**39,110**	**5,650,000**

Fisheries / Harvest		Exploitation rate				Harvest	
	Location	Avg (v ocn)	Avg (v CR)	Goal	Potential	10 yr avg	Potential
Natural & Hatchery	Ocean (AK/Can)	9.7%	--	--	30-80%	8,100	20,200
	Ocean (WA/OR)	9.8%	--	--		8,200	
	Col sport	9.1%	11.4%	21.5-45%		7,600	31,900
	Col commercial						
	Col treaty	16.0%	19.9%			13,300	
	Terminal	1.6%	2.0%	--		1,300	
	Blocked area	--	--	--	--	--	--
	Total	***46.2%***	**33.3%**	***21.5-45%***	***30-80%***	***38,500***	***52,100***

Total Return (averages)		Recent avg (2008-2017)	@ Goals Low	@ Goals Med	@ Goals High
@ Columbia R Mouth		**67,100**	**58,200**	**70,100**	**83,400**
	Natural	17,900	9,000	20,900	34,200
	Hatchery	49,200	49,200	49,200	49,200
	% hatchery	73%	85%	70%	59%
@ Bonneville Dam		**60,000**	**52,000**	**62,500**	**73,700**
	Natural	16,000	8,000	18,500	29,700
	Hatchery	44,000	44,000	44,000	44,000
	% hatchery	73%	85%	70%	60%
@ Lower Granite Dam		**38,700**	**20,800**	**36,500**	**43,000**
	Natural	10,500	5,300	11,700	18,200
	Hatchery	28,200	15,500	24,800	24,800
	% hatchery	73%	75%	68%	58%
Spawning escapement		**31,800**	**27,500**	**32,600**	**37,500**
	Natural	9,600	4,800	10,700	16,500
	Hatchery	22,200	22,700	21,900	21,000
	% hatchery	70%	83%	67%	56%
Harvest (Col basin)		**22,200**	**19,000**	**24,800**	**31,900**
	Natural	6,000	2,900	7,500	13,400
	Hatchery	16,200	16,100	17,300	18,500
	% hatchery	73%	85%	70%	58%
Harvest (total)		**38,500**	**33,100**	**41,800**	**52,100**
	Natural	10,400	5,100	12,600	21,700
	Hatchery	28,100	28,000	29,200	30,400
	% hatchery	73%	85%	70%	58%

Notes - Natural Production

Distribution: NOAA Fisheries identified two historical populations: the Lower Mainstem Snake and the Middle Mainstem Snake. Only the Lower Mainstem population is extant, due to loss of access to historical spawning habitat above the Hells Canyon Dam complex. Historically, most Snake River fall Chinook salmon spawned in the Middle Mainstem Snake River from its confluence with the Columbia River upstream to Shoshone Falls, with some production likely also coming from nine major tributaries to the Middle Snake River (Salmon Falls Creek and the Owyhee, Bruneau, Boise, Payette, Weiser, Malheur, Burnt, and Powder Rivers). Today, Snake River fall Chinook salmon spawn primarily in the 100-mile reach of the Lower Snake River downstream of Hells Canyon Dam. Lower Granite Reservoir is effectively the downstream limit of spawning, although limited spawning occurs in the tailraces of Ice Harbor, Lower Monumental, Little Goose, and Lower Granite Dams. Substantial numbers of fall Chinook salmon also spawn in the lower mainstem Clearwater River, and some spawn in the lower reaches of the Tucannon, Grande Ronde, Salmon, and Imnaha Rivers.

The listed ESU includes all natural-origin fall-run Chinook salmon from the mainstem Snake River below Hells Canyon Dam (the lowest of three impassable dams that form the Hells Canyon Complex) and from the Tucannon River, Grande Ronde River, Imnaha River, Salmon River, and Clearwater River subbasin.

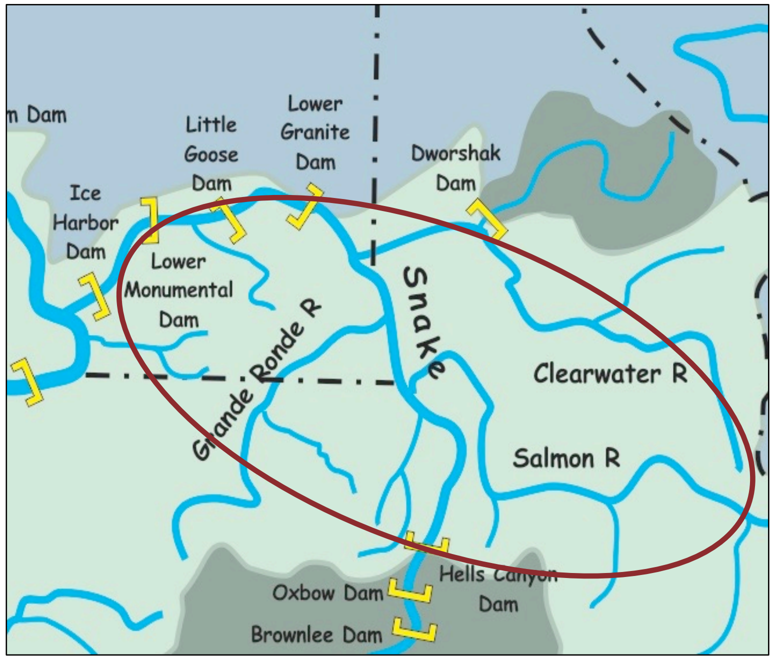
Historical abundance: Fall Chinook retrospective study by Connor et al. 2016.

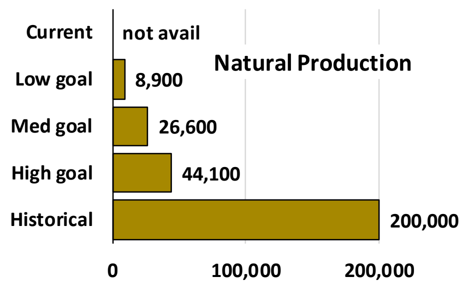
Current abundance: Run reconstruction by the Nez Perce Tribe, which incorporates counts and sampling at Lower Granite Dam and adjustments for fallback, hatchery broodstock removals, and harvest above Lower Granite Dam.

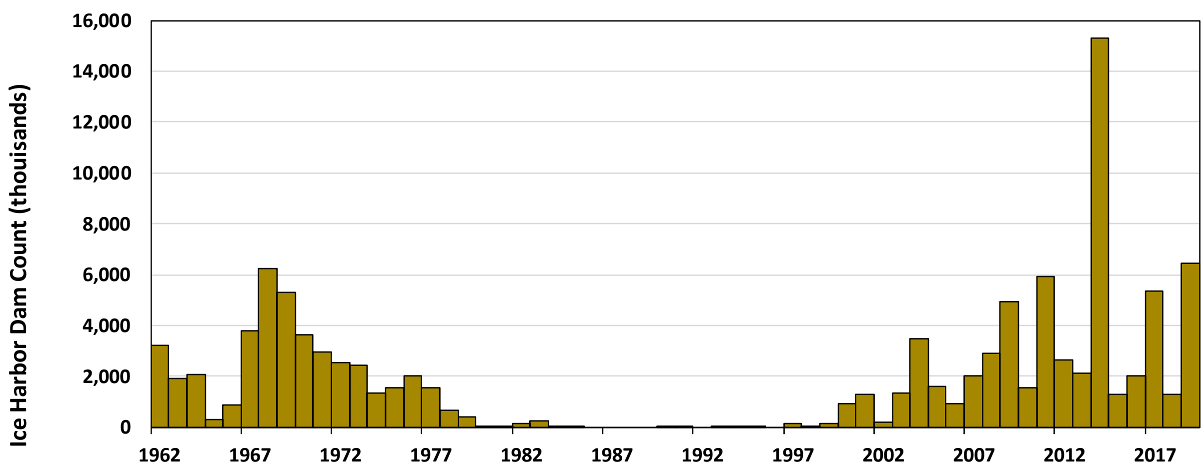
Goals:

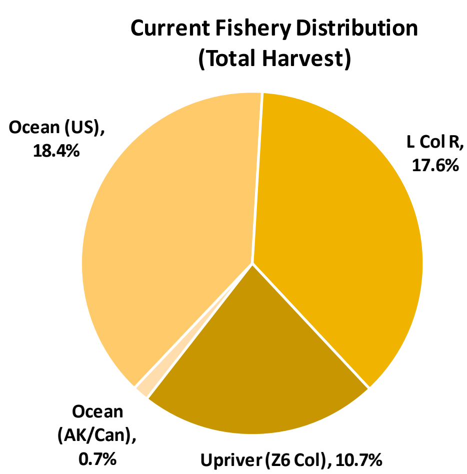
- *Low-range*: Based on recovery plan abundance goals under one of the single population recovery scenarios (achieve highly viable status for Lower Snake River population, measured in the aggregate).
- *Medium-range*: Reflect long-term objectives of the Nez Perce Tribe and the Washington Department of Fish and Wildlife as reported in ESA recovery plan.
- *High-range*: Reflect long-term objectives of the Nez Perce Tribe and the Washington Department of Fish and Wildlife as reported in ESA recovery plan.

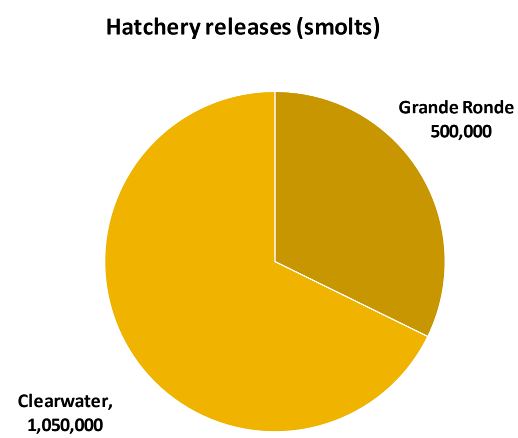
- "Upriver" Coho include fish returning to areas upstream from Bonneville Dam (including middle Columbia, upper Columbia and Snake Rivers).
- Coho were historically extirpated upstream from The Dalles Dam but subsequently reintroduced.
- Current run is predominately of hatchery origin but natural production is becoming re-established.











Total	47%

Total	1.55	million

Natural Production		Abundance		Potential Goal Range		
(ESU)/(MPG)	Population	Recent	Historical	Low	Med	High
	Tucannon	na	na	1,100	2,200	3,300
	Grande Ronde	na	5,000	2,200	2,900	3,500
	Imnaha	na	na	1,100	2,200	3,300
	Clearwater	na	na	1,100	7,600	14,000
	Salmon	na	na	3,400	11,700	20,000
Total		**na**	**200,000**	**8,900**	**26,600**	**44,100**

Hatchery Production		Current Production		Return	Anticipated
Location (Program)		Subyearlings	Yearlings	goal	production
Grande Ronde			500,000		500,000
Clearwater			1,050,000	2,573	1,050,000
Subtotal (Upriver)		**0**	**1,550,000**	**2,573**	**1,550,000**

Fisheries / Harvest		Exploitation rate			Harvest	
	Location	avg (v ocn)	avg (v CR)	Potential	10-yr avg	Potential
Hatchery / Natural	Ocean (AK/Can)	0.7%	--	≤70%	200	21,700
	Ocean (US)	18.4%	--		5,500	
	L Col R	17.6%	22.0%		1,800	28,300
	Upriver (Z6 Col)	10.7%	12.9%		2,900	
	Total	***47.3%***	***34.9%***	***≤70%***	**10,400**	***50,000***

Total Return		Abundance	@ Goals		
		recent	Low	Med	High
@ Columbia R Mouth		**22,900**	**36,600**	**63,700**	**90,600**
	Wild/Natural		13,700	40,800	67,700
	Hatchery	22,900	22,900	22,900	22,900
	% hatchery	100%	63%	36%	25%
To Mid Col R (BON)		**20,900**	**31,600**	**52,700**	**73,700**
	Wild/Natural		10,700	31,800	52,800
	Hatchery	20,900	20,900	20,900	20,900
	% hatchery	100%	66%	40%	28%
@ Ice Harbor Dam		**4,400**	**13,300**	**31,000**	**48,500**
	Wild/Natural		8,900	26,600	44,100
	Hatchery	4,400	4,400	4,400	4,400
	% hatchery	100%	33%	14%	9%
Harvest (Col basin)		**4,700**	**9,500**	**18,900**	**28,300**
	Wild/Natural	0	4,800	14,200	23,600
	Hatchery	4,700	4,700	4,700	4,700
	% hatchery	100%	49%	25%	17%
Harvest (total)		**10,400**	**18,400**	**34,300**	**50,000**
	Wild/Natural	0	8,000	23,900	39,600
	Hatchery	10,400	10,400	10,400	10,400
	% hatchery	100%	57%	30%	21%

Notes - Natural Production

Upriver coho are generally defined to include fish returning upstream from Bonneville Dam. Small numbers of coho returning to stream in Columbia River Gorge tributaries below and above Bonneville Dam are part of the listed Lower Columbia River coho ESU. Population-specific data for these listed Coho may be found in the Lower Columbia coho stock summary. For ease of calculation, small numbers of listed Lower Columbia River coho are included in the run reconstruction for upriver coho stock.

Upriver coho also return to areas of the middle Columbia, Upper Columbia and Snake. Numbers for all of these areas are combined on the stock summary for upriver coho.

Distribution: Upriver coho historically returned to tributaries throughout the Middle Columbia, Upper Columbia, and Snake River basins. NOAA Fisheries' project team and regional technical team members tentatively identified at least 15 historical populations. These populations have been largely extirpated. Reintroduction efforts are underway. ESUs or MPGs were not formally identified by technical recovery teams for these upriver coho populations – therefore the project team inferred ESUs and MPGs based on similar delineations in the Lower Columbia River.

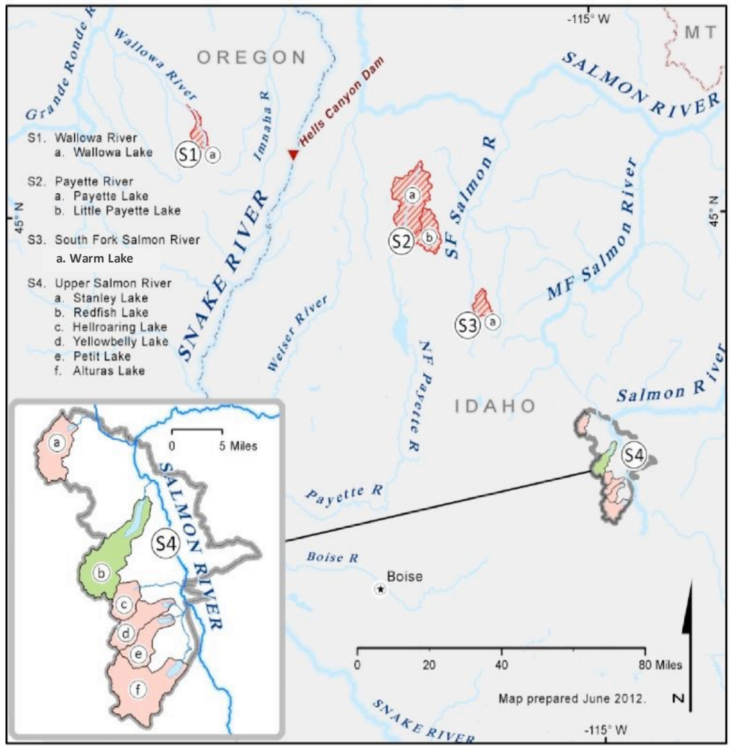
Historical abundance: Information on historical abundance is limited. Estimates for individual populations are based on a mix of EDT results and expert judgement.

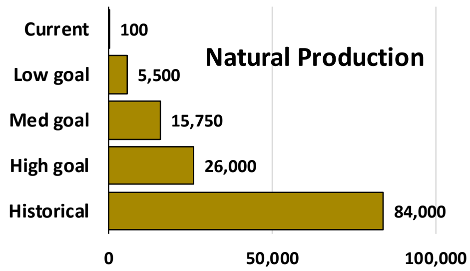
*Current abundance:*Current information on natural escapement is limited but Snake River dam counts provide an indication of the current aggregate return of hatchery and wild-origin fish. Weir counts of hatchery returns to hatchery facilities are also available.

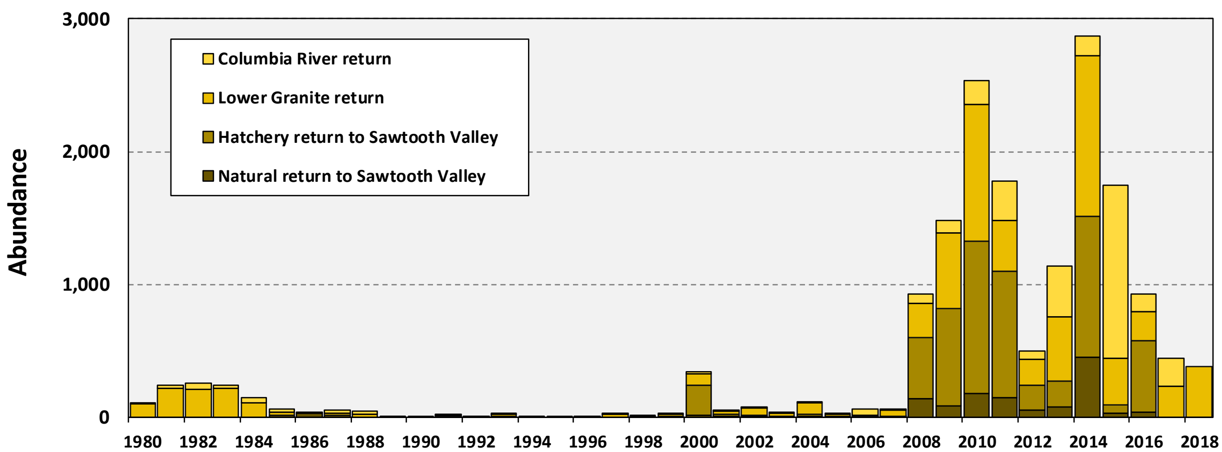
Goals:

- *Low-range*: Based on ICTRT MATs for currently accessible areas downstream from Hells Canyon Dam.
- *Medium-range*: Mid-point between low and high goals for currently accessible areas downstream from Hells Canyon Dam.
- *High-range*: Generally, three to four times low goal as placeholders for currently accessible areas downstream from Hells Canyon Dam.

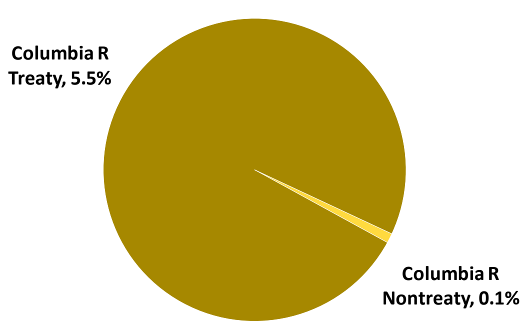
- At listing, only one populations remained (Redfish Lake in the Sawtooth Valley).
- Returns dwindled to zero to 10 fish/year.
- Extirpated from five other Stanley Basin Lakes, the Payette system upstream from Hells Canyon, and Wallowa Lake in the upper Grande Ronde.
- An intensive conservation aquaculture program with captive broodstock began in 1991.
- Hatchery fish are currently being released into Redfish, Petit, and Alturus Lakes.





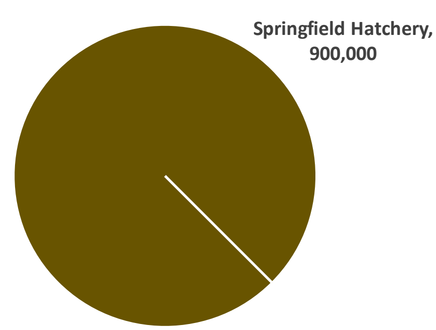


Harvest Distribution 2007-2016 avg.



Totals	5.6%

Hatchery Releases



Smolts	900,000

Natural Production		Abundance (mean)		Potential Goal Range		
ESU/MPG	Population	Recent	Historical	Low	Med	High
Stanley Basin	Redfish Lake	100	25,000	1,000	5,750	9,000
	Alturas Lake	0		1,000		
	Hell Roaring Lake	0		--		
	Stanley Lake	0		--		
	Pettit Lake	0		500		
	Yellow Belly Lake	0		--		
(SF Salmon)	Warm Lake	0		500	1,250	2,000
(Payette)	Payette	0	35,000	1,500	5,250	9,000
(Wallowa)	Wallowa Lake	0	24,000	1,000	3,500	6,000
Totals		**100**	**84,000**	**5,500**	**15,750**	**26,000**

Hatchery Production	Current Production			Return	Anticipated
Location (Program)	Brood	Smolts	Fry	goal	production
Springfield Hatchery		900,000		10,000	1,000,000
Totals		**900,000**		**10,000**	**1,000,000**

Fisheries / Harvest		Exploitation rate			Harvest	
	Location	Avg.	Limits	Potential	10-yr avg	Potential
Natural & Hatchery	Ocean	0	--	--	--	--
	Mainstem non treaty	0.1%	5-7%	10-40%	1	23,700
	Mainstem Treaty	5.5%			81	
	Terminal	0	--		--	
	Total	***5.6%***	***5-7%***	***10-40%***	**82**	***23,700***

Total Return		Recent avg	@ Goals		
		(2008-2017)	Low	Med	High
@ Columbia R Mouth		**1,460**	**36,700**	**50,700**	**94,900**
	Natural	290	16,000	50,700	94,900
	Hatchery	1,170	20,700	0	0
	% hatchery	80%	56%	0%	0%
@ Bonneville Dam		**1,460**	**36,600**	**50,600**	**94,500**
	Natural	290	15,900	50,600	94,500
	Hatchery	1,170	20,700	0	0
	% hatchery	80%	57%	0%	0%
To Snake R (L Granite)		**1,130**	**26,500**	**33,100**	**54,600**
	Natural	210	11,500	33,100	54,600
	Hatchery	920	15,000	0	0
	% hatchery	80%	57%	0%	0%
Local Return		**752**	**17,600**	**21,700**	**35,900**
	Natural	138	7,600	21,700	35,900
	Hatchery	614	10,000	0	0
	% hatchery	80%	57%	0%	0%
Harvest (Col mainstem)		**82**	**2,100**	**7,600**	**23,700**
	Natural	12	900	7,600	23,700
	Hatchery	70	1,200	0	0
	% hatchery	80%	57%	0%	0%

Notes - Natural Production

Distribution: Historically, sockeye salmon ascended the Snake River to the Wallowa River basin in northeastern Oregon and the Payette and Salmon River basins in Idaho to spawn in natural lakes. Within the Snake River drainage, Wallowa Lake, the Payette Lake basin, and the Stanley Basin are separated by distances that are consistent with those between other Sockeye Salmon ESUs (NMFS 2015). The ICTRT concluded that it is unclear, and currently unresolvable, whether these lake groups were MPGs of the same ESU or separate ESUs (ICTRT 2007). Given this uncertainty, the ICTRT treats the Snake River Sawtooth Valley Sockeye Salmon as a single ESU with a single MPG (ICTRT 2010). Within the Salmon River basin, sockeye salmon spawned in Warm Lake in the South Fork Salmon River basin, as well as in the Sawtooth Valley lakes: Stanley, Redfish, Yellowbelly, Pettit and Alturas Lakes. A smaller Sawtooth Valley lake, Hell Roaring Lake, may have also supported some Sockeye Salmon production. The historical relationships between the different fish populations are not known. All populations except Redfish Lake are extirpated; sockeye are being reintroduced into Petit and Alturas lakes. The Technical Recovery Team did not formally designate mpgs for populations in the South Fork Salmon or Payette systems but treatment of Upper Columbia River populations, the project team labeled these exitirpated sockeye as separate mpgs - parentheses are used to designate these mpgs as assumed for the purposes of this exercise.

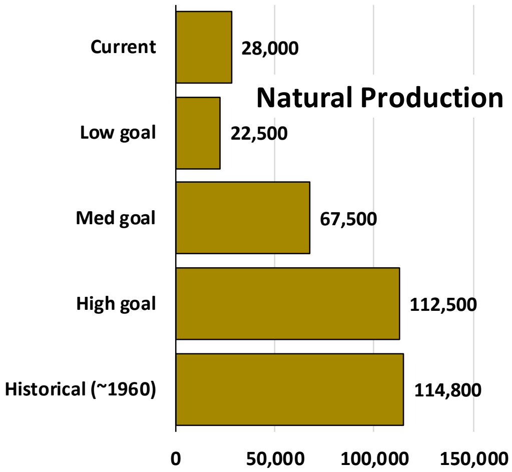
Historical abundance: From IDFG website. Little information on historical abundance exists.

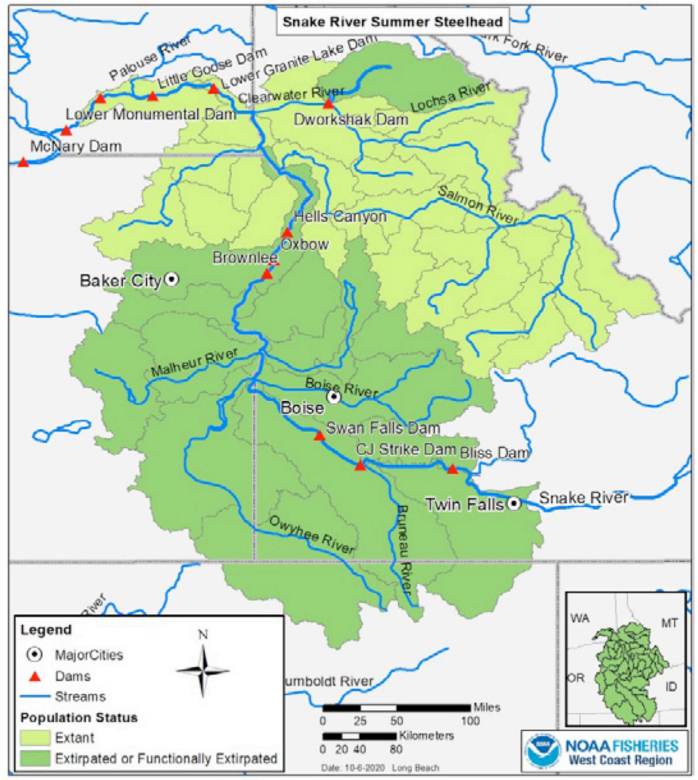
Current abundance: Fish traps and spawning surveys in the Stanley Basin.

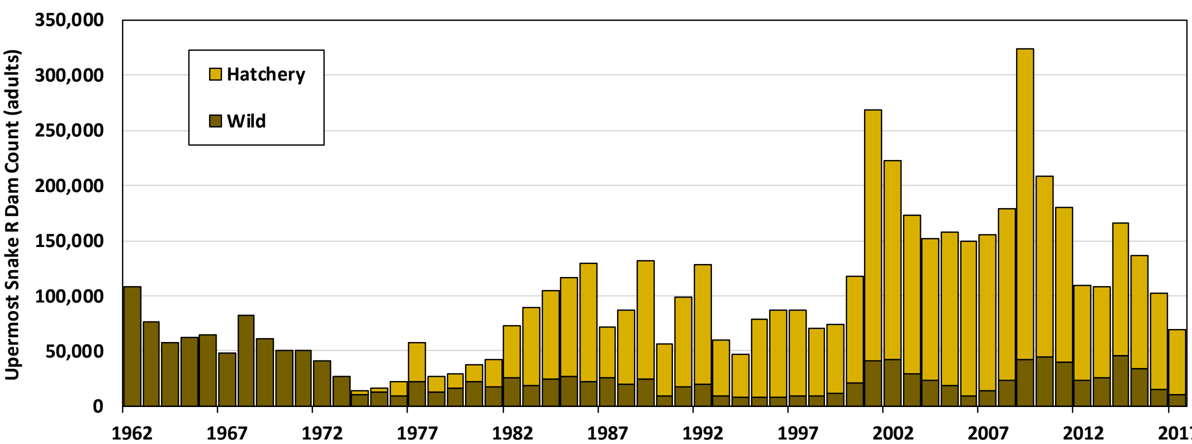
Goals:

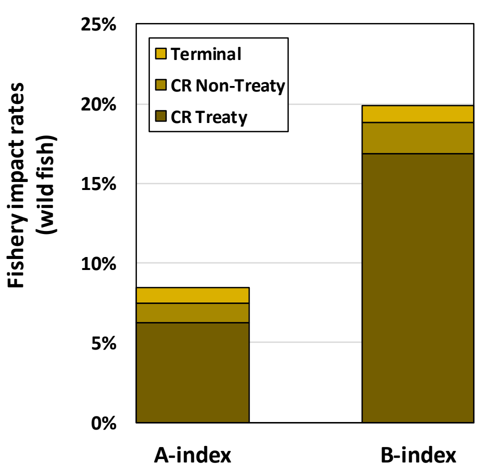
- *Low range*: ESA recovery plan (for Redfish, Alturas, and Petit Lake populations). Identified by NPT and ODFW for Wallowa Lake for Task Force purposes. Identified by NPT for Warm Lake and Payette Lake populations.
- *Medium range*: Mid-point between low and high goals
- *High range*: Identified by IDFG for Stanley Basin. Identified by NPT and ODFW for Wallowa Lake for Task Force purposes. Identified by NPT for Warm Lake and Payette Lake populations.

- Inhabit moderate to high elevation areas of major tributaries.
- Areas upstream from the Hells Canyon Dam complex are not currenty accessible. Harvest occurs entirely in freshwater and is much reduced from historical levels.
- Hatchery production is significant.

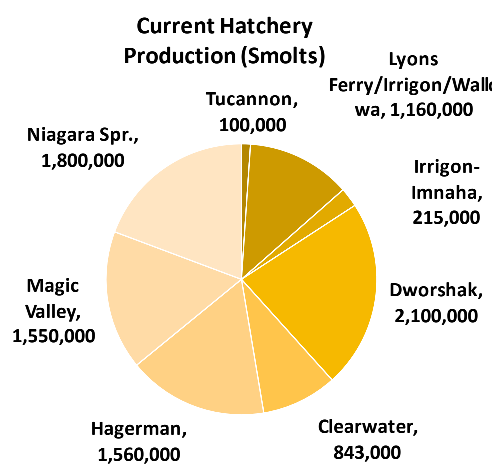








Totals	10.2%	19.1%



Smolts	9.3	million

Natural Production			Abundance (mean)		NPT ecological	Potential Goal Range		
	MPG	Population	Recent	~1960	goal	Low	Med	High
Downstream from Hells Canyon Dam	Lower Snake	Asotin Creek	610	1,700	15,000	500	1,500	2,500
		Tucannon River	640	3,400	15,000	1,000	3,000	5,000
	Clearwater	Lower Mainstem	na	43,200	45,000	1,500	4,500	7,500
		Lochsa River	340		37,000	1,000	3,000	5,000
		Selway River			55,000	1,000	3,000	5,000
		Lolo Creek	na		7,000	500	1,500	2,500
		North Fork	na		50,000	1,500	4,500	7,500
		South Fork	2,040		25,000	1,000	3,000	5,000
	Grande Ronde	Lower Mainstem	610	15,900	38,000	1,000	3,000	5,000
		Upper Mainstem	2,630		81,000	1,500	4,500	7,500
		Joseph Creek	2,330		24,000	500	1,500	2,500
		Wallowa River	1,190		41,000	1,000	3,000	5,000
	Imnaha	Imnaha River	na	4,000	21,000	1,000	3,000	5,000
	Salmon	Chamberlain Creek	na	35,200	13,000	500	1,500	2,500
		East Fork Salmon River	na		19,000	1,000	3,000	5,000
		Lemhi River	na		22,000	1,000	3,000	5,000
		Little Salmon River	na		16,000	500	1,500	2,500
		Middle Fk Lower Mainstem	2,470		31,000	1,000	3,000	5,000
		Middle Fk Upper Mainstem			28,000	1,000	3,000	5,000
		North Fork	na		6,000	500	1,500	2,500
		Pahsimeroi River	na		18,000	1,000	3,000	5,000
		Panther Creek	na		13,000	500	1,500	2,500
		Upper Mainstem	na		24,000	1,000	3,000	5,000
		Secesh River	1,220		6,000	500	1,500	2,500
		South Fork			2,000	1,000	3,000	5,000
	Other	Misc L Snake tribs	--	11,400	--	--	--	--
Subtotal			28,000	114,800	652,000	22,500	67,500	112,500

Natural Production			Abundance (mean)		USRT near-term	Potential Goal Range***		
	MPG	Population	Recent	Historical	harvest goal**	Low	Med	High
Upstream from Hells Canyon Dam	Hells Canyon	Hells Canyon	0	na	--	--	500	1,000
		Powder River	0	na	--	--	500	1,500
		Burnt River	0	na	--	--	500	1,000
		Weiser River	0	na	500-2,000**	--	500	1,500
	Payette Boise	Lower Payette	0	na	2,000**	--	500	1,000
		North Fork Payette	0	na		--	500	1,000
		South Fork Payette	0	na		--	500	1,000
		Boise River	0	na	500**	--	500	1,500
	Malheur Owyhee	Lower Malheur	0	na	2,000-3,000**	--	500	1,000
		Upper Malheur	0	na		--	500	1,500
		Lower Owyhee	0	na	500-1,000**	--	500	1,500
		Upper Owyhee	0	na	3,000-4,000**	--	500	1,500
	Bruneau Salmon Falls	Bruneau	0	na	1,000**	--	500	1,500
		Canyon Creek	0	na	--	--	500	1,000
		Salmon Falls/Rock Creek	0	na	--	--	500	1,500
Subtotal			0	na	9,500-13,500	0	7,500	19,000

Total			28,000	114,800	--	22,500	75,000	131,500

*** Upper Snake River Tribes near-term harvest goal identified for outplanting of unlisted hatchery-origin adults.*

****Until delisting occurs, these numbers represent outplanting of unlisted hatchery-origin adults. Upon delisting, the medium and high range goals represent natural production goals.*

Artificial Production		Current Production			Return	Anticipated
Location (Program)	**Type**	**Brood**	**Smolts**	**Subyearlings**	**Goal**	**production**
Tucannon	A	60	100,000		4,656	100,000
Lyons Ferry/Irrigon/Wallowa	A	472	1,160,000			1,160,000
Irrigon-Imnaha	A	132	215,000		11,184	215,000
Dworshak	B	872	2,100,000		60,264	2,100,000
Clearwater	B	452	843,000			843,000
Hagerman	A	878	1,560,000			1,560,000
Magic Valley	A	812	1,550,000			1,550,000
Niagara Spr.	B	1,152	1,800,000			1,800,000
Sawtooth/Pahsimeroi	A/B	455		1,000,000		1,000,000
Subtotal		***5,285***	***9,328,000***	***1,000,000***	***88,100***	***10,328,000***

Note: Return goal of 60,264 = sum of LSRCP, ACOE and IPC goals

Fisheries / Harvest		Exploitation rate (v Col R run)				Harvest	
	Location	**A-run avg**	**B run avg**	**Limits**	**Potential**	**10 yr avg**	**Potential**
Natural	Ocean	--	--	--	--	--	--
	Mainstem Non-treaty	1.9%	2.2%	15-22%	20-50%	700	41,200
	Mainstem Treaty	6.3%	14.9%			2,900	
	Snake R (below L. Granite Dam)						
	Snake R (abv L. Granite Dam)	2.0%	2.0%	<2%		600	
	Total	***10.2%***	***19.1%***	***17-22%***	***20-50%***	***4,200***	***41,200***
Hatchery	Ocean	--	--	--	--	--	--
	Mainstem Non-treaty	14.3%	15.5%	≤70%	≤70%	28,600	141,900
	Mainstem Treaty	6.7%	15.2%			15,500	
	Snake R (below L. Granite Dam)	4.1%				8,400	
	Snake R (abv L. Granite Dam)	38.0%				77,200	
	Total	***63%***	***73%***	***≤70%***	***≤70%***	***129,700***	***141,900***

Total Return	Recent 10-yr avg (2007-2016)			@ Goals		
	A-run	**B-run**	**Total**	**Low**	**Med**	**High**
@ Columbia R Mouth	**196,100**	**45,200**	**241,300**	**241,300**	**310,600**	**402,700**
Natural	31,800	6,100	37,900	37,900	107,200	199,300
Hatchery	164,300	39,100	203,400	203,400	203,400	203,400
% hatchery	84%	87%	84%	84%	65%	51%
@ Bonneville Dam	**185,900**	**44,400**	**230,300**	**230,300**	**296,800**	**386,400**
Natural	31,400	6,000	37,400	37,400	105,500	195,100
Hatchery	154,500	38,400	192,900	192,900	191,300	191,300
% hatchery	83%	86%	84%	84%	64%	50%
@Lower Granite Dam	**138,600**	**28,100**	**166,700**	**166,700**	**213,300**	**277,400**
Natural	26,300	4,500	30,800	30,800	83,200	147,300
Hatchery	112,300	23,600	135,900	135,900	130,100	130,100
% hatchery	81%	84%	82%	82%	61%	47%
Spawning Escapement						
Natural				22,500	67,500	112,500
Hatchery						
% hatchery						
Harvest (total)			**133,900**	**134,000**	**159,100**	**183,100**
Wild/Natural			4,200	4,300	17,200	41,200
Hatchery			129,700	129,700	141,900	141,900
% hatchery			97%	97%	89%	77%

Notes - Natural Production

Distribution: The listed DPS includes all naturally spawned anadromous O. mykiss originating below natural and manmade impassable barriers in streams in the Snake River basin of southeast Washington, northeast Oregon, and Idaho. The ICTRT identified nine historical MPGs in the Snake River Basin steelhead DPS. Five of the MPGs are extant and support 24 extant populations: Lower Snake River MPG (two populations); the Grande Ronde MPG (four populations); the Imnaha River MPG (one population); the Clearwater River MPG (five extant populations and one extirpated); and the Salmon River MPG (11 extant populations and one extirpated population). Historically, Snake River steelhead also spawned and reared in areas above the Hells Canyon Complex on the Snake River and in the North Fork Clearwater River. Steelhead are currently blocked from historical habitat in this area, but the ICTRT identified four historical MPGs in this area.

Historical abundance: Near-term historical abundance for the total return downstream from Hells Canyon is based on estimated production in the early 1960s, as identified in the Lower Snake River Compensation Plan. However, information or inferences for historical abundance prior to to development is not available for most populations. Estimates of production potential identified by the Nez Perce Tribe as ecological goals were included instead for reference purposes.

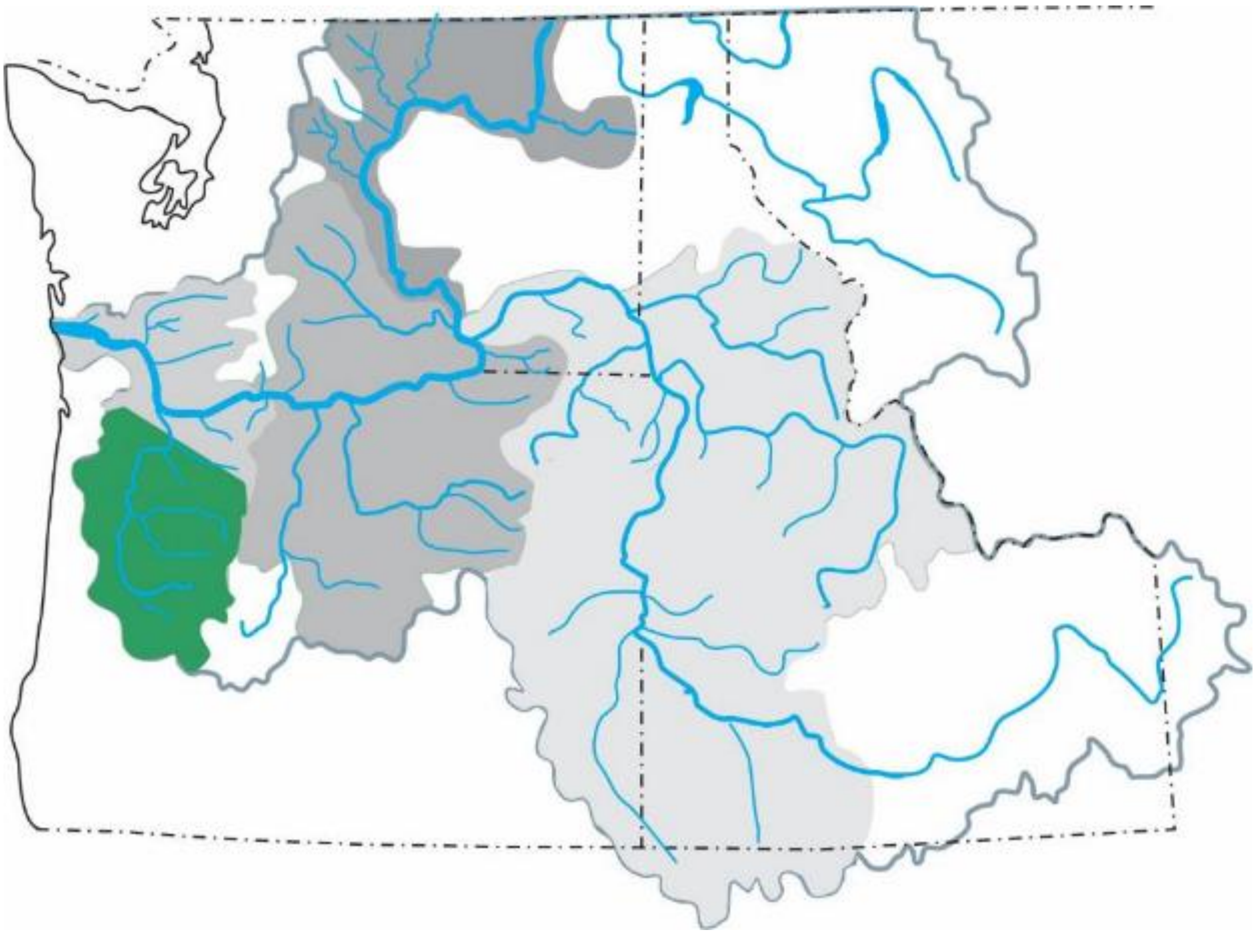
Current abundance: Identified only for aggregate returns to Lower Granite Dam. Few population-specific estimates available (due to difficulty of spawning surveys –e.g., extended spawn timing, inaccessible spawning areas in winter). Redd count indices are available for some steelhead populations but have not been translated into fish numbers. Parr density is also available but has not been related to corresponding adult abundance. EDT model-based estimates of current production potential are documented for Grande Ronde populations.

Goals:

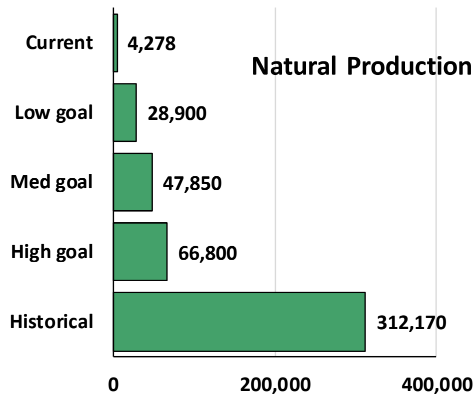
- *Low range*: Minimum Abundance Thresholds (MAT) were identified by the Interior Columbia Technical Recovery Team for currently accessible areas downstream from Hells Canyon Dam. Low-range goals were not identified for natural production in currently blocked areas upstream from Hells Canyon Dam recognizing near-term agreements and challenges in habitat conditions and passage. Near-term objectives recognize needs and opportunities for adult outplants in selected areas to support harvest and assessment.
- *Medium range*: Midpoint between low and high goals for currently accessible areas downstream from Hells Canyon Dam for currently accessible areas downstream from Hells Canyon Dam. Mid-range goals for natural production in currently blocked areas upstream from Hells Canyon Dam identify basic (minimum) viability levels for all populations.
- *High range*: High-range goals are 5x the low-range goal for currently accessible areas downstream from Hells Canyon Dam. This multiplier is based on estimates of historical dam counts during the 1950s, which were deemed by the CBP Snake River regional technical group to be a reasonable representation of the potential production capacity of existing habitats. High-range goals or natural production in currently blocked areas upstream from Hells Canyon Dam are based on minimum abundance thresholds inferred from rule set developed and applied by the Technical Recovery Teams to similar populations by species (equivalent to a viable population with low extinction risk (≤5% risk of extinction in 100 years).[14]

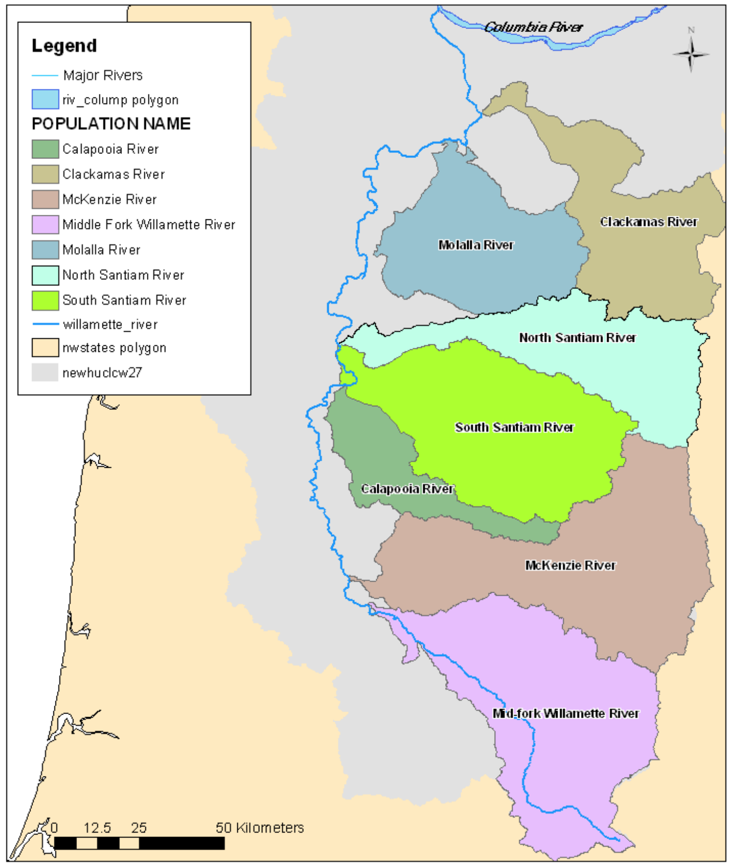
[14] The NPT has identified ecological goals which are higher than high-range goals currently identified by the Columbia Basin Partnership. The CBP recognizes that goals do not diminish the long-term desire and intent of some Fish and Wildlife Manager's to achieve higher levels of abundance.

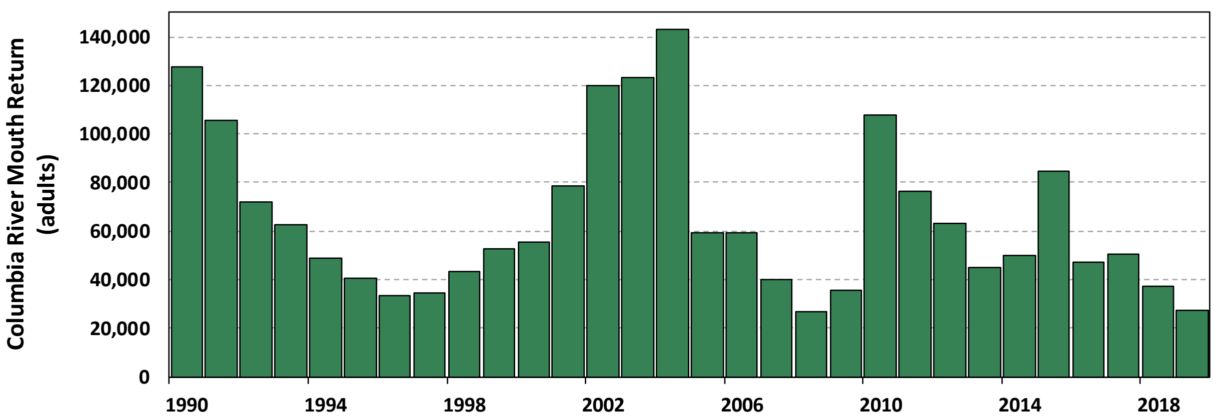
WILLAMETTE



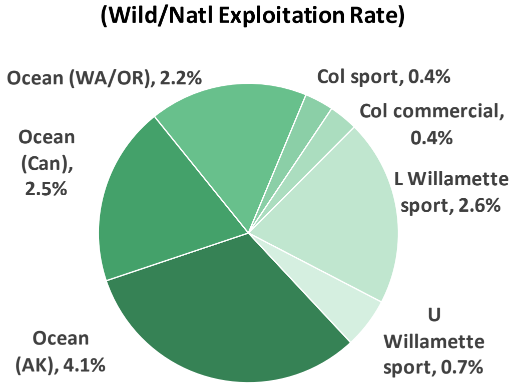
- Return to mid to high elevations streams on the western slope of the Cascades.
- Five of the seven historical populations are currently at low levels of viability.
- Dams block passage to historical production areas in the Santiam and Middle Fork Willamette Rivers.
- Significant hatchery production occurs as mitigation for reduced natural production.





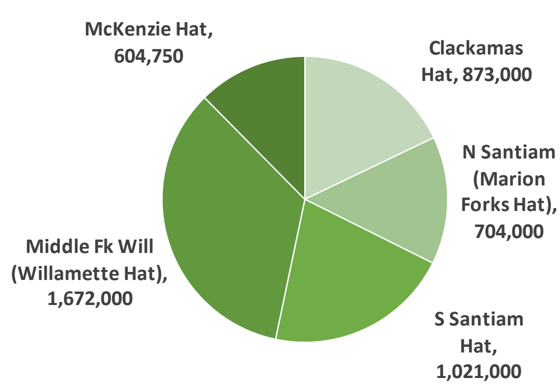


Harvest Distribution (Wild/Natl Exploitation Rate)



Totals 13%

Current Hatchery Production (smolts)



Total smolts 5.2 million

Natural Production		Abundance		Potential Goal Range		
MPG	Population	Recent	Historical	Low	Med	High
Willamette	Clackamas River	1,695	27,670	2,310	3,965	5,620
	Molalla River	NA	13,750	700	1,665	2,630
	North Santiam River	361	56,100	5,430	10,865	16,300
	South Santiam River	536	37,400	3,120	6,240	9,360
	Calapooia River	0	9,500	600	1,210	1,820
	McKenzie River	1,549	110,000	10,920	12,265	13,610
	Middle Fk Willamette	136	57,750	5,820	11,640	17,460
Totals		**4,278**	**312,170**	**28,900**	**47,850**	**66,800**

Artificial Production	Current Production		Return	Anticipated
Location (Program)	Brood	Smolts	Goal	production
Clackamas Hat		873,000		1,005,000
N Santiam (Marion Forks Hat)		704,000		704,000
S Santiam Hat		1,021,000		1,021,000
Middle Fk Will (Willamette Hat)		1,672,000		1,672,000
McKenzie Hat		604,750		787,000
Coast Fork Will		267,000		528,000
Molalla		99,700		100,000
Totals		**5,241,000**		**5,817,000**

Fisheries / Harvest		Exploitation rate				Harvest	
	Location	Avg (v ocn)	Avg (v CR)	Limits	Potential	Recent	Potential
Natural	Ocean (AK)	4.1%	--	12%	20-60%	470	21,000
	Ocean (Can)	2.5%	--			260	
	Ocean (WA/OR)	2.2%	--			280	
	Col sport	0.4%	0.4%	15%		40	75,000
	Col commercial	0.4%	0.4%			40	
	L Willamette sport	2.6%	2.6%			240	
	U Willamette sport	0.7%	0.7%			70	
	Total	**12.9%**	***4.1%***			**1,400**	**96,000**
Hatchery	Ocean (AK)	4.1%	--	≤70%	≤70%	2,400	5,300
	Ocean (Can)	2.5%	--			1,300	
	Ocean (WA/OR)	2.2%	--			1,500	
	Col sport	4.0%	4.3%			2,200	96,000
	Col commercial	2.8%	3.0%			1,600	
	L Willamette sport	19.2%	20.6%			10,500	
	U Willamette sport	6.5%	7.5%			3,800	
	Total	**41.3%**	***35.4%***	***≤70%***	***≤70%***	**23,300**	**101,300**

Total Return		Recent avg	@ Goals		
		(2008-2017)	Low	Med	High
@ Columbia R Mouth		**58,000**	**113,000**	**179,000**	**273,000**
	Natural	10,000	65,000	128,000	220,000
	Hatchery	48,000	48,000	51,000	53,000
	% hatchery	83%	42%	28%	19%
Escapement		**30,000**	**45,000**	**61,000**	**76,000**
	Natural	4,000	30,000	49,000	68,000
	Hatchery	26,000	15,000	12,000	8,000
	% hatchery	87%	33%	20%	11%
Local return (Willamette Falls)		**34,000**	**76,433**	**103,609**	**129,087**
	Natural	7,000	50,955	83,227	115,499
	Hatchery	27,000	25,478	20,382	13,588
	% hatchery	79%	0	0	0
Harvest (Col basin)		**18,800**	**20,000**	**51,000**	**110,700**
	Natural	400	3,000	25,000	75,000
	Hatchery	18,400	17,000	26,000	35,700
	% hatchery	98%	85%	51%	32%
Harvest (Total)		**25,000**	**31,000**	**68,000**	**137,000**
	Natural	1,000	9,000	37,000	96,000
	Hatchery	24,000	22,000	31,000	41,000
	% hatchery	96%	71%	46%	30%

Notes - Natural Production

Distribution: The WLCTRT identified seven demographically independent populations of spring Chinook in the UWR Chinook ESU: Clackamas, Molalla, North Santiam, South Santiam, Calapooia, McKenzie, and the Middle Fork Willamette.

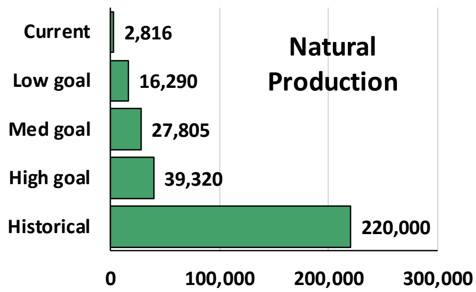
Historical abundance: Based on habitat-population viability analysis reported by ODFW in the ODFW/ESA recovery plan.

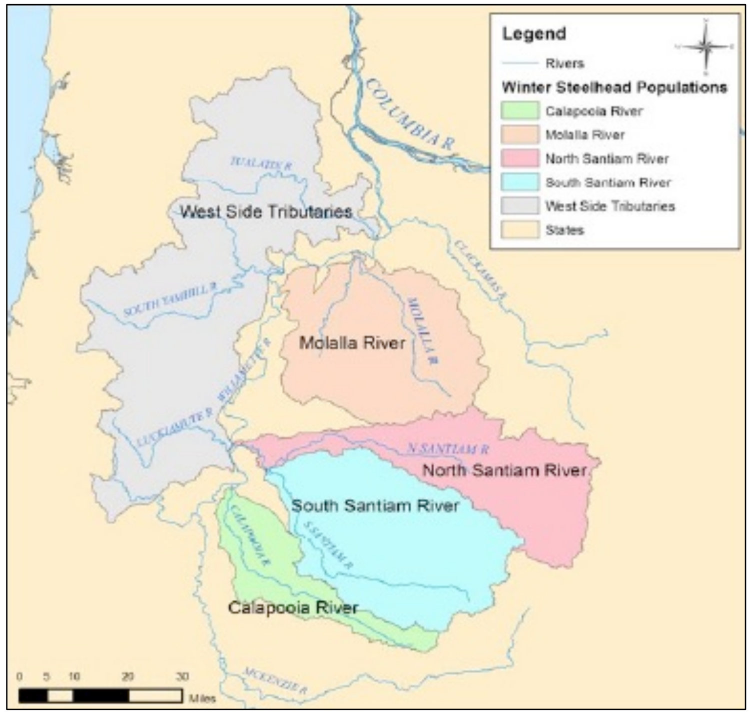
Current abundance: Based on dam counts or spawning ground surveys.

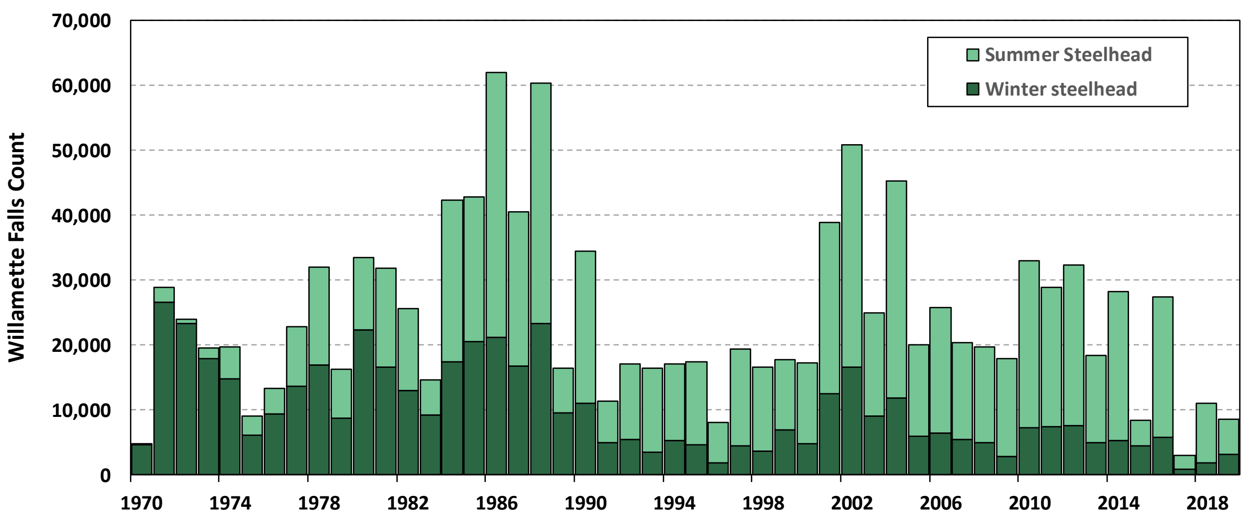
Goals:

- *Low range*: Identified in ODFW/ESA recovery plan, based on population modeling developed by ODFW and the ICTRT.
- *Medium range*: Midpoint between low and high goals.
- *High range*: For some populations, based on broad-sense goals identified in recovery plan (based on ODFW's population viability modeling). For populations for which modeling is not available (N. Santiam, S. Santiam, and MF Willamette), ODFW did not identify broad sense goals, so CBP Task Force goal is based on three times the recovery plan goal.

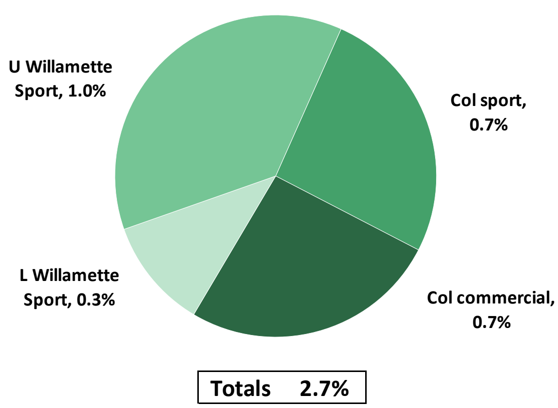
- Historically returned to four west slope Cascade tributaries upstream from Willamette Falls.
- Significant portions of the historical range are currently blocked by dams.
- Historical hatchery winter steelhead programs in the upper Willamette have been discontinued.
- Hatchery summer steelhead are released into the upper Willamette for mitigation purposes.



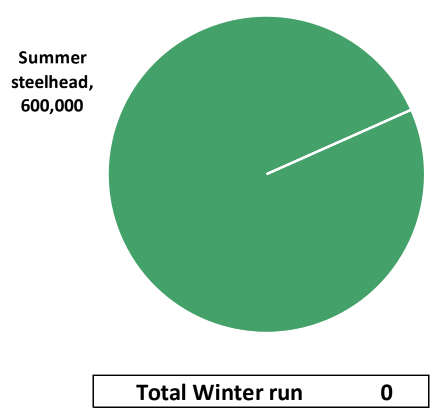




Harvest Distribution (Exploitation rate)



Hatchery Releases



Natural Production (Winter run)		Abundance		Potential Goal Range		
MPG	Population	Recent	Historical	Low	Med	High
Upper Willamette	Molalla	1,231	77,000	3,230	11,350	19,470
	North Santiam	690	75,200	8,630	9,320	10,010
	South Santiam	718	50,200	3,910	4,640	5,370
	Calapooia	177	17,600	520	2,495	4,470
	Totals	**2,816**	**220,000**	**16,290**	**27,805**	**39,320**

Artificial Production	Current Production			Return	Anticipated
Location (Program)	Brood	Smolts	Fry	Goal	production
Winter steelhead	0	0	0	0	0
Summer steelhead		600,000	0		550,000
Totals	**0**	**600,000**	**0**	**0**	**550,000**

Fisheries / Harvest		Exploitation rates				Harvest	
	Location	Avg (v ocn)	Avg. (v CR)	Limits	Potential	Recent	Potential
Winter run Natural	Ocean	0.00%	--	--	--	--	--
	Col sport	0.70%	0.70%	<2.0%	10-40%	50	28,000
	Col commercial	0.70%	0.70%			50	
	L Willamette Sport	0.30%	0.30%			20	
	U Willamette Sport	1.00%	1.00%	10-20%		70	
	Total	***2.7%***	***2.7%***		***10-40%***	**190**	**28,000**

Total Return (Winter run)		Recent (avg)	@ Goals		
		(2008-2017)	Low	Med	High
@ Columbia R Mouth		**6,300**	**36,000**	**70,000**	**114,000**
	Natural	6,300	36,000	70,000	114,000
	Hatchery	0	0	0	0
	% hatchery	0%	0%	0%	0%
Local return (Willamette Falls)		**5,500**	**32,000**	**54,000**	**76,000**
	Natural	5,500	32,000	54,000	76,000
	Hatchery	0	0	0	0
	% hatchery	0%	0%	0%	0%
Harvest (Col basin)		**200**	**1,000**	**10,000**	**28,000**
	Natural	200	1,000	10,000	28,000
	Hatchery	0	0	0	0
	% hatchery	0%	0%	0%	0%
Harvest (Total)		**200**	**1,000**	**10,000**	**28,000**
	Natural	200	1,000	10,000	28,000
	Hatchery	0	0	0	0
	% hatchery	0%	0%	0%	0%

Notes - Natural Production

Historically returned to four west slope Cascade tributaries upstream from Willamette Falls. Significant portions of the historical range are currently blocked by dams. Steelhead are broadly distributed in the north Pacific Ocean where they are not subject to marine harvest. Historical hatchery winter steelhead programs in the upper Willamette have been discontinued. Hatchery summer steelhead are released into the upper Willamette for mitigation purposes.

Distribution: The WLCTRT identified four historical populations: the Molalla, North Santiam, South Santiam, and Calapooia. Winter steelhead have also been reported spawning in the westside tributaries to the Willamette River above Willamette Falls. While ODFW recognizes these tributaries as part of the Willamette Winter Steelhead stock, the WLCTRT did not consider these tributaries to have constituted independent populations historically, but rather identified them as a population sink within the DPS. Numbers identified for the CBP Task Force address only the populations identified by the WLC TRT and incorporate into the ESA recovery plan.

Summer run steelhead return to the upper Willamette but originate from hatchery production. Summer run steelhead were historically unable to pass Willamette Falls so historically did not occur in the upper Willamette.

Historical abundance: Based on habitat-population viability analysis reported by ODFW in the ODFW/ESA recovery plan.

Current abundance: Willamette Falls counts, radio telemetry, tributary dam counts, and spawning surveys.

Goals:

- Low *range*: Identified in ODFW/NMFS ESA recovery plan, based on population modeling developed by ODFW and the ICTRT.
- *Medium range*: Midpoint between low and high goals.
- *High range*: Based on broad-sense goals identified in recovery plan (based on ODFW's population viability modeling).

Appendix B. MAFAC CBP Task Force Compiled Scenarios

Compiled Scenarios

The following is a compilation of scenarios developed by various members of the MAFAC CBP Task Force, as well as refined scenarios from the Project Team developed on behalf of the Task Force. The scenarios are presented in no particular order:

- **All in for Salmon Scenario**, Idaho Stakeholders
- **Fish Forever Scenario**, Ben Enticknap and Liz Hamilton
- **Total Salmon Scenario**, Idaho Stakeholders
- **Stronghold-anchored and Diversified Portfolio Scenario**, Rob Masonis
- **Concept for Developing Scenarios to Prepare for Climate Change and Plausible Futures**, Kevin Scribner
- **Shared Sacrifices Scenario**, Joe Lukas
- **Salmon First Scenario**, Zach Penney
- **Full Recovery Plan Implementation Scenario**, Steve Manlow and Washington's Columbia Basin Recovery Organizations
- **Level-of-Effort Scenarios**, Project Team

All in for Salmon Scenario
Idaho Stakeholders

This scenario was submitted by Idaho Stakeholders in an effort to spark conversation about making the hard decisions necessary to achieve the Partnership's Vision. The scenario maximizes predator control, eliminates harvest, removes dams on the Lower Columbia and Snake Rivers, maximizes hatchery production, and expands flow augmentation. The goal of this scenario is to push the comfort level of Partnership members, including the Idaho Stakeholders, to foster "out of the box" dialogue on meaningful solutions.

Hydro
- Immediately increase spill at dams on the lower Snake and Columbia Rivers to 125% TDG 24/7.
- Remove dams on the Columbia and Snake Rivers as follows:
  - Due to their significant impacts on salmon and steelhead, begin immediate steps to remove John Day and McNary Dams and return the river to natural river conditions.
  - Beginning with Bonneville Dam and moving up to the Lower Granite Dam on the Lower Snake River, breach/remove all structures in the river and return the Lower Columbia and Snake Rivers to natural river conditions.
  - Breach all non-federal dams in the Pacific Northwest that impact salmon recovery.
  - The Columbia Treaty Dams that are key to flood risk management will remain in place, but will have adult and juvenile passage provided immediately.
  - Add passage to all blocked areas and reintroduce all historical species.

Hatchery
- Immediately change hatchery operations to local wild brood stock and follow a conservation hatchery model.
- As wild, natural population rebound, ramp down and/or decommission hatcheries.
- Even with removal of the dams on the lower Snake and Columbia Rivers, mitigation obligations will continue until mid-level goals are reached 7 out of 10 years. Present funding levels and sources will continue — including BPA ratepayer funding from the development of hydropower in the region.

Habitat
- Increase availability of storage water from Upper Columbia, Upper Snake, and Clearwater Rivers to increase spill until dams are removed.
- All tributary habitat has been significantly reduced in quality and carrying capacity from historic resource extraction and settlement throughout the Columbia Basin. Massive increase funding for tributary and estuary habitat efforts (10x, 50x, 100x) to increase capacity and improve/rehabilitate habitat conditions.
- Habitat restoration must be process based with a focus on reestablishing and reconnecting flood plains and climate resiliency.
- Maximize efforts to restore Columbia River estuary habitat.

Harvest
- Immediate moratorium on all ocean harvest.
- Immediate reduction in tribal and non-tribal in-river harvest of salmon and steelhead, including hatchery-origin species, to maximum sustainable yield.
- All harvest reductions to remain in place until mid-level goals are reached 7 out of 10 years.

Predation
- Identify all in-river and ocean predators and take actions to minimize or eliminate their impacts on salmon and steelhead, including, but not limited to:
  - Remove quotas on all predator fish.
  - Implement population scale removal of non-native predator fish.
  - Removal of sea lions/seals up to potential biological removal (PBR) levels;
  - Remove all legal barriers for removal of avian predators.
- It is anticipated that these efforts will be ramped down as the normative river is reestablished and habitats that were conducive to predators change to a more natural environment.

Social, Cultural, Economic, and Ecological Considerations
- Prohibit new construction along all waterways.
- Remove or mitigate industrial actions that impact salmon recovery.
- Require that zoning along waterways consider the impact to salmon recovery.
- Eliminate all nonpoint and point source pollution to anadromous bearing surface waters.

- Immediately upgrade existing infrastructure, both road and rail, to accommodate lost barge transportation capacity.
- Evaluate Canadian/US storage operations to optimize for fish given evolving runoff patterns and amounts.

Additional Funding

- Impose "salmon tax" on all residents of Oregon, Washington, Montana and Idaho to fund habitat improvement efforts, point source and nonpoint source elimination, short-term conservation hatcheries, interim predator control measures and monitoring.
- "Salmon surcharge" on all recreational permits and licenses, including watercraft, fishing licenses, guide permits, etc.
- Lobby Congress to include federal funding for fish recovery.
- Surcharge on all existing flood control districts in the region.

Fish Forever Scenario

Ben Enticknap and Liz Hamilton

In May 2019, following two years of public process and deliberations, the Columbia Basin Partnership Task Force finalized its Phase 1 report for broad sense qualitative and quantitative goals for thriving salmon and steelhead populations throughout the Columbia River Basin. The Provisional Quantitative Goals translate into a total increase of naturally produced salmon and steelhead from the current annual average of 381,000 adults (2008-2017) to as high as 3.58 million adult salmonids. This represents the need for improving salmon and steelhead runs 9.4 times above current average levels. While this would be a vast improvement in total run size, achievement of the Task Force's goal would still mean salmon and steelhead runs 40% below estimated historic run sizes.

Salmon and steelhead recovery throughout the basin would have significant social, cultural and economic benefits for people throughout the basin and beyond. The values of recovery, described in our Phase 1 report include major potential benefits for ocean and in-river treaty and non-treaty commercial, and sport fishing industries, subsistence harvest, recreation, and a healthy, abundant source of food for people. Ecological benefits are equally significant. For example, recovering Columbia Basin Chinook will have great benefits for endangered Southern Resident killer whales and more than one hundred other fish and wildlife species that benefit from abundant salmon and steelhead. The Task Force has recognized that while it will not be easy, we have common values and a shared interest in achieving our qualitative and quantitative goals.

Ultimately success in achieving our goals will require major changes throughout the basin. Current efforts are insufficient and with climate change, the challenges to success are only increasing. Given global trends in greenhouse gas emissions we are likely to see severe impacts to Columbia Basin salmon and steelhead. Climate change impacts now and in coming decades will result in increasing stress on salmon at all life stages and across all habitats including increased water temperatures, alternation of stream flows, changes in prey availability, increasing ocean acidification, and increasingly frequent and intense marine heatwaves.

The impacts of climate change demand that we take steps to increase salmon habitat and ecosystem resilience through protection, restoration and increased connectivity. By recovering and protecting wild, self-sustaining salmon populations and their habitats now, we can help salmon regain and maximize their genetic diversity and resilience, which will be critical to enabling salmon to adapt and thrive as the climate continues to change.

The Fish Forever Scenario described here is intended to be a comprehensive and bold approach to achieve the broad sense qualitative and quantitative recovery goals described in the Task Force's Phase 1 report. It shares and supports many but not all of the biological strategies and underlying philosophies as described in the Salmon First Scenario. Here we provide additional specificity to some strategies plus offer new approaches. The Fish Forever Scenario recognizes the urgency for salmonid recovery needed to support both people and dependent wildlife, the increasing threats from climate change, and it aims to clearly articulate biological strategies necessary to achieve Task Force goals.

Biological Strategies

Columbia and Snake Hydropower System

- Begin immediate efforts to breach the four Lower Snake River dams while developing and implementing alternate forms of clean power generation, energy efficiency, irrigation and transportation for shipping and commerce;
- Increase spring spill to 125% total dissolved gas as measured at the tailrace for remaining mainstem lower Columbia River dams.
- Evaluate and implement salmonid passage and reintroduction options for areas that are currently blocked by dams.
- Implement operations to address flow and temperature effects from climate change.

Habitat

Similar and consistent with many of the actions described in the Salmon First Scenario for tributary habitat, estuary habitat and blocked areas, including:

- Substantially increase Basinwide habitat protection and restoration actions and ensure that efforts strategically target populations and habitat limiting factors that will provide the greatest contribution to long-term recovery goals;
- Maximize protection and restoration efforts to conserve habitats least vulnerable to climate change and most likely to improve climate resilience;
- Continue and increase efforts to alter management of water systems to provide more normative flow regimes, functional habitats, and connectivity;
- Reintroduce fish into blocked areas (Chief Joseph/Grand Coulee and Hells Canyon Complex) including advancing habitat protection and restoration above Hells Canyon Complex to prepare for eventual passage there.

In addition:

- Implement policies for an overall net ecological gain for salmon habitat (across tributary, estuary and blocked areas) - modernizing state land use, development, and environmental laws and regulations to result in a net gain of ecological health throughout the basin.
- Develop and prioritize a list of blocked areas/ dams in tributary habitat for potential removal or fish passage improvements which would benefit salmon and steelhead recovery. Implement the list.

Hatchery

- Maintain science-based hatchery production to supplement natural runs and support fisheries for mitigation until broad sense regional goals for natural production are achieved.
- Ensure that hatcheries are managed in a way that is consistent with recovery of natural runs, including marking hatchery fish to readily distinguish them from natural fish.
- Use conservation hatchery strategies as needed to proactively address future threats, including climate change.

Harvest

- Ensure that conservation and management measures are appropriately allocated such that management measures are equitable, just, and consistent with federal law;
- Continue to set harvest at levels that do not impede recovery through use of mark-selective fisheries, abundance-based management frameworks and other relevant harvest management approaches (e.g. fisheries are focused to selectively target hatchery-reared salmon and more abundant wild stocks while protecting weaker, less abundant stocks);
- Establish or continue to use existing sliding scale harvest schedules that increases the rate of harvest as runs increase (recognizing that these scales are designed for the low-end goals in Figure 2 of the Phase 1 Report of the Columbia Basin Partnership Task Force of the Marine Fisheries Advisory Committee).
- As natural returns of salmon and steelhead approach high-range goals, work towards adding retention of wild salmon and steelhead.
- Where biological benefits can be achieved, eliminate non-consumptive fishery impacts on salmon and steelhead where threatened fish populations are actively spawning.

Total Salmon Scenario

Idaho Stakeholders

Introduction

This scenario was submitted by Idaho stakeholders in an effort to spark conversation about making the hard decisions necessary to achieve the Partnership's Vision. The scenario maximizes predator control, eliminates harvest, removes dams on the lower Columbia and Snake Rivers, maximizes hatchery production, and expands flow augmentation. The goal of this scenario is to push the comfort level of Partnership members, including the Idaho stakeholders, to foster "out of the box" dialogue on meaningful solutions.

Theme

The Columbia River Basin, including the Snake River and other tributaries, is the backbone of the Pacific Northwest. Tribal, state and local communities rely on the river system for their social, cultural and economic well-being. For example:

- Tribal communities rely on the river system for dietary, spiritual, cultural, economic and subsistence needs.
- Agriculture communities rely on the river system for water to grow crops in some of the most fertile and product farmland in the world.
- Communities rely on the river system to deliver their crops and other goods from inland ports to the ocean and, from there, to the world.
- Citizens throughout the region rely on the river system to provide inexpensive, clean and renewable hydropower.
- Recreators from around the world flock to the Pacific Northwest to take part in fishing, rafting and other recreational opportunities on the river system.

The value of the river system to the region cannot be overstated.

Unfortunately, historical management practices, including overharvest and the construction of dams along the river, and variable climate and ocean conditions, have resulted in dramatic declines to salmon and steelhead populations throughout the region. Populations declined until the 1990's, when many of the populations were listed under the Endangered Species Act (ESA). At that time, the region began working collectively to recover fish populations.

Turbines have been updated. Flow regimes have been modified. Habitat restoration is ongoing. From approximately 2000 through 2014, progresses within the four H's saw significant improvement to salmon and steelhead runs. Although populations numbers have improved, recent adverse ocean conditions due to climate change have caused fish returns to decline. More can be done to brace against the impacts of climate change. More can be done to decrease the impacts of changing ocean conditions.

Most importantly, a solution will require all citizens of the Columbia Basin working together. There should not be "winners" and "losers." Rather, all of us need to work together to create a better, brighter future for the region and its salmon and steelhead populations.

This scenario is drafted to provide an "all hands-on deck" work process where all tribes and stakeholders work together to create the future, we all desire.

Hydropower System (Four Dams on Lower Columbia River and Four Dams on Lower Snake River)

- Implement spill program, which includes adaptive management measure to improve smolt travel time and reduce powerhouse encounters.
- Develop a "smart" smolt transportation program. Install degassing equipment to reduce TDG levels in the smolt holding raceways and within transport barges to no more than 102%. Following installation of degassing equipment, conduct a comparative Latent Mortality study between in-river fish and transport fish with real time data that includes in river and transport TDG exposure levels.
- Implement operations to address flow and temperature effects from climate change.
- Incorporate structural modifications, as needed, to improve salmon returns upstream.

Tributary Habitat

- In connected areas, substantially increase Basinwide habitat restoration actions.
- Strategically target populations and habitat areas that will provide the greatest contribution to long-term recovery goals.
- Maximize restoration efforts to conserve habitats least vulnerable to climate change or most likely to improve climate resilience.
- Continue research, monitoring and evaluation as necessary to quantify physical and biological benefits from tributary habitat restoration and understand the most efficient methods for improving habitat.

Estuary Habitat

- Substantially increase level of effort to maximize estuary habitat restoration.

Blocked Areas

- Continue discussions to reach consensus about restored fisheries of non-listed ESA fish above Hells Canyon Complex consistent with the Hells

Canyon agreement and the State of Idaho's blocked area policy.
- Proceed with science-based, phased approach to reintroduction of anadromous fish above Chief Joseph and Grand Coulee Dams in accordance with Northwest Power & Conservation Council's Fish and Wildlife Program.
- Expand the current range of non-listed fish consistent with current agreements, including the Hells Canyon agreement and the State of Idaho's blocked area policy.

Predation
- Population-scale removals of non-native/ introduced species.
- Eliminate harvest limits and regulations protecting non-native fish in waters that contain or are connected to waters containing anadromous salmon and steelhead.
- Increase funding for federal, state, and tribal enforcement to reduce illegal or unintentional introduction of invasive/non-native species.
- Identify and implement targeted opportunities to enhance predator control actions, including predation impacts related to climate effects (e.g., non-native fish range expansion due to dams and climate change).
- Modify or remove anthropogenic structures below Bonneville Dam that have increased predators or that make salmon and steelhead more vulnerable to predation at all life stages.

Hatchery
- Ensure that hatchery programs with a mitigation responsibility are fully and adequately funded, including routine and non-routine maintenance needs.
- Specify hatchery goals for smolts or returning adults abundance goals.
- Modernize hatchery infrastructure to ensure achievement of abundance goals.
- Prioritize hatchery production to meet escapement goals.
- Continue to improve hatchery programs using the best available science to minimize risks to natural populations.
- Establish minimum escapement objectives to meet hatchery production goals.
- Prepare for the likely role that hatchery programs and infrastructure will play in buffering against fluctuating environments and stochastic climate events.
- Implement sliding scale protocol for hatchery production as natural abundance increases and proves resilient.

Harvest
- Balance fishery effort to ensure mixed stock fisheries (sport and commercial) are not artificially changing run-timing (e.g., overharvesting the earlies run Spring Chinook or upriver bright Summer Chinook).
- Set harvest impacts at levels that do not impede recovery through use of abundance-based management frameworks or other relevant harvest management approaches.
- Establish minimum escapement objectives to meet natural production goals.
- Consider in-river refuges/sanctuaries that protect migrating salmon and steelhead.

Social, Cultural, Economic, and Ecosystem Considerations and Strategies
- Tribal dependence on salmon and other fish species to meet dietary, spiritual, cultural, economic and basic subsistence needs is a prevailing necessity of tribal culture and society.
- Ensure that existing mitigation commitments are met.
- Provide subsistence and commercial fisheries for tribal and non-tribal communities. Currently, there is a lack of accountability on meeting those obligations.
- Benchmarks should be set at intervals to ensure that salmon and steelhead adaptive management measures are effective.
- Manage the river system in a way that recognizes, and prioritizes, the diverse cultural, economic and social values of the river system on society in the Columbia River Basin.
- Work to restore stability for Tribes and other stakeholders, including sportsmen and outfitters on tributary systems, who rely on a strong fishery for their cultural, social and economic well-being.

Stronghold-anchored and Diversified Portfolio Scenario
Rob Masonis

Scenario Description
The Columbia Basin can still provide abundant, healthy populations of naturally produced salmon and steelhead long into the future if we are good stewards. But that is not true everywhere

in the Basin. The ability to produce abundant, fishable populations of naturally produced salmon and steelhead varies based on habitat quality, quantity and connectivity. Some areas of the Basin are highly degraded due to extensive habitat alteration that has severely limited their fish production potential. Others have plenty of high quality, connected habitat with substantial natural production potential. In between are areas where significant — and important for purposes of achieving long-term viability — natural production can occur with habitat improvements and good fishery management. The Columbia Basin Partnership's quantitative natural production goals reflect this reality.

This scenario calls for accepting this reality and managing habitat and fish in the context of the specific watersheds in which they live. Sub-basins with highest natural production potential will be managed as strongholds to maximize that potential. Sub-basins with low natural production potential will be managed for hatchery production that serves harvest fisheries in a way that does not jeopardize wild stocks. Other rivers will have mixed management, with both natural production and hatchery operations.

Infrastructure throughout the Columbia Basin is upgraded to meet the needs and values of the region in the 21st Century. Much of our current infrastructure (e.g., dams, hatcheries, irrigation systems) was built in the mid-20th Century based on the scientific understanding and technological capability at that time. Today, we have a much better understanding of what salmon and steelhead need to thrive and technological advances have made it possible to meet the region's power, transportation and water supply needs in new ways.

This scenario emphasizes adapting the engineered systems that serve our human needs in order to provide the functional natural ecosystems that salmon and steelhead will always need. Some dams are removed. Other dams are optimized for power generation. Grid improvements, battery storage, energy efficiency investments and other innovations enable us to meet energy needs while reducing the burden placed on our rivers. The infrastructure investments create employment opportunities and costs are equitably distributed and controlled with a more complete recognition of the social, cultural and economic values provided by a functional ecosystem.

Our outdated river governance structure is improved. Today's siloed management of habitat, fisheries (harvest and hatcheries) is integrated to ensure that management actions and policies align to achieve well-defined quantitative and qualitative goals at the stock and population scales. Opportunities to "stack" and sequence actions across "the Hs" are identified and pursued to take advantage of synergistic effects. Transparency and accountability are hallmarks of the new governance system, and consequently public confidence in river management is high and people feel that their tax and ratepayer dollars are being wisely spent.

Fishing, too, is updated for the times in which we now live. Selective gear is used in commercial fisheries to minimize take of non-target stocks. Sportfishing is managed to keep impacts controlled and to promote fishing opportunity and equitable distribution of opportunity throughout the Basin. Gear restrictions, area closures, and innovative management techniques such as periodic, temporary "fallowing" of rivers, etc. are management tools used to maintain quality fisheries that can be sustained year-in and year-out. Enforcement of fishing regulations is robust and there is a strong self-enforcement ethic among fishers because fishing opportunity is dependent on good stewardship. Longer, consistent seasons allow fishing dependent businesses to sustain themselves and is better than the status quo.

Hatcheries are deployed in an ecological context using the best available scientific information and monitoring practices (see below), in a manner consistent with achieving stock and population-specific natural production goals. In stronghold natural production watersheds, hatcheries are not used unless there is a compelling conservation need. Hatcheries designed to provide harvest opportunity are sited in areas with low natural production potential where the risk of straying is low, and the fisheries targeting hatchery fish are managed to minimize impacts on non-target stocks. Less intensive hatchery operations are located on "intermediate" rivers where significant natural production can occur but not at the stronghold level.

Large-scale experiments and robust monitoring programs are established to answer important unanswered questions. The portfolio management approach enables use of treatment and control rivers to get more clarity on issues including, but not limited to: the ecological and genetic impacts of hatchery fish on naturally produced fish; the benefits of different types of fishing, harvest and predation control management; the effect of large increases in escapement to the spawning grounds on productivity and spatial distribution; and the resiliency of salmon and steelhead to thermal and hydrologic changes caused by a warming climate.

Habitat protection and restoration is prioritized in sub-basins where there is substantial natural production potential that can be realized with such investments. Emphasis is on restoring ecological processes. As habitat is opened and restored, river-specific escapement goals are updated to ensure enough fish return to use the habitat and take advantage of the additional production potential. Habitat protection and restoration continues throughout the Basin to maintain and improve ecological function commensurate with natural production goals for stocks and populations.

Guiding Principles and Assumptions

- The needs of salmon and steelhead have been and always will be the same, regardless of human desires.
- Locally adapted, spatially distributed populations with genetic and life history diversity are the most productive, fit and resilient salmon and steelhead.
- Potential for natural production of salmon and steelhead varies by sub-basin.
- Portfolio river/stock management is more cost effective and provides better biological outcomes than the status quo.
- By sequencing and stacking actions across the Hs, large and potentially rapid gains in natural production can be made.
- Treaty obligations to Columbia Basin Tribes must be honored.
- The human actions that have been primarily responsible for the decline of wild salmon and steelhead in the past may not be the actions that can provide the biggest natural production boost in the near term.
- Hatcheries can be used to provide harvest opportunity if properly located, sized and operated to be consistent with natural production objectives at the stock and population scale.
- Large-scale experiments and better monitoring are needed to answer critical uncertainties; we lack sufficient data to accurately predict the impact of key management practices.
- Humans can adapt much more easily than fish.
- Transparency and accountability are essential to establish and maintain public confidence in salmon recovery efforts.
- We should manage with future generations in mind, not maximize short-term objectives at their expense (transgenerational equity).
- Economic losses necessitated by short-term "surge" recovery actions and transitions should be mitigated.
- Major infrastructure investments are needed to operate the Columbia-Snake system to achieve CBP goals.
- Costs and benefits of salmon recovery should be equitably distributed, recognizing the need to remedy past inequities in the distribution of costs and benefits.

Concept for Developing Scenarios to Prepare for Climate Change and Plausible Futures

Kevin Scribner

Introduction

Climate change is ahead of us, and we do not know exactly how it will play out. The future is uncertain. Predictions about climate change effects range from "slow and steady," to "dramatic and mercurial." Climate changes will result in modification to ecosystems and fish populations will have to evolutionarily adapt to these new conditions to survive. At the same time, there will be responses by people in how they adjust to these changes. This proposal introduces a concept for developing scenarios that incorporate responses to future changes in climate conditions by both fish and people.

This concept acknowledges we cannot accurately forecast the future, especially in the 25-50-100 year time frames within which the CBP Task Force has determined to achieve its goals. We cannot exactly know what kind of climate changes will occur and when, where and how. We also cannot prepare for everything. What we can do is establish a set of *plausible futures (these could happen)* that describe a range of changes to which we can envision corresponding regimes of response, i.e., strategies and actions. Connections between development of scenarios and future plausible conditions are articulated in a Pacific

Fishery Management Council report, *Fisheries Ecosystem Plan Climate and Communities Initiative: Developing Future Scenarios for Climate Change in the California Current Ecosystem*.

> "Although scenarios are stories about the future, they are not predictions, nor are they descriptions of desired future states. They are created and designed to describe the range of plausible conditions that an organization or a community could face. By thinking about these ahead of time — essentially rehearsing the future — organizations can be far better prepared for the future uncertainty. Over the past decade, many organizations have begun to use scenario planning as a means to prepare for the uncertainties and surprises associated with climate change."

The concepts and methodology described below are best applied in a workshop setting. The workshop would cover the potential physical changes and the prospective responses by both fish and humans. These envisioned responses can inform the generation of strategies to support salmon recovery that anticipates a variety of climate-influenced future conditions. A set of sample questions that could guide generation of plausible futures and the respective ranges of response is presented in Table B-1. Figures B-1 and B-2 each illustrate four plausible futures, one set for salmon, one for people. Figure B-2 is followed by a narrative of four plausible futures, each with a brief description of Basin attitudes, and a sample of corresponding salmon recovery actions for each quadrant, or plausible future. It is hoped that the CBP Task Force will engage in such a workshop in the near future to test the applicability and value of this methodology to prepare the Basin's salmon recovery strategies for future uncertainty.

The author offers these concepts with an eye towards our future generations, especially as we ponder seven generations forward, planning for our Children's Children's Children's Children's Children's Children's Children.

Plausible Futures

In this concept, "plausible futures" describe the interactions between climate change, reflected by hydrological changes, and responses to change by either fish populations or humans. For fish, the response to the new hydrological conditions is an adaptive process that requires physiological changes to individuals within the population that translates to intergenerational evolutionary changes. This adaptive process requires time to incorporate physiological changes into the population and this time period of the response can vary depending on the fish species and the types of physiological changes required. The sample salmon plausible futures below assume that humans can create conditions to help salmon adapt to climate changes.

For people, the response is in adjustments to behavior, which are influenced by attitude, especially the willingness to change. Figures B-1 and B-2 display a range of attitudes from "resistance to change," to "embracing change." These attitudes influence our ability to plan, adjust, and mitigate. They influence what we identify as barriers and our response to them. To successfully achieve the CBP Task Force goals, we must consider impacts to both the physical environment and social attitudes.

The interaction between climate change and responses from fish and humans are presented in the form of a diagram with a vertical and horizontal axis. The hydrological changes occupy the horizontal access while the fish and human response to change occupy the vertical axis. This results in establishing four quadrants, each of which represents a different plausible future. Scenarios are then developed to address each of the quadrants, or plausible futures, thereby providing a roadmap for future actions that are sufficiently informed and flexible to respond to a range of climate influenced conditions.

Figure B-1 illustrates a range of climate change predictions and adaptations by fish populations to predicted changes. The horizontal axis shows a gradation of *Climate Effects on Basin Hydrology*, from *Gradual, Steady Change* on the left, to *Dynamic, Mercurial Change* on the right. The vertical axis shows a gradation of *Salmon Adapting to Change*, from *Slow Adaptation to Change* at the bottom to Rapid Adaptation to Change at the top, with green (I) representing low risk, grey (IV) representing high risk, and yellow (II) and peach (III) representing intermediate risk.

Figure B-2 illustrates the range of plausible futures for people and their adjustments to those changes. The horizontal axis shows a gradation of *Climate Effects on Basin Hydrology*, from *Gradual, Steady Change* on the left, to *Dramatic, Mercurial Change* on the right. The vertical axis shows a gradation of *response to climate change*, from *Resistance*

FIGURE B-1. Range of Plausible Futures for Salmon and Steelhead

I. There is Time—for humans to help Salmon adapt
II. Challenging Times—humans hinder and help Salmon adapt
III. Sirens Sound—all hands on deck to help Salmon adapt
IV. The Bell Tolls for Triage—help is haphazard, some Salmon go extinct

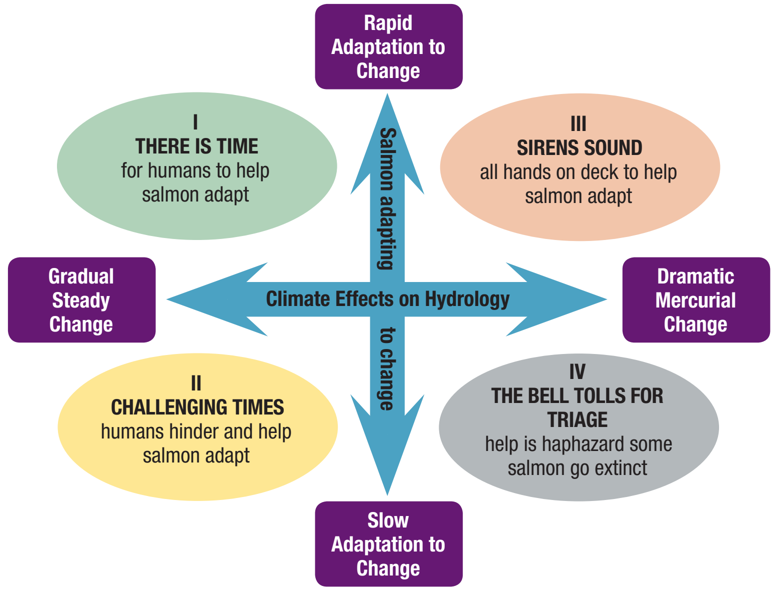
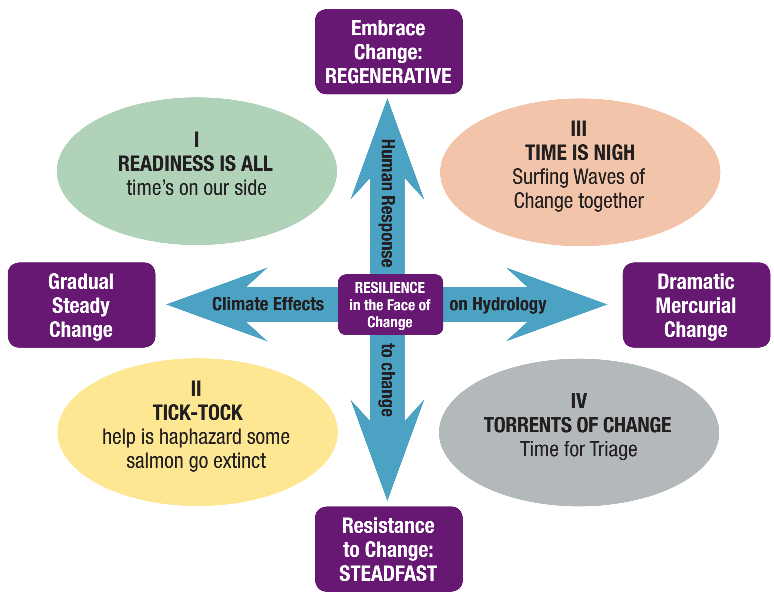


FIGURE B-2. Range of Plausible Futures for People

I. There is Time—for humans to help Salmon adapt
II. Challenging Times—humans hinder and help Salmon adapt
III. Sirens Sound—all hands on deck to help Salmon adapt
IV. The Bell Tolls for Triage—help is haphazard, some Salmon go extinct



to Change on the bottom, to *Embracing Change: Becoming Regenerative* at the top, with *Experiencing Change with Resilience* at the midpoint. The quadrants, or plausible futures, are color coded to represent the rate at which change needs to occur to address the changing climate and the current public attitude, with green (1) representing collaborative and timely responses, peach (III) representing collaborative and urgent responses, grey (IV) representing immediate, fragmented and reactionary responses, and yellow (II) representing responses with some collaboration and some civic friction.

These diagrams and plausible future narratives are provided as a demonstration of this scenario planning methodology. The proposed CBP Task Force workshop would use this methodology to:

- Identify a range of potential climate change effects and physical conditions;
- Describe the range of fish adaptation to climate change conditions;
- Describe the range of human responses and social attitudes to climate change conditions; and
- Consider the physical, fish, and human dynamics, while developing a set of strategies to support salmon recovery under those conditions.

TABLE B-1. Sample Questions for use in Workshop

Workshop on Climate Change: Questions about plausible futures

Participants would deliberate the following questions, considering the next 25/50/100 years:

- What are the projected changes to climate and environmental conditions that will affect the Basin's hydrology? Consider Annual Precipitation, temperatures, and ocean.
- How will changes in Basin hydrology over time affect salmon recovery?
- What is the capacity of salmon to evolutionarily adapt to new conditions within the given time span (0-100 years)? What influences the capacity to adapt?
- What are the projected changes to human population levels that will affect the Basin's hydrology/water?
- What are the characteristics of human and community capacities to adjust, including responding to the pace of change?

This concept can be applied at different scales — geographic, stock-specific or even population-specific. Different stocks and populations will fall into different quadrants based on their current status and set of conditions. Additionally, the plausible future can be described for different time periods (e.g. current, 25 or 50 or 100 years in the future). The questions in Table B-1 serve to prompt and guide deliberations, to lead the CBP Task Force to identify different approaches and actions to adapt, respond, and mitigate to a range of climate change futures. This set of questions is offered only as a samples. The workshop would develop its own questions.

The following plausible futures serve as examples that would be refined or replaced in a workshop. Each focuses on prospective human responses to changing climate conditions and include a sample of potential salmon recovery approaches and actions that could be expanded into a full-blown Salmon Recovery Scenario.

I. Readiness Is All—Time Is On Our Side

The prevailing Basin perspective recognizes there are changes in climate and Basin hydrology, and that these changes and their effects will proceed throughout the Basin at a gradual and steady pace. This supports the attitude that *time is on our side*, that *Basinwide, we need to be collectively preparing to embrace change*. A minimal and fading percentage of residents and leaders question—with some distrust and disbelief—the science and modeling providing the signals of change. These indicators of change, though they may seem remote (changes in the Pacific Ocean) and many residents are buffered from direct experience, are persuasive and serve to generate widespread agreement to be ready to change, to be ahead of curve, to be pro-active instead of reactive. The *CBP Task Force* is able to maintain an influential, prominent, if not dominant, voice for collaborative strategies and actions. The Basin has learned lessons from the 2020 Pandemic, including that change can swiftly accelerate and expand with ripple effects throughout the Basin's interconnected and interdependent hydrological and social, cultural, economic, and ecological considerations.

The Basin's population gradually increases, both from new births and from immigration, including from other regions within the US, as many search for increased quality of life, especially as climate conditions affect livability across the nation. The CBP Task Force is a successful champion of incorporating Salmon Culture education into both formal and informal learning processes, ensuring newcomers of all ages learn about salmon. Caring for salmon is embedded into the Basin culture, and Tribal *Traditional Ecological Knowledge* is embraced. The CBP Task Force has welcomed the younger generations into its functions and messaging, encouraging them to help demonstrate how to enthusiastically and creatively embrace change. Revenue to adequately support salmon recovery uses a variety of mechanisms that insure that opportunities to contribute are widespread and actualized by all Basin residents.

Maintaining social, cultural, and environmental relationships are hard-wired into all strategies and actions. Balance means *we are all in this together*, traveling together into the future. People tend to identify themselves by their relationships, to others, to the landscape, to the planet.

Commitment to the health and well-being of the Basin's salmon and social, cultural, economic, and ecological considerations (SCEE) are embedded in a robust regional identity, not requiring Federal rules and regulations, i.e., the Endangered Species Act.

Sample Projected Recovery Approaches and Actions:

- The CBP Task Force successfully champions robust Basinwide Recovery Plans, embracing and building upon all Recovery Plans to date. Recovery Plans will rely upon a certain amount of luck (Nature helping), but acknowledge, too, that adage that to a certain extent: *we make our luck*
- The Yakima Plan is heralded as a model and is steadily adopted, with variations, throughout the Basin.
- The CBP Task Force hosts task forces that meet regularly, developing effective, collaborative methods Basin decision-making to address mitigation & adaptation to climate change, including: biological, SCEE, integration, design, and adaptive management components
- Salmon Recovery Plans include SCEE Resilience Plans. SCEE Resilience Plans rely upon *Life Cycle Assessment* methodology to evaluate *footprints* of practices, leading the Basin toward practices that support mitigation measures and support adaptation.
- Salmon-Safe Certification of agricultural operations and urban storm-water management becomes wide-spread and eventually the industry standard, resulting in water quality baselines that are safe for salmon.
- Sufficient, dedicated funding sources are identified and implemented.
- Innovative Experimentation is a key strategy, embraced as the source of "vaccines" for future hydrological changes. The Basin *Brain* calmly and creatively approaches what are characteristically considered intractable issues. There are minor-to-major infrastructure changes and refinements.
- An elevated commitment to equity prioritizes project design and implementation for re-entry of salmon into blocked areas.
- K-12 curriculums integrate environmental lessons at every grade level, woven together by the theme of salmon, enabling every high school graduate to be familiar with and knowledgeable of salmon's essential role for Basin ecosystems and cultures. The video game, Sim-Salmon, gives learners of all ages a fun way to devise strategies to recover and sustain all Basin salmon stocks in a balanced way with SCEE.

II. Tick-Tock—Banking On Slow Change

The prevailing Basin perspective recognizes there are changes in climate and that these changes and their effects will proceed at a gradual and steady pace, gently rippling through the Basin's hydrology, ecology and SCEE functions. This supports the attitude that we have and will continue to have time to respond to these changes. A notable percentage of residents and leaders adamantly question—with some disbelief or distrust—the science and modeling providing the signals of change. Some of these indicators seem remote (changes in the Pacific Ocean—far away, out there) and many residents are buffered from direct experience with the effects. There is a Basinwide failure to realize and anticipate a potential rapid increase of change—even with the lessons available from the 2020 Pandemic—and to recognize how interconnected and interdependent the Basin's SCEE functions are. The variety of attitudes and experiences make collective responses to change difficult to achieve. Place- and demographic specific-based ecological and SCEE challenges are often seen by many as their problems, not ours.

The CBP Task Force is able to maintain an influential voice for collaborative strategies and actions for salmon recovery, but is often drowned out by the cacophony of polarization. The lack of consensus or a substantial majority to commit to a singular strategy to salmon recovery burdens the ability to mount a Basinwide balanced approach with glacial, divisive-dominated decision-making. This binds salmon recovery to no more than a steady as she goes status in the face of change. Funding to support salmon recovery is hindered by a perception and reality that the mechanisms to generate revenue are not equitably shared by everyone throughout the Basin, as well as that current levels of funding are adequate.

The Basin's population increases, both from new births and from immigration, including migrants from other regions within the US as many search for increased quality of life, especially more favorable climatic conditions. Salmon culture and its advocates gradually slide into a minority position. Many from the younger generations publicly cry for the older decision-makers to wake up and smell the change, but are constantly marginalized. People tend to identify themselves by boundaries and differences, be they regional, political, economic, racial, cultural, generational. Social and cultural equity is acknowledged but does not influence policy and false equivalencies are allowed to influence decision-making.

Sample Projected Recovery Approaches and Actions:

- Current Salmon Recovery Plans are considered sufficient, though constantly searching for increased funding and risk falling behind the curve due to inability to keep pace with changes in hydrology and SCEE water resource demands
- Salmon Recovery suffers from a fragmented approach, not integrated Basinwide nor incorporating ocean influences
- Salmon stocks on ESA life support relapse more and more, questioning the Basin's will to provide this support
- Yakima River Plan is championed as a model for watershed-level salmon recovery, but replication throughout the Basin is hesitant and spotty
- There is more leadership resistance than support for innovative experimentation, especially projects that are considered overly expensive, that may require infrastructure modifications, and require multiple years for proof of concept
- Major infrastructure changes are relegated to more study
- Block areas introduction is relegated to more study

III. Time Is Nigh—Surfing Waves of Change Together

Effects from the changing climate are rampant throughout the Basin, showing in dramatic and mercurial ways. Rapid response is necessary. The CBP Task Force has been instrumental in generating a Basin attitude of readiness and is prepared for this future-become-present of big waves of change. There are small pockets of resistance with a few residents and leaders still questioning—with some distrust and disbelief—the science and modeling providing the signals of change, but they have little-to-no influence on regional decision-making. Indicators of change are present everywhere, with every residents directly experiencing some effect of change. The Basin is incorporating pro-active strategies prepared from lessons learned from the 2020 Pandemic, including that change can accelerate rapidly and erratically, with ripple effects throughout the Basin's interconnected and interdependent SCEE functions. The CBP Task Force is viewed by the Basin as the pre-eminent voice for collaborative strategies and actions.

The Basin's population is increasing by leaps and bounds, both from new births and waves of climate refugees. The CBP Task Force has successfully championed integration of Salmon Culture and the caring for salmon into most, if not all, aspects of Basin life. The younger generations are respected partners, providing insights, commitment and energy in helping the Basin surf these waves of change. Though challenged by more frequent, significant changes in hydrology, there is a deep, strong and pervasive commitment to the health and well-being to all life in the Basin—we are unwavering in our dedication to the interrelationships and interdependency between people and natural ecosystems in the Basin that identifies who we are. Salmon recovery funding is an essential priority and has a revenue stream that is basic to all households and businesses, similar to utilities like water and electricity. The recovery of salmon runs and sustaining of Basin SCEEs are considered to be a good return on investment.

Balance becomes gymnastic, with the Basin doing its best to not fall off the balance beam when buffeted by dramatic, mercurial change, standing tall together while surfing these big waves of change.

Sample Projected Recovery Approaches and Actions:

- CBP Task Force convenes Basinwide Integrated Task Forces to manage local mobilization—all hands on deck— and declares, with Basin support, that Salmon are essential.
- VALUE OF CLEAN, COLD WATER—priority appropriation supersedes prior appropriation; water-for-flow markets accelerate—when water is precious, we will use it with precision; to maintain water quality, Salmon-Safe Certification Standards are the industry standard for agricultural and urban storm-water management.
- Strategies for Salmon Recovery and SCEE Resilience strive to restore and maintain characteristics of Living Rivers, and focus on actions to mitigate and adapt—quickly!
- The pervasive salmon-theme environmental education is paying enormous dividends by enabling significant majorities of citizens to

commit to salmon are essential policies and projects. Sim-Salmon is re-designed for these extreme changes, enabling players to conjure their own solutions, some of which may be relevant to managers.

- Strategies for Normative River alternatives are developed: interconnected and integrated basin plumbing system (many small impoundments and many spigots) + monitoring dedicated to provide quality water to where and when needed most for smolts and adults
- Yakima River Plan is the compelling model, being replicated across the Basin—readying each watershed for Congressional infrastructure stimulus funding targeted on shovel-ready projects
- Introduction of salmon in blocked areas is recognized as a top priority for expanding the essential habitat and enhancing stock diversity
- The Basin prepares for inevitable grief from unavoidable losses
- Loss of California salmon stocks due to hydrological system changes emphasizes the vulnerability of some/many Columbia Basin stocks

IV. Torrents of Change—Time For Triage

Effects from a changing climate are rampant throughout the Basin, displayed in dramatic and mercurial ways. Rapid response is necessary. The CBP Task Force has been relegated to a minority voice of preparation of responses to change. Polarization has frozen the Basin's capacity to prepare for what occurs, leaving responses to be reactive, not proactive, and fragmented. The Basin is increasingly behind the curve. The failure of the Basin to realize the potential acceleration and expansion of change—even with the lessons available from the 2020 Pandemic—and the failure to realize the extent of interaction and interdependency between the Basin's SCEE functions, contributes to falling more behind the curve. Indicators of change are present everywhere, with all residents directly experiencing effects of change.

The Basin's population is increasing by leaps and bounds, both from new births and an onslaught of climate refugees, at a rate that overwhelms growth management strategies and plans. The CBP Task Force is unable to successfully champion integration of Salmon Culture into Basin lives, and there is clear and present danger that salmon will be considered non-essential as human survival-oriented responses dominate. The younger generations are extremely exasperated and would check out if they could. They express a significant distrust of Basin leadership. The Basin population becomes stratified and fragmented. Creating and/or maintaining a broad social and cultural safety net is judged to either be non- or less-essential than taking care of one's own.

Maintaining balance is wishful thinking. The global shock from the 2020 Pandemic is now viewed as just a penetrating jab, now that the game-changing effects from changes in climate are felt to be a haymaker.

Triage decisions dominate policy, with stark determinations of what is essential and what is expendable. In a policy framework dominated by human survival, salmon recovery is felt to be non- or less-essential until SCEE functions regain resilient capacities—if they can. Funding for salmon recovery is woefully inadequate to support Basinwide recovery and difficult decisions must be made on how many and which stocks to support, and which stocks to be triaged, left to their own capacities to adapt. The paucity of funding is exacerbated by a disruption in global and national economies and the evaporation of wealth from slumping stock markets.

Sample Projected Recovery Approaches and Actions:

- The CBP Task Force is not effective.
- Basin leadership is fractured, the population fragmented. The Basin Brain is harried, stressed, rationality is a luxury; expressions of bullying and brutality begin to appear
- Survival of the fittest becomes a societal expectation.
- Warm water species expand into more and more of the Basin.
- Viable natural salmon ecosystems south of British Columbia look to be a fantasy.
- Artificial "salmon ecosystems" are possible, but only where the Basin can be significantly re-plumbed—salmon are completely dependent upon human design and engineering. At best the Columbia Basin is re-designed as a Salmon Aquarium.
- California salmon are history.

V. Wild Card: DeGrowth

In any scenario planning process there will likely be unforeseen paths or future conditions that result in what are termed as wild card scenarios. Megan Seibert summarizes this concept (see below) in her document titled: **Plotting Your Scenarios**.

> **Wild Cards:** are surprises that have the power to completely change your hand—and the outcome of the entire game…In scenario exercises built around a matrix of four logically contrasted scenarios, we will sometimes include a fifth "wild card" scenario that takes into account a dramatic yet relevant surprise that doesn't fit neatly on the matrix…Wild cards can reinforce the importance of continually "thinking out of the box." **Plotting Your Scenarios**

NOTE: this summary was submitted by Megan Seibert, megan@rndg.org, https://www.realgnd.org

The ***REAL Green New Deal Project*** (RGND) provides an eyes wide open, systems and evidence-based viability analysis of Basin functions.

RGND's core starting premises:

- Climate change is but one symptom of our overarching overshoot crisis.
- The commonly accepted narrative about renewable energy and sustainability is impossible to deliver. Its key flaws that motivate our work:
    - The notion that the system can remain the same and all we have to do is switch out one variable — replace fossil fuels with renewables — and voila, we'll have a sustainable world. As if changing the energetic basis of all of civilization is as simple as changing a battery. Quite the opposite — an energetic shift will transform everything, forcing us to re-think life as we know it.
    - There are massive limitations and impediments to the renewable energy technologies commonly put forth as solutions (e.g. solar PV, large-scale wind, batteries, hydrogen, etc.) which make them not very sustainable and likely not viable from a basic implementation perspective.
- No matter the technology considered, renewable energy simply cannot supply the same quantity or quality of energy as fossil fuels, meaning that we face massive scale-back and restructuring.

RGND hopes to re-direct the paradigm about renewable energy and sustainability away from magical, myopic thinking towards the type of sober, holistic thinking that might actually have a chance of veering us in the right direction.

Keeping in mind that energy underpins everything, from biological food webs to the human civilizations embedded within them, the mission of RGND is to:

- Concretely understand which renewable technologies are viable, how much energy they can supply, and what those supplies will mean for the type of world that's possible.
- Conduct all of the above within the context of restoring a thriving, biodiverse habitat for Earth's non-human creatures and fair, egalitarian social structures for its people.

RGND asserts that the key question for the Basin, and the planet, is "which renewable energy technologies are sustainable and viable in which contexts and how that can inform what the changes in our demand and behavior must be, keeping in mind that the two reduction levers to pull on are the number of people and the amount of energy we're each consuming."

RGND is unprecedented not just in scale and breadth, but in facing head-on subject matter that is typically considered taboo, uncomfortable, or outside the scope of energy and sustainability. A commitment to systems thinking and a genuine concern for the Earth and all its inhabitants requires nothing less than a full, honest look at the truth.

Reference Materials

- Ogilvy, Jay and Peter Schwartz. 2004. *Plotting Your Scenarios*.
- *Training Manual for Scenario Planning Method.* October 2018. https://www.researchgate.net publication/328018834
- Pacific Fishery Management Council Workshop Report. March 2020. *Developing Future Scenarios for Climate Change in the California Current System*. https://www.pcouncil.org/documents/2020/02/g-3-attachment-1-developing-climate-change-scenarios-for-the-california-current-ecosystem-workshop-report.pdf/
- Real Green New Deal description (in Appendix). At website: https://www.realgnd.org.

Shared Sacrifices Scenario

Joe Lukas

Problem Statement

ESA Litigation and endless debate on individual risk factors for Columbia River Basin salmon and steelhead declines is dividing the region. Many groups spend significant money and attention monitoring the issue hoping to avoid being drug into court or having their interests attacked in the name of salmon recovery demands. Some sectors of the economy are under direct attack and there are growing demands to dismantle portions of the Federal Columbia River Power System in the name of salmon recovery while climate policies calling for carbon-free power generation place ever greater pressure on clean electricity infrastructure. The region needs to come together to craft lasting, durable solutions that form a “Community Response” if we are to have any hope of meeting the quantitative goals envisioned in the Columbia Basin Partnership process. This requires many different entities and interests to modify their approach to salmon recovery and set aside traditional thinking to enable a focused effort at measures across the salmon and steelhead lifecycle that can provide conditions where the adaptability and productivity of these incredible creatures can flourish. **All must contribute something meaningful to this effort.** Goring one group’s Ox while others seek to avoid contributions will doom salmon and steelhead to museum-piece status. Our systems, structures and funding sources must also be critically examined. Simply relying upon minor modifications to systems that have proven to be either ineffective or mis-guided is a failed strategy. A new approach is necessary that relies upon “Shared Sacrifice” from all citizens of the Pacific Northwest. The path towards healthy, self-sustaining and harvestable salmon and steelhead populations requires contributions of some type from all corners of the Pacific Northwest. We must collectively recognize that past efforts (while well-intentioned) are failing and a new approach is needed.

Scope of the Solution

A comprehensive multi-lateral agreement that consists of needed reforms in the areas of: Governance for Salmon Recovery Systems and Funding, hydrosystem operation and configuration, habitat measures, ocean conditions considerations, harvest and weak stock management reform and hatchery mitigation changes can create an environment where salmon recovery efforts could coordinate under shared interests. The current environment encourages excessive focus on certain impacts to the salmon lifecycle without companion efforts at an appropriate scope and scale. This agreement would be implemented through Federal Legislation that would provide stability and certainty for citizens of the Pacific Northwest and create an environment where salmon and steelhead recovery is a clear objective with clear contributions from all residents that call this area home.

Governance and Funding Strategies

Most of our laws and regulations addressing salmon and steelhead call for efforts to reverse declines or avoid jeopardy of individual actions. We have no clear statutory requirements to recover salmon and steelhead to the level of abundance envisioned through the Columbia Basin Partnership quantitative goals. The best biological strategies possible will fail without the political will to fund and implement them in a timely manner. The crazy-quilt approach to governance of salmon and steelhead recovery is failing and must be replaced.

ESA

The Endangered Species Act is a remarkably powerful tool of modern conservation but its mechanisms were intended to protect discreet populations of organisms at risk of extreme impact from human activity. This tool fails miserably in its attempt to protect and recover animals that range from the inland Mountains of the Pacific Northwest into international waters and is subjected to harvest in fresh and salt water up and down the Pacific Coast and beyond. **Salmon and Steelhead should be exempted from the requirements of the Endangered Species Act and their recovery and management in the United States would be governed by replacement legislation: The Northwest Salmon Act.**

Northwest Power Act

On December 5, 1980 Congress passed the Pacific Northwest Electric Power Planning and Conservation Act which was signed into law by President Carter. The focus of this law was on power allocation and planning to avoid a future power crisis like the Washington Public Power Supply System bond default. The Northwest Power

Act also required the Council to prepare a plan to protect, mitigate and enhance fish and wildlife of the Columbia River Basin that were affected by the construction and operation of hydroelectric dams while also assuring the Pacific Northwest an adequate, efficient, economical and reliable electric power supply. It can be argued that the fish and wildlife provisions were an afterthought to hold back ESA actions for declining runs. Recovery of salmon and steelhead is an important enough and large enough scale undertaking that it requires its own unique legislation identified above which would be separate and distinct from the power focus of the Northwest Power Act.

Funding

Each utility receiving preference power from the Bonneville Power Administration or its successor would collect $0.0045 for each kwh sold to residential, commercial, agricultural, industrial or other customers for salmon and steelhead recovery. Assuming application to 7,000 aMW of priority firm power this portion of the "Salmon Tax" would generate $275,940,000 per year for salmon recovery. The same level of Salmon Tax would also be imposed on the non-firm sales of BPA or its successor which average 1,500 aMW per year which would generate an additional $59,130,000 per year. Investor-owned utilities in the region contribute to salmon and steelhead recovery primarily through requirements in their FERC Licenses. This in effect creates a different standard from the intense focus placed on the FCRPS and BPA Ratepayers. To address this inequity, 50% of the residential exchange settlement and any future program would be re-directed to salmon and steelhead recovery efforts. For FY 2022-23 this would be $129,500,000 and would increase to $143,050,000 by FY 2026. This funding would replace BPA's Direct Fish and Wildlife Program and would increase funding from this source from the current $250,000,000 per year to $464,570,000 which represents an increase of 86%!

Other sources of funding should also be developed. For instance, the state of Washington had 607,816 fishing license holders in 2019 generating total revenues of $29,598,111 Oregon sold 650,435 fishing licenses generating $28,438,654 with 520,492 fishing licenses sold in Idaho generating $12,635,326. This total of $70,672,091 includes all fisherman targeting all species in these 3 states. If a "NW Salmon Stamp" or expansion of the Columbia River Basin Endorsement at $10/fisherman was applied under the assumption that 50% of all license holders targeted salmon and steelhead it would raise another $8,893,715 from northwest anglers in these three states. This amount also places the magnitude of hydropower mitigation funding into some context.

Biological Strategies

Hydropower

Calls for dam breaching are divisive and economically damaging and should be considered a measure of last resort if innovative measures to increase salmon survival fail. The regional response to Climate Change and carbon reduction goals must recognize the critical role that hydropower plays as a renewable resource that integrates wind and solar power. We must find certainty amidst these demands for reduction of hydropower generation in the region in the name of salmon and steelhead recovery. Fish spill up to 125% Total Dissolved Gas levels represents a very risky operational regime that may be damaging the very resource it is intended to protect. This is not a binary issue, other Columbia River Basin Hydropower Operators have developed innovative solutions that reduce tainter gate spill and TDG impacts on juvenile and adult salmon. These approaches can be adapted to the Lower Snake River Projects where so much uncertainty exists with respect to the future configuration for salmon and steelhead recovery.

Lower Snake River Dams

The spillways at the Lower Snake River dams could be modified to pass a high-volume of total river flow without generating high levels of TDG. This has been accomplished at other projects through use of a full water-column slot that in effect creates a synthetic water fall without a plunge pool that causes physical damage to fish and high TDG levels. A high-flow synthetic waterfall of this type should be designed for each lower Snake project at a scale sufficient to pass a maximum volume of water without increasing TDG levels above 120% TDG. An example of such a design has been successfully used for fish passage at Wanapum Dam on the Columbia River.

Failsafe

If the spillway reconfiguration described above does not significantly increase juvenile outmigration survival above currently measured survival from Lower Granite Dam to Bonneville Dam over a 10-year test period following construction, implement more aggressive actions.

Blocked Areas

The enhanced funding available under this proposal should be used to fully fund reintroduction efforts above Grand Coulee/Chief Joseph Dams and the Hells Canyon Complex. Removal of ESA concerns as called for under this scenario should eliminate complications associated with the ESA-nexus to reintroduction efforts. In exchange for fully funding the above efforts and in recognition of the importance of the Northwest Hydrosystem in addressing climate change, these efforts must not negatively impact hydropower generation at Grand Coulee, Chief Joseph or the Hells Canyon Complex dams.

Habitat

Current habitat measures are implemented in a "peanut-butter" fashion where funds are spread around under political rather biological considerations. Future efforts should be based on biological merit giving priority under 2 primary criteria: 1) what measures will benefit the greatest number of fish at risk? And 2) without undertaking expensive and uncertain monitoring and evaluation programs what programs best address a limiting habitat factor for stocks with the greatest opportunity to benefit. An example of the application of these criteria would be immediate prioritization of high-quality estuary projects as improvements here benefit every stock in the Columbia Basin.

Harvest and Weak Stock Management

The harvest impact approach allowing for "incidental take" of at-risk stocks in mixed stocks fisheries is failing to protect the weakest stocks in the basin. The following harvest reform measures must be implemented:

- Harvest of the weakest stocks in the basin should be curtailed entirely and limited to ceremonial fisheries only. This should be considered a temporary measure to get more fish on the spawning grounds and will provide an immediate boost to recovery efforts.
- Mixed stock fisheries targeting healthy fisheries should be encouraged but reformed to reduce incidental harvest of weak stocks to the maximum extent practical. Live capture methods should be emphasized over other gear types. The enhanced funding identified above should be used to convert the fishing fleet into gear more suitable to minimizing mixed-stock fishery impacts. Funding should also be used to assist businesses, families and livelihoods impacted by temporary closures.
- Future restored fisheries should limit reliance on mixed-stock fisheries in freshwater and focus more on carefully managed terminal fisheries.

Hatchery Reform

The vast number of juvenile hatchery fish released each year within the Columbia Basin provide a relatively small return in terms of adults available for fisheries, broodstock, conservation, and recovery efforts. The specific purpose and underlying mitigation agreements for each hatchery in the Columbia Basin should be re-evaluated in terms of their contribution to achieving the quantitative goals of the Columbia Basin Partnership. Utilities, tribes, states and federal fish and wildlife agencies operating hatcheries under historic mitigation or other agreements would be released from those obligations in order to critically examine the role and operation of each facility in light of their contribution to or impact on the recovery goals. The enhanced funding identified in this scenario would be used to modify, improve or re-program facilities that could contribute to meeting the recovery goals.

Predation

Salmon and steelhead form an important food source in the Pacific Northwest for not just humans but also for birds, pinnipeds, mammals and other fish. Some of this predation is a desirable component of a healthy ecosystem, other elements are unintended consequences of various actions such as creation of new habitats through placement of dredged sediments, congregation of returning adults at fishway entrances, concentrated releases of hatchery smolts, introduction of non-native sport fish and many other anthropogenic effects. Current efforts tend to focus on one specific predator with a dedicated program of some type for each. None of these programs have any clear requirements or links back to salmon and steelhead recovery goals. Each program should have specific objectives and be tailored and prioritized based on their contributions to meeting the Quantitative Goals of the Columbia Basin Partnership.

Ocean Conditions

It has become abundantly clear that Ocean Conditions play an extremely important role in salmon and steelhead survival, growth and ultimately returns to freshwater. Chinook population declines are not unique to the Columbia River Basin and have declined sharply across their geographic range up and down the Pacific. Concurrently with this decline, pink salmon returns have increased dramatically with 500-600 million now produced which is way above historic averages. Much of this pink salmon production occurs in hatcheries and the correlation with weak chinook runs cannot be ignored. This relationship should be investigated immediately and if pink salmon competition is believed to be an issue then efforts should be made to reform those hatchery programs. Additionally, an effort should be initiated to coordinate the size and timing of Columbia River basin hatchery releases with ocean productivity information.

Social, Cultural, Economic, and Ecosystem Considerations

Tribal

The collapse of salmon and steelhead populations in the Pacific Northwest has had negative and severe impacts throughout the region and nowhere is this more severe than for tribes where salmon and steelhead meet dietary, spiritual, cultural, economic and subsistence needs. Efforts that seek to minimize continued short-term impacts also negatively affects the timeframe to recovery and delays the benefits of recovery in meeting these needs.

Economic

This scenario would create economic impacts to interests across the region. However, the business certainty and positive effects of salmon and steelhead recovery are worth the sacrifice.

Public Support

Any scenario that leans on any individual sector of the Pacific Northwest is doomed to failure. Any one group or constituency has the political power to stalemate or block the reforms and change needed for salmon and steelhead recovery. We have already experienced this and we can spend endless amounts of time and money on litigation and efforts to re-package past efforts that have failed or **we can ask each citizen to contribute something towards salmon and steelhead recovery and make this a community effort.**

Salmon First Scenario

Zach Penney

Theme

For Columbia River tribal nations, the goals for salmon and steelhead remain the same as they were in the 1800s. Before the states of Oregon, Washington, Idaho, Montana, and Nevada existed, salmon and steelhead populations were healthy, self-sustaining, and the water they depended on, unallocated, unsullied, and unblocked.
For tribes that signed treaties facilitating non-tribal settlement, the right to fish at usual and accustomed places was retained. This right also includes a habitat component that others should not engage in habitat-damaging activities that would diminish the abundance of salmon and prevent tribes from earning a moderate living through fishing. Regrettably, this has not been the case for salmon or tribes. Now is the time for the region to treat the needs of the salmon as a paramount objective to achieve and to restore them once again to healthy, self-sustaining, and harvestable levels.

In line with the Tribal Perspective of Phase 1, one of the intentions of the Salmon First Scenario is to avoid normalizing the status quo or perpetuating the false equivalencies among sovereigns and stakeholders on remaining whole. This scenario aims to achieve the fastest possible response to declining populations of salmon and steelhead with emphasis on the following philosophies:

- The baseline for tribal salmon restoration and harvest is 1855 — there is a large gap between current conditions and the baseline.
- Broad tribal alignment exists for an immediate call to action by the region to reverse the decline of salmon and steelhead;
- Implementation of biological strategies needs to be immediate. At the co-management level, tribes have been involved in trying to reverse declines since the late 1970s and are not willing to wait another 25 years for “new aspirational” scenario planning implementation to meet tribal cultural, subsistence, and economic needs;
- Regional talking points need to change from, “how do we get enough salmon to meet everyone’s needs” to “**what can we do to meet the needs of salmon**”;
- Over a century of anthropogenic modifications to the river system, such as redirection or impoundment of water and introduction of

non-native species, has created an ecosystem that is unnatural and growing increasingly inhospitable to salmon and steelhead. In order for salmon and steelhead to thrive at healthy and harvestable levels, the region needs to return the river to a more normative state, and to conditions suitable for salmon, especially as climate change exacerbates the already inhospitable conditions in the Columbia River;
- The long-game of the Salmon First Scenario is to have salmon and steelhead in all places that they historically inhabited, but with an understanding that certain geopolitical relationships, agreements, and continuing dialogue may allow certain goals to be attained sooner than others;
- The Salmon First Scenario requires the Pacific Northwest to integrate salmon recovery into everyday decision making at the local, state, and federal levels;
- An expectation that all scenarios devise a slider model baseline that does not treat hatchery production as a negative impact on recovery, but as a necessary tool to support recovery;
- An expectation that Columbia Basin hatchery mitigation funding and supplementation will be necessary while the factors/structures that caused the need for mitigation in the first place remain the primary issues negatively impacting recovery. This also includes the use of hatcheries to reintroduce extirpated stocks below and above blocked areas; and
- The Salmon First Scenario aims to achieve tribal goals in a manner that benefits all with an emphasis on getting more fish back in the river (i.e., doing what must be done to making salmon and its habitat "whole").

Additional Scenario Description

The Salmon First Scenario maximizes effort in the near term on all fronts toward achieving goals as soon as possible, consistent with fair allocation of the conservation burden and Treaty/Trust obligations the Federal government has to Indian tribes. The scenario recognizes challenges and threats of climate to the modified river system and makes strategic choices in light of related risks, but with the goal of restoring all fish in all places; including blocked areas that were historically accessible to anadromous fish.

Regional Considerations

The scenario recognizes regional/sub basin differences in stock composition, population status, management efforts and jurisdictional boundaries. Specific strategies affect different stocks, groupings of stocks, or regions differently. The scenario allows for adjusted strategies that are specific to a region with coordinated efforts in the mainstem migration corridor.

Biological Strategies

Hydro

- With dams still in place, continue to implement aggressive spill program under existing configuration, as well as other efforts devoted toward reducing delayed mortality impacts derived from dam and reservoir passage, both downstream and upstream;
- Begin immediate regional efforts to breach one or more dams and consider alternate forms of fish-friendly power generation and commerce;
- Evaluate future passage/reintroduction options in blocked regions within the Columbia Basin;
- Implement operations to address flow and temperature effects from climate change;
- Conduct outreach and education to the hydro customers on the historic and current impacts to tribal communities, benefits of salmon runs in the PNW, costs and benefits of maintaining the hydrosystem relative to other alternative forms of energy.

Tributary Habitat

- At the outset, substantially increase Basinwide habitat restoration actions and ensure that efforts strategically target populations and habitat limiting factors that will provide the greatest contribution to long-term recovery goals;
- Maximize restoration efforts to conserve habitats least vulnerable to climate change or most likely to improve climate resilience;
- Conduct research, monitoring and evaluation as necessary to quantify physical and biological benefits from tributary habitat restoration and determine whether habitat improvements can yield biological responses sufficient to meet recovery targets;
- Conduct outreach and education to local and state land and water management boards and

committees to integrate salmon recovery into local decision (rule) making;
- Continue and increase efforts to alter management of water systems to provide more normative flow regimes.

Estuary Habitat
- Substantially increase level of effort to maximize estuary habitat restoration.

Blocked areas
- Proceed incrementally as laid out in existing plans;
- Explore and begin to implement experimental reintroduction with interim hatchery supplementation concurrent with evaluation of passage potential;
- Maximize/expedite studies to reintroduce fish into blocked areas (Chief Joe/ Grand Coulee and Hells Canyon Complex) including habitat restoration above Hells Canyon Complex to prepare for eventual passage at the dam complex. Ramp up efforts to expand distribution in tributary habitat (e.g., Cowlitz, Lewis, Willamette Basin, Deschutes, Yakima, etc.) and address any other significant blockages in tributaries.[1]

Predation
- Identify and implement targeted opportunities to enhance predator control actions;
- Population scale removals of non-native/ introduced species;
- Increase funding for control efforts related to past or present federal and state introductions of non-native fish species;
- Eliminate harvest limits and regulations protecting non-native fish in waters that contain or are connected to waters containing anadromous salmon and steelhead;
- Increase funding for federal, state, and tribal enforcement to reduce illegal or unintentional introduction of invasive/non-native species;
- Identify and implement targeted opportunities to enhance predator control actions, including predation impacts related to climate effects (e.g., non-native fish range expansion due to dams and climate change);
- Modify or remove anthropogenic structures that have increased predators or that make salmon and steelhead more vulnerable to predation at all life stages.

Hatchery
- Ensure that hatchery programs with a mitigation responsibility are fully and adequately funded;
- Adequately fund routine and non-routine maintenance and support modernization of hatchery infrastructure to ensure achievement of mitigation goals;
- Prioritize hatchery production in areas where restoration and mitigation goals have not been met;
- Identify areas suitable for reintroduction and implement reintroduction programs;
- Continue to improve hatchery programs using the best available science to minimize risks to natural populations;
- Prepare for the likely role that hatchery programs and infrastructure will play in buffering against fluctuating environments and stochastic climate events;
- Implement sliding scale protocol for hatchery production as natural abundance increases and proves resilient;
- Reevaluate mitigation hatchery production when dams have been removed and the historic impacts of those dams have been fully mitigated.

Harvest
- Ensure that conservation burden is appropriately allocated such that treaty harvest is not bearing a disproportionate amount of the responsibility, consistent with federal law;
- Continue to set harvest impacts at levels that do not impede recovery through use of abundance-based management frameworks or other relevant harvest management approaches (e.g., tribal fisheries in the mainstem Columbia and in tributaries are implemented currently to target more abundant stocks while protecting weaker, less abundant stocks);
- Run-timing of salmon and steelhead is highly heritable; therefore, fishery effort needs to be balanced to ensure mixed stock fisheries (sport and commercial) are not artificially changing run-timing (e.g., overharvesting the earliest run Spring Chinook or upriver bright Summer Chinook);
- Establish or continue to use existing sliding scale tribal harvest schedules that increases the rate of harvest as runs increase (recognizing that these scales are designed for the low-end goals

[1] It is recognized some sovereigns are constrained in consideration of this issue.

in Figure 2 of Phase 1 Report of the Columbia Basin Partnership Task Force of the Marine Fisheries Advisory Committee);

- Consider in-river refuges/sanctuaries that protect migrating salmon and steelhead;
- Reduce non-treaty "sport fishery footprint" or impact limits as may be necessary to address conservation and recovery across the abundance range (e.g., limiting or eliminating catch-and-release fishing during warm water periods);
- As natural returns of salmon and steelhead approach high-range goals, work towards ending the need for mark-selective fisheries;
- Eliminate non-consumptive fishery impacts on salmon and steelhead when fish are actively spawning.

Social, Cultural, Economic, and Ecosystem Considerations and Strategies

- Tribal dependence on salmon and other fish species to meet dietary, spiritual, cultural, economic and basic subsistence needs is still a prevailing necessity of tribal culture and society. Prioritize tribal ceremonial, subsistence and commercial needs and fishing-based economy;
- Historic benefits should be weighed in comparison to future impacts. The economic sectors that may be impacted have benefitted the most;
- Stepwise implementation of dam removal will be less disruptive. Allows evaluation and adaptive management;
- Ensures that existing mitigation commitments are met. Currently there is a lack of accountability on meeting those obligations;
- Most likely scenario to address Treaty obligations by federal government;
- Benchmarks should be set at 2 generations of salmon (10 years). Goal should be to see improvements immediately.

Full Recovery Plan Implementation Scenario

Steve Manlow and Washington's Columbia Basin Recovery Organizations

Theme

Washington State's collective and local response to federal Endangered Species Act (ESA) listings in the late 1990's was unprecedented. Unlike the traditional process that has the federal government writing a recovery plan, the State created a locally-based infrastructure of regional salmon recovery organizations ("Regions") to coordinate the efforts of thousands of local professionals and volunteers working in concert with federal, tribal, and state agency scientists and policy makers to create our own regional salmon recovery plans. In the Columbia Basin, these Regions include the Upper Columbia Salmon Recovery Board, Yakama Basin Fish and Wildlife Recovery Board, Snake River Salmon Recovery Board, and Lower Columbia Fish Recovery Board. These Regions facilitated development of NOAA-adopted recovery plans that share the common goal of returning ESA-listed salmon, steelhead and bull trout to healthy, self-sustaining and harvestable levels. This bottom-up approach and the scale of their efforts was unprecedented in the United States and has been dubbed "The Washington Way" by those involved in salmon recovery. With the plans completed, the Regions turned their focus to facilitating implementation.

Today, nearly 20 years later, salmon recovery efforts have been instrumental in helping some species turn the corner toward recovery and have slowed the decline or prevented extinction of several other species. Progress has indeed been made within the level of commitment and resources applied to recovery efforts to date. For example, progress to date through Washington's Salmon Recovery Funding Board (SRFB) alone on a statewide basis includes opening access to 2,000 miles of existing habitat and restoring 519 acres of wetlands, 6,016 acres of estuaries, 19,590 acres of riparian habitat, 23,304 acres of uplands, and 499 miles of stream habitat (RCO, 2019). While some species such Snake River fall Chinook, Mid-Columbia Steelhead, and Lower Columbia steelhead are trending toward delisting abundance targets, other species, such as Lower Columbia fall Chinook and Upper Columbia River spring Chinook, are not making progress or are falling further behind. Too many ESA-listed species remain precariously close to the brink of extinction. Progress in some sectors, such as hatchery and harvest reform, is occurring too slowly in some areas or is being offset with challenges in other sectors, such as general habitat loss (especially in urbanizing areas), predation, and invasive species. In addition, warming oceans, changing stream environments, shifting food webs, and other issues associated with climate change are playing an increasing role in limiting recovery progress.

At the time recovery plans were developed, the expectation was that existing management programs that we rely upon to maintain the baseline would be updated to better reflect salmon and steelhead recovery needs, and that restoration programs aimed at improving the baseline would be fully funded. Unfortunately, we have not collectively and fully integrated salmon recovery needs into our various local, state and federal land use programs. In addition, for the 2010-2019 time period, we have funded less than one-fourth of the estimated $2.49 billion in capital and $436 million in capacity costs associated with actions in the NOAA-adopted recovery plans for the Columbia Basin. These costs are conservative, and are primarily related to habitat actions. They do not include actions and costs associated with any changes in infrastructure or operation of the hydropower system, hatchery and harvest reform, or emerging predator and invasive species control needs.

The Regions believe that the lack of recovery progress to date is not related directly to inadequacies in existing recovery plans. While impacts vary across each Region, an interconnecting theme is that we are not investing socially, politically or economically in salmon recovery at a scale necessary to fully recover fish to delisting or healthy and harvestable levels. Much stronger policy level support across various management sectors (all-H integration) is needed to meaningfully increase recovery progress across the Columbia Basin. Regions are uniquely suited and well-positioned to facilitate needed conversations to achieve a Full Recovery Plan Implementation Scenario, with the active engagement of NOAA Fisheries and state and tribal fishery co-managers. **Achieving the broad-based goals established by the Columbia Basin Partnership requires concerted effort along a continuum. The challenges that currently limit progress toward achieving population specific delisting targets must be first overcome if we wish to ever achieve the broad-based targets that we have established.**

Regional Considerations

This Full Recovery Plan Implementation Scenario recognizes biological, social, political and cultural differences in recovery approaches across the Regions. It also recognizes the differences in recovery focus within each adopted plan. For example, some Regions developed comprehensive plans that address impacts across all of the "Hs" (e.g., habitat, hydro, harvest, hatcheries, ecological interactions, and predation), whereas others focus largely on habitat protection and restoration. Regions are working diligently to update the knowledge base and technical foundation to better support decision-making across the Hs. This scenario recognizes these differences and that the various strategies, measures and actions described below do not apply equally to all stocks or Regions across the basin. It also acknowledges and fully respects tribal treaty rights and the critically important role of fishery co-managers in supporting recovery programs. Lastly, it strongly supports the concept of identifying what we can do to more fully address and elevate the needs of salmon.

Needs for Full Recovery Plan Implementation

Below is a summary of general needs that exist in the Columbia Basin Regions for full Recovery Plan Implementation. These are written generally as the scope, approach, and priorities for addressing these needs vary across the Regions.

- Ensure Regions have the capacity to build the strong partnerships and leverage the diverse resources needed to effectively and strategically implement recovery actions identified in NOAA-adopted recovery plans. This includes increasing policy and financial support to:
  - Provide for the sharing of information on recovery initiatives, programs, science, and progress;
  - Support the development of collaborative partnerships that support salmon recovery efforts in the management of forests, water, habitat, harvest, hatcheries and hydro facilities;
  - Further coordination among federal, state, local and tribal programs affecting salmon recovery;
  - Support expanded coordination, as needed among recovery partners, to better develop and implement complex, large scale projects and programs; and,
  - Provide Regions, as needed or requested, the capacity and resources to complete or update science based, community supported plans for recovery of listed and enhancement of non-listed salmon, steelhead and bull trout, to ensure effective recovery actions and strategic allocation of resources. In some Regions, this includes updating existing recovery plans to address climate change, new science, and changing conditions.

- Provide Regions and partners with the capacity and tools to adequately track, monitor and report on the progress of salmon recovery across the H's (habitat, hatcheries, harvest, hydro and predation) within each Region and across the entire Columbia Basin:
  - Ensure fish (VSP) monitoring is sufficient to support NOAA status and delisting reviews, as well as broader recovery progress;
  - Expand the ability to monitor and assess habitat status and trends, and project and action effectiveness, in a coordinated manner across the Columbia Basin; and,
  - Focus monitoring and research on improving our understanding of life-cycle bottlenecks, spatially and temporally.
- Expand existing habitat funding programs, including Pacific Coast Salmon Recovery Fund (PCSRF) and National Estuary Program (NEP), to fully address habitat restoration and protection needs identified in NOAA-adopted and tribal recovery plans. Restoration efforts should be maximized in a manner that conserves and restores habitats that are most resilient to climate change, including cold water refugia.
- Develop new and broader-based habitat restoration funding sources to provide long-term funding stability.
- Expand funding for incentive-based programs to offset impacts to those property owners who support habitat protection and restoration work on their lands.
- Ensure hatchery and harvest reform and policy updates and programs are compatible with and support recovery of at-risk locally adapted fish stocks.
- As local, state and federal land management programs are updated, fully incorporate and consider salmon, steelhead, and bull trout recovery needs. This includes strengthening policies and existing statutory requirements to ensure recovery needs are fully and explicitly integrated into decision-making processes. Key programs are identified in respective recovery plans, incorporate various "Hs", and vary across Regions.
- Identify and implement targeted opportunities to enhance predator and invasive control actions, including:
  - Population scale removal of non-native/introduced species;
  - Increase funding for control efforts related to pinniped and avian control efforts in the mainstem and estuary;
  - Eliminate harvest limits and regulations protecting non-native fish in waters that contain or are connected to waters containing anadromous salmon and steelhead; and
  - Increase funding for federal, state, and tribal enforcement to reduce illegal or unintentional introduction of invasive/non-native species.
- Ensure that future governance structures and approaches honor, build upon, and coordinate with existing recovery efforts and partner commitments made to date.
- Substantially increase funding to address mainstem-wide fish survival and passage issues across the entire fish life cycle, including key issues such as tributary overshoot.
- Finalize development of the "All-H Slider Tool", enhance it to address population-scale impacts, and make the tool and the underlying life cycle model and supporting documentation (with assumptions and data sources) available for use by Regions and other partners to support adaptive management of the NOAA-adopted Recovery Plans.

In addition to the above Basinwide needs, the following high priority regional needs must be addressed to support Full Recovery Plan Implementation in a manner that achieves established recovery goals. These needs apply only to the identified Region, and should be not viewed as endorsed by other Regions.

Upper Columbia Salmon Recovery Region

- Implementation of recommendations made by the Independent Scientific Advisory Board Review of Spring Chinook in the Upper Columbia.
- Integration among all-H management sectors (habitat, harvest, hatchery and hydropower) to maximize alignment with recovery goals.
- Reduce avian and pinniped predation.
- Increased aquatic habitat restoration on Okanogan Wenatchee National Forest managed-lands.
- Prevent Northern Pike from getting below Chief Joseph Dam.
- Clean Water Act 401/404 permit streamlining for salmon restoration projects.

Mid-Columbia and Snake River Region

- Continue extensive efforts to restore spawning and rearing in Mid-Columbia and Snake River tributaries. Sustaining this progress requires ongoing support from BPA, NOAA's Pacific Coast Salmon Recovery Fund, Washington State's salmon recovery programs, the Yakima Basin Integrated Plan, the Bureau of Reclamation, and other programs that focus on high priority actions that support recovery of the Yakima, Walla Walla, and Lower Snake MPG's.
- Improve smolt survival from spawning and rearing areas downstream through the mainstem Yakima, Columbia River and Snake Rivers. This will require:
  - Reducing high predation rates by pikeminnow, bass, walleye and other predatory fish;
  - Reducing entrainment rates and associated mortality rates at major diversion structures in the Yakima Basin;
  - Fully implementing bird predation reduction programs in the middle and lower Columbia; and,
  - Continuing efforts to improve smolt survival through the Columbia River Power system.
- Ensure that returning adult steelhead and Chinook are able to successful migrate from the ocean to tributary habitat. This will require improving reproductive success by means of downstream passage of adults that overshoot at mainstem dams, and taking other actions that improve the overall conversion rate of adults between Bonneville Dam and Mid-Columbia and Lower Snake River Tributaries.
- Seek to align Washington State's recreational and commercial harvest policy with conservation and recovery goals, and managing to meet escapement goals for ESA-listed populations.
- Maintain and expand existing population viability monitoring efforts to ensure that we can effectively track steelhead and Chinook populations relative to the goals set out in the YSRP and Snake River Salmon Recovery Plan for SE Washington, and identify life stage specific population bottlenecks that need to be addressed.
- Ensure that adequate long-term habitat status and trends and project effectiveness monitoring is in place to guide our ongoing investments and indicate when and where we need to address developing threats such as climate change.

Lower Columbia Region

- Improve fish-in fish-out monitoring for Primary and Contributing populations to support annual abundance and productivity estimates, and identification of population and species-scale life history bottlenecks.
- Fully fund and implement the Lower Columbia Habitat Status and Trends Monitoring (HSTM) Program (LCFRB, 2016).
- Establish and conduct an effectiveness evaluation for all key implementation programs (e.g., land use, hatchery, harvest, hydro, ecological interactions) identified in the Recovery Plan, to inform threat reduction progress and adaptive management.
- Ensure full integration and prioritization of salmon recovery needs and recovery plan goals in implementation of key local, state and federal recovery partner programs (e.g., land use, regulatory, natural resource management, etc) identified in the Recovery Plan.
- Update local and state Growth Management Act (GMA) programs to ensure that protection of watershed functions and processes is fully considered on par with other land use goals and objectives, and establish criteria and guidance for implementing partners.
- Accelerate salmon and steelhead reintroduction efforts in the Cowlitz and Lewis River watersheds, and manage hatchery and harvest operations in manner that ensures success.
- Substantively increase investments in fall Chinook and chum salmon habitat restoration and protection, with a focus on Primary populations.
- Ensure that recovery burden is appropriately shared and equitably allocated in a manner that ensures level of effort is proportionate to relative contribution to impacts, and that no party bears a disproportionate amount of responsibility for recovery.

Level-of-Effort Scenarios

Project Team

Theme

In the process of considering scenarios (or alternative pathways to achieving the goals), the Task Force explored potential outcomes and strategies under scenarios that involved continuing existing levels of effort, moderately increasing levels of effort, and maximizing levels of effort to address all threats. As part of this effort, the Task Force also explored an "a la carte" menu of strategies in these various categories, with the notion that it could prove useful to construct stock- or region-specific scenarios that employed a mix of strategies from the different level-of-effort categories, depending on what the most appropriate strategies were for specific stocks or regions. In addition, the Project Team held a series of meetings with local technical experts in the Upper Columbia, Snake, Mid-Columbia, and Willamette/Lower Columbia regions to explore what the three levels-of-effort scenarios might look like in a particular region. Some Task Force members also attended these meetings. The process of exploring these scenarios was useful in the following ways:

- Provided a basis to begin consideration of the strategies and levels of effort that might be required to achieve the goals.
- Provided a basis from which to evaluate qualitatively the likelihood of achieving the goals or the length of time it might take to achieve the goals.
- Provided a basis for regional discussion to explore outcomes for specific stocks and areas.
- Provided a springboard for Task Force members to consider additional scenario themes or approaches.

Ultimately, the Task Force reached a consensus that continuing existing levels of effort was highly unlikely to achieve the high-range goals and chose to consider it a baseline rather than a viable scenario.

Below we have expanded upon the "a la carte menu," the discussions at the regional meetings, and Task Force discussions to flesh out potential scenarios under the moderately increased and maximum levels of effort. In some cases, the primary variable between these two scenarios is level of investment; in others, there is a more clear distinction between strategies in the two categories. The strategies in both scenarios reflect the intended focus for the next 25 years. Both scenarios also incorporate a concept that benchmarks would be developed that could be used to evaluate progress. If those benchmarks were not met, additional actions would be triggered. Details of these benchmarks and additional actions have not been developed. Both scenarios also incorporate the concept of identifying critical uncertainties, innovative approaches, and strategic choices that might drive implementation, although those aspects of the scenarios require additional development. In addition, the strategies identified are broad and general and would need further refinement to be implemented.

Biological Strategies

Hydro

Moderate increase in effort

- With federal Columbia and lower Snake River mainstem dams still in place:
  - Continue to implement an aggressive spill program under the existing system configuration, in addition to other operational efforts aimed at reducing passage and reservoir mortality.
  - Explore further expansion of spill (e.g., to 125% dissolved gas levels at all dams at all times). Invest further in dam modifications to help reduce gas impacts and speed passage through reservoirs and spill gates.
  - Explore additional ways to reduce adult overshoot of some stocks.
  - Continue, and if possible expand, actions to manage temperature, including flow management and in-season actions in warm years for vulnerable stocks and identification and protection of cold-water refugia.
- Ensure that a credible system is in place to evaluate the effects of the aggressive spill program.
- FERC-licensed projects:
  - Look beyond FERC license agreements and corresponding biological opinions or habitat conservation plans to find additional operational measures that could be implemented to improve survival (e.g., year-round bypass operations, alternative spill regimes, adult passage technologies) or additional mitigation actions that could be implemented.
  - Explore potential to improve operations to address flow and temperature effects from climate change and implement if feasible measures are identified.

Maximum increase in effort

- Begin immediate efforts to breach one or more federal mainstem Columbia and/or lower Snake River dams. During the planning phase:
  - Continue to implement an aggressive spill program under the existing configuration, in

  - addition to other operational efforts aimed at reducing passage and reservoir mortality.
  - In addition to considering breaching of one or more lower Snake River dams, consider breaching John Day and/or McNary Dam (the latter are mortality sources for salmon in nearly the entire Columbia River, not just the Snake, plus they likely inundated important historical spawning and rearing habitat. As an alternative to breaching, consider structural and operational changes at the lower Snake/ lower Columbia (especially John Day) dams that were short of breaching (e.g., spillway crest operations).
- Consider ways to relax flood risk constraints on both flows and habitats (e.g., relax flood control operations, invest in coordinated effort to remove flood control structures and reopen floodplain habitat in major tributaries and the estuary, invest in additional flood control structures to protect existing urban areas, de-invest in storage, and find other ways to manage flood risks).
- Protect rivers from new structural changes, from land-use changes that further degrade habitat and water quality, and from new water withdrawals and in-water developments.
- Explore additional ways to reduce adult overshoot of some stocks.
- Continue, and if possible expand, actions to manage temperature, including flow management and in-season actions in warm years for vulnerable stocks and identification and protection of cold-water refugia.
- Manage dams primarily for fish, with power generation and navigation secondary.
- Establish flow augmentation targets.
- FERC-licensed projects:
  - Identify and implement additional actions such as year-round fish passage, additional turbine restrictions, fish-friendly turbines at all dams, or additional mitigation actions.
  - Ensure that efforts to restore habitat in the middle Snake River (above the Hells Canyon Dam Complex) are implemented aggressively.
  - Identify and implement additional opportunities to remove additional FERC-licensed dams in the basin.

Critical uncertainties
- Effects of increased spill.
- Extent of latent mortality.
- Survival studies are done primarily with hatchery fish. Impacts may not be the same to natural-origin fish. Fish used in PUD hydro survival studies are predominately hatchery-origin juveniles, which are often larger and could display different characteristics than natural-origin fish.

Tributary Habitat
Moderate increase in effort
- Moderately increase funding for habitat actions in the basin.
  - Optimum opportunities for improvements will involve doing more complex and costly restoration projects.
  - Achieving significant improvements in habitat productivity will require expansion of the existing implementation infrastructure and development of enhanced watershed assessment information.
- Ensure that habitat restoration efforts strategically target populations and restoration actions that will provide the greatest contribution to long-term recovery goals.
  - Ensure that such frameworks incorporate considerations related to habitats least vulnerable to climate change or most likely to improve climate resilience. Ensure that efforts focus primarily on large-scale, process-based restoration and protection of habitat function sufficient to demonstrably improve abundance and productivity of key populations.
- Ensure that areas with the greatest tributary habitat restoration potential are harmonized in the long term with hatchery programs in a manner that enhances progress toward long-term goals.
  - Conduct research, monitoring, and evaluation to quantify biological benefits from habitat restoration and determine whether habitat improvements can yield biological responses sufficient to meet recovery goals.
- Develop approaches to working with local governments and other land and water managers to enhance land-use planning and regulatory programs to better protect salmon and steelhead habitat.
- Develop outreach programs that target specific issues (e.g., irrigation efficiency).
- Develop outreach programs to private landowners.

Maximum increase in effort

- In addition to all the above actions:
  - Increase funding by an even greater amount.
  - Address major constraints, such as existing development in floodplains.
  - Enhance investments in efforts to prevent additional degradation.

Critical uncertainties

- Need better understanding of the capacity and constraints to improving tributary habitat productivity. There is uncertainty about the carrying capacity of freshwater habitats. There is also habitat in relatively good condition that is not as productive as would be expected (e.g., why is the Middle Fork Salmon River not more productive, and why is the Lemhi River more productive than more pristine habitats?).
- Need to better understand whether and how tributary habitat restoration actions lead to increases in population-level spawner abundance and productivity. Need better understanding of habitat status and fish survival at population scale, how fish respond to habitat actions, and how habitat actions contribute to recovery.
- Need better understanding of the effects of toxic pollutants on salmon and steelhead.

Innovative approaches

- Look at innovative practices for cooling tributary water (e.g., requiring wastewater dischargers to cool water before discharging; use of geothermal or hyporheic cooling).
- Explore and implement innovative approaches to preserving/restoring floodplain function (e.g., pay landowners to allow property to flood).
- Explore and implement innovative approaches for preventing land-use conversions (e.g., from agricultural or forest use to residential or industrial development).
- Explore approaches to temperature control such as the “Fifteenmile Action Plan to Stabilize Temperatures,” developed by multiple partners in the Fifteenmile Creek watershed in Oregon. Under this volunteer program, when lethal stream temperatures for fish are projected using a stream temperature and flow forecasting model, an alert goes out to irrigators. Water-rights holders are then compensated for releasing water instream. During 2015 drought conditions, enough water was released to avoid lethal temperatures.
- Elevate the power of life-cycle models as a tool to be used in evaluating restoration opportunities.

Estuary Habitat

Moderate increase in effort

- Increase funding to support a substantial increase in the level of effort to restore estuary habitat.
- Increase flexibility in existing project approval and funding processes.
- Investigate the potential for purchasing private land for habitat restoration actions and purchase land from motivated sellers.
- Focus restoration projects to benefit ecosystem function for a variety of species and increase habitat to a high level of fish function in selected priority areas.
- Use Lower Columbia Estuary Partnership habitat analyses to ensure that habitat restoration efforts strategically target populations and restoration ations that will provide the greatest contribution to long-term recovery goals.
- Implement projects with increased complexity and cost, potentially requiring some impact to existing infrastructure (e.g., dike removal).
- Increase efforts to work with local governments and other land and water managers to enhance land-use planning and regulatory programs to better protect salmon and steelhead habitat.
  - Integrate and prioritize salmon and steelhead recovery needs into land use planning processes.
- Give high priority to shoreline protection and restoration activities that focus on removing non-marine impacts from shoreline habitat.
- Give high priority to increasing and improving floodplain habitat and protecting floodplain habitat from future industry expansion.

Maximum increase in effort

- Significantly increase funding to support a substantial increase in level of effort as necessary to maximize habitat restoration in the estuary.
- Significantly increase flexibility in existing project approval and funding processes.
- Purchase privately owned land to use for habitat restoration actions wherever possible.
- Focus restoration projects to increase habitat to a high level of fish function throughout the estuary

to ensure there is rearing habitat well connected throughout the entire migratory corridor, especially in the Portland-to-Longview reach.
- Focus maximum restoration effort on securing habitats that are least vulnerable to climate change or are most likely to improve climate resilience for healthy and stronghold populations.
- Shift to large-scale process-based restoration of habitat condition and function, which will require significant increase in impacts to major infrastructure (e.g. railroads, highways, waterfronts).
- Maximize efforts to work with local governments and other land and water managers to enhance land-use planning and regulatory programs to better protect salmon and steelhead habitat.
  - Integrate and prioritize salmon and steelhead recovery needs into land-use planning processes.
- Give high priority to shoreline protection and restoration activities that focus on removing non-marine impacts from shoreline habitat.
- Give high priority to increasing and improving floodplain habitat and protecting floodplain habitat from future industry expansion.

Blocked areas

Moderate increase in effort

- Expand efforts to improve passage into tributary and mainstem blocked areas in conjunction with dedicated programs for hatchery supplementation.
  - In the Upper Columbia, develop dedicated hatchery production to support reintroduction efforts. Restore habitat (20% in 25 years).
  - In the Upper Snake, restore naturally reproducing unlisted populations of salmon and steelhead within select tributaries upstream of the Hells Canyon Complex to meet harvest, cultural, and ecological needs.
  - Pave the way for restoring a fall Chinook salmon population above the Hells Canyon Complex dams by ensuring that efforts to restore habitat in the middle Snake River (above the Hells Canyon Complex dams) are implemented aggressively.
  - Expand tributary reintroduction efforts (including in Wallowa Lake and the North Fork Clearwater River.
  - Improve passage structures and operations at FERC-licensed dams to improve efficiencies.

Maximum increase in effort

- Restore effective adult and juvenile passage consistent with high levels of self-sustaining natural abundance and production in historical ranges.
  - Breach the main blockages and reestablish anadromous fish production above Grand Coulee/Chief Joseph dams and the Hells Canyon Complex.
  - Short of breaching these dams, invest heavily in reintroducing anadromous fish to these areas and in juvenile and adult passage facilities.
  - Alternatively, invest heavily in weirs and other facilities to combine significant reintroduction with large-scale trap-and-haul transport for both juveniles and adults.
  - As a possible added element of reintroduction, invest in hatchery production in the blocked areas to supplement salmon and steelhead abundance in these areas
  - Explore and implement additional decommissioning and removal of dams after current licenses expire, along with systematic restoration of habitats in currently blocked areas.
  - In the Upper Columbia, achieve functioning juvenile and adult fish passage and have dedicated hatchery production for reintroduction. Achieve colonization of habitat in blocked areas.
  - In the Upper Snake, work toward a long-term vision in which the Hells Canyon Complex dams have been removed.

Critical uncertainties

- Engineering for passage systems.

Predation

Moderate increase in effort

- Identify and implement targeted opportunities to increase predator control actions for the purpose of reducing abundance of predatory species in specific geographic areas where predation rates are high.
  - Implement actions to reduce available habitat for predatory species in these areas.
  - Implement actions to exclude predatory species from these areas.
  - Implement management strategies that maximize harvest of non-native predaceous fish species in waters that contain or connect

  - to waters that contain anadromous salmon and steelhead.
  - Utilize various strategies (e.g., capture and transport, habitat modification) to redistribute predators to locations where salmon and steelhead are less susceptible to predators.
  - Utilize lethal actions to eliminate predators.
- Increase funding to support implementation of predator control actions.

Maximum increase in effort

- Implement large-scale predator control programs that function at the population scale to significantly reduce abundance of predatory species and associated predation impacts.
  - Implement actions to reduce the amount of habitat that supports predatory species.
  - Reduce the geographic range of predatory species by limiting access to portions of the basin.
  - Utilize lethal actions to eliminate portions of predator populations.
- Significantly increase funding to support implementation of predator control actions.

Critical uncertainties

- Need better understanding of impacts of non-native species, particularly non-native fish predators.

Hatchery

Moderate increase in effort

- Implement hatchery reform actions by modifying size or type of hatchery programs to limit adverse impacts and risks to key natural-origin populations.
  - Reduce hatchery program size or eliminate programs entirely where programs result in higher adverse impacts or risks to natural populations.
  - Modify broodstock source by incorporating natural-origin adults or developing local hatchery broodstock.
  - Modify release locations to reduce hatchery-origin spawners (e.g., release hatchery fish in areas where there will be less straying, where they can be more effectively harvested, or where adults can be removed at weirs).
  - Increase the pace of hatchery reform actions in basins where significant habitat restoration is occurring.
  - Strategically implement mitigation programs to control adverse impacts/risks to natural populations and provide intended fishery benefits.
  - Strategically implement hatchery production in areas where restoration and mitigation goals have not been met.
  - Use conservation hatchery strategies to proactively address future threats, including climate change.
  - Eliminate hatchery releases in selected areas where natural populations are healthy to establish strongholds or gene banks for natural populations.
- Utilize hatchery programs to support reintroduction, supplementation, and harvest opportunities and benefit natural populations.
  - Plant hatchery adults or juveniles into geographic areas that currently do not support a self-sustaining population for reintroduction purposes or to reduce demographic risks.
  - Focus hatchery programs in areas that support high harvest rates for hatchery fish and limit impacts/risks to natural populations.
  - Operate supplementation and conservation hatchery programs using natural-origin broodstock to assist in seeding underutilized habitat.

Maximum increase in effort

- Reconfigure hatchery programs to significantly reduce adverse impacts/risks to stronghold populations by eliminating hatchery releases in priority basins.
  - Identify stronghold populations throughout the basin where releases of hatchery juveniles or adults will not occur.
- Reconfigure harvest/mitigation programs to significantly reduce adverse impacts/risks to natural populations.
  - Focus on natural populations for broodstock and reduce dependence on hatchery broodstocks.
  - Maintain hatchery programs in basins where no natural production occurs.
  - Reevaluate mitigation programs to determine if fishery benefits are being realized and ensure the conservation of natural populations impacted by these programs.

- Limit use of hatchery programs to support conservation, supplementation, or reintroduction of natural populations.
    - Maintain hatchery programs of limited duration for the purpose of supplementing depressed populations and ensure that these programs include monitoring and adaptive management to manage the programs to benefit natural populations.
    - Implement hatchery programs to reintroduce salmon and steelhead into basins that can support natural populations but currently have no production.

Harvest

Moderate increase in effort

- Refine abundance-based management strategies to ensure that harvest rates are adequate to conserve depressed or listed populations.
- Implement management strategies that maximize ratio of hatchery to natural-origin fish handled in non-tribal fisheries where possible.
- Ensure that the conservation burden is appropriately allocated such that treaty harvest is not bearing a disproportionate amount of the responsibility, consistent with federal law.
- Curtail or eliminate fishing in selected geographic areas to create refuges/sanctuaries for migrating adults.
- Curtail or eliminate fisheries directed on natural populations where populations are not exhibiting healthy, self-sustaining abundance levels.
- Limit incidental impacts in fisheries to levels that allow for rebuilding of depressed populations.
- Close or severely limit harvest of at-risk populations.

Maximum increases in effort

- Close or severely limit all harvest to maximize natural spawning escapement.
- Adjust harvest as needed to ensure that natural production goals for stronghold populations are achieved.
- Reevaluate fishery management strategies to ensure that fisheries focus on harvest of hatchery mitigation stocks and maximize the ratio of hatchery to natural-origin adults in harvest in non-tribal fisheries.
- Allow increased or targeted harvest of natural-origin adults as stock abundance approaches high goal.

Climate

Critical uncertainties

- Future changes in temperature and precipitation could have regional effects on the timing and distribution of water, water quality, ocean conditions, and the susceptibility of areas to expansion and introduction by non-native species.


Coho. Credit: John McMillan