

## **Part Three: Basinwide Vision, Scientific Foundation, Goals, Objectives, and Strategies**

### **I. Vision for the Columbia River Basin**

The vision for this program is a Columbia River ecosystem that sustains an abundant, productive, and diverse community of fish and wildlife, supported by mitigation across the basin for the adverse effects to fish and wildlife caused by the development and operation of the hydrosystem. This envisioned ecosystem provides abundant opportunities for tribal trust and treaty-right harvest, non-tribal harvest, and the conditions that allow for restoration of the fish and wildlife affected by the construction and operation of the hydrosystem.

The vision will be accomplished by protecting and restoring the natural ecological functions, habitats, and biological diversity of the Columbia River Basin. Where this is not feasible, other methods that are compatible with self-sustaining fish and wildlife populations will be used, including certain forms of production of hatchery fish. Where impacts have irrevocably changed the ecosystem, the program will protect and enhance habitat and species assemblages compatible with the altered ecosystem.

## II. Scientific foundation and principles of the program

Significant ecological and environmental modifications have occurred in the Columbia River and its tributaries. The Council recognizes that a combination of actions is necessary to protect, mitigate, and enhance the fish, wildlife, and habitat impacted by the hydrosystem. The Council understands that to succeed in achieving its vision, strategies and actions implemented through the program must be founded on the best available scientific understanding of how to protect, mitigate, and enhance the fish, wildlife, and habitat impacted by the development, operation, and management of hydroelectric projects. This scientific foundation and guiding scientific principles are provided below.

The scientific foundation describes our best current understanding of the biological realities that govern how the program's vision will be accomplished. It is summarized in [Return to the River](#) and subsequent reports produced by the [Independent Scientific Advisory Board](#). The Council is directed by Congress, through the [Northwest Power Act](#), to use the best *available* scientific information in its decisions and to continually improve the program's scientific understanding. The Council's Independent Scientific Advisory Board is responsible for developing, reviewing, and recommending modifications to the principles. The ISAB recently recommended [revised principles](#) that focused on enhancing ecosystem resilience and adaptability.

The scientific foundation informs the program's scientific principles, which summarize our current knowledge at a broad level. Program measures and actions should be consistent with those principles.

### Guiding scientific principles

#### **Healthy ecosystems sustain abundant, productive, and diverse plants and animals distributed over a wide area**

An ecosystem includes all living things in a given area, interacting with each other and with the physical environment. This interaction affects the abundance, productivity, and diversity of plants and animals. Taking into account these interactions and the natural limits of ecosystems is critical for successfully maintaining, restoring, and enhancing ecosystems.

#### **Biological diversity allows ecosystems to adapt to environmental changes**

The natural diversity of species, populations, genes, and life history traits contributes to ecosystem stability and adaptability to environmental change. The loss of locally adapted populations can reduce species diversity in an ecosystem. Introducing non-native species can increase diversity but can also disturb the connections between native species and reduce their ability to adapt and survive. Management actions are most meaningful over the long term when they contribute to the diversity of locally adapted populations of native species and also to the habitats needed to support them.

### **Ecosystem conditions affect the well-being of all species including humans**

Humans are integral parts of ecosystems. Our actions have a pervasive impact on the structure, function, and resilience of ecosystems, while at the same time, our health and well-being are tied to ecosystem conditions. Having ecosystems that can respond to change contributes to healthy ecosystems that support healthy species and human populations. A landscape perspective and management approach is necessary to maintain redundancies and diversity that allow ecosystems to be resilient to unexpected changes.

### **Cultural and biological diversity is the key to surviving changes**

Ecosystems change over time, increasing or decreasing benefits to species, including humans. Biological diversity in species and their populations makes this adaptability possible. Similarly, the cultural diversity of people and communities represented by learned behaviors, ideas, values, and institutions allows for society to adapt to these changes.

### **Ecosystem management should be adaptive and experimental**

Ecosystems are complex, they change constantly, and our understanding of them is limited. In response, natural resource managers must strive to improve their knowledge and be adaptable to include information as it is learned. Using a structured process of learning can contribute to new scientific knowledge that informs decisions.

### **Ecosystem management can only succeed by considering people**

People live in ecosystems. Understanding what's important to people about the places they live, sharing scientific information, developing communication networks, and creating partnerships that enhance collaboration can make management actions more sustainable. Aligning policies with the appropriate level of governance can also improve effectiveness. Recognizing that local actions can affect socioeconomic outcomes at regional, national, or international scales will increase the effectiveness and efficiency of management actions.

### III. Goals and Objectives - the changes we want to achieve

#### A. Program goals and quantitative objectives

The program aims to rebuild healthy, naturally producing fish and wildlife populations adversely affected by the construction and operation of hydroelectric dams in the Columbia River Basin. It accomplishes this by protecting, mitigating, and enhancing habitats and biological systems.

Existing reports<sup>1</sup> provide a framework for understanding the magnitude of salmon and steelhead losses. Mitigating for the loss of other anadromous fish, such as lamprey and eulachon, and native resident fish such as bull trout, cutthroat trout, kokanee, and sturgeon, is equally important [see program strategies: [lamprey](#), [eulachon](#), [wild fish](#), [resident fish mitigation](#), mainstem hydrosystem [flow and passage operations](#).] The program also maintains a commitment to mitigate for [wildlife](#) losses.

The program includes [qualitative goal statements and quantitative objectives](#) to prioritize the work. The program continues to include a set of quantitative goals and related timelines for anadromous fish. These include, among others, increasing total adult salmon and steelhead runs to an average of 5 million annually by 2025 in a manner that emphasizes the populations that originate above Bonneville Dam and supports tribal and non-tribal harvest, and achieves smolt-to-adult return rates in the 2-6 percent range (minimum 2 percent; average 4 percent) for listed Snake River and upper Columbia salmon and steelhead. As part of an effort to refine objectives, the region should also consider the ISAB's recommendation to redefine the 2 to 6-percent smolt-to-adult ratio (SAR) objective to reflect the survival of populations needed to achieve recovery and harvest goals. The ability of the region to achieve these goals will depend on the coordinated actions of many parties to improve fish habitat and passage, improve hatchery operations, and limit harvest of potential spawners. The qualitative goal statements describe the changes needed to achieve the program's basinwide vision. Progress in achieving these qualitative goal statements is measured using quantitative objectives. The vision and goal statements guide the development of the objectives (see Figure 4 for an overview of this format).

How progress is monitored and evaluated is described in the [adaptive management strategy](#). It's also reported using fish and wildlife indicators on the subbasin [dashboard](#)<sup>🔗</sup> and the high-level indicators in the program's [High-Level Indicator report](#)<sup>🔗</sup>. These program-level goals and objectives also provide guidance for [subbasin](#)-level and other goals and objectives. Achieving these quantitative objectives depends on the coordinated actions of many parties.

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<sup>1</sup>["Compilation of Salmon and Steelhead Losses in the Columbia River Basin"](#) (Appendix D of the Council's 1987 Fish and Wildlife Program), ["Numerical Estimates of Hydropower-related Losses"](#) (Appendix E of the 1987 Program), and ["Compilation of Information on Salmon and Steelhead Total Run Size, Catch and Hydropower-Related Losses in the Upper Columbia River Basin, Above Grand Coulee Dam"](#)

## Principles guiding the program goals and objectives

Program goals and objectives should be:

- Consistent with the program vision statement
- Designed to achieve the ecosystem functions necessary to restore healthy, self-sustaining, and harvestable populations of native fish and wildlife in the Columbia River Basin
- Designed to provide a measurement of program success by achieving the program's fish species and population abundance, productivity, spatial distribution, and diversity objectives.
- Implemented in a manner that allows sufficient monitoring and evaluation, and provisions for adaptive management, to ensure that progress toward objectives can be tracked, and that future management can respond to new information and strategies.

### Themes for program goals and objectives<sup>2</sup>

Theme One: *Protect and enhance habitat to provide a home for species*

Theme Two: *Ensure species survival by promoting abundance, diversity and adaptability*

Theme Three: *Compensate for a wide range of hydrosystem impacts*

Theme Four: *Engage the public*

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<sup>2</sup> The term 'Biological Objectives' is used in the program when referring to the environmental characteristics and biological performance goals and objectives in themes one and two.



Figure 4. Linkages between program vision, goals, objectives, and indicators track how successful program strategies are progressing toward the goals and objectives. This figure is an expansion of a subcomponent of the program framework [see [program framework](#)]

### 1. Refining program goals and quantitative objectives

Working with others in the region, including the state and federal fish and wildlife agencies and tribes, other federal agencies and the independent science panels, the Council will oversee a regional process to survey, collect, identify, and refine a realistic set of quantitative objectives for program focal species and their habitat related to the four broad themes and program goal statements. Evaluating progress toward program goals and objectives will occur through the [adaptive management](#) strategy and will be reported using program indicators [see Tracking [Status of the Basin](#)'s Fish and Wildlife Resources section].

Where possible, the quantitative objectives identified through this regional process should be specific, measurable, attainable, relevant, time-bound,<sup>3</sup> and based on an explicit scientific rationale, as appropriate. These objectives may include various types of measurement such as specific numbers, ranges of numbers, densities, or trend direction. The data needed to assess progress about goals and objectives and inform indicator graphics used in tracking should be based on existing monitoring efforts or other publicly available sources of data. The Council will ask the Independent Scientific Advisory Board (ISAB) to review objectives for scientific quality and usefulness in tracking progress and adaptively managing our efforts.

<sup>3</sup> Objectives achieving the five criteria are referred to as SMART objectives.

The process to identify potential quantitative objectives (and program goals) should consider existing relevant Columbia River Basin documents<sup>4</sup> as they may serve to inform quantitative objectives relevant for tracking program progress. This process will also consider the quantitative objectives recommended through the 2014 Program amendment process.

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<sup>4</sup> Documents include but are not limited to, Northwest Power Act, past versions of the Columbia River Basin Fish and Wildlife program, subbasin plans, ISAB recommendations for objectives, Coordinated Assessment project's indicator tables, NOAA recovery plans, USFWS recovery plans, Hatchery Scientific Review Group documents, the Columbia Basin Fish Accords, the Washington Estuary Agreement, the Willamette Wildlife Agreement, Montana Wildlife Agreement, US V OR settlement, Columbia River Treaty, FCRPS BiOP RPA, NOAA delisting criteria, Wy-Kan-Ush-Mi Wa-Kish-Wit, and the Lower Columbia River Estuary Partnership quantitative habitat protection and restoration targets.

### **a) Objectives for adult salmon and steelhead**

The Program shares in the region's broader vision of natural-origin salmon and steelhead populations across the basin that are diverse, resilient, productive, and sufficiently abundant to allow substantial opportunities for tribal and non-tribal harvest [see [ecosystem function](#) strategy and other strategies].

Objectives that represent different perspectives on healthy and harvestable populations already exist. The Council will work with state and federal agencies and tribes in the region to collect, organize, review, and report on these quantitative objectives by the end of 2015. This effort should include a review of agency and tribal management plans, draft and final federal recovery plans, subbasin plans and other relevant documents and reports. The final report will include, but not be limited to, an inventory of non-ESA listed populations of salmon and steelhead that lack federal recovery objectives. The Council (working cooperatively with the agencies and tribes) will define a process for tracking the region's progress on enhancing salmon and steelhead population status in the context of the quantitative objectives defined in the final report. The Council will rely on the agencies and tribes to identify "best source" locations of population status information to inform this process (including but not limited to the Coordinated Assessment program and NOAA's Salmon Population Summary data base).

The Council will work with the states, federal agencies, and tribes to identify specific indicators for Bonneville-funded hatchery programs that could be tracked and reported to inform progress on meeting mitigation objectives (i.e., harvest, supplementation, reintroduction, and conservation). Potential indicators that should be tracked include: contribution to hatchery broodstock, natural spawning, and harvest by hatchery. Potential indicators that could be tracked include: in-hatchery survival (egg to smolt); juvenile production/releases; hatchery smolt-to-adult returns and hatchery recruits per spawner. The Council, agencies, and tribes will work with the Coordinated Assessment (CA) partners, the Fish Passage Center and others as appropriate, to collect existing indicator information. The Council recognizes that the development of a "common data exchange standard" for hatchery indicator information (through the CA effort) is an ongoing process.

## **b) Other anadromous and resident fish objectives**

While hydrosystem-related losses are less well understood for fish species such as lamprey, sturgeon, eulachon, bull trout, cutthroat trout, kokanee, and other focal species, the program nonetheless aims to mitigate for these losses and to track, using indicators, the progress toward meeting program goals and objectives [see program [strategies](#)]. The process for developing objectives for other anadromous and resident focal species includes the following steps:

### **Step 1**

Once the process to produce objectives for hatchery salmon and steelhead is completed, the Council will work with the fish and wildlife agencies and tribes to survey, collect, and organize existing quantitative objectives for focal species including lamprey, bull trout, eulachon, white sturgeon, kokanee, rainbow trout, and cutthroat trout.

### **Step 2**

As soon as practicable, the Council will determine which of these to consider as program objectives, as well as considering needed modifications to existing goal statements, objectives, and indicators. The Council will conduct a program amendment process if it is determined that adopting the objectives should be considered.

### **c) Ecosystem function, habitat, and hydrosystem objectives**

The program is aimed at rebuilding healthy, naturally producing fish and wildlife, habitats, and the biological systems within them [[ecosystem function](#) strategy]. The program requires goals, objectives, and indicators that track the progress of these mitigation efforts, including wildlife mitigation, which relies on acquiring habitat units.

#### **Step 1**

The Council will identify measureable objectives in the region. The data needed for these objectives should be available and not require extensive new data-gathering efforts.

The Council will:

- Work with the fish and wildlife agencies and tribes to assess feasibility of hydrosystem survival performance standards for lamprey.
- Support regional efforts to develop ecosystem health indicators as well as efforts by fish and wildlife agencies and tribes to identify quantitative biological objectives.
- Work with the fish and wildlife agencies and tribes and the ISAB to refine existing goals, objectives, and [indicators](#) related to habitat characteristics, including biological diversity.

#### **Step 2**

As soon as practicable, the Council will determine which objectives to consider as program objectives. The Council will conduct a program amendment process if it is determined that adopting the objectives should be considered.

#### **d) Public engagement quantitative objectives**

The Council will initiate an internal process to identify objectives and indicators for this topic [see program strategies: [public engagement](#)]. Once the process to produce objectives is completed, the Council will seek public input to help identify the most useful objectives. The Council will conduct a program amendment process if it is determined that adopting the objectives should be considered.

#### **IV. Strategies - how the program will achieve the changes**

Strategies articulate the long-term approach to achieve changes needed to meet goals, basinwide objectives, and the program's vision. Written with a long-term perspective, these strategies should consider future as well as current environmental conditions. Each of these basinwide strategies consists of a programmatic strategy statement, rationale, guiding principles, general measures to implement that guidance, and, as relevant, specific measures that transcend specific subbasins, such as research, monitoring, and evaluation. The guidance from these basinwide strategies informs planning and implementation at the subbasin and other geographic levels.

The program's fundamental, overarching strategy is the ecosystem function strategy. This overarching strategy responds to the direction in the Act and of the program's independent scientific groups to consider the basin as a system and not as isolated components. The approaches described under this strategy emphasize protecting quality habitat and mitigating the Columbia River Basin ecosystem through regeneration of natural processes, rather than through a primary reliance on technological solutions. Providing ecosystem guidance that can be implemented in a meaningful manner, however, is more easily conveyed when addressing aspects of interest individually. This broad strategy is subdivided into a set of sub-strategies specific to these aspects such as habitat, non-native species, and water quality.

The program acknowledges that the Columbia River Basin is an altered ecosystem that, in its altered state, provides many essential services to society, including flood control, navigation, and agricultural irrigation. Given the reliance on these services, the program accepts that given current needs and available technology, that this altered ecosystem cannot currently be restored to its pre-dam condition. Recognizing this constraint, the Council understands that the program may not achieve its obligations, or meet its objectives and vision, by relying only on an approach focused on mitigating, protecting and enhancing ecosystem function. Thus the program also has a complementary strategy that relies on hatcheries to increase fish abundance and harvest opportunities.

The program also includes a set of strategies that provide specific guidance for topics that address particular policy needs. These consist of guidance for anadromous fish mitigation in blocked areas, wildlife mitigation, resident fish mitigation, sturgeon, and lamprey. These strategies present unique policy considerations and thus are developed strategies, but the principles and general measures presented in the ecosystem strategy also apply to this additional set of strategies for specific policy areas.

Lastly, the program contains a strategy that is focused on the adaptive management elements of research, monitoring, data management, evaluation, and reporting.

## **A. Ecosystem function**

### **Core strategy**

Protect and restore natural ecosystem functions, habitats, and biological diversity wherever feasible consistent with biological objectives in the program.

### **Rationale**

Restoring functioning ecosystems in fish and wildlife habitat is critical to the long-term success of measures supported by this program to mitigate the impacts of hydropower dams in the Columbia River Basin. The extent to which these can be restored is constrained by the reality that the hydroelectric system will continue to provide essential services to people in the Pacific Northwest, and that passage improvements at the dams alone are not likely to fully mitigate these impacts. Recognizing this reality, the Act authorizes “offsite mitigation,” areas outside of the immediate area of the hydrosystem -- in the tributaries and subbasins off the mainstem of the Columbia and Snake rivers, and in the lower Columbia River and estuary. Implementing offsite mitigation provides the greatest opportunities for habitat improvements as a means of offsetting some of the impacts of the hydrosystem. This off-site mitigation does not reduce the need to mitigate in the mainstem of the Columbia and Snake rivers as, historically, these were among the most productive spawning and rearing habitats for salmonids and provided essential resting and feeding habitat for mainstem resident and migrating fish. Thus protection and restoration of mainstem habitat conditions, and offsite mitigation, are critical pieces of this habitat-based program. The program mitigates for hydropower system impacts by restoring ecosystem functions in these habitats in conjunction with passage improvements at the dams.

Guidance on specific habitat mitigation activities are in subbasin plans, which have been developed for most of the subbasins and the mainstem reaches in the Columbia River Basin. These plans include assessments of current physical and biological conditions and also identify factors that limit the productivity and capacity of focal species in priority reaches.

### **Principles**

- Ecosystem function, which means the ability of a river to sustain healthy populations of fish, wildlife, and plants, is enhanced by environmental conditions that support healthy populations.
- The existence of hydropower dams can reduce or degrade ecosystem function by impounding reservoirs, trapping or containing pollutants, raising water temperatures, disconnecting floodplain habitats, providing habitat for non-native invasive species and native and non-native predators, and through other related impacts.
- An adaptive and flexible suite of river and dam operations that can respond to changing environmental conditions, from flow fluctuations to climate-change impacts, can help improve degraded ecosystem function.
- Ecosystem function can be improved in the Columbia and Snake river tributaries by, for example, repairing and restoring riparian habitat in

spawning areas, restoring native vegetation, and changing land-management practices that can degrade water and habitat quality.

### **General measures**

- Identify and protect mainstem habitat areas and ecological functions that are relatively productive for spawning, resting, rearing, and migrating native anadromous and resident focal fish species and manage these areas to protect aquatic conditions and form a transition to floodplain terrestrial areas and side channels.
- Restore and enhance habitat areas that connect to productive areas to support expansion of productive populations and to connect weaker and stronger populations so as to restore more natural population structures.
- Protect, enhance, restore, and connect freshwater habitat in the mainstem and tributaries.
- Protect and enhance ecological connectivity between aquatic areas, riparian zones, floodplains, side channels, and uplands.
- Where feasible, reconnect protected and enhanced tributary habitats, especially in areas with productive populations.
- Identify, protect, enhance, and restore the functions of alluvial river reaches.
- Allow for biological diversity and complexity to increase among and within populations and species to increase ecological resilience to environmental variability and allow for greater life history and species diversity.
- Manage water to provide appropriately timed streamflows that promote productive populations of anadromous fish and resident fish. Where feasible, support seasonal fluctuations in flow and quantity, while reducing large, rapid, short-term fluctuations. Ensure that any changes in water management are premised upon and proportionate to scientifically demonstrated fish and wildlife benefits.
- Frame habitat restoration in the context of measured trends in water quantity and quality.
- Decrease the disparity between water temperatures and the naturally occurring regimes of temperatures throughout the basin, using stored water to the extent feasible to manage water temperatures downstream from storage reservoirs where temperature benefits from releases can be shown to provide improved fish survival.
- Identify, protect, enhance, restore, and connect ecosystem functions in the Columbia River estuary and near-shore ocean discharge plume as affected by actions within the Columbia River mainstem.
- Evaluate flow regulation and changes to estuary-area habitat and biological diversity to better understand the relationship between estuary ecology and near-shore plume characteristics and the productivity, abundance, and diversity of salmon and steelhead populations.
- Understand the status of the Columbia River ecosystem in terms of habitat and other ecosystem features (both natural and human-caused) to better inform Council decisions.

- Develop metrics of juvenile recruits-per-spawner in order to evaluate habitat effectiveness.

The following eleven strategies are sub-strategies of the overarching ecosystem function component of the program.

## 1. Habitat

### Sub-strategy

Protect, enhance, restore and connect aquatic and terrestrial habitat. Protecting existing quality habitat is as important as enhancing degraded habitats.

### Rationale

Habitat mitigation activities are important for off-site mitigation success and are guided by subbasin plans, which have been developed for most of the subbasins and the mainstem reaches in the Columbia River Basin. These plans include assessments of current physical and biological conditions and also identify factors that limit the productivity and capacity of focal species in priority reaches. Habitat mitigation also includes large-scale, biologically targeted habitat improvement projects, such as those reflected in the [Columbia Basin Fish Accords](#) and [FCRPS BiOp](#). Habitat actions can help to reduce the migration of toxic contaminants by reducing erosion and sediment transport to waterways.

### Principles

- **Build from strength**

Efforts to protect and restore fish and wildlife impacted by hydropower should protect habitat that supports existing populations that are relatively healthy and productive. Adjacent habitats should be expanded if they have been historically productive or have a likelihood of sustaining healthy populations by reconnecting or improving habitat. In a similar manner, this principle applies to the restoration of weak stocks: Restoration should focus first on habitat where portions of weak populations are doing relatively well and then extend to adjacent habitats [see [strongholds](#) strategy].

- **Restore ecosystems, not just single populations**

Increasing the abundance of single populations may not, by itself, result in long-term recovery. Restoration efforts must focus on restoring habitats and developing ecosystem conditions and functions, including within blocked areas where reintroduction is being considered, that will allow for expanding and maintaining diversity within and among species. This will help sustain a system of robust populations in the face of environmental variation.

- **Use native species wherever feasible**

Even in degraded or altered environments, native species in native habitats provide the best starting point and direction for needed biological conditions in most cases. Where a species native to a particular habitat cannot be restored, then another species native to the Columbia River Basin should be used. Any proposal to produce or release non-native species must overcome this strong presumption in favor of native species and habitats and be designed to avoid adverse impacts on native species [see [non-natives and invasive species](#) sub-strategy].

- **Address transboundary species**

Because about 15 percent of the Columbia River Basin is in British Columbia, including the headwaters of the Columbia and several of its key tributaries, ecosystem restoration efforts should address transboundary stocks of fish and

wildlife and transboundary habitats. Where mitigation measures are designed to benefit both American and Canadian fish and wildlife populations, American ratepayer funding should be in proportion to anticipated benefits to the American populations.

### **General measures**

- The core measures of this strategy include:
  - Removing fish-passage barriers
  - Screening water diversions
  - Protecting and improving riparian habitats in all areas of the Columbia River Basin to improve water quality, reduce contaminant transport, lower water temperature including creating thermal refugia, and reduce sediments through fencing, vegetation planting, erosion control, best land-management practices, and acquisition of land through conservation easements and other types of acquisition
  - Improving the amount, timing, and duration of instream flows through water rights and acquisitions
  - Reconnecting floodplains through passive and active improvements in channel structure and geomorphology and re-establishing natural river processes
  - Acquiring and enhancing terrestrial uplands for wildlife habitat
  - Continuing Bonneville funding to acquire water and pursue water rights in subbasins where water quantity has been identified in subbasin plans as a primary limiting factor and where flow targets have been identified

### **Mainstem habitat measures**

The program focuses much of its habitat efforts in the Columbia Basin tributaries. Given the importance of mainstem habitat to production of salmon and other key species, the Council supports increased investments in mainstem habitat improvements to increase the extent, diversity, connectivity, and productivity of mainstem habitats for mainstem spawning, rearing, and resting. The Council will consider primary mainstem habitat measures including:

- Coordinating actions with the flow measures intended to improve ecosystem function in the mainstem
- Enhancing the connections between the mainstem sections of the Columbia and Snake rivers and floodplains, side channels, and riparian zones
- Continuing actions to reconnect the river to its floodplains wherever possible in the mainstem, with special emphasis on the estuary and lower Columbia River
- Protecting and enhancing mainstem riparian areas and wetlands to protect aquatic conditions and form a transition to floodplain terrestrial areas and side channels

The Council will consider additional mainstem habitat actions including:

- Identifying, protecting, enhancing, and restoring the functions of alluvial river reaches in the mainstem

- Excavating, creating and reconnecting additional backwater sloughs, alcoves, and side channels to the main channel
- Dredging/excavating lateral channels that have silted in
- Creating more shallow-water habitat
- Identifying, protecting, restoring, and managing thermal refugia for salmonid use during high water-temperature periods
- Acquiring and protecting lands adjacent to the mainstem critical to protecting habitat areas and local water quality
- Where feasible, reconnecting protected and enhanced lower tributary habitats to protected and enhanced mainstem habitats, especially in the area of productive mainstem populations
- Increasing the amount of spawning habitat for mainstem core populations of Chinook, coho, chum, sturgeon, and lamprey

## **2. Strongholds**

### **Sub-strategy**

Acknowledge and encourage efforts to designate and conserve stronghold habitats and their populations of native, wild, and natural-origin fish, as well as areas managed for wild fish.

### **Rationale**

Protecting stronghold areas and associated fish populations may require the least amount of risk and investment to provide the greatest benefits to the program and for sustainable, wild, and natural-origin populations of fish. Based on current understanding, establishing reserves may be critically important to protect the remaining viable wild or natural-origin fish populations and to restore habitat with the potential to re-establish core populations at strategic locations in the basin.

### **Principles**

Stronghold areas should have the following characteristics;

- Be designated by the states and tribes, in accordance with state law in the state in which they are located
- Provide the ability to manage for wild or natural-origin fish while minimizing impacts of hatchery fish, except where state and federal fish and wildlife agencies and tribes have determined that populations would decline to the point where supplementation efforts are appropriate to avoid extinction and stabilize native wild or natural-origin stocks
- Contain relatively intact habitat
- Provide the opportunity to create genetic strongholds with adequate buffers to shield them from non-native, invasive species
- Provide a reasonable chance of eradicating non-native, invasive species
- Be characterized by healthy and abundant fish populations or populations that readily could become healthy and abundant, few invasive species, low risk of habitat degradation, and relatively good ecosystem function
- Provide the ability to monitor and evaluate the effect on wild native fish and to provide and map non-hatchery reference watersheds for hatchery-wild stream comparisons, and
- Encompass areas large enough to withstand human disturbances

### **General measures**

The Council will:

- Request states to identify stronghold areas
- Consider for stronghold recognition areas designated by states and tribes in accordance with state law
- Work with fish and wildlife agencies and tribes and others to keep up-to-date maps available for strongholds and other areas in the basin that are managed for wild fish stocks

- Inventory existing actions that have occurred and are occurring within identified stronghold areas as identified by the respective states of the Council
- Support fish habitat improvement actions implemented within strongholds
- Support actions intended to eradicate non-native and invasive species from, or prevent their introduction into, stronghold areas

**Link to subbasin plans**

See the Council's [subbasin plans](#) for subbasin-level information pertaining to subbasin protections and plans.

**Link to other relevant program guidance and sections**

Strongholds for native fish populations relate closely to our [wild fish](#), [resident fish](#), [fish propagation](#), and [non-native and invasive species](#) strategies.

### **3. Non-native and invasive species**

#### **Sub-strategy**

Prevent the introduction of non-native and invasive species in the Columbia River Basin, and suppress or eradicate non-native and invasive species.

#### **Rationale**

Non-native and invasive species imperil native species in the Pacific Northwest's ecosystems through predation, competition for food, interbreeding, disease transmission, food web disruption, and physical habitat alteration. The Council acknowledges invasive and non-native species pose direct threats to the program's fish and wildlife restoration efforts through competition, predation and habitat modification. In addition, aquatic non-native species can invade and significantly threaten infrastructure at hydroelectric dams and fish passage facilities in the Columbia River Basin. Currently, the greatest known threat in the Columbia River Basin from aquatic invasive species is introduction into the basin of zebra or quagga mussels. Other aquatic threats include hydrilla, silver carp, flowering rush, and Eurasian milfoil. Terrestrial invasive species that compromise fish habitat and wildlife mitigation projects include such species as rush skeletonweed, yellow starthistle, poison hemlock, and Japanese knotweed, among others. Once established in other locales, management actions have shown little success in removing or controlling these invasive non-native species.

#### **Principles**

- Regional prevention and management efforts for non-native and invasive species should aim to: (1) detect the presence of these species early and respond rapidly, (2) educate the public; and (3) prevent, monitor, control, and stop or minimize the spread of non-native and invasive species where these pose both a direct threat to the hydropower system, to native fish, or to wildlife species.
- Incorporate the most up-to-date environmental risk assessment methodology for non-native and invasive species into on-the-ground fish and wildlife projects, particularly in locations where management of non-native fish and invasive fish species overlaps with native fish conservation efforts and management of ESA-listed species.
- When an introduction of a non-native species is necessary for mitigation, the introduction should be done with a clear understanding of the threats to native species in the Pacific Northwest's ecosystems through predation, competition for food, interbreeding, disease transmission, food web disruption, and physical habitat alteration.

#### **General measures**

- **Evaluate potential adverse impacts**
  - The Council, in coordination with the federal action agencies, other federal, state and tribal entities, and regional organizations such as the 100<sup>th</sup> Meridian Initiative-Columbia Basin Team (hereafter referred to as the Council and federal and other regional entities) should request regional

power producers to evaluate the invasive potential and ecological risks of using non-native bioenergy feedstock species, cultivars, and hybrids.

- **Prevent establishment**

- The Council encourages federal and other regional entities to prevent non-native and invasive species introductions by:
  - Monitoring and managing the various pathways that could introduce additional aquatic nuisance species into the Columbia River Basin
  - Developing and implementing strategies to suppress, reduce, or control non-native invasive fish species where they are identified as a limiting factor and are negatively impacting salmonids and native fish populations
  - Develop strategies and public outreach tools to educate the public about regional prevention and management of invasive species
- BPA and other federal agencies should assist the Northwest states' efforts to prevent the establishment of quagga and zebra mussels.

- **Monitor and control non-native species introduction and dispersal**

- Each of the four Northwest states should continue to implement the preventative strategies in their respective state aquatic nuisance species management plans and coordinate their prevention efforts closely with the other Northwest states and British Columbia
- If non-native fish species are to be used to achieve mitigation for hydropower system impacts, the agencies and tribes shall conduct an environmental risk assessment of potential negative impacts on native fish species prior to introduction. If non-native fish species are introduced, these shall be managed to maximize the use of available existing and improved habitats, consistent with state and local regulations, to provide a subsistence and sport-fishing resource without adversely affecting native fish populations.

- **Removal and eradication of non-native species**

- Agencies and tribes shall apply existing and new scientific research to identify situations (species, times, sizes, and places) where increased removal of non-native fish would be most effective in increasing native fish populations.
- Agencies and tribes shall minimize non-native fish impacts to native fish species by using appropriate invasive fish-removal methods (e.g., gill net, chemical control, electrofishing, changes in fishing regulations, sport reward programs, etc.) and monitor their effectiveness. Lethal take to control non-native predators or competitors, consistent with state and federal law, is appropriate when non-lethal methods of control are not successful and the adverse impacts to salmonids and native fish species or their habitat are significant.
- The agencies and tribes shall prioritize non-native species control actions to ensure program funds are spent to address the most significant threats, including predation, competition, and hybridization.

- If quagga and zebra mussels become established in the Columbia Basin, BPA and other federal agencies, along with FERC-licensed utilities, shall support regional rapid-response efforts.
- **Reduce competition**
  - The federal action agencies, other federal and state agencies, tribes, and the Council should continue to review, evaluate, develop, and implement strategies to reduce competition from non-native fish species with juvenile and adult salmonids.
- **Regional coordination**
  - The Council will continue to coordinate regional stakeholder groups and partnerships on the issue of non-native invasive species, particularly those species that pose the greatest risk to the Columbia Basin ecosystem and the regional hydropower system. The Council will continue to assist with regional communication, coordination and public outreach efforts in the Columbia Basin, and will facilitate regional science/policy forums on non-native invasive species issues, as appropriate.
  - The Council will support the collaborative work of the PSMFC 100th Meridian Initiative-Columbia Basin Team and request regular reports from that group on the following items: current regional efforts for inspection and decontamination; early detection efforts and rapid response protocols; research priorities relative to invasive species control, containment and prevention; and opportunities for regional collaboration and lessons learned.
  - The Council will assist regional entities with legislative efforts to prevent the invasion and control the spread of non-native invasive species in the Columbia Basin.
  - The Council and federal action agencies should coordinate with other federal, state, and tribal entities, and regional organizations such as the 100<sup>th</sup> Meridian Initiative-Columbia Basin Team, to track and monitor data on existing non-native invasive species distribution and population trend assessments in the Columbia Basin and encourage regional data sharing on rapid response, prevention, containment, control, eradication, enforcement, and education and outreach efforts.

### **Link to subbasin plans**

See the Council's [subbasin plans](#) for subbasin-level information pertaining to the effects of non-native species on native fish, wildlife, and habitat.

## **4. Predator management**

### **Sub-strategy**

Improve the survival of salmon and steelhead and other native focal fish species by managing and controlling predation rates.

### **Rationale**

The construction and operation of the Columbia-Snake river hydrosystem, as well as disposal of dredge spoils in the lower Columbia River and estuary, have altered historical habitats and created new, hybrid habitats. These altered habitats support a wide range of predator species including native and non-native predatory fish species, predator birds such as Caspian terns, double-crested cormorants, several gull species, mergansers and pelicans, and marine mammals such as California and Steller sea lions.

### **Principles**

- In the altered habitat of the Columbia Basin, certain predators have expanded their range and adversely affected the focal fish species the program seeks to protect and enhance.
- While predation is a natural, dynamic and complex process within the Columbia Basin ecosystem, predator-management actions, guided by best available science, are necessary to manage the level of predation on, and improve the survival of, salmon and steelhead, sturgeon, lamprey, and other native resident fish species in the basin. The biological opinions contain a number of predator-control actions.

### **General measures**

- The federal action agencies, in cooperation with the Council, state and federal fish and wildlife agencies, tribes, and others, should convene a technical work group to: (a) determine the effectiveness of predator-management actions; and (b) develop a common metric to measure the effects of predation on salmonids, such as salmon adult equivalents, to facilitate comparison and evaluation against other limiting factors. Once developed and agreed upon, future predator-management evaluations funded by the action agencies should include a determination of the effectiveness of such actions and the common predation metric in their reports.
- The federal action agencies shall report to the Council annually on their respective predator-management efforts
- The U.S. Army Corps of Engineers (the Corps) or Bonneville shall evaluate the extent of predation on lamprey at Bonneville and other upstream dams
- **Management of predator fish**
  - Bonneville should continue to annually implement and evaluate the base predator-control program and, where warranted, expand northern pikeminnow removals to other mainstem dams in the lower Columbia River (for example: expand the program to include northern pikeminnow removals at McNary and Bonneville dams). The action agencies should evaluate annually the biological and cost effectiveness of focused

- pikeminnow removals for these expanded dam angling efforts and implement if warranted. Scoping of focused pikeminnow removals at other mainstem dams in the lower Columbia River will be based on evaluations and adaptive management principles with input from NOAA Fisheries and the fish and wildlife agencies and tribes and the Council.
- The federal action agencies should work cooperatively with NOAA Fisheries, U.S. Fish and Wildlife Service, states, tribes, and the Council to develop and implement systemwide strategies to manage and reduce non-native fish species that compete and feed on native fish (both anadromous and resident species) in the basin.
  - **Management of predator birds**
    - The Council will encourage more aggressive efforts by the Corps and others to make the fullest possible use of their existing authority to remove or manage avian predation that is impacting wild fish populations.
    - The federal action agencies should, in collaboration with state and federal agencies, tribes, and other hydropower operators:
      - Continue efforts to reduce the number of Caspian terns on East Sand Island in the lower Columbia River and estuary by implementing the U.S. Fish and Wildlife Service Caspian Tern Management Plan
      - Develop a double-crested cormorant management plan encompassing additional research, development of a conceptual management plan, and implementation of warranted actions in the lower Columbia River and estuary
      - Implement the avian management plans (for double-crested cormorants, Caspian terns, and other bird species) for Corps-owned lands and associated shallow-water habitat areas in the mid-Columbia area that have been developed through the Corps and other processes for predatory bird species in the Columbia River estuary. The action agencies should also develop and implement any management plans developed for double-crested cormorants, Caspian terns, and other bird species in the mid-Columbia area and prioritize actions for implementation.
      - Implement predator-bird management actions in the Columbia River Basin in coordination with state and federal fish and wildlife agencies and tribes.
    - The Corps should continue to implement and improve avian-deterrent programs at all lower Snake and Columbia River dams.
  - **Management of predator seals and sea lions**
    - The Corps should:
      - Take actions to improve the exclusion of sea lions at all main adult fish ladder entrances and navigation locks at Bonneville Dam.
      - Continue to support land- and water-based harassment efforts by NOAA Fisheries, the Oregon and Washington departments of fish and wildlife, and tribes to keep sea lions away from the area immediately downstream of Bonneville Dam.

- The federal action agencies should fund federal, tribal, and state agencies to evaluate the extent of seal and sea lion predation on salmonids, sturgeon, and lamprey in the lower Columbia River from below Bonneville Dam to the mouth of the river.
- The federal action agencies, in collaboration with the region's state and federal fish and wildlife agencies, tribes, and others, should identify opportunities and implement actions to reduce salmon, sturgeon, and lamprey losses through seal and sea lion management in the lower Columbia River and estuary.
- When federal, state, or tribal managers determine that predation by seals and sea lions is causing significant adverse impacts to salmonids or other native fish, state and federal fish agencies employing lethal and non-lethal methods to manage predation shall continue the lethal methods if non-lethal methods are not successful.

#### **Links to the subbasin plans**

See the Council's [subbasin plans](#) for subbasin-level information pertaining to predators.

#### **Links to other parts of the program**

Strategies: [non-native and invasive species](#), [strongholds](#), [sturgeon](#), [lamprey](#)

## **5. Protected areas and hydroelectric development and licensing**

### **Sub-strategy**

Protect fish and wildlife from the adverse effects of future hydroelectric project construction and operations. As part of this strategy, the Council supports protecting streams and wildlife habitats from any hydroelectric development where the Council believes such development would have unacceptable risks to fish and wildlife.

### **Rationale**

Beginning in 1983, the Council directed extensive studies of existing habitat and has analyzed alternative means of protection. In 1988, the Council concluded that: 1) the studies had identified fish and wildlife resources of critical importance to the region; 2) mitigation techniques cannot assure that all adverse impacts of hydroelectric development on these fish and wildlife populations will be mitigated; 3) even small hydroelectric projects may have unacceptable individual and cumulative impacts on these resources; and 4) protecting these resources and habitats from hydroelectric development is consistent with an adequate, efficient, economical, and reliable power supply. The Council, relying on these studies, designated 44,000 miles of river reaches as “[protected areas](#),” where the Council believes hydroelectric development would have unacceptable risks of loss to fish and wildlife species of concern, their productive capacity, or their habitat.

Most of the river reaches designated as protected areas are in the Columbia River Basin. But the designations also include river reaches outside the Columbia River Basin but within the service territory of Bonneville and thus within the scope of the Pacific Northwest’s regional power system. The designations are intended as an expression of the Council’s authority under the Northwest Power Act to protect, mitigate and enhance fish and wildlife in the Columbia River Basin from the adverse effects of the development and operation of the region’s existing hydroelectric facilities *and* as an expression of the Council’s obligations under the same Act to give due consideration in the Council’s regional power plans to the effects of new energy resources (including new hydroelectric resources) on fish and wildlife resources and environmental quality and to internalize the environmental costs and benefits of such new resources to the greatest degree possible in deciding whether to recommend their addition to the region’s power supply.

The complete provisions of this sub-strategy are in [Appendix F](#). What follows below is a summary of key elements of the sub-strategy.

#### **a) [Future Hydroelectric Development and Licensing](#)**

This sub-strategy includes a set of fish and wildlife protection [standards](#) for the Federal Energy Regulatory Commission, Bonneville, and other

agencies to apply to the development and licensing of hydroelectric facilities outside of protected areas

**b) [Protected areas](#)**

**Protected areas list:** River reaches to be protected are those reaches or portions of reaches listed on the “protected areas [list](#)” adopted by the Council on August 10, 1988, and subsequently amended. For each river reach listed on the Protected Areas List, the fish and wildlife to be protected are those on the list. The Council will also supply a list of the Protected Areas to any party free of charge.

**c) Exemptions, amendments and exceptions:**

Hydroelectric development at certain existing structures is [exempt](#) from the protected areas provisions. The program contains procedures and criteria for substantive [amendments](#) and technical corrections to protected areas designations. The program also contains a process and criteria for an [exception](#) to the protected areas provisions for projects that will have exceptional benefits for fish and wildlife.

**d) General implementation measures**

The Council expects the Federal Energy Regulatory Commission, in the exercise of its licensing authority under the Federal Power Act, to take the Council’s hydroelectric development [standards](#) and [protected areas](#) designations into account to the fullest extent practicable. This includes a Council determination whether favorable or unfavorable on a petition for an exception to a protected area designation for a project proposed to have exceptional benefits for fish and wildlife. The Commission should implement the Council’s decision in the Commission’s licensing and exemption proceedings unless the Commission’s legal responsibilities require otherwise. The Council also expects Bonneville not to acquire power from or provide transmission support for a new hydroelectric development in a manner inconsistent with the Council’s designation of protected areas.

## **6. Water quality**

### **Sub-strategy**

Provide flows and habitat conditions of adequate quality and quantity for improved survival of anadromous and native resident fish populations on the mainstem Columbia and Snake rivers, as well as improving water quality in Basin tributaries, to promote healthy and productive populations of anadromous and native resident fish and wildlife.

### **Rationale**

The mainstems of the Columbia and Snake rivers are affected annually by elevated water temperatures and periodically by total dissolved gas (TDG) levels, while various tributaries are experiencing elevated water temperatures during certain times during the year. In addition, there is a growing concern about toxic contaminants in the mainstem Columbia and Snake rivers and tributaries. Degraded water quality may be having adverse effects on the health of both our native fish and wildlife populations and the ecosystem these populations depend upon, thus impacting mitigation and recovery efforts in the Columbia River Basin.

### **Principles**

- The Council will continue to support and promote public awareness of pertinent water quality and toxic contaminant research information and related effects on the Columbia River Basin ecosystem or program mitigation efforts.
- Monitoring, assessment and reduction actions identified below will best be achieved with sustainable funding resources. The Columbia River Basin has been designated by the federal Environmental Protection Agency (EPA) as a priority Large Aquatic Ecosystem similar to Chesapeake Bay, the Great Lakes, Gulf of Mexico, and Puget Sound. While each of these other ecosystems has designated funding sources to protect and restore the water quality within their defined areas, the Columbia River Basin does not.

### **General measures to address total dissolved gas and temperature**

- Federal and non-federal project operators should:
  - Continue real-time monitoring and reporting of TDG and water temperatures measured at fixed monitoring sites in the Columbia River Basin
  - Continue to develop and implement fish passage strategies that produce less TDG, such as spillway flow deflectors, spillway weirs and surface passage outlets, including updates and improvements to the System Total Dissolved Gas (SYSTDG) model to reflect ongoing modifications to spillways or spill operations
  - Collaborate to complete the water temperature modeling capabilities in the mainstem Columbia River from Grand Coulee to McNary dams to better assess the effect of operations or flow depletions on summer water temperatures

- The Corps should continue to:
  - Develop and use the SYSTDG model for estimating TDG production to assist in real-time decision making for spill operations, including improved wind forecasting capabilities, as appropriate
  - Develop and use the CE-QUAL-W2 model for estimating mainstem Snake River temperatures and cold-water releases from Dworshak Dam on the North Fork Clearwater River to assist in real-time decision-making for Dworshak summer operations
- The federal action agencies, FERC, and the non-federal project operators, in cooperation with the EPA and other federal, tribal, regional, and state agencies, should:
  - Update and implement the Water Quality Plan for Total Dissolved Gas and Water Temperature in the Mainstem Columbia and Snake Rivers (WQP)
  - Monitor water quality parameters and implement water quality improvement measures to reduce water temperatures and TDG to meet state, EPA-approved tribal, and federal water quality standards to improve the health, condition, and survival of anadromous and native resident fish, as well as their related spawning and rearing habitat, in the Columbia Basin
- The federal action agencies should incorporate the provisions of various total maximum daily loads (TMDLs) as they are developed and approved into the regional Water Quality Plan, particularly TMDL provisions containing allocations affecting federal hydropower projects in the Columbia River Basin.

### **General measures to address toxic contaminants**

- To support ongoing regional efforts to identify, assess and reduce toxic contaminants in the Columbia River Basin, the Council may initiate and will participate in, support, and coordinate periodic science/policy workshops on characterizing the state of the science related to toxic contaminant issues. The Council will also assist regional parties in advancing public education and information on toxics issues.
- The federal action agencies, in cooperation with the EPA and other federal, tribal, regional, and state agencies, should:
  - Support implementation of the regional 2010 Columbia River Basin Toxics Reduction Action Plan. Both the WQP and the *Toxics Reduction Action Plan* are comprehensive regional documents containing water quality monitoring, research, and improvement measures needed to enhance the survival of anadromous and native resident fish and to meet Northwest Power Act, ESA, and Clean Water Act responsibilities. The Council will continue to encourage preventive and remedial actions such as those identified by the WQP and the Toxics Reduction Action Plan.
  - Monitor water quality parameters and implement water quality improvement measures to reduce toxic contaminants, as appropriate, to meet state, EPA-approved tribal, and federal water quality standards to improve the health, condition, and survival of anadromous and native

resident fish, as well as their related spawning and rearing habitat, in the Columbia Basin

- The federal action agencies should partner with and support ongoing federal, state, tribal, and regional agencies' efforts to:
  - Monitor, assess and map high priority toxic contaminant hot spots in the Columbia River Basin and evaluate their relationship, if any, to the development and operation of the hydrosystem
  - Identify and assess the effects of toxic contaminants, alone or in combination with other stressors, on native fish, including sturgeon and lamprey, wildlife, and food webs in toxic hot spots in the Columbia River Basin
- The federal action agencies should partner with and support federal, state, tribal and regional agencies' efforts to conduct targeted monitoring in the Columbia River Basin of vulnerable native fish and wildlife species for specific, high-priority toxic contaminants and other priority contaminants of emerging concern, including in the middle and upper Columbia reaches and in the Snake River, and evaluate if toxic contaminants limit the reproductive success of native fish.
- At each hydropower project, federal and non-federal project operators in the Columbia River Basin should: (a) monitor and report oil spills and leakages; (b) replace all lubricating oils and fluids containing PCBs with non-PCB oils and fluids; and (c) develop and implement best practices for reducing spills and leakages of oils and lubricating fluids
- Using all available water quality data, Bonneville and the other federal action agencies should continue to identify areas where aquatic habitat restoration projects implemented under the program may be affected by toxic contaminants and incorporate pollution reduction and mitigation techniques into restoration projects when toxic contamination is a concern.
- The Council urges Congress to provide funding, similar to the funding provided to other Large Aquatic Ecosystems, to protect and restore water quality in the Columbia River Basin, including efforts to:
  - Develop sensitive diagnostic indicators of chemical exposure and salmon health, such as biomarkers, for use in field studies in the Columbia Basin
  - Determine the extent to which toxics limit prey quality and abundance in degraded habitats and otherwise affect the food web
  - Improve understanding of contaminants of emerging concern, such as endocrine-disrupting pharmaceuticals and chemicals in personal care products, and their effects on salmonids, sturgeon, and lamprey.

### **Link to the subbasin plans**

See the Council's [subbasin plans](#) for subbasin-level information pertaining to toxics and water quality.

## 7. Climate change

### Sub-strategy

Better understand how the effects of climate change may impact fish and wildlife populations and mitigation and restoration efforts implemented under the Columbia River Basin Fish and Wildlife Program. Evaluate fish and wildlife investments and their ability to perform in the face of future climate conditions.

### Rationale

Climate records show that the Pacific Northwest has warmed about 1 °C since 1900, or about 50 percent more than the global average warming over the same period. The warming rate for the Pacific Northwest over the next half century is projected to be in the range of +0.2-0.9° C per decade. Projected annual precipitation changes for the region over the next few decades are relatively modest and unlikely to be distinguishable from natural variability. Projected future changes in temperature and precipitation will alter the snow pack, stream flow, and water quality in the Columbia Basin with the following anticipated impacts:

- Warmer temperatures will result in more precipitation falling as rain rather than snow
- Snowpack will diminish, particularly in lower-elevation watersheds, and stream flow timing will be altered
- Peak river flows will likely shift to earlier in the spring
- Water temperatures will continue to rise

These temperature and hydrologic changes are expected to have a variety of interrelated impacts on aquatic and terrestrial ecosystems in the Columbia River Basin. The Council recognizes the need to assess and, where necessary, respond to the [impacts of climate change](#), which could threaten the program's past and ongoing investments in habitat improvements in the Columbia River Basin.

### Principles

- Future planning and implementation should include explicit consideration of the possible effects of climate change on the focal habitats and fish and wildlife populations, using adaptive management principles.
- It is uncertain whether climate change will alter the suite of habitat actions the program implements; however, adaptive management is the appropriate way to respond to changes in climate.

### General measures

The federal action agencies, in coordination and collaboration with others, shall:

- Support the development of improved runoff forecasting methods and techniques for Columbia River Basin watersheds
- Work to provide early (e.g., late fall or early winter) runoff forecasts for the Columbia River Basin

- Continue to encourage, monitor, and promote public awareness of pertinent climate change research and information and assess how it should influence program mitigation efforts
- Assess whether climate change effects are altering or are likely to alter critical river flows, water temperatures or other habitat attributes in a way that could significantly affect fish or wildlife important to this program, either directly or by affecting the success of current mitigation efforts and if so, evaluate whether alternative water management scenarios, including changes in flood control operations, could minimize the potential effects of climate change on mainstem hydrology and water temperatures
- Evaluate the effectiveness and feasibility of possible actions to mitigate effects of climate change, including selective withdrawal from cool/cold water storage reservoirs to reduce water temperatures or other actions to create or protect cool water refugia in mainstem reaches or reservoirs
- Identify and evaluate management and mitigation options for fish and wildlife under various climate-change scenarios
- Assess and revise, if necessary, ongoing monitoring efforts to ensure collection of necessary data on key species responses, interactions, and productivity under future climate scenarios
- Implement long-term habitat protections for resident fish and wildlife in the basin
- Identify and implement a strategic expansion of the network of stations for surface weather and streamflow observations in high-altitude mountainous areas of the Columbia Basin
- Investigate the feasibility of mitigating climate change impacts in the estuary and plume through changes in hydrosystem operations, including changes in flood-control operations

### **Other general measures**

- Variations in regional climate and ocean conditions play a large role in the survival of anadromous fish and other native species in the Columbia River Basin. Management actions shall strive to help those species accommodate a variety of climate and ocean conditions by providing a wide range of life history strategies. The Council supports the federal action agencies, in coordination and collaboration with others, monitoring salmon returns and climate-change impacts on ocean conditions in order to identify factors affecting survival in the near-ocean and plume environments.
- The Council supports ongoing studies and development of assessment methods by the federal action agencies and others. Further, the Council requests other entities to collaborate with the federal action agencies on this work.
- The Council, in collaboration with the federal action agencies, shall convene one or more science/policy workshops on climate change effects in the Columbia Basin, including panels of climate change scientists, to inform an overarching climate change strategy for the Columbia Basin.

- The Council continues to encourage, monitor, and promote public awareness of pertinent climate change research and information and assess how it should influence program mitigation efforts.
- The Council continues to require project sponsors to consider and plan for different climate change scenarios that could affect their work.

**Link to subbasin plans**

See the Council's [subbasin plans](#) for subbasin-level information pertaining to climate change and its effects.

## **8. Mainstem hydrosystem flow and passage operations**

### **Sub-Strategy**

Manage dams and reservoir operations to protect and restore ecosystem function and habitat, and to improve fish passage and survival through the hydrosystem. Analyze the power system effects of operations for fish, and recommend adaptations to the power system so that these operations may be delivered in a reliable manner while the region continues to have an adequate, economic and reliable power supply.

### **Rationale**

The mainstem of the Columbia and Snake rivers is that central portion of the Columbia River Basin linked by systemwide water management from the headwaters into the estuary and plume and by the large structural changes related to that systemwide water management. All Columbia River Basin anadromous fish use some portion of the mainstem for juvenile migration, rearing, resting, the biophysical transition from freshwater to saltwater and adult migration. Significant populations also spawn in the mainstem, while some of the system's most productive core populations used to spawn and rear in the mainstem but have been extirpated by the inundation and blockage of more than half of the habitat area by the development of the hydrosystem. This loss of capacity is a major consideration in the Act's mitigation obligation. Most of the other native fish important to the program also have been affected by the mainstem hydrosystem development and systemwide water management, including sturgeon in both the upper and lower Columbia River Basin, lamprey, and bull trout. The program's mainstem measures also benefit these species.

System operations for multiple purposes have a direct impact on fish habitat and overall fish survival, compromising habitat conditions for spawning, rearing, resting, and migration. For more than 30 years, the program measures have altered system operations for the benefit of improved habitat conditions and fish passage survival. As relevant to listed species, these measures have largely been incorporated into FCRPS biological opinions. The Council's program also adds important consideration to the benefit of non-listed anadromous and resident species affected by hydrosystem operations. The region is also looking to the Council's program to investigate the potential for additional gains in ecosystem function and floodplain connectivity.

### **Principles**

- Native fish benefit from flow, passage and habitat conditions that best fit natural behavior patterns of these fish and the physical and biological conditions they need to thrive.
- Where there are demonstrated benefits for fish, manage water to more closely approximate natural flow patterns in terms of quantity, quality, and timing to promote productive populations of anadromous and resident fish.
- Biological diversity is promoted by managing hydrosystem operations to minimize the artificial selection or limitation of life history traits.

- As a starting point, in-river passage and water quality conditions should be improved consistent with the biological objectives of this program, the performance standards of the FCRPS biological opinions, and state and federal water quality standards under the Clean Water Act.
- The program is broader than the Endangered Species Act both in terms of species affected by the hydrosystem and the ultimate objective of the program that goes beyond just delisting endangered species. This strategy is thus designed to protect a broader range of species and their habitat, potentially utilizing different biological objectives.
- The Council assumes that, in the near term, the breaching of dams in the mainstem Columbia and Snake rivers will not occur.
- When recommending operational changes for fish and wildlife, the Council must consider the adequacy, efficiency, economics, and reliability of the power system.
- The Council's intent is to ensure more resilient and healthy ecosystem-based function throughout the mainstem Columbia and Snake rivers while: (a) maintaining an acceptable level of flood risk; (b) assuring adequate, reliable, and economic hydropower benefits and; (c) recognizing and implementing the other authorized purposes of the individual dams of the Columbia River system.

### **General measures**

- The federal action agencies shall provide streamflows with appropriate timing, quantity, and water quality to promote productive populations of anadromous and resident fish, provide reservoir conditions to promote productive populations of native fish and wildlife, and manage water to protect and improve habitat conditions for all fish affected by the hydrosystem, not just listed species.
- The federal action agencies, in collaboration with state, federal, and tribal fish agencies, shall (1) design mainstem fish passage actions to protect biological diversity by benefitting a broad range of species, stocks, and life-history types, not just listed species and not just salmon and steelhead, and (2) favor solutions that best fit natural behavior patterns and river processes and increase the likelihood of adult returns. To meet the diverse needs of multiple species and allow for uncertainty, multiple passage methods are necessary at individual projects.
- The water management and fish passage actions, flow objectives, and passage standards in the current biological opinions under Section 7 of the

Endangered Species Act and in the Columbia Basin Fish Accords are the baseline flow and passage measures for the Council's program.<sup>5</sup>

- The federal action agencies should collaborate with the Council, state, federal, and tribal fish agencies and the utilities before implementing flow and passage measures to protect habitat and improve survival of species not covered in the biological opinions including, for example, upper Columbia River summer and fall Chinook, upper Columbia sockeye, [sturgeon](#), [lamprey](#), and [resident fish](#). The Council may convene a science/policy forum to investigate whether the baseline flow and passage operations in the FCRPS biological opinions are optimum for the needs of the non-listed fish important to the Council's program.
- Following the principles of adaptive management, the federal action agencies, in collaboration with the Council, state, federal, and tribal fish agencies and the utilities, shall continue to investigate, develop, and implement flow and passage measures that improve fish life-cycle survival.
- The [Fish Passage Center](#) provides technical assistance and information to the region's fish and wildlife agencies and tribes, and the public, on matters relating to the program's flow and passage measures. NOAA Fisheries and its Northwest Fisheries Science Center, the Corps, the Columbia River Data Access in Real Time (DART) Center at the University of Washington, the Pacific States Marine Fisheries Commission, and other entities also contribute and house information relevant to the implementation of the program's mainstem measures.

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<sup>5</sup> The relevant biological opinions are:

- NOAA Fisheries, *Consultation on Remand and Biological Opinion for Operation of the Federal Columbia River Power System, 11 Bureau of Reclamation Projects in the Columbia Basin and ESA Section 10(a)(1)(A) Permit for Juvenile Fish Transportation Program* (May 2008) and two supplemental FCRPS biological opinions ([May 2010](#) and [January 2014](#)).
- NOAA Fisheries, *Consultation and Biological Opinion for the Operation and Maintenance of 10 U.S. Bureau of Reclamation Projects and 2 Related Actions in the Upper Snake River Basin above Brownlee Reservoir* (May 2008)
- [U.S. Fish and Wildlife Service, Biological Opinion regarding the effects of Libby Dam operations on the Kootenai River White Sturgeon, Bull Trout and Kootenai Sturgeon Critical Habitat](#) (February 2006)
- [U.S. Fish and Wildlife Service, Biological Opinion: Effects to Listed Species from Operations of the Federal Columbia River Power System](#) (December 2000)
- [NOAA Fisheries, Biological Opinion: Consultation on the "Willamette River Basin Flood Control Project"](#) (July 2008)
- [U.S. Fish and Wildlife Service, Biological Opinion on the Continued Operation and Maintenance of the Willamette River Basin Project and Effects to Oregon Chub, Bull Trout, and Bull Trout Critical Habitat Designated Under the Endangered Species Act](#) (July 2008).

The Columbia Basin Fish Accords are at <http://www.salmonrecovery.gov/Partners/FishAccords.aspx>.

The FPC Oversight Board will annually review the FPC's performance and help assure regional accountability, data management compatibility, and program consistency. The Fish Passage Center functions include:

- Assemble, organize, make publicly available, and maintain the primary archive of the smolt monitoring program data
- Participate in the development of the annual smolt monitoring program implementation plan, and assist in the implementation of the program
- Assemble, organize and make publicly accessible, data from other primary sources, and conduct analyses as requested to meet the information needs of the fish and wildlife agencies, tribes, and public with respect to water management, spill, and fish passage
- Provide technical information necessary to assist the agencies and tribes in formulating in-season flow and spill requests that implement the measures in the Council's program, while also assisting the agencies and tribes in making sure that operating criteria for storage reservoirs are satisfied
- Provide the technical assistance necessary to coordinate recommendations for storage reservoir and river operations that, to the extent possible, avoid potential conflicts between anadromous and resident fish
- Archive and make publicly accessible the data used in developing all analytical results, associating the specific data with the respective analyses

### **Specific flow measures**

- **Hanford Reach fall Chinook.** The federal action agencies, in collaboration with the state, federal, and tribal agencies and the Mid-Columbia Public Utility Districts (PUDs), shall continue to reliably implement operations to protect spawning and emergence of fall Chinook in the Hanford Reach, consistent with the 2004 Hanford Reach Fall Chinook Protection Program Agreement. The parties to the agreement should report to the Council periodically to assure flow measures continue to be effective in protecting fall Chinook redds and juveniles from flow and river elevation fluctuations.
- **Libby and Hungry Horse operations.** The Council continues to support the federal action agencies' current reservoir operations at Libby and Hungry Horse dams as set forth in the relevant biological opinions. These include VARQ as well as spring and summer operations developed as part of the [2003 Mainstem Amendments](#). The Council encourages the action agencies to remove any reference to these operations as "experimental" in future biological opinions. The Council supports continued investigations to refine operations at Libby and Hungry Horse dams that improve conditions for fish near those reservoirs and do not adversely affect fish in the lower river, e.g., actions that help reservoir refill, reduce the potential for uncontrolled spill, reduce downstream flooding, and make operations mutually beneficial for the United States and Canada. Montana Fish, Wildlife & Parks should continue working with the pertinent parties to discuss proposals for adjustments to

winter and spring operations at Libby and Hungry Horse dams including consideration of the potential impacts of winter operations at Libby Dam (including winter power peaking) on the recovery of native fish species, the food web, and fish and wildlife habitat restoration efforts, and mitigate for those impacts if necessary. The Council will assist in these discussions as necessary. Any significant findings or proposed changes should be reported to the Council.

- **Albeni Falls Dam.** To benefit native fish, the Corps shall investigate infrastructure changes at Albeni Falls Dam and habitat enhancements in areas impacted by the dam.
- **Grand Coulee Dam operations.** The Council calls on the Bureau and NOAA Fisheries to work with the relevant federal and state fish and wildlife agencies and tribes to evaluate [alternative operations](#) and report back to the Council. The following principles should guide this evaluation:
  - Explore the optimum operations at Grand Coulee to provide improved conditions and survival for all the fish important to the program, including salmon and steelhead migration and rearing needs in the lower Columbia River, Hanford Reach fall Chinook spawning and emergence, and resident species in the reservoir that are critical to mitigation needs of the Spokane Tribe and others, including operations in the fall and winter that protect kokanee access and spawning.
  - Refilling the reservoirs by the end of June remains a high priority.
  - As much as possible within current operating constraints, manage the reservoir and dam discharges to minimize fluctuations and ramping rates and produce steady flows across each season and each day.
- **Hells Canyon Complex project operations.** Idaho Power Company's Hells Canyon hydropower complex, consisting of three hydroelectric projects on the mainstem Snake River, is currently undergoing Federal Energy Regulatory Commission (FERC) re-licensing and ESA Section 7 consultation. The Council will review the outcome of the FERC proceeding and, as appropriate, include in the program relevant provisions recognizing the operations to benefit fish below the Hells Canyon Complex as part of the baseline flow measures of the program.
- **Investigate the potential to further improve ecosystem function and floodplain connectivity.** The federal action agencies, in collaboration with state, federal, tribal agencies, and others, should continue to investigate and adjust system water management to improve ecosystem functions in the mainstem, estuary, and plume, with an emphasis on improvements in the following areas:
  - Reconnected floodplains related to river flows
  - Enhanced Columbia River plume and near-shore ocean habitat
  - Reduced salt water intrusion during summer and fall
  - Fewer and shorter hypoxia and acidification events in the estuary
  - Lower summer water temperatures

Elements of a coordinated approach should include:

- Continued investigations into how to best regulate river flows to enhance floodplain connections
- Further develop the methods to assess the extent of physical and biological benefits that could be gained from changes in flows, floodplain connections, and flood-risk management
- Improvements in hydrodynamic modeling, mapping and investigations into sediment transport and budgets
- Periodic assessment of how flow operations might be modified to capitalize on what is learned from the investigations recommended above
- Continued search for alternative methods of flood risk management in high-value areas to reduce the demands on upriver storage and better balance the allocation of risk, costs, impacts, and benefits

### **Specific fish passage measures**

- **Passage at Mid-Columbia PUD dams.** The program's baseline passage measures and objectives include the passage actions and performance standards identified and agreed to by the operators of the Mid-Columbia PUD projects in FERC licenses and associated agreements.
- **Juvenile fish passage.** To maintain and improve juvenile fish passage survival, the Corps, in collaboration with state, federal, and tribal fish agencies shall select the most biologically effective combination of passage routes at each mainstem dam (including a spill level that does not exceed interim TDG standards or variances) which, when combined with other passage routes, maximizes juvenile fish survival and minimizes adult fish migration and fallback problems. In this effort, the Corps and its partners should:
  - Continue to refine the operation of surface bypass systems at all federal mainstem dams. The focus should be on developing the most effective training-spill patterns at mainstem dams to improve juvenile fish passage and survival while not affecting adult passage. Surface passage structures and outlets are important tools to achieve the dual goals of safe juvenile fish passage and long-term compliance with Clean Water Act total dissolved gas standards.
  - Relocate juvenile fish bypass outfalls in those circumstances where there are problems with predation, tailrace egress, or other factors contributing to juvenile fish injury or mortality.
  - Install new, fish-friendly turbines or optimize turbine operations to improve juvenile fish survival.
  - Continue to investigate ways to reduce descaling of juvenile sockeye.
- **Spill.** When making decisions regarding the timing and amount of spill, the federal action agencies should give priority to actions that (1) minimize impacts on returning adult fish; and (2) optimize in-river passage survival benefits for focal species, with particular emphasis on those species that cannot be or are not effectively transported.
- **Spill and other passage experiments.** The Council continues to recognize the value of an experimental approach to salmon recovery in the Northwest.

The Council supports the development of adaptive management experiments that address critical uncertainties related to species survival.

Proposals for such experiments must be based on the best available science, have appropriate study designs, be subject to review by the independent science panels, and address issues raised by independent scientific review and peer review. Proposed experiments will also need the necessary regulatory approvals consistent with all federal and state laws. This includes approval by the agencies with jurisdiction over the Endangered Species Act (as spill affects listed species) and the Clean Water Act. Experiments should not pose unnecessary risks to salmonids or other aquatic life in the Columbia River. And finally, the Council will take into account the compatibility of an experiment with other research taking place and future fish passage improvements at the dams in the Columbia Basin as well as the effect on the adequacy, efficiency, economics, and reliability of the power system.

Further work on proposals for mainstem spill experiments should fully engage the technical expertise in the region, including scientists from NOAA Fisheries, state fish and wildlife agencies, tribes, U.S. Fish and Wildlife Service, other federal agencies, the independent science panels, and others. The Council is interested in seeing future proposals for improving spill and other mainstem operations that meet these criteria and contain all the elements of a viable experiment as identified by the ISAB in [report 2014-2](#).

- **Juvenile fish transportation.** The Council recognizes the need to transport migrating juvenile salmon and steelhead under certain river conditions. The Council accepts this strategy as a means to achieve its biological objectives, where there are demonstrated benefits for fish. Implement juvenile fish transportation following adaptive management principles that consider and respond to new evidence regarding the relative life-cycle survival benefits when compared to in-river migration. Evaluation should include transportation effects on adult stray rates and the impacts of straying.
- **Adult fish passage.** The Corps, in collaboration with the state, federal agencies and tribes, should continue to implement improvements to the adult fish passage facilities at mainstem dams to benefit salmon and steelhead, Pacific lamprey, white sturgeon, and bull trout. In particular, cool water releases from storage reservoirs should continue to be used to facilitate adult migration. Emphasis should also be placed on research, monitoring, and evaluation; increased accuracy of fish counts; assessment of conversion rates of all adult fish species of interest, including lamprey, through key mainstem reaches; installation of PIT-tag and radio-tag detectors; evaluation of escapement numbers to spawning grounds and hatcheries; research into water temperature and spill effects on fish passage; and the connection between fish passage design and fish behavior. In particular:
  - As a priority for the Corps' capital construction program, implement structural improvements to correct adult fish-passage problems or improve reliability of adult passage facilities and report to the Council on progress

- Install adult PIT-tag detectors at key mainstem projects or near the mouths of major tributaries that do not have them
- Improve fish-counting accuracy and utilize known-origin PIT-tagged fish to evaluate adult survival (conversion rates) through key reaches of the mainstem Snake and Columbia rivers
- Investigate the use of, or need for, surface flow outlets during the winter months to provide a safer fallback route for over-wintering steelhead and kelts

### **Power system considerations**

- The Council will work with federal and non-federal operating agencies, federal and state fish and wildlife agencies and tribes to review, update, and implement procedures that accommodate power system and dam operation emergencies with the least impact on listed and non-listed fish and with consideration of protection, mitigation, and recovery objectives.
- Fish survival emergencies may require operations that temporarily reduce or curtail power production, which should be implemented in the most cost-effective manner possible by the federal action agencies and non-federal project operators.
- The Council will investigate cost-effective power system strategies that improve ecosystem conditions for fish and wildlife, relax operational constraints adverse to fish and wildlife, and ensure the regional power system remains adequate, reliable, and economical

## **9. Estuary**

### **Sub-strategy**

Restore ecosystem function to protect and enhance critical habitat and spawning and rearing grounds in the estuary and lower Columbia River.

### **Rationale**

The Columbia River estuary is an important ecological area that stretches from the mouth of the Columbia River to the Bonneville Dam tailrace including tidally influenced mouths of tributaries. Ecological functions in the estuary have been altered by upriver actions including the construction and operation of the hydropower system and local habitat change. The storage, release, and impoundment of water changes the pattern of flows and water temperatures downstream from hydroelectric dams and changes the characteristics of the estuary. Scientific research suggests that habitat-improvement actions in the estuary have the potential to improve survival benefits for fall and spring Chinook salmon, sockeye, and steelhead.

### **Principles**

- A functioning ecosystem sustains abundant, productive, and diverse communities of fish and wildlife.
- Habitat restoration supports and enhances ecosystem functions and species survival.
- Long-term monitoring helps ensure that (1) habitat-restoration projects remain effective, and (2) fish populations affected by the hydropower system including salmon, steelhead, and lamprey, respond to mitigation projects designed to improve survival in estuary habitat, the lower Columbia River, and the near-shore plume marine environment.
- In an environment as diverse as the lower Columbia River and estuary, partnerships are essential in planning, monitoring, evaluating, and implementing mitigation activities.

### **General measures**

The Council incorporates as program measures estuary actions in the Federal Columbia River Power System Biological Opinion (BiOp). The program, however, is broader than the Endangered Species Act both in terms of species affected by the hydrosystem and the ultimate objective of the program that goes beyond just delisting endangered species. Today, the Columbia Estuary Ecosystem Restoration Program (CEERP) developed by the federal BiOp action agencies directs implementation of BiOp actions in the estuary. The CEERP, along with the Council's estuary and Lower Columbia subbasin plans and locally developed recovery plans, will guide implementation, monitoring, and evaluation of habitat actions in the estuary.

The Corps and Bonneville shall implement in partnership with fish and wildlife agencies and tribes and other organizations:

- Assessments of opportunities for floodplain reconnection and removal or lowering of dikes and levees that block access to habitat, or installing fish-friendly tide gates for habitat reconnection, protection, and restoration of riparian areas and off-channel habitat
- Effectiveness monitoring of habitat-restoration actions using a programmatic approach to mirror effectiveness monitoring elsewhere in the Columbia Basin
- A long-term, continuous, status and trend monitoring and evaluation program for salmon, steelhead, and Pacific lamprey migration and survival that shall include monitoring habitat in the lower Columbia River, estuary, and the near-shore plume environment
- Research and evaluation on the effects of flow regulation, dredging, and water quality (Including toxics) on estuary habitat and food webs to better understand the relationship between estuary ecology and salmon and steelhead productivity, abundance, and diversity

The Council will:

- Work with partners in the estuary to establish biological objectives and estuary [indicators](#) for habitat restoration and ecosystem function that will serve to prioritize future actions.
- Receive from Bonneville and the Corps, a summary report on the results of action-effectiveness, status, and trend monitoring and research uncertainties in March 2015. The report must provide information to help improve and substantiate the effectiveness of habitat actions implemented in the estuary by parties that do not monitor their own habitat actions.

### **Link to subbasin plans**

See the Council's [subbasin plans](#) for information pertaining to the estuary and lower Columbia.

## 10. Plume and nearshore ocean

### Sub-strategy

Monitor ocean conditions and related salmon survival and endorses mitigation and management actions that improve the survival, growth, and viability of Columbia River fish in varying ocean conditions.

### Rationale

The ocean environment, in particular the plume, is treated as an integral component of the Columbia River ecosystem. The survival, growth, and viability of anadromous populations in the Columbia River Basin is affected by physical, biological, and ecological conditions in the ocean. The ocean is not a static environment. As a result of the varying ocean conditions, salmon populations are constantly fluctuating and may pass through cycles of abundance, followed by cycles of scarcity. The storage, release, and impoundment of water changes the pattern of flows and water temperatures downstream from hydroelectric dams and changes the characteristics of the plume.

Understanding the conditions Columbia River anadromous fish face in the ocean will help identify which factors are most critical to survival, growth, and viability and also suggest which mitigation actions will provide the greatest benefit.

### Principles

- **Identify the effects of ocean conditions and distinguish from other effects:** Baseline and real time data is needed to identify and isolate the effects of ocean conditions on the survival, growth, and viability of Columbia River anadromous fish.
- **Manage for variability:** Variations in ocean conditions play a large role in the survival of anadromous fish and other species in the Columbia River Basin. The Council supports management actions that help anadromous species accommodate a variety of ocean conditions by providing a wide range of life history strategies.

### General measures

- The Council supports monitoring plume and nearshore ocean conditions and in-river restoration actions to determine those actions of greatest benefit and to separate the effects of ocean-related mortality from that caused in the freshwater part of the life cycle.
- The federal action agencies shall evaluate the effects of flow regulation on near-shore plume characteristics and salmon and steelhead productivity, abundance, and diversity.
- The Council supports continued monitoring of the Columbia River plume and ocean conditions, assessment of impacts on salmonid survival, and evaluation of the limits of restoration potential in the basin given variable ocean conditions. Predicting future ocean conditions and anadromous fish returns allows for adjustments to inland actions and may lead to increased survival benefits.

- The Council supports coordination between ocean scientists and state fish and wildlife agencies and tribes to identify key uncertainties and opportunities to improve river management activities based on current ocean conditions.
- The Council supports efforts by the Ocean and Plume Science and Management Forum and science/policy exchanges to encourage coordination and communication between ocean researchers and fish and wildlife agencies and tribes. The Council will consider recommendations from the forum when making recommendations to Bonneville regarding implementation of this strategy.
- The Council encourages scientists to develop an annual index of ocean survival from Bonneville Dam back to Bonneville Dam.

## 11. Wildlife mitigation

### Sub-strategy

Mitigate wildlife losses caused by the development and operation of hydropower dams in the Columbia River Basin.

### Rationale

Development and operation of the hydrosystem resulted in wildlife losses, operational losses, and secondary losses. The program includes measures and implements projects to acquire and protect the habitat units identified in the loss assessments [see [Appendix C, Table C-4](#)], as mitigation for construction and inundation losses. The program maintains a commitment to mitigate for operational and secondary losses that have not been estimated or addressed. However, where operational or secondary losses already have been addressed in an existing wildlife mitigation agreement, the terms of that agreement will apply.

### Principles

- The extent of wildlife mitigation is of particular importance to agencies and tribes in blocked areas, where anadromous fish runs have been extirpated by development of the hydrosystem, and where full mitigation cannot be accomplished through resident fish substitution alone. Given the vision of this program, the strong scientific case for a more comprehensive, ecosystem-based approach, and the shift in focus to implementation through subbasin plans, the Council believes that wildlife mitigation projects should be integrated with fish mitigation projects as much as possible. In some cases, where resident fish goals cannot be accomplished, wildlife mitigation may substitute for resident fish mitigation.
- Wildlife mitigation should replace habitat units lost to hydropower dam development and operation. Beginning in the 2000 Program, the Council called for these mitigation agreements to equal 200 percent of the remaining habitat units (2:1 ratio). The Council chose the 2:1 crediting ratio to address the inability to precisely determine the habitat units resulting from acquiring an interest in property that already has wildlife value or the additional losses represented by annualization of the losses.
- The Council adopted and continues to endorse the 2:1 crediting ratio for the remaining habitat units. However, when loss estimates appear inaccurate due to habitat unit stacking and those inaccuracies cannot be resolved through use of a different, cost-effective tool or approach recommended by the [Wildlife Crediting Forum](#) and approved by the Council, then the 2:1 ratio will not apply to the remaining stacked habitat units.
- Mitigation agreements should be considered to settle operational losses in lieu of precise assessments of impacts.

### General measures

- Bonneville shall work with the agencies and tribes on the following measures:

- Where appropriate prioritization exists and agreements exist on the methodology, complete wildlife loss assessments for losses caused by operation of the hydropower projects
- Develop and implement habitat acquisition and enhancement projects to fully mitigate for identified losses
- Coordinate habitat restoration and acquisition activities throughout the basin with fish mitigation and restoration efforts to promote terrestrial and aquatic area connectivity
- Maintain the values and characteristics of existing, restored, and created habitat
- The Council encourages wildlife agencies and tribes to monitor and evaluate habitat and species responses to mitigation actions and develop a more standardized approach to wildlife monitoring.
- Bonneville and the fish and wildlife agencies and tribes will complete wildlife loss mitigation agreements for at least the remaining construction and inundation losses by 2016. In addition, for each wildlife agreement that does not already provide for long-term maintenance of the habitat, Bonneville and the applicable management agency shall propose a management plan adequate to sustain the minimum credited habitat values for the life of the project.
- Fish and wildlife agencies and tribes and Bonneville will reach agreement on how wildlife mitigation projects and fish mitigation projects should be credited toward identified losses.

### **Specific measures for habitat units**

- **Habitat units and the habitat evaluation procedure (HEP) methodology.** The Council will continue to endorse habitat units as the preferred unit of measurement for mitigation accounting and the HEP methodology as the preferred method for estimating habitat units lost and acquired. Parties to a wildlife mitigation agreement may develop and use another method for evaluating potential mitigation actions if, in the Council's opinion, that alternative method adequately takes into account both habitat quantity and quality adequate to mitigate for the identified losses.
- **Allocation of habitat units.** Bonneville shall work with the agencies and tribes for habitat acquired as mitigation for lost habitat units identified in Table C-4, which shall be acquired in the subbasin in which the lost units were located unless otherwise agreed by the fish and wildlife agencies and tribes in that subbasin.
- **Habitat enhancement credits.** Habitat enhancement credits should be provided to Bonneville when habitat management activities funded by Bonneville lead to a net increase in habitat value when compared to the level identified in the baseline habitat inventory and subsequent habitat inventories. This determination shall be made through the periodic monitoring of the project site using the HEP methodology. Bonneville shall

be credited for habitat enhancement efforts at a ratio of one habitat unit credited for every habitat unit gained.

### **Long-term agreements**

Whenever possible, Bonneville shall work with the agencies and tribes to ensure that wildlife mitigation shall take place through long-term agreements that have clear objectives, a plan for action over time, a committed level of funding that provides a substantial likelihood of achieving and sustaining the stated wildlife mitigation objectives, and provisions to ensure effective implementation with periodic monitoring and evaluation. Thus, wildlife mitigation agreements shall include the following elements:

- Measurable objectives, including acres of habitat types and number of habitat units by species to be acquired, and a statement estimating the contribution to addressing the wildlife losses identified in Table C-4 in the Appendix
- Demonstration of consistency with the wildlife policies, objectives, and strategies in the Council's program, including with the implementation priorities described in Tables C-1, C-2, and C-3 in the Appendix
- Adherence to the open and public process language found in the Northwest Power Act including measures to address concerns over additions to public land ownership and impacts on local communities, such as a reduction or loss of local government tax base or the local economic base and consistency with local governments' comprehensive plans
- When possible, protection for riparian habitat that can benefit both fish and wildlife, and protect high-quality native habitat and species of special concern, including endangered, threatened, or sensitive species
- Incentives to ensure effective implementation of the agreement, plan or action, with periodic monitoring and evaluation (including a periodic audit) and reporting of results. At a minimum, annual reports to Pisces must continue in order for the Council to evaluate the mitigation benefits.
- Provisions for funding long-term maintenance of the habitat adequate to sustain the minimum credited habitat values for the life of the project to achieve and sustain the wildlife mitigation objectives
- For a project to be credited against construction and inundation losses it must be consistent with the fish and wildlife program. Criteria include:
  - Covenants, easements, fee title acquisitions or other appropriate agreements for the life of the hydroelectric project to ensure project areas are permanently protected and dedicated to wildlife benefits
  - A demonstration that projects will benefit priority wildlife habitat, species, or populations as defined by federal, state, or tribal wildlife management plans or subbasin plans
  - A completed project-area management plan
  - A long-term funding agreement adequate to support implementation of the management plan

### **Wildlife Advisory Committee**

The Council recognizes the ongoing difficulties in addressing wildlife operational losses. At the same time the Council recognizes the progress that has been made in addressing this issue as the result of pilot projects on the Kootenai River. To address this issue the Council has directed its Wildlife Advisory Committee to examine the existing options and alternatives for providing mitigation for wildlife operational losses and to provide a recommendation to the Council for resolving the issue by October 1, 2015. In addition, the committee has been charged to make recommendations on the following issues:

- The need for additional HEP reports and future HEP Team funding
- The diminishing need for HEP on new acquisitions as Bonneville completes construction and inundation mitigation
- Current regional need for follow-up HEP capacity to track project agreement compliance on many properties. That need may be influenced by (1) long-term settlements for operation and maintenance, (2) technology advances that may allow the region to more cost effectively track changes in habitat conditions using remote sensing or other techniques, and (3) species responses.
- The need for new methods to assess operational losses that incorporate the results of ongoing pilot projects. This could include technical testing and evaluation of operational loss models and methodologies, or other alternative habitat evaluation methods.

### **Link to subbasin plans**

See the Council's [subbasin plans](#) for subbasin-level information pertaining to wildlife focal species and management strategies that help guide project selection.

## ***B. Fish Propagation Including Hatchery Programs Strategy***

Use hatchery programs as tools to help meet the mitigation requirements of the Northwest Power Act.

### **Rationale**

Hatcheries and other propagation measures are operated for multiple purposes: to provide mitigation, species protection, population conservation, research, and frequently some combination of these purposes. The majority of hatchery propagation facilities in the Columbia Basin are authorized and operated to mitigate for the construction and operation of the hydropower system. The Council also acknowledges the commitments made by federal, state, and tribal governments to implement propagation actions consistent with the Northwest Power Act, Endangered Species, Indian treaty rights and other laws, including commitments associated with on-going court cases such as [United States v Oregon](#).

Since habitat restoration actions cannot, by themselves, meet protection and mitigation requirements of the Northwest Power Act, the Council supports propagation to help meet program objectives including replacement of wild fish loss as a result of habitat degradation and dam construction. Over the last 25 years, salmon propagation practices have undergone extensive [reviews](#) by the Council, state and federal agencies, Indian tribes, and independent science panels, with particular attention following the listing of several salmon and steelhead species in the basin.

In addition, the body of scientific literature concerning hatchery programs has grown tremendously in the last 10 years. The literature and the reviews mentioned above indicate the risks and benefits of hatchery programs need to be considered on a case-by-case basis. Furthermore, these reviews have laid a scientific foundation to guide hatchery strategies to address the specific population mitigation and other management objectives in each watershed in the basin.

In 2009, the Hatchery Scientific Review Group (HSRG) conducted a detailed, thorough, and comprehensive review of hatchery programs in the Columbia River Basin. The HSRG Report was updated in 2014. The resulting population-specific recommendations were intended to provide scientific guidance for managing each hatchery more effectively in the future. The HSRG review did not end with the aforementioned recommendations because it went on to say that these were not the only options for operating hatchery programs more effectively. In its 2014 report the HSRG stated:

The central message of the HSRG is that the impacts of hatchery fish on naturally spawning populations must be carefully considered when planning and operating harvest augmentation and mitigation hatcheries

and that the best available science should be used when informing decision makers about the tradeoffs involved.

The Council understands the hatchery operators have considered the HSRG review as guidance in developing hatchery and genetic management plans (HGMPs) for each hatchery program. In addition, the Council relies on Bonneville and the Coordinated Assessment partners to provide the hatchery performance data needed to monitor the effectiveness of hatcheries funded by Bonneville.

There are several propagation strategies that are implemented in the basin including segregated programs to maintain fish abundance for harvest, integrated programs to complement wild fish restoration and provide harvest benefits, supplementation and captive rearing programs to bolster weak wild populations, and reintroduction programs to replace fish populations that have been lost completely. The Council defers to the agencies and tribes to define the scope and purpose(s) of the hatchery and fish propagation methods, as well as the appropriate management techniques, consistent with current and evolving scientific principles. The Council will ensure that research, data collection, and reporting methods allow for meaningful evaluation of hatcheries and fish propagation measures at both the local and landscape level, to assure consistency with program goals and objectives.

## **Principles**

Hatcheries should:

- Follow an adaptive management approach that uses research and monitoring data to understand, at multiple scales, how hatcheries are performing
- Operate according to sound scientific principles for fish recovery and to fully meet federal and other legal obligations for fish protection, mitigation and enhancement within the altered Columbia River ecosystem
- Support viable salmonid population (VSP) characteristics to enhance wild populations, including abundance, productivity, spatial distribution, and diversity
- Use an adaptive-management process that address variability in environmental conditions and in fish productivity and escapement levels, and includes aggressive monitoring to evaluate risks, benefits, and address scientific uncertainties
- Operate within the broader basin, regional, and global systems
- Restore, maintain, or minimize impacts upon species diversity to help ensure their resiliency
- Where appropriate, use locally adapted fish as the model for successful rebuilding and restoration of depleted populations in their native habitat
- Use appropriate marking strategies for hatchery-produced salmon and steelhead that enable effective management of the population-specific strategies in the basin and provide for appropriate harvest opportunities
- Externally mark hatchery produced Chinook, coho, and steelhead that are intended to be used for directed harvest consistent with any applicable state

policy, or for conservation or research needs. External mark use will require state-tribal agreement in some cases (e.g. United States v Oregon) to fully meet federal and other legal obligations for fish protection and recovery, mitigation, and enhancement.

- Set clear goals and identify specific criteria for evaluating hatchery performance
- Mitigate for losses in fish survival and in fish production. Agencies and tribes are encouraged to investigate new locations and opportunities to expand treaty and non-treaty harvest, including the reprogramming or expansion of hatchery production and selective harvest.
- Operate in consideration of other factors that influence species abundance, productivity, spatial structure, and diversity, and relative to legal principles, including but not limited to tribal treaty rights
- Operate based on conditions that are unique to every location. Agencies and tribes and operators will tailor hatchery program goals and objectives, performance criteria, and corresponding hatchery management practices in consideration of several local factors, including but not limited to, the status and recovery goals for local fish aggregations, the quantity and quality of fish habitat, environmental conditions, and relevant land use and other regulations.

### **General measures for comprehensive research, monitoring, assessment and reporting on hatchery effectiveness**

- For Bonneville-funded hatchery programs, Bonneville shall locate and operate propagation actions to complement the present and future management activities of the region's agencies and appropriate Indian tribes, including complements to habitat improvements by supplementing native fish populations.
- The Council's research plan will identify critical uncertainties related to hatchery performance in the Northwest. This includes determining the effectiveness of hatchery programs in meeting their intended purposes and minimizing adverse impacts to natural-origin fish.
- Bonneville should support the use of standardized performance measures by the agencies and tribes to inform effectiveness of various propagation strategies in meeting intended hatchery goals.
- The Council intends to use available reporting mechanisms where possible.
- The Council requests that NOAA Fisheries annually update the Council on the status of ESA reviews for state and tribal HGMPs.
- Where feasible, trends in abundance, productivity, distribution and, diversity of supplemented populations shall be compared to non-supplemented populations in "reference streams" before, during, and after implementation of the production effort.
- The Council requests that NOAA advise the Council on the utility of updating the list of reference streams first identified by the Ad Hoc Supplementation

Workgroup that are linked to distinct population segments (DPSs), and populations within evolutionarily significant units (ESUs).

- The Council also requests NOAA share with the Council the results of NOAA status reviews of Columbia Basin salmon and steelhead ESUs and DPSs as the reviews are completed.
- Recovery plans have been or are in the process of being developed for each of the listed salmon ESUs and steelhead DPSs in the Columbia River Basin. Each recovery plan includes or will include viability criteria, or targets that are based on the biological parameters of abundance, productivity, spatial structure, and diversity. Viability criteria, together with threats criteria, are considered when determining whether a species warrants delisting.
- Hatchery program implementation, monitoring, and evaluation results for all hatchery programs in the Columbia River Basin should be made electronically available and hatchery operators and funders should coordinate annual summary presentations to the Council.
- Hatchery summary presentations should include adaptive management actions implemented or planned to improve effectiveness in meeting intended hatchery goals or changes in goals to meet broader basin management strategies.
- To promote a diversified approach to hatchery management, hatchery operators will aspire to improve hatchery program performance and, in coordination with agencies and tribes, will seek-out opportunities to test and monitor alternative hatchery strategies and approaches and alternative hatchery practices.
- To facilitate compliance monitoring, agencies and tribes will monitor their hatchery programs for compliance with federal, state, and other relevant requirements and will make this information readily available.
- The Council continues to support PIT tagging and detection, coded wire tagging and recovery, acoustic and radio tagging and tracking, and genetic tagging and recovery. These all work together to help assure adequate effectiveness monitoring, and other monitoring as necessary, throughout fish life cycles and across various fish environments.
- In consideration of best available scientific information the Council will rely on information provided by the independent science panels and the agencies and tribes regarding hatchery science. The agencies and tribes will continue and expand their investments in research, monitoring and evaluation for the purpose of reducing uncertainties and improving hatchery performance, including developing a better understanding of the benefits and risks of hatchery programs.

### **Link to subbasin plans**

See the Council's [subbasin plans](#) for information pertaining to hatcheries within the subbasins.

## **C. Other strategies**

### **1. Wild fish**

#### **Strategy**

Native wild fish and the ecosystems they rely on must be protected, mitigated, enhanced, and recovered, as they constitute an important, genetically diverse, biological resource for the Basin (in the context of the Council's mitigation responsibility). Wild fish also provide important opportunities to rebuild and reintroduce populations where donor populations may support this. The Council also recognizes that hatcheries are an important tool for mitigating the hydrosystem's impact on wild fish and to assist in the rebuilding of certain wild fish populations.

#### **Rationale**

Because habitat restoration is a key strategy in the program, it is essential to maintain and rebuild healthy, self-sustaining fish and wildlife populations by protecting, mitigating, and restoring ecosystem conditions on which the fish depend through their entire life cycle. This wild fish strategy will help ensure that adequate attention is also given to protecting, mitigating, and enhancing populations of wild fish. The Council's program encourages collaboration and coordination to implement these measures while respecting the management role of the federal, state, and tribal natural resource agencies.

#### **Principles**

- Where native habitat is largely intact, and the fish population has good potential to rebuild, manage for wild fish except where fish and wildlife managers determine supplementation efforts are appropriate, after applying existing review procedures.
- All aspects of the life cycles of wild fish populations are important to their abundance, productivity, diversity, and distribution and all sources of mortality must be addressed in protecting, mitigating and enhancing wild fish.
- Freshwater survival of wild fish spawning, rearing, and migrating in tributary and mainstem rivers is key to maintaining healthy population conditions.
- Habitat and hydrosystem actions should be managed to address the conservation needs of wild fish.
- Ecological and genetic risks to wild fish should be managed by operating hatchery programs to address potential competition between hatchery-reared and wild fish for food resources, space, and exposure to disease, and gene flow between wild and hatchery populations.
- Impacts to wild populations in fisheries should be managed consistently with harvest biological opinions and with other conservation-based management agreements.

**General measures**

- The Council will consider the needs of wild fish in all facets of its fish and wildlife program including: hydrosystem passage, fish propagation facilities, climate change, predation, strongholds, research, carrying capacity, and habitat actions.
- Consistent with the Council's quantitative objectives for adult salmon and steelhead, the Council will collect, organize, and review biological objectives for wild fish.

**Link to subbasin plans**

See the Council's [subbasin plans](#) for subbasin-level information pertaining to wild populations of focal species.

**Links within the program**

[Objectives](#), [strongholds](#), [fish propagation](#), [habitat](#), and [adaptive management](#)

## **2. The use of hatcheries for reintroduction**

### **Strategy**

The purpose of reintroduction is to return lost salmon and steelhead into blocked areas, or to re-establish populations in watersheds accessible for anadromy but where the native population had been extirpated or the risk of extirpation is very high. A successful reintroduction approach would result over time in anadromous fish that are viable in areas where they were previously located and that meet harvest and habitat goals and objectives identified by the agencies and tribes.

Strategies to initiate a reintroduction may involve live trapping and translocation of fish, or introduction of hatchery-reared juveniles. Reintroduction would use fish of local origin, if available. Initial reintroduction may be followed by hatchery supplementation with progeny of adults returning in-basin used as broodstock. In areas where anadromous fish have been extirpated due to the construction and operation of hydropower facilities and it is not yet possible to reintroduce anadromous fish successfully, hatchery supplementation of a substitute species may be part of the mitigation strategy, along with habitat improvements to support natural production of native resident species.

### **Principles**

- Ecological and genetic interactions such as competition for food and space, straying, predation, and disease that have the potential to adversely affect existing native fish must be considered as part of an anadromous fish reintroduction program. If substitute non-anadromous fish are to be introduced, then ecological interactions must be consistent with native fish goals.
- The use of hatchery fish for replacement or substitution purposes must occur within the context of the program's anadromous fish mitigation in the blocked areas strategy. All ongoing or new substitution projects that involve or might involve a non-native species should follow the program's non-native fish strategy.
- Standards that apply to either segregated or integrated programs may also apply to reintroduction and replacement programs as circumstances and ultimate purposes require.
- Feasibility to re-establish salmon and steelhead populations in all areas within the basin where they have been extirpated should be assessed and programs for re-establishment considered where deemed feasible.

### **General measures**

- Bonneville shall locate and operate hatcheries to re-establish salmon and steelhead where they have been extirpated, and substitute for extirpated salmon and steelhead in blocked areas.
- The goals, objectives, timelines, benchmarks and experimental framework for reintroduced populations will be developed by the agencies and tribes and submitted to the Council.

### **3. Anadromous fish mitigation in blocked areas**

#### **Strategy**

Mitigate through implementation of a variety of actions that may include passage investigation, reintroduction of anadromous fish, habitat improvements, and harvest opportunities for the loss of salmon and in blocked areas of the Columbia Basin that historically had runs of anadromous fish. Flexibility in approach is needed to develop a program that addresses anadromous fish losses.

#### **Rationale**

Anadromous fish losses are identified in “Compilation of Information on Salmon and Steelhead Losses in the Columbia River Basin” and the “Numerical Estimates of Hydropower-related Losses,” first adopted in the Council’s 1987 Fish and Wildlife Program [see [Appendix B](#)].

For some time, the fish and wildlife program has included a provision calling for investigations into the passage and reintroduction of anadromous fish above Chief Joseph and Grand Coulee dams if, when, and where feasible. The huge loss of salmon capacity and productivity in the upper Columbia has been one of the key drivers of mitigation activities under the Northwest Power Act, and a number of agencies and tribes recommended for this 2014 Program that the region intensify its efforts to explore the possibilities of reintroducing anadromous fish above Chief Joseph and Grand Coulee dams.

#### **Principles**

The following principles should guide decisions on mitigation strategies to address anadromous fish losses in blocked areas:

- Restoration of anadromous fish to blocked areas should be investigated as mitigation for the impacts of hydropower dams that blocked historic passage of adult and juvenile fish. The abundance of native fish species should be restored throughout blocked areas where original habitat conditions exist or can be feasibly restored or improved.
- Mitigation for fish and wildlife losses attributable to the hydropower system generally should occur in the vicinity of the losses.
- Mitigation may include the use of resident fish, anadromous fish reintroductions, wildlife, habitat, and projects to identify or resolve data gaps.
- Mitigate according to the following ordered priorities:
  - Weak, but recoverable, native populations affected by the hydropower system, as such populations are identified for the Council by the state and federal fish and wildlife agencies and tribes (agencies and tribes)
  - Actions that investigate reintroductions of anadromous fish into blocked areas, where feasible
  - Areas of the basin where anadromous fish are not present
  - Resident fish projects that also provide benefits for wildlife or anadromous fish

- Populations that support important fisheries including both introduced and native species such as trout, sturgeon, kokanee, burbot, bass, perch, and others.
- Subsistence and sport fishing resources that meet state and local regulations should be provided when full mitigation by improving the abundance of native fish species is not feasible.
- Non-native fish should be managed to maximize use of available existing and improved habitats without adversely affecting native fish populations.
- Efforts to increase the abundance of anadromous fish should be done in a manner that is compatible with the continued persistence of native resident fish species and their restoration to near historic abundance.
- Hatcheries should be operated in a manner consistent with the hatchery strategy in this program.

### **General measures**

#### **All blocked areas**

- The action agencies, in collaboration with state agencies and tribes, shall fund mitigation of anadromous fish losses, including strategies relying on habitat improvements, reintroductions, hatcheries, harvest opportunities, and other mitigation.
- Bonneville shall provide funding to:
  - Develop and increase opportunities for consumptive and non-consumptive resident fisheries for native, introduced, wild, and hatchery-reared stocks that are compatible with the continued persistence of native resident fish species and their restoration to near historic abundance
  - Consider passage projects to benefit native species
  - Expand and rebuild native fish numbers in blocked areas where habitat exists or can feasibly be restored or improved
  - Address anadromous fish losses with resident fish and wildlife, as appropriate, where full mitigation cannot be accomplished with resident fish alone
  - Protect and improve degraded fish habitat consistent with the habitat sub-strategy

#### **Reintroduction of anadromous fish above Chief Joseph and Grand Coulee dams to mainstem reaches and tributaries in the United States**

- **Phased approach.** Pursue a science-based, phased approach to investigating the reintroduction of anadromous fish above Chief Joseph and Grand Coulee dams including juvenile and adult passage at the dams. The phases shall include:
  - Phase 1 (to be completed no later than the end of 2016):
    - Evaluate information from passage studies at other blockages and from previous assessments of passage at Grand Coulee and Chief Joseph dams

- Investigate habitat availability, suitability and salmon survival potential in habitats above Grand Coulee. This might include selective releases of salmon and steelhead. Investigate the scientific feasibility and possible cost of upstream and downstream passage options for salmon and steelhead. Before funding new investigations, provide the Council with a report for consideration of subsequent work to advance the fish passage planning process.
- As part of Phase 1, the Council will engage in discussions with tribal, state, and federal agencies and others regarding the purpose, scope and progress of reintroduction efforts above Chief Joseph and Grand Coulee dams.
- Phase 2:
  - Based on the results in the first phase, the Council in collaboration with the other relevant entities will decide how to proceed. Phase 2 activities may include one or more of the following:
    - design and test salmon and steelhead reintroduction strategies and interim fish passage facilities at Chief Joseph and Grand Coulee Dams
    - investigate alternative approaches to passage
    - identify additional studies necessary to advance the fish passage planning process
    - reintroduction pilot projects
    - monitoring, evaluation, and adaptive management of the Phase 2 activities
- Phase 3:
  - Based on the results of Phase 2, the Council in collaboration with the other relevant entities will decide whether and how to proceed to implement and fund reintroduction measures as a permanent part of the program, including construction and operation of passage facilities.
  - Monitor, evaluate, and adaptively manage the reintroduction efforts.
- **Transboundary reintroduction.** The United States should pursue a joint program with Canada, with shared costs, to investigate and, if warranted, implement the reintroduction of anadromous fish on the mainstem Columbia River to Canadian spawning grounds. This joint program would proceed on an incremental basis, comparable to the phased approach described above.
- **Reintroductions above Grand Coulee to mainstem reaches and tributaries in the United States.** Bonneville and the relevant federal action agencies, working in collaboration with state and federal fish and wildlife agencies and tribes, shall investigate and, if warranted, implement passage and reintroduction of anadromous fish into suitable habitats within the United States. This shall include:
  - Funding research associated with critical uncertainties at Chief Joseph and Grand Coulee dams required to inform Phase 1
  - Funding work required for Phases 2 and 3 based on Council recommendations

**Reintroductions above projects in the Willamette River Basin**

The Corps and Bonneville should support and implement anadromous fish passage measures prioritized through the Willamette River Basin Flood Control Project Biological Opinion.

**Link to subbasin plans**

See the Council's [subbasin plans](#) for subbasin-level information that provides historical context, strategies and objectives that will continue to help guide mitigation work for lost anadromous stocks.

#### 4. Resident fish mitigation

##### Strategy

For resident fish and other aquatic species impacted by the hydrosystem, protect and mitigate freshwater and associated terrestrial habitat, and native fish populations.

##### Rationale

Mitigation is required for native resident fish and other freshwater species impacted by the construction and operation of the hydropower system. Native resident fish and other freshwater species addressed in this strategy include freshwater mussels, threatened bull trout, burbot, westslope cutthroat trout, mountain whitefish, endangered Kootenai white sturgeon, and resident life histories of the native anadromous species, such as Columbia River white sturgeon and kokanee. Impacts have resulted in losses to abundance, genetic diversity, life history diversity, spatial diversity and movements of these species, as well as modification of their habitat resulting from inundation. The program recognizes the importance of all native resident fish and other freshwater species, in maintaining ecosystem diversity and function, and contributing to cultural aspects in the basin. It relies on a diversity of strategies to address those losses, including habitat mitigation, hatcheries, harvest augmentation, and modifying hydrosystem operations.

##### Principles

- Apply a diversified approach for mitigating losses, including hatcheries, harvest augmentation, modifying hydrosystem operations, and habitat mitigation that involves habitat protection to protect habitat for native fish in perpetuity and as a tool to mitigate for lost habitat
- Conduct research to identify and determine how to resolve limiting factors, and apply a prioritized approach for addressing limiting factors within a watershed.
  - In areas of the Columbia River Basin that have quantitative native resident fish loss assessments in terms of acres or stream miles of key habitat inundated or blocked, these losses may be most effectively mitigated by acquiring interests in real property for the purpose of preserving and enhancing fish habitat equal to the quality of habitat lost. In such cases, acquire and maintain land in perpetuity for purposes of fish habitat, at a minimum ratio of 1:1 mitigation to lost distance or area. Focus land acquisitions on parcels with connectivity and intact healthy riparian and stream habitat as these will improve fish habitat resiliency [see [guidance for resident fish settlements](#) for details]. Whenever possible, resident fish mitigation via habitat acquisitions should take place through long-term settlement agreements similar to those described above for wildlife mitigation agreements. Currently resident fish loss assessments exist for Libby and Hungry Horse dams.
- Consider the following guidance when addressing resident fish losses related to the development and operation of the hydropower system:

- Address weak, but recoverable, native populations injured by the hydropower system, as such populations are identified for the Council by the fishery agencies and tribes.
- Address areas of the basin where anadromous fish are not present.
- Implement resident fish projects that also provide benefits for wildlife.
- Enhance populations that support important fisheries.

### **General measures**

- Where feasible, Bonneville shall preserve, enhance, and restore native fish in native habitats.
- Bonneville shall develop interim fisheries where native fisheries have been lost, or where native populations and habitats are actively being recovered, and need protection.
- In areas where losses may be most effectively mitigated by acquiring interests in real property, Bonneville shall acquire fish habitat equal to the quality of habitat lost through the acquisition of appropriate interests in real property at a minimum ratio of 1:1 mitigation to lost distance or area [see [guidance for resident fish settlements](#)].
- The Council will convene a work group of fish and wildlife agencies and tribes, and Bonneville, to develop a standardized methodology for habitat loss assessments to assist areas that currently do not have the capacity to complete this assessment and do not have a mitigation settlement agreement, and to ensure a consistent level of accuracy across the basin. This task force shall consider past efforts<sup>6</sup> and will report to the Council quarterly on its progress toward developing a methodology.
- Once loss assessments are completed and adopted by the Council, the Council encourages Bonneville to negotiate settlement agreements, as described in Appendix K.
- Bonneville shall continue to support projects directed at other native freshwater species and the progression of these projects from a research and assessment phase into a restoration and monitoring phase
- Bonneville shall support efforts to address all limiting factors affecting resident fish. This might include efforts to eradicate and suppress non-native species, research on critical uncertainties, impacts from ongoing operation of the hydrosystem, and other impacts.
- Bonneville shall support evaluating the size of non-native fish populations to determine the potential effect of predation and implement a predator management program where appropriate in the Columbia Basin, for example Lake Roosevelt.

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<sup>6</sup> Consider building from the 2009 draft [inundation methodology](#) developed by the CBFWA Resident Fish Advisory Committee. [Additional draft technical documents](#).

- Bonneville, the Corps, and the Bureau shall restore passage for native resident fish where feasible, including at Albeni Falls Dam.

**Link to subbasin plans**

See the Council's [subbasin plans](#) for subbasin-level information pertaining to resident fish mitigation.

**Links within the program**

Strategies: [habitat](#), [ecosystem function](#), [non-native and invasive species](#), [climate change](#).

## 5. Sturgeon

### Strategy

Implement actions that result in increased abundance and survival for Columbia River Basin green and white sturgeon, including habitat actions, dam operations and passage, hatchery considerations, monitoring populations, and research to improve understanding of how the development and operation of the Federal Columbia River Power System affect survival and growth of sturgeon.

### Rationale

Columbia River Basin sturgeon distribution, abundance, and productivity are severely limited by habitat changes, particularly those associated with hydropower system construction and operation. Large areas of suitable sturgeon habitat remain throughout most of the historical range upstream from Bonneville Dam but use is currently limited by widespread passage limitations and natural recruitment problems that are the direct or indirect result of the development and operation of the Columbia River hydrosystem.

Food web issues, water quality (sedimentation, flow, temperature, and toxic contaminants), adequate prey for juveniles, and predators (sea lions) may have impacts on sturgeon. It is not fully understood how other factors exacerbated by the hydrosystem affect sturgeon. Research and monitoring will be key to determine impacts, population status, and mitigation actions necessary to rebuild sturgeon to sustainable numbers throughout the basin.

The Council recognizes and supports implementation efforts to restore, research and monitor white sturgeon populations in the basin consistent with the [2013 White Sturgeon Planning Framework](#) and the [Kootenai White Sturgeon Biological Opinion](#).

### Principles

- A viable Columbia River Basin sturgeon mitigation program should include a combination of monitoring, research, habitat actions, dam operations and passage, adaptive management, natural production, potential use of hatcheries, collaboration, coordination, and evaluation.
- The Council supports opportunities to incorporate sturgeon-friendly features in existing fish ladders during future ladder designs and planned modification where consistent with sturgeon population goals and objectives.
- Continue to identify, protect and restore habitat areas and ecological functions that are associated with productive spawning, resting, rearing, and migrating sturgeon.
- Continue to support interim measures to avoid extirpation of unique sturgeon populations.
- Continue to research what hydrosystem effects limit growth and survival of sturgeon throughout the basin in an effort to better define mitigation needs.

## **General measures**

### **Hydropower dam operations and fish passage**

- The action agencies shall:
  - Seek opportunities to operate the FCRPS to provide flow consistent with the needs of productive sturgeon populations including increased spring and summer flows, reduced flow fluctuations during spawning season, and spill where feasible. Recruitment in many lower Columbia River impounded areas has been positively correlated with high annual discharge during April through July.
  - Operate the hydropower system in a manner that balances needs of anadromous fish, Columbia River Basin sturgeon, and other native fish species in a way that improves the abundance and productivity of sturgeon.
  - Study the effects on downstream passage of sturgeon with and without removable spillway weirs.
  - Estimate mortality by size for fish that pass over spillways and removable spillway weirs and those that pass downstream through turbines; if significant mortality is occurring, identify and evaluate the feasibility of mitigation measures.
  - In general, evaluate the importance of connectivity among sturgeon populations; assess whether the mainstem dams isolate sturgeon populations; and if so, evaluate the feasibility of mitigation.
  - Evaluate costs, benefits, and risks of passage improvements for sturgeon relative to other potential strategies.
  - Evaluate opportunities for non-volitional passage by taking advantage of fish trapped in dewatered draft tubes or fish ladders during maintenance.
  - Continue to develop, refine, and implement protocols to prevent sturgeon entrainment, dewatering, and mortality during planned maintenance activities at passage facilities.
  - Develop an operational protocol to block access by sturgeon to turbine draft tubes during turbine dewatering and start-up.

### **Mainstem habitat**

- The action agencies, in coordination with the agencies and tribes, shall:
  - Investigate the use of site-specific habitat measures such as substrate enhancement and channel restoration as viable alternatives for improving natural recruitment in some areas.
  - Continue to identify, protect and restore habitat areas and ecological functions that are associated with productive spawning, resting, rearing, and migrating sturgeon.
  - Identify the specific aspects of hydrosystem operations, such as duration of fluctuations in water releases and of water levels, which affect natural spawning, reproduction, growth, and survival of larval and juvenile fishes, and overall recruitment success of sturgeon.
  - Conduct dredging operations in a manner minimizing operation-related mortality on sturgeon and their primary prey.

**Predation** – See [predator management](#) strategy

**Research** – See research section of the [adaptive management](#) strategy

### **Monitoring**

- The action agencies, in coordination with the agencies and tribes, shall:
  - Monitor and evaluate white sturgeon restoration actions and population responses to environmental conditions consistent with the Columbia Basin White Sturgeon Planning Framework and the Lower Columbia River and Oregon Coast White Sturgeon Conservation Plan
  - Report on the [status of sturgeon](#)  throughout the basin on a regular basis
  - Assess the effects of climate change on Columbia River Basin sturgeon populations and develop adaptation strategies to address these impacts
  - Support fishery monitoring and management in combination with the suite of other restoration options to mitigate for lost productivity and contribute to population rebuilding efforts in areas where harvest is warranted but where natural recruitment is currently limited and the subpopulation does not represent a unique component of the historical diversity
  - Develop a sturgeon spawning and rearing habitat model in the basin to quantify habitat throughout the year in conjunction with FCRPS operations
  - Continue to evaluate project operations on sturgeon reproductive success in each of the pools behind FCRPS and Mid-Columbia River dams.

### **Hatchery**

- The action agencies shall:
  - Continue to support the Kootenai Tribe Integrated Fish and Wildlife Program as interim measures to avoid extinction of endangered Kootenai white sturgeon
- The action agencies, in coordination with the agencies and tribes, shall:
  - Consider hatcheries for sturgeon as a mitigation strategy to supplement populations where natural recruitment is currently severely limited. When the strategy is implemented through the Council's step-review process for hatchery proposals, this strategy shall:
    - Be conservative and responsible in establishing protocols for source populations and numbers of hatchery fish released
    - Build on knowledge gained from ongoing hatchery efforts in other areas
    - Develop larval collection techniques for use in artificial propagation
    - Develop and implement improvements in rearing and release strategies
    - Utilize experimental hatchery releases and monitoring to assess ecological factors and population productivity limitations
    - Optimize hatchery production and practices consistent with monitoring natural production and environmental carrying capacity, which will

most effectively be identified using an experimentally adaptive approach

### **Upper-Columbia specific**

- The action agencies, in coordination with the agencies and tribes, shall:
  - Conduct baseline population assessments to monitor hatchery and natural-origin sturgeon populations (size, abundance of age classes, age/length frequency, recruitment rate, mortality, distribution, and migration patterns, life history, habitat use, etc.); environmental factors limiting sturgeon abundance; and effectiveness of recovery measures in Lake Roosevelt from Grand Coulee Dam to the international border, including the Spokane arm of Lake Roosevelt
  - Implement measures based on knowledge gained through assessments, limiting factors workshops, Upper Columbia White Sturgeon Recovery Initiative plans and Lake Roosevelt sturgeon recovery plans
  - Continue interim hatchery production, including 100-percent PIT-tagging of hatchery sturgeon and 100-percent PIT-tagging and sonic tagging of broodstock collected in the upper Columbia River

### **Link to subbasin plans**

See the Council's [subbasin plans](#) for subbasin-level information pertaining to the history of sturgeon and their associated actions.

### **Link to other relevant program areas**

Strategies: [mainstem hydrosystem flow and passage operations](#), [predator control](#), [water quality](#), [habitat](#), and [adaptive management](#).

## 6. Lamprey

### Strategy

Implement actions that result in increased abundance and survival for lamprey, including habitat actions, dam operations and passage, monitoring populations, and research to improve understanding of how the development and operation of the Federal Columbia River Power System affect migration success, survival and growth of lamprey.

### Rationale

Three species of lamprey are native to the Columbia River Basin, which historically supported productive populations: Pacific lamprey, river lamprey, and brook lamprey. Most of the information and effort in the basin for lamprey is focused on the anadromous Pacific lamprey.

Recent data indicate that distribution of lamprey has been reduced in many river drainages. Knowledge about the effects of hydropower dams on lamprey is improving, and the need for substantial additional effort addressing lamprey has become an emerging issue. Food web issues, water quality (flow, temperature, and toxic contaminants), passage, and predators all may have impacts on lamprey. It is not fully understood how other factors exacerbated by the hydropower system affect lamprey. Research and monitoring will be key to better understand impacts, population status and mitigation actions necessary to rebuild lamprey to self-sustaining numbers throughout the basin.

The Council recognizes and supports efforts to restore Pacific lamprey consistent with:

- The [Tribal Pacific Lamprey Restoration Plan](#) for the Columbia River Basin and
- The [Conservation Agreement for Pacific Lamprey](#)

Lamprey translocation efforts have been successful at increasing adult spawning activity, larval recruitment, and larval distribution and have provided important lamprey life history information. The Council recognizes progress in the development of a framework for Pacific lamprey supplementation research in the Columbia River Basin. Current and future translocation actions should be guided by the lessons learned from ongoing efforts.

### Principles

- Juvenile and adult lamprey should be able to safely pass dams in the basin.
- The population size, distribution, and other limiting factors for lamprey related to the hydropower system need improved understanding
- Lamprey throughout their historic range should be self-sustaining and harvestable.

## General measures

### Hydropower system

- The action agencies shall:
  - Identify and seek opportunities to address effects of hydrosystem operations, including reservoir elevation fluctuations and an altered hydrograph on adult and juvenile lamprey
  - Monitor adult and juvenile lamprey passage at mainstem Columbia and Snake river and Willamette Basin hydropower dams to identify operations and lighting that delay, promote fall-back, obstruct, or kill migrating adult and juvenile lamprey (e.g. ramping rates, water elevation changes)
  - Establish an interim passage standard for adult Pacific lamprey.
  - Evaluate dam passage, assess passage efficiency and direct mortality, and other metrics relating to migratory success of lamprey above dams with poor passage
  - Install lamprey-friendly passage structures for adult and juvenile lamprey
  - Monitor and report predation on adult and juvenile lamprey during passage at mainstem dams.
  - Assess the impacts of dredging on lamprey around hydropower dams and navigation facilities.

### Mainstem and tributary habitat

- The action agencies, in coordination with agencies and tribes, shall:
  - Implement instream habitat projects in a manner that minimizes mortality to lamprey by consulting the [Best Management Practices for Pacific Lamprey](#) 
  - Continue to identify, protect, and restore habitat areas and ecological functions, such as stream channel complexity and function, that are associated with productive spawning, resting, rearing, and migrating lamprey
  - Install appropriate and effective juvenile lamprey screening for tributary water diversions

**Predation** – See [predator management](#) strategy

**Research** – See research section of the [adaptive management](#) strategy

### Monitoring

- The action agencies, in coordination with agencies and tribes, shall:
  - Develop a regional strategy for monitoring passage into tributaries to better understand differences in counts of adult lamprey between dams
  - Create a monitoring framework to report on the status of lamprey in the basin on a regular basis
  - Report passage counts at dams annually and map lamprey distribution every five years
  - Conduct occupancy and distribution surveys where lamprey abundance is unknown

- Develop tags suitable for adult and juvenile lamprey monitoring and evaluation needs

### **Propagation**

- The action agencies, in coordination with the agencies and tribes, shall evaluate the potential role of lamprey propagation and translocation as a way to mitigate for lost lamprey production when passage and habitat improvements alone are insufficient to restore lamprey populations

### **Other**

- The action agencies, in coordination with agencies and tribes, shall:
  - Complete a loss assessment for lamprey
  - Determine the potential effects of climate change on lamprey, including the effects of increasing water temperatures and changing runoff regimes on lamprey energetics and performance
  - Consider vulnerability of lampreys to toxin accumulation in water and sediment and to chemical spills, and the exacerbation of such risks in the vicinity of mainstem hydroelectric dams
  - Include Pacific lamprey in the tables of measures associated with the Upper Willamette Conservation and Recovery Plan for Chinook Salmon in [Appendix O](#).

### **Links to subbasin plans**

See the Council's [subbasin plans](#) for subbasin-level information pertaining to the history of lamprey and their associated actions.

### **Links to other relevant program areas**

Strategies: [mainstem hydrosystem flow and passage operations](#), [predator management](#), [water quality](#), [habitat](#), [adaptive management](#)

## **7. Eulachon**

### **Strategy**

Increase understanding, protection, and required restoration of eulachon for the Columbia Basin, estuary, and ocean ecosystems. Better understand how the development and operation of the Federal Columbia River Power System (FCRPS) affects eulachon spawning, survival of eggs and larvae, and migration patterns.

### **Rationale**

Also known as Pacific smelt or candlefish, the eulachon run of the lower Columbia River has historically been a very important forage fish and food source for the Indian tribes. While the reasons for eulachon decline are not fully understood, NOAA Fisheries has determined the FCRPS has affected the ecosystem in which eulachon have evolved. Eulachon are listed as a threatened species under the Endangered Species Act. NOAA Fisheries is developing a recovery plan for eulachon and has prepared a Federal Recovery Outline that includes recovery tasks as part of a preliminary recovery strategy. Eulachon measures in the program should be consistent with NOAA Fisheries' recovery plan for eulachon, once the recovery plan is developed.

### **Principles**

- Eulachon have been impacted by changes to the lower mainstem and estuary caused by construction and operation of the hydropower system.
- There is a need to understand the importance of eulachon within the ecosystem and to initiate appropriate mitigation efforts.

### **General measures**

- The Council supports measures to implement the two eulachon conservation recommendations found in the 2014 Supplemental FCRPS Biological Opinion.
- Upon completion of a recovery plan for eulachon, the Council will incorporate appropriate information regarding eulachon into the program and reflect the importance of this species and the need for protection and mitigation to the extent affected by the hydrosystem. The Council will consider developing the following:
  - Biological objectives for eulachon population characteristics and habitat needs
  - A high-level indicator for eulachon abundance
  - Monitoring and evaluation of the status of eulachon and evaluation of the characteristics affecting their survival
- If NOAA Fisheries identifies actions for eulachon restoration, the Council will consider those as potential measures that may be implemented through proposed projects after science review and a Council recommendation to Bonneville.
- Mainstem and hydrograph:

- The Council, in collaboration with Bonneville, the Corps, NOAA Fisheries, and agencies and tribes, will help organize and facilitate a science/policy forum in 2015 to address the biological requirements of eulachon, combined with related inquiries into the relationship between flow, current hydropower dam operations, and the biological requirements of lamprey and sturgeon. The goal would be to report to the Council, NOAA Fisheries, and interested others on the state of the science, the reasonable next steps in the assessment process, and a recommendation for how to incorporate those steps into the recovery plan.
- Monitor and report eulachon abundance at Bonneville Dam.
- Study the role of eulachon as an alternative prey for sea lions.
- Ocean and estuary:
  - Monitor and evaluate the importance of the tidal freshwater, estuary, plume and nearshore ocean environment to the recovery of eulachon in the Columbia River Basin.

## 8. Public engagement

### Strategy

On an ongoing basis, the Council will educate and involve Northwest citizens to develop, implement, and improve understanding of the fish and wildlife program and the Council, and to promote successful ecosystem management.

### Rationale

The Act requires the Council to provide for the participation and consultation of the Pacific Northwest states; local governments; electricity consumers; customers of Bonneville; users of the Columbia River System including federal and state fish and wildlife agencies and appropriate Indian tribes; and the public in formulating regional power policies that are reflected in the Council's Northwest Power Plan and the fish and wildlife program, which is part of the power plan. Public involvement and understanding will ensure that management decisions are more sustainable.

### Principles

The public outreach and involvement strategy, actions, and anticipated outcomes are based on the following principles articulated by the Council's Independent Scientific Advisory Board [see the ISAB's [Review of the 2009 Columbia River Basin Fish and Wildlife Program](#)]:

- Actively engage the general public, landowners, county planners, traditional stakeholders, and other groups early in the program-planning process.
- Strengthen outreach to citizens, landowners, and other groups with diverse and non-traditional interests to engage in the implementation of the resulting program.
- Enhance the use of social media and other emerging social connectivity tools and measure the effectiveness of this social engagement as part of an evaluation of program success within the limits of the Council's Public Affairs budget and personnel.
- Create incentives for the general public to engage through narratives and stories linking personal well-being and personal commitment to landscapes and emphasizing benefits that come from ecological goods and services beyond simple numbers of fish.
- Develop incentives to support restoration and conservation (i.e., provide tangible support for efforts that help achieve the program vision).
- Support and champion organizations that effectively support productive partnerships among the relevant sciences, between science, management, and the public, and across social and ecological boundaries, facilitating and supporting non-traditional organizations and approaches that can bring new capacity and vision to landscape and ecosystem approaches.

### General measures

- The Council will inform and involve the public including elected officials through print, electronic, and social media; documents posted on the Council website and made available through public websites and libraries; updates of

subbasin dashboards on the Council's website; comment periods on draft fish and wildlife programs (and reports on these hearings and comments); general and specific comment periods with our subbasin partners at Council meetings, including leveraging other opportunities in addition to regular Council meetings.

- The Council, in partnership with Bonneville and other interested parties, will publicly recognize and acknowledge entities that provide good examples of productive partnerships across social and ecological boundaries.
- The Council will monitor the success of its outreach and involvement efforts.

**Link to subbasin plans**

See the Council's [subbasin plans](#) for information pertaining to program-funded work at a subbasin level and the local planning groups.