



# Executive Summary

of the FCRPS 2008 Biological Opinion

## NOAA Fisheries' Executive Summary FCRPS Biological Opinion

### Terms and Definitions

<b>ESA</b>	Endangered Species Act
<b>FCRPS</b>	Federal Columbia River Power System - Fourteen federal dams on the Columbia and Snake Rivers
<b>AAs</b>	FCRPS Action Agencies - The Bonneville Power Administration, the Bureau of Reclamation and the U.S. Army Corps of Engineers
<b>BA</b>	Biological Assessment - Prepared by the FCRPS Action Agencies, this document includes the proposed RPA and evaluation of its biological benefits to ESA listed Fish
<b>RPA</b>	Reasonable and Prudent Alternative - The performance standards, and in some cases, actions, required for compliance with this 2008 FCRPS Biological Opinion
<b>Proposed RPA</b>	Proposed Reasonable and Prudent Alternative - The comprehensive list of actions and improvements proposed by the FCRPS Action Agencies and provided to NOAA Fishers for their 2008 FCRPS Biological Opinion
<b>CA</b>	Comprehensive Analysis - Biological analysis of the Proposed RPA, developed by the FCRPS Action Agencies
<b>SCA</b>	Supplemental Comprehensive Analysis - Biological Analysis of the RPA, developed by NOAA Fisheries
<b>CH</b>	Critical Habitat – Areas that contain physical or biological features that are essential for the conservation of the species and that may require management or protection
<b>PCEs</b>	Primary Constituent Elements - Factors that contribute to good quality habitat
<b>Prospective Actions</b>	Prospective Actions – a term that refers to the collective set of actions including the FCRPS Reasonable and Prudent Alternative, the Upper Snake basin proposed actions, the <i>United States v. Oregon</i> Management Agreement
<b>ESU</b>	Evolutionarily Significant Unit – A species of Pacific Salmon or steelhead trout that is reproductively isolated from other units and represents an important component of the species evolutionary legacy
<b>MPG</b>	Major Population Group - A related group of fish populations that make up an ESU
<b>TRT</b>	Technical Recover Teams - Teams of independent scientists that developed the scientific foundation for species recovery plans
<b>RM&amp;E</b>	Research, Monitoring and Evaluation
<b>RSW</b>	Removable Spillway Weir - A structural improvement on dams that allows juvenile fish passage close to the surface for faster and safer passage than through spillways
<b>PWG</b>	Remand Collaboration Policy Working Group – The group of sovereign representatives participating in the Remand Collaboration between 2005-2008

# Executive Summary

## of the FCRPS 2008 Biological Opinion

*The purpose of this Executive Summary is to provide a general overview of the FCRPS Biological Opinion and the various documents upon which it is based, including the Supplemental Comprehensive Analysis. This Executive Summary is not intended to interpret or change the FCRPS Biological Opinion in any way and if there are any inconsistencies between this summary and the biological opinion, the latter controls. Only the FCRPS Biological Opinion is the legal document called for by the Endangered Species Act, Section 7(b).*

*For a list of all literature cited, see the Supplemental Comprehensive Analysis, Chapter 12.*

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## Introduction

The operation of the Federal Columbia River Power System (FCRPS) affects 13 species of Columbia River Basin salmon and steelhead listed for protection under the Endangered Species Act (ESA).<sup>1</sup>

The ESA requires the agencies that operate the FCRPS (FCRPS Action Agencies) to ensure that their actions are not likely to jeopardize the continued existence of a listed species, nor result in the destruction or adverse modification of habitat designated as critical to its conservation. The three FCRPS Action Agencies are the Army Corps of Engineers, Bonneville Power Administration, and the Bureau of Reclamation.

Under the law, the FCRPS Action Agencies must consult with the National Marine Fisheries Service (NOAA Fisheries) on actions they intend to undertake that may affect a listed species of anadromous fish or its critical habitat. The product of this consultation is a Biological Opinion regarding the FCRPS and the mainstem effects of other projects, as well as authorization for harm to these listed that may be incidentally caused by FCRPS operations.

In recent decisions regarding the 2004 FCRPS Biological Opinion, both the U.S. District Court in Oregon and the Court of Appeals for the Ninth Circuit held that the ESA standard of jeopardy requires NOAA Fisheries to consider not only whether the species will survive but how the prospective actions will affect the species' prospects for recovery. The opinions described below specifically adopt and follow the standard as stated by the Ninth Circuit, analyzing whether each of the listed species will survive "with an adequate potential for recovery."

In this instance, the FCRPS Action Agencies reached the conclusion that operation of these projects, without further mitigation, would jeopardize listed species. As a result, they have presented NOAA Fisheries not only with proposed operations, but also with a package of additional measures designed to benefit listed species. NOAA Fisheries has included the additional mitigation proposed by the FCRPS Action Agencies in its analysis, as well as other mitigation measures NOAA Fisheries believed to be needed to avoid jeopardizing the listed species. Collectively, these additional actions are called, in the language of the ESA, a Reasonable and Prudent Alternative. The Reasonable and Prudent Alternative for the FCRPS operations contains 73 detailed sets of additional mitigation actions that are required to avoid jeopardy and adverse modification of critical habitat.

The actions evaluated in this 2008 FCRPS Biological Opinion are, in general, a 10-year operations and configuration plan for the FCRPS facilities, as well as the mainstem effects for various other hydro projects on Columbia River tributaries operated for irrigation purposes. The FCRPS action includes additional habitat, hatchery, predation management, and harvest actions to mitigate for the adverse effects of the hydrosystem. The actions include numerous research, monitoring and evaluation

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<sup>1</sup> The FCRPS Biological Opinion also addresses green sturgeon (southern population) and Southern Resident Killer Whales and considers that the FCRPS is not likely to adversely affect these listed species.

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actions to support and inform adaptive management decisions. The actions also include transporting some juvenile salmonids through or around dams, an activity that requires a permit from NOAA Fisheries. Finally, the FCRPS Action Agencies have negotiated Memoranda of Agreement (MOAs) with various regional Indian tribes and states that augment and advance the FCRPS RPA and its implementation.

In August 2007, the FCRPS Action Agencies completed an assessment of the biological effects of the FCRPS and the mainstem effects of other hydro projects on listed salmon and steelhead. The FCRPS Action Agencies submitted this biological assessment to NOAA Fisheries on August 21, 2007 for evaluation and consultation.

NOAA Fisheries released a draft FCRPS Biological Opinion and Supplemental Comprehensive Analysis (SCA) on October 31, 2007. By the close of comment in early January, 2008, NOAA received detailed and specific comments from 50 entities, totaling over 1000 pages. NOAA also received approximately 18,000 form letters. Although there is no statutory or regulatory authority requiring NOAA Fisheries to address these comments, NOAA Fisheries has chosen to do so. Responses to comments are reflected in the revised final FCRPS Biological Opinion and Supplemental Comprehensive Analysis.<sup>2</sup>

The FCRPS Biological Opinion is the result of NOAA Fisheries' consultation with the FCRPS Action Agencies, an evaluation of the documents they prepared, and a determination on whether the actions pose jeopardy for listed species or their habitat.

Much of the legal and scientific detail for this Biological Opinion is too extensive for the purposes of this summary and can be found in 2008 FCRPS Biological Opinion itself. Here you will find a brief overview of the material and a presentation of the main points.

## **An Overview of the Status of Threatened & Endangered Salmon & Steelhead**

### **Salmon & Steelhead Species**

The FCRPS Biological Opinion addresses a total of 13 salmon species, all listed under the ESA between 1991 and 2005. The seven interior Columbia Basin species pass through various parts of the hydrosystem and are the ESA-listed salmon runs most affected by its operation for electrical power, as well as by irrigation, flood control, navigation, and other purposes. The interior species are:

Snake River Fall Chinook Salmon	Snake River Spring/Summer Chinook Salmon
Snake River Sockeye Salmon	Snake River Steelhead
Upper Columbia River Steelhead	Upper Columbia River Spring Chinook Salmon
Middle Columbia River Steelhead	

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<sup>2</sup> Responses to comments received on the October 31, 2007 Draft FCRPS Biological Opinion are found in Memorandum from B. Lohn to the Administrative Record, 5/1/08.

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In addition, six species that spawn primarily below the hydrosystem are incidentally affected by its operation. The Lower River species are:

Columbia River Chum Salmon	Lower Columbia River Chinook Salmon
Lower Columbia River Coho	Lower Columbia River Steelhead
Upper Willamette River Steelhead	Upper Willamette River Chinook Salmon

In addition to protecting the species, the ESA requires designation and protection of their critical habitat. Critical habitat for salmon and steelhead describes the sites and river environment essential to support the species at each stage of life. NOAA Fisheries previously designated critical habitat for twelve of the species and is working on a designation for the thirteenth. Critical habitat includes spawning and rearing areas, migration corridors, and the Columbia River estuary.

Abundance is one measure of a species health and its prospects for survival and recovery.<sup>3</sup> Species abundance is estimated as the number of adults returning over time. As used here, “abundance” means the number of adults that ultimately return to the spawning grounds. This number includes the effect of losses during the juvenile migration, the effect of favorable or unfavorable ocean conditions, and the incidental taking of ESA listed fish that occurs in various harvests. The charts below show annual adult abundance and the 5-year geometric mean<sup>4</sup> abundance trends for various interior Columbia Basin, ESA-listed species.

This opinion focuses primarily on inland factors that affect salmon survival, since those are factors that, for the most part, we can address and improve. However, it is important to keep in mind that ocean conditions have a profound effect on the number of adult salmon that return to the Columbia. This means that number of adult salmon that return in a given year is not necessarily a good indicator of how well the inland limiting factors have been addressed.

While the size and condition of the juvenile fish as they migrate out from the mouth of the Columbia also affects ocean survival, much of the variance in the levels of abundance, including the variance seen in the graphs in this section, is a function of the availability of food in the near shore ocean at the time the fish enter it. In general, when the offshore winds produce early and steady upwelling along the coast, the juveniles survive well and produce good adult returns. Conversely, when the upwelling does not occur, little food is available and juvenile survival drops dramatically, and adult returns are low.

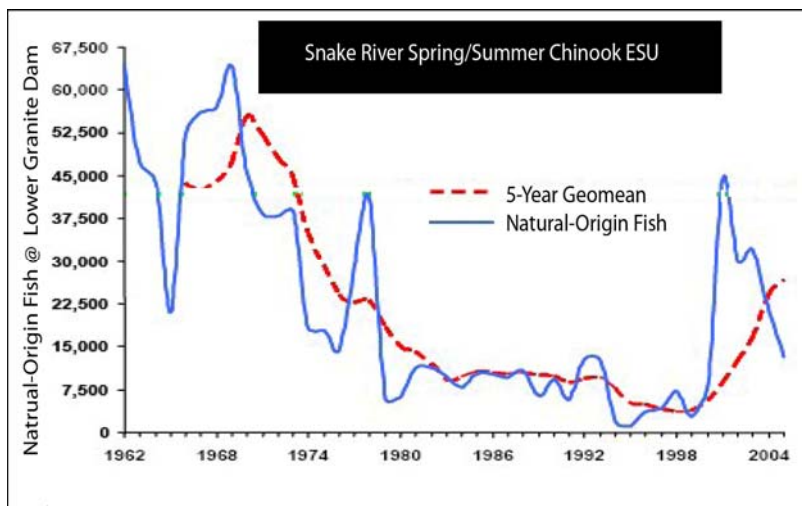
The actions analyzed in this opinion take that variance into account, and are designed to improve abundance over a range of ocean conditions. That does not, however, mean that these actions will lead automatically to high levels of abundance in every year. In determining whether the actions taken under this opinion are progressing as intended, it will continue to be necessary to not only measure the abundance of the runs, but also to gauge the extent to which ocean conditions affected that abundance.

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<sup>3</sup> A viable salmon population has four components that are used to determine its relative health-- abundance, productivity, diversity and spatial structure.

<sup>4</sup> Using the geometric mean as opposed to the arithmetic mean is a common practice when dealing with data series with inherently high annual variability. The geometric mean is the nth root of the product of n observations.

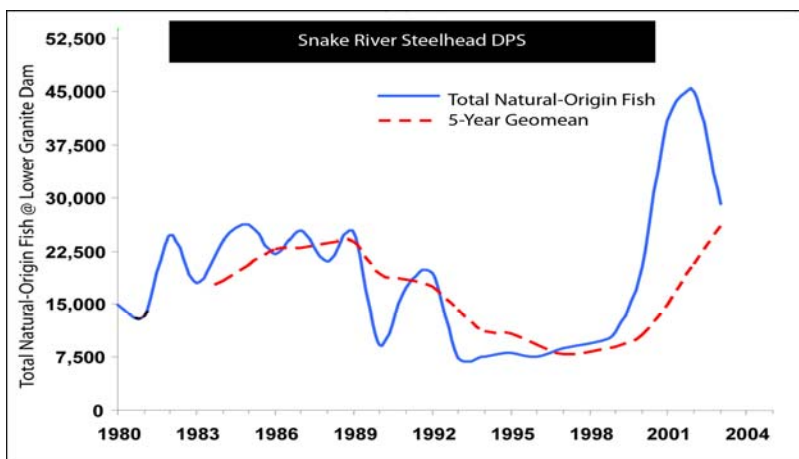
Figure 1. Snake River Spring Summer Chinook Abundance Trends (adopted from Fisher and Hinrichsen 2006)



Abundance and the rolling 5-year geometric mean for Snake River Spring/Summer Chinook are shown in Figure 1. Geometric mean abundance of this species peaked in the late 1960s and continued to decrease until the late 1990s. Most recently, geometric mean abundance of natural-origin fish has increased significantly to more than four times the mean abundance of the late 1990s.

Figure 2. Snake River Steelhead DPS Abundance Trends (adopted from Fisher and Hinrichsen 2006)

Figure 2 shows the 1980 to most recent abundance and 5-year geometric mean trends for the aggregate of all populations of the Snake River Steelhead DPS above Lower Granite Dam. The 5-year geometric mean increased from 1980, peaked in 1989 and decreased through the 1990s. Aggregate abundance of natural-origin fish peaked in 2002, and the 5-year geometric mean has been increasing since 2000.





**Figure 3. Upper Columbia River Spring Chinook Abundance Trends (Corps et al. 2007a, Chapter 8, Figure 8.2 showing annual abundance of combined populations)**

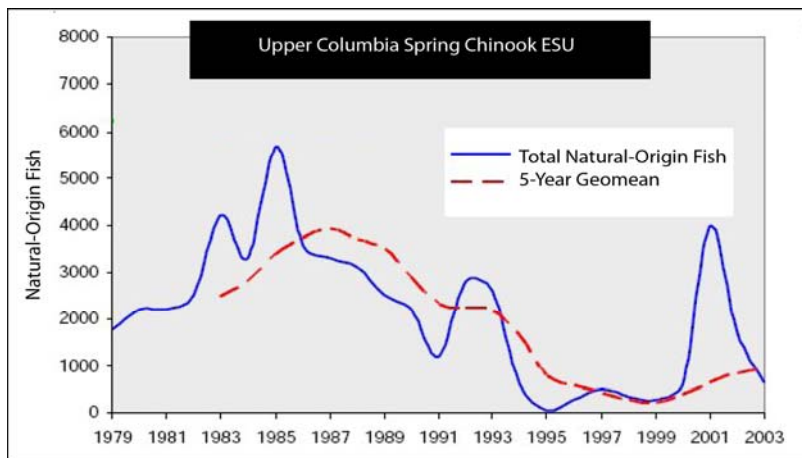
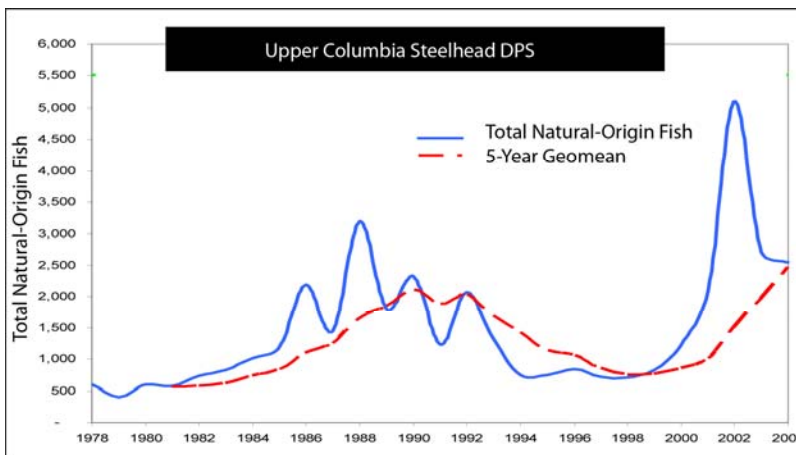


Figure 3 shows the 1979 to most recent abundance and 5-year geometric mean trends for Upper Columbia Spring Chinook. The 5-year geometric mean peaked in 1987, and continuously decreased until 1999. Abundance for this ESU declined to extremely low levels in the mid-1990s. As of 2003, the 5-year geometric mean still remains low but is trending upward.

**Figure 4. Upper Columbia River Steelhead Abundance Trends, 1978 to 2004 (adopted from Fisher and Hinrichsen 2006)**

Abundance and the rolling 5-year geometric mean abundance for the Upper Columbia Steelhead are shown in Figure 4. Abundance for the species declined to extremely low levels in the mid to late 1990s. Since that time the geometric mean abundance has substantially increased for the species as a whole.



**Figure 5. Snake River Fall Chinook Salmon Abundance Trends (adopted from Fisher and Hinrichsen 2006)**

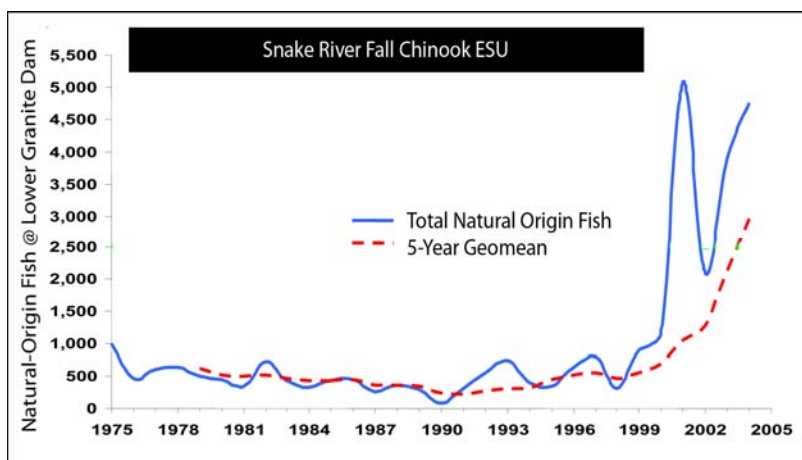


Figure 5 shows the 1975 to most recent abundance and 5-year geometric mean for natural-origin fall Chinook over Lower Granite Dam. Abundance for this ESU declined to extremely low levels in the early to mid-1990s. The total return of this species has significantly rebounded and has increased steadily from the mid-1990s to the present.

Figure 6. Middle Columbia River Steelhead Abundance Trends (adopted from Fisher and Hinrichsen 2006)

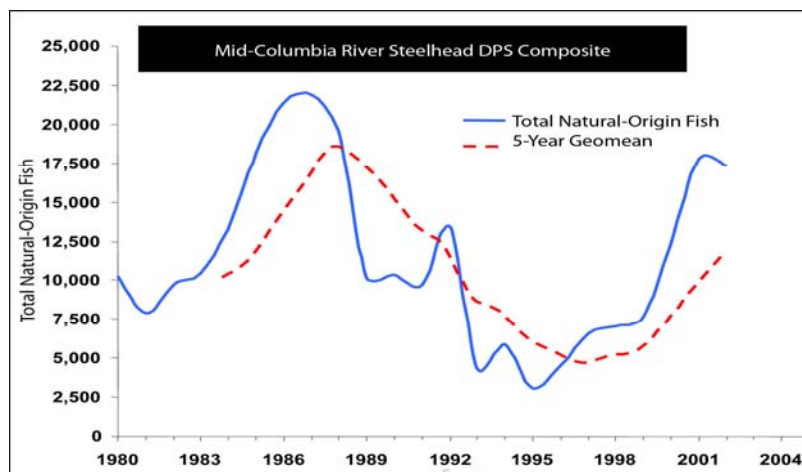


Figure 6 shows the abundance and rolling 5-year geometric mean for the Middle Columbia Steelhead DPS. Abundance for the species was relatively high during the late 1980s, declined to low levels in the mid-1990s, and returned to late 1980s levels during the early 2000s.

The salmon and steelhead in the Columbia River Basin have been negatively affected for more than a century by many factors, including urbanization, the introduction of exotic species, overfishing, development in the floodplains, diversions, dams, mining, farming, ranching, logging, hatcheries, predation, ocean conditions and the loss of habitat. As part of its analysis, NOAA Fisheries identified factors that are inhibiting the recovery of each species of salmon and steelhead listed under the ESA.

Today, these limiting factors affect all parts of the salmon lifecycle, and range from degraded spawning ground conditions (tributary habitat) to competition from artificially produced fish (hatchery effects). While the federal hydrosystem is a significant limiting factor, it is not alone in affecting the ability of all fish species to recover. Man-made threats in the form of hydrosystem operations, habitat degradation, and hatchery and harvest management all play a role in creating conditions that inhibit the recovery of listed species. So do natural threats such as predation by birds and other species of fish. Ocean conditions also play a significant role.

The nature of these impediments and their impact on species recovery demands a comprehensive strategy that addresses each. Addressing the effects of the hydrosystem alone would be inadequate to recover the Columbia River listed fish. Actions are also needed in other parts of the salmon lifecycle and in locations outside the mainstem of the Columbia River, where salmon and steelhead spend only a part of their lives. NOAA Fisheries oversees a series of recovery plans throughout the region. These recovery plans provide the blueprint for the path to long-term recovery for listed salmon and steelhead. A successful recovery strategy must address hydro, habitat, hatchery, harvest, and predator mitigation measures. That is what NOAA Fisheries offers in this Biological Opinion for the FCRPS. The following table lists the limiting factors to be addressed for the Interior Columbia River listed fish species.

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**Limiting Factors for ESA-Listed Interior Columbia Fish**

Upper Columbia Steelhead	Upper Columbia Spring Chinook	Mid-Columbia Steelhead	Snake River Spring/Summer Chinook	Snake River Fall Chinook	Snake River Steelhead	Snake River Sockeye
<ul style="list-style-type: none"> <li>▪ FCRPS and Mid-Columbia Hydropower Projects</li> <li>▪ Predation</li> <li>▪ Harvest</li> <li>▪ Hatchery Effects</li> <li>▪ Tributary Habitat</li> <li>▪ Estuary Habitat</li> </ul>	<ul style="list-style-type: none"> <li>▪ FCRPS and Mid-Columbia Hydropower Projects</li> <li>▪ Predation</li> <li>▪ Harvest</li> <li>▪ Hatchery Effects</li> <li>▪ Estuary Habitat</li> <li>▪ Tributary Habitat</li> </ul>	<ul style="list-style-type: none"> <li>▪ FCRPS Hydropower Projects</li> <li>▪ Tributary Habitat</li> <li>▪ In-Basin Hydropower</li> <li>▪ Water Storage Projects</li> <li>▪ Predation</li> <li>▪ Hatchery Effects</li> <li>▪ Harvest</li> <li>▪ Estuary Habitat</li> </ul>	<ul style="list-style-type: none"> <li>▪ FCRPS &amp; Private Hydropower Projects</li> <li>▪ Predation</li> <li>▪ Harvest</li> <li>▪ Estuary Habitat</li> <li>▪ Tributary Habitat</li> </ul>	<ul style="list-style-type: none"> <li>▪ FCRPS &amp; Private Hydropower Projects</li> <li>▪ Predation</li> <li>▪ Harvest</li> <li>▪ Hatchery Effects</li> <li>▪ Estuary Habitat</li> <li>▪ Tributary Habitat</li> </ul>	<ul style="list-style-type: none"> <li>▪ FCRPS &amp; Private Hydropower Projects</li> <li>▪ Predation</li> <li>▪ Harvest</li> <li>▪ Hatchery Effects</li> <li>▪ Tributary Habitat</li> </ul>	<ul style="list-style-type: none"> <li>▪ FCRPS &amp; Private Hydropower Projects</li> <li>▪ Tributary Habitat</li> <li>▪ Estuary Habitat</li> <li>▪ Harvest</li> </ul>

*For more information on the species and their critical habitat, see Chapter 3 of the FCRPS 2008 Biological Opinion.*

**Other Species**

The Southern Resident killer whale DPS consists of three pods, identified as J, K, and L pods. The Southern Resident killer whale Distinct Population Segment (DPS) was listed as endangered under the ESA on November 18, 2005 (NMFS 2005d). The final rule included information on the population decline in the 1990s and identified several potential factors that may have caused the decline or may be limiting recovery, including prey availability and quality within their coastal range. Although there is limited information, changes in prey abundance would affect the entire population of Southern Resident killer whales. The best available information indicates that salmon are the preferred prey of killer whales year round, including in coastal waters, and that the Southern Resident prefer Chinook salmon.

*For more information on Southern Resident Killer Whales, please see Chapter 9.*

Green sturgeon of the Southern DPS are known to range in nearshore marine waters from Mexico to the Bering Sea, and are commonly observed in bays and estuaries along the west coast of North America. Southern Green sturgeon only encounter the effects of the FCRPS between Bonneville Dam and the Columbia River plume, including the Columbia River estuary. Adults are known to be found in this portion of the action area only during late summer and fall. Quality data on current population sizes and trends for green sturgeon is non-existent. Based on the best available information, the principal factor in the decline of the Southern DPS is the reduction of the spawning habitat in the Sacramento River. (NMFS 2006d).

*For more information on Green Sturgeon, please see Chapter 10*

## **Development of the 2008 FCRPS Biological Opinion: Litigation & Collaboration**

### **Litigation History**

The 2008 FCRPS Biological Opinion reflects the evolution of many initiatives which began in the 1990s to improve the FCRPS for the benefit of salmon and steelhead. This Biological Opinion is built on a comprehensive science assessment of the listed fish and an analysis of what it will take to keep them from jeopardy and trending toward recovery. The 2008 FCRPS Biological Opinion has also been shaped by litigation and the directives of a federal court.

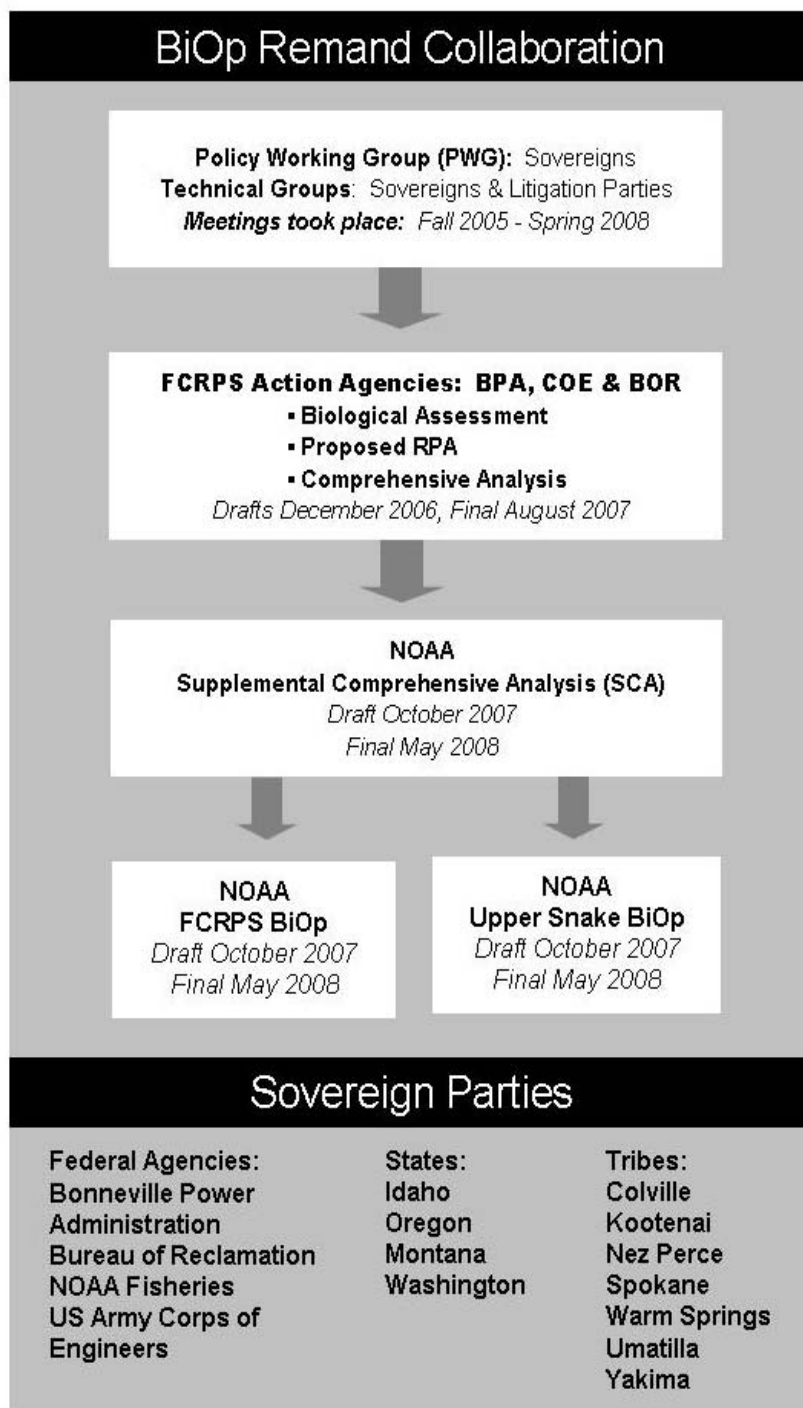
Snake River Sockeye was the first species to be listed under the Endangered Species Act in 1991. Other listings followed shortly thereafter. Between 1992 and 1994, NMFS issued several opinions regarding operation of the FCRPS, each finding no jeopardy to the continued existence of listed species. In response to litigation, NOAA Fisheries reevaluated the 1994 Biological Opinion in light of new information and court findings, and issued the 1995 Biological Opinion. The 1995 Biological Opinion found that the impacts of the FCRPS jeopardized listed Snake River salmon, and NOAA Fisheries included a reasonable and prudent alternative to avoid jeopardy.

The 1995 Biological Opinion started the drive toward significant changes in hydro system operations and configuration to improve conditions for the listed species. Supplemental Biological Opinions, which built on the work already under way and incorporated newly listed species, were issued in 1998 and 2000.

In December 2000, NOAA Fisheries issued a new FCRPS Biological Opinion, this time addressing 12 salmon and steelhead species that were by then listed under the ESA. The 2000 Biological Opinion was challenged in court and remanded to NOAA Fisheries to resolve several deficiencies.

NOAA Fisheries issued a revised FCRPS Biological Opinion in November 2004. This Biological Opinion also came under legal challenge, and the court again remanded it to NOAA Fisheries, directing the agency in October 2005 to work with the sovereign and remand parties to develop a new Biological Opinion. The parties have been working on that task since November 2005.

In looking back over the history of the ESA listings and subsequent FCRPS Biological Opinions, it is clear that NOAA Fisheries and the FCRPS Action Agencies have substantially transformed the federal hydrosystem in terms of operations and configuration, and they have been guided in their work by voluminous research and study, as well as consultation and collaboration. Appendix A of the Biological Assessment provides a detailed account of how the agencies have brought about an overhaul of the system since 1994. The changes have taken a number of forms, including improved mechanisms for juvenile passage tailored to each dam. Substantial improvements are the result of operational changes, such as alterations to system flows and the spill regimes at dams, as well as transportation of juvenile fish. With the structural and operational changes, significant benefits have accrued in both juvenile survival numbers and adult returns.



When U.S. District Judge James A. Redden remanded the 2004 Biological Opinion to address its shortcomings, he gave several instructions to NOAA Fisheries.

- Correct its improper segregation of the elements of the Proposed Actions<sup>5</sup> NOAA Fisheries deems to be nondiscretionary
- Correct its improper comparison, rather than aggregation, of the effects of the Proposed Actions on the listed salmon and steelhead
- Correct its flawed determinations as to whether the Proposed Action destroys or adversely modifies critical habitat
- Correct its failure to consider the effects of the Proposed Action on both recovery and survival of the listed species in determining whether the Proposed Action is likely to jeopardize the continued existence of listed salmon and steelhead
- Correct its past reliance on mitigation measures that are not reasonably certain to occur and/or have not undergone Section 7 consultation.

NOAA Fisheries has addressed these instructions directly in its 2008 Biological Opinion for the FCRPS. In particular:

- NOAA Fisheries' analysis aggregates the effects of the FCRPS Proposed Actions, which are incorporated in the Reasonable and Prudent Alternative, the Upper Snake basin proposed

<sup>5</sup> Given the development of the 2008 FCRPS Biological Opinion, "Proposed Action" is referred to as "Prospective Actions"

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actions, the transportation permit and the United States v. Oregon Harvest Management Agreement (all together referred to as "Prospective Actions"), with the continuing effects in the environmental baseline and anticipated future state and private actions (termed Cumulative Effects) on the listed salmon and steelhead, as reported in Chapter 8 of the Supplemental Comprehensive Analysis for each species.

- NOAA Fisheries revised the 2004 analytical treatment and effects of the Proposed Action on critical habitat, as reported in Chapter 8 of the Supplemental Comprehensive Analysis for each species.
- NOAA Fisheries addressed the prospects for both recovery and survival for each species in evaluating the effects of the Proposed Action<sup>6</sup>
- NOAA Fisheries' determination relies on measures included in the Reasonable and Prudent Alternative, which is the subject of the section 7 consultation. Actions outside of this Reasonable and Prudent Alternative, such as Federal, state, and tribal measures that are already taking place or are reasonably certain to occur, are considered as part of the Environmental Baseline or on a qualitative basis, as part of a cumulative effects analysis.

### Collaboration

Judge Redden also instructed NOAA Fisheries and the FCRPS Action Agencies to collaborate with states and tribes to determine measures to be included in the proposed action, clarify policy issues, and seek agreement on scientific and technical information. The collaboration that has taken place over the past two years to develop the FCRPS Action Agencies' proposed action has been referred to as the meetings of "sovereigns." NOAA Fisheries provided Judge Redden with updates on the progress of the FCRPS collaboration, a process organized by the participants to include a Policy Working Group (PWG) composed of one lead representative from each sovereign, in addition to technical workgroups and policy subgroups.

While the Policy Working Group meetings included only sovereign representatives, the technical work groups were open to other parties in the litigation, as well as to affected tribes that were not parties. The Remand Collaboration brought together federal, state, tribal and other scientists and fishery managers to review the latest information and make recommendations to the FCRPS Action Agencies for their Biological Assessment. There were hundreds of meetings over the course of the collaboration, involving more than 150 participants. Products from the various workgroups formed the basis of PWG deliberations, input into the proposed RPA and the methods used to evaluate the benefits of various proposals.

Many of the participants believed the collaboration should continue as the FCRPS BiOp is implemented. NOAA Fisheries and the FCRPS Action Agencies have committed to ongoing collaboration throughout the ten-year period to monitor implementation, to ensure the FCRPS Action Agencies meet performance standards in the FCRPS Biological Opinion, and to deliberate new and updated information.

The *Hydro Workgroup* included several sub groups covering a new juvenile fish passage model, potential hydro actions, and forecasting. The hydro workgroup described and evaluated several alternative scenarios for operating the hydro system to optimize survival benefits for all the listed species.

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<sup>6</sup> See Chapter 8 of the Supplemental Comprehensive Analysis

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The *Passage Model Workgroup* collaborated on the Comprehensive Passage (COMPASS) model, which is used to compare the effects of alternative hydropower operations on juvenile fish survival and migration timing through the FCRPS, with adult return rates. This workgroup helped to define relationships that characterize survival and migration through the successive reservoirs and dams of the FCRPS, dam passage survival and passage route selection, and post-Bonneville survival. COMPASS materials and alternative views were submitted to the Independent Scientific Advisory Board multiple times for review.

The *Habitat Workgroup* evaluated a comprehensive list of potential habitat actions by working closely with local stakeholder groups developing long-term recovery plans. They developed a general standardized methodology that could be used to evaluate the physical and biological benefits of proposed habitat actions. The Habitat Workgroup's methodology utilizes the best available information regarding key limiting factors, habitat improvement potential, habitat action effectiveness, and the expert views of biologists that could be applied at the Columbia Basin scale, and is fully described in Appendix C of the 2008 FCRPS Biological Opinion.

The *Hatchery & Harvest Workgroup* developed a comprehensive list of the strengths and weaknesses of all mitigation hatchery facilities in the region, described in Appendix D of the 2008 FCRPS Biological Opinion. A second report identified a comprehensive set of potential hatchery improvements for the FCRPS Action Agencies to consider. The hatchery and harvest workgroup coordinated closely with parties to the *United States v. Oregon* Harvest Management Agreement.

The *Research, Monitoring & Evaluation (RME) Workgroup* developed a comprehensive research, monitoring and evaluation framework for the FCRPS Action Agencies to consider. Their recommendations covered project implementation and compliance monitoring, status monitoring, action effectiveness research and critical uncertainties research.

Technical workgroups identified policy issues for the Policy Working Group to address. The PWG deliberated 61 distinct policy issues. While there was not always agreement among the sovereigns, it is clear that the collaboration enhanced the overall understanding of the policy and technical issues at hand, and the available solutions to resolve them.

The PWG did succeed in narrowing the areas of disagreement, as Judge Redden directed. The process added to the breadth of scientific data and knowledge available to understand the condition of the fish and the actions that would be most beneficial for their recovery. In several cases, however, unanimous agreement was not possible. Unresolved issues include use and interpretation of science and modeling. NOAA Fisheries considered all of the relevant information from the collaboration in developing the 2008 FCRPS Biological Opinion.

NOAA Fisheries based its opinion on best available science. For a discussion of key technical and policy issues underlying the 2008 FCRPS Biological Opinion, see "Issue Summaries of the 2008 FCRPS Biological Opinion." These summaries include a summary of the latest science, views and comments received by NOAA Fisheries and the rationale for NOAA's approach. Topics are:

1. Hydro Operations to Improve Juvenile Survival
2. Libby and Hungry Horse Operations
3. Snake River Fall Chinook Life History and Management Actions
4. Methodology for Evaluating Hydrosystem Effects

5. Methodology for Evaluating Tributary Habitat Effects
6. Climate Change Considerations
7. Why the 2008 FCRPS Biological Opinion does not include removal of the four Lower Snake River Dams

## An Overview of the Reasonable & Prudent Alternative

**T**he Reasonable and Prudent Alternative (RPA) for the FCRPS takes a comprehensive approach to ESA protection that includes hydro, habitat, hatchery, harvest and predation measures to address the biological needs of salmon and steelhead in every life stage. The RPA is the product of the collaboration described above. It is based on a comprehensive analysis of the salmon life-cycle conducted down to the level of the populations that make up the listed species.

The Reasonable and Prudent Alternative outlines planned improvements to the hydrosystem to boost juvenile passage survival and adult returns. These actions include water management operations, dam modifications, spill, juvenile transportation and other activities. The hydrosystem improvements must achieve performance standards of 96% per dam passage survival for spring juveniles and 93% per dam passage survival for summer juvenile migrants averaged across the Columbia or Snake River dams, by the ten-year period of the FCRPS Biological Opinion. This represents an improvement to juvenile fish passage throughout the FCRPS dams.

With regard to habitat, the Reasonable and Prudent Alternative proposes an expanded program to protect and improve tributary and estuary environments and reduce limiting factors, based on the biological needs of listed fish. These habitat actions are targeted to the populations and limiting factors where there is the greatest need, based on biological analysis. The RPA includes tributary habitat actions to protect and improve Mainstem and side-channel habitat for fish migration, spawning and rearing, and to restore floodplain function. These habitat actions must achieve specific habitat quality improvement targets tailored to particular populations. The methods used to assess these improvements were developed during the Remand Collaboration.

The Reasonable and Prudent Alternative proposes new and expanded hatchery facilities for safety-net and conservation programs that promote salmon and steelhead recovery. The proposal includes actions to increase steelhead productivity and to support hatchery reforms that reduce impacts on listed fish. While there are no quantified survival benefits in the analysis resulting from hatchery actions,<sup>7</sup> important qualitative improvements are anticipated. Performance standards in this area will track progress of competing hatchery projects. The FCRPS Action Agencies have limited authority regarding harvest, but a few harvest-related actions are included that will directly or indirectly reduce take of ESA-listed species in the near term and advance harvest reforms for application over the long term.

Predation management is another expanded element in the Reasonable and Prudent Alternative. The proposal is to expand efforts to reduce juvenile and adult losses from predation by birds, other fish,

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<sup>7</sup> There is one exception: quantified survival benefits are derived for the Snake River steelhead kelt management program.



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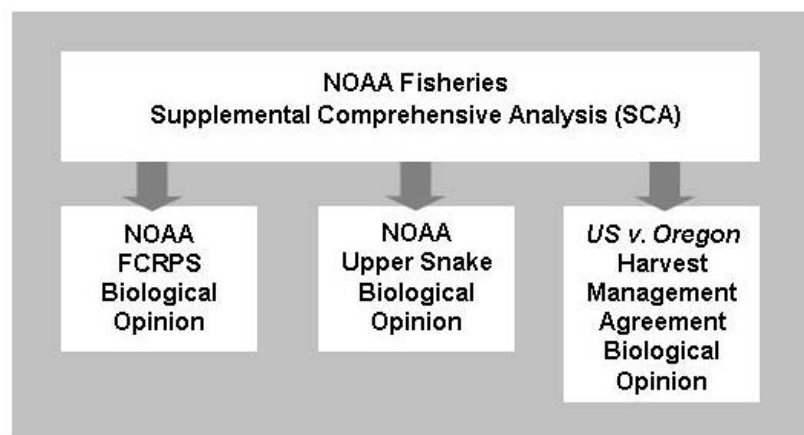
and marine mammals. Survival improvements anticipated for predation activities are 1.7 for fall Chinook salmon; 3.1% for other Chinook salmon and 4.4% for steelhead. Additional improvements are also expected from future actions to reduce avian and marine mammal predation.

To gauge the effectiveness of the actions and to explore areas of scientific and biological uncertainty, the FCRPS Reasonable and Prudent Alternative establishes performance standards and outlines a comprehensive research, monitoring, and evaluation program. The FCRPS Action Agencies propose to report on their progress annually and to adapt their efforts based on new information and the results of monitoring and evaluation. These efforts will be coordinated with states and tribes through ongoing collaboration.

Finally, the FCRPS Action Agencies have negotiated Memoranda of Agreement (MOAs) with various regional Indian tribes and states that augment and advance the FCRPS RPA and its implementation. These actions inform and buttress the conclusions NOAA reaches for the FCRPS Biological Opinion.

## NOAA Fisheries' Analysis

**N**OAA Fisheries analysis combines the effects of the FCRPS, Upper Snake River projects<sup>8</sup> and the United States v. Oregon Management Agreement into a quantitative and qualitative biological analysis that considers the prospects for survival and recovery for each of the 13 listed salmon and steelhead species. The lifecycle analysis uses updated information from the Remand Collaboration technical workgroups, including the ICTRT, and current data developed by scientists and teams of experts working on long-term recovery plans. NOAA Fisheries' analysis supports its determinations about jeopardy and destruction or adverse modification of critical habitat found in the



Biological Opinion for the FCRPS and Reclamation Projects, the Biological Opinion for Reclamation's Upper Snake Projects and the Biological Opinion for the 2008-2017 *United States v. Oregon* Management Agreement. These multiple biological opinions are tiered off of the common analysis found in the Supplemental Comprehensive Analysis (SCA).<sup>9</sup>

<sup>8</sup> While the FCRPS and Upper Snake River projects operate independently of each other, they both influence flows in the Snake and Columbia Rivers. Judge Redden directed NOAA Fisheries to aggregate the all effects on the listed salmon and steelhead.

<sup>9</sup> NOAA Fisheries conducted an independent evaluation of the Federal Action Agencies' Comprehensive Analysis. In its Biological Opinion, NOAA Fisheries cites the Comprehensive Analysis where it agrees with the data and analysis, and supplements the analysis where it has a different judgment or additional data.

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The analysis provides a picture of the past, present and expected future environmental status of each species. For each of these metrics, NOAA Fisheries first determines what the values have been over the last two decades (referred to as "base" metrics). Because some management actions have changed over this time period, the metrics are adjusted to reflect current management practices. Finally, the metrics are further adjusted to reflect new management actions that are included in the Prospective Actions. A range of expectations regarding future climate and other environmental factors is integral to the analysis. In performing its analysis, NOAA Fisheries assumes benefits only from actions that are reasonably certain to occur.

The analysis begins at the population level for each species, including an examination of limiting factors, abundance, productivity and other indicators. These results are then evaluated at the Major Population Group (MPG) level, and finally at the species (ESU) level. At the species level, takes into account information regarding the importance of particular populations to each MPG, as well as other relevant information, including recovery plans.

NOAA Fisheries' analytical methods are tailored to each unique species. There are important differences among the listed species including the status of each, the amount of relevant quantitative information available for each, and the extent to which the Prospective Actions are likely to affect each.

For the jeopardy analysis, NOAA Fisheries performs a quantitative analysis when there is sufficient empirical data available. However, because it is not possible to evaluate the metrics quantitatively for all populations, the analysis includes additional qualitative approaches to determine whether the populations of a species are on a trend to recovery and whether they are likely to have a low risk of extinction in the near term. Some qualitative factors include whether safety-net hatcheries protect important populations, whether limiting factors are being addressed, whether threats are reduced through management actions, a consideration of recent abundance levels and changes in abundance over time.

Both quantitative and qualitative methods are applicable to populations of six interior species. A qualitative approach was used for the remaining seven species. The purpose of both the quantitative and the qualitative analyses is to evaluate whether:

- Short-term extinction risk is sufficiently low—the *survival prong* of the jeopardy standard; and whether
- The populations within a species are expected to be on a trend toward recovery—the *potential for recovery prong* of the jeopardy standard.

Because the jeopardy analysis requires information about changes from the base-to-current management practices and additional changes associated with Prospective Actions, the effects of those changes must be calculated. The analysis includes an evaluation of adjustments in survival associated with hydro actions, tributary and estuary habitat actions, harvest, hatchery actions, RM&E actions, and changes in predation resulting from management actions.

NOAA Fisheries evaluates certain metrics indicative of the survival prong (24-year extinction risk) and the recovery potential prong (average returns-per-spawner, median population growth rate, and

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abundance trend) of the jeopardy standard.<sup>10</sup>

For critical habitat, NOAA Fisheries evaluates impacts of specific elements deemed necessary for the habitat to serve its conservation role. The elements may include spawning and incubation habitat, water quality, water quantity, water temperature and passage.

The Lower River species, found primarily in the lower Columbia River below Bonneville Dam, are significantly less affected by the FCRPS and Bureau of Reclamation projects, compared to listed species that range into the interior Columbia River Basin and migrate past multiple FCRPS projects. Conditions such as gas super saturation and flows were considered. For the Lower River species, NOAA Fisheries evaluated whether the Prospective Actions would provide an adequate potential for recovery.

As required by ESA, NOAA Fisheries' conclusions are based on consideration of the aggregated effects of several types of actions, including:

- Actions in the *Environmental Baseline* - includes past and present impacts of all federal, state, and private actions and other human activities that may affect listed fish. The baseline also includes state, tribal, local, and private actions already affecting the species or habitat whose effects may continue into the future.
- *Prospective Actions* - the collective set of actions including the FCRPS Reasonable and Prudent Alternative, the Upper Snake basin proposed actions, the United States v. Oregon Harvest Management Agreement actions and the FCRPS transportation permit.
- *Actions in Cumulative Effects* – state and other non-federal actions potentially impacting the listed fish that are reasonably certain to occur. Sovereign participants in the Remand Collaboration provided updated information about actions and benefits within their jurisdictions that impact listed fish. NOAA Fisheries considered these effects qualitatively.
- Actions in the FCRPS Action Agencies' Memoranda of Agreement (MOAs) with various regional Indian tribes and states.

*For a detailed account of the analytical methodology, see Chapter 7 of the Supplemental Comprehensive Analysis and the FCRPS Biological Opinion.*

### Climate Change Considerations

Climate change has potential negative implications for the current and future status of ESA-listed fish in the Pacific Northwest. NOAA Fisheries reviewed recent studies on the potential effects of climate change in the Columbia River basin and the likely impacts on salmonids.<sup>11</sup> The Independent Scientific

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<sup>10</sup> Several metrics are used in NOAA Fisheries analysis because “no one metric assesses by itself the status of a give ESU to the degree necessary to render a jeopardy determination. Any single metric is sensitive to different assumptions and measures different aspects of species’ status...Accordingly NOAA Fisheries’ jeopardy determination will not rely on a single, formulaic analysis. Instead, in exercising its scientific judgment, NOAA Fisheries will consider and synthesize a variety of metrics in common usage.” Memorandum from Bob Lohn to PWG, 9-11-2006 (NMFS 2006h)

<sup>11</sup> See Climate Change Science Summary for further detail of the studies reviewed and NOAA Fisheries’ approach in the Biological Opinion.

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Advisory Board (ISAB)<sup>12</sup> in particular, describes the potential impacts of climate change in the basin. These effects, according to the ISAB, may result in alterations to the seasonal hydrograph, constrain habitat availability and accessibility, alter precipitation and temperature levels and, in particular, impact the various life-stages of Columbia Basin salmon and steelhead. The long-term effects of this climatic variation on salmon and steelhead may include, but are not limited to, depletion of cold water habitat, variation in quality and quantity of tributary rearing habitat, alterations to specie migration patterns, accelerated embryo development, premature emergence of fry, and increased competition among species.<sup>13</sup> In order to mitigate for these potential effects, the ISAB provides detailed recommendations, including actions that fall into the following categories: Planning Actions, Tributary Habitat, Mainstem and Estuary Habitat, Mainstem Hydropower, and Harvest. The full range of these recommendations incorporate flow augmentation strategies, subbasin planning efforts, restoration activities etc. (see Section 8.1 of the Supplemental Comprehensive Analysis for further detail.)

NOAA Fisheries considered climate change in both a quantitative and qualitative manner. Because of uncertainties in predicting specific effects of climate change in the next 10 years, NOAA Fisheries applied a conservative approach to both ocean and inland climate conditions (Please see Chapter 7, Analytical Methods, of the FCRPS Biological Opinion for further detail). In addition, the Biological Opinion explicitly considers actions that are consistent with the ISAB's mitigation recommendations. However, the time frame and scope of climate change is not clear. Many climate change predictions describe changes up to 100 years. For the ten-year term of this Opinion, NOAA Fisheries employs conservative assumptions and sets the stage for additional mitigation actions should they become necessary.

ISAB recommendations to account for potential effects of climate change (ISAB 2007c) were taken into consideration in the development of NOAA Fisheries' Reasonable and Prudent Alternative. By tracking the limiting factors that result from climatic variation and subsequently affect listed species, the FCRPS Action Agencies will be able to adjust their selection of projects accordingly.

Under RPA Action 34, for example, the FCRPS Action Agencies will implement an array of tributary habitat projects to achieve species survival improvements and address limiting factors. The FCRPS Action Agencies, for instance, are currently funding the Methow Salmon Recovery Board to implement a number of habitat projects that will address limiting factors by increasing off-channel rearing and over-wintering habitat; restoring and improving riparian habitat; increasing instream complexity; restoring natural floodplain processes; restoring natural channel process; reestablishing side channel rearing habitat; restoring-improving riparian forest habitat; adding wood complexes in the mainstem; installing a rock structure to keep a majority of flow in the mainstem; breaching an existing levee; and connecting side channels (Corps et al. 2007b, Attachment B.2.2-2). For full detail of the ISAB's recommendations, as well as the corresponding RPA Actions committed to in this Opinion, please see Section 8.1 of the Supplemental Comprehensive Analysis.

The full breadth of long-term climate change (ISAB 2007 c; Crozier et al. 2008) is unlikely to be realized in the ten-year term of this Opinion. For instance, as stated in Chapter 7 of the FCRPS Biological Opinion, the Crozier et al. (2008) study is based on instantaneous attainment of expected

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<sup>12</sup> Independent Scientific Advisory Board (ISAB). Climate Change Impacts on Columbia River Basin Fish and Wildlife. Report 2007-2. May 11. (ISAB 2007c).

<sup>13</sup> For full detail of the potential effects of climate change in the Columbia River basin, as well as the impacts on listed salmonids, please see Chapter 5, Environmental Baseline, of the Supplemental Comprehensive Analysis.

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2040 climate conditions and its affect on life-stage survival, abundance, and population growth rate. The term of this Biological Opinion ceases in 2018. However, NOAA Fisheries has taken proactive measures to ensure that variation in climate conditions will be addressed either through RPA actions, as addressed above, or through the adaptive management supported by reporting requirements of this Opinion. Through this process, the FCRPS Action Agencies, in selecting their projects, will focus their efforts on the most recent limiting factors. If, during this time period, various climatic alterations are determined to be limiting factors, the FCRPS Action Agencies will allocate their projects accordingly. This allows the Action Agencies to address specific, localized impacts of climate change. Measures are in place to ensure that as climatic variation arises, the Action Agencies will be able to adaptively manage in response to these conditions.

### **The Role of Adaptive Management**

The 2008 FCRPS Biological Opinion's RPA includes a strong monitoring program to assess whether implementation is on track and to signal potential problems early. Specific contingent actions are identified within an adaptive management framework for important actions, such as hydro project improvements (e.g., RPA Actions 19 through 25, which identify Phase II actions that will be implemented if Phase I actions do not achieve goals), and tributary and estuary habitat actions (e.g., RPA Actions 34 through 37, which require additional projects in the subsequent 3-year funding cycle if projects prove infeasible). Additionally, the RPA includes implementation planning, annual reporting, and comprehensive evaluations to provide any needed adjustments within the ten-year FCRPS Biological Opinion time frame.

The FCRPS Action Agencies included additional details regarding goals and processes for adaptive management in their August 2007 Biological Assessment. The agencies have developed a comprehensive and detailed plan, with performance measures and targets in all areas where actions are proposed and a process to implement adaptive management that includes coordination with states and tribes. Highlights of the agencies' adaptive management process, some of which are also required by the RPA, are described below.

1. Performance standards and metrics, such as per dam passage survival of 96% for juvenile spring migrants and 93% for summer migrants.
2. A robust research, monitoring and evaluation program to assess performance and critical uncertainties, and also to adjust implementation on a routine basis. The FCRPS Action Agencies will monitor two aspects of performance: project implementation and biological results.
3. Annual progress reports, plus comprehensive check-ins to examine cumulative progress toward performance expectations in 2013 and 2016. Comprehensive evaluations are a tool to ensure that the FCRPS Action Agencies and regional parties take a comprehensive and cumulative check on implementation of FCRPS actions. This allows the opportunity to build both on successes and to make mid-course corrections where necessary.
4. Implementation plans that describe specific habitat actions and that detail changes to hydro, predation management, hatchery and RME actions.
5. Federal, State, and Tribal oversight of implementation and adaptive management actions through the Regional Implementation Oversight Group (using a model similar to the sovereign

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collaboration group under the remand collaboration).

6. A diagnostic framework ("All H" diagnosis) to assess problems and target solutions if fish runs are not on track toward recovery.
7. Provisions for contingencies if the diagnosis indicates that actions are not on track in achieving performance standards or that fish runs are not on track toward recovery. Contingency actions will address the appropriate limiting factors.

This disciplined approach to adaptive management augments the specific RPA actions to adjust to new or changing information or conditions. It provides a specific means for implementing different or additional actions in the event of unanticipated adverse effects on listed fish.

*For more detail on Adaptive Management, see Section 2.1 of the FCRPS Action Agencies Biological Assessment.*

## Conclusions

NOAA Fisheries has conducted a multi-level, lifecycle analysis. The analysis began with a careful look at the effects of the proposed action on each of the individual populations, then examined the results for each of the major population groups, and finally determined the overall effect for each species. The detailed outcomes of that analysis for each species including current status and recent trends, limiting factors and the aggregated effects of the environmental baseline, cumulative effects, and effects of the Prospective Actions and species conclusions are found in the FCRPS Biological Opinion.

Although some actions, such as certain improvements in the hydro system, have broad effects that benefit most species, the majority of the actions are tailored to the specific needs of particular ESUs, and often to the needs of particular populations. NOAA Fisheries' analysis reflects this level of detail, and those interested in the specific analysis and findings for particular species are referred to the Supplemental Comprehensive Analysis where each ESU is discussed at length. Based on these analyses, NOAA Fisheries has concluded that, with the RPA – the comprehensive set of actions -- each of the listed salmon and steelhead species will avoid extinction and have an adequate potential for recovery.