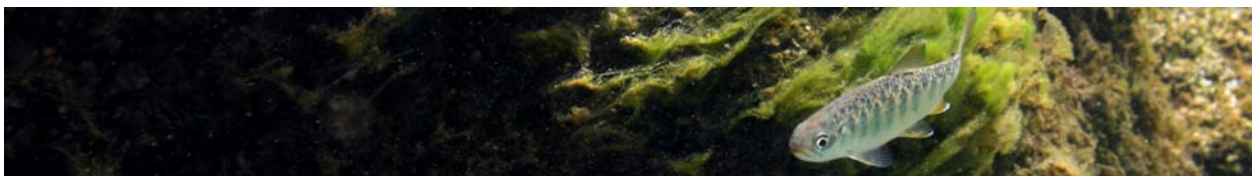




Columbia River Hatchery Reform System-Wide Report

February 2009

Prepared by
Hatchery Scientific Review Group





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Part 1 – Introduction

1.1 Project Background, Purpose, and Scope

The US Congress funded the Puget Sound and Coastal Washington Hatchery Reform Project via annual appropriations to the US Fish and Wildlife Service (USFWS) beginning in fiscal year 2000. Congress established the project because it recognized that while hatcheries have a necessary role to play in meeting harvest and conservation goals for Pacific Northwest salmonids, the hatchery system was in need of comprehensive reform. Most hatcheries were producing fish for harvest primarily to mitigate for past habitat loss (rather than for conservation of at-risk populations) and were not taking into account the effects of their programs on naturally spawning populations. With numerous species listed as threatened or endangered under the Endangered Species Act (ESA), conservation of salmon in the Puget Sound area was a high priority. Genetic resources in the region were at risk and many hatchery programs as currently operated were contributing to those risks.

Central to the project was the creation of a nine-member independent scientific review panel called the Hatchery Scientific Review Group (HSRG). The HSRG was charged by Congress with reviewing all state, tribal and federal hatchery programs in Puget Sound and Coastal Washington as part of a comprehensive hatchery reform effort to:

- conserve indigenous salmonid genetic resources;
- assist with the recovery of naturally spawning salmonid populations;
- provide sustainable fisheries; and
- improve the quality and cost-effectiveness of hatchery programs.

The HSRG worked closely with the state, tribal and federal managers of the hatchery system, with facilitation provided by the non-profit organization Long Live the Kings and the law firm Gordon, Thomas, Honeywell, to successfully complete reviews of over 200 hatchery programs at more than 100 hatcheries across western Washington. That phase of the project culminated in 2004 with the publication of reports containing the HSRG's principles for hatchery reform and recommendations for Puget Sound/Coastal Washington hatchery programs, followed by the development in 2005 of a suite of analytical tools to support application of the principles (all reports and tools are available at www.hatcheryreform.us).

In 2005, Congress directed the National Oceanic and Atmospheric Administration-Fisheries (NOAA Fisheries) to replicate the Puget Sound and Coastal Washington Hatchery Reform Project in the Columbia River Basin. The HSRG was expanded to 14 members to include individuals with specific knowledge about the Columbia River salmon and steelhead populations. This second phase was initially envisioned as a one-year review, with emphasis on the Lower Columbia River hatchery programs. It became clear however, that the Columbia River Basin needed to be viewed as an inter-connected ecosystem in order for the review to be useful. The project scope was subsequently



expanded to include the entire Basin, with funding for a second year provided by the Bonneville Power Administration (BPA) under the auspices of the Northwest Power and Conservation Council's (NPCC) Fish and Wildlife Program.

The objective of the HSRG's Columbia River Basin review was to change the focus of the Columbia River hatchery system. In the past, these hatchery programs have been aimed at supplying adequate numbers of fish for harvest as mitigation primarily for hydropower development in the Basin. A new, ecosystem-based approach is founded on the idea that harvest goals are sustainable only if they are compatible with conservation goals.

The challenge before the HSRG was to determine whether or not conservation *and* harvest goals could be met by fishery managers and, if so, how. The HSRG determined that in order to address these twin goals, both hatchery and harvest reforms are necessary.

The HSRG approach represents an important change of direction in managing hatcheries in the region. It provides a clear demonstration that current hatchery programs can indeed be redirected to better meet both conservation and harvest goals. For each Columbia River Basin Environmentally Significant Unit (ESU), Distinct Population Segment (MPG) or Major Population Group (MPG) reviewed, the HSRG presents its findings and recommendations in the form of an HSRG solution. This package of recommended changes to current hatchery and harvest program design and operation is intended to demonstrate how the programs could be managed to significantly increase the likelihood of meeting the managers' goals for both harvest and conservation of the ESU/DPS/MPG.

The "HSRG solution" also highlights the biological principles that the HSRG believes must form the foundation for successful use of hatcheries and fisheries as management tools. Those principles are intended to provide a framework for making decisions and prioritizing investments based on clear and explicit goals, defensible science and informed and adaptive management (the HSRG's analytical approach, including these principles, is described in Section 1.3).

The HSRG review focused on hatchery programs, but took into account natural populations, survival conditions in the mainstems of the Columbia and Snake rivers and the Columbia River estuary, and harvest regimes. No review of habitat or hydroelectric measures was conducted. Nonetheless, the HSRG concluded that the value of habitat improvements (in terms of the abundance and productivity of natural populations) would increase if those improvements were preceded by hatchery reforms. Similarly, hatchery and habitat improvements would be enhanced with harvest reforms. The review did not include analysis of existing laws, policies, and agreements pertaining to either harvest or hatchery management. The flexibility contained in the adaptive management clauses of many of the agreements can accommodate reforms similar to those proposed by the HSRG.

The solutions proposed by the HSRG for Columbia Basin hatchery programs demonstrate that these programs can be redesigned to better meet conservation and harvest goals. However, the HSRG is not suggesting that these are the *only* solutions available to meet those goals.



1.2 Project Organization and Implementation

The Columbia River Hatchery Reform Project was organized into three functional components: 1) scientific review, 2) facilitation, and 3) policy coordination. The scientific review, conducted by the HSRG, gathered and analyzed information relevant to the evaluation of hatchery programs in the Columbia River Basin. The facilitation team was responsible for project management, budgets, contracting, meeting preparation and coordination of work products. The policy coordination team provided a communications link between the HSRG and the federal, state and tribal managers of the hatchery system at the policy level.

Columbia River Hatchery Scientific Review Group

The Columbia River HSRG was composed of 14 members, nine of whom were affiliated with agencies and tribes in the Columbia River Basin. The remaining five members were unaffiliated biologists. Affiliated members did not represent their agency or tribe, but were expected to bring only their individual, scientific expertise to the table. The Chair and Vice Chair positions were filled by unaffiliated members. The intent of this structure and approach was to ensure the HSRG maintained scientific independence and impartiality, while at the same time assuring that it contained thorough knowledge of salmonid populations and hatchery programs in the Columbia River Basin.

The nine members of the HSRG selected for the Puget Sound and Coastal Washington review were chosen from a pool of candidates nominated by the American Fisheries Society. Seven of the original HSRG members continued as members of the Columbia River panel. The seven members who joined for the Columbia River review were selected by the original HSRG based on expertise and experience with hatcheries in general and Columbia River programs in particular. The Columbia River HSRG was chaired by Dr. Lars Moberg from March 2000 to February 2008, when the current chair, Dr. Peter Paquet, began his tenure. John Barr and Lee Blankenship served as vice chairs throughout the project.

Table 1-1 lists the Columbia River HSRG members and their associated organizations; professional biographies of the members are found in Appendix B.

Facilitation and Policy Components

Facilitation of the HSRG reviews was conducted by D.J. Warren and Associates, Inc. and lead by Dan Warren. In addition to overall project management (including contracting and budgets), the facilitation team secured venues for the monthly HSRG meetings; organized facility tours; prepared, organized, and distributed meeting materials and agendas; and facilitated the meetings. The facilitation team also managed the project website and all project records. D.J. Warren and Associates provided technical support to the HSRG via subcontracts to Moberg/Jones and Stokes; Meridian Environmental, Inc.; Serverside Software; Malone Environmental Consulting; Triangle Associates, Inc.; Nancy Bond Hemming; and the Columbia River Intertribal Fish Commission.

The policy coordination team was comprised of staff from the law firm of Gordon, Thomas, Honeywell, Malanca, Peterson & Daheim, LLP under the leadership of James Waldo. Members are identified in Table 1-2. The policy coordination team tracked the



progress of the HSRG review and convened periodic meetings with designated policy representatives from the tribal, state, and federal management agencies.

Table 1-1. Members of the Columbia River HSRG

Name	Organization
<i>Agency/Tribe Affiliated Members</i>	
Dr. Donald Campton	US Fish and Wildlife Service
Mr. Mike Delarm	NOAA Fisheries
Dr. David Fast	Yakama Nation
Mr. Tom Flagg (Dr. Des Maynard, alternate)	NOAA Fisheries
Dr. Jeffrey Gislason	Bonneville Power Administration
Mr. Paul Kline	Idaho Department of Fish and Game
Mr. George Nandor	Oregon Department of Fish and Wildlife/Pacific States Marine Fisheries Commission
Dr. Peter Paquet	Northwest Power and Conservation Council
Mr. Andy Appleby/Mr. Paul Seidel (until May 2008)	Washington Department of Fish and Wildlife
<i>Unaffiliated Members</i>	
Mr. John Barr	Independent Consultant
Mr. H. Lee Blankenship	Northwest Marine Technology
Dr. Trevor Evelyn	Fisheries and Oceans Canada (retired)
Dr. Lars Mobrand	Mobrand/Jones and Stokes
Mr. Stephen H. Smith	Stephen H. Smith Fisheries Consulting, Inc.

Table 1-2. Members of the Policy Coordination Team

Name	Organization
Ed Bowles	Oregon Department of Fish and Wildlife
Kat Brigham	Confederated Tribes of the Umatilla Indian Reservation
Gary James	Confederated Tribes of the Umatilla Indian Reservation
Claudeo Broncho	Shoshone-Bannock Tribes of Fort Hall
Jody Calica	Confederated Tribes of the Warm Springs Reservation
Dan Diggs	US Fish and Wildlife Service
Ed Schriever	Idaho Department of Fish and Game
Becky Johnson	Nez Perce Tribe
Dave Johnson	Nez Perce Tribe
Phil Anderson	Washington Department of Fish and Wildlife
Guy Norman	Washington Department of Fish and Wildlife
Joe Peone	Confederated Tribes of the Colville Reservation
Philip Rigdon	Yakama Nation
Rob Jones	NOAA Fisheries
Robert Turner	NOAA Fisheries
Jim Waldo	Gordon, Thomas, Honeywell, Malanca, Peterson & Daheim



Review Process

In order to facilitate an ecosystem-level review of such a large landscape as the US portion of the Columbia River Basin, the HSRG divided the Basin into 14 regions, based in large part on the regions defined by NPCC in 2000 (Table 1-3). The 14 regions were then grouped into 4 areas: 1) Lower Columbia, 2) Mid Columbia, 3) Upper Columbia, and 4) Snake River. The review began with the hatcheries located in the lower Columbia River area and proceeded upstream. Regional and cumulative reviews were held beginning in July 2006 and continuing through August 2008.

Table 1-3. HSRG Columbia River Basin Regions and Areas

Area	Region	Meeting Type and Date	
		Regional	Cumulative
Lower Columbia	Cowlitz	July 2006	
	Kalama and Lewis	July 2006	
	Columbia Estuary, Washington	September 2006	
	Lower Columbia to Sandy, Oregon	November 2006	
	Columbia Estuary, Oregon	November 2006	
	Columbia Gorge, Washington	September 2007	
	Columbia Gorge, Oregon	August 2007	
	Willamette, Oregon	October 2007	
	Lower Columbia Programs Cumulative Review		November 2007
Mid Columbia	Columbia Plateau, Oregon	December 2007	
	Columbia Plateau, Washington	January 2008	
	Mid Columbia Programs Cumulative Review		February 2008
Upper Columbia	Columbia Cascade, Washington	April 2008	
	Upper Columbia Programs Cumulative Review		May 2008
Snake River	Mountain Snake Salmon	June 2008	
	Mountain Snake Clearwater	June 2008	
	Blue Mountain	July 2008	
	Snake River Programs Cumulative Review		August 2008

The scientific review was conducted by the HSRG through a series of workshops of two types: 1) regional and 2) cumulative. Each regional workshop was preceded by initial fact-finding by the HSRG. Data were collected and assembled into draft reports on the hatchery programs and salmon and steelhead populations within the region.

The first step in each regional workshop was a field visit to facilities and watersheds. This usually took place over one to two days. Then, the HSRG met for two or three days to review data, apply its scientific framework and develop draft recommendations for hatchery programs. The pre-workshop draft population reports were revised on the basis of the information gathered during the field visits and data analysis.

The regional federal, state and tribal hatchery managers were invited at the end of each work session so the HSRG could ask any remaining questions and get the managers'



initial reaction to the draft recommendations. The HSRG captured all of this information in an electronic spreadsheet tool developed specifically for the purpose, the All “H” Analyzer (AHA) (see Appendix C). Information for each population was condensed in individual Population Reports (Appendix E).

When all the regional workshops within an area were completed, a cumulative workshop was held. The purpose of the cumulative workshop was to “roll up” data on all of the populations in the area, allowing the HSRG and the area fishery managers to view the “big picture” for that segment of the Columbia River Basin.

1.3 HSRG Analytical Approach

The HSRG based its analysis of Columbia River Basin hatchery programs on the framework described in Moberg et al. (2006). This report identifies three principles as prerequisites for successful hatchery programs¹: 1) well defined goals, 2) scientific defensibility, and 3) informed decision making. These principles formed the structure for the HSRG analytical approach.

Well-Defined Goals

Goals should be expressed in terms of conservation and harvest (or other values defined by the community, such as education, research, etc). Hatchery programs are tools to help meet those goals. The HSRG reviewed the Columbia River Basin hatchery programs based on its best understanding of the managers’ goals for conservation and harvest.

Conservation goals apply to populations (ESUs, DPS’ or MPGs) and species. They are expressed in terms of biological significance and viability. Hatchery programs can affect both biological significance and viability, and almost always² represent a trade-off of natural productivity loss³ for abundance gain.

Viability is usually expressed in terms of population productivity, abundance, diversity, and structure (McElhany 2003). Viability goals were provided by the managers for some, but not all, natural populations.

To establish biological significance, the HSRG used the classification system adopted by the Lower Columbia Fish Recovery Board, under which all distinct salmonid populations are classified as either *Primary*, which are targeted for restoration to high productivity and abundance; *Contributing*, where small to medium improvements are needed; or *Stabilizing*, populations that may be maintained at current levels.

The HSRG developed a set of management standards for acceptable hatchery influence for each of these three categories. The standards are most restrictive for Primary and least restrictive for Stabilizing populations. Because of uncertainty around the effects of hatchery fish on the fitness of natural populations, the HSRG also identified some

¹ A successful hatchery program is one where the benefits outweigh the risks, and where a solution including a hatchery program is better from a benefit/risk standpoint than any alternative means to achieve similar goals.

² The exception to this rule is when hatcheries are used to re-populate vacant habitat.

³ This loss is generally due to reduced fitness resulting from hatchery fish spawning with wild fish.



Primary populations where hatchery influence could be minimized, by establishing “hatchery-free” populations⁴.

Harvest goals apply to populations and fisheries. They are expressed in terms of the numbers of fish harvested by a fishery or groups of fisheries⁵ and/or as sustainable harvest rates on the aggregate run or selective rates on hatchery-origin and natural-origin fish.

The HSRG review and recommendations are based on the goal statements provided by the managers or found in planning documents. These goals are captured in the Population Reports (Appendix E).

Scientific Defensibility

Once the goals for the resource have been established, the scientific rationale for a hatchery program must be described in a working hypothesis that explains the expected benefits and risks from the hatchery program. The purpose, operation, and management of each hatchery program must be scientifically defensible. Assumptions under which the hatchery program will succeed must be consistent with available information.

The HSRG review identified 351 salmon and steelhead populations in the Columbia River Basin. The ecological, genetic and fishery context of each of these populations is unique. For each unique population, the purpose of each hatchery program must be identified (will it contribute to conservation and/or harvest?). Early in the planning process, the strategy for addressing the genetic relationship of the hatchery populations to the associated natural populations must be determined (will the recommended hatchery program be integrated with or segregated from the associated natural population?)⁶.

Using analytical procedures described in detail in Appendix C, the HSRG reviewed all current hatchery programs in the Columbia River Basin. Nearly every hatchery program was associated with a naturally spawning population. Four scenarios were examined: 1) current program, 2) no hatchery, 3) “best”⁷ segregated program, and 4) “best” integrated program. The solution that best met the managers’ conservation and harvest goals for the population was selected as the “HSRG solution.” The HSRG conclusion is that the managers’ goals for conservation and harvest of each population are more likely to be met on a sustainable basis if the proposed solution is adopted than under the current hatchery scenario. Developing the HSRG solutions was an iterative process that took into account interactions and cumulative effects across all Hs (habitat, hydropower, hatcheries and harvest). As a result, the HSRG solutions were not finalized until the review of the entire Columbia River Basin was completed.

The HSRG is confident that the hypotheses and assumptions used in its analyses are consistent with facts, knowledge and information available at the time of publication of

⁴ Recommendation 8 in Section 2.1 identifies the HSRG’s broodstock management criteria for Primary, Contributing and Stabilizing populations.

⁵ HSRG identified four groups of fisheries: marine, Columbia River below Bonneville Dam, Columbia River above Bonneville Dam, and terminal (in subbasins).

⁶ Section 2.2 provides more information about integrated and segregated hatchery programs.

⁷ The “best” program was typically the one that contributed the most to harvest goals without violating the guidelines for hatchery influence on natural populations.



this report. However, the HSRG also acknowledges that uncertainty still exists, and there may be legitimate disagreement with certain HSRG assumptions. The HSRG developed its assumptions (analytical framework/working hypothesis) in order to provide a useful starting point. Scientists and managers are encouraged to challenge and change the assumptions as new information warrants. While the HSRG has tried to make its recommendations practical and useful within the current management environment, it did not perform analyses to determine whether recommendations are consistent with existing laws, agreements and policies. It is also important to note that the HSRG's analysis projects a long-term outcome under average conditions and is not a prediction of what might occur in any given year.

Informed Decision Making and Adaptive Management

The management of hatchery programs is an ongoing and dynamic process. As long as hatchery programs are operated, they must be adapted to changing circumstances and new information. Hatchery managers must expect change and design their decision-making processes accordingly. Management must be an ongoing response/feedback system. Uncertainty is unavoidable; the only thing that's certain is that the unexpected will happen.

Therefore, the HSRG recommends that the managers' decisions be informed and modified by continuous evaluations of existing programs and by new scientific information. Such an approach will require a substantial increase in scientific oversight of hatchery operations, particularly in the areas of genetic and ecological monitoring. With implementation of clear decision-making processes that respond to new information, the HSRG believes that hatcheries can be managed in a more flexible and dynamic manner that is responsive to changing environmental conditions, new scientific information, and the economic value of the resource.

Decisions about hatcheries must also be made in a broader, integrated context. The hatchery solution must better meet management goals in a benefit/risk sense than other available means. Results of monitoring and evaluation must be brought into the decision-making process in a clear, concise way that allows needed changes to be implemented. The process should also be structured to allow for innovation and experimentation, so hatchery programs may be responsive to new goals and concepts in fish culture.

The HSRG concluded that certain information is critical to operating hatchery programs in a responsible manner:

- Hatchery fish should not be released unless the contribution of those fish to natural spawning escapement can and will be estimated with reasonable accuracy and confidence on an annual basis.
- Contributions from each hatchery program to fisheries should be monitored annually.
- Natural spawner abundance of all populations affected by hatchery fish must be estimated each year, with the highest priority placed on Primary populations.

Specific monitoring recommendations are provided in the population reports. A proposed framework for monitoring is outlined in Appendix A (White Paper No. 5, Framework for Monitoring and Evaluating Hatchery Programs).



1.4 Report Overview

This report concludes the most comprehensive review of hatchery programs ever undertaken in the Columbia River Basin. The HSRG's analysis of all 178 Columbia Basin hatchery programs and 351 salmon and steelhead populations resulted in principles, recommendations, tools and procedures that provide a foundation for managing hatcheries more effectively into the future. The HSRG's recommendations are based on well-established biological principles and on information describing the quality and quantity of habitat used by each population, fish passage survival through the mainstem Snake and Columbia rivers, hatchery program operations, and the harvest of natural and hatchery adults. The recommendations are summarized in the body of this report, with detail presented in eight appendices. The report is organized around the following components:

- This section (Part 1) provides an introduction to the Hatchery Reform Project, including the project's background, purpose and scope; the HSRG and other entities involved; the review process and analytical approach; and this overview of the report.
- Part 2 identifies several overarching conclusions about reforms needed to current hatchery practices. Part 2 also includes three general principles for hatchery management and seventeen system-wide recommendations (recommendations that apply to hatchery programs across the Columbia River Basin) that the HSRG formulated from these summary conclusions.
- The principles and system-wide recommendations described in Part 2 are the basis for the HSRG recommendations presented in Part 3 for each Evolutionarily Significant Unit (ESU), Distinct Population Segment (DPS) or Major Population Group (MPG) in the Columbia River Basin. Part 3 provides a general description of each ESU/DPS/MPG, and the fisheries, habitat limitations and hatchery programs that affect it. Recommendations for ESU/DPS/MPG-wide hatchery program changes are summarized, as are the predicted results on conservation and harvest goals from implementing those changes. This section of the report is organized by species in the following order: Chinook (3.1), coho (3.2), chum (3.3), steelhead (3.4) and sockeye (3.5). Detailed observations and recommendations for the populations within each ESU, DPS and MPG can be found in Appendix E.
- Appendix A provides eight technical papers the HSRG prepared to summarize the scientific foundation underpinning many of its principles and recommendations. These papers address the following topics: (1) Conservation and Sustainable Harvest Through Fisheries Reform; (2) Predicted Fitness Effects of Interbreeding between Hatchery and Natural Populations of Pacific Salmon and Steelhead; (3) Antibiotics in Salmonid Aquaculture; (4) Global Climate Change and its Effects on the Columbia River Basin; (5) Framework for Monitoring and Evaluating Hatchery Programs; (6) Transition of Hatchery Programs; (7) Nutrient Enhancement to Increase Salmon Production; and (8) Outplanting and Net Pen Release of Hatchery-Origin Fish.
- Appendix B provides short biographies of each HSRG member.
- Appendix C describes the analytical methods and information sources used by the HSRG. The primary analytical tool is the "All H Analyzer" (AHA), a Microsoft



Excel-based application developed to evaluate salmon management options in the context of the four “Hs”—Habitat, (passage through the) Hydroelectric system, Harvest and Hatcheries. This tool allows managers to explore the implications of alternative ways of balancing hatcheries, harvest, habitat and hydroelectric system constraints.

- Appendix D identifies data sources by ESU/DPS/MPG for individual populations and also documents the basis for assumptions made about harvest, habitat, hydropower operations and hatcheries. A user guide to the AHA tool is provided in this appendix, with clear, step-by-step instructions for evaluating a fish population, once the AHA database is downloaded. Screen images that users will encounter are displayed and explained.
- Appendix E presents individual reports on the 351 salmon and steelhead populations in the Columbia River Basin. Each report briefly summarizes the current status of the population and provides the HSRG’s observations and recommendations for that population, based on an analysis of potential management scenarios and their predicted outcomes after 60 fish generations. The organizational hierarchy of this appendix is by species, then by ESU or DPS, and then by individual population.
- Appendix F provides the verbatim comments received in response to the HSRG’s invitation to the federal, state and tribal salmon managers and others to comment on the HSRG’s recommendations for every population within their jurisdiction. Comments were provided through a structured, on-line questionnaire and are presented in Appendix F by species and then by ESU/DPS.
- Appendix G includes a glossary of terms used throughout this report.
- Appendix H describes how data and information will be managed in the future.