



Foundation for Hatchery Reform

Early in the project's first year (2000), the Hatchery Scientific Review Group (HSRG) agreed that hatchery programs should no longer be seen as surrogates for lost habitat. Instead, hatchery programs must be viewed as tools that can be managed as part of an integrated strategy to meet watershed or regional resource goals, in concert with actions affecting habitat, harvest rates, water allocation and other factors. Using the best available science, and having considered the benefits and risks to all stocks that will result, a hatchery program should be conducted only if it is deemed the best available tool for achieving those goals.

To scientifically evaluate the hatcheries in Puget Sound and the coast in this new context, the scientists recognized the need for a scientific foundation for their work, a method for updating this foundation, and tools and resources for conducting and evaluation of the Puget Sound and coastal hatchery system. This chapter summarizes the *Scientific Framework for the Artificial Propagation of Salmon and Steelhead*, the emerging issues papers, and the HSRG's research program. The complete framework, all the emerging issues papers, details of funded grants, and the tools used in the regional review process are found in the appendices.

SCIENTIFIC FRAMEWORK

The scientific framework was first published in December 2000, after review by over 200 scientists and stakeholders, and before the rest of the review tools were developed and the regional review process began. The framework was periodically updated throughout the review process to include new information as it became available. Over the last year, this framework was reorganized in order to better serve as a blueprint for achieving scientifically defensible hatchery programs (Principle 2).⁷

The scientific framework forms the basis for all of the HSRG's tools, processes and recommendations and organizes the current state of knowledge, about how actions associated with hatcheries affect the environment and fishery resources, around six key topics:

1. Hatchery Programs: Definitions of Purpose and Type;
2. Hatcheries in the Ecosystem Context: The Regional Approach;
3. Hatcheries in the Populations/Species Context;
4. Effects of Hatchery Operations on Harvest and Conservation of the Target Stock;
5. Effects of Hatchery Fish on Harvest and Conservation of Other Stocks and Species; and
6. Monitoring and Evaluation: Managing Hatchery Programs for Accountability and Success.

⁷ See *Applied Hatchery Reform* chapter, *Principles and System-wide Recommendations* section.



1. Purpose and Type

The HSRG has concluded that each hatchery program must explicitly define its strategies in terms of: a) the purpose or desired benefits to be derived from the program; and b) the type of program desired, relative to the genetic management goals for the broodstock and naturally spawning populations. These purposes and types provide the starting point for evaluating the benefits and risks of a specific hatchery program. Each hatchery program must first define its goals in terms of purpose and type before subsequent program components can be developed or evaluated.

The HSRG recognizes two primary purposes or potential benefits of hatchery programs: 1) help conserve naturally spawning populations, and 2) provide fish for harvest. Many hatchery programs are designed to provide both harvest and conservation benefits. Other purposes of hatchery programs include scientific research, education, and providing cultural benefits, particularly for American Indian tribes.

Hatchery programs for Pacific salmon and steelhead can be classified as either “integrated” or “segregated” based on the genetic management goals and protocols for propagating a hatchery broodstock. Hatchery programs are classified as genetically *integrated* if a principal goal is to minimize potential genetic divergence between the hatchery broodstock and a naturally-spawning population such that natural-origin fish are systematically included in the broodstock each year or generation. Hatchery programs are classified as genetically *segregated* if the broodstock is propagated as a reproductively distinct population primarily, if not exclusively, from adult returns back to the hatchery. In segregated programs, little or no gene flow should occur from a naturally spawning population to the hatchery broodstock.

In the context of managing salmon and steelhead hatcheries, all programs need to identify their broodstocks goal as either genetically integrated or segregated relative to naturally spawning populations. The choice of broodstock goal defines operational guidelines by which each hatchery programs can be evaluated. Successful hatchery programs must conform closely to the guidelines specified by a properly integrated or properly segregated program; no individual hatchery program can be both or intermediate without imposing significant genetic risks to naturally spawning populations.

2. Hatchery Programs in the Ecosystem Context: The Regional Approach

Hatcheries can no longer be regarded as surrogates for lost habitat. In operating hatcheries, consideration must be given not only to the receiving habitat in which they operate but also to the naturally-spawning and hatchery-propagated fish that depend on the existing habitat. In addition, hatcheries must take into account the programs of other hatcheries occurring in the same watershed or region. Only in this way will adverse interactions between salmonid stocks in the watershed or region be minimized.

This chapter outlines how to review hatchery programs in Puget Sound and coastal Washington using a regional approach, taking into account the nature of the watersheds in which the programs



occur and the goals for naturally spawning populations and the individual programs set by the regional managers. Each watershed or region differs significantly in the quality and quantity of habitat, the status of its salmonid stocks, the goals set for each stock by the managers, and the purposes of the region's hatchery programs.

3. Hatchery Programs in the Species/Population Context

Hatchery populations of salmonids are subject to many of the same biological processes as their naturally-spawning counterparts. This chapter outlines how these biological processes shape the biological significance and viability of both hatchery and naturally-spawning populations. Assessment of the biological significance and viability of salmonid populations provides an important benchmark for developing both long- and short-term goals and management strategies for a particular population or stock. In the case of integrated hatchery programs, where the management strategy is to maintain hatchery broodstocks as similar as possible genetically to naturally-spawning populations, the combined population (hatchery + wild) shares similar characteristics for biological significance and viability. In the case of segregated hatchery programs, the biological significance is based solely on the composition of the hatchery population, and the viability is linked to the performance of a "hatchery stock" in both the hatchery and natural environments.

4. Effects of Hatchery Operations on Harvest and Conservation of the Propagated Stock

Hatchery operations including broodstock choice and collection, spawning, incubation and rearing protocols as well as the hatchery environment in which fish are reared can affect the short and long-term survival and behavior of the stock that is the target of hatchery propagation. These operations can affect the achievement of harvest goals as well as the goals for biological significance and viability of the target stock. This is true whether the target stock represents only the hatchery stock as in segregated programs or represents a component of the natural stock, as in integrated programs. This chapter describes how hatchery operations can have both long-term genetic effects and short-term, non-genetic effects on the target population.

5. Effects of Hatchery Fish on Harvest and Conservation of Other Stocks and Species

Depending on the number, size, location and other release factors, hatchery fish may directly or indirectly affect other stocks and species through genetic or ecological interactions. The presence of hatchery fish may also alter fishing patterns and thereby affect harvest rates on naturally produced stocks. This chapter describes these potential effects and identifies management actions that can help alleviate adverse impacts.



6. Monitoring and Evaluation: Managing Hatchery Programs for Accountability and Success

Today's salmon and steelhead hatcheries are called upon to help meet conservation, harvest, and/or other goals (e.g., education, research, cultural and ceremonial needs, and indicator stocks), while minimizing adverse impacts on natural-origin salmonids within the watersheds or regions in which they operate. To be successful at meeting these goals, accountability for decisions and actions is required at all levels within the agencies responsible for management and operation of hatcheries. Success will also require an accurate and timely management information system that can measure benefits, evaluate actions, and provide information for hatchery management and operations. This chapter outlines a monitoring and evaluation approach to help ensure accountability and success of hatchery programs.



EMERGING ISSUES IN HATCHERY REFORM

The HSRG—recognizing that the scientific framework needs to be a “living document” that is regularly updated to include new information and issues not identified in its original drafting—decided that significant revisions to the scientific framework should be derived – not just from new published scientific literature – but also from “emerging issue” papers authored by the HSRG or its individuals members. These papers can be as simple as a few paragraphs or as detailed as an essay for a peer-reviewed journal. They are presented collectively in Appendix B under the title Emerging Issues in Hatchery Reform. The HSRG welcomes feedback on these “emerging issues.” They are incorporated into the framework once they have been reviewed and refined. Several that have been incorporated to date remain in this chapter as well, to highlight their importance.

These emerging issues papers also relate to two other key elements of the Hatchery Reform Project. They are tied to the hatchery reform research program⁸ because they discuss topics that reflect recently available scientific information or an emerging principle derived from the collation of old and new information. In addition, they are tied to the three principles of hatchery reform⁹ because developing scientific knowledge in these areas will support hatchery operation and management in the context of well-defined goals, scientifically defensible programs, and informed decision making.

In keeping with their status as “emerging issues,” it is important to keep in mind that all of these papers are “works in progress,” to be revised as new information comes to light on the issues at hand. They are not to be considered definitive, exhaustive and/or final statements on their respective topics, although some of them may form the basis for publications in the scientific literature if they so warrant.

The current list of emerging issues papers includes:

MANAGEMENT GOALS FOR HATCHERY BROODSTOCKS: GENETIC INTEGRATION VERSUS SEGREGATION	B-3
USING HATCHERY SALMON CARCASSES FOR NUTRIFICATION OF FRESHWATER ECOSYSTEMS WHILE REDUCING ASSOCIATED FISH HEALTH RISKS.	B-28
HATCHERY SMOLT QUALITY AND ACHIEVING THE WILD SALMON TEMPLATE	B-30
BENEFITS OF HATCHERY FISH AS A SOURCE OF FOOD.....	B-39
MARINE CARRYING CAPACITY	B-41
OUTPLANTING AND NET PEN RELEASE OF HATCHERY-ORIGIN FISH.....	B-44
ASSESSING THE POTENTIAL FOR PREDATION ON WILD SALMONID FRY BY HATCHERY-REARED SALMONIDS IN WASHINGTON.....	B-51
USING ACCLIMATION PONDS IN THE REARING OF SALMON	B-68

⁸ See Research Program in Applied Hatchery Reform chapter.

⁹ See Principles and System-Wide Recommendations in Applied Hatchery Reform chapter.



RESEARCH GRANTS PROGRAM

The ability to fully achieve hatchery reform goals is compromised by lack of scientific certainty on many subjects. To reduce this uncertainty, the HSRG developed a competitive grant program to fund scientific research projects that could provide new scientific information in support of the goals of hatchery reform in Puget Sound and coastal Washington. This chapter provides a description of the research grant program. A summary of each research project funded by the HSRG can be found in Appendix H.

The HSRG established the following procedures for administering this grant program:

1. The Washington State Interagency Commission for Outdoor Recreation (IAC) shall be the administrative agency for the grant program.
2. The steps involved in the grant program each fiscal year could include:
 - a. The HSRG will issue a Request for Pre-Proposals.
 - b. Pre-Proposals received will be reviewed and evaluated by the HSRG. Applicants with pre-proposals selected for further consideration will be asked to prepare full proposals.
 - c. Full proposals will be reviewed and evaluated by the HSRG. External ad hoc reviewers with scientific expertise complementary to the HSRG may be solicited to assist the HSRG with their reviews of specific proposals.
 - d. The HSRG will inform applicants whether their proposal was accepted.
 - e. Funds will be disbursed by IAC to accepted research proposals.
 - f. Progress reports and final reports will be provided to the HSRG by funded researchers.
3. The HSRG will use its Scientific Framework for Artificial Propagation of Salmon and Steelhead (Scientific Framework) to identify research needs. Innovative research in other areas of Hatchery Reform will also be considered.
4. Proposals will be judged—using a standardized evaluation system—based on scientific merit, the qualifications of the investigators, ability to provide quantifiable results and the potential to achieve results applicable to hatchery reform goals. Preference will also be given to projects that show collaboration among researchers and agencies.
5. To avoid conflicts of interest, agency members of the HSRG will participate in discussion of proposals sponsored by their respective agencies but will excuse themselves from final voting to avoid potential conflicts of interest.
6. Written progress and annual/final reports are required of all funded projects. In addition, an oral presentation describing the project and its progress is required each year. The presentations are given each year (January/February) and open to the public.



7. Multiple-year projects are encouraged, but funds will only be awarded on a year-to-year basis. Successful grants from the previous year must submit pre-proposals to be considered for a second year of funding.
8. Although the HSRG respects and understands the need for protecting the intellectual property contained in research proposals, Washington state law requires that materials submitted in response to this grant announcement shall become the property of the IAC and shall be deemed public records.
9. Applications approved for funding will be required to sign a Project Agreement that incorporates the full proposal, negotiated parameters and any required federal terms and conditions as appropriate.

The HSRG has awarded over two million dollars in research funds to help answer questions such as how to reduce harvest on natural-origin fish, how to avoid adverse genetic effects of hatchery fish on natural-origin stocks, how to avoid adverse ecological interactions, how to improve hatchery practices, and how to monitor and measure success. Grantees have reported back to the HSRG at annual research review meetings and they are making good progress. But there are many questions left to answer and a number of projects that will take several years to provide useful findings.

During HSRG meetings in the early part of each year, research proposals have been evaluated by the group, with projects receiving funding being divided into four general categories for prioritized research: A) Sustainable Fisheries; B) Recovery and Conservation of Naturally Spawning Populations; C) Improvement in Quality and Cost-effectiveness of Hatchery Programs; and D) Protection of Genetic Resources. A list of funded projects is included as Table 1 with details provided in Appendix H.

TABLE 1: Summary of Research Grants

Year Funded	Project Description ¹⁰	Principal Investigators ¹¹
Category A: Sustainable Fisheries		
2000, 2001	1. Development of Field Methods to Determine the Effects of Hatchery Release Methods on Residualism and Interactions Between Hatchery and Wild Juvenile Salmonids in Relation to Stream Carrying Capacity	Howard Fuss, WDFW; Stephen Riley, NOAA Fisheries

¹⁰ Multiple year projects list the most recent title.

¹¹ Multiple year projects list the most recent Principle Investigator(s).

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2000, 2001	2. Test Commercial Selective Harvest Gears	Geraldine VanderHaegen, WDFW
2000	3. Impacts of Size Selective Gillnet Fisheries on Puget Sound Coho Salmon Populations	Curtis Knudsen, Craig Busack, WDFW
2001, 2002, 2003	4. Salmon Marine Trophic Demand-Distribution	David Beauchamp, UW
Category B: Recover and Conserve Natural Spawning Populations		
2000	1. Genetic Characterization of Lake Ozette Sockeye Salmon	Ken Currens, NWIFC; Jim Shaklee, WDFW; Michael Crewson, Makah Tribe
2000	2. White River Acclimation Pond Evaluation	Chuck Baranski,WDFW; Blake Smith, Puyallup Tribe; Richard Johnson, Muckleshoot Tribe
2000, 2001, 2002, 2003	3. Differences in Natural Production between Hatchery and Wild Coho Salmon	Howard Fuss, WDFW; Michael Ford, NMFS
2000, 2001, 2002, 2003	4. Snow Creek Coho Recovery Program	Steve Schroder, WDFW
2000, 2001, 2002, 2003	5. Hamma Hamma River Steelhead Supplementation Evaluation	Barry Berejikian, NOAA Fisheries
Category C: Improve Quality and Cost-Effectiveness of Hatchery Programs		
2000, 2001, 2002, 2003	1. Development of Engineered Streams for Salmon Production	Ernest Brannon, UI
2000, 2001, 2002, 2003	2. Increase Post-Release Survival by Rearing Coho with NATURES Semi-Natural Raceway Habitat	Desmond Maynard, NOAA Fisheries
2000	3. Using Semi-Natural Rearing Habitat to Improve Smolt-Adult Survival of Chinook Salmon	Geraldine VanderHaegen, WDFW; Bill St. Jean, Nisqually Tribe



2001	4. Development of BKD Vaccine	Jed Varney, WDFW
2001	5. Nature vs. Nurture: Do Hatchery Practices Impair Brain Development?	Penny Swanson, NOAA Fisheries
Category D: Protect Genetic Resources		
2000, 2001	1. Interactions between Wild and Hatchery Steelhead: Evaluating Key Assumptions	Thomas Quinn, UW
2001	2. Residualism in Wild Broodstock Steelhead	Cameron Sharpe, WDFW
2001	3. Olfactory Imprinting in Hatchery Salmon	Andrew Dittman, NOAA Fisheries

Hatchery Research Agenda

After three years of administering this program and working to develop program-specific recommendations for 10 regions and over 200 hatchery programs throughout Puget Sound and the Washington coast, the HSRG has concluded that a research agenda must be established to guide funding for applied hatchery research in the Pacific Northwest. Hatchery research answering specific unknowns and that can be directly applied to better, more informed decision making will be essential to the long-term success of hatchery reform.

Hatchery programs must be operated to adapt to changes in the status of naturally spawning stocks, carrying capacity of the receiving waters, ocean productivity and harvest demands. Hatchery research is needed to reduce uncertainty and better evaluate the risks and benefits from hatchery practices. Additionally, new information is required to further understand the impacts of hatchery programs on natural-origin salmonids and on the environment within the watersheds or regions in which they operate.

The development of this agenda will require collaboration among states, institutions and disciplines. The HSRG is developing a proposal for an Applied Hatchery Research Agenda that builds on the outcomes of the HSRG Research Grant Program, uncertainties identified in the development of the HSRG’s scientific framework and operational guidelines, and the findings from the three-year regional review process.