Fish and Wildlife Program Performance: Tracking Progress Toward Program Goals and Objectives

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This is a staff product and has not been reviewed or approved by the Council. This working draft functions as supplementary documentation for the Goals and Objectives presentation, and contains information to inform the upcoming amendment process. While the goals, objectives, and SPIs within this document were developed in collaboration with the region's state and federal fish and wildlife agencies and tribes, the document itself has not been reviewed by anyone other than Council staff and should be considered preliminary. We welcome feedback and/or corrections for future drafts of this documentation.

Northwest **Power** and **Conservation** Council

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Purpose and Scope

The Northwest Power and Conservation Council's Fish and Wildlife Program represents a 40+ year effort to mitigate the effects of the hydropower system on fish and wildlife in the Columbia Basin. Beginning with the first Program in 1982, every Fish and Wildlife Program has mentioned the need for some evaluation of performance, but the 2020 addendum was almost entirely focused on performance. This was achieved through (1) reorganizing and compiling Program goals and objectives and (2) developing strategy performance indicators (SPIs). These were developed through eight regional work sessions with topical experts and relied on existing information that is already collected and reported in some way. Considering the size and complexity of the Fish and Wildlife Program, this represented a significant step toward understanding the outcomes of this long-term, large-scale investment in mitigation.

In anticipation of the 2025 Program amendment process, staff have been reporting on Program implementation and performance through Council presentations (see the Program amendments page) and using a newly developed webtool – the Program Tracker – that contains datasets on Strategy Performance Indicators (SPIs) and goals and objectives. This report covers progress toward Program goals and objectives and provides supplementary documentation corresponding to the Council presentation in December 2024. Information has been annotated into the 2020 addendum such that the full context from the original development of these goals and objectives, along with any references or targets, can be included. For each Program goal and objective, we incorporate relevant information from Strategy Performance Indicators (SPIs) and any other available information. In some cases, additional refinement of goals or objectives may be required for them to be quantitative and trackable.

Background

Staff are assessing Program performance through three complementary efforts- the retrospective, categorical assessments, and evaluating progress toward Program goals and objectives. In 2024, staff released a Retrospective of the Fish and Wildlife Program that included a one-time review of the Program's history and key events. This historical context provided information on why different elements have been included in the Program over time, what kind of changes were expected to occur, where those changes could occur, and when they could occur.

The categorical assessments (linked above) provide more detailed information on implementation of the major topics identified in the retrospective. These cover four main *categories* in the Program: hydrosystem, artificial production, habitat, and Program adaptive management. In 2024, staff presented the first three categories and described (1) what was called for in the Program, (2) what was implemented, and (3) how implementation compares to available benchmarks. These assessments incorporated content from existing summaries (e.g., Strategy Performance Indicators (SPIs), published research or reports, and dashboards on particular topics) and included new summaries from a variety of information sources. Strategy

Performance Indicators are updated annually on the Program Tracker (and some SPIs are updated in real-time), and categorical assessments will be updated prior to Program amendments, approximately every five years.

The last piece of Program performance is evaluating progress toward the goals and objectives described in the 2020 Addendum. Evaluating progress relies on multiple sources of data, including the SPIs. The Council has invested in expanding the Program Tracker web tool to incorporate information on goals and objectives. Goals and objectives will be updated annually on Program Tracker.

The 2020 Addendum to the 2014 Fish and Wildlife Program contains 5 goals and 37 objectives, implemented through 23 strategies and hundreds of measures. Program goals and objectives are diverse. They may define a responsibility toward mitigating for the hydrosystem and fall entirely under a Program obligation. Alternatively, objectives may originate from other regional efforts and describe how implementation of the Program will "contribute to" achieving those regional targets. This occurs when regional targets seek to address losses that extend beyond those attributed to the hydrosystem. Goals and objectives may also be quantitative or qualitative, associated with large monitoring datasets, or no data at all, and range from highly specific targets for the short term to long term aspirational targets.

The Program framework defines the reciprocal relationship between objectives and strategies and measures. Objectives define the conditions the Program seeks to establish as a step toward achieving long-term goals. If measures are already being implemented, associated objectives might contain targets that can be used to measure progress. If implementation has not yet occurred, the objective might be qualitative and point to a need for further implementation and development of quantitative targets. The Program benefits from both kinds of objectives- those pointing toward future implementation and those tracking progress from current implementation.

The time frame when measures appeared in the Program, when planning and implementation began, and when or where physical or biological results may be detectable all influence progress toward Program goals and objectives. For example, early Program efforts were heavily focused on modifying the structures and operations of the hydrosystem. These modifications dramatically improved fish survival as they navigate the hydrosystem. Subsequently, the Program shifted toward a bigger focus on habitat planning in the mid-2000s, and then implementation of restoration projects. From the point when a restoration project is implemented on the landscape, it may take decades to mature and achieve the physical result- perhaps reduced erosion, increased connectivity, or riparian shading. Fish that are present in the stream may begin to experience improved growth or survival or access to spawning habitat early in the process. However, an increase in population abundance may take multiple fish generations as each generation may have slightly higher survival than the previous and contribute more offspring to the next generation (assuming no other significant negative impacts occur). Taken together, this means that restoration work done under the Program is at varying levels of maturity, and fish populations may have only been responding to restoration for a generation or two.

Anadromous Salmon and Steelhead

Goal

Increase total adult salmon and steelhead runs of Columbia River origin to a 10-year rolling average of five million annually by 2025, in a manner that emphasizes increases in the abundance of the populations that originate above Bonneville Dam.

For the purposes of this goal, total adult salmon and steelhead abundance numbers should be obtained by combining the number of adult salmon of all species counted at Bonneville Dam, the number of fish spawning below Bonneville Dam, and the estimated number of salmon caught in the ocean and in rivers below Bonneville Dam. Increases in abundance everywhere in the river are important, given that hydropower development and operations affect the entire river and all the salmon and steelhead in the river. But because most of the loss of salmon and steelhead production as a result of hydroelectric development has occurred above Bonneville Dam, increases in abundance to satisfy this goal must come predominantly from the area above Bonneville Dam.

Increasing the total salmon and steelhead runs to five million is an interim Program goal that began in the 1987 Program's commitment to "double the runs." This total abundance target is lower than the Council's estimates of the losses of anadromous fish due to the development and operation of the Columbia River hydroelectric facilities (Figure 1). See the program's Compilation of Information on Salmon and Steelhead Losses in the Columbia River Basin and Numerical Estimates of Hydropower-Related Losses. While the Program has always assumed artificial production will be one of the strategies used to achieve this goal, the proportion of naturally spawning fish contributing to this goal should increase as natural production increases.

The Program's numerical goal for salmon and steelhead is part of an overarching qualitative goal, consistent with the Program's vision and the NW Power Act, to protect, mitigate, and enhance salmon and steelhead adversely affected by the Columbia River hydroelectric power system, including related spawning grounds and habitat. And, by doing so, contribute to reversing the decline in populations and make progress toward restoring and then maintaining stable healthy populations of salmon and steelhead that support sustainable fisheries and allow for desired expressions of traditional cultural values and practices. Populations that are healthy and support sustainable fisheries are defined as abundant, productive, genetically diverse, and spatially distributed within the Columbia River Basin, and provide ample opportunities for subsistence, ceremonial, recreational and (where appropriate) commercial fisheries that are of tribal trust, treaty, and non-treaty origin.

The Anadromous Salmon and Steelhead Goal language and definition is based on the following sources of information:

1. 1987 Fish and Wildlife Program, section 203
2. 1994/1995 Fish and Wildlife Program section 4.1
3. 2000 Fish and Wildlife Program section on Objectives for Biological Performance
4. 2014 Fish and Wildlife Program section III. Goals and Objectives – the changes we want to achieve
5. 2014 Fish and Wildlife Program Appendix D, Theme 2, objective 2.a

Figure 1. Estimate of historical returns of salmon and steelhead in the Columbia Basin (10-16 million), losses from all sources (7-14 million), and losses attributed to the hydrosystem as reported in NPPC 1986 (5-11 million). Darker color bars represent upper end of estimate and lighter bars represent lower end of estimate.

In addition to the estimates provided above, the Council acknowledges that other ranges of historical estimates exist based on the specific assumptions made and datasets used by researchers. These other estimates range from around 6 million as described by the ISAB in their 2015 report on density dependence, to 35 million- as estimated by BPA in an early report based on fish wheel catch rates.

Summary of progress

The definition and process for calculating the 5 million fish goal has been described in Fish and Wildlife Programs since 1987 (Table 1).

Table 1. History of the Council's Fish and Wildlife Program goal for 5 million salmon and steelhead

Program	History of the 5 million fish goal
1987	*Interim goal*: **Double salmon and steelhead runs from 2.5 million to 5 million adult fish** in the Basin as a whole, above Bonneville is an added priority.
1992 *Strategy for Salmon*	Maintenance of the interim goal to double the total number of adult salmon and steelhead in the Columbia Basin as fast as possible **without further loss of biological diversity among or within anadromous and resident fish populations**. **Numbers should be obtained by combining:** 1) Number of adult salmon of all species counted at Bonneville Dam. 2) Number of fish spawning below Bonneville Dam. 3) Estimated number of salmon caught in the ocean and in rivers below Bonneville Dam.
1994	Fish and wildlife agencies and tribes consistently recommended the retention of this interim abundance goal as an interim target for overall program efforts.
2000/2009	Target date to reach 5 million salmon and steelhead set as 2025.
2014/2020	Further emphasis on the populations that originate above Bonneville Dam.

There are three areas that contribute to the estimate of salmon and steelhead returns: (1) ocean fisheries of Columbia River origin salmon and steelhead, (2) lower river harvest and natural spawners, and (3) counts of salmon and steelhead at Bonneville Dam (Figure 2). Scientists at tribes, state agencies, federal agencies, and regional governmental agencies provided data for ocean harvest, lower river harvest, and natural spawners (Figure 2). Columbia River origin Chinook and coho are harvested by ocean fisheries off Southeast Alaksa, Canada, Puget Sound, and the Washington, Oregon, and California coasts (Figures 2 and 3). These include waters overseen by both the Pacific Salmon Commission (PSC) and the Pacific Fisheries Management Council (PFMC). In the lower river between the estuary and Bonneville Dam, data are reported annually by the states of Oregon and Washington, tribes, and the U.S. v. OR Technical Advisory Committee. Bonneville Dam counts are reported by the US Army Corps of Engineers via the Fish Passage Center (FPC).

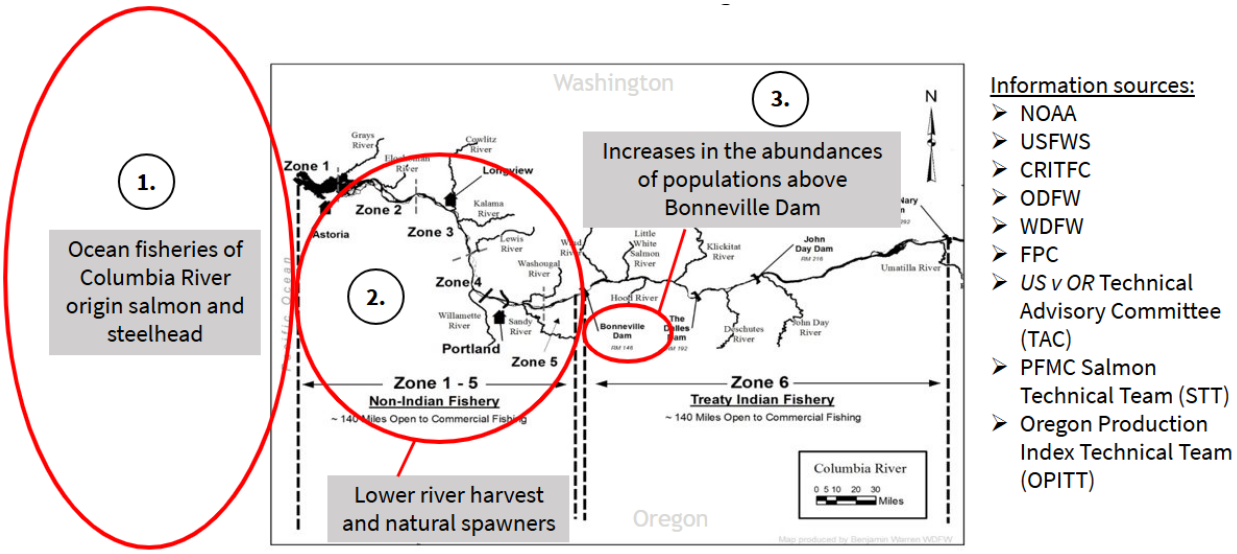

Figure 2. Map of three areas delineated by the Council's Fish and Wildlife Program to be counted toward the 5 million goal (left) and a list of entities that contributed data and/ or expertise in the 2024 update (right)

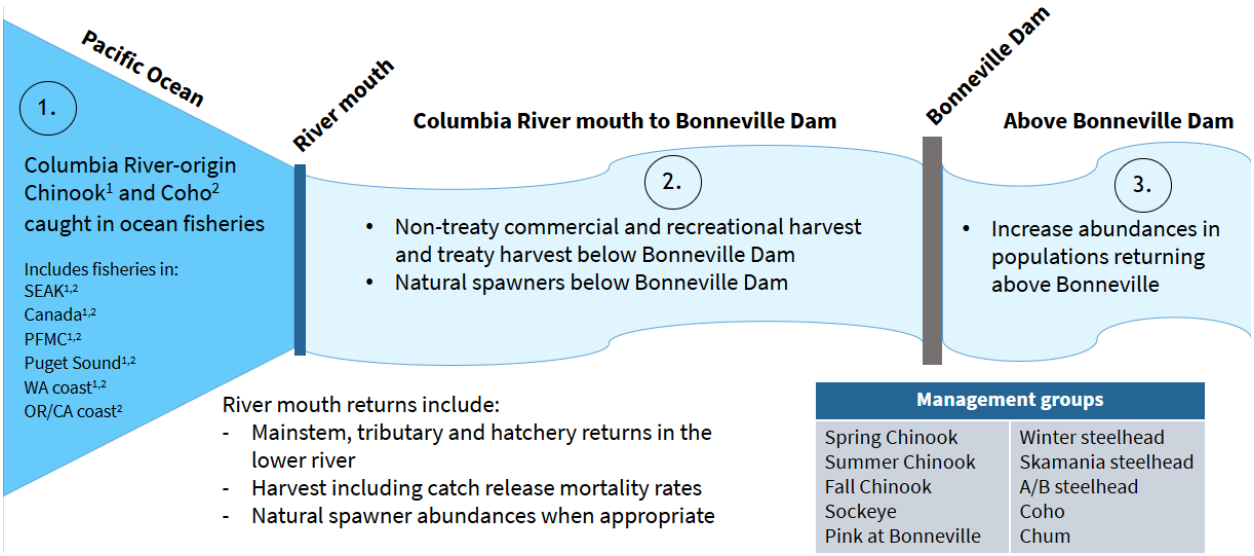

Figure 3. Information contributing to the goal of 5 million adult salmon and steelhead returning annually. Area 1 (left) represents ocean fisheries of Columbia River origin fish. Area 2 (middle) represents in-river harvest (treaty and non-treaty) between the Columbia River mouth and Bonneville Dam and natural spawner estimates in the same area. Area 3 (right) represents Bonneville Dam counts. A description of river mouth returns and the relevant management groups in this analysis are also included.

In 2023, the 10-year rolling average for adult salmon and steelhead returning to the Columbia River was approximately 2.3 million adult fish (Figure 4). As directed by the Program, this estimate was obtained by combining:

1. Number of adult salmon of all species counted at Bonneville Dam.
6. Number of fish spawning below Bonneville Dam.
7. Estimated number of salmon caught in the ocean and in rivers below Bonneville Dam.

The minimum return of adult salmon and steelhead since 1993 is estimated at 1.3 million in 1995 and the maximum return in 2014 at 2.7 million.

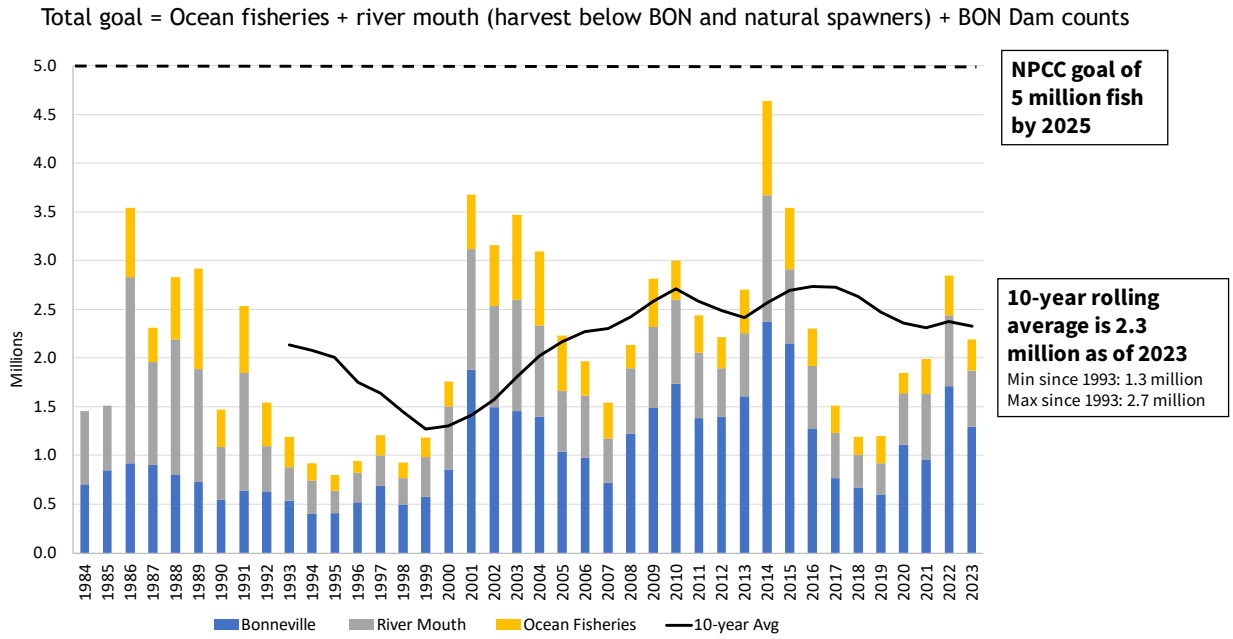

Figure 4. Adult salmon and steelhead returns to the Columbia River including ocean fisheries 1984-2023

From the time Bonneville Dam was completed in 1938 until 1966, the average annual count for adult salmon and steelhead crossing the dam was approximately 601,700 (Figure 5). This number was just slightly higher between 1967-1994 at 648,100 fish. Depressed returns and downward trends in abundance culminated with ESA listings in the 1990s. As a result of regional actions to improve survival and abundance, the average from 1995-2023 is estimated to have increased to approximately 1,181,300. The 2023 rolling 10-year average is approximately 1,231,900 adult salmon and steelhead crossing Bonneville Dam annually. It is important to remember that all these estimates are considered indices of abundance with their own variation as it is impossible to count each individual fish at different geographic and time scales. The observation of general trends, although not precise, can still be valuable to understand changes in populations over time.

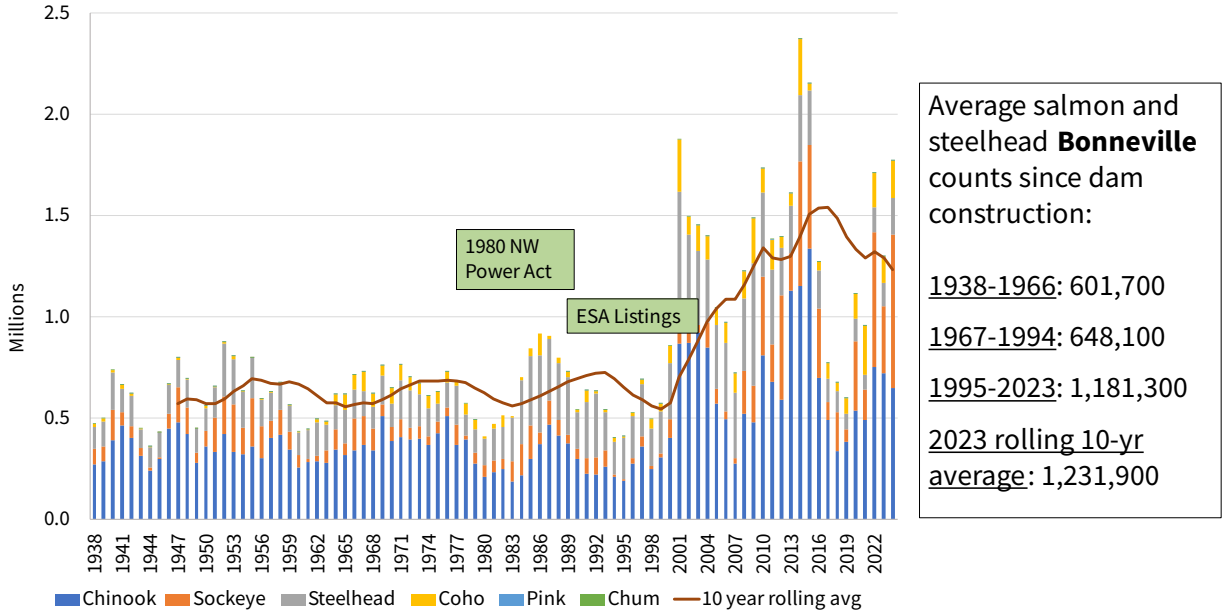

Figure 5. Adult salmon and steelhead returns to Bonneville Dam by species 1938-2023 (FPC)

By comparing the river mouth return to the number of fish over Bonneville Dam, we can estimate the proportion of the annual run headed for areas above Bonneville Dam. As demonstrated by the heat map in Figure 6, this has generally improved since 1984 with some variation due to species return differences, ocean conditions, and outmigration success, among other factors.

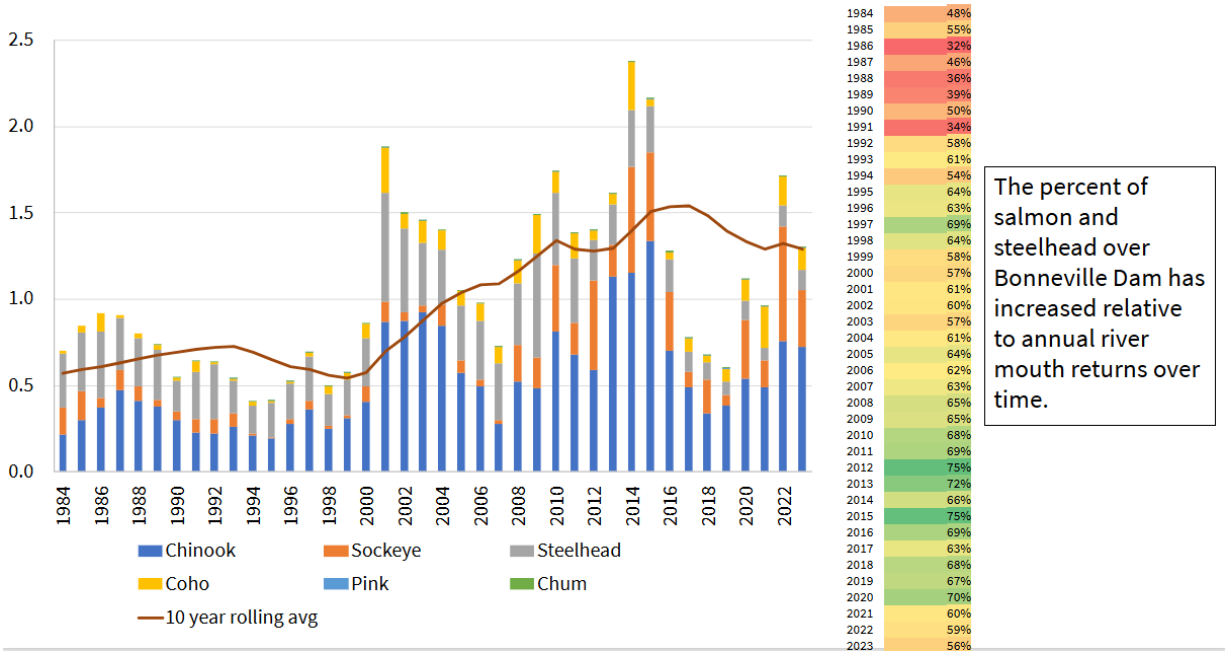

Figure 6. Adult salmon and steelhead returns to Bonneville Dam 1938-2023 (FPC)

Upriver fish have increased in average annual abundance over time while lower river fish have slightly decreased in average annual abundance over time (Figure 7). This supports the Council's goal of increasing the proportion of fish headed upstream of Bonneville Dam. It should be noted that there is still much work to be done to rebuild certain populations in both areas.

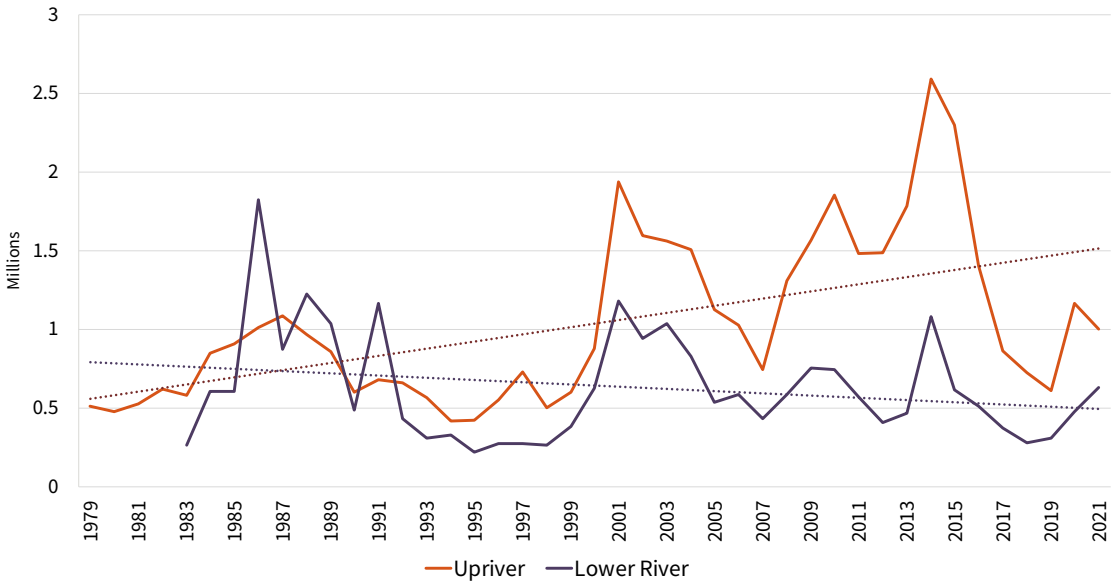

Figure 7. Annual salmon and steelhead estimates at the Columbia River mouth bound for either above Bonneville Dam (upriver fish) or below Bonneville Dam (lower river fish)

Discussion

Early work under the Program focused on improved management of ocean fisheries, moving production upstream of Bonneville Dam, development and improvement of fish passage structures, and improving flows for ecosystem benefits.

Efforts that targeted improved management of ocean fisheries included support of the Pacific Salmon Treaty, requirements that harvest be well managed as a condition for supporting rebuilding efforts for any given stock and calls for investments in marking to allow for mark-selective fisheries where stocks are mixed.

The effort to move production upstream of Bonneville Dam, reflecting where the majority of losses had occurred, has been an ongoing priority of the Program and an important component of the 5 million fish goal. Historically, Mitchell Act funding supported artificial production downstream of Bonneville. Increased releases upriver (above Bonneville) were designed to improve returns of fish above the dam that could be harvested or contribute to natural production.

Fish passage improvements and water management have also been critical for increasing survival and returns of fish passing above Bonneville Dam. Prior to implementation of these

actions, juvenile and adult salmon and steelhead experienced extremely poor survival during migration through the Columbia hydrosystem. In 1986, the Council reported that "passage mortality was estimated at about 15 to 30% per dam for downstream migrants and 5 to 10% per dam for upstream migrants. Cumulative juvenile passage mortality for fish passing nine dams on the way to the ocean was approximately 77 to 96%. Adult passage mortality for fish passing nine dams on the way to spawning areas was approximately 37 to 51%." Since then, these estimates have dropped to between 1- 33% per reach for juveniles and 38-50% cumulatively from the Snake River to Bonneville Dam.

From the low point of returns in the 1990s, there has been a general increase in returns, although annual returns are variable. Returns are comprised of diverse stocks exhibiting a range in survival and abundance across stocks. There is a continued need to address limiting factors for these different stocks and identify actions that will continue to increase their survival and abundance.

Habitat restoration throughout the Columbia River Basin has resulted in increased availability and quality of spawning and early rearing habitat. In the early 2000s, the Council and region invested substantial resources and time into developing Subbasin Plans to guide future restoration and production activities. Implementation of these plans has occurred over the last 20 years. Considering how long it takes for restoration projects to begin affecting physical habitat conditions beneficial for fish, and the number of fish generations it may take to see a population response, restoration projects likely have yet to reach their full potential benefit in some cases. It may be too early to tell whether these projects are implemented at a scale and pace that will result in improved population abundance or survival, but there are positive examples to point to already.

Concurrently with these efforts to increase survival, the basin continues to change. Climate change, increasing human population, and higher resource use threaten gains that have been made. One common question is what the condition of this basin and fish returns might be if the Program had never existed. While we cannot answer that quantitatively, we can point to the improvements in survival during migration for juveniles and adults, the life-support system of hatchery production and its more recent focus on upriver fish, and efforts to expand distribution into the blocked areas- thus increasing the capacity of the basin to support salmon populations.

SPIs referenced in summary:

- **S1-5** Wild Fish Strategy: Total Bonneville Dam, Lower Granite Dam and Willamette Falls counts.

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WDFW/ODFW. 2024. Columbia River reports, forecasts, returns, and fishery plans (Joint State Staff Reports). https://wdfw.wa.gov/fishing/management/columbia-river/compact/other-information

Objective S1

Contribute to achieving the targets for salmon and steelhead adult abundance by stock and subregion developed by the NOAA Marine Fisheries Advisory Committee's (MAFAC) Columbia Basin Partnership Task Force.

The tables below display summary information for both natural-spawning and hatchery-origin adult salmon and steelhead. For the complete details on these abundance targets and supporting information see A Vision for Salmon and Steelhead, Goals and Pathways for Restoring Thriving Salmon and Steelhead to the Columbia River Basin: Phase 2 Report of the Columbia Basin Partnership Task Force to the NOAA Fisheries Marine Fisheries Advisory Committee (July 16, 2020 version).

The Council adopts this program objective under the following premise: The Council has never distributed the Program's total salmon and steelhead abundance goal among stocks and areas of the basin. The Task Force has recently developed abundance targets distributed across stocks and areas but has not allocated responsibility for meeting those targets among the Columbia hydropower system and other mortality sources. For that reason, the Task Force's abundance targets are not to be understood as a division of the Council program's interim hydrosystem goal of an average annual abundance of 5 million total salmon and steelhead adults. Nor does the Council intend these distributed targets to represent, by themselves, the basis for distribution of the program's effort under the Northwest Power Act to protect, mitigate and enhance salmon and steelhead in the different areas of the basin. Instead, the Council expects work implemented under the Program will contribute toward achieving these distributed targets along the way to achieving the overarching program goal, and thus the Council will track progress toward these distributed abundance targets as part of program performance.

Natural Origin Adult Returns to the Mouth of the Columbia River

Subregion	Low	Medium	High
Lower Columbia	193,900	426,700	772,500
Mid-Columbia	109,200	303,000	678,400
Upper Columbia	634,300	1,539,500	3,480,600
Snake River	143,600	451,600	836,400
Willamette River	101,000	198,000	334,000

Hatchery Origin Adult Returns to the Mouth of the Columbia River

Subregion	Current	Future anticipated
Lower Columbia	425,800	427,800
Mid-Columbia	381,700	385,500
Upper Columbia	265,700	610,400
Snake River	362,270	386,900
Willamette River	64,000	67,700

Summary of progress

Around 2017, NOAA convened MAFAC – comprised of parties from throughout the basin – to develop estimates of current abundance of natural and hatchery origin salmon and steelhead at the stock scale. The group established low, medium, and high goals for natural origin adult abundance and summarized hatchery production targets for salmon and steelhead at the stock scale. In the 2020 Addendum, stock scale natural origin and hatchery origin targets for returns to the mouth of the Columbia River were rolled up to a subregional scale (see tables above from 2020 Addendum).

StreamNet is the primary source for natural-origin adult abundance data and population estimates. Population estimates overlap to a great degree with MAFAC stocks, although the population boundaries can differ from the stock boundaries. Not all stocks or populations have abundance data or population estimates, so combining information across populations to report at the stock level, for every stock, requires developing an approach to combine different data types and statistical methods.

There are a lot of assumptions involved in developing an estimate of stock abundance, let alone subregional returns to the mouth. In 2021, staff worked with StreamNet and PNAMP and managers within a Fish Monitoring Work Group to determine how many populations within each MAFAC stock currently had data for both whole population estimates or some other kind of abundance data within StreamNet. Our focus was specifically on determining how we could roll up whole population estimates to the stock scale. StreamNet developed a list of all the kinds of data available for each population and reported on assumptions that need to be met to summarize population data at the stock scale.

The most comparable datasets across stocks are whole population estimates. When considering only whole population estimates where datasets appear in StreamNet, 33% of stocks have estimates for at least 80% of composite populations (Table 2). The remaining 67% of stocks have less complete data and any roll up to the stock level could be spurious. Some of these populations do have data outside StreamNet or other kinds of abundance data – but not population estimates – within StreamNet.

Table 2. Percentage of populations within each MAFAC stock that have population estimates in at least 8 of the last 10 years or at least 6 of the last 10 years. Only includes data on natural-origin whole-population estimates available in StreamNet. This does not include dam counts, partial-population estimates, raw monitoring data, or any population estimates outside of StreamNet.

Stock	Number of populations		Percent of current populations with estimates in last 10 yrs	
	Historical	Current	8 - 10 years of estimates	6 - 10 years of estimates
LCR / SW WA Winter Steelhead	7	7	85.7	85.7
LCR Chum	18	16	25.0	25.0
LCR Coho	25	25	96.0	96.0
LCR Fall Chinook (bright)	1	1	0.0	0.0
LCR Fall Chinook (late bright)	2	2	50.0	100.0
LCR Fall Chinook (tules)	21	21	76.2	81.0
LCR Spring Chinook	9	8	50.0	62.5
LCR Summer Steelhead	6	6	66.7	83.3
LCR Winter Steelhead	17	17	70.6	70.6
Mid-C Coho	5	3	0.0	0.0
Mid-C Sockeye	2	2	0.0	0.0
Mid-C Spring Chinook	15	15	20.0	20.0
Mid-C Summer Steelhead	20	18	94.4	94.4
Mid-C Summer/Fall Chinook	1	1	0.0	0.0
SR Coho	5	2	0.0	0.0
SR Fall Chinook	2	1	0.0	0.0
SR Sockeye	9	1	100.0	100.0
SR Spring/Summer Chinook	68	38	73.7	81.6

SR Summer Steelhead	40	24	62.5	66.7
UCR Coho	5	2	0.0	0.0
UCR Fall Chinook	5	4	0.0	0.0
UCR Sockeye	5	2	0.0	0.0
UCR Spring Chinook	10	4	75.0	75.0
UCR Summer Chinook	14	7	42.9	42.9
UCR Summer Steelhead	11	5	80.0	80.0
Willamette Spring Chinook	7	7	71.4	71.4
Willamette Winter Steelhead	4	4	0.0	0.0

StreamNet developed a dashboard where stocks and populations can be visualized so that it is clear which stocks have partial or complete population data (Figure 8). We were interested in looking at abundance data for only those stocks where 80% of their populations had data for at least 6 of the last 10 years. These stocks are fairly well represented by data in StreamNet. We took this data and compared it to the low goal established by MAFAC (SPI S1-3).

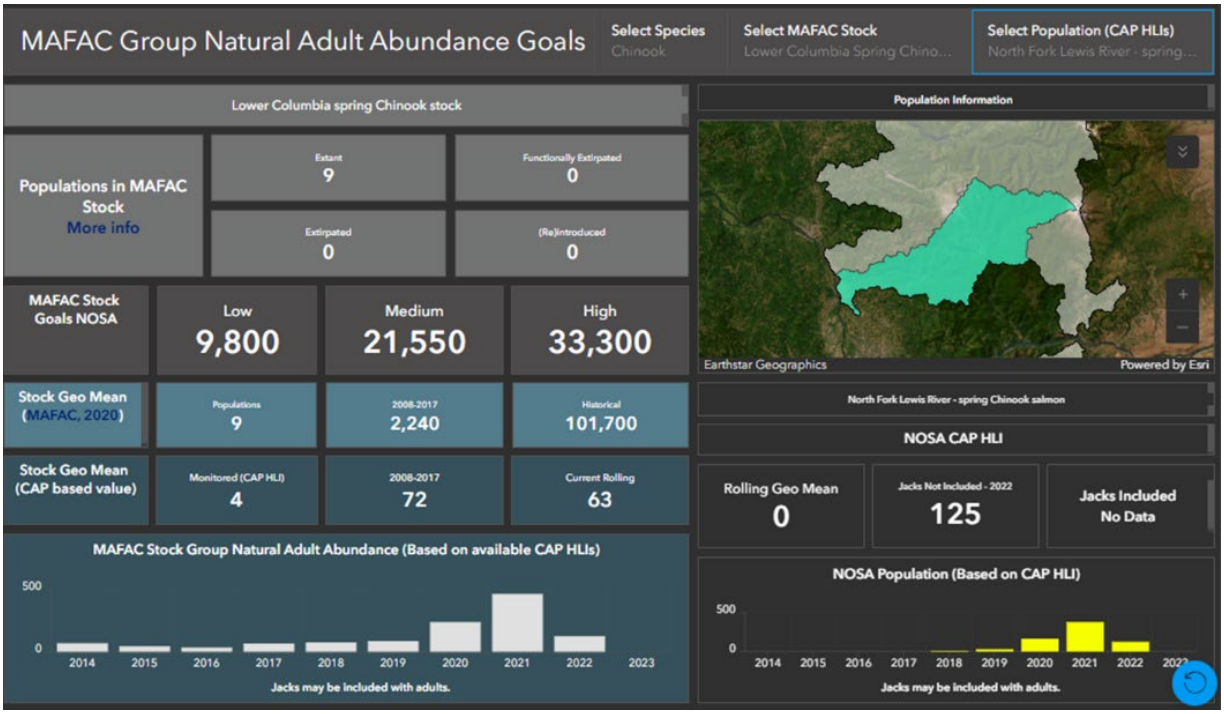

Figure 8. Screenshot of StreamNet's MAFAC dashboard for abundance of natural origin adults

There are two steps to determining progress of stocks toward meeting the low goal. The first step is to compare mean stock abundance data from StreamNet and MAFAC for the same period of time – 2008 - 2017. This comparison is needed because some of the data summarized by MAFAC in 2017 does not appear in StreamNet. MAFAC estimates included data provided by managers and professional opinions when data were not available. From StreamNet, the dashboard only includes whole population estimates, and not the other kinds of trends data that StreamNet has.

If the StreamNet value is less than 100% of the MAFAC value, it might suggest that the dashboard value underestimates abundance. If the value is greater than 100%, there may have been data sets that were not incorporated in the MAFAC report. Of the nine stocks with sufficient data, five had higher abundance estimates in StreamNet for 2008-2017 than values reported by MAFAC and one was slightly below the MAFAC estimate (Table 3).

The second step is to compare the contemporary geo mean reported on the dashboard to the MAFAC low goal. We report on the percentage of the low goal achieved. If the value is greater than 100%, the low goal has been exceeded. Only one stock exceeds the low goal, and it also exceeds the medium goal (Table 3). It is important to note that other stocks may have higher abundances but are not currently well represented by whole-population datasets in StreamNet.

Table 3. Comparison of historical (2008-2017) abundance estimates in StreamNet as a percentage of estimates in the MAFAC report, and contemporary abundance (StreamNet only) as a percentage of the MAFAC low-goal, for stocks with whole-population estimates for at least 80% of composite populations over the last 6-10 years in StreamNet.

MAFAC Stock	Comparing abundance estimates in SN and in MAFAC report, 2008 – 2017 If < 100%, SN data may underestimate abundance	Contemporary StreamNet abundance estimates as percentage of MAFAC Low Goal If > 100%, Low Goal exceeded
LCR / SW WA Winter Steelhead	20.5%	3.6%
LCR Coho	24.8%	13.1%
LCR Fall Chinook (late bright)	130.6%	169.8% also exceeds medium goal
LCR Fall Chinook (tules)	135.8%	74.1%
LCR Summer Steelhead	87%	46.1%

Mid-C Summer Steelhead	108%	61.6%
SR Sockeye	14%	0%
SR Spring/Summer Chinook	127.8%	15.9%
UCR Summer Steelhead	154.3%	19.7%

Given data availability at the stock scale, we cannot take these estimates and summarize them at the larger subregional scale (Figure 9). Recently, the Columbia Basin Collaborative (CBC, formerly Columbia Basin Partnership) has been working to identify next steps to track toward these MAFAC targets. In the short term, efforts are focused on better supporting the entities in the basin who have abundance data which might not be in StreamNet. The CBC formulated a recommendation to increase funding for data stewards, which contribute data from individual organizations to StreamNet, and ensure it follows data exchange standards. More effort and funding to bring this information, including dam counts or external data sources, into StreamNet could result in better representation of contemporary stock abundance.

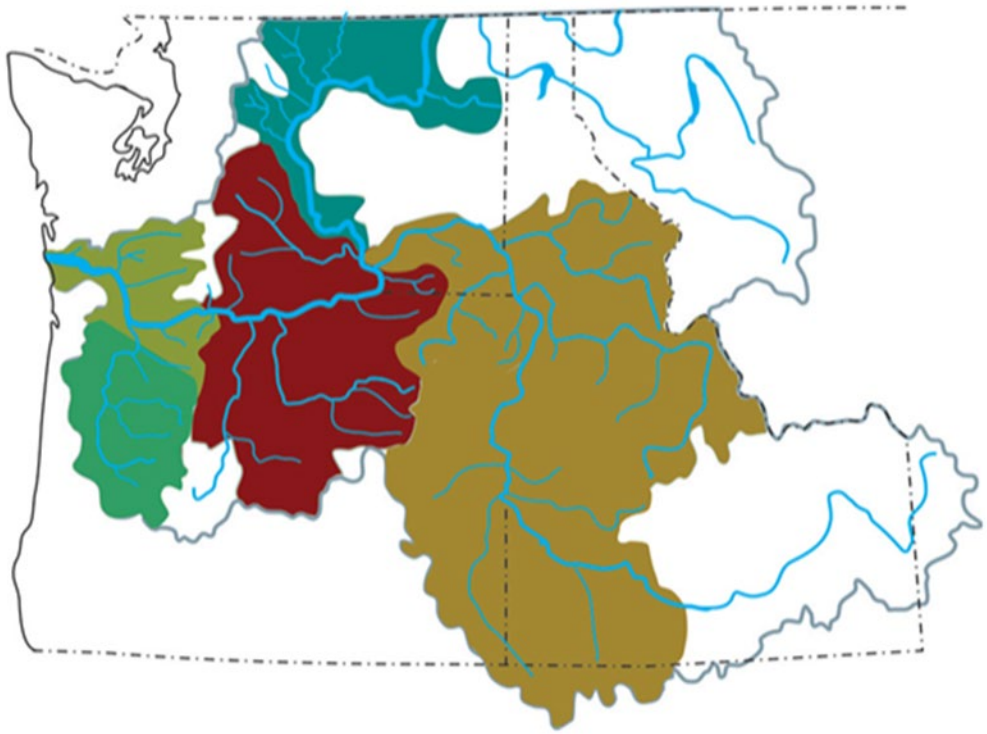

Figure 9. MAFAC subregions in the Columbia Basin. Map source: CBPTF Report

The next part of the objective relates to hatchery-origin fish. As written, the objective calls for summarizing returns of adult hatchery fish to the mouth of the Columbia by stock and subbasin. However, associated SPIs in the addendum describe hatchery production by stock and subregion- not adult returns. In the salmon and steelhead goal, we reviewed the complex information associated with calculating returns to the mouth. Typically, hatchery fish are not tracked at the mouth, they are tracked during adult migration at dams (e.g., Bonneville, Lower Granite), in Columbia River fisheries, or at adult return locations (i.e., hatchery, spawning tributary). To back these abundance estimates down to the mouth of the Columbia River, additional information on natural and fishing mortality would be required.

In lieu of summarizing information on hatchery adult returns to the Columbia River mouth, we present data on the associated SPI relating to juvenile releases at the stock and subregion scales (SPI S1-2), as hatchery releases contribute to subsequent adult returns. Council staff have been working over the last year to understand the relationship between hatchery production under the F&W Program, and production targets for MAFAC stocks. This required compilation of a lot of information, in cooperation with hatchery managers (Table 4; additional data in the Hatchery Categorical Assessment). The first step was to identify information on production authorized under the Act. This is compiled in the Council's Program Hatchery Tracker tool. The second step was to align the Program's hatchery production in context to the MAFAC stocks. This information can be found in tables within the MAFAC reports. Next, hatchery release targets- for both individual production programs and rolled up to the MAFAC stock level were aggregated from the US v. OR management agreement, F&W managers and MAFAC reports. Where hatchery programs were jointly funded by BPA and an external source (e.g., Mitchell Act, LSRCP), F&W managers helped estimate the funding portion associated with each funding source to summarize juvenile releases targets under the F&W Program. Details can be found in the Program Tracker (see Context, Metadata, and Sources for S1-2).

Table 4. Information compilation steps, status, and sources to assess progress toward regionally agreed-upon targets for salmon and steelhead hatchery production

Information compilation steps	Status	Sources
1. Hatchery program information (NW Power Act associated production only)	Complete	Program Tracker hatchery tool (compiled with F&W managers)
2. Identify how hatchery program fits within context of Columbia Basin Partnership (MAFAC) stocks	Complete	Reference Tables 5 and 11 – CBP phase 1 report Table A-5 – CBP phase 2 report
3. Identify hatchery release targets: individual program-specific & total stock-specific	Complete	*US v. Oregon* Management Agreement; F&W managers Table A-5 – CBP phase 2 report

4. Estimate BPA-funded portion for jointly-funded hatchery programs	Complete	F&W managers
5. Summarize compiled information showing contribution of the F&WP hatchery production to total releases by stock	Complete	Above steps
6. Review preliminary/draft compiled information with F&W managers to finalize	TBD	

Using the data from the above steps, information was compiled on the contribution of the Program's hatchery releases to annual total hatchery release targets by MAFAC subregion and stock. Across stocks, there are very different juvenile release targets. The Council's Program represents ~13% of total juvenile release targets, basin wide (Figures 10 and 11). Moreover, the Program's artificial production contributes to a diversity of the MAFAC stocks (more than 50% of them), many of which are in the interior Columbia River Basin, above Bonneville Dam.

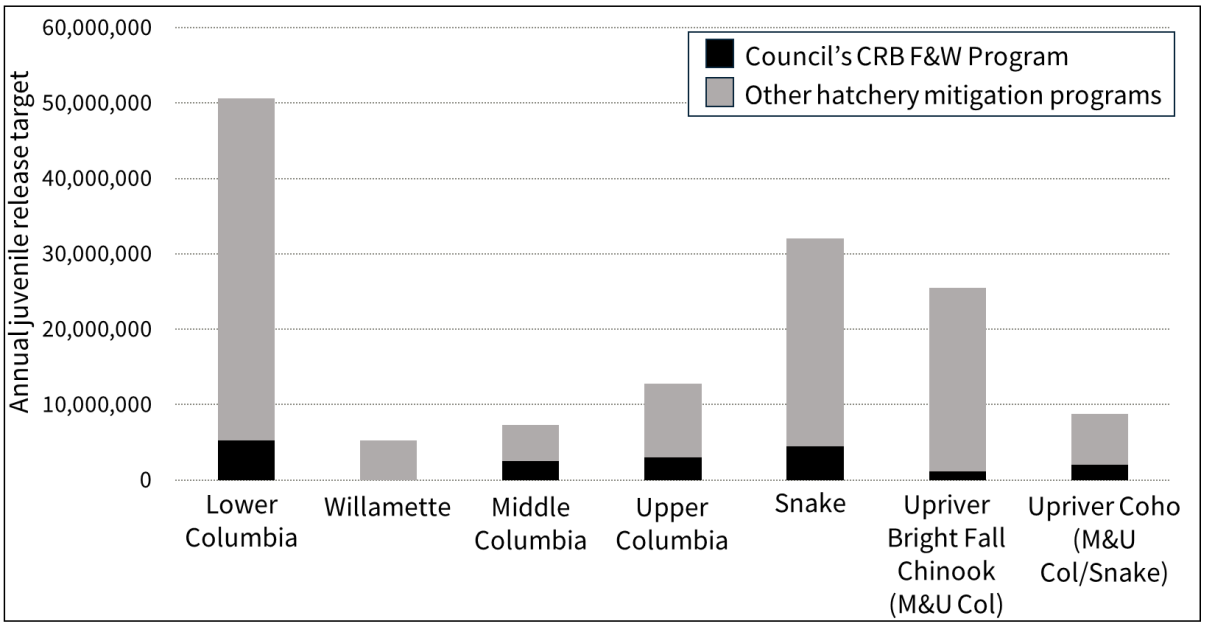

Figure 10. Council's Program contribution toward annual juvenile release targets within each MAFAC subregion. Black bars represent the Council's F&W Program contribution, and the grey bar represents contributions outside of the Program toward hatchery release targets within each subregion. This figure is based on a draft compilation of data.

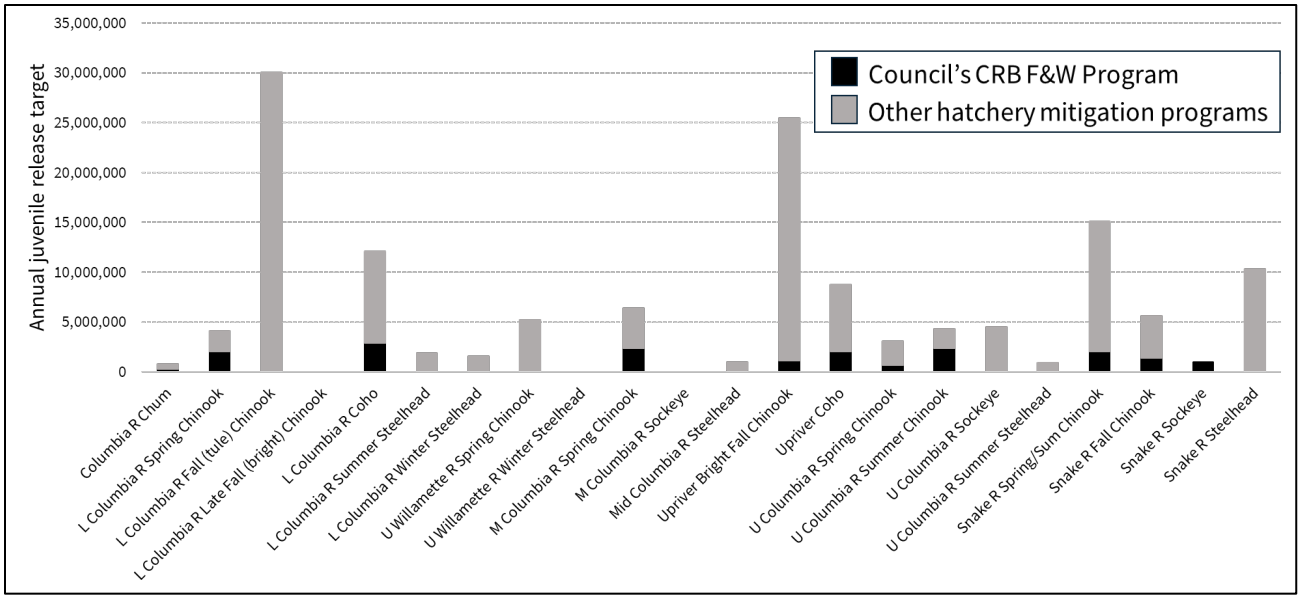

Figure 11. Council's Program contribution toward annual juvenile release targets within each MAFAC stock. Black bars represent the Council's F&W Program contribution, and the grey bar represents contributions outside of the Program toward hatchery release targets within each stock. This figure is based on a draft compilation of data.

SPIs referenced in summary:

- **S1-2** Fish Propagation and Hatchery Strategy: Progress toward the following regionally agreed-upon targets for salmon and steelhead hatchery production. These targets were summarized by the NOAA Marine Fisheries Advisory Committee's (MAFAC) Columbia Basin Partnership Task Force. Note that the calculations for S1-2 were not based on the Program Addendum table below but were based on the published tables in phase 1 and 2 MAFAC reports.

Group	Current Hatchery Juvenile Production	Future Total Hatchery Juvenile Production
Lower Columbia Chum	770,000	770,000
Lower Columbia Coho	12,108,600	12,239,000
Lower Columbia Fall Chinook (tules)	19,366,500	19,366,500
Lower Columbia Fall Chinook (brights)	0	0
Lower Columbia Fall Chinook (brights) Select Area	2,100,000	2,100,000

Lower Columbia Spring Chinook	4,120,000	6,340,000
Lower Columbia Winter Steelhead	1,381,000	1,381,000
SW Washington Winter Steelhead	223,000	223,000
Lower Columbia Summer Steelhead	1,307,000	1,307,000
Mid-Columbia Coho	5,200,000	5,200,000
Mid-Columbia Sockeye	0	0
Mid-Columbia Spring Chinook	6,380,000	6,930,000
Mid-Columbia Fall Chinook (tules)	10,700,000	10,700,000
Mid-Columbia Fall Chinook (brights)	11,000,000	12,000,000
Mid-Columbia Summer Steelhead	960,000	710,000
Snake River Fall Chinook	5,650,000	5,650,000
Snake River Sockeye	900,000	1,000,000
Snake River Spring/Summer Chinook	15,340,500	18,115,500
Snake River Summer Steelhead	10,328,000	10,328,000
Snake River Coho	1,550,000	1,550,000
Upper Columbia Fall Chinook	14,450,000	24,140,000
Upper Columbia Sockeye	4,500,000	14,100,000
Upper Columbia Spring Chinook	3,094,000	10,200,000
Upper Columbia Summer Chinook	4,286,000	14,400,000
Upper Columbia Summer Steelhead	935,300	2,750,000
Upper Columbia Coho	2,000,000	2,250,000
Willamette River Spring Chinook	5,241,000	5,817,000
Upper Willamette River Summer Steelhead	600,000	550,000
Upper Willamette River Winter Steelhead	0	0

- **S1-3** Wild Fish Strategy: Progress toward the following regionally agreed-upon adult abundance escapement targets for natural-origin salmon and steelhead. These targets were developed by the NOAA Marine Fisheries Advisory Committee's (MAFAC) Columbia Basin Partnership Task Force.

Group	Low, 10-year geometric mean	Med, 10-year geometric mean	High, 10-year geometric mean
Lower Columbia Spring Chinook	9,800	21,550	33,300
Lower Columbia Chum	16,500	33,000	49,500
Lower Columbia Coho	67,925	129,550	191,400
Lower Columbia Fall Chinook (tules)	28,050	54,100	82,000
Lower Columbia Fall Chinook (late brights)	11,100	16,700	22,200
Lower Columbia Fall (brights)	11,000	11,000	11,000
Lower Columbia Summer Steelhead	21,100	29,800	38,100
SW Washington Winter Steelhead	4,650	5,850	6,950
Lower Columbia Winter Steelhead	19,000	27,900	36,400
Mid-Columbia Coho	5,300	11,600	19,900
Mid-Columbia Sockeye	7,500	45,000	107,500
Mid-Columbia Spring Chinook	17,750	40,425	114,500
Mid-Columbia Summer/Fall	4,000	13,000	16,000
Mid-Columbia Summer Steelhead	21,500	43,850	69,150
Snake River Fall Chinook	4,200	10,780	23,360
Snake River Sockeye	5,500	15,750	26,000
Snake River Spring/Summer Chinook	33,500	98,750	159,500
Snake River Summer Steelhead	22,500	75,000	131,500
Snake River Coho	8,900	26,600	44,100

Group	Low, 10-year geometric mean	Med, 10-year geometric mean	High, 10-year geometric mean
Upper Columbia Fall Chinook	9,200	62,215	87,835
Upper Columbia Sockeye	31,500	580,000	1,235,000
Upper Columbia Spring Chinook	11,500	19,840	30,135
Upper Columbia Summer Chinook	9,000	78,350	131,300
Upper Columbia Summer Steelhead	7,500	31,000	47,000
Upper Columbia Coho	7,500	15,000	26,000
Upper Willamette Spring Chinook	28,900	47,850	66,800
Upper Willamette Winter Steelhead	16,290	27,805	39,320

- **S1-4** Wild Fish Strategy: Abundance of populations tracked as identified through Coordinated Assessments Partnership.

Other SPIs associated with objective: data available on Program Tracker

- **S1-1** Plume and Nearshore Ocean Strategy: NOAA's stop light indicator chart of ocean conditions.
- **S1-5** Wild Fish Strategy: Total Bonneville Dam, Lower Granite Dam and Willamette Falls counts.

References

Marine Fisheries Advisory Committee (MAFAC) 2020. A Vision for Salmon and Steelhead, Goals and Pathways for Restoring Thriving Salmon and Steelhead to the Columbia River Basin. Phase 2 Report of the Columbia Basin Partnership Task Force to the NOAA Fisheries Marine Fisheries Advisory Committee, July 16, 2020, version. https://www.fisheries.noaa.gov/vision-salmon-and-steelhead-goals-restore-thriving-salmon-and-steelhead-columbia-river-basin

Pacific Northwest Aquatic Monitoring Partnership (PNAMP) 2021. Fish Monitoring Workgroup (FMWG) Task summary: https://pnamp.org/projects/fish-monitoring-work-group/fmwg-mafac-npcc/

PNAMP 2022. FMWG Report on data availability: https://pnamp.org/wp-content/uploads/2024/08/2022-10-20_MAFAC_NPCC_SPI_Task_1_Summary.pdf

Objective S2

Contribute to achieving a smolt-to-adult return ratio (SAR) in the 2-6 percent range (minimum 2-percent; average 4-percent) for listed Snake River and upper Columbia salmon and steelhead, as well as for non-listed populations.

Summary of progress

Many variables are involved in calculating and interpreting smolt to adult return ratios (SAR). Examples include:

- Starting location and ending location for different species/ runs
- Whether jacks included in calculation
- Migration distance
- Life histories/ natural vs hatchery origin
- Variation in mortality while navigating hydrosystem
- Exposure to different environmental conditions during migration
- Susceptibility to predation
- Migration patterns and distribution in ocean (and corresponding environmental and biological conditions experienced during ocean residence)

The Independent Science Advisory Board (ISAB) is currently finalizing a report on the use, calculation, and interpretation of SAR and the related metric SAS (smolt to adult survival).

Objective S2 covers SAR for both ESA-listed and non-listed populations. For 2024, we focused on ESA-listed stocks in the upper Columbia and Snake Rivers. These stocks each have different life histories and starting and ending points for estimating SAR and this means different migration distances, migration timing, migration conditions, and exposure to mortality sources. Data summarized below does not include jacks and does include the information currently available in Program Tracker (~2007 – 2018 brood years). Additional data will be available by the end of 2024.

For each stock, we calculated average SAR over the period of record and summed the number of years when SAR exceeded the minimum target of 2%. For the period of record in this review, no stocks have achieved an average SAR of 4%, and only six stocks have had any annual SAR values above 2% (Table 5).

Table 5. ESA listed stocks of salmon and steelhead in the Upper Columbia and Snake Rivers, number of brood years with Smolt-to-Adult (SAR) data, average SAR over period of record (~2007-2018) and number of years SAR exceeds 2%. Starting and ending points for SAR calculations differ and data does not include jacks. Survival data reported in Fish Passage Center's Comparative Survival Study.

Stock	# brood years with SAR data	Avg SAR (# years > 2%)
SR Spring/ Summer Chinook	11	0.84 (1)
SR Steelhead- A	10	1.62 (3)
SR Steelhead- B	10	1.44 (2)
SR Fall Chinook	4	0.77 (0)
SR Sockeye- Sawtooth Hatchery	7	0.35 (0)
SR Sockeye- Oxbow Hatchery	3	1.57 (2)
SR Sockeye- Springfield Hatchery	4	0.0025 (0)
UCR Spring Chinook	11	0.64 (0)
UCR Summer Chinook	7	0.39 (0)
UCR Steelhead	10	1.724 (3)
UCR Sockeye	5	1.64 (1)

SPIs referenced in summary

- **S2-1** Mainstem Hydrosystem Flow and Passage Strategy: SARs for salmon and steelhead, in the Columbia and Snake Rivers.

Other SPIs associated with objective: data available on Program Tracker

- **S2-2** Plume and Nearshore Ocean Strategy: NOAA's stop light indicator chart of ocean conditions.

References

Fish Passage Center (FPC) 2020. Comparative Survival Study. Available online at: https://www.fpc.org/documents/CSS/2020-CSS-Report.pdf

Objective S3

Continue to improve juvenile passage survival through the hydrosystem.

Summary of progress

Juvenile salmonid survival and travel times are dependent on many environmental factors, some natural and some due to the operation of the hydrosystem. Accurate and precise estimates of survival are considered critical for the recovery of depressed stocks of Pacific salmon and steelhead that migrate through Snake and Columbia River reservoirs, dams, and free-flowing reaches (NOAA, 2023). In 1986 a Council report stated that passage mortality over 9 dams was estimated to be 15-30% per dam for downstream juvenile migrants resulting in a 77-96% cumulative mortality through the system. Current estimates are in the range of 1-33% mortality per reach with a 48-50% cumulative mortality from the Snake River to Bonneville Dam (data reported on Program Tracker under SPIs S3-2 and S3-4).

Infrastructure upgrades such as juvenile bypass structures, screens, attractant flows, predation deterrents at dams, and other methods have been employed throughout the Basin and continue to be improved. Both passive and active tag studies track downstream survival throughout the hydrosystem. Survival and travel times are reported annually via regional partners including the Fish Passage Center (FPC), NOAA, USGS, and others.

Different study types and locations offer different types of challenges. For example, a passive integrated transponder (PIT) tag is not detected when a juvenile fish does not pass a detection site installed in a juvenile bypass system (JBS) due to high levels of spill, which has been observed recently during certain seasons due to current agreements. That said, long-running studies such as the 30-year report by NOAA (Table 6) for spring-migrating juveniles through Snake and Columbia River dams and reservoirs are valuable resources when assessing how the system is performing over time. Active tag studies (such as radio or acoustic tags) can offer insights into questions about passage at a certain location at a specific time especially when current detection systems are not sufficient. The survival of transported fish is also tracked and, when appropriate, compared to in-stream migration. Transportation can be a helpful tool in certain situations to allow fish to bypass difficult migration conditions.

Table 6. Average survival estimates by reach for combined hatchery and wild yearling Chinook salmon and steelhead during 2022. Standard error in parentheses. (NOAA, 2023)

	Yearling Chinook salmon	Steelhead
Snake River Smolt Trap to Lower Granite Dam	0.963 (0.072)	0.940 (0.023)
Lower Granite to Little Goose Dam	0.823 (0.035)	0.881 (0.027)

Little Goose to Lower Monumental Dam	1.014 (0.059)	0.992 (0.043)
Lower Monumental to McNary Dam[a]	0.869 (0.138)	0.681 (0.043)
Lower Monumental to Ice Harbor Dam	0.921 (0.104)	1.036 (0.078)
Ice Harbor to McNary Dam	0.929 (0.172)	0.672 (0.052)
McNary to John Day Dam	0.806 (0.087)	1.265 (0.198)
John Day to Bonneville Dam[b]	0.892 (0.077)	0.737 (0.091)
Snake River Smolt Trap to Bonneville Dam[c]	0.508 (0.044)	0.520 (0.038)

[a] Two-project reach, including Ice Harbor Dam and reservoir.
[b] Two-project reach, including The Dalles Dam and reservoir.
[c] Entire hydropower system, including eight dams and reservoirs.

SPIs referenced in summary

- **S3-2** Mainstem Hydrosystem Flow and Passage Strategy: Juvenile salmon and steelhead reach survival by year.
- **S3-4** Mainstem Hydrosystem Flow and Passage Strategy: Average mortality (%) of juvenile salmon and steelhead at Columbia and Snake River dams.

Other SPIs associated with objective: data available on Program Tracker

- **S3-1** Mainstem Hydrosystem Flow and Passage Strategy: Powerhouse encounter rates, Lower Granite to Bonneville Dam.
    - S3-1 based on recommendations submitted by ODFW, WDFW, and Nez Perce Tribe, for the 2018-2019 Fish and Wildlife Program amendment process and the 2019-2021 Spill Operation Agreement.
- **S3-3** Mainstem Hydrosystem Flow and Passage Strategy: Number of salmon and steelhead transported in Snake River.

References

NOAA (National Oceanic and Atmospheric Association). 2023. Survival Estimates for the Passage of Spring-Migrating Juvenile Salmonids Through Snake and Columbia River Dams and Reservoirs, 2022. Available online at: https://repository.library.noaa.gov/view/noaa/55826/noaa_55826_DS1.pdf

NPPC (Northwest Power and Conservation Council). 1986. Compilation of information on salmon and steelhead losses in the Columbia River Basin. Northwest Power Planning Council.

Portland, OR. Available online at: https://www.nwcouncil.org/sites/default/files/AppendixDLosses_3.pdf

Objective S4

Achieve the following annual adult salmon and steelhead survival standards for the Bonneville Dam to Lower Granite Dam reach and the Bonneville Dam to McNary Dam reach:

- Objective S4 is based on 2014 Fish and Wildlife Program Appendix D, Theme 2, objective 5b.
- It originates from the 2009 NOAA Fisheries FCRPS Biological Opinion the Reasonable and Prudent Alternative No. 52 – Hydrosystem Research, Monitoring and Evaluation Strategy 2 of the NOAA Fisheries 2008 FCRPS Biological Opinion, including Table 7 (see details: nwcouncil.box.com/s/j5jpgzb1hpp64w0zb12z91ydc724p73y)

Table 7. Adult Performance Standard by ESU

ESU	Adult Performance Standard	Reach
Snake River fall Chinook	81.2%	BON to LGR
Snake River spring-summer Chinook	91.0%	BON to LGR
Snake River sockeye	Use Snake River spring/summer Chinook salmon and steelhead as surrogate until a standard is developed	BON to LGR
Snake River steelhead	90.1%	BON to LGR
Upper Columbia River spring Chinook	90.1%	BON to MCN
Upper Columbia River steelhead	84.5%	BON to MCN
Middle Columbia River steelhead	Use Snake River steelhead as surrogate until a standard is developed	Variable
Columbia River chum	None; assume survival is adequate if Snake River chinook BON to LGR standard is met	None
Lower Columbia River Chinook	None; assume survival is adequate if Snake River spring/summer Chinook and Snake River fall Chinook standards are met	None

Lower Columbia River coho	None; assume survival is adequate if Snake River fall Chinook standards are met	None
Lower Columbia River steelhead	None; assume survival is adequate if Snake River steelhead standards are met	None
Upper Willamette River Chinook	None	None
Upper Willamette River steelhead	None	None

Summary of progress

Adult survival varies geographically and between species and runs. As part of their effort to track the status of listed salmon and steelhead, NOAA summarizes survival of adults on their upstream migration. In the Snake River, this analysis is done separately for fish that migrated in river as juveniles and those that were transported, because juvenile migration history affects adult survival.

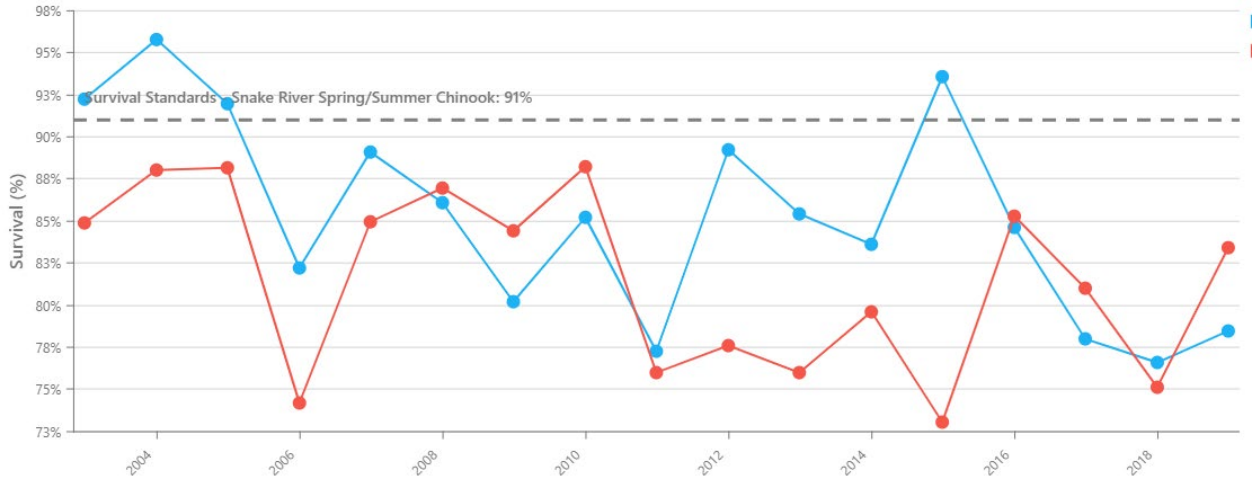

Figure 12. Examples of annual survival data for Spring/Summer Chinook Salmon Bonneville to Lower Granite Dam for fish that migrated in river as juveniles (blue) or were transported (red). Data provided by Blane Bellerud (NOAA) and reported on Program Tracker as SPI S4-1

We report on annual survival for different species and runs in Program Tracker (Figure 12). Upper Columbia stock survival is calculated from Bonneville Dam to McNary Dam. Snake River stock survival is calculated from Bonneville Dam to Lower Granite Dam. From this annual data, we calculate average survival over the period of record for runs and report this relative to survival standards (Figure 13). Survival is consistently higher for fish that migrated in river, regardless of species, and survival standards were met for Snake River Fall Chinook, upper Columbia Spring

Chinook, upper Columbia Steelhead, and mid-Columbia Steelhead. During this time, the poorest survival was observed for Snake River sockeye, but this includes the 2015 migration year, when water temperatures were excessively hot and there was a mass die-off of migrating adult sockeye.

Although not all survival standards are met, contemporary survival still represents a substantial improvement from estimates reported in 1986. According to NPCC 1986, "Passage mortality is estimated at about 5 to 10% [per dam] for upstream migrants. Adult passage mortality for fish passing nine dams on the way to spawning areas is approximately 37 to 51 percent."

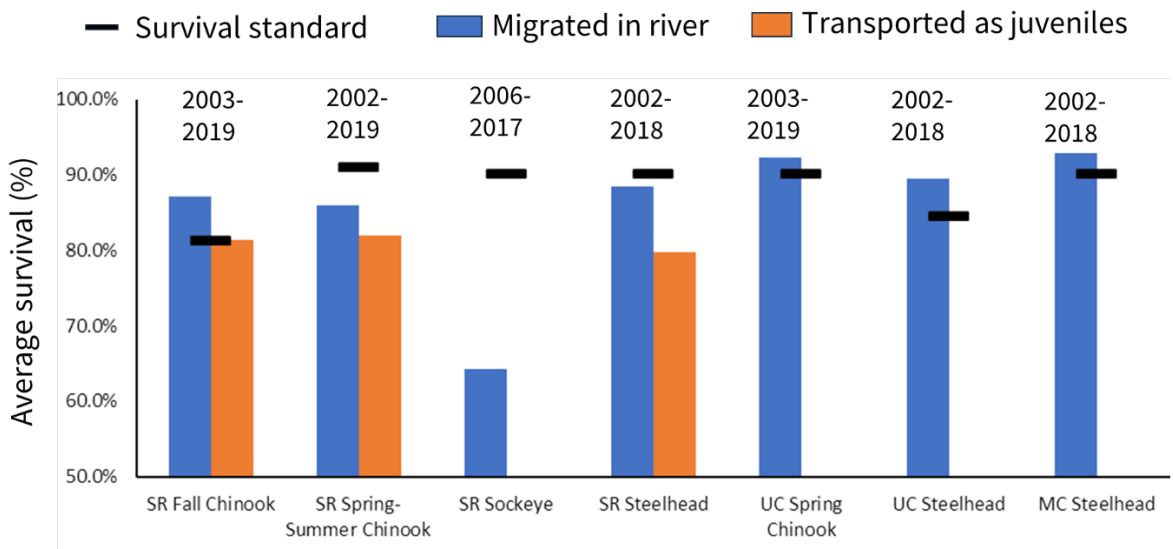

Figure 13. Average survival of adult salmon and steelhead that migrated in river as juveniles (blue bars) or were transported (orange bars), relative to survival standards in the 2020 addendum and FCRPS BiOp

SPIs referenced in summary

- **S4-1** Mainstem Hydrosystem Flow and Passage Strategy: Annual adult salmon and steelhead survival in select Columbia and Snake River reaches.

Other SPIs associated with objective: data available on Program Tracker

- **S4-2** Mainstem Hydrosystem Flow and Passage Strategy: Average mortality (%) of juvenile salmon and steelhead at Columbia and Snake River dams.

References

NPPC (Northwest Power and Conservation Council). 1986. Compilation of information on salmon and steelhead losses in the Columbia River Basin. Northwest Power Planning Council.

Portland, OR. Available online at: https://www.nwcouncil.org/sites/default/files/AppendixDLosses_3.pdf

2009 NOAA Fisheries FCRPS Biological Opinion the Reasonable and Prudent Alternative No. 52 - Hydrosystem Research, Monitoring and Evaluation Strategy 2 of the NOAA Fisheries 2008 FCRPS Biological Opinion, including Table 7 (see details: nwcouncil.box.com/s/j5jpgzb1hpp64w0zb12z91ydc724p73y)

Objective S5

With the agreement of the relevant co-managing state agencies and tribes, contribute to assessing and, where appropriate, expanding anadromous fish distribution into historical habitat above blocked areas.

- Objective S5 is related to the Anadromous Mitigation in Blocked Areas strategy in the 2014 Fish and Wildlife Program and the provision on Blocked Areas Mitigation implementation in Part II of the 2020 Addendum. Reintroduction possibilities of various kinds are being investigated or discussed for most blocked areas; all are at different levels of progress. This objective is intended to reflect and track agreements that exist to investigate reintroduction, and not be a mechanism to drive implementation of reintroduction proposals. Differences in policy (e.g., Idaho's Blocked Areas Policy as Approved by the Governor's Office, 24 Feb 2020 and Upper Snake River Tribes' Hells Canyon Complex Fish Management Program, April 27, 2018) need to be worked out in other fora and then brought to the Council's Program.

Summary of progress

The Program calls for investigating and where appropriate, expanding anadromous fish distribution into historical habitat above blocked areas (Figure 14).

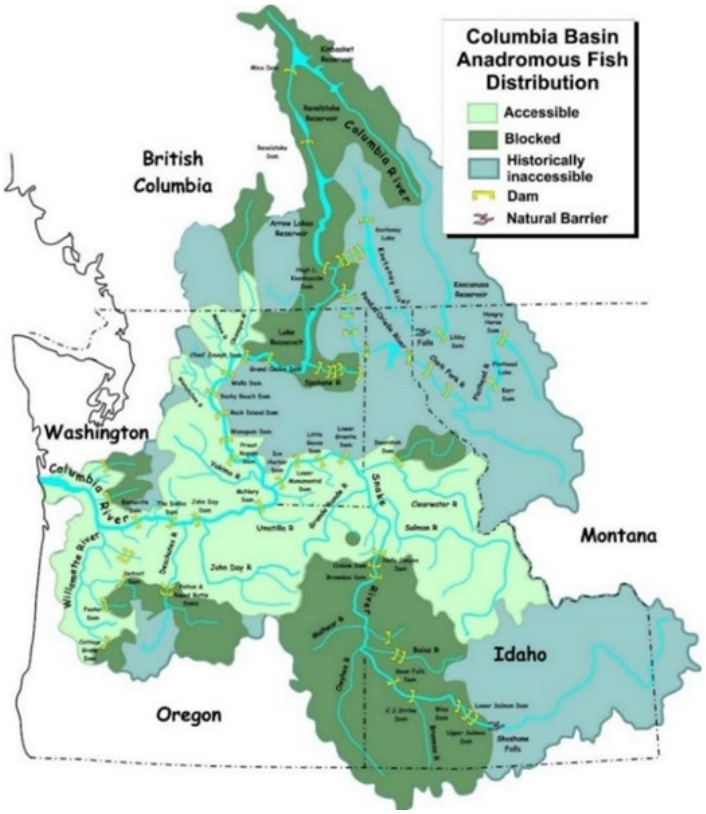

Figure 14. Areas of the Columbia Basin blocked to anadromy. Map from: https://media.fisheries.noaa.gov/2022-07/icrb-salmon-steelhead-recovery-summary-draft-v2.5.pdf

We often hear about two large, blocked areas- the upper Columbia and the Upper Snake. There has been progress in both areas since the 2014/2020 addendum. The U.S. Columbia Basin Tribes and Canadian First Nations developed a plan for reintroduction (U.S. Columbia Basin Tribes and Canadian First Nations 2015). The 2014 Program contains a draft of the phased approach. In 2019, UCUT completed Phase 1, which included studies covering reintroduction risk, donor stock, habitat availability and suitability, fish passage technologies at high-head dams, and more (UCUT 2019). The Phase 2 implementation plan (UCUT 2022) describes research needed to resolve remaining critical uncertainties and tools to guide management and measure progress.

The Upper Snake River Tribes Foundation is exploring reintroduction above the Hells Canyon Complex (story map link). As a first effort, they collaborated with a consulting firm to develop an assessment of historical returns above the Hells Canyon Complex (Parametrix 2024). This is meant to serve as a benchmark for developing future reintroduction plans. The ISAB reviewed this assessment (ISAB 2024), at the request of the USRTF. They noted that early work on assessing losses was valuable, particularly considering the limited resources that were available to do so, and they provided suggestions for upcoming, more quantitative steps to be taken to continue improving loss assessments (ISAB 2024). A second and related effort involves discussion around

whether fish passage might be required at these dams as a condition of the supplemental environmental impact statement.

There are other smaller areas in the basin blocked by non-federal hydro dams and mitigation is guided by the Federal Energy Regulatory Commission (FERC). The following are recent examples of efforts to restore access to blocked areas.

Cowlitz River – Construction of Mossyrock Dam in 1968 and Mayfield Dam in 1963 blocked access to portions of the Cowlitz River to anadromous fish. In the relicensing agreements (2003), FERC calls for trap and haul and further investigations into how to restore fish passage above blockages. Details on (1) investigations, (2) the FERC license, (3) the 2000 settlement agreement that specified blocked area mitigation, and (4) the current status of trap and haul and restoration are available here: https://www.mytpu.org/about-tpu/services/power/about-tacoma-power/dams-power-sources/cowlitz-river-project/cowlitz-license-documents/#pattern_1

NF Lewis River – Construction of Merwin Dam (1931), Yale Dam (1953), and Swift Dams 1 (1958) and 2 (1959) blocked access to anadromous fish on the North Fork Lewis River. **The license for these dams was renewed in 2008, and that included an agreement by PacifiCorp to provide fish passage throughout the upper Lewis River.** Post-renewal, PacifiCorp explored whether there might be alternatives to fish passage **–** particularly habitat restoration **–** which would be less costly. Ultimately restoration was not considered sufficient because of uncertainties in whether it would achieve the same response as passage. Passage is due to be constructed by the end of June 2025.

Currently there are discussions underway on how to pursue passage. Correspondence on these is available on the FERC website here.

Deschutes River – Construction of the Pelton Round Butte Project in the 1960s blocked access to a large portion of the Deschutes River basin to anadromy. Reintroductions of salmon and steelhead upstream of the Pelton Round Butte Project began in 2007 and the first returns to the Upper Deschutes basin occurred in 2011. These returns were possible because passage facilities (upstream and downstream) were completed at Pelton. According to ODFW, "The reintroduced fish are repopulating three major tributaries to the Deschutes River – these include the Upper Deschutes River, the Metolius River, and the Crooked River." In 2019, a fish ladder was constructed on the Crooked River, allowing further volitional migration.

SPIs referenced in summary

- **S5-2** Anadromous Fish Mitigation in Blocked Areas Strategy: Studies completed regarding fish passage, experimental pilot releases and testing interim fish passage facilities, fish reintroduction approaches, upstream/downstream passage options and costs, and habitat suitability.
- **S5-3** Anadromous Fish Mitigation in Blocked Areas Strategy: The blocked-area reintroduction implementation plans are completed.

Other SPIs associated with objective: data available on Program Tracker

- **S5-1** Wild Fish Strategy Indicators: Progress toward the following regionally agreed-upon adult abundance escapement targets for natural-origin salmon and steelhead. These targets were developed by the MAFAC Columbia Basin Partnership Task Force.
- Anadromous Fish Mitigation in Blocked Areas Strategy: In blocked areas where the program has committed to any or all of these anadromous fish reintroduction activities, track the following:
    - **S5-4** Increase in habitat access for anadromous fish in the blocked waters above the blockage including, but not limited to, miles of fish habitat made accessible and high-head dam interim fish passage facilities in operation.
    - **S5-5** Number of salmon passed above and below the blockage through interim fish passage facilities and trap and haul.
    - **S5-6** Number of salmon released in reintroduction pilot projects and selective releases.

References

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Upper Columbia United Tribes (UCUT). 2019. Fish Passage and Reintroduction Phase 1 Report: Investigations Upstream of Chief Joseph and Grand Coulee Dams. Available online at: https://ucut.org/wp-content/uploads/2019/05/Fish-Passage-and-Reintroduction-Phase-1-Report.pdf

UCUT. 2022. The Phase 2 Implementation Plan: Testing Feasibility of Reintroduced Salmon in the Upper Columbia River Basin. Available online at: https://ucut.org/wp-content/uploads/2022/08/UCUT-Phase-2-Implementation-Plan-Version-4Aug2022.pdf

U.S. Columbia Basin Tribes and Canadian First Nations. 2015. Fish passage and reintroduction into the U.S. and Canadian Upper Columbia Basin: Joint paper of the U.S. Columbia Basin Tribes and Canadian First Nations, Available online at: https://ucut.org/wp-content/uploads/2016/09/Fish_Passage_and_Reintroduction_into_the_US_And_Canadian_Upper_Columbia_River4-1.pdf

Objective S6

Bonneville-funded hatcheries meet hatchery mitigation goals as described in the management plans or Hatchery Genetic Management Plans (HGMPs).

Summary of progress

SPI S6-1 calls for all program-funded hatcheries to have a final management plan and a reviewed and approved master plan, with specific objectives to track performance. This information is available and has been documented in the Program Tracker hatchery tool.

SPI S6-2 calls for Salmon and steelhead indicators for Bonneville-funded hatcheries to be tracked and compared to management goals as described in hatchery management plans and HGMPs. This information is under development. Currently the Program Tracker contains information on annual juvenile hatchery release data relative to established targets. Additional SPIs need to be developed and then tracked.

SPIs referenced in summary

- **S6-1** Fish Propagation and Hatchery Strategy: All program-funded hatcheries have a final management plan and a reviewed and approved master plan, with specific objectives to track performance.
- **S6-2** Fish Propagation and Hatchery Strategy: Salmon and steelhead indicators for Bonneville-funded hatcheries tracked and compared to management goals as described in hatchery management plans and HGMPs.

Other SPIs associated with objective: data available on the Program Tracker

- **S6-3** Fish Propagation and Hatchery Strategy: Sturgeon hatchery objectives are tracked and compared to the hatchery management plan and a reviewed and approved master plan.
- **S6-4** Fish Propagation and Hatchery Strategy: Cutthroat Trout hatchery objectives are tracked and compared to the management plan and a reviewed and approved master plan.
- **S6-5** Fish Propagation and Hatchery Strategy: Kokanee hatchery objectives are tracked and compared to the management plan and a reviewed and approved master plan.
- **S6-6** Fish Propagation and Hatchery Strategy: Burbot hatchery objectives are tracked and compared to the management plan and a reviewed and approved master plan.

Objective S7

Maintain genetic diversity over time.

Summary of progress

Since the 1980s, the Program has called for research on genetic diversity, particularly in relation to hatchery-wild interactions. In 1991, maintaining genetic diversity appeared as a measure in the Program. No basin-scale or stock-scale data exist with which to establish baseline diversity or contemporary diversity. This is an example of an objective that remains a statement of priority, but to track progress, there would need to be implementation of new monitoring and a determination of diversity levels to be maintained.

SPIs referenced in summary

- **S7-1** Wild Fish Strategy: Trends in genetic diversity measures (heterozygosity, allelic diversity, private alleles, etc.)

All Other Native Aquatic Focal Species

Goal

The Program goal, consistent with the Program's Vision and the Northwest Power Act, is to protect, mitigate and enhance these other native focal aquatic species adversely affected by the development and operation of the Columbia River hydroelectric power system, including related spawning grounds and habitat.

The program does not include quantitative hydropower loss assessments and hydropower-related quantitative mitigation goals for aquatic species other than anadromous salmon and steelhead, with the one exception of the impacts of Hungry Horse and Libby dams on certain resident fish species. The Program will contribute to this goal by protecting, mitigating and enhancing other native focal species, which will contribute to reversing the decline in populations and making progress toward restoring and then maintaining stable healthy populations that support sustainable fisheries and allow for desired expressions of traditional cultural values and practices. Populations that are healthy and support sustainable fisheries are defined as abundant, productive, genetically diverse, and spatially distributed in areas of the historic range within the Columbia River Basin, and provide ample opportunities for subsistence, ceremonial, recreational and (where appropriate) commercial fisheries that are of tribal trust, treaty, and non-treaty origin.

- The qualitative native aquatic species goal is based on the 2014 Fish and Wildlife Program Appendix D, Theme Two.

Summary of progress

- This goal is tracked through individual objectives. There is no trackable goal for all other native aquatic species, as a group.
- The goal refers to "**these other**" focal species. It is not clear if this refers to species with associated objectives or if this should be a more extensive list.
- Most objectives under this goal are described as "**contributing to**" other regional targets.
- The Hydrosystem portion of losses has not been assessed to define targets, with exception of resident fish losses at Libby and Hungry Horse Dams
- This goal covers a diverse group of fish:
    - Migratory and resident
    - Some broadly distributed
    - Unique conditions affecting fish throughout range
    - Different management targets geographically
    - Different size categories monitored against different criteria

White Sturgeon Objective WS1

Abundance:

In the absence of quantitative goals and objectives based in hydropower loss assessments, contribute to achieving the following White Sturgeon adult abundance targets, as well as other population characteristics, derived from sturgeon management plans across the region.

The values for the White Sturgeon objectives are based on the following sources of information:

(a) Lower Columbia: ODFW Lower Columbia River and Oregon Coast White Sturgeon Conservation Plan, 2011
(b) Bonneville, The Dalles and John Day Reservoir: Draft (unpublished) ODFW Zone 6 management plans based on the same PVA methodology as the ODFW, 2011 plan
(c) Middle Snake: 2005 White Sturgeon Management Plan in the Snake River between Lower Granite and Hells Canyon dams
(d) Upper Snake: 2004 Middle Snake Subbasin Management Plan
(e) A.D. Schreier et al. Aquaculture 416–417 (2013) 141–145; Idaho Power Company. 2015. Snake River White Sturgeon Conservation Plan, 2015-2020 Planning and Implementation. Unpublished Report to Idaho Power Company, Boise ID. p. 132.
(f) Transboundary Upper Columbia: Upper Columbia White Sturgeon Recovery Initiative Operational Plan 2013-2017, Upper Columbia White Sturgeon Recovery Plan - 2012 Revision, and 2013 Columbia Basin White Sturgeon Planning Framework

(g) Kootenai USFWS Revised Recovery Plan for the Kootenai River Distinct Population segment of White Sturgeon, 2019

Lower Columbia and Lower Snake:

- Lower Columbia: Three-year running mean of wild fish 300,000 Sub-Adults (38-65" fork length (FL) and 6,250 Adults (66"+ FL) by 2026
- Bonneville Reservoir: Three-event sampling mean of wild fish 67,973 Sub-Adults (38-65" FL) and 6,728 Adults (66"+ FL)
- The Dalles Reservoir: Three-event sampling mean of wild fish 47,125 Sub-Adults (38-65" FL) and 3,392 Adults (66"+ FL) by 2029
- John Day Reservoir**:** Three-event sampling mean of wild and hatchery 208,081 Sub-Adults (38-65" FL) and 5,055 Adults (66"+ FL) by 2029
- McNary Reservoir and free-flowing section: Sub-adult and adult abundance **targets when available** based upon population viability analysis.
- Ice Harbor Reservoir: Sub-adult and adult abundance targets **when available** based upon population viability analysis
- Lower Monumental Reservoir: Sub-adult and adult abundance targets **when available** based upon population viability analysis
- Little Goose Reservoir: Sub-adult and adult abundance targets **when available** based upon population viability analysis

Middle Snake:

- Natural, stable age structure population with a minimum of **2,500 adult fish** from Lower Granite to Hells Canyon as measured every 5 years

Upper Snake:

Reach	Abundance
Shoshone Falls downstream to upper Salmon Falls Dam	1,400
Upper Salmon Falls Dam downstream to Lower Salmon Falls Dam	340
Lower Salmon Falls Dam downstream to Bliss Dam	630
Bliss Dam downstream to C.J. Strike Dam	2,900
C. J. Strike downstream to Swan Falls	1,340
Swan Falls downstream to Brownlee Dam	7,100

Brownlee Dam downstream to Oxbow Dam	630
Oxbow Dam downstream to Hells Canyon Dam	1,300

Transboundary Upper Columbia:

- Interim adult populations of 2,000 in the Canadian Transboundary Reach and 5,000 in the U.S. Transboundary Reach. Subsistence and recreational fishery harvest of 2,000 fish per year

Kootenai River:

- Stable, self-sustaining, healthy population within all available historical habitats. Adult abundance targets for hatchery-reared and wild fish will be developed over time as understanding of constraints are refined. Those constraints may change over time based on flow management, habitat, and nutrient restoration efforts.
- The USFWS recovery goal for Kootenai River White Sturgeon is:
    - Number of Kootenai sturgeon wild recruits (offspring that survive to sexual maturity at 25 years) added to the adult (25 years or older) population annually averages at least 250 individuals per year over 10 years. In addition, the population includes at least 10,000 wild juveniles, ages 3 to 24 years. The population demonstrates consistent natural production of at least 700 wild age-3 juveniles in at least three of 10 consecutive years.
- Offspring of hatchery-reared sturgeon will count towards the recovery criteria because those offspring will have been naturally spawned and reared in the Kootenai River.

Summary of progress

White sturgeon are a long-lived anadromous species inhabiting the Columbia basin from the estuary upstream to the upper Columbia and Upper Snake Rivers. Historically, white sturgeon migrated long distances to find productive habitats for spawning. When habitat, flow, and temperature condition are suitable, sturgeon broadcast spawn. Over the next few weeks, their embryos develop the ability to swim and then mature to the larva stage. Age-0 fish are the young of year and an indicator of successful reproduction. Those fish are juveniles from ages 1- 9, become subadults around age 10 until age 15, and then mature to spawning-age adults at around 10-15 years old for males and 15-25 years old for females. Males might spawn every year if conditions are suitable, but females might only spawn every 5 years.

Because white sturgeon do not spawn every year, historical migrations were critical for ensuring they spawned in the best habitat available in any particular year to maximize survival of their offspring. Construction of the hydrosystem has blocked these migrations and passage has not

been constructed for white sturgeon. As a result, the river is fragmented and populations inhabit isolated pools with habitat quality that varies geographically and sometimes among years. In pools with poor habitat, spawning may not occur. In pools with available habitat, the success of spawning depends on environmental conditions in a given year and if spawning conditions are poor, sturgeon are unable to migrate to better habitat. In addition, historical patterns of high flow, which prompted spawning and affected survival of embryos, no longer occur to the same degree or with the same timing.

The Program calls for a variety of techniques to support populations of sturgeon and rebuild abundance. These techniques include:

- Active management of harvest
    - Slot limit allows for harvest within the size range specified
    - Can be used to protect reproductive-aged fish and maintain pool of fish that can grow and recruit into harvest range
    - Also can reduce abundance of over-represented age classes (e.g., Lake Roosevelt)
- Flow management at Libby Dam
- Habitat restoration
- Improved research on life history, habitat needs, demographics
- Hatchery production to address lack of productivity
- Collaborations between Tribal, state, federal, and private entities on management and monitoring

Objective WS1 calls for contributing to abundance targets that vary by life stage- subadults, or adults, and by location throughout the basin. These locations are individual reservoirs/ also referred to as pools. Sturgeon objectives were derived from management plans throughout the region. Since the 2020 Addendum was finished, newly revised objectives exist**. Should the objectives in the Program match these new management objectives?**

For abundance, there are adult and subadult targets, and other targets that do not note a life stage but perhaps should. Some populations don't have targets at this time. Because abundance targets differ throughout the basin, results are reported as the percentage of the abundance target that is met, by pool. Data on sturgeon abundance in the Lower Columbia were reported in ODFW and WDFW 2023. In the reach below Bonneville Dam, adult abundance is at 141% of the target (Figure 15). In the Snake River reach between CJ Strike and Bliss, abundance- of fish > 60cm is at 118% of target. Adult abundance in the McNary pool is at 96% of target. For subadult sturgeon, targets only exist for the Lower Columbia. The highest abundance of subadults occurs downstream of Bonneville Dam but is still only 43% of the target (Figure 16)

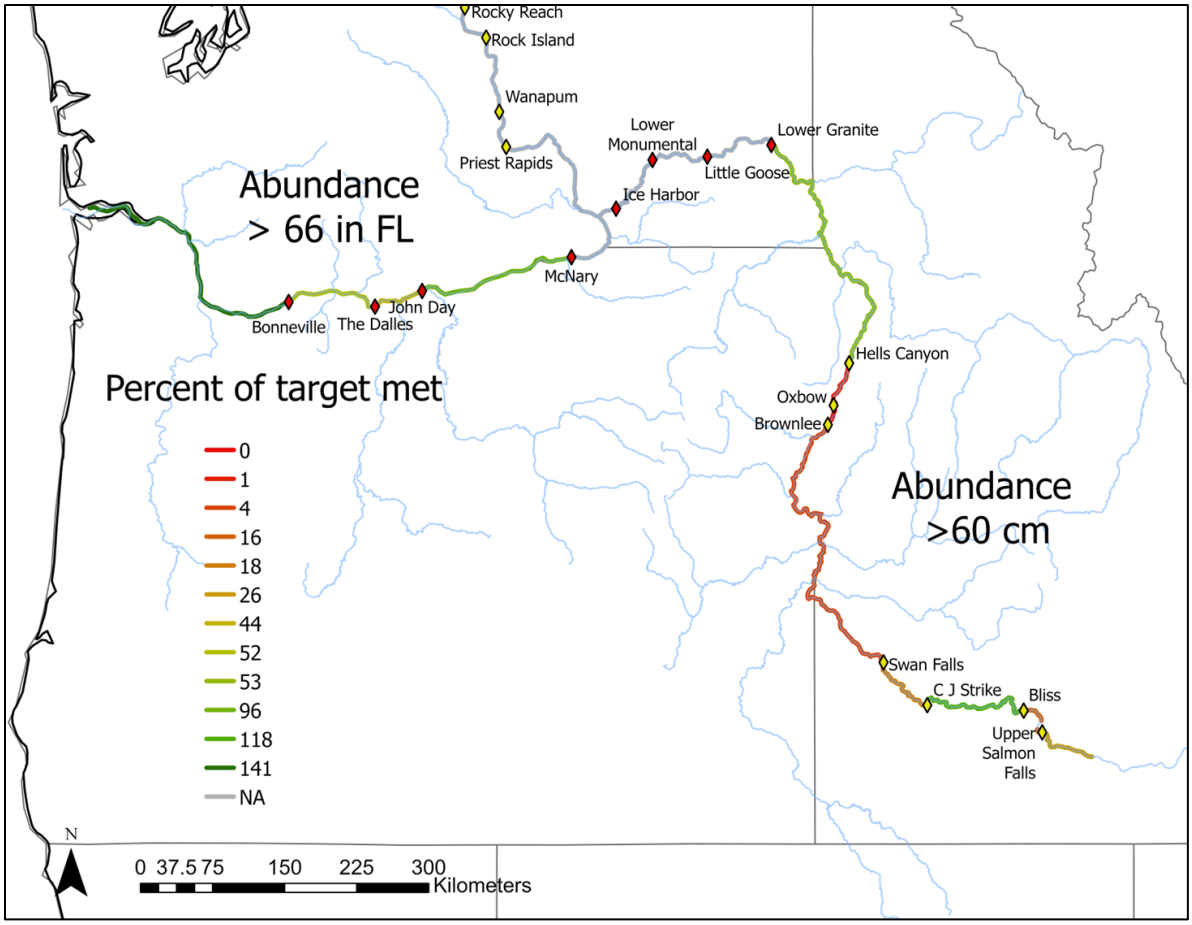

Figure 15. Percentage of the white sturgeon abundance target that is met by pool in the lower Columbia River (fish >66" FL), middle Snake River (adults), and upper Snake River (fish > 60cm) in the Columbia Basin. Data on abundance reported in Program Tracker from population monitoring that occurs at uneven intervals throughout the Basin.

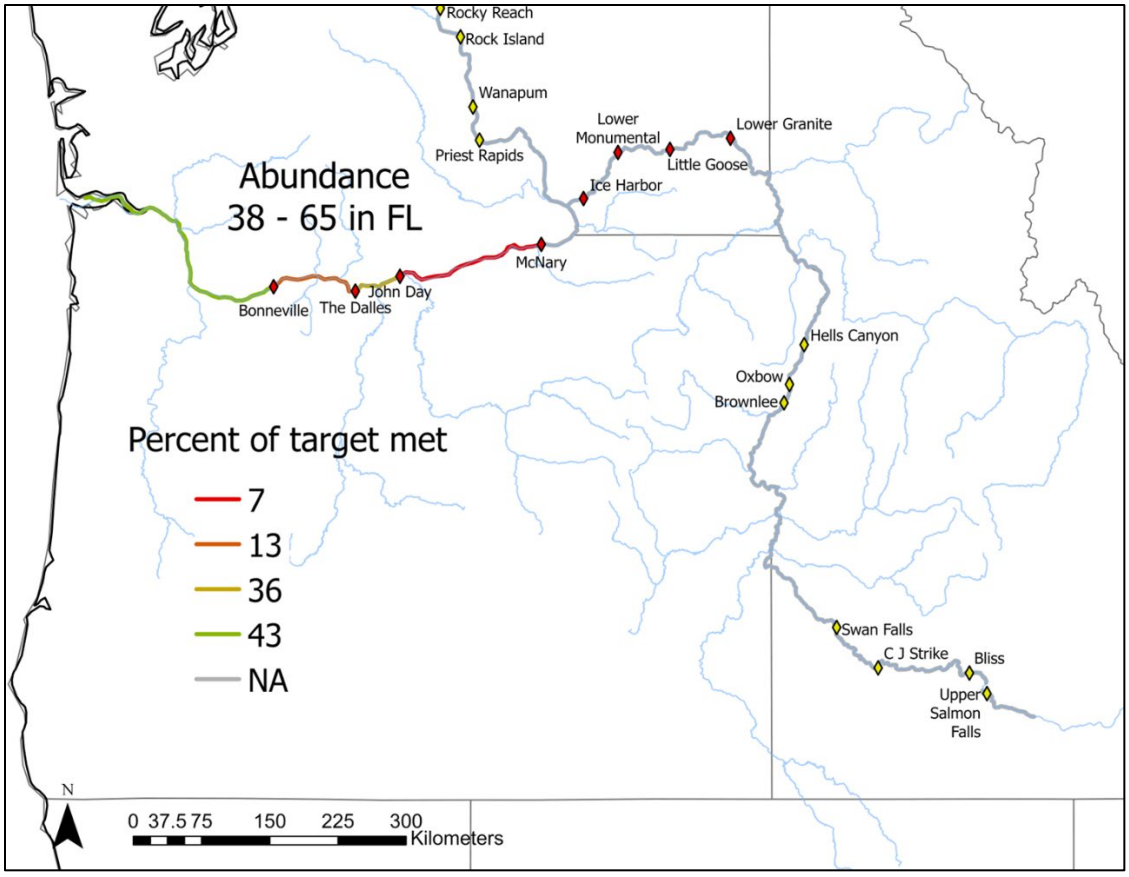

Figure 16. Percentage of the white sturgeon abundance target that is met by pool in the lower Columbia River (fish 38 – 65" FL). Data on abundance reported in Program Tracker from population monitoring that occurs at uneven intervals throughout the Basin.

Abundance and harvest objectives in the transboundary reach are described in the Upper Columbia White Sturgeon Recovery Plan (UCWSRI 2012) and the target date for achieving these objectives is 2080. Staff are looking for current data on abundance and harvest and this will be added to the Program Tracker when available under SPI WS1-7. In a presentation by WDFW on white sturgeon in the transboundary reach, they described the recreational and subsistence fishery that has operated since 2017. It is managed with a slot limit to decrease over abundant size classes that were produced from previous hatchery releases based on collection of gametes. Contemporary hatchery production uses wild caught larvae and has achieved increased genetic diversity.

Kootenai River White Sturgeon (KRWS) were listed as endangered under the ESA in 1994 (USFWS 1994) and the recovery plan was finalized in 1999 (USFWS 1999). This population inhabits the Kootenai River from Kootenai Falls, MT downstream to the Cora Linn Dam, B.C., and has been isolated in this reach since the last ice age (10,000 years ago). In the 2024 USFWS five-year review, no change was made to their listing status (USFWS 2024). The Program objective for KRWS is for a stable, self-sustaining, healthy population that is not associated with any numerical target at this time. The estimated number of adult sturgeon in the Kootenai River has

declined consistently since 1990 (Figure 17). Early estimates exceeded 2,750 adults and the most recent estimate (2017) was 1,750 adults (Hardy et al. 2020). These estimates cover the accessible habitat range from B.C. to Kootenai Falls. Hardy et al. (2020) further note, from 2016 estimates, that only 85 wild juveniles are produced annually and that this level of recruitment is not replacing the aging out population or trending toward recovery. Sampling has occurred in the Montana portion of the Kootenai River since 2009, and no successful reproduction has been observed (Sylvester et al. 2024).

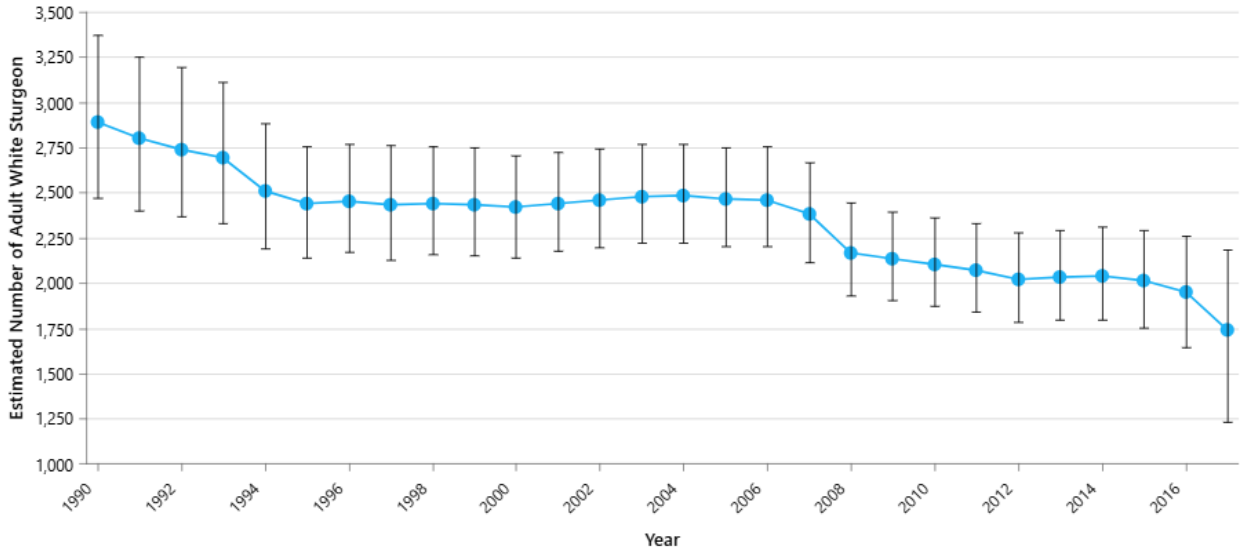

Figure 17. Estimated number of adult white sturgeon in the Kootenai River. Data available on Program Tracker, SPI WS1-8.

In the Hydrosystem Categorical Assessment, we discussed sturgeon flows released from Libby Dam (see SPI WS1-1). This action has been consistently implemented at varying levels and is necessary for spawning. However, it is not the only factor affecting sturgeon reproduction. Conditions for spawning may be ideal, but if spawners have not regained their fecundity following a prior spawning event, they may not be biologically ready to take advantage of those conditions. Likewise, other factors- habitat, food availability, also affect the success of spawning and survival of all life stages.

SPIs referenced in summary

- **WS1-1** Mainstem Hydrosystem Flow and Passage Strategy: Number of days of streamflow at or above 30kcfs at Bonners Ferry to support White Sturgeon spawning migration.
- **WS1-4** Abundance- Lower Columbia and Lower Snake

- **WS1-5** White Sturgeon Strategy: Abundance- Middle Snake: Population abundance (>60 cm FL) and stock structure (juvenile, sub-adult, adult) recorded at 10-year sampling intervals for Brownlee Dam to Lower Granite Dam.
- **WS1-6** White Sturgeon Strategy: Abundance- Upper Snake: (> 60 cm FL) and stock structure (juvenile, subadult, adult) compared at five-year sampling intervals for all Upper Snake reaches between Shoshone Falls and Brownlee.
- **WS1-7** White Sturgeon Strategy: Abundance-Transboundary Upper Columbia: Adult populations in the Canadian Transboundary Reach and the U.S. Transboundary Reach. Subsistence and recreational fishery harvest per year.
- **WS1-8** White Sturgeon Strategy: Abundance-Kootenai River: Kootenai River White Sturgeon adult abundance estimate.
- **WS1-9** White Sturgeon Strategy: Productivity: Kootenai River: 10-year average of number of Kootenai sturgeon wild recruits (offspring that survive to sexual maturity at 25 years) that are added to the adult (25 years or older) population annually. Production of wild age-3 juveniles in three of 10 consecutive years.

Other SPIs associated with objective: data available on Program Tracker

- **WS1-2/ E3-4** Mainstem Hydrosystem Flow and Passage Strategy: Daily average flows and water temperatures downstream of McNary Dam in reference to flow and spawning temperature needs for Columbia River White Sturgeon.
- **WS1-3** Fish Propagation and Hatchery Strategy: Sturgeon hatchery objectives are tracked and compared to the hatchery management plan and a reviewed and approved master plan.

References

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Oregon Department of Fish and Wildlife (ODFW) and Washington Department of Fish and Wildlife (WDFW). 2023. Joint staff report concerning stock status and fisheries for sturgeon and smelt. Available online at: https://wdfw.wa.gov/sites/default/files/2023-01/2023-sturgeon-smelt-joint-staff-report.pdf

Sylvester, R. M., J. L. Dunnigan, C. R. Gabreski, J. G. Lampton, J. D. Johnson, M. R. Benner, B. C. Stephens, N. J. Benson, C. J. Dyke, K. L. Stansberry and M. C. Boyer. 2024. Kootenai River White Sturgeon *Acipenser transmontanus*: 2009-2023 Investigations in Montana. Report

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U.S. Fish and Wildlife Service (USFWS). 1994. Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for the Kootenai River Population of the White Sturgeon. Federal Register document number: 94-21864.

USFWS. 1999. Recovery Plan for the White Sturgeon (*Acipenser transmontanus*): Kootenai River Population. U.S. Fish and Wildlife Service, Portland, Oregon. 96 pp. plus appendices.

USFWS. 2024. Kootenai River White Sturgeon 5-year review summary and evaluation. Available online at: https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/16776.pdf

Presentation on White Sturgeon in the transboundary reach: https://wdfw.wa.gov/sites/default/files/2023-12/fish-committee-sturgeon-121423-0.pdf

White Sturgeon Objective WS2

Spatial distribution: Stable, healthy populations within all available historic habitats. These habitats include the lower Columbia River and its estuary, the Willamette River downstream of Willamette Falls; the Bonneville, The Dalles, John Day, McNary, Priest Rapids, Wanapum, Rock Island, Rocky Reach, Wells, and Rufus Woods reservoirs; and Lake Roosevelt on the Columbia River mainstem; the Kootenai River from Kootenai Falls, Montana, downstream to Corra Linn Dam at the outflow from Kootenay Lake in British Columbia; Ice Harbor, Lower Monumental, Little Goose, and Lower Granite reservoirs in the lower Snake River upstream to Shoshone Falls; and Oregon and Washington coastal rivers, bays, and estuaries.

Summary of progress

Objective WS2 builds off WS1 (abundance) and WS4 (productivity). Abundance and productivity objectives exist for many of the populations within the historically available habitat, but not for the reach between Priest Rapids and Grand Coulee and reaches within the lower Snake River. Is information contained within objectives WS1 and WS4 sufficient, or is further tracking of distribution needed?

The objective also references coastal rivers, bays and estuaries in Oregon and Washington. Aside from the Columbia River estuary, these other estuaries are outside the basin. Is there a need to define the relationship to hydrosystem impacts?

SPIs referenced in summary

- None

White Sturgeon Objective WS3

Genetic diversity:

Columbia River populations:

- Maintain or attain genetic diversity within all populations similar to historic levels. Maintain diversity sufficient to respond to future conditions and permit population adaptation and persistence. The average number of alleles for groups of several similar-aged year classes of white sturgeon (minimum number examined = 50) at 14 standardized loci is ≥ 235.

Snake River populations:

- Preserve genetic integrity (including rare alleles) similar to current levels. Number of alleles is 184 alleles at 13 baseline microsatellite loci for Lower Granite Dam to Brownlee Dam; 184 and 121 alleles at 13 baseline microsatellite loci for reaches between Brownlee Dam to Shoshone Falls as measured at 5-year intervals for Shoshone, Upper Salmon, Bliss, CJ Strike, Swan Falls) and ten-year intervals for Hells Canyon. (IPC White Sturgeon Genetics Management Plan, Schreier et al. 2013)

Kootenai River:

- Number of alleles is 97 at 14 microsatellite loci.

Summary of progress

Contemporary genetic monitoring uses different techniques than those used to establish the baseline for genetic diversity in the Program. Recent publications highlight the change in techniques. For example, Willis et al. 2022 evaluated genetic population structure of white sturgeon throughout the basin using a panel of Single Nucleotide Polymorphisms (SNPs). Those data would not be comparable to the standards set in terms of allelic diversity at microsatellite loci. In order to track genetic diversity, these geographic objectives and the baseline for genetic diversity need to be updated to reflect how it is currently assessed.

During the development of the Program Tracker, Council staff held numerous meetings with managers to understand what kind of data were available for SPIs and how information should be tracked. Regarding Kootenai River White Sturgeon, managers noted that the number of alleles in wild fish has not changed over time and is not likely to increase because the population is closed. Managers reported that current genetic samples will begin to be processed once hatchery fish

recruit to spawning age, at which time other possible genetic metrics (like SNPs) may be used instead. There was some thought that it would be useful to make sure that the number of alleles is not decreasing, but without any contemporary data collection, managers did not think it was worth tracking at this time.

SPIs:

- **WS3-1** White Sturgeon Strategy: Genetic Diversity: The average number of alleles.

References

Willis, S. C., B. Parker, A. D. Schreier, R. Beamesderfer, D. Miller, S. Young, and S. R. Narum. 2022. Population structure of White Sturgeon (*Acipenser transmontanus*) in the Columbia River inferred from Single-Nucleotide Polymorphisms. Diversity: 14(12) 1045. Available online at: https://www.mdpi.com/1424-2818/14/12/1045

White Sturgeon Objective WS4

Productivity:

Lower Columbia and Lower Snake:

Annual recruitment and length-frequency distribution of wild white sturgeon populations in all impounded and non-impounded reaches indicates a balanced, robust, productive, and viable population capable of supporting societal needs. The below population-specific recruitment index objectives are provisional until full sturgeon loss assessments are completed.

1. Recruitment Index: Three year running mean of proportion of positive sets (E_p)
    a. Lower Columbia: Ep ≥ 0.52
    b. Bonneville Reservoir: $E_p \geq 0.51$
    c. The Dalles Reservoir: $E_p \geq 0.53$
    d. John Day Reservoir: $E_p \geq 0.22$
    e. McNary Reservoir and Free-flowing section: Ep when available based upon recruitment surveys.
    f. Ice Harbor Reservoir: Ep when available based on recruitment surveys.
    g. Lower Monumental Reservoir: Ep when available based on recruitment surveys.
    h. Little Goose Reservoir: Ep when available based on recruitment surveys.
2. Length-Frequency Distribution: (In conjunction with above objectives) ~95% juveniles (21-38” FL), ~4.5% sub-adult (38-65” FL), ~0.5% adult (≥ 66” FL)

Snake River:

1. Recruitment Index: Annual standardized YoY gill net sampling (CPUE) in Core Conservation populations (BLS to CJS and HCD to LGR) when available.
2. Length-Frequency Distribution – numbers to be developed.

Kootenai River:

Annual recruitment of Kootenai sturgeon reflects a balanced, self-sustaining, viable population.

The USFWS downlisting criteria is production of wild age-3 juveniles occurring at an annual average of at least 700 individuals over 10 consecutive years. Production of 700 or more wild age-3 juveniles should occur in at least 3 of the 10 years, ensuring the annual average is not the result of an anomalous single-year event.

The USFWS delisting criteria is the number of wild recruits (offspring that survive to sexual maturity at 25 years) added to the adult (25 years or older) population annually averages at least 250 individuals per year over 10 years and includes at least 10,000 wild juveniles aged from 3 to 24 years.

Summary of progress

In the Lower Columbia and Lower Snake, the objective contains targets for productivity in terms of the proportion of positive sets. A positive set is one when young-of-year (YOY) are captured in net. There are different targets for each reservoir. The highest productivity in the lower Columbia occurs in the Bonneville Pool, where 88% of the productivity target is currently met (Figure 18).

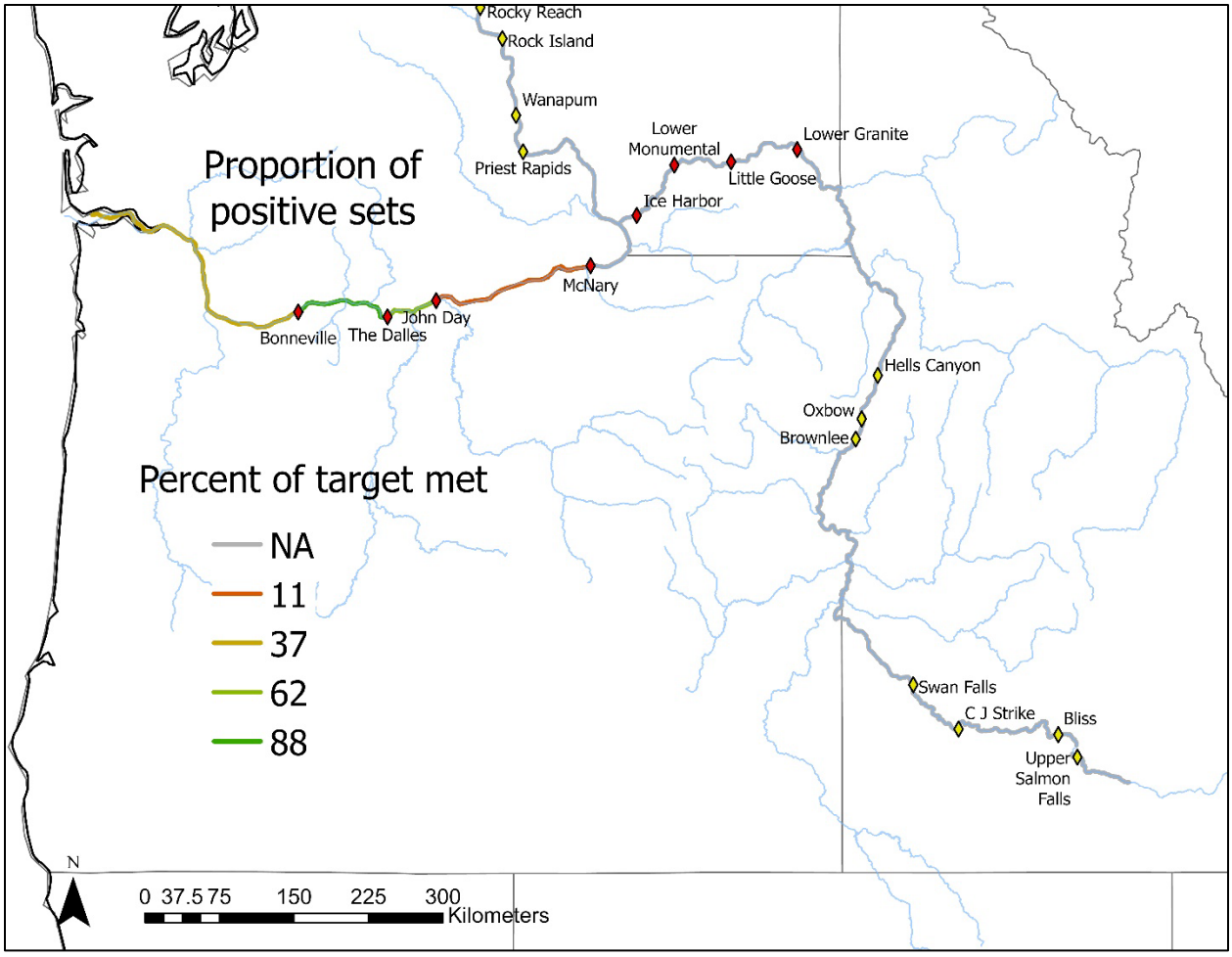


Figure 18. Percentage of the White Sturgeon productivity target that is met by pool in the lower Columbia River. Productivity is described in terms of the proportion of positive sets (i.e., sets where young of year are captured). Data on productivity reported in the Program Tracker comes from population monitoring that occurs at uneven intervals throughout the basin. Greener colors mean a higher percentage of the productivity target is met.

Productivity is also described in terms of length-frequency distribution. The objective target for each age class appears as the lightest blue line Figure 19- where ideally 95% of the population are juveniles, 4.5% are subadults, and 0.5% are adults. Length frequency data for Bonneville pool, The Dalles Pool, and John Day Pool are compared to that target. John Day pool is the most skewed, reflecting a lack of juvenile fish in the population (Figure 19).

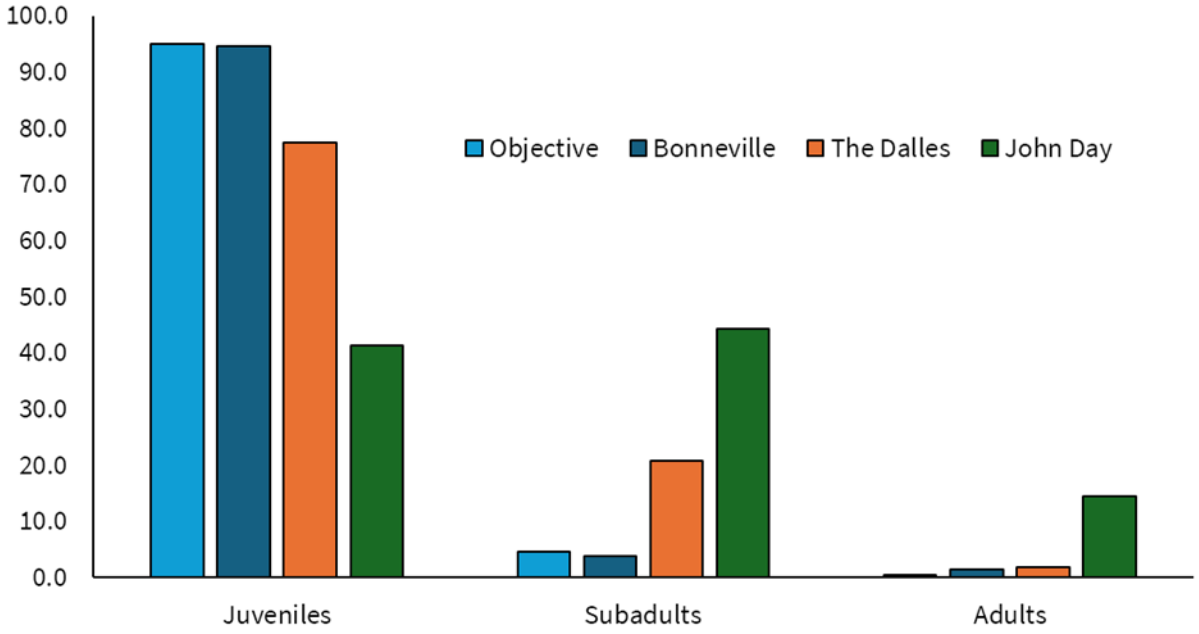


Figure 19. Length-frequency targets (expressed by age class) for white sturgeon populations (light blue) relative to observed frequency of age classes in Bonneville pool (dark blue), The Dalles pool (orange), and John Day pool (green). Data reported in Program Tracker from population monitoring that occurs at uneven intervals throughout the Basin.

There is also a productivity objective for the Snake River between Lower Granite Dam up to Hells Canyon, and between C.J. Strike and Bliss. In this part of the Snake, young of the year sampling occurs in core-conservation populations, but the frequency of sampling varies- it can occur annually or less often (Ken Lepla, Idaho Power, personal communication). There is no target for catch per unit effort in the Program. We can report on what is observed but not whether that value represents progress or stability (Figure 20).

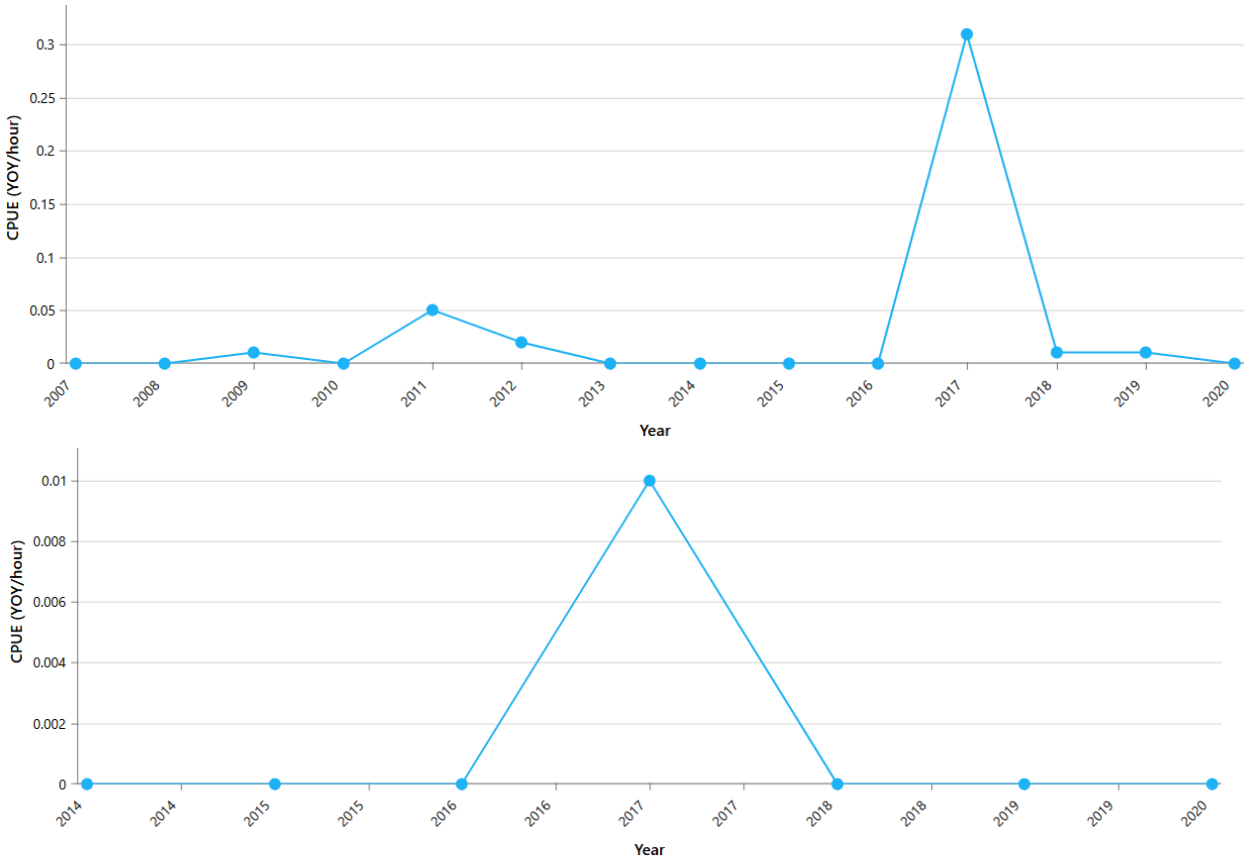


Figure 20. Number of young-of-year caught per hour of sampling in the reach between Lower Granite Dam and Hells Canyon (upper figure), and between C.J. Strike and Bliss Dam (lower figure), in years when data were collected, 2007 – 2020. Data reported in the Program Tracker from population monitoring that occurs at uneven intervals throughout the Basin.

SPIs referenced in summary:

- White Sturgeon Strategy: Productivity: Annual recruitment and length frequency distribution of wild White Sturgeon populations in all impounded and non-impounded reaches.
    - Lower Columbia and Lower Snake:
        - **WS4-3** Recruitment Index: Three-year running mean of proportion of positive sets (E_p).
        - **WS4-4** Length-Frequency Distribution: juveniles, sub-adult, adult.
    - Snake River:
        - **WS4-5** Recruitment Index: Annual standardized YoY gill net sampling (CPUE) in Core Conservation populations (Bliss Dam to C. J. Strike Dam and Hells Canyon Dam to Lower Granite Dam).

Other SPIs associated with objective: data available on Program Tracker

- **WS4-1** Mainstem Hydrosystem Flow and Passage Strategy: Flows from Libby Dam for Kootenai River White sturgeon.
- **WS4-2** Mainstem Hydrosystem Flow and Passage Strategy: Percent of days with flow equal to or greater than 250 KCFS from McNary Dam May through July for sturgeon recruitment.
- **WS4-6** White Sturgeon Strategy: Productivity: Annual recruitment and length frequency distribution of wild White Sturgeon populations in all impounded and non-impounded reaches.
    - Snake River: Length-Frequency Distribution.

Pacific Lamprey Objective L1

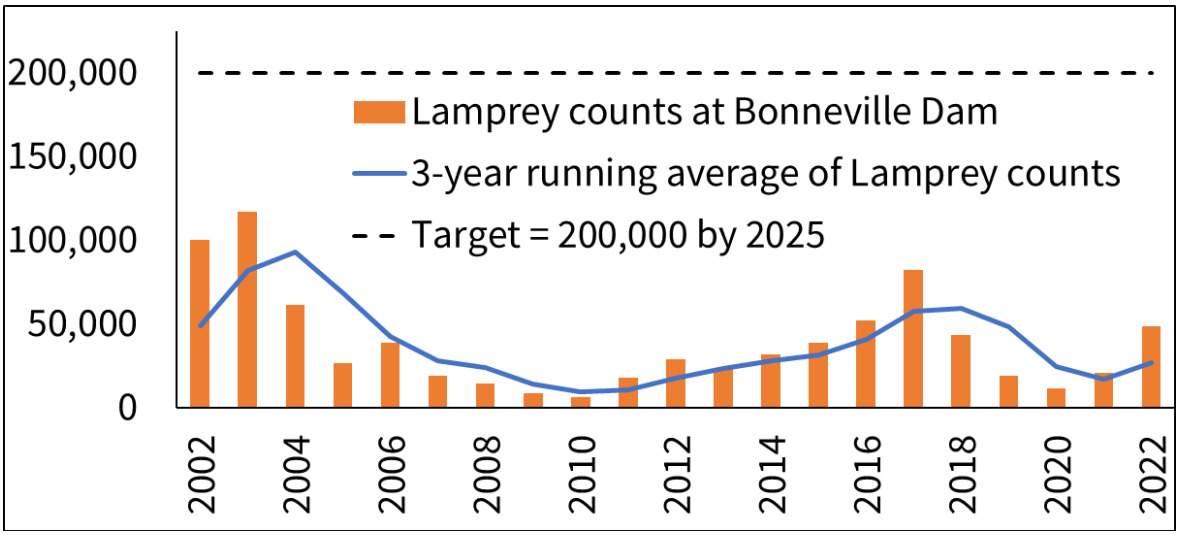
In the absence of quantitative goals and objectives based in hydropower loss assessments, contribute to achieving the following adult abundance and other population targets for Pacific lamprey:

Adult Pacific lamprey abundance target of a three-year rolling average of 200,000 at Bonneville Dam by 2025, progressing toward 1,000,000 by 2035.

- Objective L1 is based on the 2011 Tribal Pacific Lamprey Restoration Plan for the Columbia River Basin.

Summary of progress

There is no loss assessment defining the hydrosystem share of mitigation for Pacific lamprey losses, so the Program calls for contributing to the adult abundance target stated in the goal. Using data at Bonneville Dam, the three-year running average of adult lamprey has ranged from approximately 9,800 fish to over 93,000 (Figure 21). Count data reported at Bonneville Dam represent a minimum estimate of abundance because there are multiple passage routes where fish can migrate (some are not monitored) and monitoring occurs at different times of day (not always corresponding with peak lamprey migration). These monitoring data are subsequently expanded to represent the routes or times of day that are not monitored. Because different proportions of fish pass through each route, it is not clear how much contemporary monitoring reflects actual abundance. Adult passage monitoring needs to be improved if the region hopes to achieve Objective L1.



Notes:
1. During the fish passage season (April through October) the USACOE uses visual counting from 0400-2000 PST, during periods with daylight savings time this time is actually 0500 to 2100. The COE's QA/QC program involves a 1-hour test each month for all fish counters. During this test, both the tested fish counter and the fish count supervisor each count each species passing for one hour. The tested fish counter must score within 95% of the counts recorded by the fish count supervisor for all species other than shad which is within 85%. During visual counting, fish counters typically get a 10-minute break every hour; therefore, counts over a 50 minute period are multiplied by a factor of 1.2 to obtain an estimate of a full hour's counts.

2. Lamprey counts at Lower Columbia River and Snake River facilities occurs during the day, while counts at Upper Columbia River facilities represent an entire 24-hour period.

Figure 21. Pacific lamprey counts reported at Bonneville Dam, 2002-2022. Note caveats contained below figure. Data reported in Program Tracker as SPI L1-2

SPIs referenced in summary:

- **L1-2** Pacific Lamprey Strategy: Total end-of-year dam count at Bonneville Dam.

Other SPIs associated with objective: data available on Program Tracker

- **L1-1** Fish Propagation including Hatchery Strategy: Pacific lamprey hatchery objectives are tracked and compared to a reviewed and approved master plan.
- **L1-3** Pacific Lamprey Strategy: Geographic distribution as indicated by total end-of-year counts at Willamette Falls, Columbia and Snake River dams.
- **L1-4** Pacific Lamprey Strategy: Abundance of juvenile and larval outmigration tracked at John Day Dam and Bonneville Dam.

References

Fish Passage Center (FPC). Adult lamprey counts. Available online at: https://www.fpc.org/adults/Q_adults_passagedata.php

Pacific Lamprey Objective L2

Reduce the risk of extirpation and improve adult abundance toward sustainable harvestable levels across the historic distribution and range of Pacific lamprey in the Columbia basin, including across all six Pacific Lamprey Regional Management Units (RMU), measured every five years.

- Objective L2 is based on U.S. Fish and Wildlife Service (2012). Pacific Lamprey Conservation Agreement. U.S. Fish and Wildlife Service, Portland, Oregon. 57 pp.

Summary of progress

Through the Pacific Lamprey Conservation Initiative, range-wide status and abundance are estimated by regional management unit (RMU). Data are shown in Figures 22 and 23 for RMUs in the Columbia Basin, for 2017 – 2022. The maps in both of the following figures show some areas of improvement and some of decline, but most importantly is more regions being tracked over time. This ability to establish baselines for Pacific lamprey is of critical importance to understand recovery actions and goals. The data are reported by NatureServe which is a diagnostic tool that characterizes the conservation risks of Pacific lamprey.

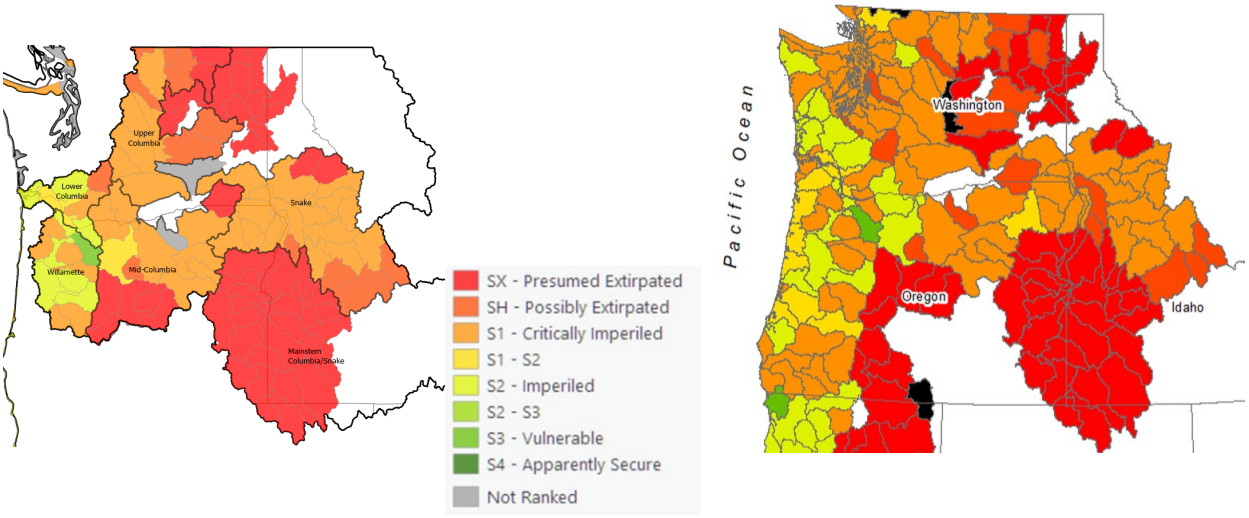


Figure 22. NatureServe ranking of Lamprey population status in the six Pacific Lamprey Regional Management Units (RMU)s for 2017 (left) and 2022 (right) from the Lamprey Conservation assessment

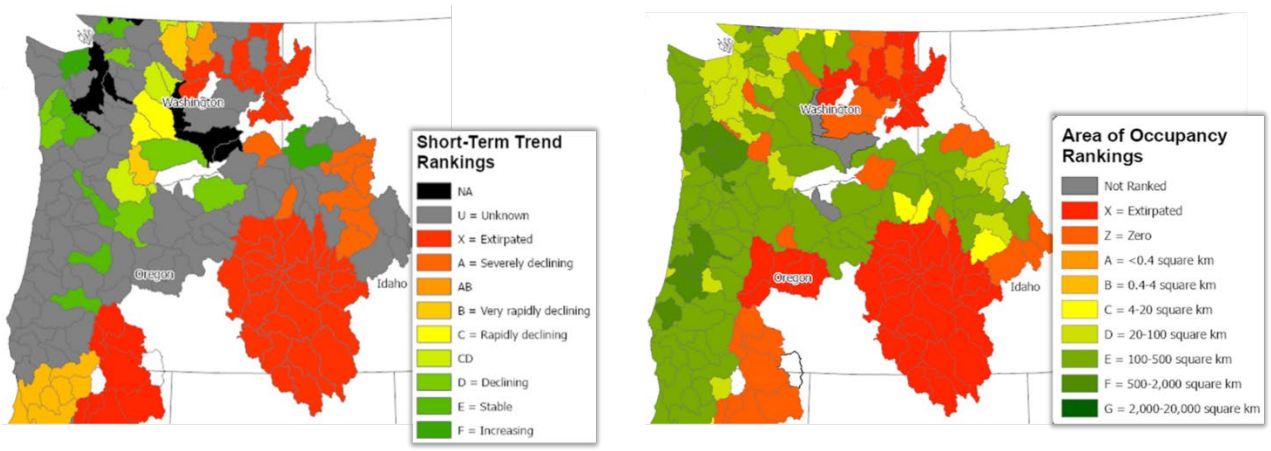


Figure 23. Short term trends in abundance (left) and current area of occupancy (right) in 2022 from the Lamprey Conservation assessment

SPIs referenced in summary:

- **L2-2** Pacific Lamprey Strategy Indicators: PLCI Risk category as reported by RMU every five years.
- **L2-3** Pacific Lamprey Strategy Indicators: RMU abundance and distribution indicators as reported every five years.

Other SPIs associated with objective: data available on Program Tracker

- **L2-1** Fish propagation including hatcheries Strategy: Pacific lamprey hatchery objectives are tracked and compared to a reviewed and approved master plan.

References

Pacific Lamprey Conservation Initiative. (2022). 2022 Pacific Lamprey Assessment. Available online at: https://www.pacificlamprey.org/assessment/

Pacific Lamprey Conservation Initiative. (2022). 2022 Pacific Lamprey Conservation Agreement. Available online at: https://www.pacificlamprey.org/conservation-agreement/

Pacific Lamprey Objective L3

Improve passage efficiency for adult Pacific Lamprey to an interim standard of at least 80 percent at each dam on the mainstem Columbia and Snake rivers.

- Objective L3 is based on the 2011 Tribal Pacific Lamprey Restoration Plan for the Columbia River Basin.

Summary of progress

Although adult Pacific lamprey migrate through the Columbia River hydrosystem, they require different passage routes than salmon and steelhead to optimize their success. There is no one solution to improving upstream passage for adult lamprey and a diversity of routes is key to passage success as demonstrated in Figure 24. There is a need to continue to improve counting methods as traditional window counts often underestimate lamprey passage.

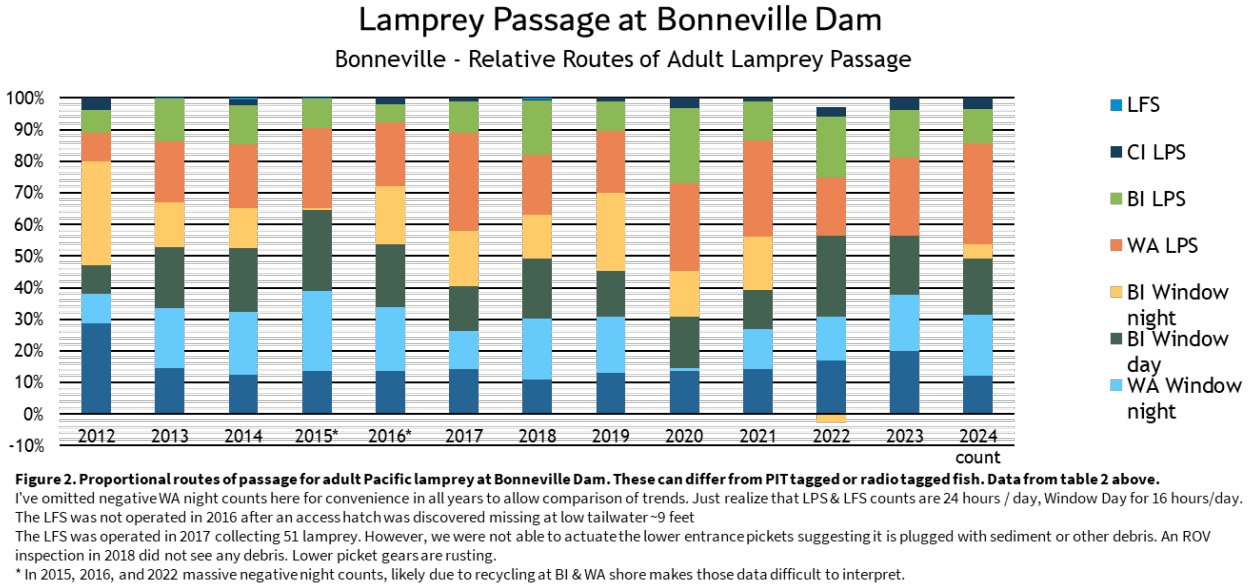


Figure 2. Proportional routes of passage for adult Pacific lamprey at Bonneville Dam. These can differ from PIT tagged or radio tagged fish. Data from table 2 above.
I've omitted negative WA night counts here for convenience in all years to allow comparison of trends. Just realize that LPS & LFS counts are 24 hours / day, Window Day for 16 hours/day.
The LFS was not operated in 2016 after an access hatch was discovered missing at low tailwater ~9 feet
The LFS was operated in 2017 collecting 51 lamprey. However, we were not able to actuate the lower entrance pickets suggesting it is plugged with sediment or other debris. An ROV inspection in 2018 did not see any debris. Lower picket gears are rusting.
* In 2015, 2016, and 2022 massive negative night counts, likely due to recycling at BI & WA shore makes those data difficult to interpret.

Figure 24. Relative routes of adult Pacific lamprey passage at Bonneville Dam. Sites of passage enumeration reported here include lamprey flume system (LFS), Cascades Island (CI) Lamprey Passage Structure(LPS), Bradford Island (BI) LPS, Washington shore (WA) LPS, BI window day and night, and WA window night.

Bonneville, The Dalles, and John Day Dams offer a mix of volitional passage, lamprey passage structures/traps, and transportation options. For example, there are currently four volitional passages at Bonneville Dam in addition to lamprey passage structures (LPS)s (Figure 25) and The Dalles and John Day Dams also have LPS options. Many of these methods did not exist prior to the relatively recent attention in the Basin to lamprey passage. The ability to consistently and accurately enumerate lamprey is needed to evaluate passage efficiency. It should be noted that lamprey scientists have worked hard to get LPS' installed away from salmon attractants and closer to intuitive entrances for lamprey. This has helped lamprey avoid going through picket leads and ending up in auxiliary water channels.

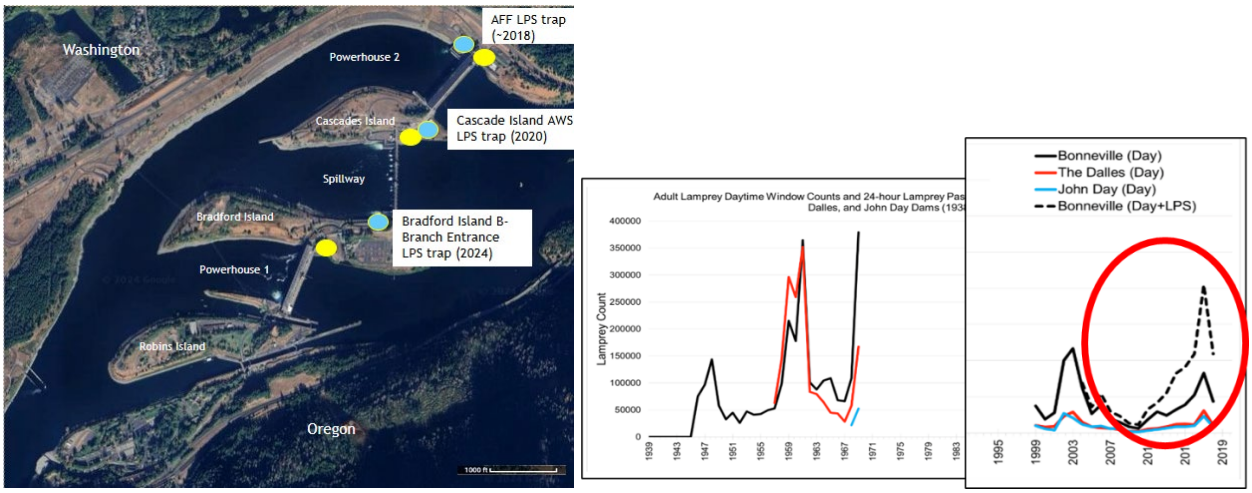


Figure 25. Aerial map (left) of Bonneville Dam showing lamprey passage structures (blue) and traditional fish ladder locations (yellow). Adult lamprey window counts 1938-2018 with highlight box showing resumption of counting in 1999 and improved passage via Bonneville Dam LPS (right).

SPIs referenced in summary:

- None

Other SPIs associated with objective: data available on Program Tracker

- **L3-1** Pacific Lamprey Strategy: Adult passage efficiency for each Columbia and Snake mainstem dam.

References

Clabough, Tami S., et al. Evaluation of Adult Pacific Lamprey Passage at Lower Columbia River Dams and Behavior in Relation to Fishway Modifications at Bonneville and John Day Dams-2014. 2015. Available online at: https://www.uidaho.edu/-/media/uidaho-responsive/files/cnr/ferl/technical-reports/2015/2015-10-lamprey-fishway-use.pdf?la=en&rev=61f2abf8caac494b8162fd40972719e1

USACE (US Army Corps of Engineers). "Pacific Lamprey passage improvements implementation plan: 2008–2018." (2014). Available online at: https://pweb.crohms.org/tmt/documents/FPOM/2010/Task%20Groups/Task%20Group%20Lamprey/10%20Year%20Lamprey%20Plan%20update%20final%202015.pdf The USACOE has developed a draft revision of this document but it has not been released.

Pacific Lamprey Objective L4

For juvenile lamprey, improve passage efficiency and survival progressing toward standards used to measure juvenile salmonid survival.

- Objective L4 is based on (a) 2011 Tribal Pacific Lamprey Restoration Plan for the Columbia River Basin; and (b) recommendations submitted for the 2014 Program amendment process by BPT, CRITFC, CTGR, CTUIR, Cowlitz, NPT, USRTF, USFWS.

Summary of progress

So far, the Program has worked to document:

- Abundance of juvenile and larval outmigration tracked at certain dams. Data displayed in Figure 26 at Bonneville Dam are available for John Day Dam, McNary Dam, Lower Monumental Dam, Lower Goose Dam, Lower Granite Dam, Rock Island Dam, and Rocky Reach Dam on the Council's **Program Tracker.**
    - Improved enumeration of juveniles is needed to calculate passage efficiency and survival.

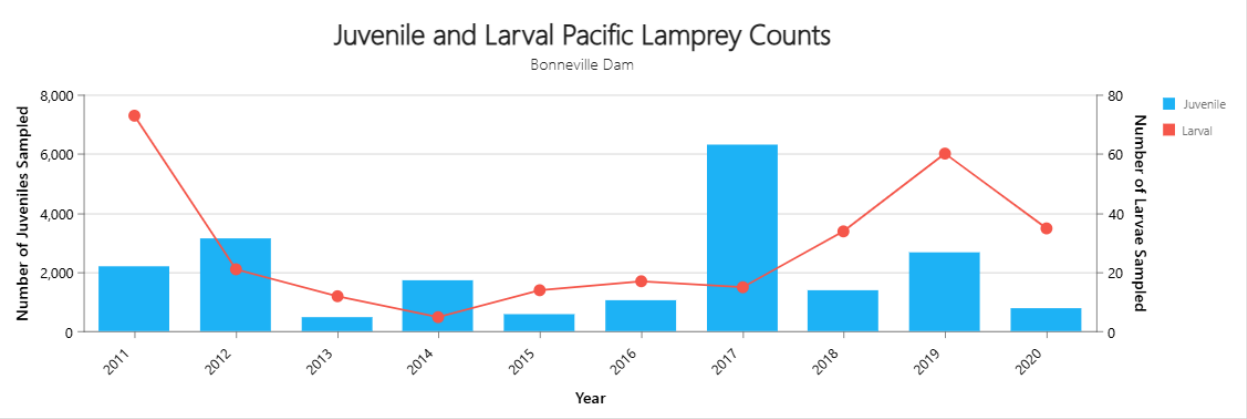


Figure 26. Juvenile (blue bars) and larval (red dot line) Pacific lamprey counts at Bonneville Dam. Data reported on Program Tracker as SPI L1-4

- Annual weighted average injury rates for Pacific lamprey macrophthalmia at Bonneville, McNary and John Day dams as seen in Figure 27.

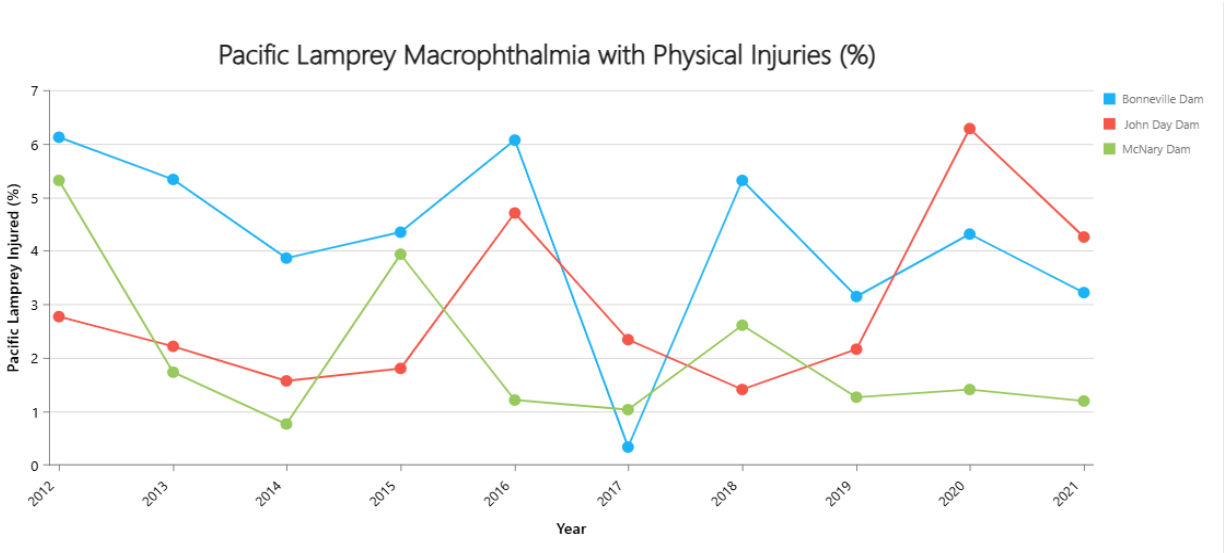


Figure 27. Percent of Pacific lamprey macrophthalmia with physical injuries. Data reported on Program Tracker as SPI L4-2

SPIs referenced in summary:

- **L1-4** Counts of juvenile and larval outmigration tracked at Bonneville Dam, John Day Dam, McNary Dam, Lower Monumental Dam, Lower Goose Dam, Lower Granite Dam, Rock Island Dam, and Rocky Reach Dam.

Other SPIs associated with objective: data available on Program Tracker

- **L4-1** Pacific Lamprey Strategy: Annual weighted average mortality rate for Pacific Lamprey macrophthalmia at Bonneville, McNary and John Day dams.
- **L4-2** Pacific Lamprey Strategy: Annual weighted average injury rates for Pacific Lamprey macrophthalmia at Bonneville, McNary and John Day dams.
- **L4-3** Pacific Lamprey Strategy: Juvenile and larval passage efficiency for each Columbia and Snake mainstem dam.

References

Fish Passage Center (FPC). Lamprey data. Available online at: https://www.fpc.org/lamprey/lamprey_queries/Q_lamprey_lampreyqueries_subsite.php

Pacific Lamprey Conservation Initiative. (2022). 2022 Pacific Lamprey Assessment. Available online at: https://www.pacificlamprey.org/assessment/

Pacific Lamprey Conservation Initiative. (2022). 2022 Pacific Lamprey Conservation Agreement. Available online at: https://www.pacificlamprey.org/conservation-agreement/

Resident Salmonids Objective R1

Except for assessments of the impacts of Hungry Horse and Libby dams on resident fish, the Fish and Wildlife Program does not include quantitative loss assessments or related goals and objectives for the hydropower system's impacts on resident salmonids. In their absence…

For bull trout, contribute to achieving self-sustaining populations geographically widespread across their native range, providing for genetic integrity and exchange and with stable and/or increasing fish populations capable of sustaining harvest across that range.

- Objective R1 is based on the 2014 Fish and Wildlife Program Appendix D, Theme 2, and documents compiled in the Fish Objectives mapping tool including the 2002 USFWS Bull Trout Draft Recovery Plan.

Summary of progress

Monitoring resident fish is quite a bit different than monitoring anadromous fish. Resident fish may occupy habitats smaller than 1 km or exhibit migratory life histories covering distances greater than 100 km. Understanding population demographics at a range-wide scale requires sampling, range-wide. The resident fish objectives are primarily qualitative statements of the kinds of conditions that allow populations to thrive. Different sources of data are available to describe these conditions, but not to determine quantitatively whether progress is being made toward mitigation.

Bull trout are a threatened species and the USFWS released the 5-year status update in 2024, recommending no change in status. As part of that update, resiliency scores were developed from demographic and habitat factors. The USFWS summarized resilience data for the 118 core areas (Figure 28). The most resilient core areas exist in mountainous regions of Idaho, N. Montana near Glacier NP, the North cascades, and the Oregon Cascades.

Demographic factors

- Growth rate: population trend
- Life history diversity
- Number of occupied local populations
- Connectivity
- Abundance

Habitat factors

- Water quality
- Access to feeding, migration, and overwintering habitats
- Fish community quality
- Instream quality

- Riparian quality
- Habitat quantity

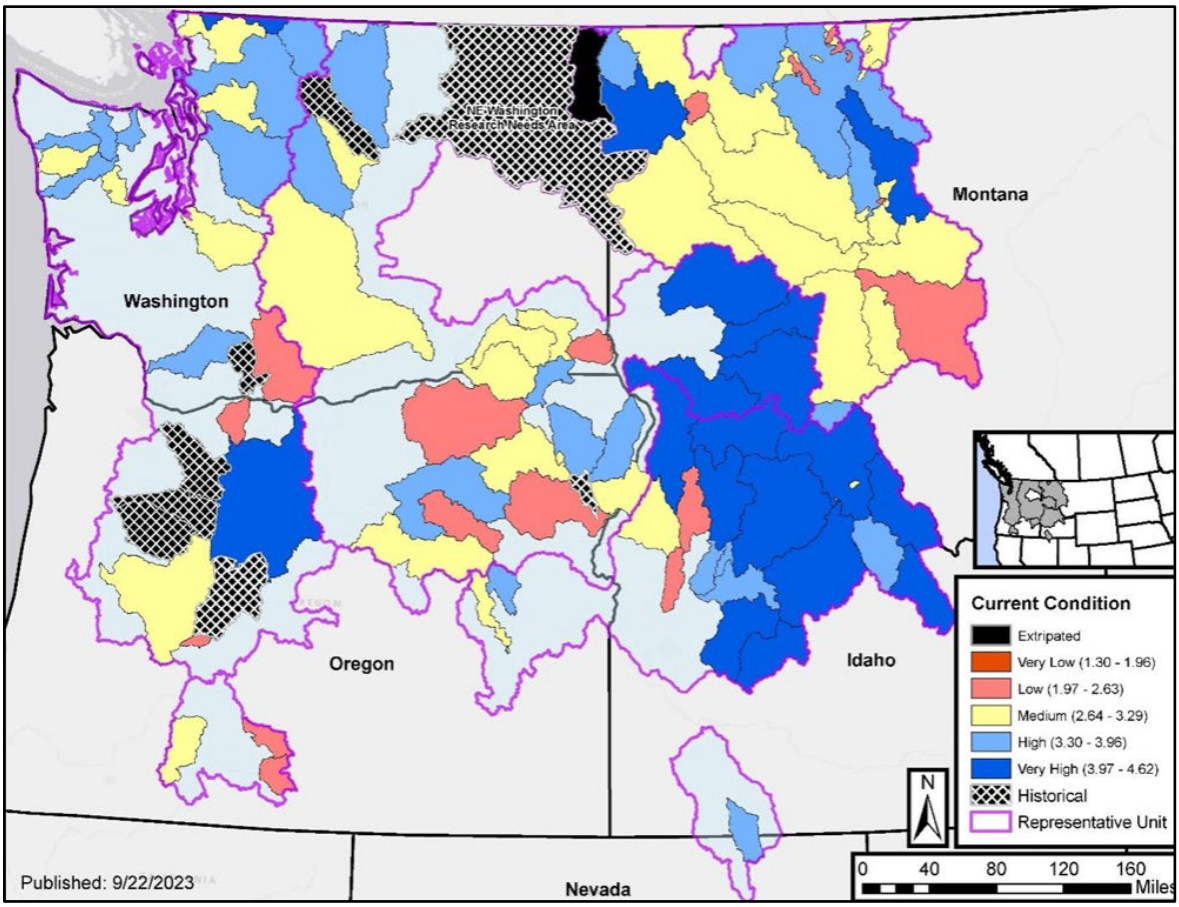


Figure 28. Map of current resiliency ratings of the 118 bull trout core areas. The seven historical core areas and the RNA are shown in black hatch and currently have no resiliency. Bluer colors mean higher resiliency, redder colors mean very low resiliency. Map from USFWS 2024.

We also track bull trout abundance using redd count data provided by managers throughout the Basin. In Figure 29, subbasins with data in Program Tracker are highlighted and the distribution of bull trout is shown as blue lines. The datasets on bull trout redd counts are very dense, with different streams and reaches monitored from year to year, numerous streams monitored within each subbasin, and variable monitoring effort. Determining trends from these data requires a substantial understanding of sample design.

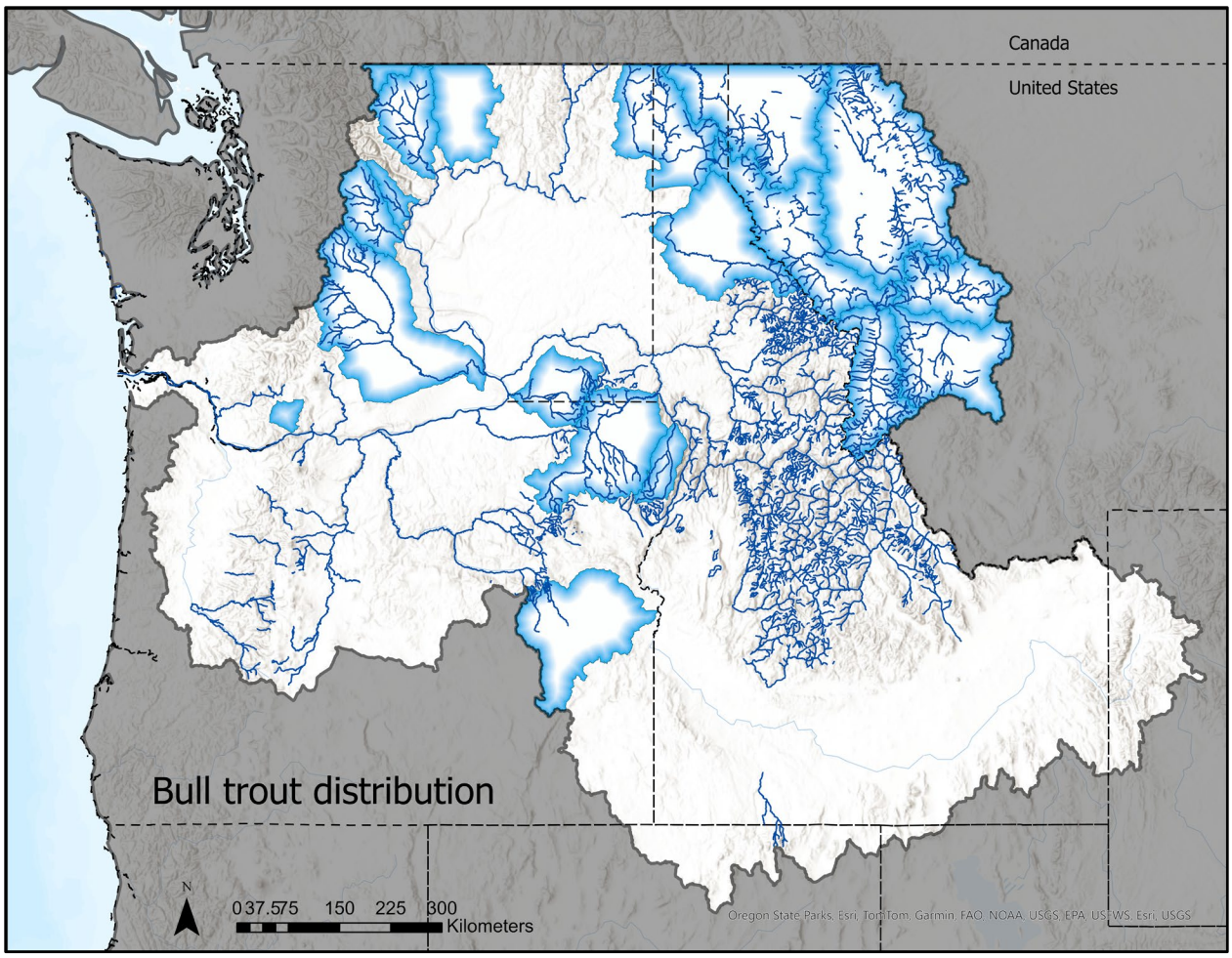


Figure 29. Subbasins (highlighted) with bull trout redd count data currently available in the Program Tracker compared to the distribution of bull trout (blue lines) in the Columbia Basin

Some of the areas we are not tracking show up as very resilient in the 5-year status assessment.

If we wish to track information beyond that which appears in that status assessment and the redd count data on the Program Tracker, we would need more quantitative targets for the following terms in the objective statement:

- Self-sustaining
- Geographically widespread
- Genetic integrity and exchange
- Stable and/or increasing fish populations
- Capable of sustaining harvest

Further developing this objective would require knowing what information exists and what would be meaningful to track. It would also be beneficial to develop loss assessments to define what hydrosystem mitigation needs exist for bull trout throughout their range.

SPIs referenced in summary:

- **R1-1** Resident Fish Mitigation Strategy: Bull Trout population abundance by subbasin.

Other SPIs associated with objective: data available on Program Tracker

- **R1-1** Predator Management Strategy: Annual average catch rate of Lake Trout in Upper Priest, Flathead, and Pend Oreille lakes.

Note: SPI code R1-1 is duplicated and will be revised.

References

U.S. Fish and Wildlife Service (USFWS). 2024. Species Status Assessment for the Coterminous Distinct Population Segment of Bull Trout (*Salvelinus confluentus*). Version 1.1, September 3, 2024. Boise, Idaho. 182 pp. Available online at: https://ecos.fws.gov/ServCat/DownloadFile/255078

Resident Salmonids Objective R2

For cutthroat trout, contribute to achieving self-sustaining populations of geographically widespread across their native range, providing for genetic integrity and exchange and with stable and/or increasing fish populations capable of sustaining harvest across that range.

- Objective R2 is based on the 2014 Fish and Wildlife Program Appendix D, Theme 2.

Summary of progress

There are over a dozen subspecies of Cutthroat Trout. In the Columbia Basin, Coastal Cutthroat, Westslope cutthroat, Yellowstone cutthroat, and Finespotted Cutthroat Trout are present (Figure 30).

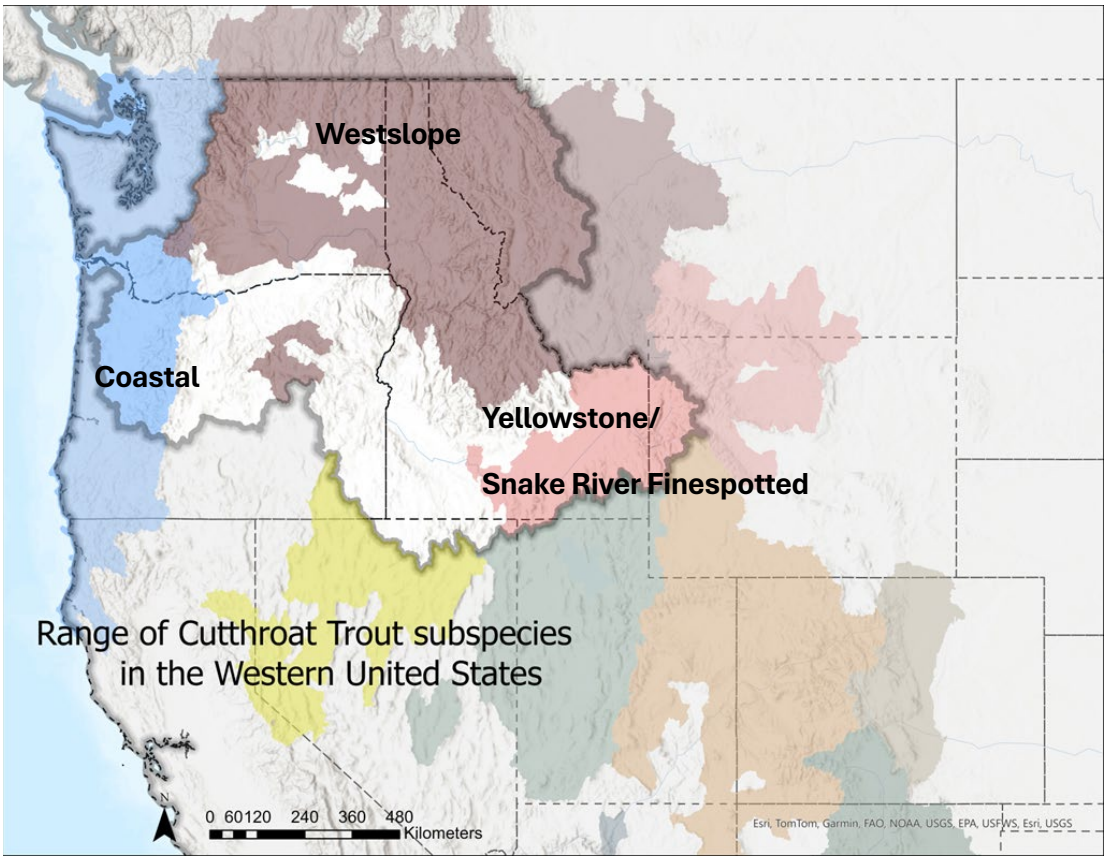


Figure 30. Cutthroat Trout subspecies distribution in the Western United States. Subspecies within the Columbia Basin are labeled

In the Program Tracker, we include data for two SPIs for two subspecies of Cutthroat Trout: Westslope cutthroat trout (data from range-wide assessments in 2002 and 2009; May 2009) and Yellowstone cutthroat trout (data from range-wide assessments in 2006 and 2011; May et al. 2007; Endicott et al. 2016). Because they are range-wide, data summaries include populations outside the Columbia Basin.

The first SPI (R2-2) covers the miles of stream occupied by core-conservation and conservation populations of Cutthroat Trout. Core-conservation populations are those that have been tested and found to be unaltered genetically (not hybridized) or not tested but suspected to be unaltered. Conservation populations have less than 10% hybridization. Between the earlier and later dates of the assessments we report, there was an increase in the stream miles occupied (Figure 31).

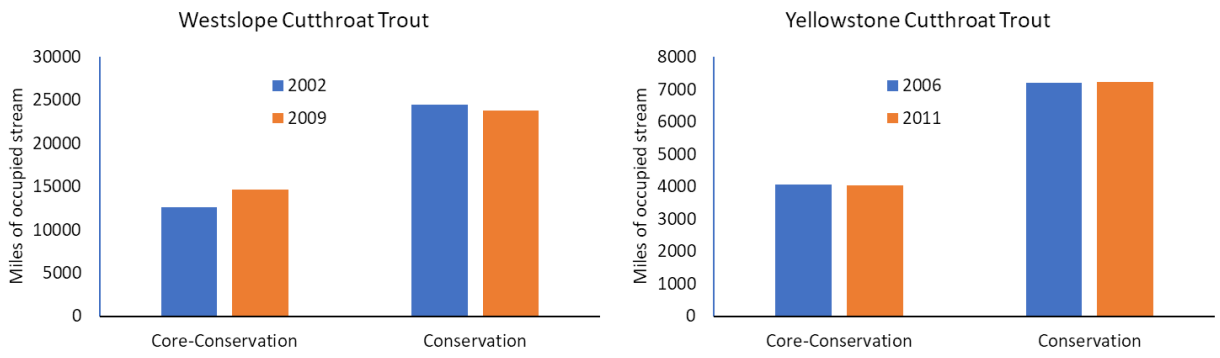


Figure 31. Miles of stream occupied by core-conservation and conservation populations of Westslope Cutthroat Trout and Yellowstone Cutthroat Trout, as reported in the last two range-wide assessments for each subspecies

The second SPI (R2-3) covers the number of core-conservation and conservation populations. Between the earlier and later dates of the assessments we report, there was an increase in the number of core-conservation and conservation populations for both Westslope and Yellowstone cutthroat trout (Figure 32).

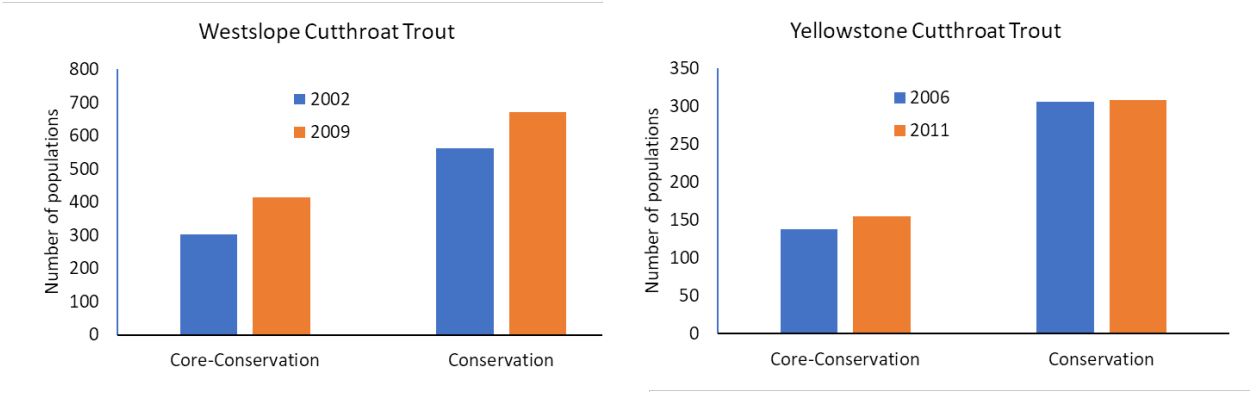


Figure 32. Number of core-conservation and conservation populations of Westslope Cutthroat Trout and Yellowstone Cutthroat Trout, as reported in the last two range-wide assessments for each subspecies

Numerous studies have been published on cutthroat trout genetics, distribution, abundance, and more over the last decade, but we have not found updated range-wide assessments that we could compare to the data in the Program Tracker. The last assessments are 13 to 15 years old and may not represent current trends in abundance or habitat occupancy. Moreover, some of the changes observed in the number of core conservation populations or habitat occupied were due to increased sampling and detection, rather than solely increased distribution and abundance.

Further tracking of cutthroat trout data requires either updated range-wide assessments, or a targeted set of questions on distribution, abundance, genetics, or other data that are regularly

updated. It would also be beneficial to develop loss assessments to define what hydrosystem mitigation needs exist for cutthroat trout throughout their range.

SPIs referenced in summary:

- **R2-2** Resident Fish Mitigation Strategy: Miles of stream occupied by core-conservation and conservation populations of Cutthroat Trout
- **R2-3** Resident Fish Mitigation Strategy: Number of core and conservation populations of Cutthroat Trout.

Other SPIs associated with objective: data available on Program Tracker

- **R2-1** Fish Propagation and Hatchery Strategy: Cutthroat Trout hatchery objectives are tracked and compared to the management plan and a reviewed and approved master plan.

References

May, B.E., S.E. Albeke, and T. Horton. 2007. Range-wide status assessment for Yellowstone cutthroat trout (Oncorhynchus clarkii bouvieri): 2006. Report prepared for the Yellowstone Cutthroat Trout Interagency Coordination Group. Wild Trout Enterprises, LLC. Bozeman, Montana.

May, B.E. 2009. Westslope Cutthroat Trout Status Update Summary, Wild Trout Enterprises, LLC, Bozeman, Montana.

Endicott, C., L. Nelson, S. Opitz, A. Peterson, J. Burckhardt, S. Yekel, D. Garren, T. M. Koel, and B. Shepard. 2016. Range-wide status assessment for Yellowstone Cutthroat Trout, (*Oncorhynchus clarkii bouvieri*): 2012. Available online at: https://westernnativetrout.org/wp-content/uploads/2019/06/Rangewide-YCT-Status-Assessment-2012-Final.pdf

Resident Salmonids Objective R3

For Kokanee, contribute to achieving self-sustaining, broadly distributed populations in the 11 subbasins in which they are present, with stable and/or increasing populations capable of sustaining harvest where they are identified as a focal species.

- Objective R3 is based on (a) the 2014 Fish and Wildlife Program Appendix D, Theme 2, and (b) documents compiled in the Fish Objectives mapping tool including: Montana Statewide Fish Management Plan 2013-2018, IDFG Fisheries Management Plan 2013-2018, 2012 Coeur d'Alene Tribe Integrated Resource Management Plan, 2000 Draft Pend Oreille Subbasin Summary, 2000 Draft San Poil River Subbasin Summary, 2004 Spokane Subbasin Plan, 2000 Kootenai River Subbasin Management Plan, and MFWP/CSKT Flathead Lake and River Fisheries Co-Management Plan 2001-2010.

Summary of progress

Kokanee salmon are managed differently throughout the Columbia Basin. Within their native range, there are naturally reproducing and hatchery-origin populations. Within the basin, there have also been reintroductions into locations that are outside their native range. The objective does not distinguish between whether fish are natural or hatchery origin or within their native range. During our SPI workshops, we assembled available information on kokanee salmon abundance in six lakes or reservoirs. Data types differed among locations and included abundance estimates of specified size classes, spawner estimates, and catch per unit effort (CPUE), covering data ranges from 1980 to approximately 2020.

Abundance varies widely among lakes and from year to year. The highest observed abundance was at Lake Pend Oreille, where a peak estimate approached 25 million kokanee salmon (Figure 33). Data on other lakes are available on the Program Tracker, SPI R3-2.

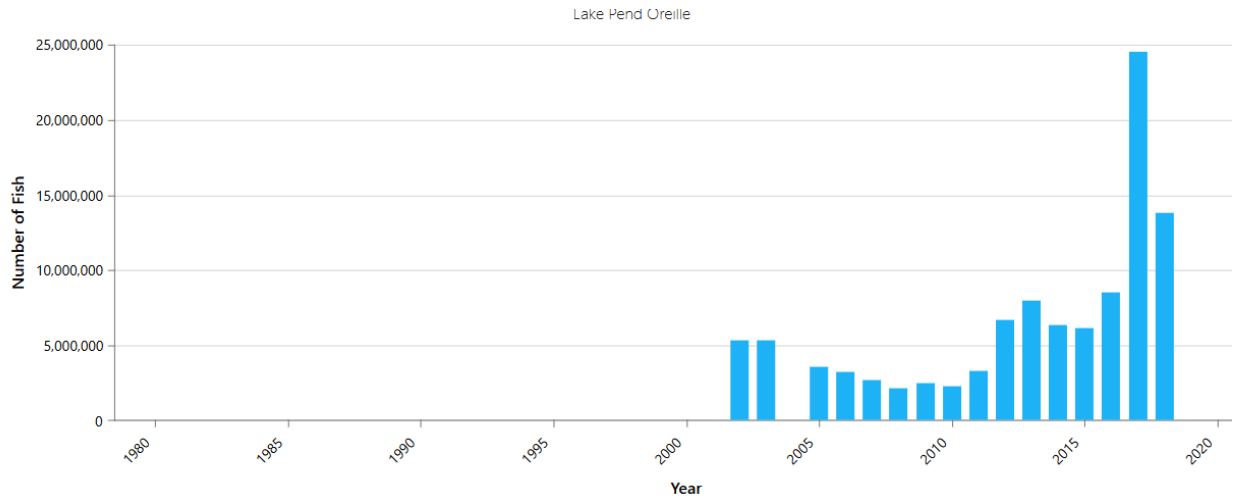


Figure 33. Kokanee abundance (ages 1 - 4) in Lake Pend Oreille. Data reported on the Program Tracker as SPI R3-2 and provided by Idaho Department of Fish and Game

There has been a lot of research on factors that affect kokanee abundance over time, including food web effects (e.g., Wilson and Corsi 2019) and entrainment at dams (e.g., at Dworshak, Libby, and Grand Coulee). Examples from Dworshak:

- Maiolie and Elam 1997: "At Dworshak Reservoir, it was estimated that 1.4 million kokanee (95% of the population) were lost through the dam in a period of five months in 1996."
- Felts et al. 2023: "With the exception of high runoff years, entrainment was reduced beginning in the early 1990s when drawdown began occurring primarily during the summer and early autumn to provide cool water for Chinook in the Snake River… Bennett (1997) found that discharge from January through March had the highest negative correlation with survival compared to other time periods examined. While entrainment remains a limiting factor for kokanee in some years, oligotrophication is more often the primary limiting factor."

It would be beneficial to develop loss assessments to define the hydrosystem mitigation needs for kokanee salmon throughout their range.

SPIs referenced in summary:

- **R3-2** Resident Fish Mitigation Strategy: Status and trend of Kokanee.

Other SPIs associated with objective: data available on Program Tracker

- **R3-1** Kokanee hatchery objectives are tracked and compared to the management plan and a reviewed and approved master plan.
- **R3-1** Predator Management Strategy: Annual average catch rate of Lake Trout in Upper Priest, Flathead, and Pend Oreille lakes.

Note: SPI code R3-1 is duplicated and will be revised.

References

Bennett, D. H. 1997. Evaluation of current environmental conditions and operations at Dworshak Reservoir, Clearwater River, Idaho, and an analysis of fisheries management mitigation alternatives. U.S. Army Corps of Engineers Walla Walla, Washington.

Felts, E. A., S. M. Wilson, A. M. Piette, and R. S. Hardy. 2023. Dworshak Dam resident fish mitigation progress report, 2019-2023. Dworshak Dam resident fish mitigation project. Idaho Department of Fish and Game, Report Number 23-02, Boise.

Maiolie, M. A., and S. Elam. 1997. Kokanee abundance and distribution in Dworshak Reservoir and implications toward minimizing entrainment: Dworshak Dam impact assessment and fisheries investigation project. Idaho Department of Fish and Game, Project 87-99, Report number 97-17, Boise.

Wilson, S. M., and M. P. Corsi. 2019. Dworshak Dam resident fish mitigation progress report, 2017-2018. Dworshak Dam resident fish mitigation project. Idaho Department of Fish and Game, Report Number 19-15, Boise.

Resident Salmonids Objective R4

For Redband Trout, contribute to achieving self-sustaining populations of geographically widespread across their native range, providing for genetic integrity and exchange and with stable and/or increasing fish populations capable of sustaining harvest across that range.

- Objective R4 is based on (a) the 2014 Fish and Wildlife Program Appendix D, Theme 2, and, (b) documents compiled in the Fish Objectives mapping tool including: 2016 Conservation Strategy for Interior Redband (Oncorhynchus mykiss subsp.) in the states of California, Idaho, Montana, Nevada, Oregon and Washington, 2000 Fifteen mile Subbasin Summary, 2009 Lake Roosevelt Fisheries Guiding Document, IDFG Fisheries Management Plan 2013-2018, 2014 Range wide Conservation Agreement for the Conservation and Management of Interior Redband Trout, Montana Statewide Fisheries Management Plan 2013-2018, and 2004 Intermountain Province Subbasin Plan.

Summary of progress

Similar to Cutthroat trout, we have SPIs for Redband that draw on data from the 2012 range-wide status assessment and Muhlfeld et al. 2015, as reported in IRCT (2016). In the Columbia Basin, there are five Geographic Management Units (GMU; Figure 34). For each GMU, data comparisons between current and historical habitat occupancy cover different time periods, corresponding with when surveys were complete.

Figure 34. Redband trout Geographic Management Units (GMU) In the Columbia Basin. Map developed by the U.S. Forest Service

For each of the five GMUs, there has been a decrease in stream length occupancy between the historical and current time periods (Table 8). In contrast, there has been a varied response in lake area occupancy within each GMU, reflecting the effect of newly constructed reservoir habitat.

Table 8. Current and historical stream length (km) and lake area (ha) within each Geographic Management Unit (GMU) occupied by Redband trout. Data from IRCT 2016

GMU	Historical stream length (km)	Historical lake area (ha)	Current stream length (km)	Current lake area (ha)	Table referenced in report
Upper Columbia-Spokane	9,636	3,694	2,886	35,363	Table 5
Kootenai	1,907	356	1,017	211	Table 6

Clearwater River	1,147*	779*	155*	6,622*	Table 7
Snake River	36,216	1	13,355	35,263	Table 8
Deschutes	4,265	12,451	2,306	12,272	Table 10

*There appear to be errors in the GMU summaries.

Specific targets for abundance, distribution, and genetic status (core-conservation and conservation populations) exist in various conservation plans, but the Program only calls for contributing to general characteristics of healthy populations. Developing more quantitative targets based on a hydro mitigation responsibility would improve our ability to track progress. However, it would require either loss assessments or resident fish settlement agreements like those developed for Libby and Hungry Horse Dams.

SPIs referenced in summary:

- **R4-2** Resident Fish Mitigation Strategy: Redband Trout stream length (miles) and lake area (hectares) occupancy within each of the five geographic management units (GMUs).

Other SPIs associated with objective: data available on Program Tracker

- **R4-1** Fish Propagation and Hatchery Strategy: Redband Trout populations' genetic integrity is protected from non-native hatchery trout by program-funded hatchery actions.
- **R4-3** Resident Fish Mitigation Strategy: Percent of currently occupied habitat that contains genetically unaltered Redband Trout for the five GMUs.
- **R4-4** Resident Fish Mitigation Strategy: Redband Trout patch sizes at the population level.
- **R4-5** Resident Fish Mitigation Strategy: Percent of Redband Trout population that is hybridized for the five GMUs.

References

Interior Redband Conservation Team (IRCT). 2016. A Conservation Strategy for Interior Redband (Oncorhynchus mykiss subsp.) in the states of California, Idaho, Montana, Nevada, Oregon, and Washington. Available online at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd525054.pdf

Muhlfeld, C.C., Albeke, S.E., Gunckel, S.L., Writer, B.J., Shepard, B.B. and B.E. May. 2015. Status and conservation of interior Redband in the western United States. North American Journal of Fisheries Management 35(1): 31-53.

Resident Salmonids Objective R5

Hungry Horse Dam impacts on Westslope cutthroat and bull trout have been assessed and partially mitigated. Mitigation for these losses has been expressed and implemented under the program primarily in terms of operations and habitat protection targets and not species numbers. A current mitigation target for these salmonids is by 2024 to restore and protect 448 miles (721 km) of suitable stream habitat within the Flathead River watershed that is closely equivalent to the habitat blocked and inundated by Hungry Horse Dam.

- Objective R5 is based on the Hungry Horse Mitigation Plan; Fisheries Mitigation Plan for Losses Attributable to the Construction and Operation of Hungry Horse Dam, Bonneville Project No. 1990-2003, Technical Report, Project No. 199301904, available nwcouncil.box.com/s/fqjl4sdeqg6i9mad6bu8j2hfo4wa25pr

Summary of progress

Construction and operation of Hungry Horse Dam caused losses of multiple resident fish species. Fish losses at Hungry Horse Dam were assessed both due to habitat inundation and loss of connectivity to the Flathead Lake ecosystem and included juvenile and adult cutthroat trout, adult bull trout, and adult kokanee salmon (Fraley et al. 1990 and references contained within). The loss assessment was approved by the Council and adopted into the Program.

Mitigation for resident fish losses occurs through habitat restoration and protection, reducing non-native species interactions, and other activities. Since 2004, a total of 14,097 acres have been protected or restored as mitigation for resident fish losses at Hungry Horse Dam (Figure 35, left). This corresponds to 67.67 stream kilometers protected (Figure 35, right). As of 2022, approximately 10% of the stream kilometer objective has been met.

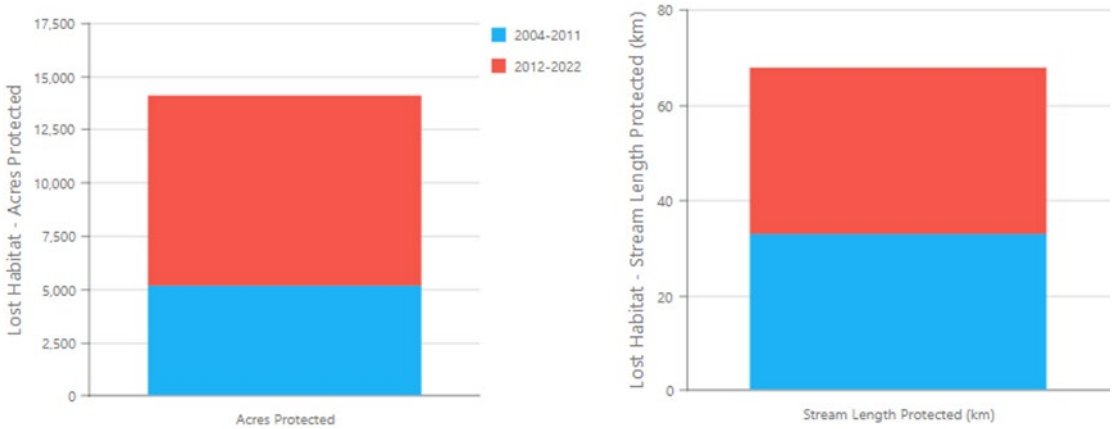


Figure 35. Hungry Horse Dam mitigation for inundated lost habitat reported in acres (left) and kilometers (right), for 2004-2011 (blue) and 2012-2022 (red) through implementing the NPCC Fish and Wildlife Program. Data reported on Program Tracker as SPI R5-1

SPIs referenced in summary: data available on Program Tracker

- **R5-1** Resident Fish Mitigation Strategy: Number of miles or kilometers of suitable stream habitat in the Flathead River.

References

Fraley, J., B. Marotz, and J. DosSantos. 1990. Hungry Horse Mitigation Plan: Mitigation Plan for Losses Attributable to the Construction and Operation of Hungry Horse Dam. 1990-2003 Technical Report, Project number 199301904, 74 electronic pages, (BPA report DOE/BP-00004100-1).

Resident Salmonids Objective R6

Libby Dam impacts on Westslope cutthroat and bull trout have been assessed and partially mitigated. Mitigation for these losses has been expressed and implemented under the program primarily in terms of operations and habitat protection targets and not species numbers. Current mitigation targets for these salmonids are by 2028 to protect or restore 109 miles (175.42 km) of Kootenai River and 40 miles (64.37 km) of tributary stream that were inundated by Libby Dam and make accessible 60 miles or more of previously blocked suitable streams.

- Objective R6 is based on the Fisheries Mitigation and Implementation Plan for Losses Attributable to the Construction and Operation of Libby Dam, Bonneville Project No. 1995-00400, available at nwcouncil.box.com/s/aye1lypekqusy550bnuxf7yn9k7ij6bq

Summary of progress

Construction and operation of Libby Dam caused losses of multiple resident fish species. Loss assessments were completed in 1991 and were approved by the Council and adopted into the Program. Fish losses upstream of Libby dam included rainbow trout, westslope cutthroat trout and mountain whitefish (FWP, CSKT, and KTOI 1998). Downstream losses included westslope cutthroat trout, ~ 90% of burbot, and effectively all Kootenai River white sturgeon (FWP, CSKT, and KTOI 1998).

Substantial restoration has occurred in Kootenai River above and below Libby Dam through the efforts of multiple partners. During our SPI workgroup meetings, we heard from managers about efforts to protect land for resident fish and wildlife together, or solely for resident fish. No specific habitat restoration program exists to implement this objective. Data on total acreage or stream kilometers protected for resident fish are not currently summarized because it has not been determined how to credit existing mitigation against the loss assessment.

SPIs referenced in sum4mary: data available on Program Tracker

- **R6-1** Resident Fish Mitigation Strategy: Number of acres of suitable stream or reservoir habitat in the Kootenai River Basin.
- **R6-2** Resident Fish Mitigation Strategy: Number of accessible miles of previously blocked suitable streams in the Kootenai River Basin.

References

Montana Department of Fish, Wildlife, and Parks, Confederated Salish and Kootenai Tribes, Kootenai Tribe of Idaho (FWP, CSKT, KTOI). 1998. Fisheries Mitigation and Implementation Plan for Losses Attributable to the Construction and Operation of Libby Dam. Project number 1995-00400, 63 electronic pages, (BPA Report DOE/ BP-00006294-4).

Other Native Aquatic Focal Species Objective NF 1

The Fish and Wildlife Program does not include quantitative loss assessments or objectives for the hydropower system's impacts on other native aquatic focal species, including Eulachon, Burbot, Oregon Chub and freshwater mussels. Currently, the program's biological objectives for these other native aquatic focal species are expressed in the goal statement.

- The ecological goal and relevant ecological objectives and related strategy performance indicators also apply to the aquatic species goal and biological objectives, as do the communication, assessment, and coordination goal and relevant objectives and related strategy performance indicators.

Summary of progress

This objective does not lend itself to a quantitative assessment of progress. Because loss assessments have not been done, it is not clear to what degree mitigation is required for hydrosystem impacts. Eulachon, burbot, Oregon chub, and freshwater mussels are called out in the objective and the language implies other aquatic focal species should also be part of this biological objective. Without a loss assessment, it is unclear which species should be included and what the biological target (abundance? distribution? productivity? all?) should be for each.

In the November 2024 Categorical Assessment presentation to the Council, we reviewed SPI data associated with Eulachon, burbot, and mussels, and noted that Oregon chub are the first fish species to be delisted under the Endangered Species Act.

Eulachon spawning stock biomass is reported annually in joint state staff reports. Without a target, it is hard to judge how the population in the lower Columbia River is performing. The southern distinct population unit (DPS) is listed as threatened under the Endangered Species Act

with the most serious threat to the population's persistence identified as climate change impacts on ocean conditions (NOAA).

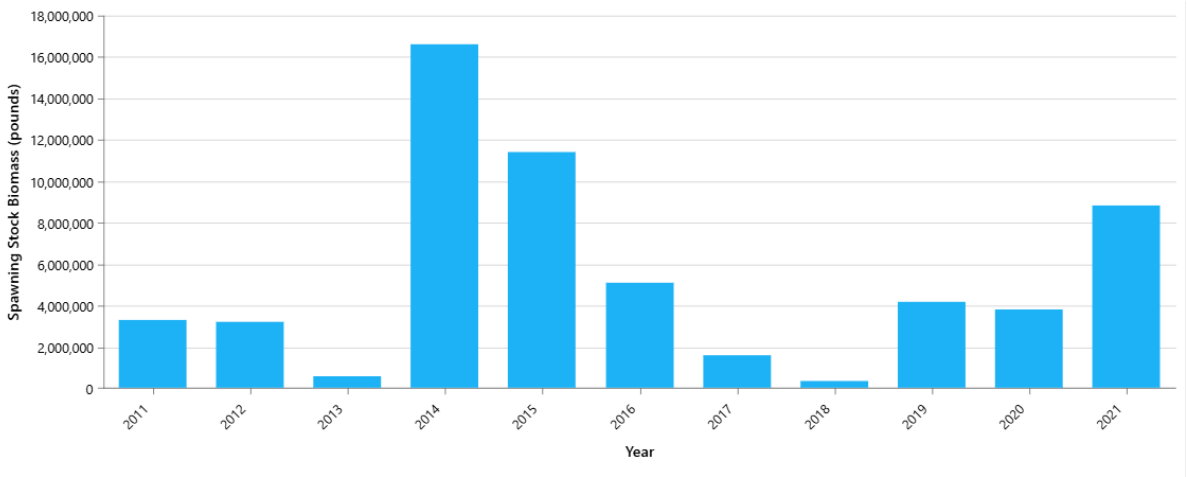


Figure 36. Eulachon spawning stock biomass in the lower Columbia River, 2011-2021. Data reported on Program Tracker as SPI NF-4

Burbot catch per unit effort (CPUE) is reported by the Council's Program Tracker for the Kootenai River and Lake Roosevelt. Although there is monitoring data in certain locations, there is no target identified. More details are needed if there is to be a target and goal determined for these populations.

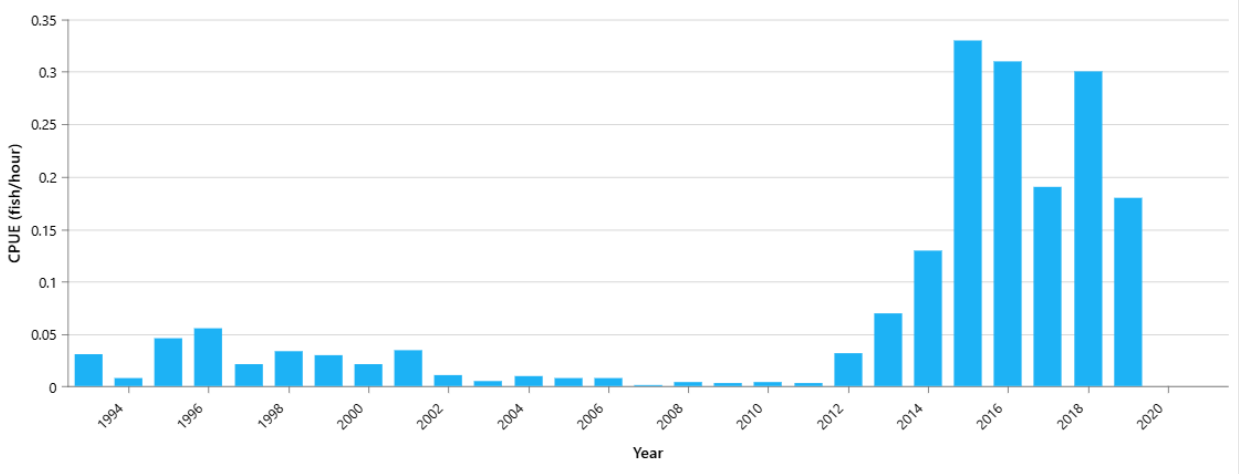


Figure 37. Burbot catch per unit effort (CPUE) in the Kootenai River, 1993 - 2019. Data reported on Program Tracker as SPI NF-2

Current freshwater mussel data in the Program Tracker is tied to CBFish. This is another example of asking what data should we track? What data are available? Which species? This is an area

that would benefit from attention by Council staff in collaboration with managers. Targets are needed to gather the best available data or to support expanded research.

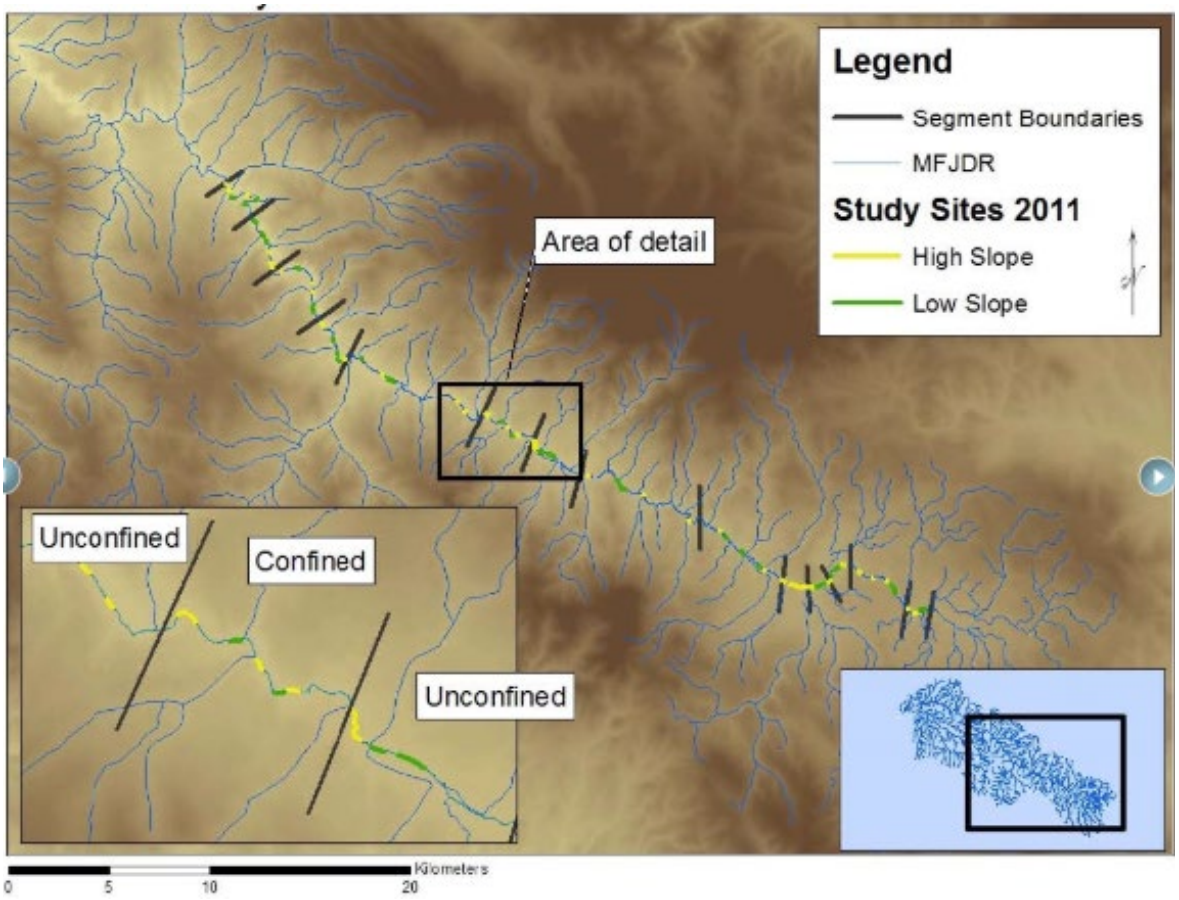


Figure 38. Study for 2011 data collection on freshwater mussels; data example from CBfish reported on Program Tracker as SPI NF-3

SPIs referenced in summary:

- **NF-2** Status and trend of Burbot.
- **NF-3** Resident Fish Strategy: Status, trend and distribution of native freshwater mussels.
- **NF-4** Eulachon Strategy Indicator: Spawning stock biomass of lower Columbia River eulachon. Evaluate to determine if biomass is stable and/or increasing.
    - NF-4 is based on 2019 Briefing on Columbia River Eulachon by Laura Heironimus (Washington Department of Fish and Wildlife) presented to NPCC Fish and Wildlife Committee on 11 May 2019, available at www.nwcouncil.org/sites/default/files/2019_0409_4.pdf

Other SPIs associated with objective: data available on Program Tracker

- **NF-1** Fish Propagation including hatcheries Strategy: Burbot hatchery objectives are tracked and compared to the management plan and a reviewed and approved master plan.

References

Information relevant to goals and objectives for other native aquatic species can found in: 2014 Fish and Wildlife Program Appendix D, Theme 2

Lower Columbia Fish Recovery Board, 2004. Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan Volume II – Subbasin Plan Chapter A – Lower Columbia Mainstem and Estuary

NMFS, 2013. Federal Recovery Outline Pacific Eulachon Southern Distinct Population Segment WDFW/ODFW .

NOAA, 2017. Endangered Species Act Recovery Plan for the Southern Distinct Population Segment of Eulachon (*Thaleichthys pacificus*)

NOAA, 2024. Eulachon. https://www.fisheries.noaa.gov/species/eulachon

NPCC, 2015. Eulachon: State of the Science and Science to Policy Forum available nwcouncil.box.com/s/9smx3zqt6y8ym5ipw45g10fihillpsme

ODFW and WDFW, 2024. 2024 Joint State Staff Report Concerning Stock Status and Fisheries for Sturgeon and Smelt. https://wdfw.wa.gov/sites/default/files/2024-03/2024-sturgeon-smelt-joint-staff-report-030624.pdf

WDFW, 2023. Washington and Oregon Eulachon Management Plan 2nd Edition.

Wildlife

Goal

Mitigate for wildlife losses caused by the development and operation of hydropower dams.

- The Wildlife Goal (W) is based on the 2014 Fish and Wildlife Program Appendix C and Appendix D, Theme 1. For a quantification of losses from construction and inundation of the hydrosystem, see Appendix C, Table C-4.
- These values are described in the Wildlife Strategy Program Mitigation and Remaining Loss Ledger presentation to the Fish and Wildlife Committee February 2019. See Loss Ledger PowerPoint

Summary of progress

In the Habitat Categorical Assessment, we comprehensively reviewed the background on wildlife mitigation. This review covered (1) status and loss assessments (2) the development of crediting, (3) mitigation plans and settlement agreements, (4) criteria for protection and monitoring, (5) decision making and planning, and (6) FCRPS mitigation by subregion (Upper Columbia tributaries, Upper Columbia mainstem, Mid-Columbia tributaries, Lower Columbia, Upper Snake River, Lower Snake River, and Willamette Basin). The documentation associated with the November 2024 presentation includes a substantial amount of data and citations. That information is the basis for determining progress toward the mitigation targets in the Wildlife Goal.

Mitigation for the Federal Columbia River Power System occurs under the Fish and Wildlife Program. There are 30 dams and related facilities in Basin that are federally owned and operated. Of these facilities, mitigation for Construction and Inundation (C&I) losses and Operational (Op) losses is as follows:

- 27% (8) fully mitigated for C&I and Op
- 33% (10) fully mitigated for C&I only
- 30% (9) with C&I mitigation remaining
- 10% (3) where mitigation was not called for

Wildlife mitigation at non-federal hydroelectric facilities occurs through FERC relicensing agreements and Habitat Conservation Plans. This mitigation has not been tracked.

There are areas of agreement between the Council's asset management strategy and BPA's Strategic Asset Management Plan – SAMP – related to lands. BPAs 2022 SAMP included three long term objectives (1) pursuing settlement agreements to permanently extinguish remaining mitigation debt, (2) improving sponsor compliance for submitting land management plans, and (3) developing a system to provide regular reporting on the condition of acquired lands. In the 2024 SAMP, BPA removed the first long-term objective on settlement agreements. BPA pursues individual agreements but noted limited support from the region to pursue additional settlement agreements. The Council's Program continues to call for 2014 Program and 2020 Addendum continues to call for settlement of remaining C&I and Op losses. Settlement of losses can be a more efficient route to full mitigation than first conducting intensive studies of losses and subsequently developing mitigation plans and agreements.

References

Wildlife Mitigation Agreement for Dworshak Dam. Bonneville Power Administration, State of Idaho and Nez Perce Tribe, See Dworshak Dam Agreement

Northern Idaho Memorandum of Agreement between the State of Idaho and the Bonneville Power Administration for Wildlife Habitat and Stewardship, August 2018, See Northern Idaho MOA;

Wildlife Mitigation Agreement for Libby and Hungry Horse Dams between the Bonneville Power Administration and the State of Montana (1992). See Montana Agreement

Willamette River Basin Memorandum of Agreement Regarding Wildlife Habitat Protection and Enhancement between the State of Oregon and the Bonneville Power Administration, October 22, 2010, See Willamette MOA; and,

Bonneville Power Administration, Administrators' Record of Decision and Response to Comments Southern Idaho Wildlife Mitigation Memorandum of Agreement, September 2014, See Southern Idaho MOA

Objective W1

Complete mitigation for construction and inundation losses over the next five-year period by acquiring lands or through settlement to turn the entire C&I portion of the Wildlife Loss Mitigation table (below) to Dark Blue or Light Blue

Wildlife losses from dam construction and inundation have been assessed and quantified and are displayed in Appendix C, Table C-4 of the 2014 Fish and Wildlife Program. The program expressed wildlife losses caused by dam construction and inundation (C&I) through a measurement of affected and inundated acres and then a calculation of lost habitat area and quality for representative species on those acres, called habitat units (HU), not through species numbers.

Mitigation for the assessed C&I losses is nearly complete after three decades of the acquisition and protection of properties. The value of properties acquired has been assessed either as an amount of HUs acquired or as properties acquired of a certain acreage with an agreement among the relevant entities that acquisition of these properties sufficed to mitigate for an understood portion of the losses.

The Wildlife Loss Mitigation table (below) provides the Council's assessment of the degree to which Bonneville has completed its C&I mitigation responsibility. In Table 9, the colors for each dam or dam group signify:

- **Dark Blue (DB)** - The C&I loss has been mitigated through the acquisition of sufficient HUs.
- **Light Blue (LB)** - The C&I loss has been mitigated through a settlement agreement. In some instances, the parties to the agreement have not completed the acreage or HU amounts, but Bonneville has fulfilled its obligation by dedicating funding to complete mitigation.
- **Yellow (Y)** - C&I mitigation has taken place and might be nearing completion, but issues remain to be addressed or settled.

- **Purple (P)** - C&I mitigation has been unaddressed or significant issues remain to be addressed or settled.

Table 9. Status of mitigation for construction and inundation losses as of the 2020 addendum

Dam or Dam Complex	C&I Loss
Willamette	LB
Bonneville	DB
The Dalles	DB
John Day	DB
McNary	DB
Lower Snake	DB
Upper Snake (Idaho MOA, including Deadwood operation)	LB
Anderson Ranch	Y
Black Canyon	P
Deadwood	P
Minidoka	Y
Palisades	Y
Dworshak	LB
Chief Joseph	DB
Grand Coulee	Y
Albeni Falls (Idaho MOA)	LB
Albeni Falls (Kalispel MOU)	LB
Albeni Falls (Other)	Y
Libby	LB
Hungry Horse	LB

Summary of progress

Staff summarized progress toward mitigation for construction and inundation losses at each FCRPS facility in the Basin (Figure 39). A lot of mitigation for construction and inundation losses has occurred through projects and settlement agreements. Additional mitigation is needed at Albeni Falls, possibly Grand Coulee, Bonneville and The Dalles, and in the upper Snake River and tributaries.

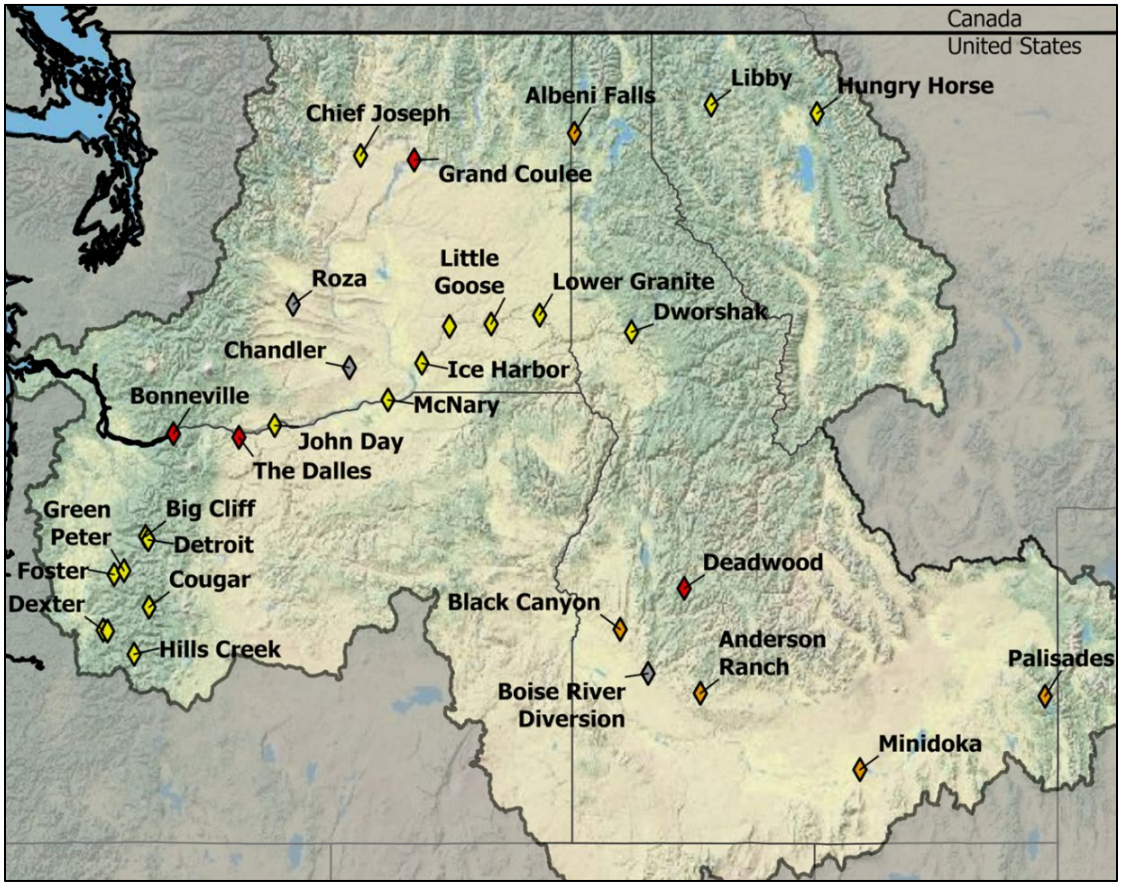


Figure 39. Status of mitigation for construction and inundation losses at FCRPS facilities in the Columbia Basin. Yellow diamonds indicate where losses are covered under a settlement agreement or have been completely mitigated through a project. Orange diamonds indicate where losses partially settled or partially complete, and red diamonds indicate where there is no settlement or agreement, and mitigation is incomplete. Grey diamonds indicate that losses were not assessed, or mitigation was not warranted.

SPIs referenced in summary: data available on the Program Tracker

- **W1-1** Wildlife Mitigation Strategy: Amount of construction and inundation mitigation acquired at each hydro-facility or number of settlement agreements covering C&I losses.

References

Full details of losses and mitigation are available in the supplementary documentation for the Habitat Categorical Assessment, focused on Wildlife.

Objective W2

Assess and mitigate for losses due to the operation of the hydroelectric facilities. Mitigate for the assessed losses of wildlife associated with the ongoing operations of Hungry Horse and Libby at 26,321 acres for Hungry Horse Dam and 35,571 acres at Libby Dam. The objective for the next five-year period will be to turn the Purple portions of the Wildlife Loss Mitigation Table Yellow or Light Blue.

- The values for Objective W2 are described in the Wildlife Strategy Program Mitigation and Remaining Loss Ledger presentation to the Fish and Wildlife Committee February 2019. See Loss Ledger PowerPoint.
- Supporting documents include 2018 recommendations and comments on the 2014 F&W Program received from Montana Fish, Wildlife & Parks, Confederated Salish & Kootenai Tribes, and Kootenai Tribe of Idaho.

Wildlife Loss Mitigation table (below) provides the Council's assessment of the degree to which Bonneville has completed its operation mitigation responsibility. In Table 10, the colors for each dam or dam group signify:

- **Dark Blue (DB)** - In the case of operation losses, the loss has been mitigated through acquisition of the appropriate metric.
- **Light Blue (LB)** - The operation loss has been mitigated through a settlement agreement. In some instances, the parties to the agreement have not completed the acreage or HU amounts, but Bonneville has fulfilled its obligation by dedicating funding to complete mitigation.
- **Yellow (Y)** - For operation losses the loss has been assessed and some mitigation may have occurred.
- **Purple (P)** - For operations, the loss has not been assessed, therefore no mitigation has occurred to count against the unassessed loss.

Table 10. Status of mitigation for operational losses as of the 2020 Addendum

Dam or Dam Complex	Operation Loss
Willamette	LB
Bonneville	P

The Dalles	P
John Day	P
McNary	P
Lower Snake	P
Upper Snake (Idaho MOA, including Deadwood operation)	LB
Anderson Ranch	P
Black Canyon	P
Deadwood	P
Minidoka	P
Palisades	P
Dworshak	P
Chief Joseph	P
Grand Coulee	P
Albeni Falls (Idaho MOA)	LB
Albeni Falls (Kalispel MOU)	P
Albeni Falls (Other)	P
Libby	Y
Hungry Horse	Y

Summary of progress

Staff summarized progress toward mitigation for operational losses at each FCRPS facility in the Basin (Figure 40). Limited mitigation for operational losses has primarily occurred through settlement agreements. Significant work remains to assess and/ or settle operational losses for remaining FCRPS dams throughout the basin.

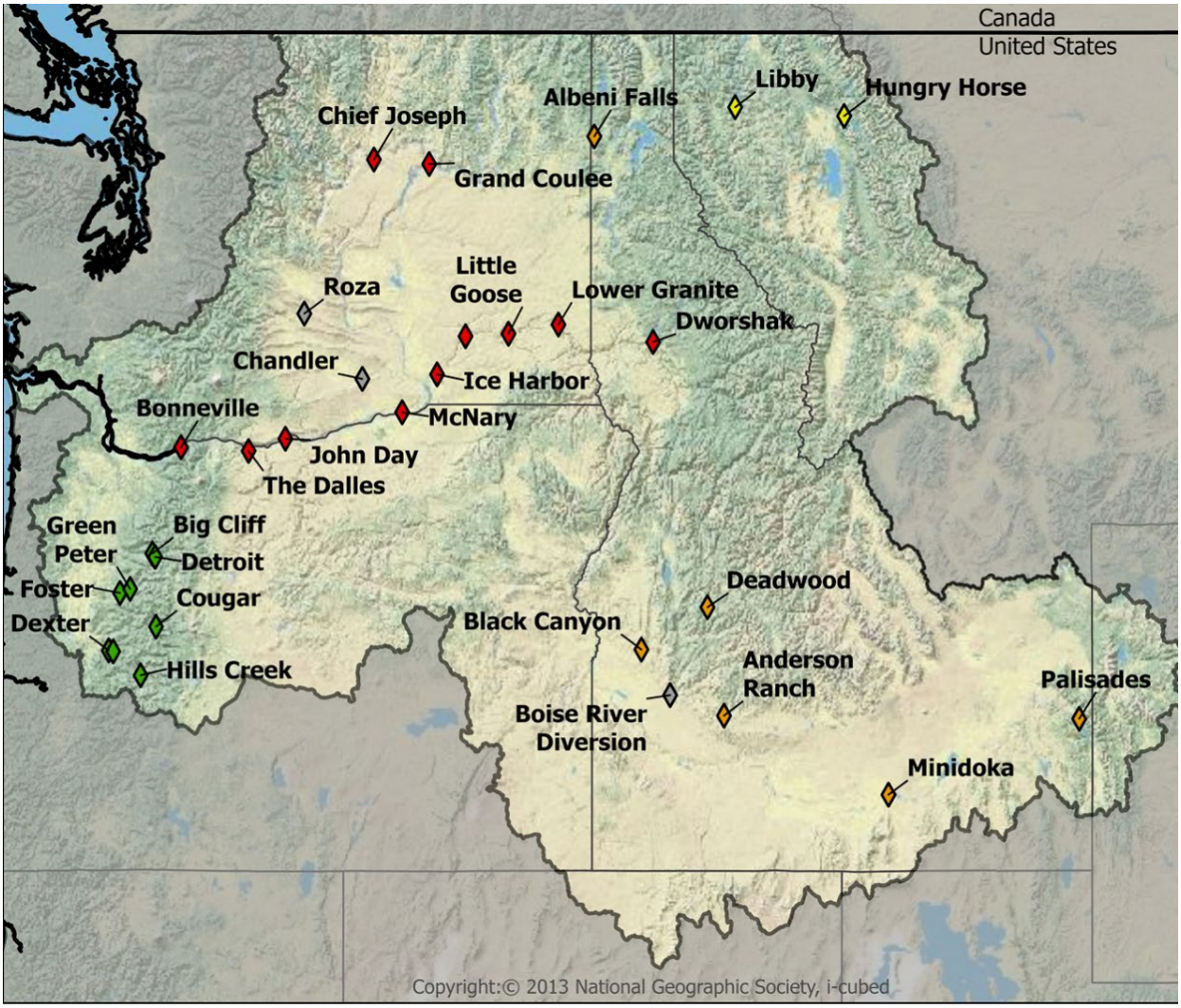


Figure 40. Status of mitigation for operational losses at FCRPS facilities in the Columbia Basin. Green diamonds indicate that losses have been mitigated, yellow diamonds indicate where losses are assessed, orange diamonds indicate where losses partially settled or partially mitigated, and red diamonds indicate where losses have not been assessed. Grey diamonds indicate that losses were not assessed, or mitigation was not warranted.

SPIs referenced in summary: data available on the Program Tracker

- **W2-1** Number of operational loss assessments or settlement agreements covering operational losses completed for each hydro-facility.

References

Full details on losses and mitigation are available in the supplementary documentation for the Habitat Categorical Assessment, focused on Wildlife.

Objective W3

All parcels and/or management units operate under an approved management plan.

Summary of progress

Land management plans (LMPs) are meant to be in place within 18 months of completing an acquisition or agreement. These plans include operation and maintenance (O&M) requirements, objectives, and associated monitoring needs. The O&M identified in the plans is meant to be funded and implemented to maintain the conservation value for which the parcel was protected.

To determine the current number of land management plans, we reviewed all files submitted as part of the most recent Wildlife Project Review cycle. Some project sponsors submitted their latest LMPs or updates on when LMPs would be developed. We also contacted wildlife staff at BPA to determine which LMPs they had for the parcels or wildlife management areas in their lands database. As of 2024, LMPs are not available for approximately 45-50% of parcels. It is not clear if the LMPs do not exist or if they just have not been provided to BPA or NPCC. Regardless, it impedes tracking conservation values and determining whether wildlife mitigation is working as designed from a habitat quality perspective. It is a current priority of BPA to improve sponsor compliance for submitting land management plans (BPA 2024).

- **55%** of parcels in CBFish operate under an approved management plan.
- It is unclear if remaining parcels lack management plan, or they are just not available.

SPIs referenced in summary: data available on Program Tracker

- **W3-1** Number of parcels and/or management units being managed though an approved management plan.

References

Full details on wildlife mitigation are available in the supplementary documentation for the Habitat Categorical Assessment, focused on Wildlife.

BPA. 2024. Hatcheries and land, strategic asset management plan. Available online at: https://www.bpa.gov/-/media/Aep/finance/strategic-asset-management-plans/2024-efw-hatchery-and-land-samp.pdf

Objective W4

Maintain existing habitat mitigation values on the parcels and/or management units as described in their individual management plans.

Summary of progress

Mitigation values are maintained through O&M (defined in management plans) which requires sufficient funding to be in place. Sponsors report annually on progress on land management plans, violations of any conservation easement prohibitions, and how stewardship money was used on the property. In addition, BPA evaluates 10% of parcels for compliance with LMPs using remote sensing and conducts on-the-ground surveys when potential issues exist.

There is no comprehensive, public database on the condition of acquired parcels, relative to defined mitigation values. Individual entities have information on their own activities and the condition of their lands, and there are annual reports on each parcel or wildlife management area. Compiling information from this full set of sources would be time-consuming and challenged by the different types of O&M and physical characteristics of the various parcels. It would be more informative to collect all LMPs in one location, identify a very simple but useful set of indicators to track, and then populate those indicators using data uploaded to CBFish annually. It is a current priority of BPA to develop a system to provide regular reporting on the condition of acquired lands (BPA 2024). Currently, with only 55% of parcels in CBFish with approved management plans, more work is needed to meet this objective.

SPIs referenced in summary: data available on Program Tracker

- **W4-1** Number of parcels or management units that report concerns related to meeting their habitat mitigation values.

References

Full details on wildlife mitigation are available in the supplementary documentation for the Habitat Categorical Assessment, focused on Wildlife.

BPA. 2024. Hatcheries and land, strategic asset management plan. Available online at: https://www.bpa.gov/-/media/Aep/finance/strategic-asset-management-plans/2024-efw-hatchery-and-land-samp.pdf

Ecological

Goal

Contribute to providing environmental conditions and processes that support the ecosystem functions necessary to restore healthy, self-sustaining and harvestable populations of native anadromous and resident fish and wildlife adversely affected by the hydroelectric power system, including related spawning grounds and habitat.

- The Ecological Goal is based on the 2014 Fish and Wildlife Program Appendix D, Theme 1, Goal 1.
- The ecological objectives are based on the 2014 Fish and Wildlife Program Appendix D, Theme 1 and consultation during program amendment goals and objectives workshop.

Summary of progress

The ecological goal is tracked entirely through its objectives. In general, those objectives are qualitative statements of program priorities, and not quantitative targets written using S.M.A.R.T. criteria. Most of the objectives are designed to "contribute to" regional targets, with the exception of flow objectives. While implementation that relates to this goal is a significant part of the Program (the majority of offsite mitigation), no benchmark exists, and it is not currently trackable.

Implementation of associated measures was thoroughly reviewed in the Hydrosystem Assessment and the Habitat Assessment. Many of the objectives in this section are identical to the SPIs tracked as part of those categorical assessments. Rather than duplicate that full content, we present excerpts from the assessments or examples of graphs for individual objectives.

Objective E1

Contribute to maintaining and improving habitat quantity, quality, connectivity, and functions while taking into account climate change.

Summary of progress

This objective does not lend itself to a quantitative assessment of progress. There is no specific target for types, volumes, or locations of habitat to be restored. As we discussed in November, the Columbia Basin is enormous and there are very different kinds of habitats and needs for restoration throughout the basin. The Program does not contain a basin-scale target for restoration because it would be meaningless to call for acreage restored without the context of what local needs exist.

The Program also does not contain a specific target on the amount or type of restoration work that is required to achieve outcomes at smaller geographic or biological scales. Guidance is drawn from planning documents like subbasin plans or watershed plans.

The Program does not define the scope of the problem that needs to be addressed through offsite mitigation in general, or restoration specifically. In assessing progress, it would also be quite difficult to determine results related to Program actions versus those resulting from external efforts because the Program is part of the tapestry of habitat restoration in the basin. What does mitigation mean in this context? How much are we trying to achieve?

In the Habitat Categorical Assessment, we reviewed examples of restoration to improve habitat quantity and quality and examples of how project sponsors are adapting project work in a changing climate. The emphasis was on Program scale summaries- not project scale- using data available in CBFish or other regional data sources. Here we present examples of those summaries.

Some types of restoration projects, like reconnecting channels, adding large wood, or placement of other physical structures can change the form of the river channel. It may transition from a channelized river to one with more side channels, a range of habitat types (like pools, riffles, alcoves, undercut banks), and better connection with the floodplain. In increasing the complexity of the stream channel, the total length of stream channel also increases. On the Program Tracker, we report on miles of stream with improved complexity of improved channel form using data from CBfish (Figure 41). Over the last 20 years, there has been a consistent increase in the miles of stream with improved complexity or channel form.

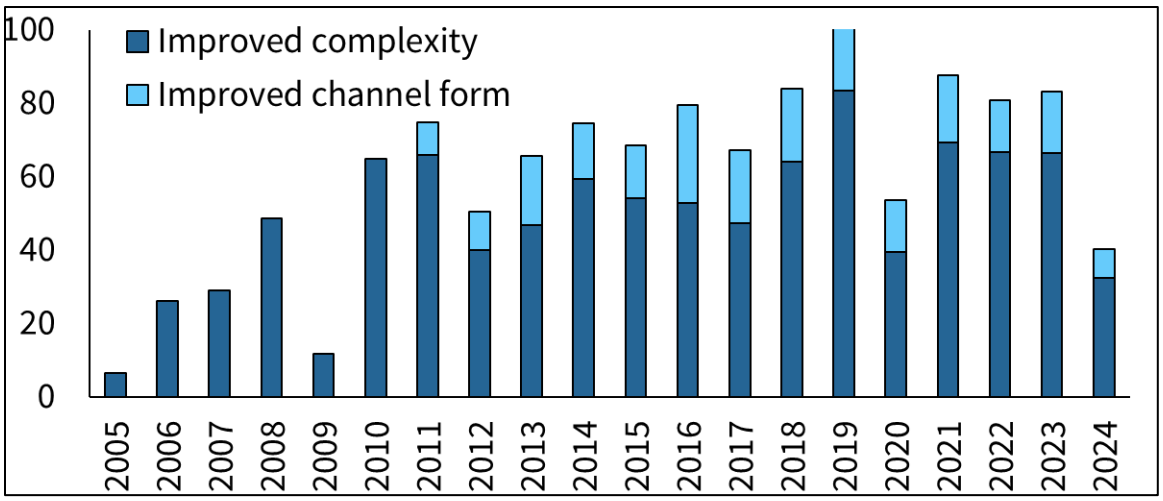


Figure 41. Miles of stream with improved complexity or improved channel form in the Columbia Basin through implementing the NPCC Fish and Wildlife Program, 2005 - 2024. Data reported on Program Tracker as SPI E1-4 and summarized from measures 6 and 70 reported on CBFish.

Another example of increased habitat quantity and quality is illustrated by SPI E1-7.1. Data are provided by the Lower Columbia Estuary Partnership and covers the acres of land impacted by restoration, or acquisition, or a refuge. These data are summed for each geomorphic reach (Figure 42) and are summed in a way that there is no double counting of acres. The initial target was to protect and/ or restore 25,000 acres of habitat by 2025. That target was met in 2016 and updated to no-net loss of native habitats as of 2009. All told, 44,796 acres have been protected or restored, with a big emphasis on reaches B and F (Figure 43).

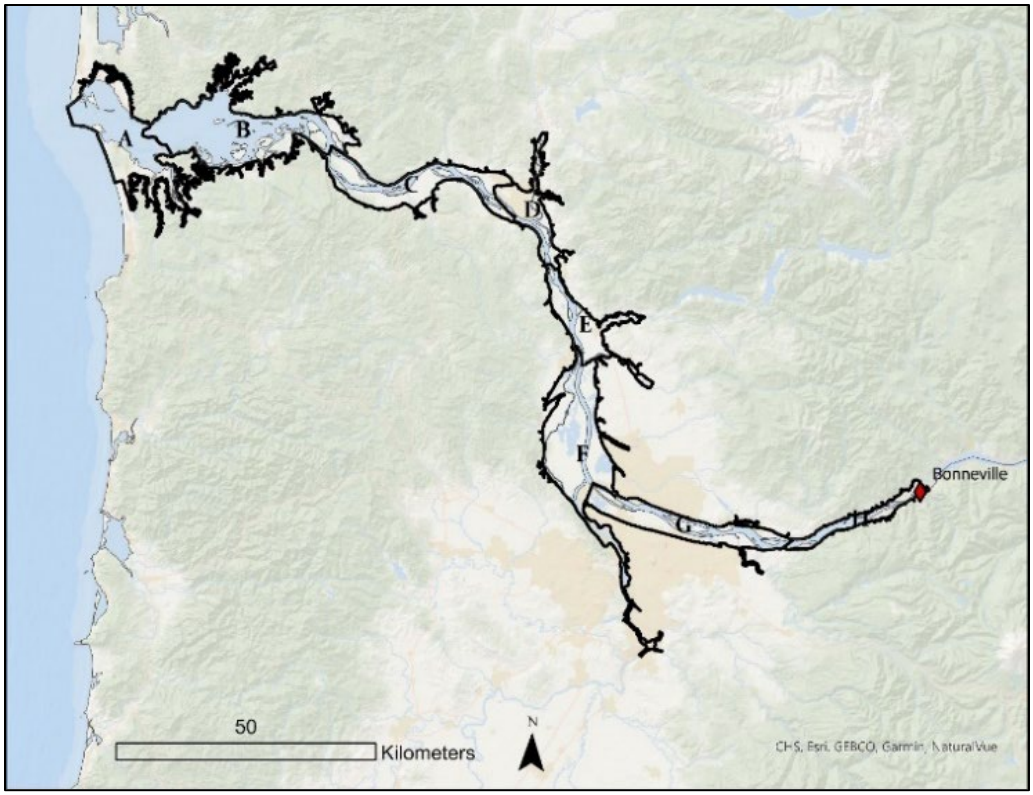


Figure 42. Geomorphic reaches in the Lower Columbia River and estuary

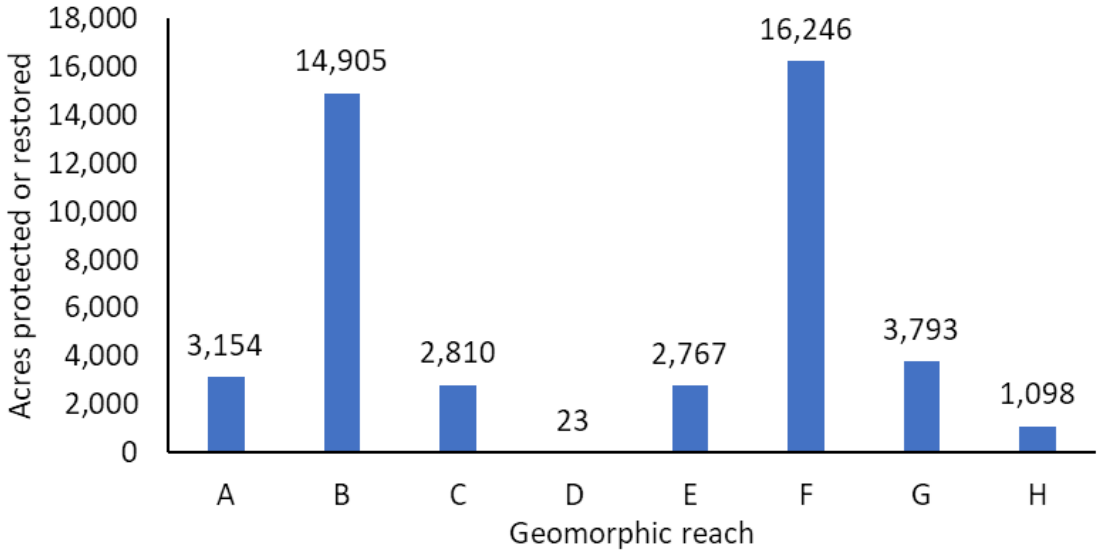


Figure 43. Total acres of land impacted by restoration and/or acquisition projects or protected by a refuge (no double counted areas). Data compiled by Lower Columbia Estuary Partnership and reported on the Program Tracker as SPI E1-7.1.

We also reported on examples of how project sponsors are taking climate change into consideration when implementing habitat restoration. During the Anadromous Fish Habitat and Hatchery project review, the Council asked project sponsors to more specifically address climate change impacts and adaptation measures. Project managers provided thoughtful and comprehensive responses to climate change questions. Many identified potential site-specific impacts to the local ecosystem and included citations and links to reports. The responses show that most project sponsors have been thinking seriously about climate change impacts in their region.

Examples of stepwise analysis:

- Applying broad-scale analyses to local areas and conditions
- Utilizing existing tools (Climate toolbox, NorWeST, etc.)
- Developing local-scale models
- Developing Climate Adaptation Plans

Examples of restoration actions:

- Prioritizing resilient habitats
- Designing for higher flood stages
- Revising planting regimes for future climate
- Identifying and connecting cold-water sources
- Ensuring connectivity under altered hydrologic conditions

In the Habitat Categorical Assessment, we reviewed numerous challenges related to data availability and quality. These challenges limit the scope of summaries that can be produced and our understanding of how the Program contributes to improvements in habitat quantity, quality, and connectivity. In the assessment, we propose that development of a publicly available habitat database- rather than a contract- management database (like CBFish), would greatly enhance the capacity of the region to understand how the landscape is changing in parallel with the substantial investments in and implementation of habitat restoration.

SPIs referenced in summary:

- **E1-4** Habitat Strategy: Miles of stream with improved complexity or channel form
- **E1-7** Estuary Strategy: Acres of estuary floodplain protected or restored per hydrogeomorphic reach. Compare to target of no net loss of native habitats and recovery of 40 percent of historic extent for priority habitats
    - E1-7 is based on the 2014 Fish and Wildlife Program Appendix D, Theme 1, and Corbett, C. et al. in preparation (Lower Columbia Estuary Partnership).

Other SPIs associated with objective: data available on Program Tracker

- **E1-1** Habitat Strategy: Number of habitat acres protected by purchase or conservation easement
- **E1-2** Habitat Strategy: Miles of stream protected by purchasing or leasing land
- **E1-3** Habitat Strategy: Miles of stream habitat accessed
- **E1-5** Habitat Strategy: Acres of habitat improved
- **E1-6** Habitat Strategy: Number of new fish screens installed, or number of screens improved

References

References for all data used for SPIs appear in the "Context, metadata, and sources" tab in Program Tracker.

Full details on habitat restoration are available in the supplementary documentation for the Habitat Categorical Assessment.

Objective E2

Contribute to maintaining and improving water quantity and quality.

Summary of progress

In our November presentation on the Habitat Categorical Assessment, we included examples of improving water quantity through acquisitions and leases under the Columbia Basin Water Transactions Program. Currently, over 1,200 CFS (Figure 44) and 217,800 acre-feet of water are protected.

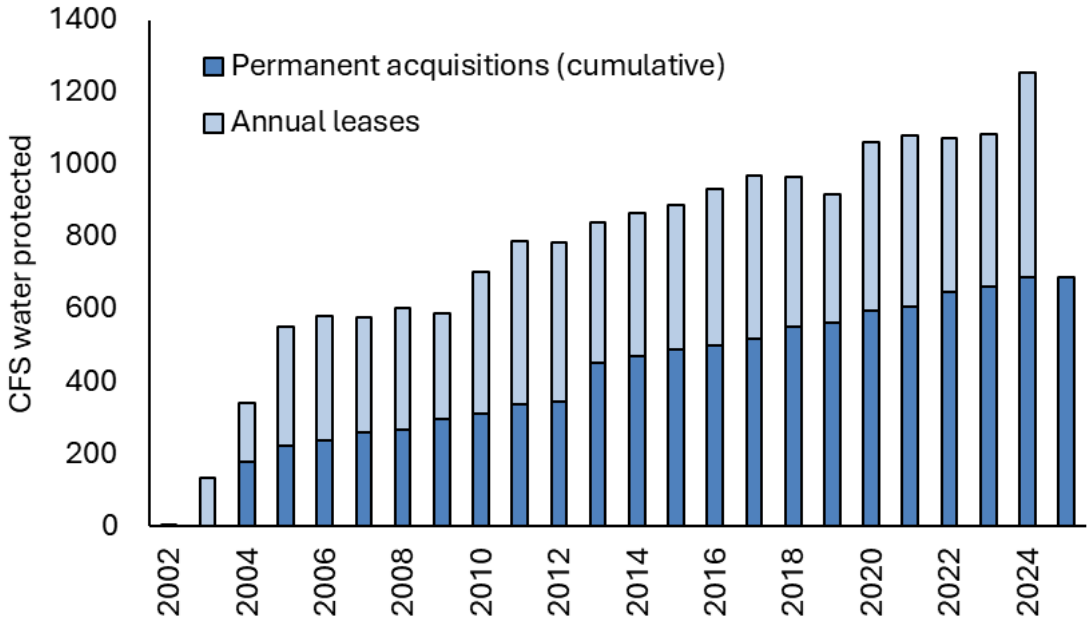


Figure 44. Permanent (acquisitions) and temporary (leasing) cubic feet per second (CFS) of water protected under the Columbia Basin Water Transactions Program, 2002-2025. Leases for 2025 were not available at the time of this report

We also described water quality (temperature) conditions in the mainstem in relation to exceedances of water quality standards. Temperature conditions are an indicator of ongoing and increasing climate change impacts and degradation, which affect fish during their migrations through the mainstem. Under the Clean Water Act (CWA 1977), designated uses of water bodies are identified, which includes uses for fish. Standards are set for temperature or other variables that reflect where impairment for this designated use is likely to occur. These standards do not describe conditions that may have existed previously or might exist in the absence of the hydrosystem. The EPA produced a report (EPA 2021) on the average number of days/month where the maximum daily temperature exceeded the water quality standard. We compare that data from 2011-2016 to contemporary data from 2017 – 2022 for Grand Coulee, McNary, The Dalles, Lower Granite, and Ice Harbor dams (example from The Dalles Dam; Figure 45).

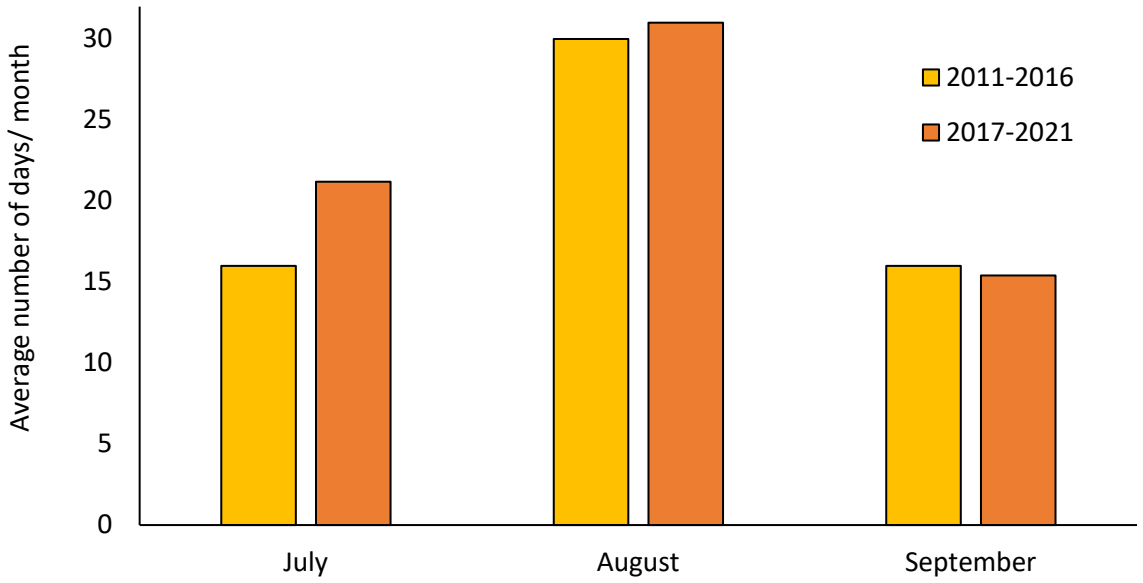


Figure 45. Average number of days/month when maximum daily temperature at The Dalles Dam exceeded the water quality standard of 20 °C. Data from 2017-2022 are compared to data from 2011-2016, which were reported in EPA 2021

We also reported on annual summer temperatures at those same dams, relative to the water quality standard at those dams. In general, there has been an increase in the amount of time and the degree to which mainstem temperatures exceed water quality standards (example from The Dalles Dam; Figure 46). This has implications for fish health and survival during migration and we discussed efforts to identify and protect cold water refugia in the mainstem.

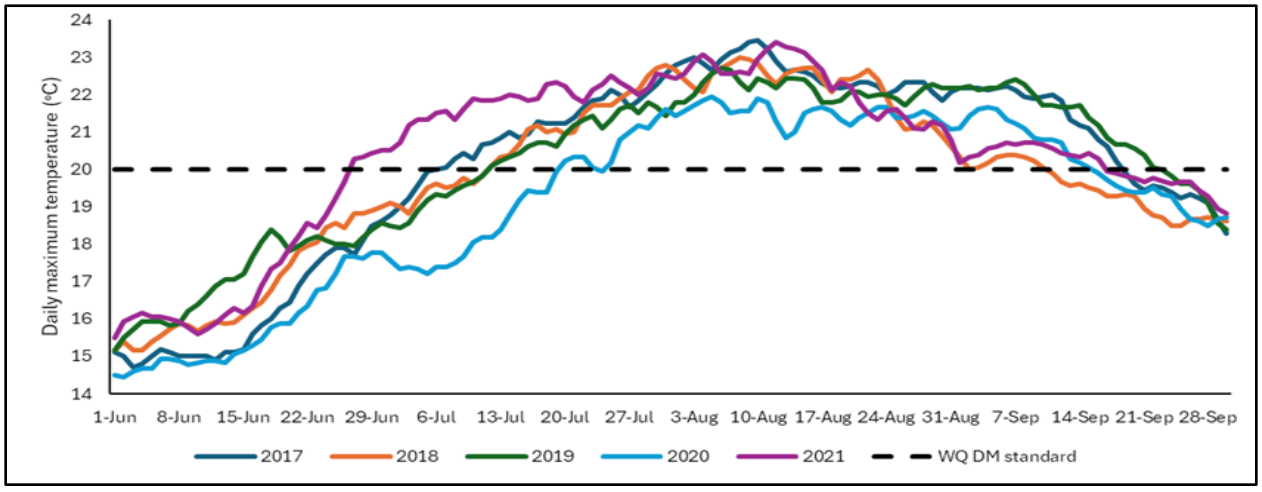


Figure 46. Daily maximum temperatures at The Dalles June – September in relation to the water quality standard of 20 °C (dashed line), 2017 – 2021. Abnormally early warming in 2021 resulted from an atmospheric "heat dome" event. Data reported on the Program Tracker under SPI E2-2/E2-4.

The Program does not contain SPIs on tributary temperature because of their complexity, but we drew on NorWest Stream Temperature data and models developed by USFS RMRS.

According to projected mean August temperatures (°C) for a forecast date of 2040, certain areas of the basin are expected to be quite a bit warmer (Figure 47) than baseline conditions reported for 1993-2011. Further warming is anticipated to occur by 2080, reducing the overall availability of cold-water habitats, fragmenting current habitats, and affecting flows. This information could be useful when planning or prioritizing restoration projects or where monitoring and research should occur.

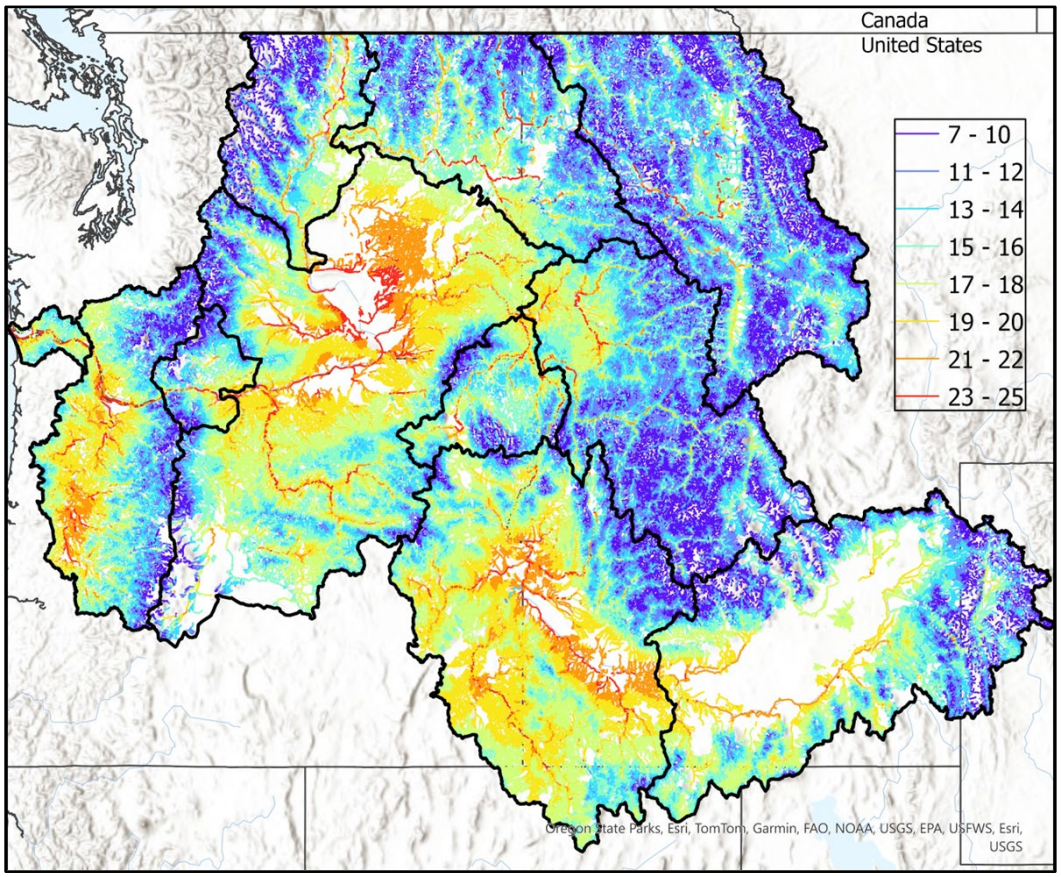


Figure 47. Mean August stream temperatures (°C) forecast for 2040 in the Columbia Basin, developed by the U.S. Forest Service, Rocky Mountain Research Station in their NorWeST stream temperature model

SPIs referenced in summary:

- **E2-1** Habitat Strategy: Instream flow added (acre-feet or cubic feet per second of protected water)
- **E2-2 / E2-4** Water Quality Strategy: Daily maximum water temperatures at fixed monitoring sites in the mainstem in reference to water quality targets.

- E2-2/ E2-4 consists of the standards promulgated or adopted by the five governments with jurisdictions over the Columbia, Lower Columbia, and Lower Snake Rivers listed in the February 5, 2018 draft document for Temperature Water Quality Standards for the Columbia, Lower Columbia, and Lower Snake Rivers prepared by U.S. EPA Region 10. This performance indicator relates to the general measures to address temperature under the 2014 Program's Water Quality sub-strategy.

Other SPIs associated with objective: data available on the Program Tracker

- **E2-3** Water Quality Strategy: Number of days of spawning temperatures between 12 °C and 18 °C for Columbia River (downstream of McNary Dam) white sturgeon.
  - E2-3 is based on Parsley, Michael J., Lance G. Beckman and George T. McCabe JR. Spawning and Rearing Habitat Use by White Sturgeons in the Columbia River Downstream from McNary Dam. Transactions of the American Fisheries Society 122:217-227,1993.
- **E2-5** Water Quality Strategy: Total dissolved gas (TDG) exceedances during spill events at Dworshak, Libby, Grand Coulee, Hungry Horse, Albeni Falls dams, and at other Columbia River and Snake River dams. Compare to the following standards:
  - E2-5 is based on the 2014 Fish and Wildlife Program Appendix D, Theme 1 and the Kalispel Tribe of Indians 2018/2019 program amendment recommendation to add the Albeni Falls Dam total dissolved gas standard of 110%.

Projects	TDG Standard
Dworshak	110% as set by Idaho State
Libby	110% as set by Montana State
Grand Coulee	Operate to minimize TDG production
Hungry Horse	110% as set by Montana State
Albeni Falls	110% as set by Idaho State
Columbia River and Snake River Dams	TDG Levels set by Oregon and Washington

References

Clean Water Act (CWA). 1977. The Federal Water Pollution Control Act Amendments of 1977 (Clean Water Act of 1977), Public Law 95–217, 91 Stat. 1566, (33 U.S.C. 1251 et seq.). Approved December 27, 1977.

Columbia Basin Water Transactions Program (CBWTP) website: https://www.nfwf.org/programs/columbia-basin-water-transactions-program?activeTab=tab-3

U.S. Environmental Protection Agency (EPA). 2021. Columbia and lower Snake Rivers Temperature total maximum daily load. Available online at: https://www.epa.gov/system/files/documents/2022-06/tmdl-columbia-snake-temperature-errata-update-05102022.pdf

U.S. Forest Service (USFS) Rocky Mountain Research Station (RMRS) NorWeST Stream Temperature website: https://www.fs.usda.gov/rm/boise/AWAE/projects/NorWeST.html

Objective E3

Provide flows through the hydrosystem of sufficient quality and quantity to improve production, migration, and survival of fish.

The Northwest Power Act allows for modifying both the structures and operations of the hydrosystem to improve conditions for fish and wildlife. The 2024 Hydrosystem Categorical Assessment (presentation and supplemental documentation available January 2025) described general constraints around flow management, prioritization of actions, and addressed who makes decisions and how flows are implemented. The Program does not contain priorities for how to implement multiple fish operations, but water management plans and Biological Opinions do contain priorities (i.e. reservoir refill vs. seasonal flows). We learned that flow measures are generally implemented as described with some obvious exceptions (i.e. summer flow targets). Targets in these operations function as sideboards but actual implementation requires ongoing management decisions including in-season adaptive management. This is something that the Program has called from the beginning and consistently encouraged evaluation and processes for coordination.

The 2014 Program and Part II of the 2020 Addendum describe the Program's objectives include flow objectives and reservoir elevation targets recognized in the Program and in most cases embedded in the federal system operating plans and intended to benefit both listed and key unlisted populations of anadromous and resident fish. These objectives include managing water through the hydroelectric system to attempt to achieve seasonal flow objectives at specified mainstem Columbia and Snake River dams, with limitations and adjustments on meeting these targets as described by the Action Agencies in the 2018 ESA Section 7 consultation documents and in the 2014 Program's Mainstem strategy.

- Objective E3 is based on (a) the 2019 CRS Biological Opinion, (b) 2018 Consultation Package related to the 2019 CRS Biological Opinion, (c) the 2008 FCRPS BiOp, and (d) 2007 Biological Assessment for Effects of Federal Columbia River Power System and

Mainstem Effects of Other Tributary Actions on Anadromous Salmonid Species Listed Under the Endangered Species Act.

Table 11. Spring and summer flow targets (KCFS) as determined by the 2007 Biological Assessment for Effects of Federal Columbia River Power System and Mainstem Effects of Other Tributary Actions on Anadromous Salmonid Species Listed Under the Endangered Species Act. Data reported on Program Tracker under SPI E3-1.

Location	Spring		Summer	
	Dates	Objective (kcfs)	Dates	Objective (kcfs)
Snake River at Lower Granite Dam	4/03 to 6/20	85 to 100(1)	6/21 to 8/31	55 to 55(1)
Columbia River at McNary Dam	4/10 to 6/30	220 to 260(1)	7/01 to 8/31	200
Columbia River at Priest Rapids	4/10 to 6/30	135	N/A	N/A
Columbia River at Bonneville Dam	11/1 to emergence	125 to 160(2)	N/A	N/A

(1) the KCFS objective varies according to value forecasts.
(2) the KCFS objective varies based on actual and forecasted water conditions.
KCFS: thousand cubic feet per second

The Columbia River hydrosystem is a highly integrated web of storage and response locations. Changes in operations or annual water supply can affect the entire system.

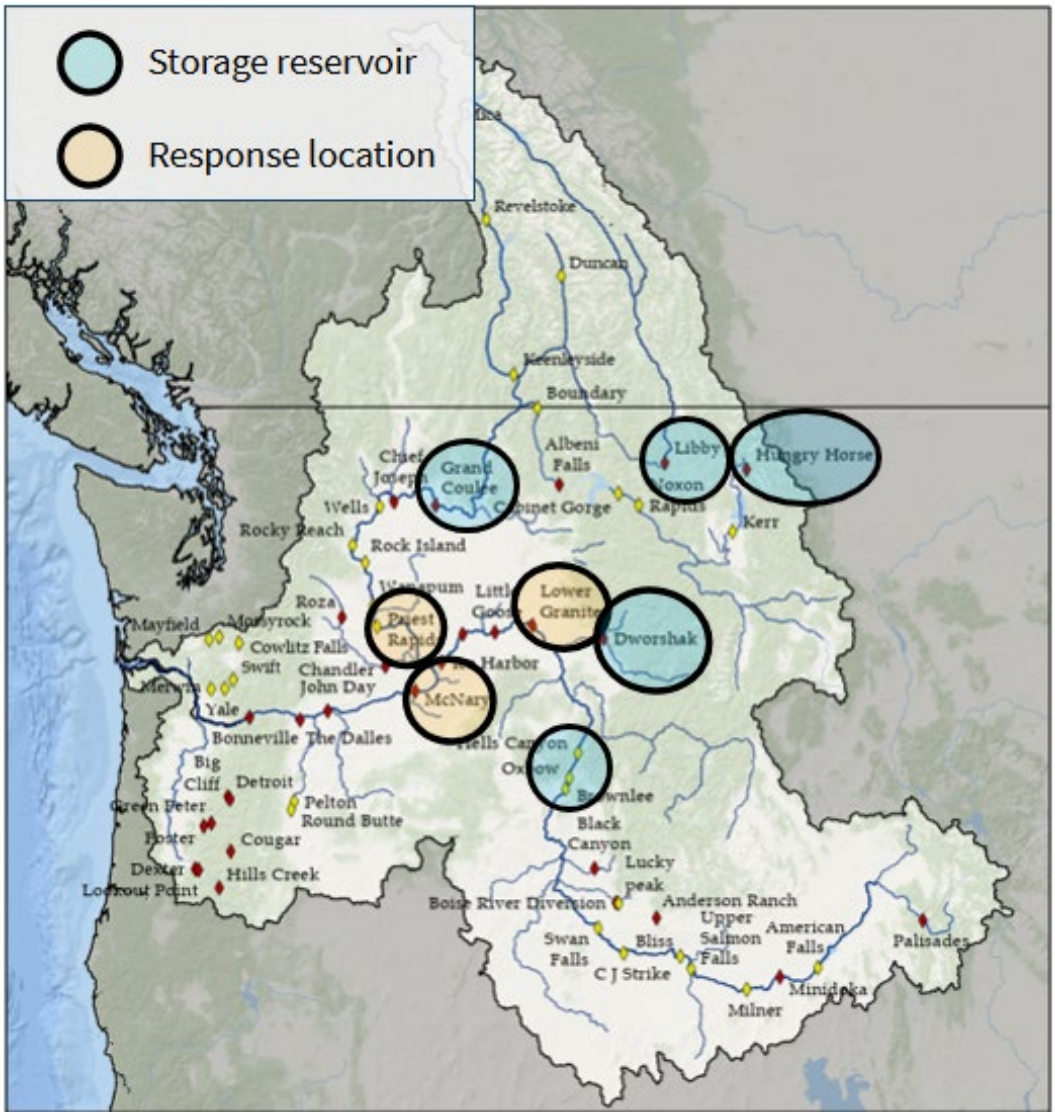


Figure 48. Location of major dams (diamonds; red = federally owned, yellow = publicly or privately owned) in the Columbia River Basin with storage reservoirs and the main response dam circled in blue and orange, respectively. Map created in ArcGIS Pro © 2020 ESRI.

Summary of progress

The NW Power Act allows for modifying operations and structures of the hydrosystem for the benefit of fish and wildlife, as part of mitigation. Operations are designed for a range of species or seasons and are implemented throughout the basin. Council staff reviewed hydrosystem measures in the Program in great detail in the Hydrosystem Categorical Assessment and presented this information to the Council in both October 2023 and September 2024. For specific details on individual operations, their implementation, challenges, opportunities, and adaptive management, please review the Hydrosystem Categorical Assessment.

In the hydrosystem assessment, we identified general constraints around flow management and prioritization, including who makes decisions, how flows are implemented, and who is responsible. In general, operations in the Program are implemented as described, but we also identified specific operations that are either partially implemented or not implemented at all. We also identified operations where new information or management strategies/ priorities has resulted in alternative implementation to what is described in the Program.

We also noted that many improvements have occurred over the lifetime of the Fish and Wildlife Program. These include improved modeling (e.g., forecasts), integration of lessons learned from 40 years of implementation, and establishment of systems to allow for in-season adaptive management.

Following our review of implementation, we proposed some key points for the region to consider in anticipation of this upcoming Program amendment. These points include:

- How to address cases of incomplete implementation? Are there missed opportunities to increase survival through existing operations?
- How to incorporate changing demands and operation of system now and into future?
    - Columbia River Treaty, ramp rates, spill, BiOps, climate change, population growth
- Are operations adaptable? Flexible? Do they support system resilience?

SPIs referenced in summary:

- **E3-1** Mainstem Hydrosystem Flow and Passage Strategy: Seasonal flows at specified Columbia and Snake River dams

Other SPIs associated with objective: data available on the Program Tracker

- **E3-2** Mainstem Hydrosystem Flow and Passage Strategy: Travel time for salmon and steelhead – Lower Granite to Bonneville Dam and uppermost dam to Bonneville Dam
- **E3-3** This code is not used in the Program
- **E3-4** Mainstem Hydrosystem Flow and Passage Strategy: Percent of days with flow equal to or greater than 250 KCFS from McNary Dam May through July for sturgeon recruitment
- **E3-5** Mainstem Hydrosystem Flow and Passage Strategy: Reservoir elevation and retention times at storage reservoirs

References

BPA, 2008. May 2008 NOAA Fisheries FCRPS Biological Opinion on Operation of the Federal Columbia River Power System. https://www.bpa.gov/-/media/Aep/about/publications/records-of-decision/2008-rod/rod-20080813-may-2008-noaa-fisheries-fcrps-biological-opinion.pdf

NOAA, 2018. ESA Section 7(a)(2) Initiation of Formal Consultation for the Operations and Maintenance of the Columbia River System on NOAA Fisheries Listed Species and Designated Critical Habitat. Full text: https://www.noaa.gov/sites/default/files/legacy/document/2020/Oct/07354626569.pdf

NOAA, 2024. Federal Columbia River Power System Biological Opinion. Landing page: https://www.fisheries.noaa.gov/west-coast/endangered-species-conservation/federal-columbia-river-power-system-biological-opinion

Objective E4

Contribute to further reducing avian, pinniped and fish predators that negatively impact the habitat and populations of focal fish species in order to improve abundance and survival of these fish species.

Summary of progress

The Council acknowledges that predator management is a complex issue that often pits one species against another. To balance a highly modified ecosystem like the Columbia River Basin, there will be short-term winners and losers but hopefully long-term improvements in the relative overall health of the ecosystem.

Predator management has expanded in the current decade. A science and policy exchange on predation was held in 2012. This was followed by the 2014 Program which included numerous measures on predator management – both of native species (sea lions, seals, northern pikeminnow, double-crested cormorants, Caspian terns, white pelicans) and non-native species (northern pike, brook trout, other game fish). The 2020 Addendum re-emphasized these measures with a near-term priority of sustaining and supporting ongoing efforts to reduce predation by northern pike. The years 2016, 2019, and 2021 saw ISAB reports on predation impacts.

The earliest measures in the Program addressed study methods to control pikeminnow. Pikeminnow suppression was a continued focus in the ‘90s. Efforts also expanded to include avian predators at outfalls and the initial push to explore options for lethal take of marine mammals and evaluate predator abundance in Lake Pend Oreille. Agreements with PUDs and the Columbia Basin Accords further supported predator management. In the 2000s, evaluations to assess the impact of predation on listed fish (following ESA listings in the ‘90s) which resulted in specific predator management policies targeting native piscivorous fish, birds, and pinnipeds. Most recently, work has evaluated predation on certain species, continued to remove predators like Northern pikeminnow, and sustained and supported ongoing efforts to reduce predation by pinnipeds and birds through multiple active technical workgroups.

In the fall of 2024 staff presented a summary of avian predation throughout the Columbia River Basin (Figure 49). Recent data suggest that the numbers of terns and cormorants nesting in the Basin have declined, which was the objective of management, but has also resulted in declines in the Pacific Flyway breeding populations of both species. This raises concerns about the conservation status of these populations, especially for the rapidly declining Pacific Flyway breeding population of Caspian terns.

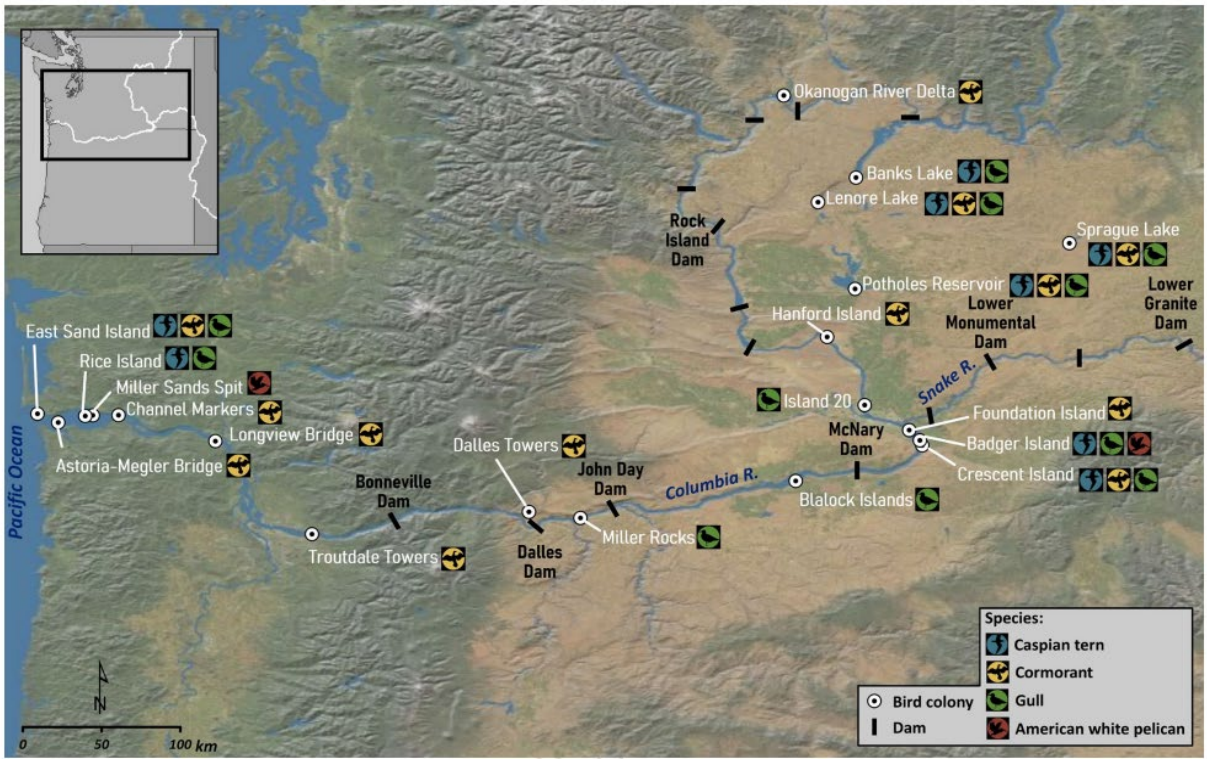


Figure 49. Locations of bird colonies and dams in the Columbia River Basin. Credit: Allen Evans, Real Time Research, August 2024

The staff also summarized the shift of double-crested cormorants in the estuary from their historical nesting areas in the marine zone to further upstream in the mixing and freshwater zones. As double-crested cormorants have relocated from East Sand Island to the Astoria-Megler Bridge and other colonies, per capita predation rates have increased substantially. The Oregon Department of Fish and Wildlife (ODFW) estimates total estuary-wide DCCO predation on these runs to have been about 12-14% during the same year (Figure 50).

Figure 50. Relative predation rates over time as double-crested cormorants have relocated from East Sand Island to the Astoria-Megler Bridge and other colonies further upstream. Credit: James Lawonn, ODFW, 2024.

The most extensively managed areas of the Columbia Basin for marine mammal predation on juvenile salmonids are currently the I-205 Bridge to Bonneville Dam and at Willamette Falls (Figure 51). There is also monitoring above Bonneville Dam to McNary Dam, but a sea lion has never been confirmed upstream of The Dalles Dam.

Figure 51. Areas of marine mammal monitoring left to right Willamette Falls, I-205 Bridge to Bonneville Dam, and Bonneville Dam to McNary Dam

Counts of pinnipeds are conducted at certain times and locations annually to assess whether the population is increasing or decreasing over time. Shifts in species and abundance has been observed at Bonneville Dam (Figure 52).

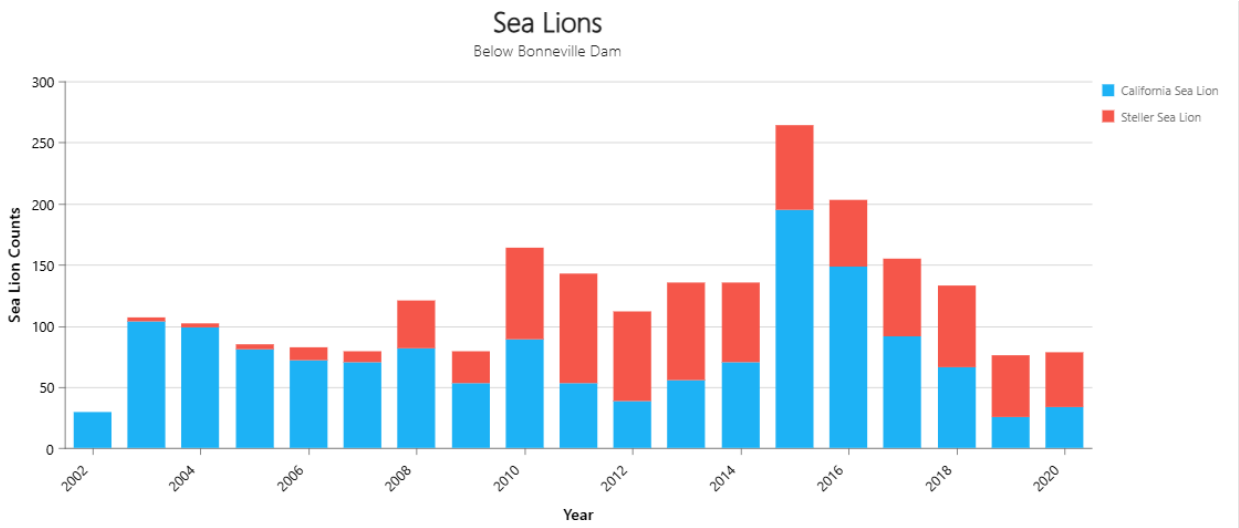


Figure 52. Minimum estimated number of individual California and Stellar sea lions counted during the spring sampling period. Data reported on the Program Tracker as SPI E4-6.

Sea lion management at Willamette Falls has shown a measurable decrease in individuals exploiting salmon runs during the spring season since 2019 (Figure 53).

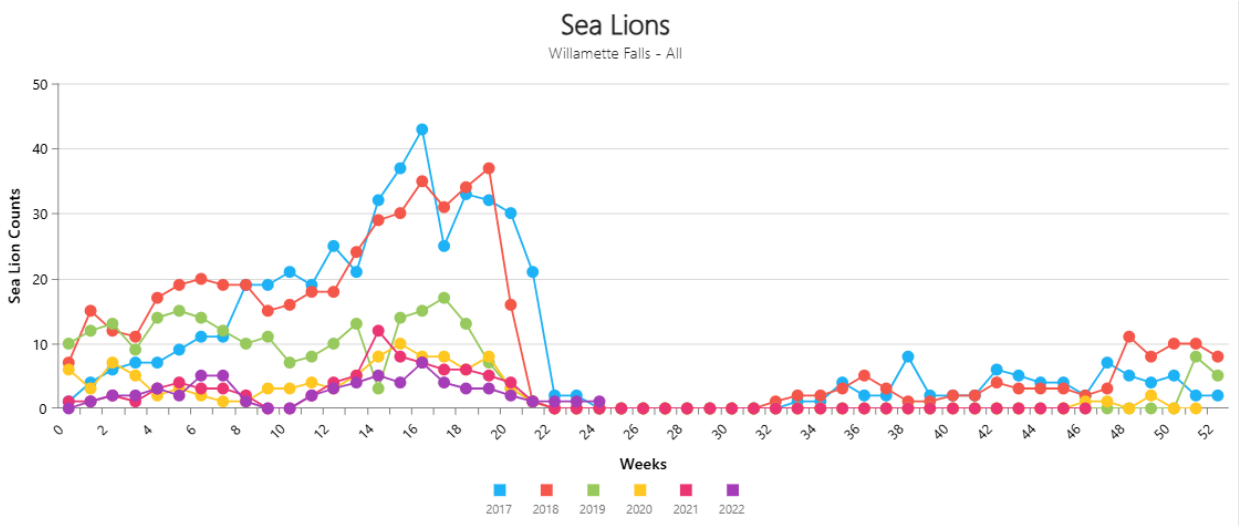


Figure 53. Number of individual pinnipeds by reported by week at Willamette Falls. Data reported on the Program Tracker as SPI E4-6.

The monitoring and control of Northern pikeminnow has been one of the longest running measures and actions supported by the Program. Prior to the 1990s, removals had decreased population abundance by about 10%. The new direction in the '90s was to increase that level to approximately 20% which was expected to result in at least a 50% reduction in predation on juvenile salmonids (NPPC 1994). The goal of the Program is not to eliminate Northern pikeminnow, a native species, but rather to reduce the number of large fish that have increased in numbers due to the environmental conditions created by the hydrosystem. Reducing the number of these larger predators can greatly increase the salmon and steelhead juveniles making it out to sea.

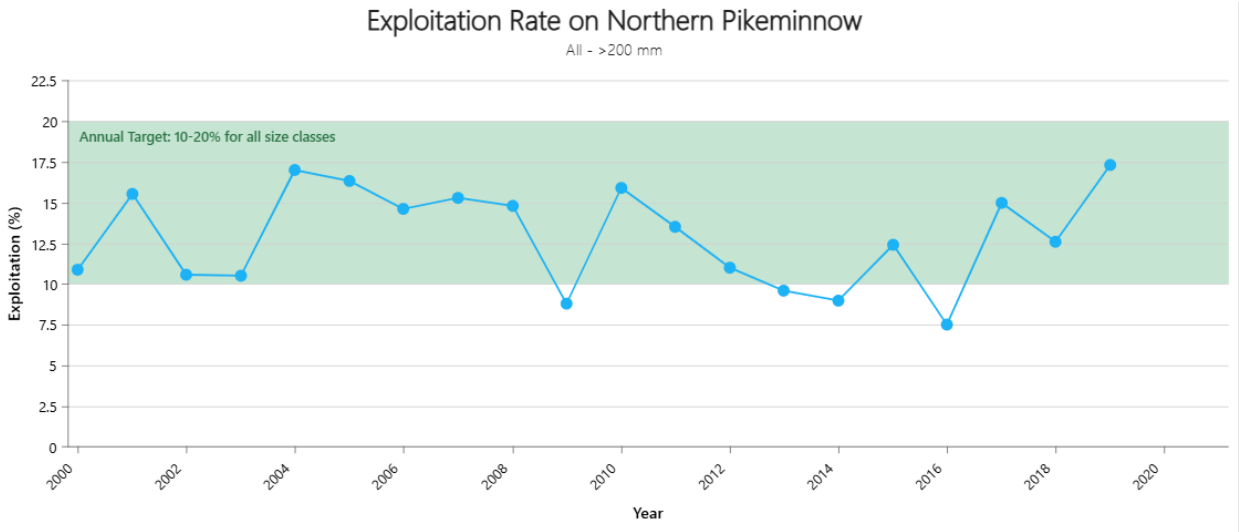


Figure 54. Percent exploitation rate on Northern pikeminnow. For years without data, either sampling was not conducted or no exploitation was calculated due to low sample sizes. Sport Reward Fishery regulations changed in 2000 to allow angler retention of Northern Pikeminnow ≥ 200 mm FL. During prior years (1991–1999), Sport Reward Fishery retention was limited to Northern Pikeminnow ≥ 250 mm FL. Data can be found in the Program Tracker SPI E4-4.

In summary:

- Predator management techniques and implementation in the Columbia Basin vary widely based on the species.
- Priorities tend to shift with ESA listings, regional focus, and funding opportunities.
- Incentive programs can be useful to engage the public and ensure continued monitoring.
- Relieving the pressure of one type of predation can invite other types to fill that niche.

SPIs referenced in summary:

- **E4-4** Predator Management Strategy: Exploitation rate on Northern Pikeminnow measuring nine inches or greater in total length (228 mm fork length). Compare the exploitation rate to the 10-20 percent annual target.
    - The Performance Indicator E4-4 is based on (a) the 2014 Fish and Wildlife Program Predator Management Strategy; and (b) Williams, S.E. et al. 2017 Report on the predation index, predator control fisheries, and program evaluation for the Columbia River Basin Northern pikeminnow sport reward program, 2017 Bonneville Annual Project Report, Project No. 1990-077-00.
- **E4-6** Predator Management Strategy: Counts of sea lions observed at Bonneville Dam, the lower Columbia River, estuary and Willamette Falls. Compare trend to determine if the impacts are decreasing over time.

Other SPIs associated with objective: data available on the Program Tracker

- **E4-1** Predator Management Strategy: The number of breeding pairs of Caspian Terns and availability of suitable nesting habitat on East Sand Island. Compare the breeding pairs to the target range of 3,125 to 4,375, and the suitable nesting habitat to the target of one acre.
    - The Performance Indicator E4-1 is based on (a) the 2014 Fish and Wildlife Program Predator Management Strategy; (b) USFWS 2005 Caspian Tern Management to Reduce Predation of Juvenile Salmonids in the Columbia River Estuary, Final Environmental Impact Statement; (c) USACE 2014 Inland Avian Predation Management Plan Environmental Assessment; and, (d) Roby D.D. et al. 2015 Avian Predation on Juvenile Salmonids: Evaluation of the Caspian Tern Management Plan in the Columbia River Estuary. 2015 Bonneville Annual Project Report, Project No. 1997-024-00.
- **E4-2** Predator Management Strategy: Cormorant colony size at East Sand Island. Compare to management goal that colony size does not exceed management average of 5600 breeding pairs.
    - The Performance Indicator E4-2 is based on Double-Crested Cormorant Management Plan to Reduce Predation of Juvenile Salmonids in the Columbia River Estuary Final Environmental Impact Statement (FEIS).
- **E4-3** Predator Management Strategy: Predation rate on ESA-listed juvenile salmonids by Caspian Terns in the Columbia Plateau region compares to target of less than 2%.
    - The Performance Indicator E4-3 is based on Avian Predation in the Columbia Plateau Region: Management, Monitoring and Evaluation, 2019 Final Annual Report
- **E4-5** Predator Management Strategy: Emigration, spatial distribution, and index of abundance of non-native Northern Pike in the Columbia River Basin. Evaluate trend to determine if the numbers and range are reducing over time.
    - The Performance Indicator E4-5 is based on (a) from the 2014 Fish and Wildlife Program Predator Management Strategy; and (b) Northern Pike Suppression and Monitoring, Bonneville Project No. 2017-004-00, implemented by the Colville Confederated Tribes, Spokane Tribes, and WDFW.
- **E4-6** Predator Management Strategy: Counts of sea lions observed at Bonneville Dam, the lower Columbia River, estuary and Willamette Falls. Compare trend to determine if the impacts are decreasing over time.
- **E4-7** Predator Management Strategy: Proportion of the adult salmon and steelhead run consumed by sea lions in the lower Columbia River and estuary, with emphasis on upper Columbia spring Chinook and wild Winter Steelhead.

- **E4-8** Predator Management Strategy: Number of adult salmon and steelhead, White Sturgeon, and Pacific Lamprey consumed by sea lions at Bonneville Dam, the lower Columbia, estuary and Willamette Falls.
    - The Performance Indicators E4-6, E4-7 and E4-8 are based on (a) the 2014 Fish and Wildlife Program Predator Management Strategy; (b) 2011 Tribal Pacific Lamprey Restoration Plan for the Columbia River Basin; (c) Hatch D.R. et al. 2018. Sea Lion Monitoring and Non-Lethal Hazing. 1/1/2017 – 12/31/2017 Bonneville Annual Project Report, Project No. 2008-004-00; and (d) Tidwell K.S. et al. 2018. Evaluation of Pinniped Predation on Adult Salmonids and other Fish in the Bonneville Dam Tailrace, 2018. USACE Portland District, Fisheries Field Unit. Cascade Locks, Oregon, available at pweb.crohms.org/tmt/documents/FPOM/2010/Task%20Groups/Task%20Group%20Pinnipeds/2018%20Pinniped%20Annual%20Report.pdf

References

Real Time Research and Oregon State University, 2021. Avian Predation Synthesis Report. https://www.birdresearchnw.org/Avian%20Predation%20Synthesis%20Report%20Final_v2.pdf

M. James Lawonn, 2023. A Status Assessment of the Double-crested Cormorant (Nannopterum auritum) in the Columbia River Estuary and Implications for Predation on Outmigrating Juvenile Salmonids. https://digitalcollections.library.oregon.gov/nodes/view/123246?keywords=lawonn&type=all&highlights=WyJsYXdvbm4iXQ%3D%3D&lsk=4e10c15606956d7f08978bd47ad98726)

Objective E5

Contribute to management, prevention or eradication of non-native and invasive species in order to improve abundance and survival of focal fish and wildlife species.

Summary of progress

Since the 1990's, Programs have called for investigating the effect of non-native or invasive species on resident and anadromous fish, particularly if they were ESA-listed.

- The first calls for investigating these species included shad and brook trout in the 1990s followed by zebra and quagga mussels and others.
- Monitoring and evaluation of species varies widely from highly intensive monitoring throughout the basin (mussels and Northern Pike) to no monitoring at all (American Shad and certain aquatic vegetation species).

Zebra and Quagga mussels

The 2014 Program called the introduction of zebra or quagga mussels "the greatest known threat in the Columbia River Basin from aquatic invasive species." Quagga veligers and 1 adult were detected for the first time in the Columbia Basin in the Snake River in 2023 and 2024 (Figure 55). Rapid response plans were successfully executed and additional resources were provided.

Zebra and quagga mussels multiply rapidly, clogging pipes and intake structures. The potential economic, hydropower and ecological impacts from invasive quagga mussels should not be underestimated.

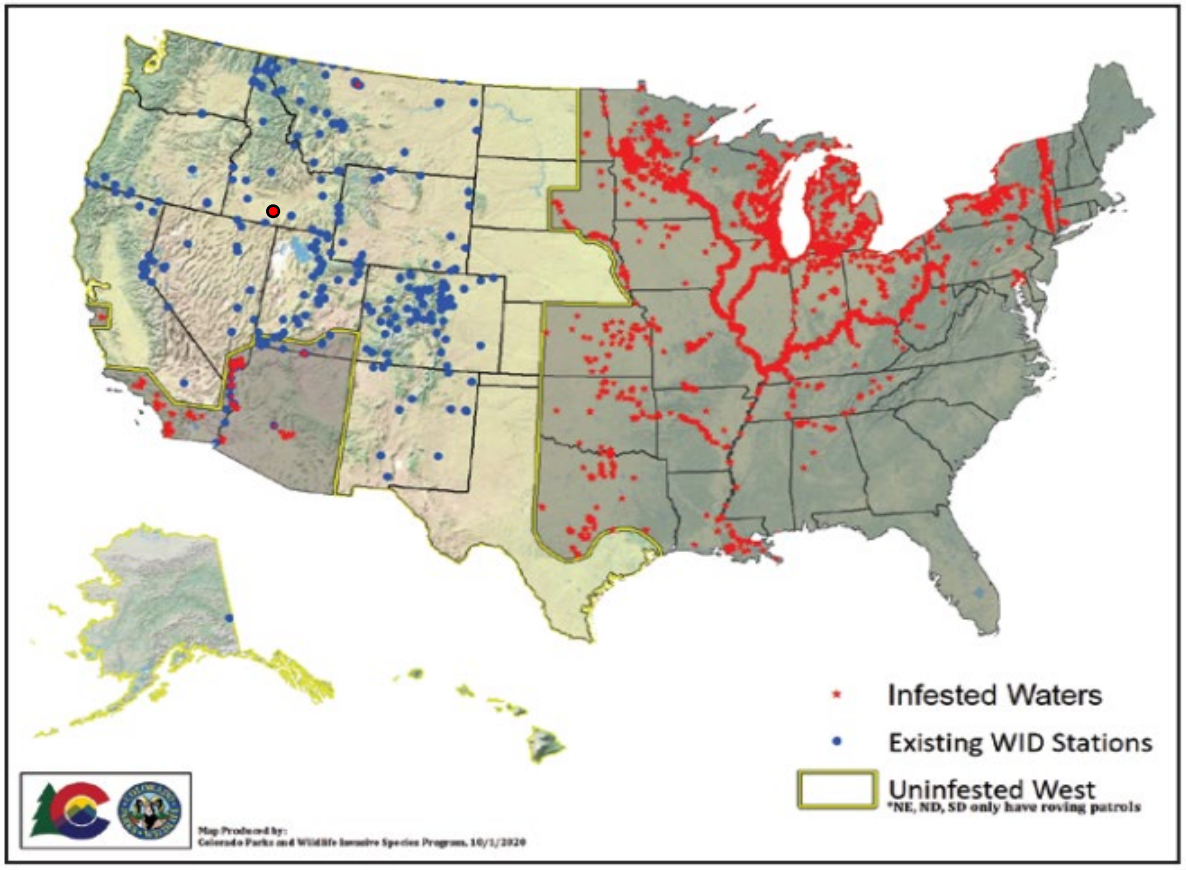


Figure 55. Map of quagga mussel occupancy in the United States. Source: CO Parks and Wildlife

American shad

Council staff summarized adult counts of American shad at Bonneville Dam since 1938 to show the dramatic increase in the population with four peak returns alone since 2019 (Figure 56). The 2021 ISAB report provides recent analysis on what the Council called for as early as 1994 to "Explore the population ecology of shad to determine effective methods for control and develop programs to eliminate shad from the Columbia River system above Bonneville Dam and reduce the shad population below Bonneville Dam".

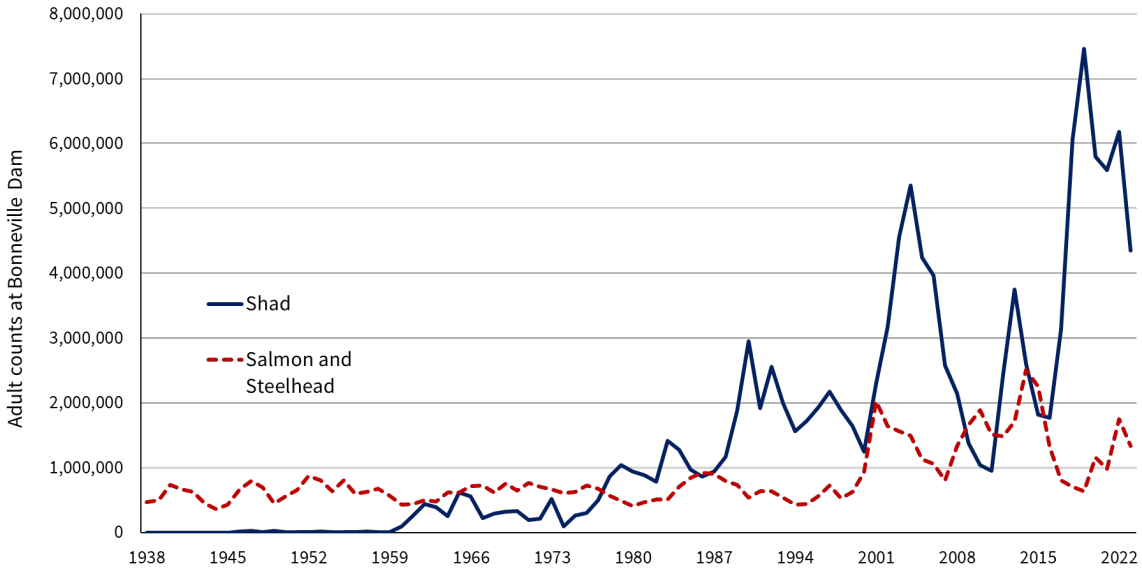


Figure 56. American shad and salmon and steelhead returns at Bonneville Dam 1938-2023

The prioritization of non-native and invasive species research, monitoring, and evaluation should be strongly considered in a changing basin. Why?

- Shifting climate regimes often benefit invasive and non-native species.
- Human demands on the ecosystem affecting flow, temperature, etc. may exacerbate these changes.
- Alterations to water temperature and water quality
- The creation of habitat conditions favorable to non-native and invasive species and native predators, changing patterns of predation throughout the mainstem and estuary, and changes to the ecological function of rivers, lakes, the estuary, and the nearshore plume.
- Drawdown and refill rates and volumes in reservoirs can exert a substantial impact on the food web in reservoirs, free-flowing reaches of rivers, and lakes.

The Columbia River Basin is highly modified and complicated.

- Emerging niches may benefit non-native and invasive species.
- Anticipation may help improve management and protection of native species or species of concern.

SPIs referenced in summary: NA

Other SPIs associated with objective: data available on the Program Tracker

- **E5-1** Non-Native and Invasive Species Strategy: Number of watercraft inspected and decontaminated in the northwest states of the Columbia River Basin for zebra/quagga mussels.

- **E5-2** Non-Native and Invasive Species Strategy: Ratio of positive detections of zebra/quagga mussels to number of inspected watercraft.

References

ISAB, 2021. American Shad in the Columbia River: Past, Present, and Future. https://www.nwcouncil.org/media/filer_public/18/19/1819d013-b3d5-4340-9ebd-dfd3580cd236/ISAB_2021-4_Shad_Report_22Oct.pdf

NPCC, 2024. Update on Response to Detection of Quagga Mussels. Link to presentation: https://www.nwcouncil.org/fs/18851/2024_0813_4.pdf

Objective E6

Contribute to maintaining and improving habitat quality on land purchased or managed to mitigate for hydrosystem impacts on wildlife, resident fish, and/or anadromous fish by developing and using approved land management plans for all parcels purchased under the program.

Summary of progress

This objective appears to cover the same information as under Wildlife Objective 4, but explicitly references lands acquired for resident and anadromous fish. As noted under W4, land management plans are required for all parcels purchased under the Program. Approximately 55% of parcels currently have approved plans in CBFish; additional plans exist elsewhere (e.g., within agencies). There is an ongoing need to continue developing or updating land management plans and to compile that full set of plans in CBFish.

Land management plans form the basis for maintaining and improving mitigation values on acquired lands. There is no comprehensive, public database on the condition of acquired parcels, relative to defined mitigation values. Individual entities have information on their own activities and the condition of their lands, and there are annual reports on each parcel. Compiling information from this full set of sources would be time-consuming and challenged by the different types of O&M and physical characteristics of the various parcels. It would be more informative to collect all LMPs in one location, identify a very simple but useful set of indicators to track, and then populate those indicators using data uploaded to CBFish annually. It is a current priority of BPA to develop a system to provide regular reporting on the condition of acquired lands (BPA 2024). Currently, with only 55% of parcels in CBFish with approved management plans, more work is needed to meet this objective.

SPIs referenced in summary:

- NA

Other SPIs associated with objective: data available on the Program Tracker

- **E6-1** Habitat Strategy: Number of habitat acres protected or improved.
- **E6-2** Habitat Strategy: Miles of road or trail removed or improved.

References

BPA. 2024. Hatcheries and land, strategic asset management plan. Available online at: https://www.bpa.gov/-/media/Aep/finance/strategic-asset-management-plans/2024-efw-hatchery-and-land-samp.pdf

Communication, Assessment and Coordination

Goal

Inform the public about the Fish and Wildlife Program to encourage awareness and involvement, including consideration of the program within an ecological and social context. Track and report on progress in program implementation and performance. Secure improved access to all program-related information and data.

- The Communication goals and objectives are based on the Public Engagement goals in 2014 Program App D and consultation during the program amendment goals and objectives workshop.

Summary of progress

All objectives under the Communication, coordination, and assessment goal are achieved through actions implemented by the Council, in coordination with the region. This goal reflects the Council's responsibility under the Northwest Power Act to: *(1) to develop a program to protect, mitigate and enhance fish and wildlife affected by hydroelectric facilities in the Columbia River Basin, (2) to develop a power plan assuring the Pacific Northwest of an adequate, efficient, economical, and reliable power supply, consistent with the fish and wildlife program, and (3)* ***to inform and involve the public***. These objectives are generally qualitative, and we report on them by linking to the reporting tool developed to share the referenced information.

Objective C1

Annually report on progress toward program objectives, program strategy performance indicators, and addressing research critical uncertainties.

Summary of progress

The Council has taken a variety of actions to meet this objective. Over the last four years, we developed a webtool to track strategy performance indicators and populated it with all available data on SPIs. The Program Tracker data are updated in real time whenever possible using API connections to other databases or annually when information is contained in reports or received directly from managers. In 2024, we added new capacity to the Program Tracker to be able to track progress toward meeting Goals and Objectives

Additional reporting is needed on addressing research critical uncertainties.

SPIs referenced in summary: data available on Program Tracker

- **C1-1** Public Engagement Strategy: Status and summary reports on strategy performance indicators and progress toward objectives and goals.

Objective C2

Review progress toward achieving objectives and strategy performance indicators and refine program objectives and program strategy performance indicators as needed.

Summary of progress

This objective sounds similar to the last, but we interpret the first objective to be focused on the tools used to report and the second objective to be focused on the analytical process and identification of refinements that are needed. Staff have reviewed progress toward goals and objectives. We further identified goals and objectives that may need to be refined to be S.M.A.R.T. or that are not currently trackable. Refinement of these or any other changes to goals and objectives must occur through a Program amendment.

We also reviewed data on Strategy Performance Indicators in categorical assessments and this presentation. To develop and refine Strategy Performance Indicators, staff held workgroup meetings and subgroup meetings with managers to determine what data were available, how it should be reported, and whether any SPIs needed to be refined to match that data. Because SPIs are not adopted in the Program, modifications to them can occur outside of an amendment process.

Staff also presented to the Council and RCF on SPIs during their development and as part of Categorical Assessments.

SPIs referenced in summary: data available on Program Tracker

- **C2-1** Public Engagement Strategy: Periodic review and refinement of strategy performance indicators with managers and the Regional Coordination Forum (RCF).

- **C2-2** Public Engagement Strategy: Review meeting(s) with managers and RCF on program objectives and strategy performance indicators prior to next program amendment.

Objective C3

Improve access to information to inform decisions about program investments, operation and maintenance, and factors that affect program activities and success.

Summary of progress

A substantial part of Council work relates to communicating information that relates to Program implementation, activities, performance, and investment. These are just a few examples of how this objective has been met.

- On Program investments:
  - Governor's report
  - Start of year budget presentation (example from 2024) from Bonneville
- On O&M
  - BOG- working for improved transparency and tracking of implementation
  - Asset Management plan- contains transparent and public elements
  - Assessing non-recurring maintenance needs associated with Program assets (e.g., hatcheries, screens, lands)
- On Program activities and success
  - Project review all done in public
  - Increasing outreach by Public Affairs division, more and better social media, newsletter,
  - Improved website, Program Tracker, other communication tools
  - Support of existing collaborative regional information exchange groups and databases- most recently through a presentation series on data management in the Basin
  - Support of numerous meetings, seminars, and workgroups- in-kind and through sponsorships

SPIs referenced in summary: data available on Program Tracker

- **C3-1** Public Engagement Strategy: Updates to and review of the Council's Program Tracker and Program Performance & Progress sites.

- **C3-2** Public Engagement Strategy: Annual updates to the Council's tracking document for Operation and Maintenance (O&M) needs for hatcheries, fish screens and lands and fish objectives and associated mappers.
- **C3-3** Public Engagement Strategy: Publication of the Columbia River Basin Fish and Wildlife Program Cost Report to the Northwest Governors.
- **C3-4** Public Engagement Strategy: Update on Columbia River Fish Mitigation annual capital investments.
- **C3-5** Public Engagement Strategy: Support of existing collaborative regional information exchange groups and databases, especially program-supported efforts. Examples are: The Coordinated Assessments Partnership, StreamNet, Fish Passage Center, CRITFC Inter-Tribal Monitoring Data, Columbia Basin Fish & Wildlife Library, Pacific Northwest Aquatic Monitoring Partnership, the Intermountain Province Subbasin Data Management Project and YNStar.
- **C3-6** Public Engagement Strategy: Financial and/or in-kind support to existing regional forums contributing to the program's progress, such as the RCF, Fish Screen Oversight Committee, Lamprey Technical Work Group and Conservation Team, collaborative White Sturgeon workshop, Lake Roosevelt Forum, Washington Salmon Recovery Conference, American Fisheries Society local meetings, The Columbia Basin Transboundary Conference, and Council science-policy exchanges.

Objective C4

Track FERC hydroelectric project applications with respect to the program's protected areas.

Summary of progress

The Council periodically tracks applications for hydroelectric development and any preliminary permits that FERC issues to make sure they are not in areas designated as protected from future hydroelectric development. BPA used to employ someone who tracked FERC relicensing but no longer funds that position. No licenses have been granted by FERC in protected areas since they were designated in 1988.

SPIs referenced in summary:

- **C4-3** Protected Areas and Hydroelectric Development and Licensing Strategy: Licenses granted by FERC in protected areas.

Other SPIs associated with objective: data available on Program Tracker

- **C4-1** Protected Areas and Hydroelectric Development and Licensing Strategy: Number of preliminary permits issued by FERC in protected areas; proposed exclusions from protected areas; and exclusions granted by the Council.
- **C4-2** Protected Areas and Hydroelectric Development and Licensing Strategy: Draft license applications submitted to FERC for hydroelectric projects in protected areas.
- **C4-4** Protected Areas and Hydroelectric Development and Licensing Strategy: Proposed exclusions from protected areas and exclusions granted by the Council.

Objective C5

Advance efforts to complete remaining loss assessments.

Summary of progress

Loss assessments form the basis for defining targets for the hydro share of mitigation. Alternatively, BPA can enter into settlement agreements without going through a specific loss assessment. Loss assessments cover anadromous fish, resident fish, and wildlife.

- Anadromous
    - Progress in upper Snake River blocked areas to assess losses
- Resident
    - Only established losses are for resident fish affected by Libby and Hungry Horse Dams
    - No additional assessment of resident fish losses
- Wildlife
    - Operational loss assessments for Libby and Hungry Horse added to 2020 addendum
    - Additional operational loss assessments needed

SPIs referenced in summary: data available on Program Tracker

- **C5-1** Resident Fish Mitigation Strategy: Discussions with fish managers are undertaken to evaluate and identify the best approach to assess remaining native focal fish losses.