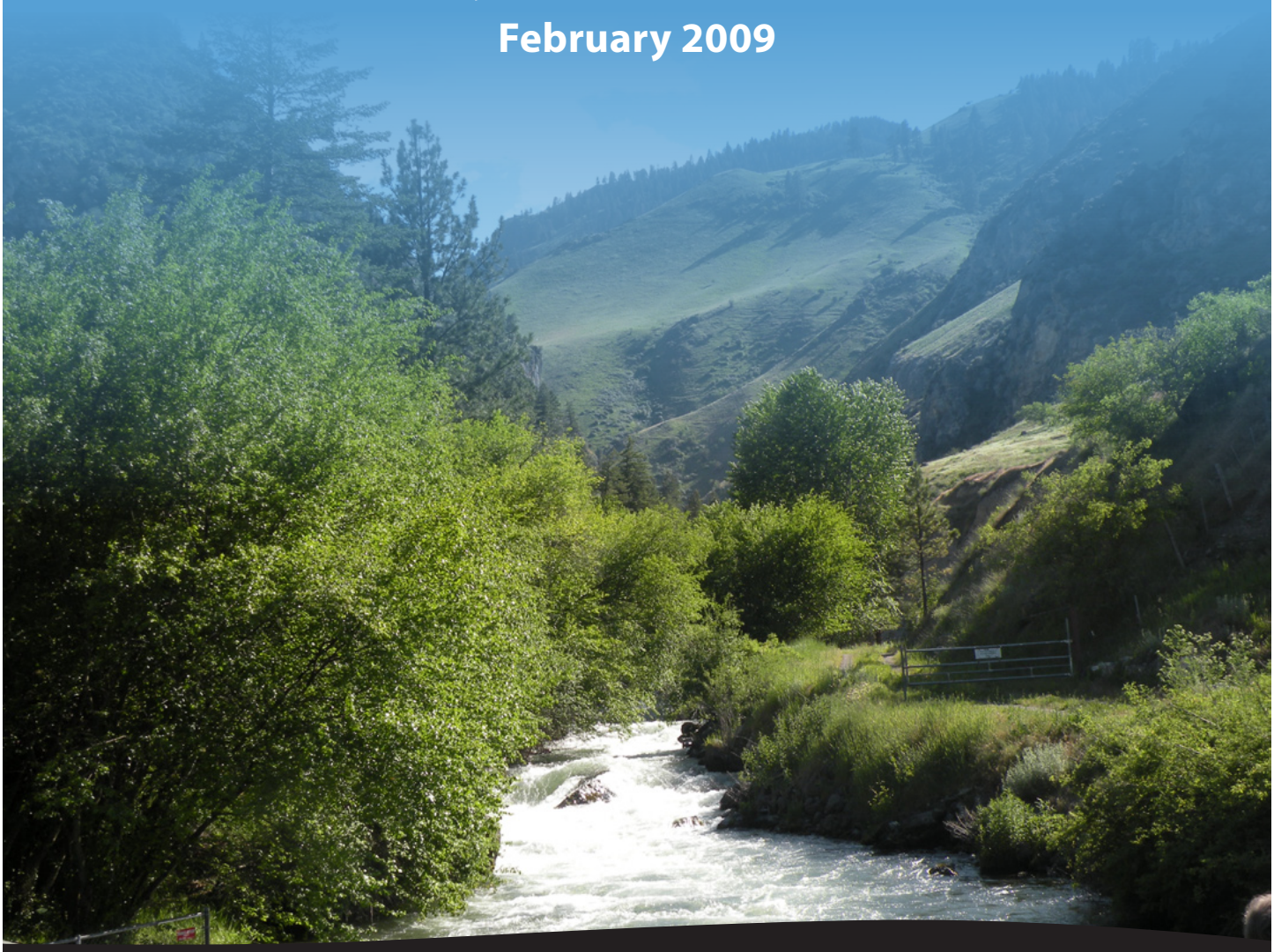
Report to Congress on Columbia River Basin Hatchery Reform

Hatchery Scientific Review Group

February 2009



Rapid River Hatchery

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Executive Summary

The Congressionally-established Hatchery Scientific Review Group (HSRG) offers a foundation for hatchery reform, to help salmon and steelhead hatcheries in the Pacific Northwest meet conservation and sustainable harvest goals. In order to address these twin goals, the HSRG determined that both harvest and hatchery reforms are needed.

The HSRG is recommending principles for hatchery management based on: 1) setting clear goals; 2) scientific defensibility; and 3) monitoring, evaluation and adaptive management. By applying these principles, the HSRG has demonstrated that the Columbia Basin hatchery system can be managed consistent with conservation goals, while still providing sustainable economic benefits from salmon harvest. To be successful, managers will need to support both hatchery and harvest reforms, and funding entities will need to provide the investments needed for implementation.

The HSRG has developed management tools to support application of these principles, including a scientific framework for artificial propagation of salmon and steelhead; benefit/risk assessments tools; hatchery operational guidelines; monitoring and evaluation criteria; and others. The primary analytical tool is the "All H Analyzer" (AHA), a Microsoft Excel-based application that allows managers to explore potential outcomes of alternative strategies of balancing hatcheries, harvest, habitat and hydroelectric system constraints. These tools are available for future use by managers.

The HSRG has used these products to review and provide recommendations for state, tribal and federal hatchery programs; first in Puget Sound and coastal Washington (2001–05) and now in the Columbia River Basin (2006–08). The HSRG's specific recommendations are not presented as the only possible solution, but rather as a clear demonstration that current hatchery programs can be redirected to better meet both conservation and harvest goals.

The HSRG concludes that in order for hatcheries to contribute to harvest on a sustainable basis, they must be operated in a manner that is compatible with conservation goals for salmon and steelhead resources at both the local and regional levels. These conclusions imply that hatcheries must be managed consistent with basic biological principles and viewed as integral components of the affected ecosystems.

The most central aspect of this approach involves genetic management, where hatchery broodstocks need to be managed as either genetically segregated from or integrated with natural populations. To guide this genetic management, the HSRG has developed standards that must be met—or preferably exceeded—

regarding the level of hatchery influence on natural populations under either type of hatchery program. The HSRG has also provided methods for meeting those standards.

The HSRG also recommends the managers assure that ecological impacts of hatchery structures and operations are minimized and that they at minimum meet all regulatory requirements (i.e., water withdrawal and discharge, fish passage and screening).

The HSRG has reached several critical, summary conclusions regarding areas where current hatchery practices need to be reformed. Each of these conclusions (described in more detail later in this report) must be addressed through policy, management, research and monitoring:

- Manage hatchery broodstocks to achieve proper genetic integration with, or segregation from, natural populations;
- Promote local adaptation of natural and hatchery populations;
- Minimize adverse ecological interactions between hatchery- and natural-origin fish;
- Minimize effects of hatchery facilities on the ecosystem; and
- Maximize survival of hatchery fish.

However, the HSRG also concludes that hatchery reforms alone will not achieve recovery of natural populations—complementary actions taken by harvest, habitat and hydropower managers are all necessary if long-term conservation goals are to be achieved. The effectiveness of current habitat and future habitat improvements will be greatly increased if combined with hatchery and harvest reforms. A holistic strategy combining reforms and improvements in all of the "H's" will be necessary to meet the managers' conservation and harvest goals for salmon and steelhead.

This *Report to Congress on Columbia River Basin Hatchery Reform* summarizes information provided in the HSRG's *System-Wide Report on Columbia River Basin Hatchery Reform*. That System-Wide Report concludes a comprehensive review and analysis of all 178 hatchery programs and 351 salmon and steelhead populations in the Columbia River Basin. The HSRG's recommendations are summarized in the body of the System-Wide Report, with details presented in eight appendices. All reports, tools, appendices and other resources described in this Report to Congress are available at www.hatcheryreform.us.

Introduction

Background and Purpose

The US Congress funded the 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 play a necessary role in meeting harvest and conservation goals for Pacific Northwest salmon and steelhead, the hatchery system was in need of comprehensive reform. With many species listed as threatened or endangered under the Endangered Species Act (ESA), conservation of salmon was a high priority, and many hatchery programs—as currently operated—were contributing to the risks those species were facing.

Central to the project was the creation of an independent scientific review panel called the Hatchery Scientific Review Group (HSRG). The HSRG was initially charged 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.

In 2005, Congress directed the National Oceanic and Atmospheric Administration–National Marine Fisheries Service (NOAA Fisheries) to replicate the project in the Lower Columbia River Basin. The scope was then expanded to include the entire Basin, with additional funding provided by the Bonneville Power Administration (BPA) under 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

Columbia River HSRG

Agency/Tribe Affiliated Members

Mr. Andy Appleby/
Mr. Paul Seidel (until May 2008)
Washington Department of Fish and Wildlife

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NOAA Fisheries

Dr. David Fast
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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 (chair, 2008–present)
Northwest Power and Conservation Council

Unaffiliated Members

Mr. John Barr (vice chair)
Independent Consultant

Mr. H. Lee Blankenship (vice chair)
Northwest Marine Technology

Dr. Trevor Evelyn
Fisheries and Oceans Canada (retired)

Dr. Lars Mobrand (chair, 2000–08)
Mobrand/Jones and Stokes

Mr. Stephen H. Smith
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programs have been aimed at supplying fish for harvest, primarily as mitigation for hydropower development in the Basin. Hatchery reform centers around a new, ecosystem-based approach based 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 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 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 members of the HSRG for the Puget Sound and Coastal Washington review were chosen from a pool of candidates nominated by the American Fisheries Society. The original nine-member HSRG was expanded to 14 members in 2006 to include individuals with specific knowledge about Columbia River salmon and steelhead. The 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.

Nine of the 14 HSRG members are affiliated with agencies and tribes in the Columbia River Basin. The remaining five members are unaffiliated biologists. Affiliated members do not represent their agency or tribe, but are expected to bring only their individual, scientific expertise to the table. 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.

Facilitation, Technical and Policy Team

Facilitation of the HSRG reviews, including project management and logistics, was conducted by DJ Warren and Associates, Inc., lead by Dan Warren. DJ Warren and Associates provided technical support to the HSRG via subcontracts to Mobrand/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 under the leadership of James Waldo. The policy coordination team tracked the progress of the HSRG review and convened periodic meetings with a committee of designated policy representatives from the tribal, state and federal management agencies.

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 regions defined by NPCC in 2000. The 14 regions were then grouped into 4 areas: 1) Lower Columbia, 2) Mid Columbia, 3) Upper Columbia, and 4) Snake River. Lower Columbia is defined as the mainstem Columbia River below Bonneville Dam and its tributaries; Mid Columbia is defined as the mainstem Columbia River between Bonneville and McNary dams and its tributaries; the Upper Columbia extends from McNary Dam upstream to Chief Joseph Dam.

The HSRG's scientific review was conducted through a series of regional and cumulative workshops. The review began with populations and hatcheries located in the Lower Columbia River area in July 2006 and progressed upstream through the Snake River Basin in August 2008.

Each regional workshop was preceded by initial fact-finding by the HSRG. Data were collected and assembled into draft reports on the salmon and steelhead populations and hatchery programs within the region. The regional workshop began with a field visit to facilities and watersheds. The HSRG then met to review data, apply its scientific framework and develop draft recommendations for hatchery programs. The federal, state and tribal managers of the region's hatchery programs were included at the end of each regional workshop, so the HSRG could ask remaining questions and get the managers' initial reactions to the draft recommendations.

The HSRG captured all of this information in the "All H Analyzer" (AHA) tool (see section below on Analytical Methods and Tools) and individual Population Reports (see section below on ESU/DPS/MPG Reports). When the regional workshops within an area were completed, a cumulative workshop was held to "roll up" data (at an ESU level) 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.

This comprehensive review and analysis of all 178 hatchery programs and 351 salmon and steelhead populations in the Columbia River Basin is concluding with the publication of the HSRG's *System-Wide Report on Columbia River Basin Hatchery Reform*. The System-Wide Report is organized around the following components:

Columbia River Basin Hatchery Reform Policy Committee

Ed Bowles
Oregon Department of Fish and Wildlife

Kat Brigham
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

Dave Johnson
Nez Perce Tribe

Becky Johnson
Nez Perce Tribe

Rob Jones
NOAA Fisheries

Robert Turner
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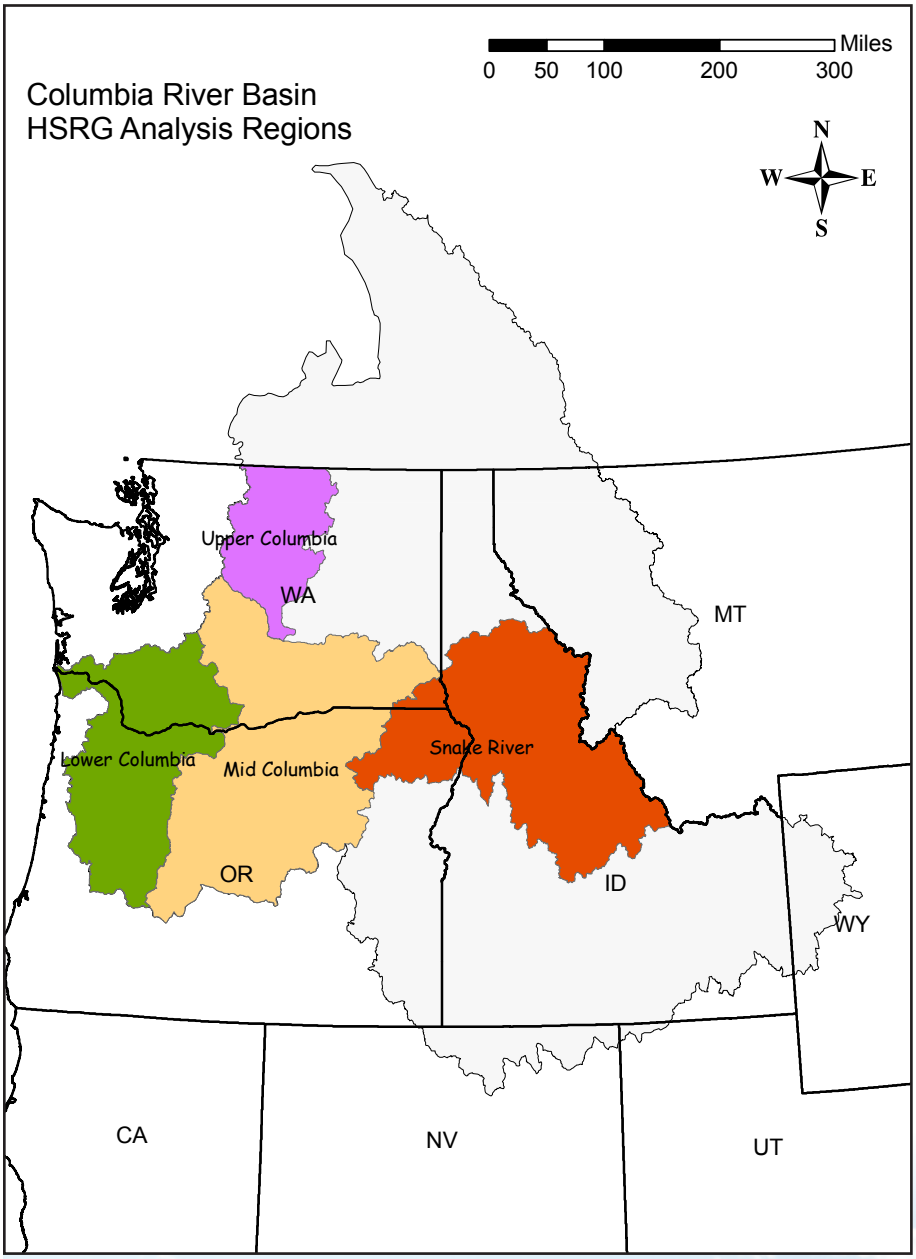
Phil Anderson
Washington Department of Fish and Wildlife

Guy Norman
Washington Department of Fish and Wildlife

Joe Peone
Confederated Tribes of the Colville Reservation

Philip Rigdon
Yakama Nation

Jim Waldo
Gordon, Thomas, Honeywell, Malanca, Peterson & Daheim, LLP



HSRG Columbia River Basin Regions and Areas

Lower Columbia

- Cowlitz
- Kalama and Lewis
- Columbia Estuary, Washington
- Lower Columbia to Sandy, Oregon
- Columbia Estuary, Oregon
- Columbia Gorge, Washington
- Columbia Gorge, Oregon
- Willamette, Oregon

Mid Columbia

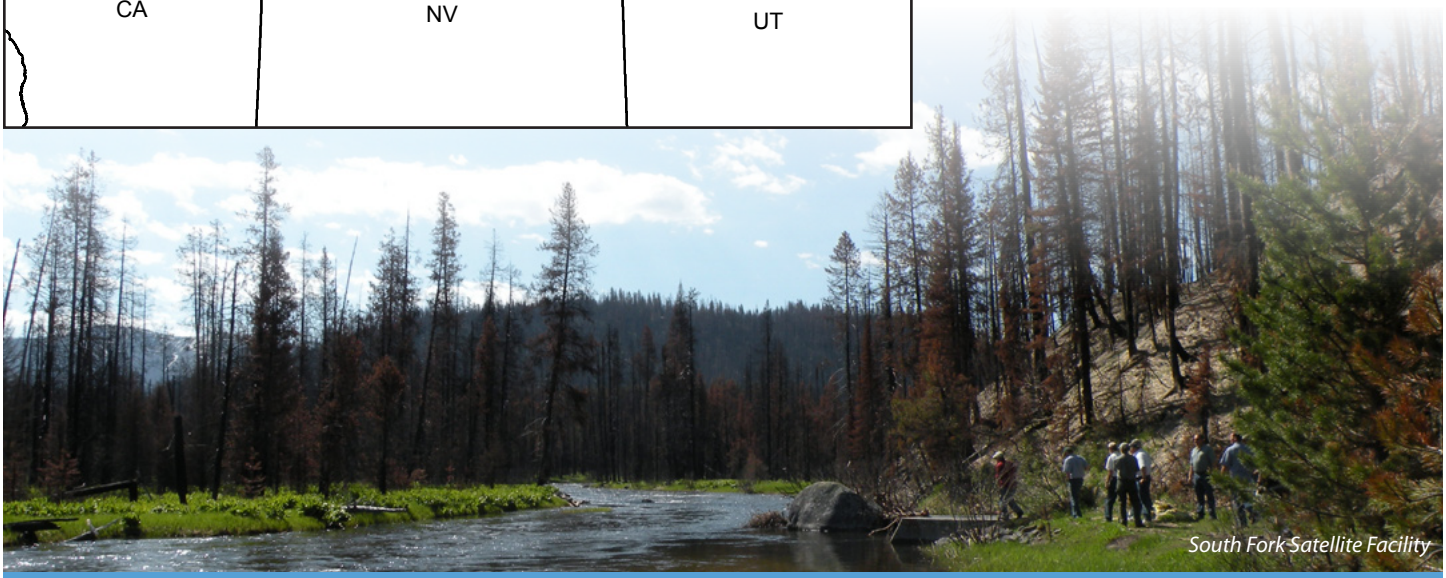
- Columbia Plateau, Oregon
- Columbia Plateau, Washington

Upper Columbia

- Columbia Cascade, Washington

Snake River

- Mountain Snake Salmon
- Mountain Snake Clearwater
- Blue Mountain



South Fork Satellite Facility

- Part 1 provides an introduction to the Hatchery Reform Project.
- Part 2 identifies several summary conclusions about reforms needed to current hatchery practices, three general principles for hatchery management, and 17 system-wide recommendations (recommendations that apply to hatchery programs across the Columbia River Basin).
- Part 3 presents the HSRG's proposed solutions for each Evolutionarily Significant Unit (ESU), Distinct Population Segment (DPS) or Major Population Group (MPG) in the Columbia River Basin.
- Appendix A provides eight technical papers summarizing the scientific foundation underpinning many of the HSRG's principles and recommendations.
- Appendix B provides short biographies of each HSRG member.
- Appendix C describes the HSRG's analytical methods and information sources.
- Appendix D identifies data sources for individual populations and documents the basis for assumptions made about harvest, habitat, hydropower and hatcheries.
- Appendix E presents individual reports on the 351 salmon and steelhead populations in the Columbia River Basin.
- Appendix F provides comments received from the federal, state and tribal salmon managers and others in response to the HSRG's recommendations.
- Appendix G includes a glossary of terms.
- Appendix H contains a strategy for how hatchery reform data and information can be updated and managed in the future.

The System-Wide Report and all other reports, tools, appendices and resources described in this Report to Congress are available at www.hatcheryreform.us.

Summary Conclusions

The HSRG conducted a detailed, thorough and comprehensive review of 178 hatchery programs and 351 salmon and steelhead populations in the Columbia River Basin. The resulting population-specific recommendations are intended to provide scientific guidance for managing each hatchery more effectively in the future.

The HSRG concluded that hatcheries play an important role in the management of salmon and steelhead populations in the Columbia River Basin. Nevertheless, the traditional practice of replacing natural populations with hatchery fish to

mitigate for habitat loss and mortality due to hydroelectric dams is not consistent with today's conservation principles and scientific knowledge. Hatchery fish cannot replace lost habitat or the natural populations that rely on that habitat. Therefore, hatchery programs must be viewed not as surrogates or replacements for lost habitat, but as tools that can be managed as part of a coordinated strategy to meet watershed or regional resource goals, in concert with actions affecting habitat, harvest rates, water allocation and other important components of the human environment.

The benefits and risks of a hatchery program depend on the biological significance of the affected salmon and steelhead populations, and the current and future status of all factors affecting the regional ecosystem within which the hatchery program operates (including fresh water and marine habitats, hydropower facilities and operations, harvest patterns and other regional hatchery programs). Hatchery programs should be used only to the extent that they provide a better option—from the benefit/risk standpoint—than available alternative methods to meet the same or similar goals.

Hatchery reforms that improve the reproductive fitness of natural salmon and steelhead populations also increase the benefit of habitat restoration by providing more successful adult fish to occupy the habitat. Conversely, when habitat improvements are made without hatchery and harvest reforms, the resulting benefits will be smaller. Improvements from hatchery reform are also likely to occur on a shorter time scale than improvements from habitat restoration actions. Given these factors, there is no reason to wait for future habitat improvements before implementing hatchery and harvest reforms.

Hatchery management must be aligned with harvest management and vice versa. The HSRG has demonstrated that increasing selective harvest on hatchery-origin fish can have a conservation benefit (population fitness and productivity), economic benefit (increase the harvest) and increase the value of current habitat and habitat improvements. Improvements in survival through the hydropower system for outmigrating smolts and returning adults will also benefit conservation and harvest goals.

The HSRG has demonstrated that the Columbia Basin hatchery system can be managed consistent with conservation goals, while still providing sustainable economic benefits from harvest. To be successful, managers will need to support both hatchery and harvest reforms and funding entities will need to provide the investments needed for implementation.

The HSRG has reached several critical, overarching conclusions regarding areas where current hatchery and harvest practices need to be reformed. Each of these conclusions (summarized below) must be addressed through policy, management, research and monitoring.

Manage Hatchery Broodstocks to Achieve Proper Genetic Integration with, or Segregation from, Natural Populations

Hatchery programs should be managed as either genetically *integrated* with, or *segregated* from, the natural populations they most directly influence. In an idealized integrated program, natural-origin and hatchery-origin fish represent two genetically equal components of a single gene pool, locally adapted to the natural habitat. A hatchery supporting an integrated program can be viewed conceptually as an artificial extension of the natural environment, allowing for a larger overall population (hatchery plus natural) than the existing natural habitat could sustain on its own.

The intent of a segregated hatchery program is to maintain a genetically-distinct hatchery population. The segregated approach uses only hatchery-origin fish for broodstock and results in a population that is adapted to the hatchery environment and can maximize the efficiency of hatchery propagation.

The integrated and segregated strategies both have strengths and weaknesses, so the decision regarding which strategy to follow must be determined on a case-by-case basis. While the primary purpose of most integrated hatchery programs is to contribute to harvest, they may also contribute to conservation by providing a demographic "safety net" for the natural population (keeping that population from dwindling to dangerously small numbers). But they can pose a demographic risk to natural populations if the size of the hatchery program exceeds the size of the associated naturally spawning population. On the other hand, segregated hatchery programs can pose significant genetic and ecological risks to natural populations if they reproduce naturally with wild fish. The primary way to reduce these risks from segregated programs is to reduce the number of hatchery fish spawning in the natural environment.

The ideal integrated or segregated hatchery program is nearly impossible to achieve in practice. Because hatchery fish have lower reproductive fitness (even when they come from well-integrated programs), they represent a risk to a natural population when they spawn in the natural environment, rather than returning to the hatchery (such fish are known as "strays"). However, as noted above, hatchery fish on the spawning grounds may confer a net conservation benefit when the demographic extinction risk is high.

In order to address the fitness risks posed by hatchery fish, the HSRG developed standards that must be met —or preferably exceeded—regarding the level of hatchery influence on natural populations under either type of hatchery program. (see System-Wide Recommendation #8 below). These standards, which vary depending on the biological significance of the natural population, are intended to support recovery of natural populations while retaining overall

harvest benefits. They are also designed to be simple to implement and monitor. The HSRG has also proposed methods for achieving those standards.

Promote Local Adaptation of Natural and Hatchery Populations

The biological principle behind the HSRG's standards for both integrated and segregated populations is promoting local adaptation (this refers to how well an organism is adapted, through natural selection, to the local environment it inhabits). Local adaptation of natural populations is important because it maximizes the viability and productivity of the population, maintains biological diversity within and between populations, and enables populations to adjust to changing environmental conditions (for example through climate change).

A major concern with many current hatchery programs is that they have been operated in a manner that disrupts the natural selection for population characteristics that are tailored to local conditions in the natural environment. Proper integration or segregation of hatchery programs is the HSRG's recommended means for minimizing the adverse effects of hatcheries on local adaptation of natural populations. Local adaptation of hatchery populations is achieved by using local broodstock and avoiding transfer of hatchery fish among watersheds.

Minimize Adverse Ecological Interactions between Hatchery- and Natural-Origin Fish

Another important concern associated with hatchery programs is ecological interaction between hatchery and natural fish, such as competition for feeding and spawning locations, predation of hatchery fish upon natural-origin fish, and the potential transfer of disease from hatchery- to natural-origin fish. One way to address these interactions is for hatchery programs to be operated so the released fish are segregated from their natural counterparts in time and space. Alternatively, hatchery fish can be reared and released to be as similar biologically to their natural counterparts as possible (though this does not always preclude the adverse effects of competition).

For example, competition between hatchery and natural steelhead juveniles in the Columbia River Basin is of concern to the HSRG, with adverse effects on the natural population having been documented (see HSRG 2009 report for details and references). Size, time, age, location and method of release of hatchery fish affect the severity of this risk. Predation of hatchery fish upon other salmonids is less well understood, but generally assumed to be less significant than competition.

Hatchery fish can also pose a disease threat to natural-origin fish both before and after their release from the hatchery. To avoid this threat, hatcheries should adopt fish culture practices that minimize or avoid disease risks. Suggested practices include providing suitable water supplies, low rearing densities, appropriate feeds and feeding protocols, careful sanitary procedures, avoiding out-of-basin fish transfers and using pathogen-free broodstock. Antibiotics should be judiciously used when necessary (see Appendix A of the System-Wide Report on Columbia River Basin Hatchery Reform, *Antibiotics in Salmonid Aquaculture*).

Minimize Effects of Hatchery Facilities on the Ecosystem

Facilities operated in support of hatchery programs (traps, weirs, water intake screens and hatchery effluent discharges) can have adverse effects on salmonid populations and other aquatic species. The HSRG noted that, for the most part, existing laws and regulations related to facilities and operations are adequate to protect the environment. Not all facilities, however, are in compliance with those laws and regulations. It is important that those facilities be identified and brought into compliance. Recognizing that weirs and traps have a legitimate role in controlling hatchery strays that could affect naturally spawning populations, the HSRG encourages the use of low impact weirs that have minimal effect on natural populations and their habitats.

Maximize Survival of Hatchery Fish

In order for hatchery programs to effectively contribute to harvest and/or conservation, the reproductive success and survival of hatchery releases must be high relative to those of naturally spawning populations. The primary performance measurement for hatchery programs should be the total number of adults produced (those caught in fisheries plus those that escape to the hatchery or natural environment) per adult spawned at the hatchery. All too often in the past, hatcheries have instead been evaluated based on the number of smolts released (which is like evaluating a farm based on the pounds of seed planted, rather than the size and quality of the crop produced).

Principles and System-Wide Recommendations

The HSRG's three principles for hatchery management are presented below, with each of 17 system-wide recommendations (applicable to programs across the Columbia River Basin hatchery system) listed under the principle from which it is derived. These principles and system-wide recommendations represent the key findings of the HSRG in its review of Columbia River Basin hatcheries. The more

closely hatchery programs adhere to these principles and recommendations, the greater the likelihood of their contribution to the managers' harvest and conservation goals.

Principle: Develop Clear, Specific, Quantifiable Harvest and Conservation Goals for Natural and Hatchery Populations within an "All H" Context

During its reviews, the HSRG observed that goals for fish populations were not always explicitly communicated and/or fully understood by the managers and operators of hatchery programs. These goals should be quantified, where possible, and expressed in terms of values to the community (harvest, conservation, education, research, etc.). At times, goals have been expressed in terms of the numbers of smolts to be released without specifying whether or how this hatchery production contributes to harvest and/or conservation. Hatchery production numbers may be the *means* of contributing to harvest and/or conservation values, but they are not endpoints. When population goals are clearly defined in terms of conservation and harvest, hatcheries can be managed as tools to help meet those goals.

To be successful, hatcheries should be used as part of a comprehensive strategy where habitat, hatchery management and harvest are coordinated to best meet resource management goals that are defined for each population in the watershed. Hatcheries are by their very nature a compromise—a balancing of benefits and risks to the target population, other populations, and the natural and human environment affected by the hatchery program. Use of a hatchery program is appropriate when the benefits significantly outweigh the risks and when the benefit/risk mix from the program is more favorable than the benefits/risks associated with non-hatchery strategies for meeting the same goals.

The HSRG offers the following three system-wide recommendations for defining goals for natural and hatchery populations.

Recommendation 1: Express conservation goals in terms of a population's biological significance (Primary, Contributing, Stabilizing) and viability (natural-origin spawning abundance and productivity)

Different definitions of biological significance are used by the managers throughout the Columbia River Basin. In order to provide a consistent analysis, the HSRG used the classification system adopted by the Lower Columbia Fish Recovery Board in 2004, under which all distinct salmon and steelhead 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. Viability goals are expressed in terms of population productivity

and abundance and also take into account spatial structure and diversity. Although designation of a population as Primary, Contributing or Stabilizing is a policy decision, for its analysis, the HSRG made assumptions based on the status of each population and goal statements provided by the managers or found in planning documents. These goals are captured in the individual population reports (see Appendix E of the System-Wide Report on Columbia River Basin Hatchery Reform).

Recommendation 2: Express harvest goals in terms of a population's contribution to specific fisheries

Harvest goals should be expressed quantitatively where possible, either in terms of catch (number of fish) in specific fisheries (e.g., tributary sport or other terminal fisheries), or as mixed-stock, pre-terminal, sustainable harvest rates.

Recommendation 3: Ensure goals for individual populations are coordinated and compatible with those for other populations in the Columbia River Basin

Many important populations of salmon and steelhead do not meet the conservation expectations identified by managers. Achieving these expectations requires that population goals be developed that consider other populations in the Columbia River Basin, watershed or ESU. The contribution of each hatchery program to the cumulative impact of all hatchery programs in the Basin also needs to be considered.

Principle: Design and Operate Hatchery Programs in a Scientifically Defensible Manner

Once a set of well-defined population goals has been identified, the scientific rationale for a hatchery program (in terms of benefits and risks) must be formulated, explaining how the program expects to achieve its goals. The purpose, operation and management of each hatchery program must be scientifically defensible. The strategy chosen must be consistent with current scientific knowledge. Where there is uncertainty, hypotheses and assumptions should be articulated.

Scientific defensibility should be a central consideration throughout all phases of a hatchery program—when determining whether a hatchery should be built or a program initiated; during the hatchery or program planning and design phase; and during the operations phase. This ensures a scientific foundation for hatchery programs, a means for addressing uncertainty, and a method for demonstrating accountability. Documentation for each program should include a description of analytical methods and should be accompanied with citations from the scientific literature.

The HSRG offers the following ten recommendations aimed at ensuring scientifically-defensible hatchery programs.

Recommendation 4: Identify the purpose of the hatchery program (i.e., conservation, harvest or both)

Once the goals for a population have been established, it is necessary to identify the purpose of hatchery programs affecting that population. In the past, the purpose of many hatchery programs was described as the release of specified numbers of juveniles, without identifying whether those releases were intended to achieve conservation goals, harvest goals or both. Unless the purpose of a hatchery program is clear, it is not possible to effectively design, operate or evaluate the program.

Recommendation 5: Explicitly state the scientific assumptions under which a program contributes to meeting the stated goals

Once population goals have been defined and the purpose(s) of a hatchery program have been established, the scientific rationale for the program must be documented. The scientific rationale explains (in terms of benefits and risks) how the hatchery program is expected to achieve its purpose. The purpose, operation and management of the program must be scientifically defensible and the chosen strategy consistent with current scientific knowledge. Where there is uncertainty, hypotheses and assumptions should be documented, so they can be evaluated and modified as new information becomes available. Documentation should include citations from the scientific literature and analytical tools that take into account the factors that will affect the success of the program.

Recommendation 6: Select an integrated or segregated broodstock management strategy based on population goals and hatchery program purpose

Hatchery programs should be managed as either genetically integrated with, or segregated from, the natural populations they most directly influence (see Summary Conclusions above and Appendix A of the System-Wide Report on Columbia River Basin Hatchery Reform for more details). For most integrated hatchery programs, the intent is to minimize the genetic and reproductive fitness differences between the hatchery broodstock (fish used for spawning) and the naturally spawning population from which they are derived. To achieve this, at a minimum, the proportion of hatchery broodstock comprised of natural-origin fish has to be greater than the proportion of the natural spawning population made up of hatchery-origin fish. Fish from segregated hatchery programs would ideally be propagated solely from hatchery returns and not allowed to spawn with the natural population.

The HSRG concluded that when these broodstock management standards for an integrated or segregated program are met and managers' abundance goals are

achieved, the benefits of the hatchery program outweigh the risks. Because of uncertainty around the effects of hatchery fish on the reproductive fitness of natural populations, the HSRG also identified some Primary populations (as defined in System-Wide Recommendation #1) where hatchery influence could be minimized by establishing "hatchery-free" populations. These "hatchery free" populations provide both a hedge against unknown or poorly understood hatchery influences and a reference for future changes in abundance and productivity of all populations.

Recommendation 7: Size hatchery programs based on population goals and as part of an "all H" strategy

A hatchery program should be sized to achieve goals for harvest and conservation, while reducing the effects on natural populations from straying, ecological interactions and from collecting more natural broodstock than the population can support. The appropriate size of an integrated or segregated program is directly related to the productivity and abundance of the natural population, taking into account the effects of harvest, hydropower operations and habitat conditions.

Concerns about ecological interactions can be addressed in part by making the hatchery program as small as possible, while assuring that benefits from the program still outweigh the risks. The HSRG recommends that managers size their hatchery and harvest programs to reduce excessive adult returns to a hatchery and use some of the surplus fish to provide ecological benefit through nutrient enhancement of streams and rivers (see Appendices A and E of the System-Wide Report on Columbia River Basin Hatchery Reform).

Recommendation 8: Manage harvest, hatchery broodstock and natural spawning escapement to meet HSRG standards appropriate to the affected natural population's designation

To limit genetic and fitness risks and meet conservation goals, the HSRG developed quantitative standards for the proportion of natural-origin spawners made up of hatchery-origin fish (pHOS), the proportion of hatchery broodstock derived from natural-origin fish (pNOB), and the proportionate natural influence (PNI) on an integrated population that results from the combination of pHOS and pNOB. Those standards vary according to the biological significance/population viability of the natural population (as defined in System-Wide Recommendation #1 These standards are presented below:

Primary populations

- pHOS should be less than five percent of the naturally spawning population, unless the hatchery population is integrated with the natural population.

- For integrated populations, pNOB should exceed pHOS by at least a factor of two, corresponding to a PNI (proportionate natural influence) value of 0.67 or greater and pHOS should be less than 0.30.

Contributing populations

- pHOS should be less than ten percent of the naturally spawning population, unless the hatchery population is integrated with the natural population.
- For integrated populations, pNOB should exceed pHOS, corresponding to a PNI value of 0.50 or greater and pHOS should be less than 0.30.

Stabilizing populations

- The current operating conditions were considered adequate to meet conservation goals. No criteria were developed for pHOS or PNI.

In order to meet these standards, the number of hatchery fish on the spawning grounds must be monitored and controlled. The HSRG's analysis showed that both conservation goals and harvest goals could be met with an appropriate combination of reduced hatchery production, selective harvest of hatchery fish, and/or selective removal of hatchery adults with tributary traps or weirs. Marking or tagging all hatchery fish so that they are easily distinguished (in real time) from natural-origin fish is a basic requirement for selective harvest, as well as for monitoring and achieving desired levels of pHOS, pNOB and PNI.

Note that the designation of a population as Primary, Contributing or Stabilizing is a policy decision.

Recommendation 9: Manage the harvest to achieve full use of hatchery-origin fish

Many salmon fisheries can be restructured to increase the beneficial harvest of hatchery salmon, while reducing the adverse biological effects of excessive numbers of hatchery fish spawning in the wild. Hatchery fish from a harvest program need an external mark (adipose fin-clip) so they can be distinguished from natural-origin fish and selectively harvested in various fisheries.

Because salmon survival in any given year can vary by an order of magnitude, fisheries must be flexible enough to harvest highly variable numbers of hatchery salmon. In many cases, if fisheries are not managed to remove more hatchery salmon, hatchery programs need to be reduced or terminated to avoid adverse effects on natural populations.

To both increase salmonid harvests and minimize adverse biological effects on natural populations, the HSRG recommends that most fisheries be managed as selective fisheries, where marked hatchery fish are retained and unmarked fish are released with minimal mortality. Selective commercial fishing gear needs to

be developed and assessed for use in the Columbia River Basin. Additionally, the HSRG recommends that more hatchery fish be transferred to, and acclimated in, terminal fishing locales, where they can be harvested in known stock fisheries, with little mortality to other populations.

Recommendation 10: Ensure all hatchery programs have self-sustaining broodstocks

Many current hatchery programs import juveniles from out-of-subbasin sources. This practice inhibits local adaptation and contributes to the loss of genetic diversity within and among populations. Use of local broodstock and in-basin rearing promotes selection for traits favorable to survival in the local environment and improves homing fidelity, thereby reducing straying risks to other populations. In this context, the same biological principles used to manage wild populations should be used to manage hatchery populations. Exceptions to this are the designated terminal area fisheries, where the intent is to harvest all returning adults.

Recommendation 11: Coordinate hatchery programs within the Columbia River Basin ecosystem to account for the effects of all hatchery programs on each natural population and each hatchery program on all natural populations

Columbia River Basin fish production needs to be regionally coordinated if system-wide conservation and harvest goals are to be met. The focus should be on limiting negative ecological and genetic impacts of harvest production on naturally rearing populations, and ensuring that system-wide hatchery propagation does not overwhelm individual, biologically significant, natural populations.

Hatchery fish released in each subbasin will interact with wild and hatchery fish from other subbasins as they migrate through the downstream corridor, estuary and ocean. The effects of these interactions are heightened as the cumulative number of hatchery fish released into the Columbia River Basin for harvest increases. Therefore, overall hatchery fish production should be limited to the minimum number needed to meet system-wide harvest and conservation goals of the various managers. In addition, the cumulative natural and hatchery production should take into account the carrying capacity of the migratory corridor, estuary and ocean.

Basin-wide coordination would require that regional decision-makers have convenient access to reports showing population goals, current status of populations and fisheries, and expected and realized contributions from hatchery programs. This information should be up to date and easily accessible via the Internet. It should be possible to view the information at several levels—by population, ESU and species—for the entire Columbia River Basin. AHA and

other tools provided by the HSRG will help make this information available in this manner (see section below on Analytical Methods and Tools).

Recommendation 12: Assure that facilities are constructed and operated in compliance with environmental laws and regulations

Hatchery facilities include adult collection, spawning, incubation and rearing and release facilities as well as structures for the removal and discharge of water. These structures are usually located in riparian areas or within streams and can affect habitat quality and quantity, as well as the use of habitat by juvenile and adult fish. Hatchery structures can create obstacles to migration for juvenile and adult fish, change instream flow, alter riparian habitat and diminish water quality through hatchery discharges. If hatchery facilities and operations are not in compliance with environmental laws and regulations, the consequence could be loss of natural production. In addition, failure to comply with these requirements could lead to closure of facilities and the loss of any harvest or conservation benefit derived from the programs.

Recommendation 13: Maximize survival of hatchery fish consistent with conservation goals

Maximizing the survival of hatchery fish enables conservation programs to accelerate their rebuilding efforts. It allows production hatcheries to reduce their ecological impacts on natural populations. With higher survival, harvest and/or conservation goals can be reached with smaller hatchery programs. There are many approaches to increasing fish survival, including the release of healthy fish at the appropriate time, size, age and location; improving water quality and reducing loading and density during rearing; allowing smolts to outmigrate when they are ready, rather than forcing them out at a preset date; removing juveniles that do not outmigrate; proper acclimation and imprinting of hatchery juveniles; and other culture and release practices (see System-Wide Report on Columbia River Basin Hatchery Reform for more details).

Principle: Monitor, Evaluate and Adaptively Manage Hatchery Programs

In addition to establishing resource goals and a defensible scientific rationale for a hatchery program, the HSRG recommends that the managers' decisions be informed and modified by continuous evaluation of existing programs, changing circumstances and new scientific information. Decisions about hatcheries must also be made in a broader, integrated context and hatchery solutions must meet the test of being better, in a benefit/risk sense, than alternative available means to meet similar goals. Systems affected by hatchery programs are dynamic and complex; therefore, uncertainty is unavoidable. The only thing certain is that the unexpected will occur.

Hatchery managers' decision-making processes must include provisions to monitor the results of their programs and identify when environmental conditions or scientific knowledge has changed. Climate change and human population growth are examples of the factors that must be taken into consideration in the future. New data will change our understanding of the ecological and genetic impacts of hatchery programs. Recognizing these changes should lead directly to changes in hatchery operations.

Results of monitoring and evaluation must be brought into the decision-making process in a clear and concise way, so needed changes can be implemented. This responsive process should be structured to allow for innovation and experimentation, so hatchery programs may incorporate new goals and concepts in fish culture practice.

Recommendation 14: Regularly review goals and performance of hatchery programs in a transparent, regional, "all-H" context

The HSRG recommends that the managers' decisions be informed and modified by periodic evaluations of existing programs in light of new scientific information. This evaluation process should be on-going to allow incorporation of new knowledge as soon as possible. Comprehensive reviews of hatchery programs should be conducted at regularly scheduled intervals, say every five years. These reviews should include hatchery operation and performance, as well as hatchery program performance standards, to ensure continued consistency with overall population goals. HSRG data sets, reports, and tools can facilitate these reviews. These periodic reviews will help keep the region focused on hatchery reform implementation and will help monitor benefits and risks over time.

The HSRG has 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 on an annual basis. Contribution from each hatchery program to fisheries should be monitored annually. Natural spawner abundance of 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 Part 3, ESU/DPS/MPG reports section of the System-Wide Report on Columbia River Basin Hatchery Reform).

Recommendation 15: Place a priority on research that develops solutions to potential problems and quantifies factors affecting relative reproductive success and long-term fitness of populations influenced by hatcheries

Hatcheries have demonstrated that they can successfully provide fish for harvest, but uncertainty remains about the reproductive success of hatchery-origin fish

in the wild. A growing body of research has shown that traditional hatchery practices produce adults that may exhibit lower reproductive success in nature than locally adapted natural fish. In addition, it appears that a number of natural populations continue to have low productivity and are at risk of going extinct. Future research should be prioritized to identify factors causing reduced fitness and reproductive success of hatchery fish and investigate whether changes to fish culture practices can overcome these problems.

Recommendation 16: Design and operate hatcheries and hatchery programs with the flexibility to respond to changing conditions

The concept of adaptive management is well established in the Columbia River Basin. It is a structured, iterative process of optimal decision-making in the face of uncertainty, aimed at reducing uncertainty over time through system monitoring and evaluation. The HSRG developed its recommendations using analyses based on best available scientific knowledge, reasonable assumptions where information was lacking, and management goals (as understood by the group). The analytical methods used to develop those recommendations will need to be updated, and management decisions adapted as new knowledge is gained through the implementation, monitoring and evaluation of hatchery reform.

It will be important for hatchery managers to design and operate hatchery programs with the flexibility to respond to both new knowledge and changing conditions. This is likely to be increasingly important in light of changing climate conditions (see Appendix A of the System-Wide Report on Columbia River Basin Hatchery Reform, Global Climate Change and its Effects on the Columbia River Basin).

Recommendation 17: Discontinue or modify programs if risks outweigh the benefits

Many of the Columbia River Basin hatchery programs were initiated in the 1950s and 1960s to support high levels of harvest. The importance of maintaining viable natural populations was not well understood and was not a priority during the development of hatchery infrastructure, especially in much of the Columbia River Basin. But now, scientific information has shown that hatchery fish can pose significant risks to natural populations if managed improperly and many salmon and steelhead stocks have been listed under the ESA. Both conservation and harvest goals can be achieved if resources are provided to modify these hatchery programs. Without these investments, programs will have to be reduced or discontinued in order to achieve the conservation goals.

ESU/DPS/MPG Reports

The principles and system-wide recommendations presented above served as the basis for the population-specific recommendations the HSRG presents in its Population Reports and in the Part 3, ESU/DPS/MPG Reports section of the System-Wide Report on Columbia River Basin Hatchery Reform. That section provides a general description of each Columbia River Basin Evolutionarily Significant Unit (ESU), Distinct Population Segment (DPS) or Major Population Group (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 conservation and harvest results from implementing those changes. That section of the report is organized by species in the following order: Chinook, coho, chum, steelhead and sockeye. Detailed observations and recommendations for the populations within each ESU, DPS and MPG can be found in Appendix E of the System-Wide Report on Columbia River Basin Hatchery Reform.

Using analytical procedures described in detail in Appendix C of the System-Wide Report on Columbia River Basin Hatchery Reform, the HSRG reviewed all current hatchery programs in the Columbia River Basin. Four scenarios were examined: 1) current program, 2) no hatchery, 3) "best" segregated program, and 4) "best" integrated program (see section above on Summary Conclusions for a description of integrated and segregated hatchery programs). The solution that best met the managers' conservation and harvest goals for each ESU, DPS or MPG was selected as the "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 (as interpreted by the HSRG from goal statements provided by the managers or found in their planning documents).

For example, the threatened Lower Columbia River Chinook Salmon ESU includes all naturally spawned populations from the mouth of the Columbia River upstream to and including the White Salmon River in Washington and the Hood River in Oregon. This ESU also includes naturally spawning Chinook in the Willamette River upstream to Willamette Falls (exclusive of the spring-run Chinook in the Clackamas River), as well as fish from 17 hatchery programs. Of the 31 populations in the ESU, 27 are considered by NOAA Fisheries to be at high or very high risk of extinction and only one at low risk.

Historically, this ESU has been managed for harvest; conservation has not been a high priority. With the recent ESA listing of these 27 populations in the ESU, conservation has been elevated to a higher management priority, requiring changes in hatcheries, harvest and habitat actions. After reviewing the ESU in the context of the entire Lower Columbia area, the HSRG determined that, in order

to be consistent with their conservation goals for the ESU, managers need to implement both hatchery and harvest reforms.

Hatchery programs affecting this ESU will require implementing effective integrated or segregated hatchery broodstock protocols to achieve the standards described by the HSRG. For segregated programs, the number of hatchery-origin fish spawning naturally will need to be limited, in some cases through the use of weirs or a combination of weirs and selective harvest. For integrated programs, an appropriate number of natural-origin fish need to be included in the hatchery broodstock and the contribution of hatchery fish to natural spawning areas needs to be controlled, which will require hatchery infrastructure modifications.

For harvest programs affecting this ESU, increased selective fisheries will be necessary in marine, mainstem and terminal areas to maintain current harvest numbers. Achieving these harvest benefits will also require developing harvest methods and gear for commercial freshwater fisheries to enable selective removal of hatchery fish with low mortality to natural fish.

The HSRG also concluded the hatchery and harvest reforms alone will not achieve recovery of the listed populations in this ESU—habitat improvements are also necessary. In addition, the effectiveness of habitat actions in this ESU will be greatly increased (more than doubled, under the HSRG assumptions) if they are combined with hatchery and harvest reforms.

The HSRG performed this type of detailed review for every ESU, DPS and MPG in the Basin. 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.

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.

The population recommendations are not presented as the only possible solution for those populations, but rather as a clear demonstration that current hatchery programs can be redirected to better meet both conservation and harvest goals.

Analytical Methods and Tools

Appendix C of the System-Wide Report on Columbia River Basin Hatchery Reform 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.

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 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; and then update the HSRG tools accordingly.

Scientific White Papers

Appendix A of the System-Wide Report on Columbia River Basin Hatchery Reform 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:

- Conservation and Sustainable Harvest Through Fisheries Reform
- Predicted Fitness Effects of Interbreeding between Hatchery and Natural Populations of Pacific Salmon and Steelhead
- Antibiotics in Salmonid Aquaculture
- Global Climate Change and its Effects on the Columbia River Basin
- Framework for Monitoring and Evaluating Hatchery Programs
- Transition of Hatchery Programs
- Nutrient Enhancement to Increase Salmon Production
- Outplanting and Net Pen Release of Hatchery-Origin Fish

Next Steps in Hatchery Reform

Hatchery management and the reforms recommended by the HSRG could affect many entities in the Columbia River Basin—fishery managers; funding entities such as utilities, BPA and Congress; and regulators such as NOAA Fisheries. All of these entities will have important roles in the implementation of hatchery reform. Hatchery reform is also important to the NPCC, which is mandated to develop a comprehensive fish and wildlife program. Additionally, proper hatchery management affects the full range of land and water users in the Basin, since hatchery practices greatly influence the success of investments in habitat protection and restoration for steelhead and salmon conservation. The entire region, therefore, has a stake in hatchery reform.

The work of the HSRG can add significant value to the management of salmon and steelhead only if the principles and system-wide recommendations are fully integrated into everyday hatchery and harvest planning and operations. To this end, the HSRG provides the following recommendations for implementation.

Institutionalize and Apply a Common Implementation Framework

Hatchery design, programming and reform often occur simultaneously within the Columbia River Basin due to the many funding, regulatory and management entities and forums involved. These activities are complicated by the large number of Basin salmon and steelhead populations and hatchery programs that cross multiple political jurisdictions. If hatchery benefits and risks are to be scientifically assessed, a common language and framework is needed to ensure such critical work is efficiently and effectively completed within the Basin.

To that end, the HSRG recommends application of its implementation framework. The framework comprises scientific principles, biological standards, scientific methods and assessment tools. It is and should continue to be available and maintained on a public web site (www.hatcheryreform.us), to ensure a consistent and transparent assessment for management and reform of hatchery programs.

Institutionalizing the HSRG implementation framework is critical to achieving meaningful and sustained reform, and to optimizing long-term management. In addition to its scientific underpinnings, this framework is also beneficial because it allows managers and their constituents to consider future hatchery reforms and affected fisheries in a quantitative manner. It allows sound scientific principles and standards to be applied using sets of comprehensive parameter values and stated assumptions for individual populations and the ecosystem as a whole. Being able to assess future management scenarios will allow managers and constituents to more easily visualize future options and adapt current

management to achieve greater biological and social benefits while reducing biological and social risks.

Use the Framework to Set Priorities, Guide Project Review, Make Funding Decisions and Determine Return on Investments

The region's hatchery managers should incorporate the HSRG implementation framework into their ongoing hatchery program planning and reviews. This framework is, at this time, the most comprehensive method available to programmatically review hatchery programs and apply the best available scientific information in a methodical and consistent manner.

In its current ESA consultations on each hatchery program, NOAA Fisheries should require assessment of hatchery programs by applying the HSRG standards, tools and data in development of the Hatchery and Genetic Management Plans (HGMPs). HGMPs should also address how each hatchery program incorporates the HSRG's system-wide recommendations. The HSRG tools will allow consultations on hatchery management to be quantitatively integrated into an "all-H" or ecosystem management context along with population effects from hydropower, harvest and habitat. NOAA Fisheries should also fully consider the HSRG's program-specific population reports and recommendations in its reviews with each hatchery operator.

The HSRG encourages the regional hatchery funding entities (the utilities, BPA, Army Corps of Engineers, Bureau of Reclamation, NOAA Fisheries and the USFWS) to uniformly adopt the HSRG framework and system-wide recommendations as a requirement for future funding and accountability of their respective hatchery mitigation or enhancement programs. Similarly, NPCC is encouraged to integrate the HSRG framework and system-wide recommendations into its three-step hatchery planning process, along with previous independent scientific guidance on hatchery programs from the Independent Science Advisory Board and Independent Scientific Review Panel.

Provide Training of Fishery Staff

Adopting the HSRG implementation framework will require immediate training of fishery staff throughout the region. The HSRG encourages the fishery managers, NPCC and program funding entities to sponsor training on use of the HSRG tools.

Perform Regular Programmatic Performance Reviews

Implementation of the HSRG recommendations requires regular, programmatic performance reviews of hatchery programs. Using the HSRG's program-specific

population reports and recommendations would be a useful starting point for future hatchery assessments.

While hatchery operators will need to review programs annually, the HSRG also recommends a regional performance review of hatchery programs that assesses program performance against the managers' goals, the HSRG standards and system-wide recommendations. These reviews could be undertaken at the Columbia Basin "province" level and scheduled so that hatchery programs in each province are publicly reviewed every five years.

The reviews could accomplish necessary oversight for a number of processes, including funding, ESA regulation, consistency with the NPCC's fish and wildlife program, consistency with the US v. Oregon management plan, independent scientific oversight and for public accountability. As part of the scientific oversight, each hatchery program should be rated on its conservation and harvest performance objectives and its adherence to the HSRG system-wide recommendations.

Maintain and Update Data Sets and a Website

An implementation plan, as well as maintaining and updating the current data sets and population reports, is needed to fully realize the substantial benefits of adopting the HSRG framework. The HSRG had to apply many assumptions in its assessment of hatchery programs. As scientific knowledge evolves from ongoing research, these assumptions will need to be documented and changed. The HSRG tools readily allow for such revisions. The HSRG recommends that the hatchery operators make a commitment to maintain and update data sets and analytical tools, and that the hatchery funding entities and NPCC include annual information updates as a component of—and a requirement for—hatchery program funding.

The publicly-accessible website currently housing the HSRG framework (www.hatcheryreform.us), data sets and analytical tools will require a permanent home and long-term funding, which has yet to be secured. This is critical to ensuring that the data sets are up to date. The website must include the HSRG tools and data sets, so that hatchery managers can access them, create and update population reports, and make the reports available to the funding entities, NOAA Fisheries, NPCC and the public. The data sets will also need to be accessible for watershed and mainstem passage planning groups to update critical habitat and passage survival information.

REPORT TO CONGRESS ON COLUMBIA RIVER BASIN HATCHERY REFORM

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