APRE

Artificial Production Review and Evaluation

FINAL
Basin-Level Report

Northwest Power and Conservation Council

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Executive Summary

This report summarizes the results and conclusions of the Artificial Production Review and Evaluation (APRE) conducted by the Northwest Power and Conservation Council (Council) in response to a request from Congress to review all federally funded hatchery programs in the Columbia River Basin. The goal of the review is to develop coordinated policies for the use of artificial production in the Basin.

Interest in a comprehensive review of artificial production in the Basin stems from scientific and policy concerns about the success of artificial production programs and how they affect other aspects of fisheries management. Despite the fact that artificial production has occurred in the Pacific Northwest for over 100 years, a comprehensive evaluation of the programs has not been undertaken. The APRE partially addresses this deficiency by conducting an in-depth evaluation of 225 individual salmonid hatchery programs within the U.S. portion of the Columbia River Basin. The results of the review are expected to provide a basis for regional fisheries planning efforts by all parties involved in Pacific Northwest hatcheries. Discussions of the future of hatcheries and identification of the benefits and risks of hatchery practices should also occur as a result of the review and evaluation.

Hatcheries in the Columbia River Basin were established originally to maintain commercially harvestable numbers of salmon. Within the past few decades, however, the focus of restoration has turned more toward supplementation of wild populations. The passage of the Endangered Species Act of 1973 and changing public perceptions about the importance and use of salmon have had great influences on the purpose of hatcheries.

For each hatchery program in the Basin, APRE identified the program's purpose, the extent to which the program is meeting that purpose (benefit), and considered the potential for negative impacts on other purposes and priorities (risk). The review process was based on the hatchery review developed by the Hatchery Scientific Review Group (HSRG) in Washington State. Questionnaires which collected information on hatchery goals and operations from hatchery managers and operators were developed and the responses entered into a database (www.apre.info). The responses were evaluated against the APRE working hypothesis which states that: a) to be successful, a hatchery program must be internally consistent with its own stated purpose and externally consistent with the goals and priorities of the environment, including other potentially affected fish populations; and b) almost any human intervention to manipulate the environment poses some level of risk to the existing environment and species. A hatchery program was judged to be successful if it met the following four major conditions:

1. It must produce a healthy and viable hatchery population.
2. It must make a sustainable contribution of adult returns to conservation and/or harvest.
3. Its potential effects on wild and native populations and the environment must be understood.
4. It must collect, record, evaluate, and disseminate information pertaining to the first three conditions so that decision-makers may be informed about the benefits and risks

of the program relative to other means of achieving similar conservation and harvest goals.

The information database is intended to form the foundation for continuing consideration of artificial production in the Basin. The individual program reports contain a summary of facility information including operator, funding sources, and overall performance. The database is designed to be updated as new information becomes available and hatchery reforms are enacted.

The results of the APRE are examined in 6 major categories: fish stocks, hatchery operations, distribution of hatchery releases, hatchery goals and purposes, funding, and monitoring and evaluation.

- *Fish Stocks*: The study identified 512 fish stocks of which 250 were natural stocks and 262 were hatchery stocks. Of the hatchery stocks identified, 174 were anadromous salmonid programs, 66 were resident salmonid programs and 23 non-salmonid programs. The largest portion of stocks was found in the Lower Columbia province.
- *Hatchery Operation*: About half of the anadromous salmonid hatchery programs in the Lower Columbia are segregated; most in the upper river are integrated programs.
- *Hatchery Practices*: Many segregated hatchery programs contribute significantly to wild spawning populations, despite the intention to separate hatchery and wild fish. The amount of mixing was unknown in a third of segregated programs. In addition, 31 percent used non-local broodstock and 75 percent transferred in fish from outside the basin or released fish outside the stream system. In contrast, 93 percent of integrated programs used broodstock derived from within the subbasin and 92 percent avoided transfers from outside the basin or avoided releasing fish outside the stream system.
- *Distribution of Hatchery Releases*: Hatchery managers reported planned, as opposed to actual, releases of 172,162,986 juvenile fish of all species in the U.S. portion of the Columbia River Basin. Of these releases, 156,737,635 fish are planned releases of anadromous salmonids below the fish passage barriers at the Chief Joseph and Hells Canyon dams. The largest proportion (50 percent) occurs in the Lower Columbia provinces to provide fish for the ocean and lower river commercial fisheries.
- *Goals and Purpose*: For anadromous salmonids, harvest remains the primary purpose for hatchery programs in the Columbia River Basin.
- *Funding*: Identification of hatchery funding is a complex issue because most programs are funded from a variety of direct and indirect sources. The Lower Columbia Province has the most funding because it has the majority of programs.
- *Monitoring and Evaluation*: Monitoring and evaluation consists primarily of reports of typical fish statistics such as number of recruits per spawner, smolt-to-adult survival, escapement, and total catch. Even so, many programs did not collect information for any of these categories. Information for anadromous salmonid programs regarding the number of recruits per spawner collected was available for less than 10 percent of programs, smolt-to-adult survival data was available for 53 percent of the programs,

23 percent of programs had data for escapement and 35 percent of programs had catch data.

The APRE was designed to address concerns that the Columbia River Basin hatchery system needed to be reformed. The study applied hatchery reform principles developed by the HSRG to the information received from the fishery and hatchery managers. These principles included the following:

- Goals for stocks affected by hatcheries must be clearly articulated, expressed in terms of resource values, and reflective of current biological, economic, and cultural circumstances.
- Hatchery programs must be scientifically defensible.
- Decision-making about hatchery programming and operations must be responsive and well-informed.

When these principles were applied, a number of questions arose about artificial production within the Basin. These questions explored such issues as whether or not hatchery programs can be used more strategically to better accommodate ecological and social goals and how many hatchery fish should be released each year. Broad answers to these questions were formulated and used to arrive at the general conclusions of the study:

- Hatcheries are limited in what they can accomplish.
- The social, economic, and ecological purposes upon which the current hatchery programs were established have changed and will continue to change.
- Hatcheries will continue to play a part in recovery and management of fish in the Columbia River and elsewhere.
- Hatcheries require reform to align their policies and practices with current social priorities and scientific knowledge, to determine hatchery performance, and to operate in a business-like fashion.

This document will be the basis for an issues paper which will delineate the Council's approach to hatchery reform. Both the Basin-Level report and the issues paper will contribute to a Report to Congress.

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Acronyms and Abbreviations

APRE	Artificial Production Review and Evaluation
BPA	Bonneville Power Administration
CRFMP	Columbia River Fish Management Plan
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FERC	Federal Energy Regulatory Commission
HGMP	Hatchery and Genetic Management Plan
HSRG	Hatchery Scientific Review Group
IHOT	Integrated Hatchery Operations Team
ISAB	Independent Scientific Advisory Board
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NWPCC	Northwest Power and Conservation Council (formerly NWPPC)
NWPPC	Northwest Power Planning Council (former name of the NWPCC)
OFWC	Oregon Fish and Wildlife Commission
PFMC	Pacific Fishery Management Council
PST	Pacific Salmon Treaty
PUD	Public Utility District
SRT	Scientific Review Team
WDFW	Washington Department of Fish and Wildlife

Glossary

Adaptive Management	A scientific policy that seeks to improve management of biological resources, particularly in areas of scientific uncertainty, by viewing program actions as vehicles for learning. Projects are designed and implemented as experiments so that even if they fail, they provide useful information for future actions. Monitoring and evaluation are emphasized so that the interaction of the system's various elements are better understood.
Adipose fin	a small, fatty, fin-shaped projection behind the dorsal fin of certain fishes, such as trout and salmon, that lacks supporting rays
Anadromous	indicates fish which hatch in fresh water, spend part of their lives in salt water, and return to fresh water to spawn
Artificial Production	the concept of using artificial habitats to enhance the survival of one or more fish life stages with the intent of increasing the abundance of a fish population. In the case of APRE, the fish are species of salmon and trout (*Oncorhynchus spp.)*
Escapement	the number of salmon returning to the spawning beds
Fingerling	juvenile salmonids approximately the size of a finger (usually less than a year in age)
Fry	newly hatched fish generally less than an inch long
Hatcheries	facilities containing raceways, ponds, and incubators that form artificial fish habitats for fish
Hatchery Program	the release of a fish of a particular species or race, e.g., spring Chinook salmon, at a location within a subbasin or along the mainstem of the Columbia River
Heritable	that which can be inherited

Salmonid	fish in the family *Salmonidae,* especially the genera *Oncorhynchus* and *Salmo,* which include salmon and trout
Smolt	the seaward migrating stage of anadromous salmonids
Stock	a group of fishes, often a population, that is believed to constitute a unique genetic fishery resource
Subbasin	a major watershed that is a tributary to the mainstem Columbia River or the Snake River, e.g., the Yakima River
Terminal Fisheries	Fisheries which occur off the main river channel, in estuaries, or in tributaries and which are designed geographically to focus the harvest on those species or stocks that originated from the fishing area

Chapter I: Purpose of the APRE

I.A Introduction

This report summarizes the results and conclusions of the *Artificial Production Review and Evaluation* (APRE) conducted by the Northwest Power and Conservation Council. In this review, the Council is responding to a Congressional request[1] to review all federally funded hatchery programs in the Columbia River Basin (Figures I-1 and I-2) and to develop a set of coordinated policies for the use of artificial production in the Basin. Congress also requested that the operations goals and principles of State, tribal, and federal hatcheries be reviewed.

It should be noted that, though the APRE was initiated because of concerns that there are "problems" with hatcheries within the Columbia River Basin, many hatchery managers and operators have been striving in recent years to improve hatchery programs and operations. APRE was structured to objectively obtain data which would identify successes as well as problem areas. However, as with all human endeavors, the problems always get more attention than the programs which have well-defined and appropriate goals and are making progress toward achieving those goals. Hatchery program "successes" are invaluable and can serve as examples of the environmental, social, and economic benefits that can be achieved by hatcheries.

Reformation of artificial production with the Columbia River Basin is a task that must be entered into thoughtfully and deliberately in order to achieve the greatest good in the most cost effective manner. Some programs will require very little change, some will require more. Tailoring strategies for each program will be the product of continued discussion with agencies, owners, managers, and other interested parties. This report represents the first step in determining what those changes might be; it is an examination and analysis of hatchery data and information received through interviews and questionnaires (Chapter III and Chapter IV). Conclusions based on those data are drawn (Chapter V). The next step in the process is to define a set of issues related to hatchery reform. An implementation plan setting forth the details of the types of changes that may be needed and how those changes can be applied to individual programs will follow development of the issues.

The Northwest Power and Conservation Council (formerly known as the Northwest Power Planning Council) was established under the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Northwest Power Act) to, among other things, create a program to "protect, mitigate and enhance" fish and wildlife in the Columbia River Basin affected by development and operation of the Columbia River hydroelectric system. The Council**,** through its Fish and Wildlife Program (Northwest Power Planning Council 2000), recommends funding of projects by the Bonneville Power Administration (BPA) including construction and operation of several hatcheries for salmon, trout, and other species. The program lays out Basin-level policies for the use of artificial production and establishes an overall role for hatcheries consistent with the Council's vision for restoration of fish populations in the Columbia River. In addition, the Council has recognized the influence of artificial production on the success of

[1] U.S. Senate Energy and Water Development Appropriation Bill, 1998, Report 105-44.

many aspects of its program and has spearheaded several efforts to coordinate the management of artificial production in the Columbia River.

Congressional and Council interest in a review of artificial production stems from scientific and policy concerns about the success of artificial production programs and how artificial production may affect other aspects of fisheries management. Artificial production of salmon and trout has been used in the Pacific Northwest to enhance fish populations for well over 100 years (Bottom 1997). Despite the lengthy use of artificial production, the National Research Council concluded that hatcheries had not been evaluated over the long term and that consequently their success or failure has not been demonstrated (National Research Council 1996).

The APRE partially addressed these concerns by conducting an in-depth evaluation of 225 individual salmonid hatchery programs throughout the U.S. portion of the Columbia River Basin. The review was designed to evaluate benefits and risks of hatchery programs based on responses to a set of structured questions posed to hatchery operators and managers. APRE cannot substitute for the kind of long-term scientific evaluation advocated by the National Research Council (NRC) and others; however, the results should provoke thoughtful consideration of the future purpose and role of hatcheries in the Columbia River Basin and identify hatchery practices that contribute to the benefits and risks of hatcheries. It should also provide a basis for regional fisheries planning efforts by the Council and federal, state, and tribal management agencies.

In the July 1998 request from Congress, the Council was directed to recommend a coordinated policy for future operation of artificial production programs and to describe a process for developing policies in the future. Congress directed the Council to conduct its review with the assistance of the Independent Scientific Advisory Board (ISAB), a panel of 11 scientists who advise the Council and National Oceanic and Atmospheric Administration-Fisheries (NOAA Fisheries) on scientific issues related to fish and wildlife in the Columbia River Basin.

The Council, in coordination with the ISAB, appointed a Scientific Review Team (SRT) of experts in artificial production to provide an independent assessment of artificial production in the Columbia River Basin. In April 1999, the SRT submitted its review of scientific issues to the Council (Brannon et al. 1999). The Council also conducted an extensive public review of the team's conclusions that included input and comment from hatchery managers, tribes, environmental groups, recreational fishers, and others. The Council appointed a Production Review Committee to coordinate the artificial production review and assist it in developing artificial production policies. The Council also conducted public workshops and numerous public meetings to discuss artificial production, explain progress on the review, and to receive public comment.

The result of these efforts were collected into the Council's initial report to Congress (Northwest Power Planning Council 1999). In that report, the Council provided Congress with a set of artificial production principles and policies intended to "guide decisions on the use of artificial production for specifically defined purposes, based on scientific and management principles…" The Council included a set of science-based statements that form its policy on the

Figure I-1. Columbia River Basin

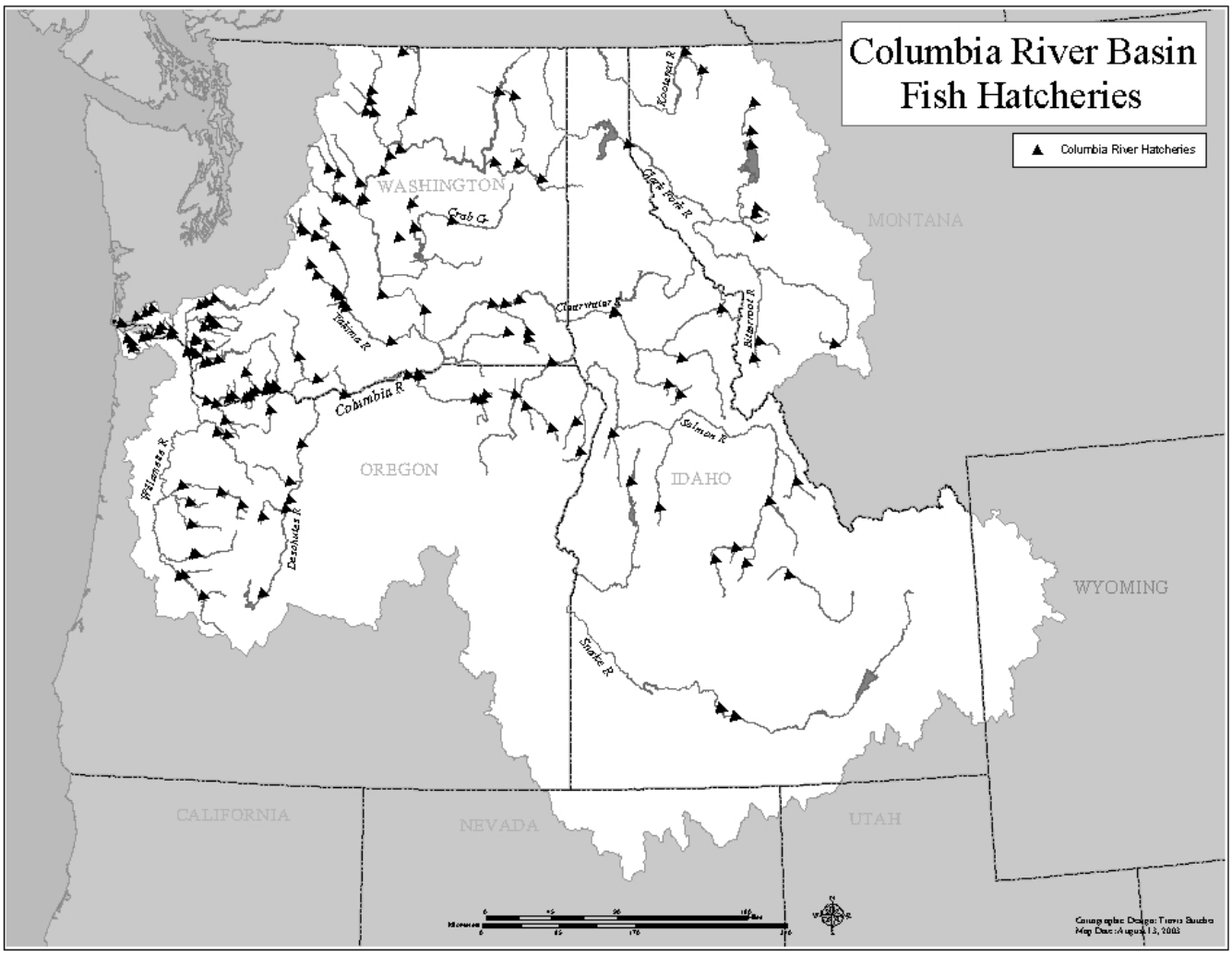


Figure I-2. Hatcheries within the U.S. portion of the Columbia River Basin

use of artificial production. These policies place artificial production in the context of the Columbia River natural-cultural ecosystem and recognize that use of hatcheries represent a social policy guided by scientific knowledge. The Council's artificial production principles and policies also provided a framework for organizing the purposes of artificial production programs.

The Council's report described a process for implementing hatchery reform in the Columbia River Basin. This procedure relies on the Council's fish and wildlife program amendment process, including subbasin planning (see below and Section I.E), as the means to define the use of future artificial production in the region. To move its proposals forward, the Council recommended to Congress the following six actions for implementing hatchery reform:

1. Identify the purposes for all artificial production facilities and programs and review these purposes relative to the Council's artificial production principles and policies

2. Evaluate the purposes of artificial production facilities and programs through fish and wildlife planning processes such as the Council's subbasin planning process
3. Use existing processes to implement artificial production reforms based on the Council's artificial production principles and policies
4. Ensure that funding is available to implement the Council's artificial production principles and policies
5. Form an *ad hoc* team to oversee the implementation of hatchery reforms consistent with the Council's artificial production principles and policies
6. Assess the success of the recommended reforms after five years.

APRE was the next step in the Council's artificial production review process and was prepared in response to the first of the Council's implementation recommendations. It identified the goals for each hatchery program and evaluated the benefits and risks of current operations compared to existing criteria derived from other regional artificial production reviews. The programs were reviewed in terms of their contribution to these purposes and their potential to adversely affect other priorities identified in the Council's goals and principles. Evaluation of the appropriateness of the purpose for each program was left to planning processes such as subbasin planning.

Subbasin plans will be developed as part of the Council's Fish and Wildlife Program. These plans are being developed for each of the 62 subbasins in the U.S. portion of the Columbia River Basin. They will be used as recommendations to the Council for funding priorities within the subbasins.

Recovery plans will be developed by the federal agencies responsible for fish populations listed under the Endangered Species Act (ESA). Recovery plans for anadromous salmonids will be developed by NOAA Fisheries while those for resident salmonids and sturgeon will be developed by the U.S. Fish and Wildlife Service. These plans, which are being developed concurrently with the subbasin plans, will delineate the relationship between ESA-listed populations and hatchery programs through Hatchery and Genetic Management Plans (HGMPs). All hatchery programs will eventually have an HGMP. The HGMPs will prescribe how individual hatchery operations will be conducted to minimize impacts on ESA-listed populations and/or contribute to their conservation and recovery. The Council and the federal managers are working together to coordinate activities and avoid duplicative planning processes. For this reason, the APRE was structured to also provide the basis for development of HGMPs. APRE will produce partial draft HGMPs that will be revised through the federal process. Note that USFWS has chosen not to use APRE to develop its HGMPs.

The Council's APRE has benefited from other reviews of artificial production, particularly the ongoing review in Washington State. That Congressionally mandated review has evaluated hatcheries in Puget Sound and on the Washington coast. The Washington review has been led by the Hatchery Scientific Review Group (HSRG), which is composed of independent scientists familiar with artificial production issues. The HSRG developed guidelines for hatchery reform and has successfully used them to evaluate a variety of hatchery programs in Puget Sound and on the Washington coast. The Columbia River APRE built on the work of the Washington

State HSRG and has employed the HSRG guidelines to evaluate hatchery practices in the Columbia River (Section III.B).

In addition, APRE drew on the work of the Council's Integrated Hatchery Operations Team (IHOT) in the Columbia River Basin. IHOT developed and implemented hatchery review procedures to audit most hatcheries in the Basin.

I.B Need for Review of Artificial Production

Artificial production of anadromous and resident salmonids is a fisheries management technique that has been used throughout the Columbia River Basin and the Pacific Northwest for over 100 years (Chapter II.) Hatcheries were initially used as a means to produce fish for harvest and avoid restrictive harvest regulations. Later, hatcheries were constructed in the hope that abundance and harvest rates could be maintained even as dams and other activities degraded and eliminated freshwater habitat (Bottom 1997). Hatcheries have proliferated throughout the Basin and returns of adult fish to hatcheries and fisheries in the Columbia River now greatly exceed the return of naturally spawning fish. Arguably, hatcheries have allowed continuation of commercial and sport harvest of salmon and trout in the face of widespread environmental degradation.

Now, however, the use of hatcheries is being reassessed. Over the past several years, reviews of Columbia River hatcheries have questioned the scientific basis for current programs and uniformly concluded that change is needed, e.g. National Research Council 1996, Brannon et al. 1999, and Independent Scientific Group 2000. Many hatchery programs were developed under an agricultural conceptual foundation in which hatcheries selected for domesticated traits and isolated fish from the perceived inefficiencies of the natural world (Bottom 1997). This view is inconsistent with prevailing scientific concepts of ecosystems and species functions, and many scientific reviewers have called for a new conceptual foundation for fisheries management (Brannon et al.1999, Independent Scientific Group 2000). The National Research Council (1996) noted that the scientific basis for artificial production is not clear and that adverse impacts from artificial production can occur. They went on to say that "Most artificial production programs have not undertaken long-term evaluation and documentation of the extent to which intended goals were reached (e.g., increase the catch for a given population, prevent extinction of populations whose spawning grounds were destroyed by dams) and unintended risks were imposed (e.g., adverse genetic or ecological impacts on naturally reproducing fish)." There is great concern about whether or not artificially produced fish adversely affect naturally spawning populations of fish (National Research Council 1996, Flagg et al. 2000).

In addition, the economics of fishing, as well as societal views on the value of natural resources, have shifted since the mid-20th century when many existing hatchery programs were conceived. The role of hatcheries is less certain today (Bottom 1997). The commercial salmon fishing industry is undergoing rapid change, while recreational fishing is assuming a greater priority for fishery managers. Society now attaches intrinsic value to salmon in addition to their commercial value. These considerations dictate the need for a thorough review of artificial production. This is especially important because of the efforts by the Council (through subbasin planning) and the federal agencies (through Endangered Species Act recovery planning) to develop long-term, strategic plans for fisheries management in the Columbia River Basin.

I.C Scope of the APRE

The purpose of the APRE was to evaluate the benefits and risks of current hatchery programs in the U.S. portion of the Columbia River Basin as a foundation for regional planning efforts by the Council, federal managers, and others. A fundamental premise of the APRE was to use information freely provided by the fishery managers. On the basis of such information, the project identified the purposes for hatchery programs and looked at how current hatchery programs are contributing to these purposes. Although information was provided for a variety of native and non-native fish species, the most complete information was provided on anadromous salmonid programs. Because of this, the summary provided in this report focuses on anadromous salmonid programs; however, it is emphasized that information on additional programs is available in the APRE database.

The APRE focused on programs in the U.S. portion of the Columbia River Basin for hatcheries supported by federal, state, tribal, and private funds and which are producing anadromous salmonids. For each hatchery program, the extent to which the program was meeting its stated purpose (benefit) was evaluated along with the extent to which the program may be negatively impacting other populations and priorities (risk). This implies that each hatchery program has a clearly stated purpose, an assumption that was not always valid and which itself forms an important aspect of the evaluation. The evaluation addressed only generally the appropriateness of the purposes of hatchery programs in the present economic, social, and scientific context. These are more properly addressed through the Council's process, including subbasin planning, and through other state, federal and tribal policy processes.

Information on each program was collected through a series of regional workshops using a standardized questionnaire. The questionnaire collected descriptive information on each program, summarized what the managers stated to be the purpose of the program, and described the program's relationship to activities and fish populations within the subbasin. Information has been compiled on a web-based system that provides access to hatchery information providing a resource for hatchery management in the Columbia River Basin. The information base is far from complete due to a lack of basic information about many programs. As information is collected in the future, it can be added to the information base to form a more complete description of ongoing hatchery practices.

I.D APRE Process

The APRE review process was based on the hatchery review developed by HSRG in Washington State and the IHOT process in the Columbia River Basin (Section III.B). This allowed the APRE to build on the extensive scientific and public review process developed in Washington and to use products that had a record of successful use in reviewing similar hatchery programs. The APRE process evaluated information on current hatchery goals and operations in the Columbia River against the HSRG/IHOT criteria that were used to define the APRE working hypothesis.

To establish its review criteria, the HSRG identified requirements which must be met for hatcheries to successfully contribute to harvest and conservation goals. These requirements and their scientific bases were reviewed by more than 200 scientists and stakeholders and ultimately led to the development of guidelines that reflected current scientific knowledge and fish

husbandry practices (HSRG 2002, www.hatcheryreform.org). Based on these guidelines, the HSRG developed a set of questions for its review of Puget Sound and Washington coastal hatcheries. The HSRG review questions, as well as questions from the federal HGMP template and the IHOT review, were used to develop the APRE hatchery questionnaire. The questionnaire collected information on hatchery goals and operations from the hatchery managers and operators. Responses to the questionnaire were collected in a web-accessible database containing the basic evaluation data for the APRE (www.apre.info) and evaluated against the APRE premises (Section III.A).

I.E Organization of the APRE Project

The results of the APRE project have been organized using the ecological framework presented in the Council's Fish and Wildlife Program (Northwest Power Planning Council 2000). This is a hierarchical structure for organizing fish restoration efforts intended to reflect underlying ecological patterns across the Columbia River Basin. The Council's framework organized the Columbia River Basin into ecological *provinces* and *subbasins*. Provinces are groups of subbasins, e.g. the Columbia Plateau, sharing similar climate, geology, and biogeography**,** i.e. similar plant and animal groups. The Council has defined 11 Ecological Provinces within the Columbia River Basin (Figure I-3). These provinces contain 62 individual subbasins. A subbasin is a major watershed that is a tributary to the mainstem Columbia River or Snake River, e.g. the Yakima River. Hatcheries are located within subbasins and hatchery programs (see below) represent releases of fish at a specific location within a subbasin.

This Basin level report contains a synthesis of the APRE conclusions. The Basin level report looks at trends in artificial production across the Council's ecological provinces. It includes results, discussion, and general conclusions from the APRE review to date. Recommendations will be formulated following a public review of the Basin level report. Attached to the Basin level report is a series of Ecological Province reports. These province reports are structured similarly to the Basin level report, but report results across subbasins within each province. Attached to the subbasin reports will be the individual program reports for the hatchery programs in each province. The individual program reports identify the stated purpose for each program and the contribution of the program to these purposes. They also provide an assessment of the current operations of the hatchery contributing to the program relative to prevailing fish cultural practices. These individual program reports, which are intended to be a resource for hatchery managers, are generated from the web-based APRE information system and can be reviewed and updated into the future. They allow comparison of artificial production across subbasins to identify provincial level purposes and highlight similarities and differences between subbasin artificial production programs.

I.F Definitions

The terms defined here are essential to understanding the APRE approach, results, and conclusions. Definitions of additional terms may be found in the Glossary which appears on page xii.

The APRE defines a *hatchery program* as production of a "like" group of fish which spends some portion of its life cycle in a hatchery environment and is released at a location within a subbasin or along the mainstem Columbia River. A hatchery program was identified by species,

Figure I-3. Provinces and Subbasins within the U.S. portion of the Columbia River Basin

stock, and release location. A hatchery facility may contribute to several hatchery programs and a hatchery program may involve more than one hatchery for different rearing phases.

A group of fish delineated by the fishery managers on the basis of management purpose is termed a *stock*. Because of the management implications in this definition, fish are often divided into hatchery and natural stocks. A *population* is a group of fish delineated on the basis of genetic affinity. A population may include both hatchery and natural components if the fish are believed to represent a common evolutionary legacy and have a close genetic relationship. A group of related populations is termed an Evolutionarily Significant Unit (ESU) under the Endangered Species Act (Waples 1995). An ESU is a legal and management notion that draws on the scientific concept of a *metapopulation*, which is a group of local breeding populations which are genetically connected by patterns of migration and straying and which occupy distinct habitat patches.

Two types of programs, integrated and segregated, were recognized in the APRE based on the intended amount of genetic connection to naturally spawning fish. *Integrated* hatchery programs are "open" systems designed to combine hatchery and natural components into a

single stock or population. Integrated programs attempt to minimize the divergence of the hatchery population from its natural counterpart. In an integrated program, the hatchery is viewed as an artificial extension of the natural environment. Brood stock includes progeny from natural and hatchery spawners and the intent is to minimize genetic divergence of the combined natural-hatchery population from the original natural population. Integrated programs are often referred under the general heading supplementation. This term was avoided in the APRE because it was considered to be a less precise term for designating hatchery programs which are integrated with natural populations.

Segregated programs are "closed" systems in which the hatchery is a distinct stock which has minimal interaction with natural population components. Segregated hatchery programs are designed to minimize the genetic interaction of the hatchery population with natural populations. Brood stock in a segregated program typically consist of progeny from adults of the same hatchery. Genetic divergence from natural populations may be allowed and, in some cases, encouraged through selection for traits and behavior.

I.G Next Steps

The hatchery reformation effort will not end with this document. The APRE Basin-Level Report will be used to formulate issues which must be addressed in hatchery reform. The paper will be released for public review and comment. The final issues paper will lead to an implementation plan which will define the ways in which the issues will be addressed by the Council and cooperating groups. Concurrently, the APRE report and issues paper will form the basis for a Report to Congress delineating progress to this point and future actions.

Chapter II: Background

Artificial propagation of Pacific salmon began in 1875 with construction of the McCloud River Hatchery in California. The first hatchery in the Columbia River Basin was built two years later on the Clackamas River. The earliest hatcheries were built to produce salmon for the lucrative salmon canning industry in an effort to avoid a collapse as had occurred with Atlantic salmon on the east coast of the United States. Pacific salmon stocks were showing signs of depletion due to high harvest rates and habitat loss.

The 1930s saw the beginning of the construction of series of large hydroelectric projects in the Columbia River Basin. Hatcheries were built to produce fish in an attempt to mitigate for habitat loss caused by development and operation of the hydroelectric dams. In the past few decades, the role of hatcheries has shifted to conservation of natural populations. Artificially propagated salmon and trout are provided for recreational and tribal use as well as commercial harvest. Captive programs to conserve genetic resources have also been instituted. As science and technology have advanced, culture techniques have evolved, and continue to evolve, in order to reduce risks and maximize benefits to natural habitats and populations.

II.A Legal Framework

Hatcheries are managed by a complex array of treaties, laws, and policies. The legal requirement for artificial production addresses the need to replace or mitigate losses of fish caused by degradation or elimination of habitat as well as to uphold obligations under international and tribal treaties and the Endangered Species Act. Table II-1 summarizes the various mitigation settlements that have resulted in construction and operation of hatcheries in the Columbia River Basin.

Table II-1. Relationships among artificial production programs and the regulatory framework

Artificial Production Program	Establishing Mechanism	Type of Program	Responsible Entity
Columbia River Fishery Development Program	Mitchell Act of 1938	federal dam mitigation	NOAA Fisheries
Lower Snake River Compensation Plan	Water Resources Development Act of 1976	federal dam mitigation	U.S. Fish and Wildlife Service
Grand Coulee Dam Mitigation	Mitchell Act of 1938	federal dam mitigation	U.S. Bureau of Reclamation
Dworshak Dam Mitigation	Flood Control Act of 1962	federal dam mitigation	U.S. Fish and Wildlife Service
John Day Dam Mitigation	Agreement between COE, Oregon and Washington	federal dam mitigation	Mitigation provided at Mitchell Act Facilities
Willamette River Basin Dams Mitigation	River and Harbor Flood Control Act of May 17, 1950	federal dam mitigation	U.S Army Corps of Engineers
Cle Elum, Umatilla, Northeast Oregon, Walla Walla River, Nez Perce Tribal artificial production	Pacific Northwest Electric Power Planning and Conservation Act of 1980	Columbia River Basin Fish and Wildlife	Various tribes, states and federal agencies

programs		Program	
Hells Canyon Project Mitigation	Hells Canyon Settlement Agreement of February 14, 1980	FERC license	Idaho Power Company
North Fork Lewis River Mitigation	FERC licenses	FERC license	PacifiCorp
Condit Dam Mitigation	voluntary	voluntary	PacifiCorp
Bull Run and North Fork Projects Mitigation	FERC licenses	FERC license	Portland General Electric Company and City of Portland
Deschutes River Mitigation	FERC license	FERC license	Portland General Electric Company
Cabinet Gorge Kokanee Hatchery	voluntary	voluntary	Avista Corporation
Wells Dam Mitigation	FERC license	FERC license	Douglas County PUD
Rocky Reach Dam Mitigation	FERC license	FERC license	Chelan County PUD
Priest Rapids and Wanapum Dams Mitigation	FERC license	FERC license	Grant County PUD
Swift II Project Mitigation	FERC license	FERC license	Cowlitz County PUD
Mayfield and Mossyrock Project Mitigation	FERC license	FERC license	Tacoma Public Utilities

Since the beginning of the dam construction era in the 1930s, artificial production in the Columbia River Basin has been tied primarily to mitigation for habitat loss, especially due to the construction of the hydropower system. Large portions of the Columbia River were eliminated from salmon and steelhead production by Grand Coulee (mainstem Columbia River) and Hells Canyon (mainstem Snake River) dams. Other dams have led to the loss of nearly all mainstem spawning habitat in the Columbia River above Bonneville Dam with the exception of the Hanford Reach. Hydropower dams in tributaries such as the Deschutes, Clearwater, Okanogan, White Salmon, Lewis, Cowlitz, and Willamette subbasins also blocked access to important habitat. In an attempt to mitigate for these habitat losses and maintain fish abundance, numerous hatchery programs have been developed.

The first legally mandated artificial production program in the Basin was initiated under the Mitchell Act of 1938. This act provided funding for efforts to address the general decline of harvest and fish populations in the Columbia River Basin resulting from impacts of water diversions, mainstem dams, deforestation, and pollution. It did not, however, tie project funding to fish losses attributable to any specific locations or activities, or to obligations to address the importance of the fish loss to any particular human population. The Mitchell Act (amended) paid for construction of the large production facilities in the Lower Columbia River such as Little White Salmon, Willard, Carson, and Spring Creek hatcheries. The program provides federal funding for hatcheries through the Department of Commerce to the states of Oregon, Washington, and Idaho and the U.S. Fish and Wildlife Service.

The Lower Snake River Compensation Program provides compensation for habitat lost to construction of the four lower Snake River hydroelectric projects. The program, which originally was funded through Congressionally appropriated funds reimbursed by BPA, is now funded by BPA directly and operates 27 hatchery facilities in Idaho, Oregon, and Washington.

Private firms provide mitigation hatcheries as well. Idaho Power Company funds the construction and operation of hatcheries in Idaho to compensate for construction of Hells

Canyon Dam Complex. Public Utility Districts (PUDs) operate dams in the mid-Columbia and in several tributaries and fund mitigation hatcheries which are usually operated under agreements negotiated with the Federal Energy Regulatory Commission (FERC).

One effect of artificial production mitigation activities has been to change the location of fish production in the Columbia River Basin. To compensate for dams that completely block access, it is not possible to provide in-place mitigation. Consequently, salmon mitigation hatcheries have often been located in other areas of the Basin where migration has not been blocked. Many of the largest mitigation hatcheries were constructed when the primary goal was to support the commercial fishing industry off Oregon, Washington, and in the lower Columbia River. Therefore, it made little sense to mid-20th century hatchery planners to locate hatcheries upriver where the fish produced would be subjected to mortalities imposed by the dams. Consequently, many federally funded hatcheries whose purpose was to mitigate for the loss of upriver fish habitat were constructed downstream of Bonneville Dam or in other areas away from where the production was lost. Tribal and non-tribal communities in areas no longer accessible to fish are deprived of resources that were used for religious, cultural, and economic purposes.

This problem is particularly acute for the non-Treaty tribes in the upper Basin near or above the impassible dams for whom salmon were completely denied and who received no benefit from downriver mitigation hatcheries. The four Treaty Tribes below the impassible dams (Yakama, Warm Springs, Umatilla, and Nez Perce) were provided some mitigation from facilities such as the Leavenworth Complex, but for many years, the practice of placing mitigation hatcheries in the lower river limited mitigation benefits to the Treaty Tribes and other upriver interests. To address this issue, a significant number of fish produced at down-river hatcheries are now transported upriver and released. The fish management plan developed as a result of the *U.S. v Oregon* court case was the impetus for the transport of artificially produced fish to upriver release locations. This practice has been on-going since 1980, but is increasingly questioned on biological grounds. With the exception of coho transport, few programs now engage in stock transfers.

The loss of fishing opportunity for the Treaty Indian Tribes in the Columbia River due to habitat loss and management decisions led to court decisions that have radically changed fishery management throughout the Pacific Northwest. In 1969, a federal court determined in *U.S. v Oregon* that the Yakama, Warm Springs, Umatilla, and Nez Perce tribes retained fishing and hunting rights under their treaties and that the states had limited management authority over tribal fishing. The treaties were interpreted to guarantee the tribes 50 percent of the harvest of fish destined for tribal fishing areas and the right of the tribes to the management of their own natural resources. However, mainstem hydroelectric projects, agriculture, and other development have severely eroded the natural capability to support these rights and the tribal fisheries. The tribes have pursued hatchery programs to support their treaty rights and subsistence, ceremonial, and commercial harvests. Several tribally managed hatchery programs have been developed above Bonneville Dam under the Council's Fish and Wildlife Program as hydropower mitigation. The tribes have become leaders in the development of hatchery programs that attempt to be compatible with current scientific information on genetics and ecological processes.

The Endangered Species Act of 1973 was established by Congress with the purpose of providing "a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved [and], to provide a program for the conservation of such endangered species and threatened species…" Threatened and endangered species under the Act have been interpreted to include significant population segments that, for salmonids, have been defined as Evolutionarily Significant Units (Waples 1995). An ESU is a fish population or group of populations that "(1) is substantially reproductively isolated from other conspecific [fish of the same species] population units, and (2) represents an important component in the evolutionary legacy of the species."

There are now 12 Columbia River Basin ESUs listed as threatened or endangered. An additional ESU (lower Columbia/SW Washington coho) was designated as a candidate species in July 1995. In addition, numerous other listed or candidate ESUs along the California, Oregon, and Washington coasts affect ocean fisheries that may harvest Columbia River salmonids. Because of the ESA status of many Columbia River salmonids, harvest managers must consult annually with NOAA Fisheries to assure fishers are regulated to meet "no-jeopardy" standards established for ESA-listed species. NOAA Fisheries issues incidental take permits to regulatory agencies and tribes for fisheries which have satisfied ESA regulatory requirements.

Current management of artificial production is substantially impacted by the legal obligations under the Endangered Species Act. In response to the ESA, the potential impact of hatcheries on listed populations must be evaluated through HGMPs developed for each hatchery operation. The use of artificial production in recovery of listed fish populations and how these practices comply with the legal mandates of ESA are being debated in the legal and scientific community. While the statutes and agreements that fund these programs allow artificial production for this purpose, the ESA is not clear under what circumstances it is appropriate. Regardless, artificial production practices have been modified in some instances to assist in recovery of listed populations. In addition, some listed populations have been captured and put into hatcheries in order to boost survival and avoid potential extirpation. The NOAA Fisheries Hatchery Policy, which is currently under development, is expected to influence how hatcheries are used in the future.

The legal basis for artificial production of fish populations is straightforward; it is based on the replacement of lost fish for purposes related to religious, cultural, and harvest concerns and, increasingly, conservation. Implementation is often compromised, however, by conflicting mandates and the complexity of legal debate. The social and legal questions that remain include the geographic location of mitigation programs and the use of artificial production to address the requirements of the Endangered Species Act.

II.B Regulatory Framework

II.B.1 Council Guidance

The Northwest Power and Conservation Council's Columbia River Basin Fish and Wildlife Program addresses fish and wildlife aspects of hydroelectric system operation, artificial production, restoration of habitat, and acquisition and protection of habitat for fish and wildlife

(Section I.A). As a result of the Council's program, BPA has funded significant hatchery programs at several locations throughout the Columbia River Basin.

Several versions of the fish and wildlife program have been developed since 1981 and reflect an evolution of thinking about hatcheries in the Columbia River Basin. The earliest versions of the Council's program were aimed at construction of hatcheries primarily to support commercial harvest by treaty Indian fishers. By this time, the region had moved away from large facilities that segregated the hatchery from the wild populations toward more integrated programs. Subsequent versions of the Council's program show the development of supplementation (integrated programs), use of artificial production to conserve depleted natural populations, and an increasing focus on restoration of aquatic habitat.

The latest edition of the Council's Fish and Wildlife Program (Northwest Power Planning Council 2000) is a departure from the previous programs and reflects the region's concerns about declining wild fish populations, negative effects on habitats, and obligations to restore fish populations listed under the Endangered Species Act. The 2000 Program lays out a comprehensive, ecologically based framework for fish and wildlife restoration and management. Development of specific measures is left to subbasin planning. The Council's framework includes an overall vision for the program as well as generalized biological objectives. It also describes the Council's assumptions, guidelines, and policies for restoration strategies including the use of artificial production.

Artificial Production in the 2000 Fish and Wildlife Program

The Council's 2000 Fish and Wildlife Program moves away from large segregated production hatcheries toward integration of artificial production and habitat restoration. For example, a planning assumption set by the Council states:

> "This is a habitat-based program, rebuilding healthy, naturally producing fish and wildlife populations by protecting, mitigating and restoring habitat and the biological systems within them, including anadromous fish and migration corridors. *Artificial production and other non-natural interventions should be consistent with the central effort to protect and restore habitat and avoid adverse impacts to native fish and wildlife species*." (emphasis added)

In this, the Council firmly placed artificial production into the context of functioning ecosystems and productive habitat. The program also provided ecologically based scientific principles to guide the use of recovery strategies including artificial production. As regional policy guiding major funding and operation of hatcheries in the Columbia River Basin, these principles represent a significant departure from past policies where artificial production was used in an attempt to replace natural habitat and ecosystems. The Council did, however, recognize that, where habitat has been permanently eliminated (for example, as a result of construction of dams without adult fish passage), artificial production may be the best alternative to replace lost capacity and productivity (Table II-2).

Table II-2. Relationship between habitat condition and artificial production strategies specified in the Council's 2000 Fish and Wildlife Program

Criteria			Examples of Strategies	
Habitat Condition	**Description**	**Biological potential of target species**	**Habitat strategy**	**Possible artificial production strategy**
Intact	Ecological functions and habitat structure largely intact	High	Preserve	No artificial production
		Low	Preserve	Limited supplementation
Restorable	Potentially restorable to intact status through conventional approaches	High	Restore to intact	Interim supplementation
		Low	Restore to intact	Limited supplementation
Compromised	Ecological functions or habitat structure substantially diminished	High	Moderate restore	Limited supplementation
		Low	Moderate restore	Supplementation
Eliminated	Habitat fundamentally altered or blocked without feasible recovery option	High	Substitute	Replacement hatchery
		Low	Substitute	Replacement hatchery

The Council's program also acknowledges the experimental nature of hatcheries and the need for continuing research and evaluation. The experimental aspect of hatcheries is seen in the context of an adaptive management strategy that recognizes that scientific knowledge regarding artificial production and ecosystem functions will continue to be refined while the societal role of hatcheries within the context of natural resource management will continue to evolve. The program calls for each hatchery to develop a plan describing its purpose, method of operation, and its relationship to the vision, biological objectives, and strategies of the appropriate subbasin plan.

Specific strategies for the use of artificial production are to be developed locally as part of subbasin plans. However, the Council does provide significant guidance reflecting its policy of using hatcheries in conjunction with development of functional habitat. In Table II-2, the Council links the use of artificial production to the condition of the habitat, its potential for restoration, and the biological potential of the target species.

The Council recommends against use of artificial production in cases where habitat is largely intact and the species has a high biological potential. These areas are to remain as refuges for wild production. As the condition of the habitat declines, the use of supplementation (integrated hatchery programs) increases, although it always remains within the context of habitat restoration. Finally, in instances where habitat has been completely eliminated, a hatchery could be proposed to partially mitigate for lost habitat. In keeping with other principles and goals in the Council's program, however, the replacement hatchery would have

to operate quite differently from past hatcheries and must ensure minimal impacts on natural populations or other resource goals.

II.B.2 NOAA Fisheries Guidance

During the 1990s, as a result of widespread declines in the abundance of Pacific salmon and steelhead and petitions to list populations under ESA, NOAA Fisheries conducted a status review of all West Coast salmon and steelhead populations pursuant to the Endangered Species Act. NOAA Fisheries identified 52 Evolutionarily Significant Units along the West Coast. Of the 52 ESUs, 26 were subsequently listed as threatened or endangered. The Columbia River Basin contains 12 of the listed ESUs.

Pursuant to the ESA, NOAA Fisheries regulates federal and non-federal actions that might incidentally or directly take listed salmon and steelhead. Fish hatchery programs have been identified as actions that might incidentally take listed species or require direct take of listed species. NOAA Fisheries, in conducting its regulatory responsibilities, has described the potential risks and benefits of hatchery programs that should be considered relative to the species conservation goals of the ESA (Hard et al. 1992).

NOAA Fisheries must analyze the effects of a hatchery's propagation actions (facility operations, adult fish collection, juvenile fish releases and related monitoring and evaluation activities) to determine whether listed fish might be taken and whether the continued existence of listed fish is jeopardized. The steps in this analysis are described in the Endangered Species Act Consultation Handbook (U.S. Fish and Wildlife Service and National Marine Fisheries Service 1998).

If a hatchery propagates non-listed fish that do not subsequently affect listed species, no regulatory authorization from NOAA Fisheries is necessary. If hatchery operations do affect listed species and an incidental take is possible, the operations must be assessed and authorized via an ESA Section 7 consultation for federal facilities or an ESA Section 10 Incidental Take Permit for non-federal facilities. Any hatchery program that propagates a listed species must be authorized through a Section 10 Scientific Research/Enhancement Permit. These regulatory processes require the hatchery program manager to submit a biological assessment or permit application that fully describes the program's action and likely effects.

Recently, NOAA Fisheries adopted the 4(d) Rule (NOAA 2000a) which provides an alternative means (other than Section 7 or 10) for authorizing hatchery operations affecting threatened species. The 4(d) Rule, however, applies only to 14 ESUs of listed salmon and steelhead of which seven are located in the Columbia River Basin. The rule provides needed protections for threatened salmon and steelhead while loosening take prohibitions for approved hatchery programs and providing them with ESA regulatory approval. NOAA Fisheries can also authorize a hatchery program by approving a Hatchery and Genetics Management Plan submitted by the program manager. The advantages of the HGMP approach are long-term management planning, more public involvement, and less government paperwork.

The 4(d) Rule specifies that HGMPs must, among other things:

- have clearly stated goals, performance objectives, and performance indicators against which the program's success or failure can be measured
- provide as the primary purpose the conservation of that species

- account for the program's genetic and ecological effects on natural populations
- describe relationships between artificial propagation and harvest management
- include measures to avoid hatchery-influenced selection or domestication
- include monitoring and evaluation on program benefits and risks
- provide for adaptive management based on evaluations
- be consistent with plans and conditions established for tribal harvest allocations

The 4(d) Rule also includes a limitation on the take prohibition to accommodate a resource management plan developed jointly by the states and tribes under the jurisdiction of *U.S v. Oregon*. Such a joint plan could include harvest management and artificial propagation actions. In approving a joint plan developed under the framework of *U.S. v. Oregon*, NOAA Fisheries must determine that the plan would not appreciably reduce the likelihood of survival and recovery of threatened salmon and steelhead. In making such a determination, NOAA Fisheries must take public comment on how any HGMP included in the joint plan addresses the above criteria.

Simultaneously with adoption of the 4(d) Rule, NOAA Fisheries adopted a separate Tribal 4(d) Rule that limits take prohibitions for tribal resource management plans that do not appreciably reduce the likelihood of survival and recovery of threatened salmon and steelhead (NOAA 2000b). These tribal plans can also include hatchery programs.

The HGMP is now used in consideration of artificial propagation programs by NOAA Fisheries regardless of the approval mechanism, i.e. sections 7, 10, or 4(d). NOAA Fisheries' approval of an HGMP constitutes compliance with the substantive requirements of the ESA. The template for an HGMP can be viewed on NOAA Fisheries' web page at www.nwr.noaa.gov/1hgmp/hgmptmpl.htm.

With respect to artificial propagation programs, NOAA Fisheries' ESA regulatory authorities have objectives similar to those of the Northwest Power and Conservation Council's Columbia River Basin Fish and Wildlife Program, i.e. to increase the social benefits of artificial propagation programs while minimizing risks to naturally spawning populations. The HGMP template was developed in concert with Council efforts to improve the cost-effectiveness of hatchery programs and improve long-term fisheries planning in subbasins throughout the Columbia River Basin. NOAA Fisheries and the Council were looking for a single informational template that would efficiently satisfy both ESA regulatory and Fish and Wildlife Program processes for hatchery review and reform.

II.B.3 Fisheries Management

Pacific salmon and steelhead are exposed to commercial fisheries along most of the west coast of North America. Because they cross national and state boundaries, their management is governed by a number of organizations. All fisheries of the Columbia River are established within the guidelines and constraints of the Pacific Salmon Treaty (PST), the Columbia River Fish Management Plan (CRFMP), the Endangered Species Act, management agreements negotiated between the parties to *U.S. v Oregon*, and state fishery regulatory processes.

Pacific Salmon Commission

Management of Pacific salmon has long been a matter of common concern to the United States and Canada. Due to their migratory patterns, salmon originating in one country are often harvested ("intercepted") in fisheries of the other country. After many years of negotiation, the Pacific Salmon Treaty was signed in 1985. The PST set long-term goals for salmon management for both countries and is advisory in nature. The principal goals of the treaty are to enable both countries, through better conservation and enhancement, to increase production of salmon and ensure that the benefits resulting from each country's efforts accrue to that country. The countries negotiate specific fishery regimes for each species (or geographical area) that each country is responsible for implementing via its domestic management processes. A comprehensive set of new multi-year fishery regimes was negotiated and agreed to in 1999.

Pacific Fisheries Management Council

The Pacific Fishery Management Council (PFMC) is one of eight regional fishery management councils established by the Magnuson-Stevens Fishery Conservation and Management Act of 1976. The PFMC is responsible for all ocean fisheries off the coasts of California, Oregon, and Washington; Chinook and coho salmon are the main salmon species managed through PFMC's Salmon Fishery Management Plan.

The plan sets annual spawner escapement goals for the major salmon stocks and allocates harvest among commercial, recreational, and tribal users in ocean, estuarine, and inland fisheries. PFMC also uses season length, quotas, bag limits, and gear restrictions to achieve fishery management goals.

Columbia River Compact

The Columbia River Compact, ratified by Congress in 1918, established concurrent jurisdiction by the states of Oregon and Washington over Columbia River fisheries. The responsible entities are the Washington Department of Fish and Wildlife (WDFW) Commission and the Oregon Fish and Wildlife Commission (OFWC). The Compact sets harvest seasons and regulations for treaty and non-treaty harvest within the Columbia River.

U.S. v Oregon

The U.S. District Court ruled in 1968 that, under existing treaties, Columbia River treaty Indians were entitled to an equitable share of upper Columbia River fish returns. Later court rulings interpreted treaties as providing the treaty tribes the opportunity to take 50 percent of the harvestable surplus of upper Columbia River salmon. After 20 years of legal tests and negotiations, a ten-year Columbia River Fish Management Plan was adopted by District Court

order in 1988. Parties to the agreement were the United States; the states of Oregon, Washington, and Idaho; and the four treaty Indian tribes (Yakama, Warm Springs, Umatilla, and Nez Perce). The purpose of the CRFMP as defined by the court was to

> ". . . provide a framework within which the Parties may exercise their sovereign powers in a coordinated and systematic manner in order to protect, rebuild, and enhance upper Columbia River fish runs while providing harvests for both treaty Indian and non-Indian fisheries. In order to achieve the goals of the CRFMP, the Parties intend to use habitat protection authorities, enhancement efforts, artificial production techniques, and harvest management to ensure that Columbia River fish runs continue to provide a broad range of benefits in perpetuity."

II.C Harvest and Economics

Commercial and recreational harvest of salmon has long been an important economic factor in the Pacific Northwest. While this document is not focused on the economics of harvest, it is important to acknowledge that salmonids have both economic and intrinsic values.

II.C.1 Harvest

Columbia River Indians used salmon for thousands of years before the Europeans arrived. Europeans began using salmon about 1830 and, by 1861, commercial fisheries became significant. In 1866, salmon canning began in the Northwest, and the non-Indian commercial fishery grew rapidly. Salmon and steelhead landings exceeded 40 million pounds annually several times between 1883 and 1925 (WDFW-ODFW 2002).

Since the early 1940s, Columbia River commercial landings of salmon and steelhead have declined, reflecting declines in salmonid abundance. Treaty Indian commercial landings became a larger portion of the total Columbia River commercial landings following the 1969 *U.S. v Oregon* federal court ruling which confirmed Treaty Indian rights to an equitable share of the harvest.

In the early part of the 20th century, nearly all commercial fisheries operated in freshwater, where only mature salmon were harvested. Ocean fisheries became more important in the late 1950s as more restrictions were imposed on freshwater and coastal estuary fisheries. Ocean harvest of salmon peaked in the 1970s and 1980s. In recent years, ocean commercial and recreational (sport) harvests of salmon have generally been reduced as a result of international treaties, fisheries conservation acts, regional conservation goals, and state and tribal management agreements.

II.C.2 Economics

Many of the hatchery programs in the Columbia River Basin were developed during the mid-20th century for the purpose of supporting commercial fishing in the face of dwindling wild fish stocks. For several decades, Columbia River hatcheries sustained commercial and sport fisheries off Oregon, Washington, British Columbia, and southeast Alaska. Today, the

economics of the Pacific salmon fishery are changing. The market for commercially harvested salmon is affected by the growing supply of farmed salmon. Though sport fishing remains an important economic factor, participation has varied over recent years. In addition, economists have increasingly recognized that salmon are valued broadly for their less tangible, but no less important, "existence values." These values demonstrate that people still value the existence of salmon even if they personally will never catch or eat salmon.

II.D Environmental and Biological Framework

Hatcheries culture salmonids for only a portion of their freshwater existence; the remainder of their lives are spent in the ocean and in freshwater habitats outside of the hatchery. Management of hatcheries as well as conditions experienced by the fish outside of the hatchery can affect the success of fish stocks. The insight that ocean and freshwater conditions greatly affect the survival of hatchery stocks is a surprisingly recent contribution to the conceptual foundation for artificial production (Independent Scientific Group 2000). Prior to the 1970s, hatcheries were viewed as separate from the natural ecosystem and somehow immune to the natural ecological principles and cycles of productivity that govern the natural world. However, the continued declines in salmon populations despite massive infusions of juvenile fish from hatchery programs has led to a re-examination of the precepts of artificial production and a more ecologically grounded conceptual foundation in recent years. (Independent Scientific Group 2000).

Part of the current conceptual foundation is the recognition of the role of environmental change and cycles in determining the abundance of salmon in both the short and long term (Lawson 1993, Hare and Francis 1995). Ocean, freshwater, and terrestrial environments apparently fluctuate significantly over 10 year or longer time periods (Hare and Francis 1995) and global climate change may result in fundamental shifts in environmental conditions. Although almost all management focus is on their freshwater life stages, salmon are a predominantly marine species. The success of any restoration action in freshwater, especially when viewed over short time periods, is strongly affected by ocean conditions. Actions may appear beneficial if taken during periods of favorable ocean conditions while beneficial actions may be viewed as having little, or even a negative effect, if evaluated during periods of poor ocean conditions. The apparent success of hatchery programs during the 1960s which led to a massive expansion of programs was in part due to its coincidence with favorable ocean conditions (Pearcy 1992). Likewise the collapse of these same programs in the 1970s was marked by a reversal of ocean conditions leading to poor returns from hatchery and wild populations alike (Pearcy 1992). The impact of climate change resulting from human or natural causes is likely to have fundamental impacts on salmon populations (Mote et al. 1999) and should be considered in the use and operation of artificial production.

The presence of hatchery fish (juveniles and adults) in the environment affect the performance and abundance of other species and wild fish of the same species. The nature of these effects is increasingly the subject of numerous studies. The salmonid environment encompasses an immense area including freshwater streams, rivers, estuaries, and vast areas of the Northeast Pacific Ocean. Interactions of hatchery fish with wild fish of the same species are known as intra-species effects; interactions with other species of fish including non-salmonids

are inter-species effects. Recent studies indicate that it is important to understand the effects of those interactions on the environment and fish habitat.

Many traits, such as behavior, morphology, and physiology, of salmon can be shaped by the rearing environment. Traditional hatchery practices (where fish are maintained at high densities in flow-through tanks with ample food) show little resemblance to the natural rearing environment. In fact, by design, traditional hatcheries deliberately remove most of the complexity and "dangers" of the natural environment to increase efficiency and maximize the survival rate. Hatcheries represent unique environments with regard to feeding regimes, density, substrate, exposure to predators, and interactions with other fish. These differences can have substantial impacts on the resulting traits of hatchery fish (reviewed in Einum and Fleming 2001) with the potential for ecological impacts when they are released into the natural environment.

Hatchery fish released into the environment can affect natural populations in terms of competition, disease, and genetics. In many cases, the exact extent and nature of the effects have not been fully defined. However, hatcheries can have positive or negative impacts on the interaction between salmon and their environment. Hatchery management must continually take into consideration these myriad effects, striving to minimize risk and maximize benefits.

Chapter III: Methods

The Artificial Production Review and Evaluation examined 225 Columbia River salmon and trout hatchery programs to determine if current hatchery operations were consistent with harvest and conservation goals identified for each program. This chapter describes the APRE approach to data gathering, evaluation, and reporting/accountability. APRE resulted in the creation of a web-based system that allows information to be updated in the future. The web-based system currently produces two reports: the APRE benefit-risk profile and the HGMP for a selected hatchery program. The review and report should not be viewed as an end product, but rather as an on-going effort to reform hatcheries. It is envisioned that the web-based system will be expanded in the future through links to other existing datasets and that this expansion will lead to the development of other types of reports.

III.A Premises

The APRE approach was based on two premises for determining the success of a hatchery program. First, to be successful, a hatchery program must be *internally consistent* with its own stated purpose and *externally consistent* with the goals and priorities for the environment, including other potentially affected fish populations. For example, if the purpose of a hatchery program is to contribute to a particular harvest, its benefits were judged by its contribution to that fishery (internal consistency) and the degree to which it posed an acceptable level of potential risk to conservation, genetic, and other goals for nearby populations (external consistency).

The second premise of the APRE was that almost any human intervention to manipulate the environment poses some level of risk to the existing environment and species. There are few, if any, "no risk" strategies for fisheries restoration and management. Instead, different strategies present a variety of risks that must be evaluated by decision-makers in an informed manner. The APRE evaluated the risk associated with each hatchery program relative to its intended purpose and its potential impact on other goals.

A hatchery program was judged to be successful if it met the following conditions:

1. It must produce a healthy and viable hatchery population.
2. It must make a sustainable contribution of adult returns to conservation and/or harvest.
3. Its potential effects on wild and native populations and the environment must be understood.
4. It must collect, record, evaluate and disseminate information pertaining to conditions 1 – 3 so that decision makers may be informed about the benefits and risks of the program relative to other means for achieving similar conservation and harvest goals

Conditions 1 and 2 dealt with the potential benefits of a hatchery program. Conditions 3 and 4 dealt with the potential risks. Note that Condition 3 does not imply that a successful hatchery program will pose no risk; rather it calls for the risk to be clearly identified and accepted relative to the risk of alternative strategies to achieve resource goals. It is important to

recognize that all strategies, including hatcheries, have potential benefits and risks. Potential risks imposed by hatcheries must be compared to the risks of alternatives (including no action) and weighed through informed decision-making. The underlying working hypothesis must then be carefully monitored and evaluated within a framework of adaptive management. The determination of whether the benefits associated with a hatchery program outweigh the risks is a policy judgment that should take into account the relative benefits and risks associated with alternative strategies to meet the same or similar resource goals.

III.B Approach

The APRE was based on information collected from federal, state, and tribal hatchery managers and operators through a structured interview process. Interviews with fishery and hatchery managers used a questionnaire designed in consultation with an expert in censuses and questionnaires to facilitate collection of unbiased responses from the managers. Managers were not required to document the basis for their responses to the APRE questions. At several points in the process, review opportunities were provided to the managers to ensure that the information accurately reflected their knowledge of the facilities and current operations. The potential benefits and risks of each program were evaluated by comparing the information provided by the managers to criteria developed from the Scientific Framework and Hatchery Review Program (HSRG 2002) prepared by the Hatchery Scientific Review Group and by the Council's Integrated Hatchery Operations Team (IHOT 1995). The IHOT was established by the Council to conduct performance audits on all hatcheries in the Columbia River Basin. A set of hatchery review protocols and guidelines was developed by IHOT for that purpose. The results of the evaluation of all 225 artificial production programs identified in the Columbia River Basin are summarized in individual program reports maintained within a web-based system developed for the APRE. Managers were provided the opportunity to review and comment on the information and conclusions before the program reports were posted to the system.

The APRE process can be broken down into three general steps: information gathering, evaluation, and reporting/accountability.

Step 1. Information gathering

The first step was to gather information on currently identified fish stocks and existing hatchery programs. The fish stock list was compiled from information provided by the management agencies and included salmonid and non-salmonid species with natural and hatchery components (Chapter IV). The APRE process identified 262 hatchery and 250 natural fish populations throughout the U.S. portion of the Columbia River Basin. While the stock list includes several non-salmonid fish stocks, development of goals by the fishery managers has focused largely on salmonid stocks. Through a structured questionnaire termed "Form 1", managers were asked to describe the current status of each stock as well as short term (less than 15 years) and long term (more than 15 years) goals in regard to harvest (type and location) and conservation (biological significance, genetic viability, and habitat status).

Conservation status and goals for each salmonid stock were described by the fishery managers in terms of biological significance, genetic viability, and habitat status. Biological significance is a measure of the importance of the population to the long-term persistence of its ESU and is a function of its stock origin, the uniqueness of its biological attributes (life history,

physiology, morphology, behavior, etc.), and metapopulation structure (number of spawning aggregations). *Genetic viability* is a measure of the ability of a population to survive over time in the natural environment as a function of effective population size, productivity (recruits per spawner), and composition of spawning population (natural vs. hatchery). *Habitat status* describes the ability of the environment to support the population over time as a function of quantity and quality of habitat available to the population.

Information on each hatchery program was also collected from the hatchery managers. Programmatic and operational information on each program was provided through the Form 2 questionnaire. Programmatic information described the nature, i.e. broodstock source, number released, life stage, and location, of the releases comprising the program. The HSRG framework that formed the basis for these questions is presented in Appendix A.

Operational information collected in Form 2 described the procedures and practices used to produce the fish in a hatchery program. This information was grouped into sections relating to 1) the health and viability of the hatchery population 2) the effect of the hatchery on natural populations and the environment, 3) the hatchery's contribution to harvest and conservation, and 4) the measures employed for accountability and monitoring of hatchery operations.

Information provided by the managers in Form 1 and Form 2 was compiled in a web-accessible database. Prior to the evaluation step, hatchery managers were able to review and refine information in the data set.

Step 2. Evaluation

The second step in the APRE process was to evaluate the responses provided by the managers relative to the criteria for hatchery success developed by the HSRG (2002). The information provided by the managers on stock goals (Form 1) and on hatchery program operations (Form 2) was evaluated against the HSRG guidelines to yield a set of statements describing benefits and risk (Figure III-1). Forms 1 and 2 are presented in appendices B and C.

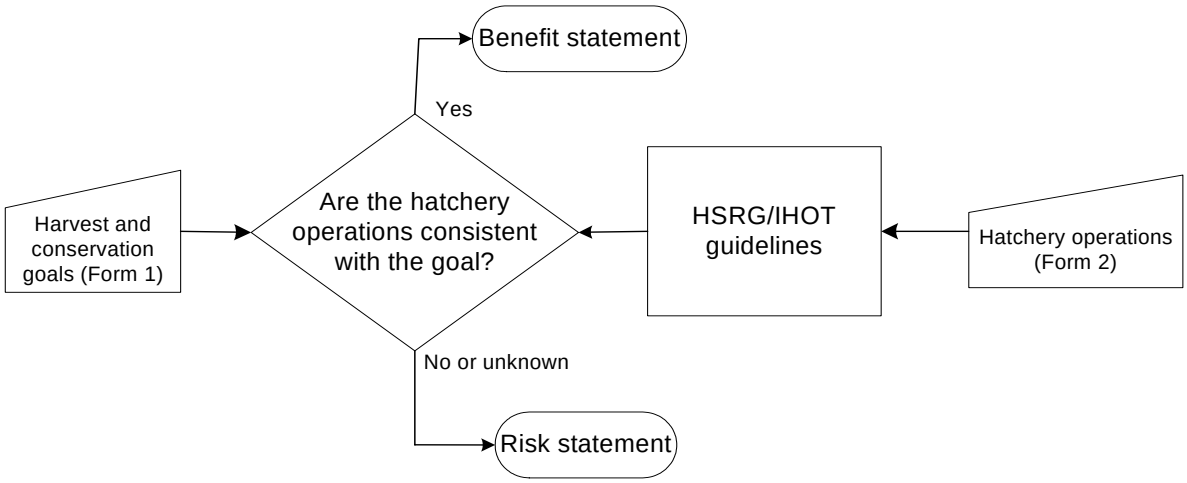


Figure III-1. APRE process for evaluation of information provided on harvest and conservation goals (Form 1) and hatchery operations (Form 2)

The evaluation process determined if the current operations at each hatchery, as described by the managers, were consistent with the goals identified for the hatchery program using the criteria established by HSRG/IHOT. The responses provided to the questions in Forms 1 and 2 were matched to criteria that were appropriate to the goal (harvest or conservation) and to the type of hatchery program (integrated or segregated). The result was a series of benefit and risk statements indicating areas where current operations are consistent with the goals based on the guidelines or where operations were inconsistent with the guidelines and could be improved.

Hatchery managers were asked to review the results of the evaluation prior to the results being posted on the APRE web system. This review provided another opportunity to refine the data and examine the preliminary results.

Step 3. Reporting and Accountability

An example of an APRE benefit and risk report for the Cowlitz spring Chinook hatchery program is shown on Table III-1. Additional excerpts from the APRE database are show in Appendix D; a summary of findings by province is presented in Appendix E. Each hatchery program report in the web-based APRE system contains similar tables. In addition to the evaluation shown in Table III-1, the hatchery program reports include programmatic information for each program as well as information on returns, harvest, and survival rates provided by the managers for each program.

In Table III-1, the columns are evaluation criteria for the target stock (Cowlitz spring Chinook) and for other stocks in the Cowlitz River. The rows are categories of hatchery practices. The cell contents, e.g. 2/0/0, are the number of evaluation criteria guidelines met for each hatchery practice category, the number that were not met, and the number of guidelines for which information is missing. Each number in a cell is hyperlinked to benefit and risk statements on the web site which explain the evaluation conclusions.

The upper left box marked “Harvest” under “Target Stock” shows the numbers 2/0/0. This shows that for the harvest goal provided on Form 1 by the managers for the Cowlitz spring Chinook program, two guidelines were met (*2*/0/0), indicating a benefit. For choice of broodstock, all guidelines were met (no guidelines were not met) (2/*0*/0), indicating no risk, and no information on broodstock choice was missing (2/0/*0*), also indicating no risk. Under the Target Stock-Survival column and the Hatchery Practices-Release row, the effect of smolt release practices described for the Cowlitz spring Chinook program indicates that nine guidelines were met (a benefit) (*9*/7/1), but seven guidelines were not met (risks) (9/**7**/1), and information was not provided to address one guideline (a risk)(9/7/*1***)**.

After the reports for each hatchery program were developed through the APRE web database, managers were able to review and comment on the reports prior to the reports being made available to the public. The individual program reports are intended as a resource for hatchery managers and subbasin planners. Because the reports contain many of the elements of the Hatchery and Genetics Management Plan (HGMP) required by the federal managers under the Endangered Species Act, the option is available within the APRE web site to reformat the results into a form that can serve as a draft HGMP. It is anticipated that the federal managers will work with the state and tribal hatchery managers to refine these drafts into final HGMPs for each hatchery program.

Table III-1. Example of APRE web-based evaluation report for a hatchery program (Cowlitz Spring Chinook)

Hatchery Practices	Criteria for Successful Outcomes (Table entries are: Guidelines met / Guidelines NOT met / Insufficient Information)							
	Target Stock			Other Stocks			Environment (Fish passage, NPDES Discharge)	Implementation Monitoring
	Harvest	Biological Significance	Survival	Ecological Interactions	Genetic Interactions	Harvest Interactions		
Broodstock Choice	2 / 0 / 0	3 / 0 / 0	2 / 0 / 0	1 / 1 / 0	1 / 0 / 0	1 / 0 / 0		1 / 0 / 0
Broodstock Collection	11 / 1 / 0	4 / 0 / 0	15 / 1 / 0	7 / 0 / 0	5 / 0 / 0			11 / 1 / 0
Adult Holding	3 / 0 / 0		3 / 5 / 0				1 / 0 / 0	3 / 0 / 0
Spawning	5 / 0 / 0		6 / 1 / 0	1 / 0 / 0				
Incubation	13 / 3 / 0	0 / 3 / 0	20 / 4 / 0	2 / 1 / 0			0 / 1 / 0	10 / 2 / 0
Rearing	18 / 10 / 0	2 / 3 / 0	19 / 15 / 0	5 / 6 / 0			1 / 2 / 0	13 / 6 / 0
Release	9 / 8 / 1	2 / 3 / 1	9 / 7 / 1	5 / 6 / 1	3 / 2 / 0	4 / 1 / 0	2 / 0 / 0	8 / 7 / 1
Facilities	3 / 0 / 0		3 / 0 / 0				3 / 2 / 0	1 / 0 / 0
Effectiveness Monitoring	1 / 0 / 0	2 / 2 / 0	3 / 3 / 0					9 / 3 / 0

Chapter IV: Results

The primary product from the APRE is the database which contains the responses from the fishery and hatchery managers for individual hatchery programs within the Columbia River Basin. The results presented in this chapter are a summary of the information contained in the database. The database, which is accessible through the APRE website at www.apre.info, contains reports for each of the reviewed hatchery programs as well as links to this Basin level report and the federal HGMP process.

The APRE database is intended to form the foundation for continuing consideration of artificial production in the Columbia River Basin. The individual program reports in the database contain a summary of facility information including operator, funding sources, and overall performance, as well as recommendations for each hatchery based on the HSRG and IHOT guidelines. In addition, the reports provide a basis for other regional review efforts including the Council's subbasin planning effort and development of federal HGMPs. The database, which hatchery managers and other interested persons are encouraged to use, is designed to be updated as hatchery reforms are enacted.

This chapter summarizes results of the APRE into the categories of fish stocks, hatchery operations, distribution of hatchery releases, hatchery goals and purposes, funding, and monitoring and evaluation.

IV.A Fish Stocks

Fishery managers identified a total of 512 fish stocks within the U.S. portion of the Columbia River Basin. Of these 512 stocks, 262 were identified as hatchery programs; and 225 of these programs were reviewed within the APRE (Table IV-1) while 37 were not reviewed because of inadequate information. The numbers of hatchery programs reviewed within the APRE are shown on Table IV-1 in parentheses.

Table IV-1. Number and production origin for anadromous salmonids, resident salmonids, and non-salmonid fish stocks identified by fishery managers in the U.S. portion of the Columbia River Basin

	Salmonids		**Other Species**	**Total**
	Anadromous	*Resident*		
Natural Stocks	88	100	62	**250**
Integrated Stocks	105 (105)	10 (9)	3 (2)	**118 (116)**
Segregated Hatchery Stocks	68 (68)	57 (36)	19 (5)	**144 (109)**
Total	**261**	**167**	**84**	**512**

It is important to note that there are no common criteria for defining stocks either within or between management agencies; stocks are simply groups of fish for which the managers have identified a management goal or interest. There are species, primarily non-salmonid species, for which stocks were not identified, whereas salmonid species usually were divided into many stocks with varying management goals. Identified stocks do not necessarily have a genetic basis; however anadromous salmonid stocks appear to be associated with identified genetic populations. Natural stocks are defined more broadly than hatchery stocks which are related to specific hatcheries and programs. Despite these inconsistencies, the distribution of stocks has some basis in the biological organization of fish populations within the Columbia River Basin and reveals a great deal about management agency emphasis.

Anadromous salmonid stocks accounted for 51 percent (261) of stocks identified by managers, 33 percent (161) were non-anadromous (resident) salmonid stocks, and 16 percent (84) were non-salmonid stocks. The majority of stocks were found in the Lower Columbia region, which reflects the large number of hatchery programs in this region (Figure IV-1).

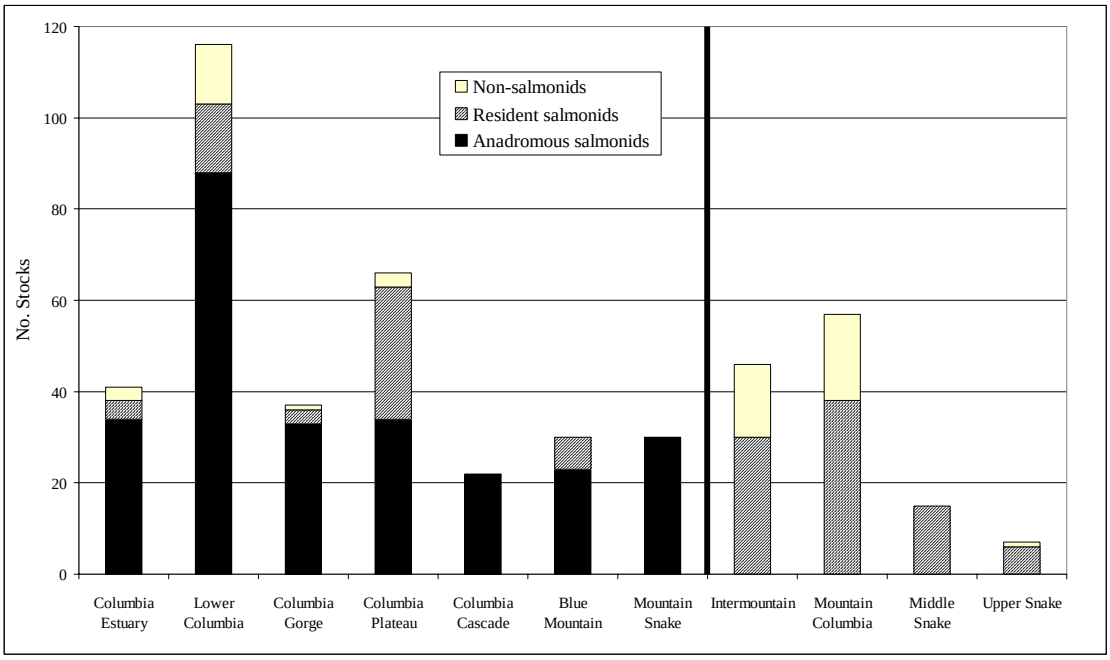


Figure IV-1. Distribution of fish stocks identified by fishery managers within the U.S. portion of the Columbia River Basin

Note: Vertical line represents the limit to anadromous fish passage.

The smallest number of stocks are found in the Upper Snake province. There are no anadromous stocks above the blockages to anadromous passage at Hells Canyon Dam on the Snake River and Chief Joseph Dam on the Columbia River. However, resident salmonid stocks were identified both above and below the limit to anadromous fish passage. The greatest numbers of resident salmonid stocks were in the Intermountain and Mountain Columbia provinces. These provinces also had the greatest number of non-

salmonid stocks in the Basin. Non-salmonid stocks represented a wide variety of fish species including non-native species such as crappie, bullheads, channel catfish, tiger muskie, and largemouth and smallmouth bass, as well as native species such as burbot, sturgeon and lamprey. Of the total number of stocks identified, 26 percent were part of populations that are listed under the Endangered Species Act. Of these listed stocks, 52 percent have a hatchery component, although the hatchery component may not be listed.

Fish stocks identified by the managers represented both hatchery and natural production (Table IV-1). About half the stocks were natural fish. However, the majority of anadromous salmonid populations derived from hatchery programs. The Columbia Cascade province had the highest proportion of hatchery populations of anadromous fish and the Columbia Gorge the lowest. However, in the Columbia Cascade, the hatchery stocks represent several relatively small programs while in the Columbia Gorge, the hatchery stocks represent a few very large programs. The greatest number of natural populations was in the Lower Columbia province while the smallest number was in the Columbia Cascade province.

Except for the Middle Snake province, the majority of resident salmonid populations represented naturally spawning fish. The largest numbers of resident salmonid stocks were described for the Mountain Columbia (47) and Intermountain (42) provinces; most of these were natural populations. The fact that there were no resident salmonid stocks in the Columbia Cascade or Mountain Snake provinces does not mean that there are no resident salmonids in these areas or that they are of no management interest; it simply means that the managers did not identify any.

IV.B. Hatchery operations

Type of operation.

The stocks discussed above were placed by the managers into one of three production categories: (1) natural stocks, (2) integrated stocks, and (3) segregated hatchery stocks. A natural stock is intended to have minimal influence from artificial production and to survive through its own productivity and the capacity of the environment. Likewise, a segregated hatchery stock is intended to have minimal influence from and on surrounding wild stocks. This type of program minimizes interbreeding of hatchery fish with wild populations. Segregated programs typically release large numbers of juvenile fish.

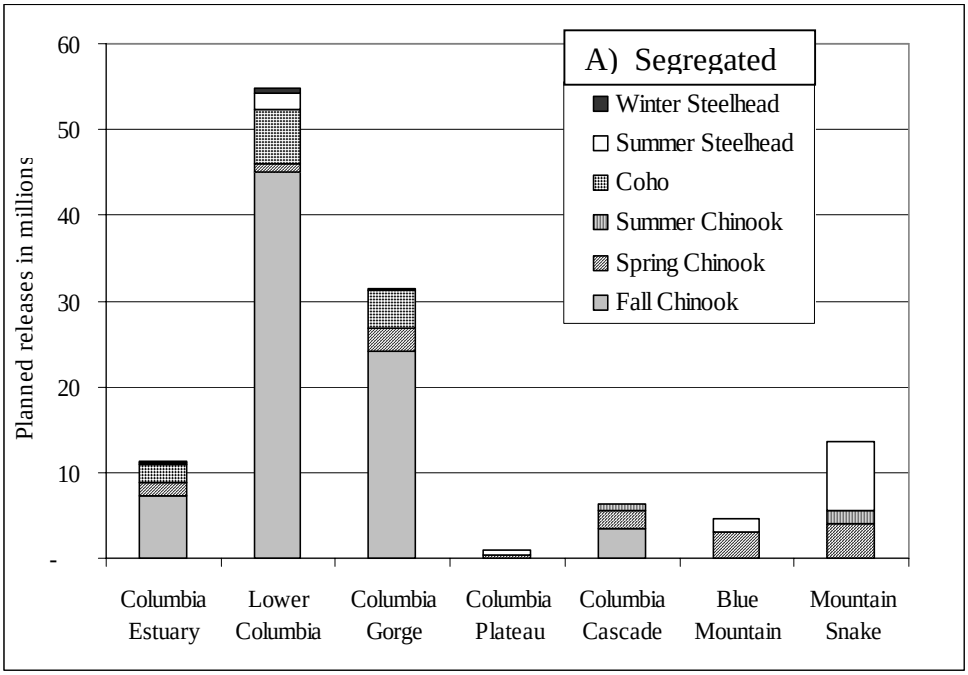
An integrated hatchery program, in contrast, uses an open production cycle in which the hatchery population is combined with the wild population to form a single aggregate population. Controlled genetic exchange is encouraged between hatchery and the wild components of the population. The proportion of hatchery and wild spawners in either population component is limited to minimize genetic and behavioral divergence between hatchery and wild components. The intent of an integrated program is to minimize genetic drift within the combined population and to produce hatchery fish which are equivalent in fitness and behavior to the fish produced by natural spawners in the same system. The ideal integrated hatchery program contributes to the abundance of its naturally spawning counterpart without significantly altering the genetic or behavioral characteristics of the wild population.

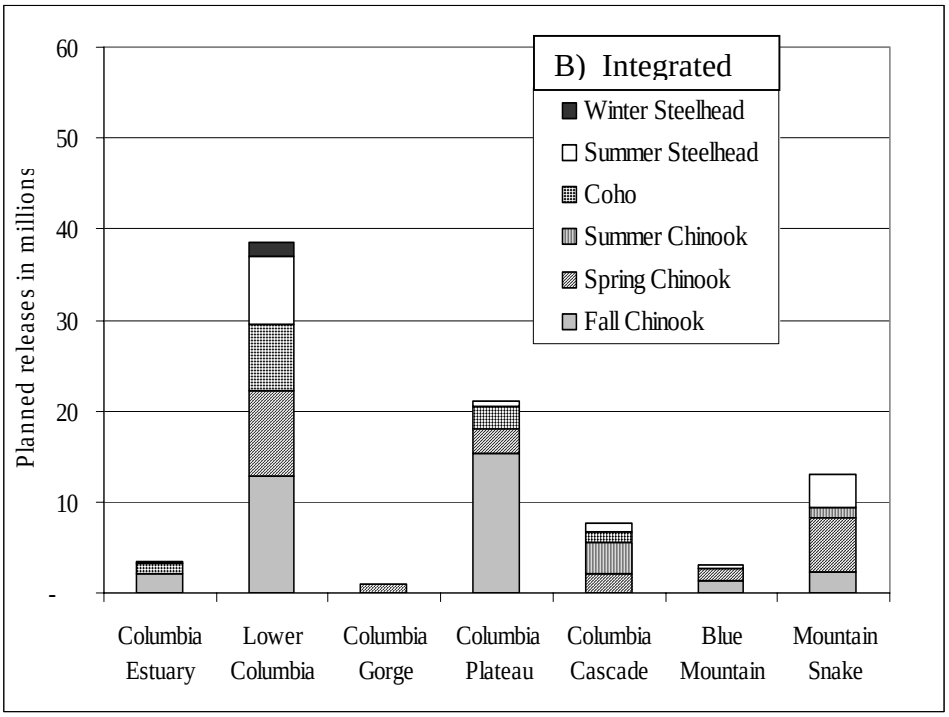
The results indicate that the majority of programs in the lower portion of the river (Estuary, Lower Columbia, and Columbia Gorge provinces) are segregated programs (Figure IV-2A), while a greater proportion of programs in the upper part of the Basin are integrated (Figure IV-2B). More than 95 percent of the programs in the Columbia Gorge are categorized as segregated. This is the result of a few very large, older facilities, such as Bonneville and Spring Creek hatcheries, which, like many programs in the lower river, release large numbers of fall Chinook and coho to supply lower river and ocean fisheries. (The USFWS notes that Spring Creek Hatchery was also established as a conservation hatchery and has been instrumental in helping preserve an original Columbia River stocks.)

Because of the earlier practice of locating most mitigation hatcheries in the lower river, those in the upper river are usually the newest facilities constructed since the 1970s. Many of these programs were either designed as integrated programs or have been recently modified to operate under the new conservation approach aimed at rebuilding wild populations. Almost 95 percent of the programs in the Columbia Plateau, just upstream from the Columbia Gorge, are classified as integrated (Figure IV-2). Artificial production programs in the Columbia Plateau include those in the Yakima and Umatilla provinces which were developed with the intent of producing integrated hatchery/wild populations. Priest Rapids Hatchery is also an integrated program, combining hatchery fish with the large native fish population spawning in the Hanford Reach.

The differences in fish culture practices between and among provinces can be identified using the APRE information. For example, most fall Chinook in the Columbia River Basin are released from segregated programs at large production facilities in the Lower Columbia and Columbia Gorge provinces (Figure IV-2A). These facilities were, for the most part, constructed to support the ocean fishery off Oregon and Washington. Because fall Chinook migrate to the ocean as sub-yearlings (only a few months after emergence), they are relatively inexpensive and easy to rear in hatcheries in large numbers. Spring Chinook, on the other hand, migrate as yearlings and must be maintained in hatchery facilities for a full year prior to release. Most coho in the Columbia River Basin, like fall Chinook, are released from segregated programs in the lower river. Segregated programs also account for most summer steelhead in the Basin. The majority of steelhead programs are located in the Mountain Snake province of Idaho.

Most spring Chinook in the Columbia River Basin are released through integrated programs (Figure IV-2B). Integrated programs for spring Chinook are located throughout the Basin with the majority in the Lower Columbia, Columbia Plateau, and Mountain Snake provinces. Large numbers of coho are released from integrated programs in the Washington tributaries in the Lower Columbia province (Lewis, Cowlitz, Washougal rivers) and are expected to contribute to natural populations. Fall Chinook are released through integrated programs mainly in the Lower Columbia and Columbia Plateau provinces. The fall Chinook released within the Columbia Plateau are primarily from Priest Rapids Hatchery which integrates production with integrated with natural populations of fall Chinook in the Hanford Reach.





A) Planned releases in segregated programs, B) planned releases in integrated programs

Figure IV-2. Distribution of planned releases of anadromous salmonids by cultural practice (integrated versus segregated), by species, and ecological province

Evaluation of Hatchery Practices.

As stated earlier, segregated hatchery programs are intended to have minimal genetic exchange with wild populations and integrated programs are intended to have a controlled mixing to minimize genetic divergence of the hatchery and wild components. Therefore, it is appropriate to ask if the programs are achieving their intended levels of segregation or integration. A rigorous genetic study to answer these questions is beyond the scope of the APRE; however, the managers' responses to questions regarding broodstock choice, hatchery practices, and movement of fish between hatchery and wild components can give some insight into the question.

It appears that many segregated programs contribute significantly to wild spawning populations and, therefore, may allow gene flow from the hatchery to the wild population. For example, managers indicated that 28 percent of the segregated programs contributed more than 30 percent of the spawners in associated wild populations. Only in 18 percent of the segregated anadromous programs was there a contribution of less than 5 percent of naturally spawning hatchery fish to neighboring wild stocks. In addition, managers reported they did not know the level of contribution to wild spawners in 24 percent of the programs.

The controlled mixing of wild and hatchery components in integrated programs is more difficult to assess. There are no generally accepted standards defining the proper amount of mixing. However, HSRG has established guidelines that can at least serve as a point of comparison for current hatchery practices (HSRG 2002). The HSRG guidelines state that a program is well integrated if it incorporates at least 10 percent wild fish in the hatchery broodstock and if no more than 30 percent of the wild spawning escapement consists of hatchery fish. These criteria were met by only 17 percent of the integrated anadromous programs. About 53 percent of the integrated programs allowed more than 30 percent hatchery fish to mix with the wild component. Managers reported that, for 22 percent of the programs, they did not know the contribution of wild fish to the hatchery or how hatchery fish contribute to natural spawning.

The source of fish used in hatchery programs is also a measure of the degree of segregation and integration**.** For much of the last century, hatcheries were not managed with sufficient attention to the genetic aspects of population fitness and the importance of local adaptation. Fish were freely moved between streams and hatcheries at all life stages. If a hatchery did not receive its full broodstock needs from returns, broodstock might be imported from another hatchery with a surplus. Central hatchery facilities distributed juvenile fish from a single broodstock to many different streams. More recently, however, managers are recognizing the need to facilitate local adaptation of fish and to conserve locally adapted populations. Integrated programs in particular emphasize the use of local broodstock and attempt to minimize transfer of fish between facilities and streams. From a genetics standpoint, these practices may not be as important for a segregated program, but they may affect ultimate performance of the hatchery. Because some mixing of wild and segregated hatchery population inevitably occurs, the use of non-local broodstock can result in genetic impacts on associated wild populations.

As part of the APRE, managers were asked to describe the source of broodstock used in each hatchery program and to describe practices relating to transfer of fish between facilities at various life stages. Of the 105 integrated stock programs, 93 percent (98 programs) use broodstock derived from fish native to the subbasin where program fish are released and 91 percent (96 programs) avoid transferring fish into the watershed from another program or avoid releasing fish from outside the subbasin. Of the 68 segregated programs, 31 percent (21 programs) used non-local broodstock and 75 percent (51 programs) transferred or released fish from outside the stream basin.

IV.C. Distribution of Hatchery Releases

Hatchery managers reported planned releases of 172,162,986 juvenile fish of all species from all hatchery programs in the U.S. portion of the Columbia River Basin. Actual releases in any year vary from this figure due to changes in hatchery operations, management priorities, or availability of brood stock. The planned releases, however, are an indication of the fishery managers' intentions and provide a basis for comparison between species, areas, and programs.

Of the total number of juvenile fish released from hatcheries in the Columbia River Basin (156,737,635) are planned releases of anadromous salmonids below the anadromous passage barriers at Chief Joseph and Hells Canyon dams. The spatial and species distribution of anadromous salmonid releases clearly demonstrates how the Columbia River Basin hatchery system has been shaped by social and economic priorities (Figure IV-3). The largest proportion (38 percent) of anadromous salmonid releases comes from hatchery programs in the Lower Columbia and Columbia Estuary provinces. If releases from the Columbia Gorge province are included, most of which come from a few very large programs located just below and above Bonneville Dam, 59 percent of all anadromous salmonid releases come from the lower portion of the Columbia River.

This distribution reflects previous policies of using hatcheries primarily to support commercial fisheries in the lower Columbia River and ocean fisheries off Oregon and Washington. About 48 percent of all anadromous salmonid planned releases in the Columbia River are fall Chinook (Figure IV-3) because fall Chinook are large contributors to the ocean troll fisheries. Spring Chinook, in contrast, are caught only in small numbers in the ocean commercial fisheries, although they are highly valued by the in-river and tribal ceremonial fisheries. In addition, as stated above, fall Chinook are released as fingerlings (sub-yearlings) which means that large numbers can be reared a lower cost than spring Chinook.

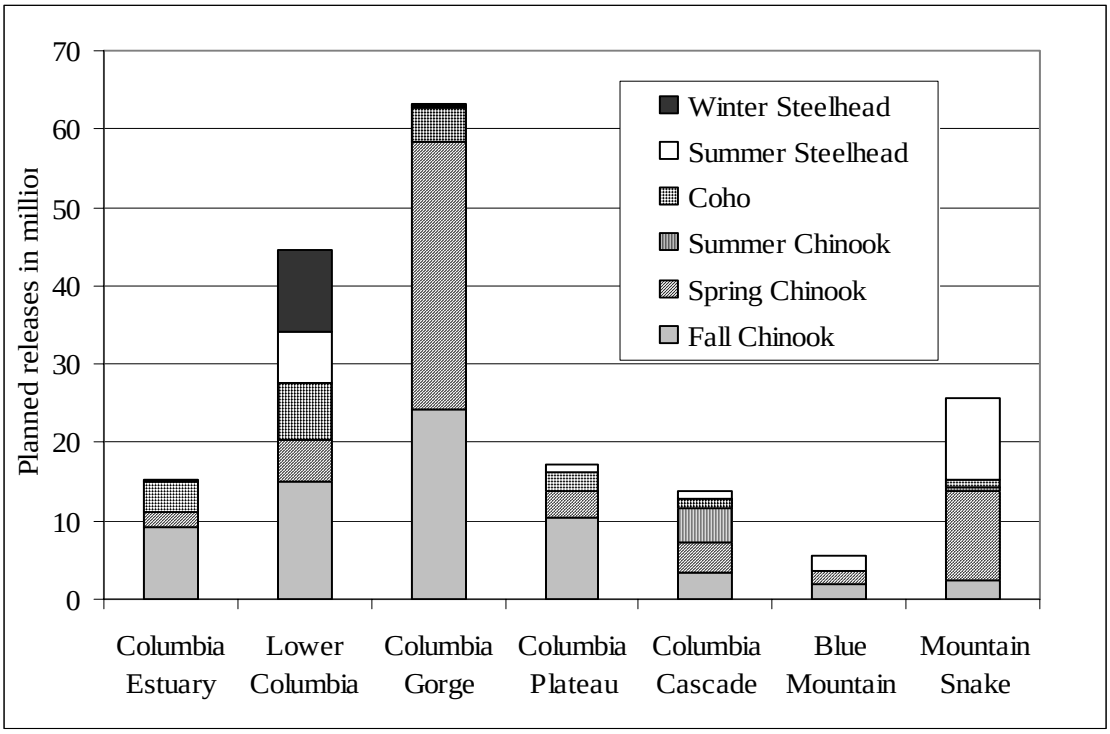


Figure IV-3. Distribution of planned hatchery releases by species across provinces

Although the number of fish released in each province varies considerably, the number of programs releasing fish is relatively constant between provinces (Figure IV-3). The relationship between the number of programs and the number of fish released indicates that, in general, the lower river is dominated by a few very large programs, whereas the upper river has many smaller programs. Programs in the upper river areas are generally newer and many have been designed as integrated programs to raise a variety of species as opposed to the large segregated fall Chinook and coho programs in the lower river.

Almost all coho hatchery releases are from the lower Columbia River (Figure IV-3). The Estuary, Lower Columbia, and Columbia Gorge provinces account for about 85 percent of all coho releases in the Columbia River. Historically, coho were distributed throughout most of the accessible parts of the Columbia River Basin although they apparently were concentrated toward the mouth of the river (Mullen 1984). In addition, coho are major contributors to the commercial troll fisheries off Oregon and Washington. Hatcheries were developed in the lower river to support these fisheries. The result was a vigorous ocean fishery for coho with harvest rates of around 90 percent during the 1970s (Figure II-1). Naturally spawning populations could not sustain these high harvest rates and have now been largely extirpated (Johnson et al. 1991).

The largest proportion (37 percent) of anadromous salmonids released above the Columbia Gorge province comes from the Mountain Snake province (Figure IV-3). Most

of these are spring Chinook and summer steelhead. Many of the hatchery programs in the Mountain Snake province represent mitigation programs for habitat lost to Hells Canyon Dam, the lower Snake River projects, and Dworshak Dam on the Clearwater River.

IV.D. Goals and purpose

Hatchery managers were asked to characterize the purpose of each artificial production program in terms of whether the program was intended to provide fish for harvest, contribute to conservation, or provide scientific research and educational opportunities. An individual program may serve all three purposes. For example, a program might be intended to contribute to rebuilding a wild population which eventually will provide a harvest opportunity. The program may also be used to educate school children about aquatic ecology.

Bars represent the distribution of identified purpose within a province. Programs often have multiple purposes and add to more than 100 percent.

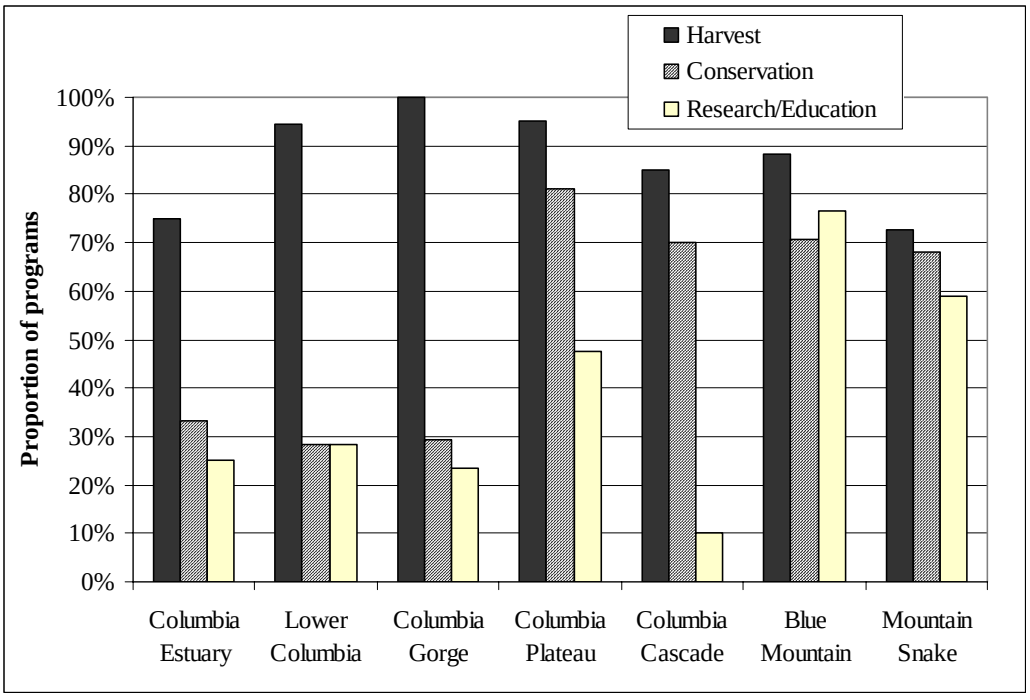


Figure IV-4. Distribution of purpose among artificial production programs in the Columbia River Basin

Figure IV-4 shows that harvest remains the predominant purpose of hatchery programs in the Columbia River Basin. The majority of programs in all provinces identified Harvest as a purpose. In the upper Basin provinces, Conservation was nearly as important as Harvest. Research/Education was also identified as a purpose in a greater proportion of programs in the upper Basin, especially for Snake River hatcheries (Mountain Snake and Blue Mountain). These results are consistent with the original purposes for which hatcheries in the lower and upper rivers were constructed. As stated

earlier, hatcheries in the lower river are generally older and were built to contribute to commercial harvests in the lower river and ocean. The upper river hatcheries are generally newer and built primarily to contribute to rebuilding natural populations while providing a harvest benefit, especially for tribal and sport fisheries. Because the contribution of hatcheries to conservation through integrated programs is relatively new, hatchery programs in the Basin above the Columbia Gorge are more likely to be viewed as experiments and to be associated with monitoring and research efforts than are the older, segregated programs in the lower Basin.

IV.E. Funding

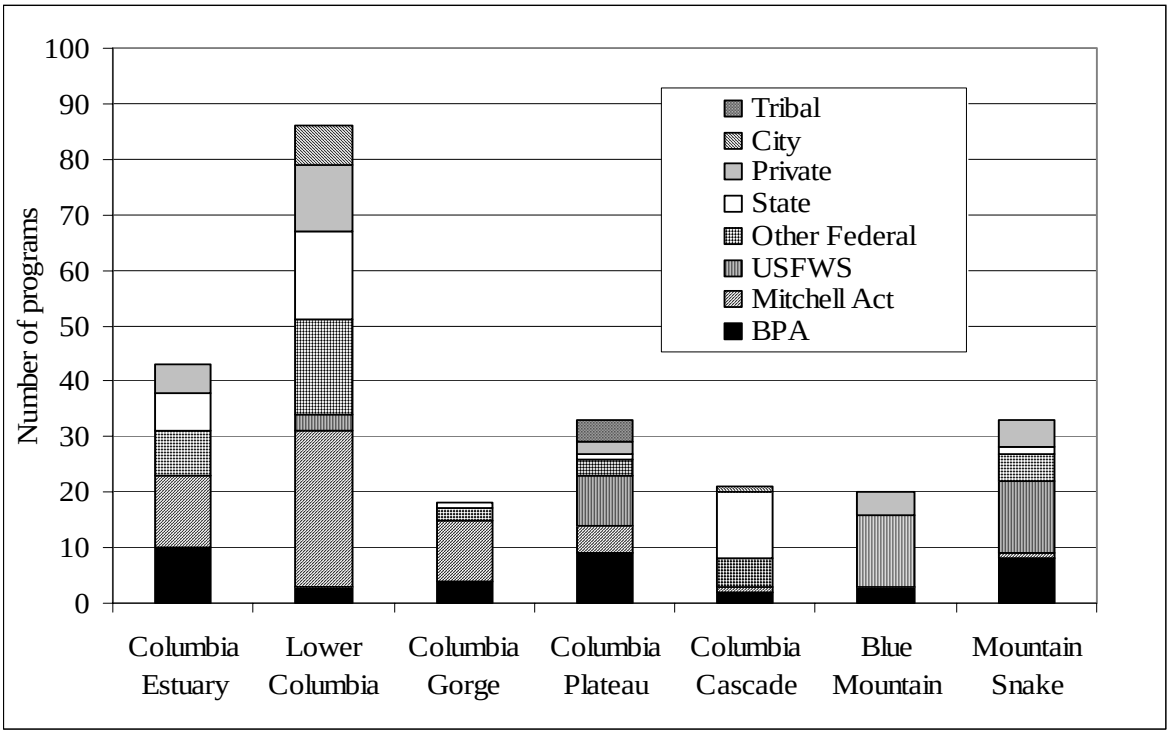
Few hatcheries are funded from a single source, making tracking funding of artificial production programs in the Columbia River Basin difficult. Hatcheries often receive funds from several sources contributing to specific programs. In addition, funds may be appropriated by one entity and administered by another. Other funds derive from the Bonneville Power Administration but are routed through reimbursements to other agencies. For example, the Lower Snake River Compensation Program supports numerous hatcheries on the Snake River, many of which are operated by the U.S. Fish and Wildlife Service through reimbursable funding from BPA. Finally, some sources contribute personnel and services while others provide capital and operating funds.

The APRE did not attempt to trace all hatchery funding as this was beyond the scope of the project; however, through the questionnaires, managers were asked to characterize the major funding for each hatchery program. This information is most useful in identifying the number of programs funded by various groups. The results of the data gathering did not produce sufficient information to allow conclusions about how much money each agency spends on which programs, on which species, and in which areas. Nevertheless, the managers' responses still tell much about the distribution of funding sources in the Columbia River Basin.

In Figure IV-5, "city funding" refers to mitigation hatchery funding by city utilities. For example, the City of Tacoma provides funding for hatcheries in the Cowlitz River as mitigation for hydroelectric dams operated by Tacoma PUD. The City of Portland provides partial support for hatcheries on the Sandy River to mitigate for Bull Run reservoir which supplies much of the city's water. "Private contributors" are private utilities such as Idaho Power Company, PacifiCorp, and PUDs operating in various counties, e.g. Grant, Douglas, and Chelan counties in Washington. These entities also fund hatcheries which mitigate for hydroelectric dams.

Funding for Columbia River Basin hatcheries derives from a variety of federal sources. Funds through the Mitchell Act (Section II.B) continue to support much of the hatchery production in the Basin, especially in the lower river. The Mitchell Act has funded hatcheries in the Columbia River since the 1940s. Mitchell Act hatcheries often are those that produce large numbers of fall Chinook and coho for harvest.

The Bonneville Power Administration (BPA) directly provides partial or complete funding for hatchery programs throughout the Basin through the Council's



Support includes contributed personnel in addition to funding.

Figure IV-5. Funding and support for anadromous fish production programs in the Columbia River Basin

Fish and Wildlife Program. BPA programs in the Estuary province provide terminal area commercial harvest opportunities in the lower river. In the Columbia Plateau and Mountain Snake provinces, BPA programs are largely tribal operations that, in most cases, are integrated programs designed to augment natural production and support tribal fishers. BPA, through a direct funding agreement with the Bureau of Reclamation, funds the Leavenworth Hatchery Complex in the Columbia Cascade Province. In addition, BPA funds hatcheries through various indirect routes such as the Lower Snake River Compensation Program described above.

The U.S. Fish and Wildlife Service directly funds facilities such as the Warm Springs National Fish Hatchery on the Deschutes River (Columbia Plateau province). USFWS also funds hatcheries, as noted above, through the Lower Snake River Compensation Program. USFWS uses funds from the Army Corps of Engineers to support several programs in the Columbia Plateau, Blue Mountain and Mountain Snake provinces (Figure IV-5).

The category of "Other Federal" in Figure IV-5 refers to "other" Corps of Engineers funds which support hatcheries mitigating for hydroelectric and flood control projects. For example, the "Other Federal" funding in the Lower Columbia province represents Corps-funded facilities in the Willamette River operated by the State of Oregon. (Note that funding for the Willamette River hatcheries is provided by BPA through a direct funding agreement with the Corps.)

"State and Tribal" funding can include monetary as well as "in kind" contributions of staff and supplies to operate facilities. For example, the Yakama Indian Nation has contributed staff to operate Yakima River facilities built with BPA funds.

IV.F. Monitoring and Evaluation

The APRE did not attempt to catalog or assess ongoing research and evaluation in the Columbia River Basin associated with artificial production. However, as part of the APRE survey, managers were asked to supply information relating to the performance of each program. This information consisted of commonly reported fisheries statistics which could be used by hatchery operators to determine the success of their programs and account for their contribution to regional goals.

Table IV-2 summarizes information provided by the managers using four types of fisheries statistics: Recruits per Spawner, Smolt-to-Adult Survival, Escapement, and Total Catch. Less than 10 percent of the programs reported Recruits per Spawner, which is the ratio between the number of fish spawning and the number of fish estimated to contribute to fisheries and escapement. It is valuable as a measure of fish survival and their contribution to fisheries and spawning. The Smolt-to-Adult Survival measures the survival from the smolt stage to adult return and is a function of mortality factors associated with the hatchery as well as natural and artificial conditions encountered over the life cycle. This was the most common statistic reported by the managers. Escapement is the number of fish returning to spawn naturally or in the hatchery. The managers reported measuring Escapement for only about 23 percent of the programs. Total Catch is the number of fish the hatchery program contributes to all fisheries. This statistic was reported for about 35 percent of the programs.

Table IV-2. Monitoring and evaluation statistics reported for anadromous fish hatchery programs in the Columbia River Basin

Recruits per Spawner	9.6 percent
Smolt-to-Adult Survival	53 percent
Escapement	23 percent
Total Catch	35 percent

Chapter V: Discussion and Conclusions

The Congressional request for hatchery review and the Northwest Power and Conservation Council's subsequent instigation of the APRE was stimulated by the growing realization of the need for hatchery reform (Section I.A). The results of the APRE indicate that reform is essential for the hatchery system within the Columbia River Basin. The following discussion outlines the principles of hatchery reform and presents the general conclusions of the APRE project team.

Hatchery reform principles

The APRE based its approach to analysis and evaluation on that of the Hatchery Scientific Review Group (www.hatcheryreform.org) in Washington State, which had been instituted in response to a similar Congressional request. After four years of in-depth review of hatchery programs in the Puget Sound and coastal areas of Washington, the HSRG concluded that, for hatcheries to be successful, 3 principles must be adhered to:

- goals for stocks affected by hatcheries must be clearly articulated, expressed in terms of resource values, and reflective of current biological, economic, and cultural circumstances
- hatchery programs must be scientifically defensible
- decision-making about hatchery programming and operations must be responsive and well-informed

The application of these principles to the APRE produced a series of questions which were answered through analysis of the information collected through forms 1 and 2 and the accompanying interviews with fishery and hatchery managers.

(1) Establishment of Goals

In the APRE, goals for existing hatchery programs were identified and, where possible, the extent to which the goals were being achieved was evaluated. It became clear, however, that hatcheries are often managed without clearly stated goals. Goals are often vague or may conflict, negatively affecting success. In some cases, the goals that exist are not necessarily consistent with current social or conservation priorities.

To be successful, hatcheries must have clear and measurable goals reflecting priorities established by scientific thought, legislation, treaty agreements, and legal judgments. Goals must be periodically reviewed to make sure they are still consistent and relevant. The APRE review raised specific questions about goal setting for Basin hatcheries. These include:

- **Are the current goals for fish stocks in the Columbia consistent with the current biological, economic, and cultural values and legal requirements?**

  The APRE analysis indicates that many programs are achieving their original objectives and goals. However, until the region clearly defines the role

and future goals of hatcheries, it is difficult to determine how each program should be altered to best meet the updated goals.

- **Can anadromous fish production be better balanced to provide greater access to fish for communities upriver?**

  Many lower river hatchery programs are operated as mitigation for the construction of the Columbia River hydrosystem and provide fish to coastal and lower river communities. A sizeable majority of Columbia River Basin hatchery production takes place in the lower three provinces. Unfortunately, the communities most affected by the construction of the dams do not share equally in this production. Communities farther inland normally have less access to returning adults because of their geographic location. Columbia River Basin hatchery programs have exacerbated this situation by producing a disproportionate number of fish in the lower Columbia River. Attention should be given to the questions of whether and how to balance hatchery production.

- **Should more emphasis be placed on conservation relative to harvest for most stocks?**

  Managers need to ensure that the goals for their programs are consistent with currently required conservation, harvest, and educational objectives. Many of the Lower Columbia River programs are being managed primarily for harvest despite the presence of ESA-listed populations within their area. The NOAA 4 (d) guidelines state that the primary purpose of hatcheries affecting listed populations should be conservation (Section II.E).

- **Should less emphasis be placed on stocks produced primarily for commercial harvest?**

  Many hatchery programs produce fish which are currently under utilized because it is not economically viable to catch them. This creates surpluses of adult fish at hatcheries and increases the risk of hatchery fish straying into unintended areas. Hatcheries may be able to shift emphasis away from production of stocks targeted for commercial harvest to stocks for sustainability which will, in the future, benefit all users, including the commercial industry.

- **Can hatchery programs be used more strategically to better accommodate ecological and social goals?**

  Hatchery fall Chinook production is large relative to other hatchery programs in the Columbia River Basin. This production adds to the already large peak of Chinook returning in the fall of each year. Hatcheries could be used to enhance biodiversity by producing a wider variety of salmonid species and life histories. Greater species and life history diversity makes sense ecologically and could provide greater harvest opportunities by enhancing adult returns over a longer time period.

- **Are hatchery programs planned and operated consistent with the goals for all stocks of interest?**

  The data developed by the APRE show that, in some cases, little attention is paid to the cumulative effects of hatchery programs on native stocks both within and outside each subbasin or province. For example, 78 percent of the programs evaluated indicated that the carrying capacity of the area where fish are released is considered in sizing the program. Therefore, 21 percent of programs still do not consider the carrying capacity. Additionally, only a few programs listed any legal or other restrictions that limited the number of hatchery fish released on a given year.

- **Should hatchery operators emphasize quality over quantity?**

  Many lower river hatcheries designed to support ocean fisheries release massive numbers of juvenile fish to achieve harvestable numbers of adult fish. The impacts on native populations and hatchery performance of a large number of juvenile hatchery fish entering the relatively small Columbia River estuary has not been considered. Mitigation agreements dictate that hatcheries release prescribed numbers or even poundage of juvenile fish regardless of success in production of adult returns. Conservation hatcheries are increasingly emphasizing release of smaller numbers of juveniles more closely resembling their natural counterparts in morphology, behavior, and run timing. Balancing biological requirements of the fish with scientific constraints and legal mandates must be addressed when establishing goals of hatcheries and individual programs.

- **How many hatchery fish should be released each year?**

  Hatchery releases should be sized to achieve identified goals consistent with the ecological context of the hatchery program. In practice, this is difficult to define as changing freshwater and ocean conditions dramatically influence resulting adult production. As a result, goals are likely to be met in some years, but not in others. In addition, changing harvest management practices also impact the number of fish caught in fisheries and the number returning to the Basin. Variable hatchery returns to the Basin can be problematic for wild fish. In large return years, the number of hatchery fish on the spawning grounds may exceed HSRG guidelines, resulting in more risk to wild fish. In low productivity years, insufficient numbers of returning wild fish may not maintain the genetic mix required for a properly integrated hatchery program. Hatchery production levels need to take into consideration both high and low production conditions in order to accommodate the risks posed to conservation and harvest goals.

- **When should hatchery production be reduced?**

  The data show that, historically, hatcheries have sought to increase rather than reduce production, generally to meet the primary goal of achieving harvest benefits. For programs where conservation becomes the primary concern, it may be necessary to reduce hatchery production. The HSRG guidelines propose a self-limiting approach to hatchery production based on the composition of the run returning to the Basin. The HSRG calls for strict adherence to the number of

hatchery fish allowed to spawn with wild fish and the number of wild fish used as hatchery broodstock. If the guidelines cannot be met, hatchery production must be reduced to a level where they can. The values are not an average, but are limits that must be achieved each year.

- **Should more hatchery programs be integrated rather than segregated?**

  This question involves the goals to be achieved and the amounts of risk managers are willing to accept to achieve them. The HSRG guidelines allow for the use of both approaches, but put different restrictions on each. The Council has identified areas where habitat is fundamentally altered or blocked, with no possibility of recovery, as potential choices for locating replacement hatcheries to provide harvest and conservation benefits (Table II-2). These areas may be the best choice for locating segregated programs designed to provide harvest benefits primarily. Additionally, NOAA has stated that hatcheries affecting listed stocks must have as their primary purpose the conservation of that species. This would seem to indicate that many of the segregated programs in the Lower Columbia need to be converted to integrated programs. A scientifically credible rationale needs to be established for the management of each program, goals need to be explicitly stated, and the expected benefits and risks clearly defined in order to answer this question.

(2) Scientific Defensibility

Current scientific knowledge should determine and guide the use of hatcheries. Given that natural resource science acts within the context of continually changing social priorities, the scientific foundation for strategies such as artificial production is best viewed as a "working hypothesis."[1]

The HSRG developed a scientific framework for hatchery reform that can serve as a basis for working hypotheses for hatchery use (HSRG 2002). The framework includes guidelines for operating hatcheries to meet goals for the target stock while minimizing adverse genetic and ecological interactions on natural populations. Guidelines are matched to the purpose of hatchery programs (harvest, conservation, education, etc) and type (integrated vs. segregated) of hatchery program.

Key HSRG guidelines include:

- Programs should facilitate local adaptation by hatchery and natural population components.

[1] A working hypothesis is a depiction of the scientific logic behind an action and which is constructed in a manner facilitating scientific testing and refinement over time. It does not represent certainty and may, in fact, incorporate considerable uncertainty regarding future conditions and existing knowledge. Nonetheless, a working hypothesis represents a logic trail that provides scientific accountability for actions.

All artificial production programs should strive to operate in a manner that promotes local adaptation. This means that broodstock native to, or likely to adapt to, the watershed where they will be released should be chosen so that the program perpetuates only adults returning to the same watershed. No importation of broodstock from outside a stream basin should be allowed. The APRE indicated that 21 percent of anadromous hatchery programs imported broodstock from out of subbasin. Out-of-basin rearing should also be avoided; 41 percent of the anadromous programs relied to some extent on rearing facilities outside the stream basin where the fish were released.

- Integrated programs are intended to directly benefit a natural stock (through supplementation) and/or increase its abundance without adversely affecting the natural stock

  Integrated hatchery programs should meet minimum criteria for wild fish contribution to the hatchery broodstock and maximum criteria for the contribution of hatchery fish to the natural spawning escapement. Less than half of anadromous programs included 10 percent or more wild fish in the hatchery broodstock and less than half of those programs limited hatchery contribution to 30 percent or less of the wild escapement. Hatchery practices employed for integrated programs should also attempt to minimize the effects of domestication. For example, less than half of the anadromous programs rear fish under natural temperature regimes and no more than 10 percent produce fish with growth rates similar to wild fish.

- The management intent for segregated hatchery programs is to minimize all interaction with wild stocks.

  Straying of hatchery returns should be minimized. Only 18 percent of the segregated anadromous programs were reported to contribute less than 5 percent of the spawning escapement of any wild stock. Less than half of the programs indicated that they had a goal for hatchery-wild composition.

  One way to reduce the potential for competition and predation at juvenile life stages is to assure that hatchery fish are “migration ready.” Less than half of the programs practiced volitional releases during the natural outmigration time period.

The APRE found that few hatchery programs adhere to all key guidelines identified by the HSRG, suggesting ample room for improvement in the performance of hatchery programs. Significant improvements in long-term survival can be achieved through such measures as avoidance of stock transfers and culture practices that reduce domestication. Adopting and adhering to stricter guidelines for proper integration and segregation of hatchery stock can minimize the effects of negative interactions with wild stocks.

(3) Informed decision-making:

Hatcheries reflect a considerable investment in public funds and have implications that can extend far into the future. For these reasons, hatcheries need to be operated in a manner in which successes and failures are observed and responded to by managers accountable for their success. All hatchery programs must be thoroughly examined on a regular basis from both within and outside the responsible organization.

For decision-makers to be successful, they must be informed about potential problems in a timely manner and must act on the basis of factual and complete information. Gathering and disseminating information and a commitment to continued monitoring of hatchery programs are essential. One of the most notable results of the APRE is the frequency of the "Do not know" response to key questions regarding performance and the impact of hatcheries on surrounding stocks (Table IV-2). Managers often are not able to answer the most basic questions regarding the success or potential harm caused by hatchery programs. Information about hatchery performance is often poorly evaluated and inaccessible. For example, while a majority of the hatchery programs listed harvest as a primary goal, only 1/3 provided data on the number of fish harvested and fewer still provided total Recruit per Spawner information.

While there is a critical need for more monitoring both from within and outside the hatchery, there is an even more urgent need to improve analysis and distribution of existing data to all personnel involved in management and operation of hatchery programs. Success of hatchery operations is still too frequently measured in terms of numbers of fish released regardless of the number of adults eventually produced from those releases.

Indicators and standards that directly or indirectly relate to success need to be defined and measured regularly. The results must be evaluated and effectively communicated so that informed and responsive decisions can be made at all levels of management and operations. The APRE information revealed that programming and operational decisions for most hatchery programs were reported to be based on "adaptive management." Also, most programs reported that standards for in-culture performance were specified and met. Most programs reported that goals for Smolt-to-Adult Survival, Recruits per Spawner, and other post-release performance standards were specified, but few programs computed these indicators each year.

In reviewing the programs throughout the Basin, it was found that the majority of hatchery operators were eager to share their knowledge and provide constructive suggestions for the improvement of hatchery operations. A frequent complaint heard from hatchery staff was that the drive to meet production goals interfered with good fish culture practices. At times, fish are released on a schedule based not on biology, but on the need to free-up space for another species or life-stage. The decision to emphasize quantity over quality poses risks that need to be better documented and monitored. There appears to be a need for better communication between the managers designing the programs and the operators producing the fish.

General Conclusions

The Artificial Production Review and Evaluation process is the most comprehensive review of hatchery programs in the Columbia River Basin to date. In addition to the conclusions related to the HSRG key guidelines stated above, four general conclusions emerged from this review:

1) Hatcheries are limited in what they can accomplish.

Hatcheries, by their nature, cannot single-handedly accomplish the restoration of fish populations within the Columbia River Basin. They must be used together with other strategies such as habitat restoration and in-stream flow to achieve the goals of restoration programs. Used properly, hatcheries can continue to be one of the most useful tools in the restoration tool kit; they cannot, however, be expected to be the panacea for diminished stocks in the Basin.

2) The social, ecological, and economic purposes upon which the current hatchery programs were established have changed and will continue to change.

Hatcheries have been used to achieve social, legal and economic goals. Until relatively recently, hatchery programs were intended almost solely to support non-Indian commercial fisheries in the ocean and lower river. Existence values, spiritual values, and conservation were rarely considered in placement or development of hatchery programs. Mitigation was a matter of balancing the equation between the potential loss of fish to fisheries and the pounds of fish biomass released from hatcheries. This approach is the foundation of most of the hatchery programs in the Columbia River Basin.

The latter part of the 20th century, however, saw a philosophical shift in the basis for hatcheries. Conservation of the environment, ecosystems, and species became important national and local priorities. The importance of Indian spiritual and cultural values was legally recognized. At the same time, the commercial salmon fishing industry began to decline due to rising costs, conflicts with conservation concerns, and competing sources of salmon, such as aquaculture. This decline continues today.

Judged on current priorities, hatcheries are often found lacking and have been subject to criticism from many quarters. In fact, it can be concluded from the results presented in this report that, for the most part, Columbia River hatchery programs continue to be operated under an outdated paradigm**.** Although changes have been made in recent years, most hatchery releases still originate from lower river facilities which release large numbers of fall Chinook and coho intended for commercial fisheries. Likewise, past hatchery practices (such as the use of non-local broodstock) continue to be employed in some facilities in order to meet production goals.

As stated in the first conclusion (above), hatcheries cannot be expected to solve problems of diminishing salmon stocks on their own. Instead, a conscientious and systematic review of the goals and practices of hatchery programs is required in order to improve the alignment between the use of hatcheries as a tool and current social and environmental priorities. Existing legal

mandates, agreements, and legislation may need to be reviewed and changed to allow the flexibility to use hatcheries in ways which reflect current scientific thinking and social priorities.

3) Hatcheries will continue to play a part in recovery and management of fish in the Columbia River and elsewhere.

At present, producing fish in hatcheries appears to be the only way to mitigate for stocks whose habitats have been lost to development and to honor treaty obligations while retaining the benefits of hydroelectricity, agricultural irrigation, transportation, and flood control. Therefore, hatcheries appear to be part of the solution to maintaining viable fish runs in the Columbia River system. For example, hatcheries still offer the only way to mitigate for fish habitat lost to dams without fish passage facilities. In addition, hatcheries may offer the only means of providing sufficiently productive stocks to allow the continuation of tribal fisheries above Bonneville Dam.

4) Hatcheries require reform.

Finally, it is concluded that these considerations and the results of the APRE review point to the need for hatchery program reform. While reform of the system may result in closure of some hatcheries, hatchery elimination *per se* is not advocated. Hatchery reform is needed to:

- align hatchery policies and practices with current social priorities and scientific knowledge
- determine hatchery performance
- operate hatcheries in an accountable and cost-effective manner

As discussed above, determination of hatchery performance requires collection of appropriate information. It appears that most hatcheries do not do this. Performance and its impact on other priorities often cannot be determined for a given hatchery. What should be routine monitoring and data collection is often sacrificed to budget priorities because of the perceived need to maintain production numbers. The result of this is that it is impossible to assess the performance of hatchery programs or to distinguish successful from unsuccessful programs.

As important, and also frequently inadequate, is the evaluation and communication of monitoring results. The lack of good monitoring and timely evaluation makes hatchery programs vulnerable to possible elimination due to the lack of careful consideration of their contributions to conservation or other goals.

Reform requires that hatcheries operate in a “business-like” manner that is accountable and cost-effective. As discussed above, hatcheries must be operated so that successes and failures are observed and responded to by managers who are accountable. Data and information must be available to all hatchery management and operations personnel and communications among and between entities involved in hatchery management and operations must be complete and uninterrupted. After application of

business principles, hatcheries that are successful should be retained, while those that are not should be eliminated.

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Appendices

Appendix A: Scientific Framework

The scientific framework and the hatchery review approach used in the APRE process is based on the work products of the Hatchery Scientific Review Group (HSRG). These work products and the background on the HSRG project are available on the internet at www.hatcheryreform.org . Table A-1 shows the operational guidelines as they were adapted to the APRE review of individual hatchery programs in the Columbia River.

TABLE A-1. Operational guidelines and their applicability as used in the APRE review (adapted from Hatchery Scientific Review Group)

		Applicable Programs					Affected Outcomes						
Operational Phase	**Guidelines**	Integrated	Segregated	Education (Yes on 2032)	Harvest	Conservation	Harvest	Biological Significance	Survival (Viability)	Ecological Interactions	Genetic Interactions	Environment (Passage, NPDES Discharge, Nutrient Enhancement)	M & E
Broodstock Choice	Wild fish should make up less than 5% of the broodstock for this program.		X		X			X	X				
Broodstock Choice	The broodstock chosen should represent natural populations native or adapted to the watersheds in which hatchery fish will be released.	X	X		X	X	X	X	X	X	X		
Broodstock Choice	The broodstock chosen should have a pathogen history that indicates no threat to other populations in the watershed.		X		X					X			
Broodstock Choice	The broodstock chosen should have the desired life history traits to meet harvest goals.		X		X		X						X
Broodstock Collection	Sufficient broodstock should be collected to maintain an effective population size of 1000 fish per generation.	X	X		X	X			X				X
Broodstock Collection	Integrated Hatchery Operations Team (IHOT) and Pacific Northwest Fish Health Protection	X	X		X	X	X		X	X			X

TABLE A-1. Operational guidelines and their applicability as used in the APRE review (adapted from Hatchery Scientific Review Group)		**Applicable Programs**					**Affected Outcomes**						
Operational Phase	**Guidelines**	Integrated	Segregated	Education (Yes on 2032)	Harvest	Conservation	Harvest	Biological Significance	Survival (Viability)	Ecological Interactions	Genetic Interactions	Environment (Passage, NPDES Discharge, Nutrient Enhancement)	M & E
	Committee (PNFHPC) standards should be followed for broodstock fish health inspection.												
Broodstock Collection	The broodstock should be collected and held in a manner that results in less than 10% prespawning mortality.	X	X		X	X	X		X				
Broodstock Collection	Integrated Hatchery Operations Team (IHOT) adult holding standards should be followed for loading.	X	X		X	X	X		X	X			X
Broodstock Collection	Sufficient numbers of donors should be collected from the natural stock to minimize founder effects when a program is initiated.	X			X	X		X	X				
Broodstock Collection	Representative samples of natural and hatchery population components should be collected with respect to size, age, sex ratio, run and spawn timing, and other traits important to long-term fitness.	X			X	X	X	X	X	X	X		X
Broodstock Collection	10% or more of the broodstock should be derived from wild fish each year.	X			X	X		X	X				X
Broodstock Collection	The proportion of the spawners brought into the hatchery should follow a “spread-the-risk” strategy that attempts to improve the probability of survival for the entire population.	X				X			X				
Broodstock Collection	If the wild population has 150 fish or more, collection of wild broodstock should be limited to 30% of the population.	X				X			X				X

TABLE A-1. Operational guidelines and their applicability as used in the APRE review (adapted from Hatchery Scientific Review Group)		**Applicable Programs**					**Affected Outcomes**						
Operational Phase	**Guidelines**	Integrated	Segregated	Education (Yes on 2032)	Harvest	Conservation	Harvest	Biological Significance	Survival (Viability)	Ecological Interactions	Genetic Interactions	Environment (Passage, NPDES Discharge, Nutrient Enhancement)	M & E
Broodstock Collection	The program should avoid the use of stocks from outside the watershed.		X		X		X		X		X		
Adult Holding	Hatchery intake screening for the adult holding supply should comply with Integrated Hatchery Operations Team (IHOT) and National Marine Fisheries Service facility standards.	X	X		X	X						X	X
Adult Holding	The water used for adult holding should meet or exceed the recommended Integrated Hatchery Operations Team (IHOT) water quality standards for temperature.	X	X		X	X	X		X				X
Adult Holding	The water supply for adult holding should be protected by flow and/or pond level alarms at the holding pond.	X				X			X				
Adult Holding	Water for adult holding should be available from multiple sources.	X				X							
Spawning	Males and females available for spawning on a given day should be randomly mated.	X	X		X	X	X		X				
Spawning	Gametes should not be pooled prior to fertilization.	X	X		X	X	X		X				
Spawning	Precocious males (mini-jacks and jacks) should be used for spawning as a set percentage or in proportion to their contribution to the adult run.	X	X		X	X	X		X				
Spawning	Disinfection procedures during adult spawning should be implemented that prevent pathogen transmission between stocks of fish on site.	X	X		X	X	X		X				
Spawning	Back-up males should be used in	X				X	X		X				

TABLE A-1. Operational guidelines and their applicability as used in the APRE review (adapted from Hatchery Scientific Review Group)		Applicable Programs					Affected Outcomes						
Operational Phase	**Guidelines**	Integrated	Segregated	Education (Yes on 2032)	Harvest	Conservation	Harvest	Biological Significance	Survival (Viability)	Ecological Interactions	Genetic Interactions	Environment (Passage, NPDES Discharge, Nutrient Enhancement)	M & E
	the spawning protocol.												
Incubation	The water used for incubation should meet or exceed the recommended Integrated Hatchery Operations Team (IHOT) water quality standards for temperature.	X	X		X	X	X		X				X
Incubation	The water used for incubation should meet or exceed the recommended Integrated Hatchery Operations Team (IHOT) water quality standards for the following compounds: ammonia, carbon dioxide, chlorine, pH, copper, dissolved oxygen, hydrogen sulfide, dissolved nitrogen, iron, and zinc.	X	X		X	X	X		X				X
Incubation	IHOT species-specific incubation recommendations should be followed for water temperature.	X	X		X	X	X		X				X
Incubation	IHOT species-specific incubation recommendations should be followed for density parameters.	X	X		X	X	X		X				X
Incubation	Disinfection procedures should be implemented during incubation that prevent pathogen transmission between stocks of fish on site.	X	X		X	X	X		X				X
Incubation	Hatchery intake screening for the incubation water supply should comply with Integrated Hatchery Operations Team (IHOT) and National Marine Fisheries Service facility standards.	X	X		X	X						X	X
Incubation	If eggs are culled, culling should be done randomly over all segments of the egg-take.	X			X	X	X	X	X				

TABLE A-1. Operational guidelines and their applicability as used in the APRE review (adapted from Hatchery Scientific Review Group)		**Applicable Programs**					**Affected Outcomes**						
Operational Phase	**Guidelines**	Integrated	Segregated	Education (Yes on 2032)	Harvest	Conservation	Harvest	Biological Significance	Survival (Viability)	Ecological Interactions	Genetic Interactions	Environment (Passage, NPDES Discharge, Nutrient Enhancement)	M & E
Incubation	Eggs should be incubated under conditions that result in equal survival of all segments of the population to ponding.	X			X	X	X		X				
Incubation	The water source for incubation should be pathogen-free.	X				X			X				
Incubation	The water supply for incubation should be protected by flow alarms at the incubation unit(s).	X				X			X				
Incubation	IHOT species-specific incubation recommendations should be followed for using substrate.	X				X	X		X				X
Incubation	Water for incubation should be available from multiple sources.	X				X							
Incubation	Families should be incubated individually.	X				X		X	X				
Rearing	Rearing water should have a chemical profile significantly different from natural stream conditions to provide adequate imprinting of hatchery fish and minimize the attraction of naturally produced fish into the hatchery.	X	X		X	X	X	X	X				X
Rearing	The water used for rearing should meet or exceed the recommended Integrated Hatchery Operations Team (IHOT) water quality standards for temperature.	X	X		X	X	X		X				X
Rearing	The water used for rearing should meet or exceed the recommended Integrated Hatchery Operations Team (IHOT) water quality standards for the following compounds: ammonia, carbon	X	X		X	X	X		X				X

TABLE A-1. Operational guidelines and their applicability as used in the APRE review (adapted from Hatchery Scientific Review Group)		Applicable Programs					Affected Outcomes						
Operational Phase	**Guidelines**	Integrated	Segregated	Education (Yes on 2032)	Harvest	Conservation	Harvest	Biological Significance	Survival (Viability)	Ecological Interactions	Genetic Interactions	Environment (Passage, NPDES Discharge, Nutrient Enhancement)	M & E
	dioxide, chlorine, pH, copper, dissolved oxygen, hydrogen sulfide, dissolved nitrogen, iron, and zinc.												
Rearing	The correct amount and type of food should be provided to achieve the desired growth rate for the species and life stage being reared.	X	X		X	X	X		X	X			
Rearing	The correct amount and type of food should be provided to achieve the desired condition factor for the species and life stage being reared.	X	X		X	X	X		X	X			
Rearing	Juvenile rearing density and loading guidelines used at the facility should be based on life-stage specific survival studies conducted on-site.	X	X		X	X	X		X				X
Rearing	The hatchery should operate to allow all migrating species of all ages to by-pass or pass through hatchery related structures.	X	X		X	X						X	
Rearing	Hatchery intake screening for the rearing water supply should comply with Integrated Hatchery Operations Team (IHOT) and National Marine Fisheries Service facility standards.	X	X		X	X						X	X
Rearing	IHOT fish health guidelines should be followed to prevent pathogen transmission between lots or stocks of fish on site or transmission or amplification to or within the watershed.	X	X		X	X				X			X
Rearing	The water used for rearing should provide natural water temperature profiles that result in fish similar in size to naturally produced fish of	X			X	X	X	X	X	X			X

TABLE A-1. Operational guidelines and their applicability as used in the APRE review (adapted from Hatchery Scientific Review Group)		Applicable Programs					Affected Outcomes						
Operational Phase	**Guidelines**	Integrated	Segregated	Education (Yes on 2032)	Harvest	Conservation	Harvest	Biological Significance	Survival (Viability)	Ecological Interactions	Genetic Interactions	Environment (Passage, NPDES Discharge, Nutrient Enhancement)	M & E
	the same species.												
Rearing	If juveniles are culled, culling should be done randomly over all segments of the population.	X			X	X	X	X	X				
Rearing	The program should attempt to better mimic the natural stream environment by rearing under natural water temperature profiles.	X			X	X	X	X	X	X			X
Rearing	Fish should be reared under conditions that result in equal survival of all segments of the population to release.	X			X	X	X		X				
Rearing	The program should use a diet and growth regime that mimics natural seasonal growth patterns.	X			X	X	X		X	X			X
Rearing	The program should attempt to better mimic the natural stream environment by providing natural or artificial cover.	X			X	X	X		X	X			
Rearing	The water source for rearing should be specific-pathogen free.	X				X			X				
Rearing	The water supply for rearing should be protected by flow alarms at the rearing unit(s).	X				X			X				
Rearing	IHOT juvenile rearing standards should be followed for alarm systems.	X				X	X		X				X
Rearing	IHOT juvenile rearing standards should be followed for predator control measures to provide the necessary security for the cultured stock.	X				X	X		X				X
Rearing	Rearing water should be available	X				X							

TABLE A-1. Operational guidelines and their applicability as used in the APRE review (adapted from Hatchery Scientific Review Group)		Applicable Programs					Affected Outcomes						
Operational Phase	**Guidelines**	Integrated	Segregated	Education (Yes on 2032)	Harvest	Conservation	Harvest	Biological Significance	Survival (Viability)	Ecological Interactions	Genetic Interactions	Environment (Passage, NPDES Discharge, Nutrient Enhancement)	M & E
	from multiple sources.												
Rearing	Fish should be reared in multiple facilities or with redundant systems to reduce the risk of catastrophic loss.	X				X			X				
Release	Fish produced should be qualitatively similar to natural fish in growth rate.	X	X		X	X	X	X	X	X			X
Release	Fish should be identified with nonlethal detectable identification marks or tags.	X	X		X	X		X	X		X		
Release	Marking/tagging techniques should be used to distinguish between the hatchery and natural populations.	X	X		X	X		X			X		X
Release	Fish produced should be qualitatively similar to natural fish in physiological status.	X	X		X	X	X		X	X			X
Release	Volitional releases during natural out-migration timing should be practiced.	X	X		X	X	X		X	X			X
Release	Fish should be released at an optimum time and size that has been determined by a site-specific survival study.	X	X		X	X	X		X				X
Release	Fish should be released in numbers that do not exceed the carrying capacity for the natural population.	X	X		X	X	X		X	X	X		
Release	Fish should be released in same drainage as rearing facility.	X	X		X	X				X		X	
Release	Marking/tagging techniques should be used to distinguish among segments of the hatchery population.	X	X		X	X							X
Release	Fish produced should be	X			X	X	X	X	X	X			X

TABLE A-1. Operational guidelines and their applicability as used in the APRE review (adapted from Hatchery Scientific Review Group)		Applicable Programs					Affected Outcomes						
Operational Phase	**Guidelines**	Integrated	Segregated	Education (Yes on 2032)	Harvest	Conservation	Harvest	Biological Significance	Survival (Viability)	Ecological Interactions	Genetic Interactions	Environment (Passage, NPDES Discharge, Nutrient Enhancement)	M & E
	qualitatively similar to natural fish in size.												
Release	Fish should be released at sizes and life history stages similar to those of natural fish of the same species.	X			X	X	X	X	X	X			X
Release	Fish produced should be qualitatively similar to natural fish in behavior.	X			X	X	X		X	X	X		X
Facilities	The facility should operate within the limitations established in National Pollution Discharge Elimination System permit.	X	X		X	X						X	X
M&E	Accurate fish inventory data that reflects pond populations within 10% should be maintained with a minimum of handling stress.	X	X		X	X	X		X				X
M&E	Goals for the program should be documented so that results can be adequately evaluated.	X	X		X	X							X
M&E	Results of program evaluation should be reported/documented so that they can be taken into consideration when determining whether hatchery operations should be changed.	X	X		X	X							X
Effectiveness	Adults from this program should not make up more than 30% of the natural spawning escapement (for the species/race) in the subbasin.	X			X	X		X	X				X
Accountability	All new relevant information from research or other sources should be made available to hatchery staff and others and used for attaining goals.	X	X		X	X							

TABLE A-1. Operational guidelines and their applicability as used in the APRE review (adapted from Hatchery Scientific Review Group)		**Applicable Programs**					**Affected Outcomes**						
Operational Phase	**Guidelines**	Integrated	Segregated	Education (Yes on 2032)	Harvest	Conservation	Harvest	Biological Significance	Survival (Viability)	Ecological Interactions	Genetic Interactions	Environment (Passage, NPDES Discharge, Nutrient Enhancement)	M & E
Accountability	The most recent information obtained from monitoring and evaluation programs for the production cycle, including performance indicators and progress toward goals, should be taken into consideration when determining whether hatchery operations should be changed or not.	X	X		X	X							
Accountability	Standards should be specified for in-culture performance of hatchery fish and their offspring.	X	X		X	X							
Accountability	Standards should be specified for post release performance of hatchery fish and their offspring.	X	X		X	X							
Education	The hatchery facility should be open to the public during hours of operation.			X									
Education	Hatchery operations should be visible to facility visitors.			X									
Education	Hatchery operations (egg take, incubation, rearing) should be demonstrated to the public.			X									
Education	The facility should have a fish ladder and/or adult holding facilities that are open to the public.			X									
Education	The hatchery should have signage describing the facility, fish production goals, ties to management goals, ecosystem function.			X									
Education	There should be a visible link to riparian zone such as viewing boardwalk or bridge.			X									

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		Applicable Programs					Affected Outcomes						
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Education	The hatchery should regularly schedule tours for groups.			X									
Education	The program should provide opportunities for student interns.			X									
Education	The program should provide opportunities for citizen volunteer involvement.			X									
Education	The agency should maintain a web page describing the hatchery program.			X									
Education	A pamphlet or brochure describing the agency or hatchery programs should be available.			X									
Education	Hatchery staff should be involved in community/volunteer meetings or outreach programs.			X									
Education	Hatchery staff should regularly give classroom presentations.			X									
Education	Hatchery staff should participate in formal professional presentations/seminars.			X									
Education	Where appropriate and beneficial, the facility should be used and staff should participate in agency, university, or other research projects?			X									
Education	Data and information pertaining to the program should be accessible to interested parties.			X									

Appendix B: APRE Questionnaire, Form 1

APRE FORM 1[2]: CURRENT STATUS and GOALS for Stocks and Habitat

(The following is a list of the questions in form 1, the actual form as used in the survey can be viewed on APRE on-line questionnaire.)

Name of STOCK: _____

1. [#2028] Is a hatchery program associated with this stock?
   a. yes
   b. no

2. [#2029] If the answer to Question 1 was yes, is this an ***integrated***[3] program?
   a. yes
   b. no

3. [#2030] Is the **purpose** of the program to ***provide harvest***?
   a. yes
   b. no

4. [#2031] Is the **purpose** of the program to ***contribute to conservation/ recovery***?
   a. yes
   b. no

5. [#2032] Is the **purpose** of the program to ***contribute to research and/or education***?
   a. yes
   b. no
6. [#2033] Is the program **mitigation** for ***hydro impacts***?
   a. yes
   b. no

7. [#2034] Is the program **mitigation** for ***habitat loss***?
   a. yes
   b. no

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[2] Dr. Don A. Dillman, Washington State University, provided invaluable help in structuring this form to assure accurate and complete responses to the questions.

[3] A principal goal of an *integrated* hatchery programs is to minimize genetic divergence of the hatchery broodstock/population from a naturally spawning population. In an idealized integrated program, natural-origin and hatchery-origin fish within a particular watershed simply represent two genetically equal components of a common gene pool, where habitat conditions experienced by the natural component drive the local adaptation of the stock.

In contrast, a *segregated* hatchery program is one in which the goal is to allow the hatchery population to evolve along its own trajectory while minimizing genetic interactions with natural populations. As a consequence, segregated broodstocks can change genetically over time via domestication effects and hatchery management practices (e.g. selective breeding for run timing).

8. [#2035] Is the program **mitigation** for ***impacts other than hydro and habitat loss***?
   a. yes
   b. no

The following questions pertain to the *Biological Significance*[4] of the stock:

9. [#3] What is the ESA status for this stock?
   a. Endangered
   b. Threatened
   c. Candidate
   d. Not listed and not a candidate for listing

Comment:
Data Source:

10. [#4] Which of the following best describes the origin for this stock?
   a. **Native**
   b. Admixture: **≥ 50% native genes**
   c. Admixture: **< 50% native genes**
   d. **Reintroduced**: species occurred historically in watershed, was extirpated, but stock transfers re-established species in watershed
   e. **Introduced**: species was historically absent from watershed/habitat
   f. **Harvest**: species was historically absent from watershed/habitat but introduced for harvest purposes

Comment:
Data Source:

11. [#5] Which of the following best describes the population characteristics of this stock?
   a. Population has **unique, irreplaceable phenotypic attributes** (e.g. fish size, run timing, age structure, etc.) that are not shared with other stocks within or outside the province.
   b. Population is **common within the province**: it shares phenotypic attributes with other stocks within the province, but **not** outside the province.
   c. Population is **common**: key phenotypic attributes are shared with other stocks **within and outside** the province.

Comment:
Data Source:

12. [#6] How many distinct spatially-separated spawning aggregations are within this stock?

[4] The *Biological Significance* of a stock is a measure of its evolutionary importance in the context of its ESU. It is a function of stock origin, uniqueness (of phenotypic characteristics), and population structure (within the stock and within the ESU).

a. ≤ 5
b. > 5

Comment:
Data Source:

13. [#7] How many total stocks (of the same species/race) are there within the province or adjacent provinces?

a. ≤ 3
b. > 3

Comment:
Data Source:

The following questions pertain to the *Viability*[5] of the stock:

14. [#8] What is the effective population size of this stock? (May be approximated by census data.)

a. Ne ≤ 100
b. 100 < Ne ≤ 500
c. 500 < Ne ≤ 2,500
d. 2,500 < Ne ≤ 5,000
e. Ne > 5,000

Comment:
Source of data/information:

15. [#9] What is the intrinsic rate of population growth (R/S at low densities)?

(**NOTE: *Question is worded differently on the web form***)

a. Population is **highly productive** and **sustains high harvest levels** (R/S > 5)
b. Population is **stable** while **supporting a moderate harvest** (3 < R/S ≤ 5)
c. Population is **clearly stable** (2 < R/S ≤ 3)
d. Population **appears to be replacing itself** (1 < R/S ≤ 2)
e. Population is **declining** (R/S < 1)

Comment:
Source of data/information:

16. [#10] For a natural stock or integrated hatchery stock, what proportion of the natural spawners for this stock are hatchery-origin returns (HoR)?

a. HoR ≤ 1%
b. 1% < HoR ≤ 5 %
c. 5% < HoR ≤ 30%
d. HoR >30%

[5] The *viability* of a stock is a measure of its genetic fitness, i.e. its ability to persist within the natural environment (for natural or integrated hatchery populations) or in the combined hatchery and receiving natural habitat (for segregated hatchery populations).

Comment:
Source of data/information:

17. [#2027] For segregated hatchery populations, what proportion of eggs, fry or adults are from wild fish or another hatchery?

a. ≤ 1%
b. 1% - 5 %
c. 5% - 30%
d. >30%

Comment:
Source of data/information:

The next set of questions deal with *GOALS* for stock status, habitat, and harvest.

18. [#11] Assign a rating of "**High**," "**Medium**," or "**Low**" to short-term and long-term goals for biological significance, viability, and habitat for this stock with respect to the following definitions:

Biological significance is determined by considering a number of specific factors relating to stock origin, biological attributes and population subdivisions, with the stock defined as being of either ***low***, ***medium*** or ***high*** significance.

Population viability is also determined by considering a number of specific factors such as age class structure, spawner escapement and proportion of hatchery-origin fish in natural spawning, with the stock's viability defined as being either *critical*, *at risk* or *healthy*. This rating refers to the stock's ability to sustain itself in the natural environment (except in the case of a segregated harvest program, in which case the ratings are ***low***, ***medium*** and ***high*** and refer to the stock's ability to sustain itself in the culture environment).

Habitat: The stock's spawning, freshwater, migration and estuarine **habitat** is rated as either *inadequate* (**Low**) (target stock is unproductive and the population will go extinct, even without terminal harvest), *limiting* (**Medium**) (target stock is productive enough for the population to sustain itself at a low level terminal harvest) or *healthy* (**High**) (productivity of the stock is high and the population is capable of growth and supporting significant terminal harvest).

	Biological significance	**Viability**	**Habitat**
Present Status			
Short-term goal (10-15 yrs)			
Long-term goal (30-50 yrs)			

Comment:
Source of data/information:

19-23. [#12, 121, 122, 123, and 124]
Assign a rating of **H**, **M, L**, or **N** for each type of fishery (**targeted and consumptive fisheries**) for this stock for:

- **Present** (current status)
- **Short-term** (10-15 years) goal
- **Long-term** (30-50 years) goal

Using the definitions:

- **H** = High (harvest opportunity each year, spread over seasons)
- **M** = Medium (opportunity most years, for some seasons)
- **L** = Low (occasional opportunity, single run)
- **N** = No harvest opportunity

			Location of Fishery				
			Marine	L Columbia	Zone 6	U. Columbia	Subbasin
Type of Fishery	Commercial	Present					
		Short-term					
		Long-term					
	Ceremonial	Present					
		Short-term					
		Long-term					
	Subsistence	Present					
		Short-term					
		Long-term					
	Recreational Harvest	Present					
		Short-term					
		Long-term					
	Recreational Catch& Release[6]	Present					
		Short-term					
		Long-term					

Comment:
Source of data/information:

The questions that follow deal address potential impacts of hatchery programs on the target stock

24. [#2036] Do you have a numerical goal for total catch in all fisheries?
    a. yes

[6] A recreational *catch and release* fishery is one where the purpose of the fishery is to catch and release the target stock. It does not refer to the incidental catch of the stock in fisheries that are targeting marked fish or fish of a different species.

b. no

25. [#2037] Do you have a goal for spawning escapement composition (hatchery vs. natural) in the ***hatchery***? APPLIES TO HATCHERY PROGRAMS ONLY
   a. yes
   b. no

26. [#2038] Do you have a goal for spawning escapement composition (hatchery vs. natural) in the ***wild***?
   a. yes
   b. no

27. [#2039] Do you have a goal for smolt-to-adult return survival? APPLIES TO HATCHERY PROGRAMS ONLY
   a. yes
   b. no

28. [#2040] Do you have goals for recruits per spawner (R/S)?
   a. yes
   b. no

29. [#2041] How often do you compute the recruits per spawner for this stock?
   a. every year
   b. periodically (at least once every five years)
   c. seldom
   d. never

30. [#2042] Are the goals to this program documented? (Indicate source of documentation below.) APPLIES TO HATCHERY PROGRAMS ONLY
   a. yes
   b. no

31. [#2043] Are results of program evaluation reported/documented? (Indicate source below.) APPLIES TO HATCHERY PROGRAMS ONLY
   a. yes
   b. no

32. [#14] For **natural stocks**, how is the stock potentially (directly or indirectly) affected by hatchery programs in the subbasin? Through:

a. directed supplementation
b. unintended straying
c. competition
d. predation
e. hatchery structures or water quality/quantity
f. broodstock collection
g. monitoring and research activities
h. not affected
i. harvest

Comments:

Data Source:

33. [#13] **Catch and Escapement**. Enter catch and escapement information in the left-hand table and survival information in the right-hand table for this stock for the most recent 12 years for which data is available. Enter goals in the shaded, first row of each table. Enter **NA** if *Not Applicable* and **M** if information is *Missing*.

Return Year	*Total Catch (all ages)*	*Escapement*		
		NoR's Spawning	*NoR's to Hatchery*	*HoR's*
Goal				

Brood Year	*Smolt to Adult Return Survival (%)*	*Recruits per Spawner*

Comment:
Source of data/information:

Appendix C: APRE Questionnaire, Form 2

APRE FORM 2[7]: Hatchery Program Description

(The following is a list of the questions in form 1, the actual form as used in the survey can be viewed on APRE on-line questionnaire.)
Form 2 has four parts: Parts A covers hatchery program description, Part B consists of the questions derived from the APRE framework (conditions for success), Part C covers the Hatchery Genetics Management Plan items related to threatened and endangered species (response to most of the HGMP items will be provided though the answers to Part B questions), and Part D covers the supporting data.

The questions that follow all pertain to the following hatchery program
_____(NAME OF PROGRAM)
_____(SUBBASIN –of release)
_____(PROVINCE –of release)
_____(SPECIES/RACE)
_____(DATE)

Part A: Program Description

The first set of questions deal with a general description of the hatchery program.

Question 1: [1121] Using the table provide the planned release numbers, size data, release date and release location for the program.

Age Class	Maximum Number	Size (fpp)	Release Date	Location			
				Stream	Release Point (RKm)	Major Watershed	Eco-province
Eggs							
Unfed Fry							
Fry							
Fingerling							
Yearling							

Data Source

[7] Dr. Don A. Dillman, Washington State University, provided invaluable help in structuring this form to assure accurate and complete responses to the questions.

Question 2: [#2053]
Briefly describe the hatchery program including the following items:

Broodstock source: _____
Broodstock collection location (Stream, RKM, subbasin):_____
Adult holding location (Stream, RKM, subbasin):_____
Spawning location (Stream, RKM, subbasin):_____
Incubation location (Facility name, stream, RKM, subbasin):_____
Rearing location (Facility name, stream, RKM, subbasin):_____

Comments:
Source:

Question 3: [#1003]

First, identify the agency or organization that operates this hatchery program: _____(name of agency)

Next, the name and address of the contact person for the program is:
Name: _____
Address: _____
_____
Phone: _____
Fax: _____
Email: _____.

Question 4: [#1004]

Name any co-operators (other agencies, tribes, or organizations involved—including contractors) involved with this program:

1. _____ 4. _____
2. _____ 5. _____
3. _____ 6. _____

For each cooperator briefly describe their involvement in the program:
1.
2.
etc.

The next three questions deal with program funding and costs. Note that these costs/funds pertain to the specific program costs- NOT to those of the entire facility or complex.

(If cost estimates for the individual program is not available, indicate the total cost for the facility and the proportion of the total poundage attributable to this program.)

Question 5: [#1005]

First, what are the funding sources for the program?

List sources:

_____

_____

Question 6: [#2005]

a. Next, what is the number of full time equivalent staff?_____[enter number]

b. What are the annual operating costs? _____[enter approximate dollar amount]

Question 7: [#1020]

What was the first year of operation for this hatchery program? (This is the first year fish were released for this program.)

_____ [enter year here]?

Question 8: [#1007] (*Note: this question is worded as a multiple choice question on the web form****)

Hatchery programs are typically classified as either *integrated* or *segregated*.

Is your program *integrated*. _____*(Yes or No)*

(If *No* we can assume that it is segregated)

Next we will talk about the purpose of your program.

Question 9: [#1008]

a. Is it the purpose of the program to provide *harvest?*. _____*(Yes or No)*

b. Is it the purpose of the program to contribute to *conservation/recovery?* _____*(Yes or No)*

c. Is the purpose of the program *research and/or education.* _____*(Yes or No)*

Question 10: [#1009]

a) Is this program mitigation for hydro impacts? _____ *(Yes or No)*
b) Is this program mitigation for habitat loss? _____ *(Yes or No)*
c) Is this program mitigation for impacts other than hydro or habitat? _____ *(Yes or No)*

The following question pertains to the guidelines followed by your program.

Question 11: [#2054]

List the fish culture guidelines followed for this program (*check all that apply*)

a) _____IHOT
b) _____PNFHPC
c) _____State guidelines
d) _____Tribal guidelines
e) _____Federal guidelines
f) _____Other guidelines (please specify)

Part B: Facilities and Operations

Next we would like to talk about the facilities and operations involved with your hatchery program. First we have several questions that deal with the water sources used for adult holding, incubation and rearing. We start with <u>adult holding</u>. (*If standards other than IHOT are followed, specify in comments section*.)

Question 12: [#1033]

For adult holding:

a) Is the water source [for adult holding] gravity flow? _____*(Yes or No)*
b) Is the water source [for adult holding] pumped? _____*(Yes or No)*
c) Is the water source [for adult holding] pathogen-free? _____*(Yes or No)*
d) Is the water source [for adult holding] specific-pathogen free? _____*(Yes or No)*
e) Is the water source [for adult holding] fish free? _____*(Yes or No)*
f) Is the water source [for adult holding] accessible to anadromous fish? _____*(Yes or No)*
g) Is water [for adult holding] available from multiple sources? _____*(Yes or No)*
h) Is water [for adult holding] from the natal stream for the cultured stock? _____*(Yes or No)*

i) Does the water used [for adult holding] result in natural water temperature profiles that provide optimum maturation and gamete development? _____*(Yes or No)*
j) Does the water used [for adult holding] meet or exceed the recommended Integrated Hatchery Operations Team (IHOT) water quality standards for temperature? _____*(Yes or No)*
k) Does the water used [for adult holding] meet or exceed the recommended Integrated Hatchery Operations Team (IHOT) water quality standards for the following compounds: ammonia, carbon dioxide, chlorine, pH, copper, dissolved oxygen, hydrogen sulfide, dissolved nitrogen, iron, and zinc? _____*(Yes or No)*
l) Is the water supply [for adult holding] protected by flow alarms at the intake(s) ? _____*(Yes or No)*
m) Is the water supply [for adult holding] protected by flow alarms at the head box? _____*(Yes or No)*
n) Is the water supply [for adult holding] protected by flow and/or pond level alarms at the holding pond(s) ? _____*(Yes or No)*
o) Is the water supply [for adult holding] protected by back-up power generation? _____*(Yes or No)*
p) Do naturally produced fish have access to intake screens? _____*(Yes or No)*
q) Do hatchery intake screening comply with Integrated Hatchery Operations Team (IHOT) and National Marine Fisheries Service facility standards? _____*(Yes or No)*

Next we go to water source questions for <u>incubation</u>.

Question 13. [#1035]
For incubation:

a. Is the water source [for incubation] gravity flow? _____*(Yes or No)*
b. Is the water source [for incubation] pumped? _____*(Yes or No)*
c. Is the water source [for incubation] pathogen-free? _____*(Yes or No)*
d. Is the water source [for incubation] specific-pathogen free? _____*(Yes or No)*
e. Is the water source [for incubation] fish free? _____*(Yes or No)*
f. Is the water source [for incubation] accessible to anadromous fish? _____*(Yes or No)*
g. Is water [for incubation] available from multiple sources? _____*(Yes or No)*
h. Is water [for incubation] from the natal stream for the cultured stock? _____*(Yes or No)*
i. Does the water used [for incubation] provide natural water temperature profiles that result in hatching/emergence timing similar to that of the naturally produced stock? _____*(Yes or No)*
j. Can incubation water [for incubation] be heated or chilled to approximate natural water temperature profiles? _____*(Yes or No)*

k. Does the water used [for incubation] meet or exceed the recommended Integrated Hatchery Operations Team (IHOT) water quality standards for temperature? _____*(Yes or No)*
l. Does the water used [for incubation] meet or exceed the recommended Integrated Hatchery Operations Team (IHOT) water quality standards for the following compounds: ammonia, carbon dioxide, chlorine, pH, copper, dissolved oxygen, hydrogen sulfide, dissolved nitrogen, iron, and zinc? _____*(Yes or No)*
m. Is the water supply [for incubation] protected by flow alarms at the intake(s) ? _____*(Yes or No)*
n. Is the water supply [for incubation] protected by flow alarms at the head box ? _____*(Yes or No)*
o. Is the water supply [for incubation] protected by flow alarms at the incubation unit(s) ? _____*(Yes or No)*
p. Is the water supply [for incubation] protected by back-up power generation? _____*(Yes or No)*
q. Do naturally produced fish have access to intake screens? _____*(Yes or No)*
r. Does hatchery intake screening comply with Integrated Hatchery Operations Team (IHOT) and National Marine Fisheries Service facility standards? _____*(Yes or No)*

Next a similar set of questions for the <u>rearing water supply</u>.

<u>Question 14</u>**.** [#1037]

For rearing:

a. Is the water source [for rearing] gravity flow? _____*(Yes or No)*
b. Is the water source [for rearing] pumped? _____*(Yes or No)*
c. Is the water source [for rearing] pathogen-free? _____*(Yes or No)*
d. Is the water source [for rearing] specific-pathogen free? _____*(Yes or No)*
e. Is the water source [for rearing] fish free? _____*(Yes or No)*
f. Is the water source [for rearing] accessible to anadromous fish? _____*(Yes or No)*
g. Is water [for rearing] available from multiple sources? _____*(Yes or No)*
h. Is water [for rearing] from the natal stream for the cultured stock? _____*(Yes or No)*
i. Does the water used [for rearing] provide natural water temperature profiles that result in fish similar in size to naturally produced fish of the same species? _____*(Yes or No)*
j. Does rearing water [for rearing] have a chemical profile significantly different from natural stream conditions to provide adequate imprinting of hatchery fish and minimize the attraction of naturally produced fish into the hatchery? _____*(Yes or No)*

k. Does the hatchery operate to allow all migrating species of all ages to by-pass or pass through hatchery related structures? _____*(Yes or No)*

l. Are adequate flows maintained to provide unimpeded passage of adults and juveniles in the by-pass reach created by hatchery water withdrawals? _____*(Yes or No)*

m. Does the water used [for rearing] meet or exceed the recommended Integrated Hatchery Operations Team (IHOT) water quality standards for temperature? _____*(Yes or No)*

n. Does the water used [for rearing] meet or exceed the recommended Integrated Hatchery Operations Team (IHOT) water quality standards for the following compounds: ammonia, carbon dioxide, chlorine, pH, copper, dissolved oxygen, hydrogen sulfide, dissolved nitrogen, iron, and zinc? _____*(Yes or No)*

o. Is the water supply [for rearing] protected by flow alarms at the intake(s) ? _____*(Yes or No)*

p. Is the water supply protected [for rearing] by flow alarms at the head box ? _____*(Yes or No)*

q. Is the water supply [for rearing] protected by flow alarms at the rearing unit(s) ? _____*(Yes or No)*

r. Is the water supply [for rearing] protected by back-up power generation? _____*(Yes or No)*

s. Do naturally produced fish have access to intake screens? _____*(Yes or No)*

t. Do hatchery intake screening comply with Integrated Hatchery Operations Team (IHOT) and National Marine Fisheries Service facility standards? _____*(Yes or No)*

Next we take a look at the hatchery discharge.

Question 15. [#1039]

a. Does the facility operate within the limitations established in its National Pollution Discharge Elimination System (NPDES) permit? _____*(Yes or No)*

b. If the production from this facility falls below the minimum production requirement for an NPDES permit, does the facility operate in compliance with state or federal regulations for discharge? _____*(Yes or No)*

c. Does the facility have a discharge permit? _____*(Yes or No)*

The next set of questions deal with broodstock collection.

Question 16: [#1246]

In this hatchery program:

a. is broodstock collected by volitional return to adult capture pond? _____*(Yes or No)*

b. is broodstock collected at another facility? _____*(Yes or No)*

c. is broodstock collected from wild by weir? _____*(Yes or No)*
d. is broodstock collected from wild by net? _____*(Yes or No)*
e. is broodstock collected from wild by hook and line? _____*(Yes or No)*
f. is broodstock collected from wild by gaffing? _____*(Yes or No)*
g. is broodstock collected by methods other than those mentioned above? _____*(Yes or No)*
h. does spawning take place in covered facility? _____*(Yes or No)*
i. does spawning takes place at remote location? _____*(Yes or No)*

The following questions pertain to CHOICE of broodstock

Question 17: [#1260]
Does the broodstock chosen represent natural populations native to the watersheds in which hatchery fish will be released? _____*(Yes or No)*

Question 18: [#1261]
If stock has been extirpated, is the broodstock chosen likely to adapt to the system based on life history and evolutionary history? _____*(Yes or No)*

Question 19: [#1262]
Does the broodstock chosen display morphological and life history traits similar to the natural population? _____*(Yes or No)*

Question 20: [#1263]
Does the broodstock chosen have a history of pathogens NOT endemic to the watershed? _____*(Yes or No)*

Question 21. [#1264]
Does the broodstock chosen have the desired life history traits to meet harvest goals? (e.g. timing and migration patterns that result in full recruitment to target fisheries)_____*(Yes or No)*

The following information request and questions pertain to COLLECTION of broodstock

Question 22: [#1051]
Are sufficient numbers of donors collected from the natural stock to minimize founder effects? _____*(Yes or No)*

Question 23: [#1052]
Is intentional artificial selection of broodstock practiced with respect to size, age, sex ratio, run or spawn timing or other trait? _____*(Yes or No)*

Question 24: [#1053]

Are representative samples of natural and hatchery population components collected with respect to size, age, sex ratio, run and spawn timing, and other traits important to long-term fitness? (*For integrated populations, consider both natural and hatchery components; for segregated populations, you should only consider the hatchery component*.) _____*(Yes or No)*

Question 25: [#1054]
Does the proportion of the spawners brought into the hatchery follow a "spread-the-risk" strategy that attempts to improve the probability of survival for the entire population (hatchery and natural components)? _____*(Yes or No)*

Question 26. [#1055]
If the wild population has 150 fish or more, is collection of wild broodstock limited to 30% of the population? _____*(Yes or No)*

Question 27: [#1056]
Are sufficient broodstock collected to maintain an effective population size of 1000 fish per generation? (More than 500 successful spawners of each sex.) _____*(Yes or No)*

Question 28: [#1057]
Is more than 10% of the broodstock derived from wild fish each year?_____*(Yes or No)*

The following questions pertain to hatchery fish spawning in the wild

Question 29: [#1271]
Do you have guidelines for acceptable contribution of hatchery origin fish to natural spawning? _____*(Yes or No)*

Question 30: [#1272]
Are guidelines for hatchery contribution to natural spawning met for all affected naturally spawning populations? _____*(Yes or No)*

Please provide relevant documentation to support this answer.

The next set of questions deal with fish health standards for broodstock handling.

Question 31: [#1062]
Does the program avoid stock transfers and subsequent releases of eggs or fish from outside the watershed? _____*(Yes or No)*

If no, provide a brief description of the transfers in the comments box.

Question 32: [#1063]

a. Are Integrated Hatchery Operations Team (IHOT), Pacific Northwest Fish Health Protection Committee (PNFHPC), state or tribal guidelines followed for *broodstock fish health inspection*? _____*(Yes or No)*
b. Are IHOT, PNFHPC, state or tribal guidelines followed for *transfer of eggs or adults*? _____*(Yes or No)*
c. Are IHOT, PNFHPC, state or tribal guidelines followed for *broodstock holding and disposal of carcasses*? _____*(Yes or No)*

Question 33: [#1064]
Is the broodstock collected and held in a manner that results in less than 10% prespawning mortality? _____*(Yes or No)*

The calculation should include capture and holding up to spawning.

Next we address health standards for adult holding…

Question 34: [#1066]

a. Are Integrated Hatchery Operations Team (IHOT) adult holding guidelines followed for loading? _____*(Yes or No)*
b. Are IHOT adult holding guidelines followed for density? _____*(Yes or No)*
c. Are IHOT adult holding guidelines followed for water quality? _____*(Yes or No)*
d. Are IHOT adult holding guidelines followed for alarm systems? _____*(Yes or No)*
e. Are IHOT adult holding guidelines followed for predator control measures to provide the necessary security for the broodstock? _____*(Yes or No)*

The following questions pertain to spawning…

Question 35: [#1070]
Are males and females available for spawning on a given day randomly mated? _____*(Yes or No)*

Question 36: [#1071]
Are gametes pooled prior to fertilization? _____*(Yes or No)*

Question 37: [#1072]
Are back-up males used in the spawning protocol? _____*(Yes or No)*

Question 38: [#1073]
Are precocious males (e.g. mini-jacks and jacks) used for spawning as a set percentage or in proportion to their contribution to the adult run? (note whether mini-jacks are used in the comment box.)_____*(Yes or No)*

Question 39: [#1076]
Are fish allowed to select their own mates and go through all normal spawning behavior in a natural environment? _____*(Yes or No)*

Question 40: [#1077]
Are disinfection procedures during adult spawning implemented that prevent pathogen transmission between stocks of fish on site? (i.e. no leakage into other holding ponds, equipment is disinfected, no water reuse, etc.) _____*(Yes or No)*

(If you have written protocols then list the document in the data source box.)

Question 41: [#1078]
Is spawning waste collected and disinfected prior to discharge to receiving water? (e.g. Is ovarian fluid and blood from spawning activities disinfected or simply discharged into receiving waters? If discharged, the answer is no) _____*(Yes or No)*

Next we will talk about incubation and rearing operations of the program…

Question 42: [#1081] Are eggs incubated under conditions that result in equal survival of all segments of the population to ponding? (Does any portion of the eggs derive a survival advantage or disadvantage from incubation procedures? If yes, then mark NO in above box.)_____*(Yes or No)*

Question 43: [#1082] Are incubation conditions manipulated as to synchronize ponding of fry? _____*(Yes or No)*

Question 44: [New Question #2055] For each brood, how many times are eggs culled for this program? (*Select best answer*)

a) 0
b) 1
c) 2
d) >2

Question 45: [#2044] If eggs are culled, is culling done randomly over all segments of the egg-take? _____*(Yes or No)*

Question 46: [#1083]
Are eggs incubated in a manner that allows volitional ponding of fry? _____*(Yes or No)*

Question 47: [#1097]
Are families within spawning groups mixed randomly at ponding so that unintentional rearing differences affect families equally? _____*(Yes or No)*

Question 48: [#1084]

Are families incubated individually? (Includes both eying and hatching.)_____*(Yes/No)*

Question 49: [#1085]
Does incubation take place in home stream water? _____*(Yes or No)*

Question 50: [#1086]
Does the program use water sources that result in hatching/emergence timing similar to that of the naturally produced population? _____*(Yes or No)*

The next several questions deal with IHOT recommendations for incubation…

Question 51: [#1088]

a. Are IHOT species-specific incubation recommendations followed for water quality? _____*(Yes or No)*
b. Are IHOT species-specific incubation recommendations followed for flows? _____*(Yes or No)*
c. Are IHOT species-specific incubation recommendations followed for temperature? _____*(Yes or No)*
d. Are IHOT species-specific incubation recommendations followed for substrate? _____*(Yes or No)*
e. Are IHOT species-specific incubation recommendations followed for incubator capacities? _____*(Yes or No)*

Question 52: [#1089]
Are disinfection procedures implemented during incubation that prevent pathogen transmission between stocks of fish on site? (Do you have written protocols? If so, describe in the data source box.) _____*(Yes or No)*

Question 53: [#1090]
Are eggs monitored when needed to determine fertilization efficiency and embryonic development? (Defines proper time to shock.) _____*(Yes or No)*

Question 54: [#1091]
Following eye-up stage, are eggs inventoried, and dead or undeveloped eggs removed and disposed of as described in the disease control guidelines? _____*(Yes or No)*

Next we will talk about how you determine when fry will be ponded…

Question 55: [#1093]

a. Are fry removed from incubation units when 80-90% of observed fry have yolk-sac material that is 80-90% utilized and contained within body cavity ("button-up")? _____*(Yes or No)*
b. Are fry ponded based on visual inspection of the amount of yolk remaining? _____*(Yes or No)*
c. Are fry ponded based on a reaching a specified number of accumulated temperature units? _____*(Yes or No)*
d. Are fry ponded based on a measured maximum wet weight? _____*(Yes or No)*
e. Are fry ponded based on the recommendations of the facility's fish health specialist? _____*(Yes or No)*

Question 56: [#1094]
Are eggs (dead or culled) discarded in a manner that prevents pathogen transmission to the receiving watershed? _____*(Yes or No)*
(Provide protocols in comment or cite data source)

Question 57: [#1095]
Are fish reared under conditions that result in equal survival of all segments of the population to release? _____(Yes or No)
(In other words, does any portion of the population derive a survival advantage or disadvantage from rearing procedures? If yes, then mark NO in box.)

Question 58: [#1096]
For Segregated Harvest programs, are all fish reared under environmental conditions to improve survival of all segments of the population? _____*(Yes or No)*
(For example, the answer to this question would be No, if growth of later returning steelhead is accelerate to meet juvenile release size guidelines.)

Question 59: [#2056]
For each brood, how often are juveniles culled in this program? (*Select the best answer*)
a) 0
b) 1
c) 2
d) >2

Question 60: [#1098]
If juveniles are culled, is culling done randomly over all segments of the population?

(Check the Does not apply box if juveniles are not culled. Otherwise, make sure to capture (in the comments box) the number culled, and the rational for culling. Include also, the disposition of juveniles)

Question 61: [#1099]
When required to maintain effective population size, are larger families culled to minimize family size variation? _____*(Yes or No)*

Next we have two questions about fish health…

Question 62: [#1100]
Are IHOT fish health guidelines followed to prevent pathogen transmission between lots or stocks of fish on site or transmission or amplification to or within the watershed? _____*(Yes or No)*
(If other standards/guidelines are used note in comments…get copy of guidelines.)

Question 63. [#1103]
Whenever possible, are vaccines used to minimize the use of antimicrobial compounds? _____*(Yes or No)*

The next set of questions deal with Feeding

Question 64: [#1105]
Does the operator follow:

a. Are proper feeding rates followed so that fish size is within 10% of program goal each year? _____*(Yes or No)*
b. Does the operator conduct periodic feed quality analysis? _____*(Yes or No)*
c. Is feed stored under proper conditions as described in IHOT guidelines? _____*(Yes or No)*

Question 65. [#1106]
Is the correct amount and type of food provided to achieve the desired: (Check all that apply)

a. Is the correct amount and type of food provided to achieve the desired growth rate? _____*(Yes or No)*
b. Is the correct amount and type of food provided to achieve the desired body composition? _____*(Yes or No)*
c. Is the correct amount and type of food provided to achieve the desired condition factors for the species and life stage being reared? _____*(Yes or No)*

Note: Body composition (b) determined by internal measurements (lipids etc.) while Condition factor (c) is based on physical measurements (Length and weight).

Question 66: [#1109]
Does the program use a diet and growth regime that mimics natural seasonal growth patterns? If not, describe the differences in the comment field. _____*(Yes or No)*

Note: For most programs this is rapid growth in spring, maintenance condition during winter. If yes, note in the comment box how this is determined.

Question 67: [#1110]
Are settleable solids, unused feed and feces periodically removed to ensure proper cleanliness of rearing container? _____*(Yes or No)*

In the comments field note what the procedure is and cite if there is a document that supports a yes answer to the question.

Next we will talk about whether the program is attempting to mimic natural rearing conditions

Question 68: [#1111] Is the program attempting to better mimic the natural stream environment?

a. Is the program attempting to better mimic the natural stream environment by reducing rearing density below agency or other guidelines? _____*(Yes or No)*
b. Is the program attempting to better mimic the natural stream environment by rearing under natural water temperature? _____*(Yes or No)*
c. Is the program attempting to better mimic the natural stream environment by actively simulating photoperiod? _____*(Yes or No)*
d. Is the program attempting to better mimic the natural stream environment by providing a range of hydraulic characteristics? _____*(Yes or No)*
e. Is the program attempting to better mimic the natural stream environment by subsurface feeding conditions? _____*(Yes or No)*
f. Is the program attempting to better mimic the natural stream environment by predator avoidance training? _____*(Yes or No)*
g. Is the program attempting to better mimic the natural stream environment by providing natural or artificial cover?

The next set of questions deal with the quality of fish produced from the program…

Question 69: [#1112]
Are the fish produced similar to natural fish:

a. Are the fish produced qualitatively similar to natural fish in size (fpp and length)? _____*(Yes or No)*
b. Are the fish produced qualitatively similar to natural fish in morphology? _____*(Yes or No)*
c. Are the fish produced qualitatively similar to natural fish in behavior? _____*(Yes or No)*
d. Are the fish produced qualitatively similar to natural fish in growth rate? _____*(Yes or No)*
e. Are the fish produced qualitatively similar to natural fish in physiological status? _____*(Yes or No)*
f. Are the fish produced qualitatively similar to natural fish in health? _____*(Yes or No)*
g. Are the fish produced qualitatively similar to natural fish in other characteristics?_____(explain)

Next we talk about guidelines for juvenile rearing…

Question 70: [#1113]
Are fish reared in multiple facilities or with redundant systems to reduce the risk of catastrophic loss? _____*(Yes or No)*

Question 71: [#2045] What is the basis for the juvenile rearing density and loading guidelines used at the facility?

a. Are juvenile rearing density and loading guidelines used at the facility based on *standardized agency guidelines?* _____*(Yes or No)*
b. Are juvenile rearing density and loading guidelines used at the facility based on *life-stage specific survival studies conducted on-site?* _____*(Yes or No)*
c. Are juvenile rearing density and loading guidelines used at the facility based on *life-stage specific survival studies conducted at other facilities?* _____*(Yes or No)*
d. Are juvenile rearing density and loading guidelines used at the facility based on *staff experience (e.g. trial and error)?* _____*(Yes or No)*
e. Are juvenile rearing density and loading guidelines used at the facility based on *other criteria?* _____*(Yes or No)*

Question 72: [1114]
Are IHOT rearing guidelines followed?

a. _____Are IHOT juvenile rearing standards followed for water quality? *(Yes or No)*
b. _____Are IHOT juvenile rearing standards followed for alarm systems? *(Yes or No)*
c. _____Are IHOT juvenile rearing standards followed for predator control measures to provide the necessary security for the cultured stock? *(Yes or No)*
d. _____Are IHOT juvenile rearing standards followed for loading?
e. _____Are IHOT juvenile rearing standards followed for density?

The next few questions apply to <u>captive broodstock</u> programs only. These questions should be skipped if they do not apply.

Question 73: [#1115]

a. For captive broodstocks, are fish maintained on a *natural photoperiod* to ensure normal maturation? _____*(Yes or No)*
b. For captive broodstocks, are fish maintained at 12^0C to minimize disease? _____*(Yes or No)*

Question 74: [#1116]

For captive broodstocks, are diets and growth regimes selected that produce potent, fertile gametes and reduce excessive early maturation of fish? _____*(Yes or No)*

If yes, describe in the comments how this objective is achieved.

Question 75: [#1117]
For captive broodstocks, are families reared individually to maintain pedigrees? _____*(Yes or No)*

The next two questions deal with record keeping…

Question 76: [#1118]
Does the fish inventory data accurately reflect pond or rearing vessel populations within 10%?._____*(Yes or No)*

In the comment box please provide the data to support the answer.

Question 77: [#1119]
Identify the inventory program (e.g. HATPRO) used at this facility
._____ [text]

Next we turn to questions about hatchery security…

Question 78: [#1255]
Is the facility sited so as to minimize the risk of catastrophic fish loss from flooding? _____*(Yes or No)*

In the comments box capture relevant data regarding flooding incidences and their severity at the hatchery.

Question 79: [#1256]
Is staff notified of emergency situations at the facility through the use of alarms, autodialer, and pagers? _____*(Yes or No)*

Question 80: [#1257]
Is the facility continuously staffed to ensure the security of fish stocks on-site? _____*(Yes or No)*

A yes answer means that someone either lives on-site or the facility is staffed 24-hours.

Now we will address the potential environmental impacts of the program…

Question 81: [#1258]
Has a facility riparian management plan been implemented that incorporates vegetation management, herbicide and pesticide use, and surface water management provisions? _____*(Yes or No)*

Question 82: [#1259]
Has an on or off-site facility habitat mitigation plan been implemented? _____*(Yes or No)*
The plan would have been designed to mitigate for hatchery facilities or operations.

Question 83: [#1120]
Does the hatchery operate to allow all migrating species of all ages to pass through hatchery related structures to maximize use of natural habitat? _____*(Yes or No)*

Provide rational for answer in comments box

The next set of questions deal release operations of the program.

Question 84: [#1125]
Are fish released at sizes and life history stages similar to those of natural fish of the same species? _____*(Yes or No)*

Document life-stages released in comment field.

Question 85: [#1126]
Are fish released at a time, size, location, and in a manner that achieves the harvest goals established for the stock? _____*(Yes or No)*

Question 86: [#1127]
Are volitional releases during natural out-migration timing practiced? _____*(Yes or No)*

For a yes answer, releases should occur over multiple-days to weeks. At least 90% of the fish exit rearing facility voluntarily.

Question 87: [#2046]
How is the migratory status of the release population determined?

a. Is the migratory status of the release population determined by *ATPase testing* (or other physiological tests)? _____*(Yes or No)*
b. Is the migratory status of the release population determined by *salt-water challenge?* _____*(Yes or No)*

c. Is the migratory status of the release population determined by *volitional release?* _____*(Yes or No)*
d. Is the migratory status of the release population determined by *behavior*? _____*(Yes or No)*
e. Is the migratory status of the release population determined by *condition factor*? _____*(Yes or No)*
f. Is the migratory status of the release population determined by *physical appearance?* _____*(Yes or No)*
g. Is the migratory status of the release population determined by *other criteria?* _____*(Yes or No)*

Question 88: [#1128]
Are fish released in a manner that simulates natural seasonal migratory patterns? _____*(Yes or No)*
Releases should occur over multiple-days to weeks during each season. (But does not have to be volitional)

Question 89: [#1129]
Are fish released at an optimum time and size that has been determined by a site-specific survival study? _____*(Yes or No)*
Cite study in Data Source Field

Question 90: [#1130]
Are fish released at an optimum time and size that has been determined by survival studies from another facility? _____*(Yes or No)*

Question 91: [#1131]
Are fish released at a specific time and size specified in an established juvenile production goal? _____*(Yes or No)*
Provide data in comments if not already entered previously.

Question 92: [#1132]
Are fish released at a specific time and size based on favorable environmental conditions in the receiving habitat? _____*(Yes or No)*
Describe in comments

Question 93: [#1265]
Has the carrying capacity of the **subbasin** been taken into consideration in sizing this program in regards to determining the number of fish released? _____*(Yes or No)*

Question 94: [#1135]
Are fish released in stream reaches within the historic range of that stock? _____*(Yes or No)*

Question 95: [#1136]
Are fish released at times of the year and sizes to allow adoption of multiple life history strategies? _____*(Yes or No)*

The answer to this question is Yes, if hatchery is releasing multiple life-stages, on different release dates (over many weeks or months).

Question 96: [#1138]
Are fish released in the same subbasin as rearing facility? _____(Yes or No)
This question is trying to determine if fish (juveniles) are transported into the subbasin.

The next couple of questions deal with health and inspection issues

Question 97: [#1139]
Are all fish examined for presence of "reportable pathogens" as defined in the PNFHPC disease control guidelines, no less than 3 weeks prior to release? _____*(Yes or No)*

Question 98: [#1140]
Are fish transfers into the subbasin inspected and accompanied by appropriate notifications as described in IHOT or PNFHPC guidelines? _____*(Yes or No)*

Question 99: [#1141] Are Integrated Hatchery Operations Team (IHOT) guidelines followed for fish transport? _____*(Yes or No)*
If no, list other guidelines followed in comment box.

Next we have three questions about fish marking…

Question 100: [#1142]
Are marking/tagging techniques used to distinguish among segments of the hatchery population (e.g. yearlings or subyearlings)? _____*(Yes or No)*

Question 101: [#1266]
Are 100% of the hatchery fish marked so that they can be distinguished from the natural populations? _____*(Yes or No)*

Note that marking can be internal or external.

Question 102: [#1143]
Can marked fish be identified using non-lethal means? _____*(Yes or No)*

Question 103: [#1145]
Are hatchery adults (carcasses or live fish) distributed by staff within the subbasin?

a. Are hatchery adults distributed (by staff) within the subbasin to provide ecological benefits (marine nutrients, wildlife food etc.)? _____*(Yes or No)*

b. Are hatchery adults distributed (by staff) within the subbasin to provide fishing opportunity? _____*(Yes or No)*
c. Are hatchery adults distributed (by staff) within the subbasin to provide natural production? _____*(Yes or No)*

Note: Could be carcasses or live fish

Question 104: [#2047]
What percent of the naturally spawning population in the subbasin consists of adults from this program? Check best answer!

a. Adults from this program make up *less than 5% of the natural* spawning escapement (for the species/race) in the subbasin.
b. Adults from this program make up *between 5 and 30% of the natural* spawning escapement (for the species/race) in the subbasin.
c. Adults from this program make up *more than 30% of the natural* spawning escapement (for the species/race) in the subbasin.

Question105: [#2057]
The percent of hatchery fish spawning in the wild each year is estimated by: (*Check all that apply*)

a) Annual stream surveys (e.g. carcasses)
b) Escapement data from a weir or dam
c) Staff experience
d) Harvest records, creel surveys
e) Is not estimated

Question 106: [#2048]
Wild fish make up what percent of the broodstock for this program?

a. Wild fish make up *less than 5% of the broodstock* for this program.
b. Wild fish make up *between 5 and 30% of the broodstock* for this program
c. Wild fish make up *more than 30% of the broodstock* for this program.

Question 107: [#2058]

The percent of wild fish used as broodstock for this program is estimated based on: (*Check all that apply*)

a) External marks (e.g. fin clips)

b) Internal marks (CWT, Pit tags)

c) Staff experience

d) Is not estimated

Next we move to a different topic …the following questions pertain to accountability…

Question 108: [#1149]
Are key hatchery personnel aware of the goals for the hatchery with respect to conservation, harvest and other purposes? _____*(Yes or No)*

In the comment box describe how they are made aware of goals (written report?)

Question 109: [#1150]
Are expenditures tracked to assure that funds are expended as intended for the hatchery program? _____*(Yes or No)*

Question 110: [#1151]
Are key staff aware of the funding available for carrying out the various activities in the production cycle so that it can be done in the most cost effective manner? _____*(Yes or No)*

Question 111: [#2049]
Are hatchery programming and operational decisions based on an **Adaptive Management Plan**? _____*(Yes or No)*

(For example, is an annual report produced describing hatchery operations, results of studies, program changes etc? If a written plan does not exist then the answer is No.)

Question 112: [#1152]
Is all new relevant information from research or other sources made available to hatchery staff and others and used for attaining goals? _____*(Yes or No)*

Question 113: [#1153]
Is the most recent information obtained from monitoring and evaluation programs for the production cycle, including performance indicators and progress toward goals, taken into consideration when determining whether hatchery operations should be changed or not? _____*(Yes or No)*

Provide examples in the comments box if available.

Question 114: [#1154]
Is there a management program in place that assures that information pertaining to items #1150-1153 is available on a "real-time" basis and that changes warranted by that information are implemented? _____*(Yes or No) ("Real-time" is within a year.)*

Question 115: [#1155]
Are standards specified for in-culture performance of hatchery fish? _____*(Yes or No)*
Provide documentation in source box

Question 116: [#2050]
Are in-culture performance standards met? _____*(Yes or No)*
Provide documentation in source box.

Question 117: [#2051]
Are standards specified for post release performance of hatchery fish and their offspring? _____*(Yes or No)*

Question 118: [#2052]
Are post-release performance standards met? _____*(Yes or No)*

Question 119: [#1156]
Are there state or federal laws or policies that constrain the program by specifying objectives, such as numbers and size of fish produced? _____*(Yes or No) (Does not mean the NMFS estuary release numbers.)*

Next we will talk about education related questions…

Question 120: [#1157]
Is the hatchery facility open to the public during hours of operation? _____*(Yes or No)*

Question 121: [#1158]
Are the hatchery operations visible to facility visitors? _____*(Yes or No)*

Question 122: [#1159]
Are hatchery operations (egg take, incubation, rearing) demonstrated to the public? _____*(Yes or No)*

Question 123: [#1160]
Does the facility have a fish ladder and/or adult holding facilities that are open to the public? _____*(Yes or No)*

Question 124: [#1161]
Does the hatchery have signage describing the facility, fish production goals, ties to management goals, and ecosystem function? _____*(Yes or No)*

Question 125: [#1162]
Is there a visible link to the riparian zone such as viewing boardwalk or bridge? _____*(Yes or No)*

Question 126: [#1163]
Is the facility used by other fish and wildlife programs? _____*(Yes or No)*

Question 127: [#1164]
Does the hatchery schedule tours for groups? _____*(Yes or No)*

Question 128: [#1165]
Does the program provide opportunities for student interns? _____*(Yes or No)*

Question 129: [#1166]
Does the program provide opportunities for citizen volunteer involvement? _____*(Yes or No)*

Question 130: [#1167]
Does the agency maintain a web page describing the hatchery program? _____*(Yes or No)*

Question 131: [#1168]
Is a pamphlet or brochure describing agency or hatchery programs available?
_____*(Yes or No)*

Question 132: [#1169]
Are eggs or fish provided to volunteer groups and educational groups? _____*(Yes or No)*

Question 133: [#1170]
Is hatchery staff involved in community/volunteer meetings or outreach programs?
_____*(Yes or No)*

Question 134: [#1171]
Does hatchery staff regularly give classroom presentations? _____*(Yes or No)*

At least yearly in order to answer yes.

Question 135: [#1172]
Does hatchery staff participate in formal professional presentations/seminars?
_____*(Yes or No)*

Question 136: [#1173]
Is the facility used or does staff participate in agency, university, or other research projects? _____*(Yes or No)*

Question 137: [#1174]
Are data and information pertaining to the program accessible to interested parties?
_____*(Yes or No)*

Part C: HGMP Questions

Question 138 : [#1011]

Which of the following statements apply? (*Check all that apply*)

a. Hatchery fish are not accessible to fisheries
b. Hatchery fish accessible to fisheries because the fish produced are temporarily and/or spatially separated from weaker stocks
c. Hatchery fish accessible to fisheries because the fish produced are differentially marked to enable selective harvest
d. Hatchery fish accessible to fisheries because the fish produced are available in sufficient number to the fisheries (location, time, gear) that are intended to benefit from the program (i.e. to meet the harvest goals)
e. It is unknown if hatchery fish are accessible to fisheries

Question 139: [#1012]
Identify the performance indicators for harvest benefits.

Indicator	**Performance Standard**	**Indicator is monitored**
Spawner to spawner survival of hatchery fish.		
Contribution of hatchery fish to target fisheries.		
Angler success (hatchery fish per angler day) in target recreational fisheries		
Contribution of hatchery fish to cultural needs		
Selective harvest success (expected benefits of mass marking)		
Value of harvest (lbs)		
Quality of hatchery fish harvested		

In the Performance Standard box enter the performance standard for all that apply. You can use a number, provide a brief text description, and use NA for No Applicable, or U for unknown, and No if no standard is defined.

In the Indicator is monitored box; enter Y if the standard is monitored, N if it is not, NA if not Applicable, or U for unknown.

Question 140: [#1013]
Identify the performance indicators for harvest risks.

Indicator	**Performance Standard**	**Indicator is monitored**
Harvest impacts on co-mingled stocks		
Bias in run size estimation of natural stocks due to masking effect		
Lack of harvest access (under harvest due e.g. to co-mingling with weaker stocks)		

In the Performance Standard box enter the performance standard for all that apply. You can use a number, provide a brief text description, and use NA for No Applicable, or U for unknown, and No if no standard is defined.

In the Indicator is monitored box; enter Y if the standard is monitored, N if it is not, NA if not Applicable, or U for unknown.

Question 141: [#1014]
Identify the performance indicators for conservation benefits.

Indicator	**Performance Standard**	**Indicator is monitored**
Genetic and life history diversity (over time)		
Spawner to spawner reproductive success of hatchery fish		
Reproductive success of the receiving (supplemented) naturally spawning population		
Contribution to the abundance of the naturally spawning population		
Time and location of spawning		
Contribution to ecosystem function (e.g. through nutrient enhancement, food web effects, etc.)		

In the Performance Standard box enter the performance standard for all that apply. You can use a number, provide a brief text description, and use NA for No Applicable, or U for unknown, and No if no standard is defined.

In the Indicator is monitored box; enter Y if the standard is monitored, N if it is not, NA if not Applicable, or U for unknown.

Question 142: [#1015]
Identify the performance indicators for conservation risks.

Indicator	**Performance Standard**	**Indicator is monitored**
Unintended contribution of hatchery fish to natural spawning (through straying)		
Loss of genetic and life history diversity		
Loss of reproductive success		
Ecological interactions through competition with natural stocks (by life stage)		

Ecological interactions through predation on natural stocks (by life stage)		
Adverse effects of hatchery operations and facilities on fish migration		
Disease transfers		

In the Performance Standard box enter the performance standard for all that apply. You can use a number, provide a brief text description, and use NA for Not Applicable, or U for unknown, and No if no standard is defined.

In the Indicator is monitored box; enter Y if the standard is monitored, N if it is not, NA if not Applicable, or U for unknown.

Question 143: [#1016] Identify the performance indicators for information gain. Which of the following statements are true?

a. Hatchery program contributes to research to improve performance and cost effectiveness
b. New information affects change to the hatchery program through a structured adaptive decision making process
c. Hatchery program participates in basin wide-coordinated research efforts
d. Hatchery program actively contributes to public education
e. Funding for monitoring of performance indicators is adequate

Question 144: [#1017]
Describe plans and methods proposed to collect data necessary to respond to each "Performance Indicator" identified for the program.
[text field to be completed by manager/operator]

Question 145: [# 15]
Identify ESA-listed populations that may incidentally be affected by the program *(includes ESA-listed fish in target hatchery fish releases, adult returns, and broodstock collection areas)*

Question 146: [#1018]
Indicate whether funding, staffing, and other support logistics are available or committed to allow implementation of the monitoring and evaluation program.

[text field to be completed by manager/operator]

Question 147: [#1019]
Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from monitoring and evaluation activities.

(*e.g. "The Wenatchee River smolt trap will be continuously monitored, and checked every eight hours, to minimize the duration of holding and risk of harm to listed*

spring chinook and steelhead that may be incidentally captured during the sockeye smolt emigration period.)"

[text field to be completed by manager/operator]

Question 148: [#1021]
What will be the final year of hatchery program? Enter "U" if that is "Undetermined.

Question 149: [#1022]
If the answer to the previous question (hatchery termination date) is undetermined, which of the following statements are true?

a. The program is on-going with no planned termination
b. The program meets goals that cannot be accomplished in any other manner and is expected to continue indefinitely
c. The program is expected to end when goals can be met by other means not requiring artificial production
d. The program will be terminated when it is determined that the program will not meet its goals

Question 150: [#1025]
List all ESA permits or authorizations in hand for the hatchery program (select one or more):

a. Section 7 or Section 10 permit
b. 4D rule
c. 401 certification
d. Other (Specify)
e. None

Question 151-153. [#1273, 1026, 2026] Provide projected annual take levels for listed fish by life stage (juvenile and adult) quantified (to the extent feasible) by the type of take resulting from the hatchery program (e.g. capture, handling, tagging, injury, or lethal take).

Table 1. Estimated listed salmonid take levels of by hatchery activity.

Listed species affected: _____ **ESU/Population:_____ Activity:_____** **Location of hatchery activity:_____ Dates of activity:_____ Hatchery program operator:_____**				
	Annual Take of Listed Fish By Life Stage (*Number of Fish*)			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)				
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				

Listed species affected: _____	
ESU/Population:_____ Activity:_____	
Location of hatchery activity:_____ Dates of activity:_____ Hatchery program operator:_____	
Intentional lethal take f)	
Unintentional lethal take g)	
Other Take (specify) h)	

a. Contact with listed fish through stream surveys, carcass and mark recovery projects, or migration delay at weirs.
b. Take associated with weir or trapping operations where listed fish are captured and transported for release.
c. Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream.
d. Take occurring due to tagging and/or bio-sampling of fish collected through trapping operations prior to upstream or downstream release, or through carcass recovery programs.
e. Listed fish removed from the wild and collected for use as broodstock.
f. Intentional mortality of listed fish, usually as a result of spawning as broodstock.
g. Unintentional mortality of listed fish, including loss of fish during transport or holding prior to spawning or prior to release into the wild, or, for integrated programs, mortalities during incubation and rearing.
h. Other takes not identified above as a category.

Instructions:
1. An entry for a fish to be taken should be in the take category that describes the greatest impact.
2. Each take to be entered in the table should be in one take category only (there should not be more than one entry for the same sampling event).
3. If an individual fish is to be taken more than once on separate occasions, each take must be entered in the take table.

Question 154. [#1027] Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.

(*e.g. "The number of days that steelhead are trapped at Priest Rapids Dam will be reduced if the total mortality of handled fish is projected inseason to exceed the 1988-99 maximum observed level of 100 fish."*)

[text field to be completed by manager/operator]

Question 155. [#1028] Describe alignment of the hatchery program with any ESU-wide hatchery plan (e.g. *Hood Canal Summer Chum Conservation Initiative*) or other regionally accepted policies (e.g. the NPPC *Annual Production Review* Report and Recommendations - NPPC document 99-15). Explain any proposed deviations from the plan or policies.

(e.g. "The hatchery program will be operated consistent with the ESU-wide plan, with the exception of age class at release. Fish will be released as yearlings

rather than as sub-yearlings as specified in the ESU-wide plan, to maximize smolt-to-adult survival rates given extremely low run sizes the past four years.").
[text field to be completed by manager/operator]

Question 156. [#1029] List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates.

Question 157. [#1030] Relationship to harvest objectives.

Explain whether artificial production and harvest management have been integrated to provide as many benefits and as few biological risks as possible to the listed species. Reference any harvest plan that describes measures applied to integrate the program with harvest management.

[text field to be completed by manager/operator]

Question 158. [#1031] Relationship to habitat protection and recovery strategies.

Describe the major factors affecting natural production (if known). Describe any habitat protection efforts, and expected natural production benefits over the short- and long-term. For Columbia Basin programs, use NPPC document 99-15, section II.C. as guidance in indicating program linkage with assumptions regarding habitat conditions.

[text field to be completed by manager/operator]

Question 159. [#1032] Which of the following species co-occur to a significant degree with the program fish in either freshwater or early marine life stages.

Significant co-occurrence between program fish and this species (check all that apply)	
	Steelhead
	Pink
	Chum
	Sockeye
	Coho
	Chinook
	Bull Trout

Question 160. [#1251] Describe operational difficulties or disasters that have led to significant fish mortality.

[text field to be completed by manager/operator]

Question 161. [#1067] Are procedures in place that maintain broodstock collection within programmed levels?

If the answer is yes, describe that procedure:

Check all that apply	
	A collection plan for natural origin adults is in place that prevents collection of surplus fish
	All fish returning to the hatchery are needed to maintain the programmed hatchery level
	Excess adults are used for seeding available habitat in accordance with genetic guidelines
	Excess adults are culled at random and sold, buried, or donated to food banks depending on their quality

Questions 162. [#1074] Are cryopreserved gametes used?
If used describe the number of donors, year of collection, number of times donors were used in the past, and expected and observed viability.

[text field to be completed by manager/operator]

Question 163. [#1080] Describe circumstances where extra eggs may be taken *(e.g as a safeguard against potential incubation losses),* and the disposition of surplus fish safely carried through to the eyed-egg or fry stage to prevent exceeding programmed levels.
[text field to be completed by manager/operator]

Question 164. [#1101] For the facility, provide a five year disease history of pathogens that significantly affect fish health.
[text field to be completed by manager/operator]

Question 165. [#1102] Have hatchery specific performance standards for carrying capacity that consider fish health and post-release survival been developed and are they followed? (*yes/no*)

Question 166. [#1133] For off-station releases, describe fish acclimation procedures including methods applied and length of time.
[text field to be completed by manager/operator]

Question 167. [#1134] Describe disposition plans for fish identified at the time of release as surplus to programmed or approved levels.
[text field to be completed by manager/operator]

Question 168. [#1148] Describe emergency release procedures in response to flooding or water system failure.
[text field to be completed by manager/operator]

Research Information

Provide the following information for any research programs conducted in direct association with the hatchery program described in this HGMP. Provide sufficient detail

to allow for the independent assessment of the effects of the research program on listed fish. If applicable, correlate with research indicated as needed in any ESU hatchery plan approved by the co-managers and NMFS. Attach a copy of any formal research proposal addressing activities covered in this section. Include estimated take levels for the research program with take levels provided for the associated hatchery program.

Question 169. [#1175] What is the objective or purpose of the research program?

Indicate why the research is needed, its benefit or effect on listed natural fish populations, and broad significance of the proposed project.

[text field to be completed by manager/operator]

Question 170. [#1176] Identify cooperating and funding agencies.
[text field to be completed by manager/operator]

Question 171. [#1177] Identify principal investigator or project supervisor and staff.
[text field to be completed by manager/operator]

Question 172. [#1178] Identify stocks affected by the research project.
[text field to be completed by manager/operator]

Question 173. [#1179] Identify techniques used: include capture methods, drugs, samples collected, tags applied.
[text field to be completed by manager/operator]

Question 174. [#1180] Identify dates or time period in which research activity occurs.
[text field to be completed by manager/operator]

Question 175. [#1181] Describe the care and maintenance of live fish or eggs, holding duration, transport methods.

Question 176. [#1182] Describe the expected type and effects of take and potential for injury or mortality.

Question 177. [#1184] Identify alternative methods to achieve project objectives.

Question 178. [#1185] List species similar or related to the threatened species; provide number and causes of mortality related to this research project.

Question 179. [#1186] Indicate risk aversion measures that will be applied to minimize the likelihood for adverse ecological effects, injury, or mortality to listed fish as a result of the proposed research activities.
(*e.g. "Listed coastal cutthroat trout sampled for the predation study will be collected in compliance with NMFS Electrofishing Guidelines to minimize the risk of injury or immediate mortality.").*

Questions 180-182. [#1274, 1269, 1270] For research projects describe the level of take of listed fish: number or range of fish handled, injured, or killed by sex, age, or size (Table 1) if not already indicated above.

Table 1. Estimated listed salmonid take levels of by hatchery activity.

Listed species affected: _____ **ESU/Population:_____ Activity:_____**				
Location of hatchery activity:_____ Dates of activity:_____ **Hatchery program operator:_____**				
	Annual Take of Listed Fish By Life Stage *(Number of Fish)*			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)				
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

a. Contact with listed fish through stream surveys, carcass and mark recovery projects, or migrational delay at weirs.
b. Take associated with weir or trapping operations where listed fish are captured and transported for release.
c. Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream.
d. Take occurring due to tagging and/or bio-sampling of fish collected through trapping operations prior to upstream or downstream release, or through carcass recovery programs.
e. Listed fish removed from the wild and collected for use as broodstock.
f. Intentional mortality of listed fish, usually as a result of spawning as broodstock.
g. Unintentional mortality of listed fish, including loss of fish during transport or holding prior to spawning or prior to release into the wild, or, for integrated programs, mortalities during incubation and rearing.
h. Other takes not identified above as a category.

Instructions:

1. An entry for a fish to be taken should be in the take category that describes the greatest impact.
2. Each take to be entered in the table should be in one take category only (there should not be more than one entry for the same sampling event).
3. If an individual fish is to be taken more than once on separate occasions, each take must be entered in the take table.

Part D: Supporting Data Tables

Question 183. [#1010] Provide information on the broodstock source that has been used in the hatchery program in the last 12 years. Indicate where the broodstock source is from natural origin or hatchery origin fish
e.g. Natural origin returns from Howling Creek used 1980 – 1985, hatchery origin returns from returns to the Howling Creek hatchery 1986 – 1987 and 1991 – 2001, and hatchery origin returns from Silver Creek hatchery 1988 – 1990, e.g.:

Broodstock Source Used	*Year(s) Used*
Howling Creek Natural	*1980 – 1985*
Silver Creek Hatchery	*1988 - 1990*
Howling Creek Hatchery	*1986 - 1987,1991 - 2001*

Broodstock Source Used	**Year(s) Used**

Question 184. [#1034] Fill out the tables below choosing the source(s) of water available. Provide available information on flow and temperature means and ranges. For **adult holding:**

Water Source	***Mean Flow* (gpm)**	***Min. Flow* (gpm)**	***Max. Flow* (gpm)**	***Mean Temp.* ^{o}F**	***Min. Temp.* ^{o}F**	***Max. Temp.* ^{o}F**	***Mean D.O.* (ppm)**	***Min. D.O.* (ppm)**	***Max. D.O.* (ppm)**
Spring									
Well									
Surface Water									
Brackish Water									
Saltwater									

Question 185. [#1036] Same for **incubation.**

Water Source	***Mean Flow (gpm)***	***Min. Flow (gpm)***	***Max. Flow (gpm)***	***Mean Temp. ^{o}F***	***Min. Temp. ^{o}F***	***Max. Temp. ^{o}F***	***Mean D.O. (ppm)***	***Min. D.O. (ppm)***	***Max. D.O. (ppm)***
Spring									
Well									
Surface Water									

Question 186. [#1038] Same for **rearing.**

Water Source	***Mean Flow (gpm)***	***Min. Flow (gpm)***	***Max. Flow (gpm)***	***Mean Temp. ^{o}F***	***Min. Temp. ^{o}F***	***Max. Temp. ^{o}F***	***Mean D.O. (ppm)***	***Min. D.O. (ppm)***	***Max. D.O. (ppm)***
Spring									
Well									
Surface Water									

Brackish Water									
Saltwater									

Question 187. [#1047] Using the table below, indicate the type of fish transportation equipment used, the length of time in transit, and any chemical treatment and dosage applied during transport.

Equipment Type	**Capacity *(gallons)***	**Supplemental Oxygen *(Y/N)***	**Normal Transit Time**	**Chemical(s) Used**	**Dosage *(ppm)***
Tank					
Other Equipment					

Data Source

Question 188. [#1048] Using the following table, describe the type *(concrete, asphalt, gravel, etc),* pond volume, dimensions (if applicable) and flow for each broodstock holding pond.

# of Ponds	**Pond Type**	**Volume *(cu. ft.)***	**Length *(ft.)***	**Width *(ft.)***	**Depth *(ft.)***	**Available Flow *(gpm)***

Data Source

Question 189. [#1049] Using the following table fill in the number of each type of incubator, the water flow used, and volume (if applicable) and loading of incubation units.

Incubator Type	**Number of Units**	**Flow (*gpm)***	**Volume (if applicable)**	**Loading – Eyeing *(eggs/unit)***	**Loading – Hatching *(eggs/unit)***
Pull down list and other					

Data Source

Question 190. [#1050] Using the following table, describe the type *(concrete, asphalt, gravel, etc),* pond volume, dimensions (if applicable) and flow for each rearing, acclimation, and release pond.

# of Units	**Pond Type**	**Volume *(cu. ft.)***	**Length *(ft.)***	**Width *(ft.)***	**Depth *(ft.)***	**Flow *(gpm)***	**Maximum Flow Index**	**Maximum Density Index**

Data Source

Question 191. [#1065] Using the following table, enter the planned and past broodstock collection levels for the last 12 years, or for most recent years available.

Year	Adults			Eggs	Juveniles
	Females	Males	Jacks		
Planned					
1990					
1991					
1992					
1993					
1994					
1995					
1996					
1997					
1998					
1999					
2000					
2001					

Data Source

Question 192. [#1079] Using the following table, enter the program egg take, egg survival to eye-up and/or ponding, fry to fingerling survival, and fingerling to smolt survival for the last 12 years, or for most recent years available. Also provide any performance standards for incubation and rearing survival that the hatchery is operating under.

Year	Egg Take	Green-Eyed Survival *(%)*	Eyed-Ponding Survival *(%)*	Egg Survival Performance Standard	Fry – Fingerling Survival *(%)*	Rearing Survival Performance Standard	Fingerling – Smolt Survival *(%)*
1990							
1991							
1992							
1993							
1994							
1995							
1996							
1997							
1998							
1999							
2000							
2001							

Data Source

Question 193. [#1104] Provide a list of the vaccines used at this facility

Vaccine	Species

Question 194. [#1107] Using the table below, provide biweekly or monthly growth information *(average program performance),* including length, weight, condition factor, growth weight, and if available, hepatosomatic index *(liver weight/body weight)* and body moisture content as an estimate of body fat concentration data collected during rearing.

Rearing Period	**Length (mm)**	**Weight (fpp or gms)**	**Condition Factor**	**Growth Rate**	**Hepatosomatic Index**	**Body Moisture Content**

Data Source

Question 195. [#1108] Using the table below, indicate the food type used, daily application schedule, feeding rate range (e.g. % B.W./day and lbs/gpm inflow, and estimates of total food conversion efficiency during rearing *(average program performance).*

Rearing Period	Food Type	Application Schedule *(# feedings/day)*	Feeding Rate Range *(% B.W./day)*	Lbs. fed per gpm of inflow	Food Conversion During Period

Data Source

Question 196. [#1122] For existing programs, provide fish release number and size data for the past three fish generations, or approximately the past 12 years, if available.

Release year	Eggs/ Unfed Fry	Release Date	Avg size (fpp)	Fry	Release Date	Avg size (fpp)	Fingerling	Release Date	Avg size (fpp)	Yearling	Release Date	Avg size (fpp)
1991												
1992												
1993												
1994												
1995												
1996												
1997												
1998												
1999												
2000												
2001												
2002												
Average												

Data Source

Appendix D: Excerpts from APRE Database

Table D-1 shows a summary of the statistics used in this report. This only a small subset of the over 200 questions covered in this survey, the complete set of answers are contained in the APRE data base (www.APRE.INFO)

Table D-1. Summary responses to a subset of the questions in the APRE data base	All Programs	Integrated Programs	Segregated Programs
Operational Questions	**# Yes Answers**	**# Yes Answers**	**# Yes Answers**
Identify the program type (integrated or segregated)	106		
Has a final year of operation for this program been specified?	8	77	106
Are representative samples of natural and hatchery population components collected with respect to size, age, sex ratio, run and spawn timing, and other traits important to long-term fitness? Explain.	144	91	53
Are sufficient broodstock collected to maintain an effective population size of 1000 fish per generation? (More than 500 successful spawners of each sex.)	104	60	44
Is more than 10% of the broodstock derived from wild fish each year?	49	47	2
Does the program avoid stock transfers and subsequent releases of eggs or fish from outside the watershed? Explain.	108	82	26
Are fish released at sizes and life history stages similar to those of natural fish of the same species?	67	46	21
Are volitional releases during natural out-migration timing practiced? Explain	88	59	29
Are fish released in the same subbasin as rearing facility?	102	69	33
Can marked fish be detected using non-lethal means?	163	96	67
Are standards specified for in-culture performance of hatchery fish?	167	99	68
Has the carrying capacity of the subbasin been taken into consideration in sizing this program in regards to determining the number of fish released?	136	90	46
Are 100% of the hatchery fish marked so that they can be distinguished from the natural populations?	148	87	61
Do you have guidelines for acceptable contribution of hatchery origin fish to natural spawning?	137	87	50
Are guidelines for hatchery contribution to natural spawning met for all affected naturally spawning populations?	111	76	35
Is the purpose of the program to provide harvest?	151	83	68
Is the purpose of the program to contribute to conservation/ recovery?	85	75	10
Is the purpose of the program to contribute to research and/or education?	64	52	12
Is the program mitigation for hydro impacts?	159	93	66
Is the program mitigation for habitat loss?	123	75	48
Do you have a goal for spawning escapement composition (hatchery vs. natural) in the hatchery?	98	62	36

Table D-1. Summary responses to a subset of the questions in the APRE data base	All Programs	Integrated Programs	Segregated Programs
Operational Questions	**# Yes Answers**	**# Yes Answers**	**# Yes Answers**
Do you have a goal for spawning escapement composition (hatchery vs. natural) in the wild?	63	31	32
Do you have a goal for smolt-to-adult return survival?	76	54	22
Do you have goals for recruits per spawner (R/S)?	73	53	20
Wild fish make up less than percent of the broodstock for this program?	92	33	59
Are hatchery programming and operational decisions based on an adaptive management plan?	152	95	57
Are in-culture performance standards met?	160	96	64
Are standards specified for post-release performance of hatchery fish and their offspring?	133	82	51
Are post-release performance standards met?	76	38	38
Are natural rearing conditions simulated for:			
reducing rearing density below agency or other guidelines?	45	36	9
rearing under natural water temperature?	62	43	19
actively simulating photoperiod?	45	28	17
providing a range of hydraulic characteristics?	8	4	4
subsurface feeding conditions?	5	2	3
predator avoidance training?	8	6	2
cover?	19	10	9
does not apply/answer unknown/not yet answered	75	40	35

Table D-1. Summary responses to a subset of the questions in the APRE data base	All Programs	Integrated Programs	Segregated Programs
Operational Questions	**# Yes Answers**	**# Yes Answers**	**# Yes Answers**
Are the fish produced qualitatively similar to natural fish in:			
size	37	26	11
morphology	134	86	48
behavior	67	46	21
growth rate	13	10	3
physiological status	122	81	41
health	135	87	48
other	16	9	7
does not apply/answer unknown/not yet answered	18	4	14
If the answer to the previous question is undetermined, which of the following statements are true?			
Is the program on-going with no planned termination?	140	72	68
Does the program meet goals that cannot be accomplished in any other manner and is expected to continue indefinitely?	32	11	21
Is the program expected to end when goals can be met by other means not requiring artificial production	29	25	4
Will the program be terminated when it is determined that the program will not meet its goals?	12	5	7

Table D-2. How many anadromous hatchery programs contribute the indicated percentage to the naturally spawning population in their subbasin?

	0-5%	5-30%	>30%	unk
All Programs	**28**	**33**	**76**	**38**
Integrated Programs	**16**	**18**	**57**	**15**
Segregated Programs	**12**	**15**	**19**	**23**

Appendix E. Province Reports

A summary of findings by province is provided in electronic form on the enclosed CD. Attached to each province summary are the reports for all individual programs reviewed within the province. The Province reports focus on the anadromous hatchery programs. Information about resident programs included in the APRE review are available on the APRE database: www.APRE.INFO .

Appendix F: Public and Agency Comments

Comments on the Draft APRE Basin-Level Report (Document 2003-17) were received from various agencies and members of the public. The efforts of agency members and the public to respond to the call for comments on the draft report are very much appreciated. Indeed, the purpose of sending a document out in draft form for review by knowledgeable and interested persons is to receive comments in an effort to improve the final version. Table F-1 lists the persons from whom comments were received.

Table F-1: Participants in the Public Review

Name	Affiliation
Kevin Marshall	Member of public
Allan Vernon Minor	Member of public
D. Noble	Member of public
Lisa and Keith Hansen	Member of public
Rod Sando	Columbia Basin Fish and Wildlife Authority
Dale Kelley	Alaska Trollers Association
Joel Kawahara	Member of public
David L. Ward	American Fisheries Society, Oregon Chapter
Joe Peone	Colville Confederated Tribes
Keith Kutchins	The Shoshone-Bannock Tribes
William K. Drummond	Western Montana Electric Generating & Transmission Cooperative, Inc.
Harry L. Brunsdon	Member of public
Bill M. Bakke	Native Fish Society
Norman Nelson	Echo Film Productions
Steve Pauley	Member of public
Sue Ireland	Kootenai Tribe of Idaho
Stephen D. Zimmerman	Member of public
George Nandor	Oregon Department of Fish and Wildlife
Doug Fricke	Washington Trollers Association
Olney Patt, Jr.	Columbia River Inter-Tribal Fish Commission
Terry A. Larson	Bonneville Power Administration, U.S. Dept. of Energy
(No signature)	U.S. Fish and Wildlife Service, U.S. Dept. of Interior

The comments can be generally grouped into several categories: 1) comments outside the scope of the document, 2) comments about the context within which this document exists, 3) comments about the methodology and interpretation of data, 4) comments requesting inclusion of examples of hatchery "successes", 5) comments about a perceived anti-hatchery bias, 6) questions about fulfillment of the Congressional request, and 7) corrections, clarifications, and updates.

The first two categories are related to one another: the scope and the context of the document. It was clear that many reviewers expected this document to "do more" than was intended. This document, as stated in the introduction, contains a presentation of an in-depth evaluation of over 200 salmonid hatchery programs within the U.S. portion of the Columbia River Basin. The document does not purport to cover non-salmonid species nor does it cover hatchery programs outside the United States. It does not pretend to contain exhaustive analyses of harvest, economic factors, or the effects of hatcheries on fish populations (although these subjects will need to be considered during future deliberations regarding individual hatchery programs.) It does not present detailed "reform recipes" for each hatchery program. It is not the report to Congress. It simply presents the methodology and interpretation of data received and draws general conclusions from those data.

This report cannot be viewed in isolation; rather, it is part of an on-going, deliberate effort to produce a plan for hatchery reform that will be cost-effective, logical, fair, and environmentally responsible. It will not "sit on a shelf gathering dust" as was feared by some reviewers. On the contrary, it has already been used to formulate an issues paper which is currently in public review. The issues paper will be used in two ways: it will form the basis of a report to Congress and it will be used to formulate an implementation approach to hatchery review and reform. Implementation will involve consideration of funding sources, continued structure and use of the data base, and periodic reviews of hatchery programs. In addition, the database produced by APRE will be a "living" document in that it will continue to be updated and used by managers and other interested persons into the future. Many of the comments received from reviewers, while not applicable to this document, will be helpful in defining both issues and implementation strategies.

The APRE was designed to produce the most information possible within certain budgetary and time constraints. Given those constraints, APRE had to rely upon data provided by the managers and operators of the hatchery programs, as well as existing data bases and published literature. It was believed that the managers and operators could provide the greatest amount of up-to-date information through workshops and questionnaires. The methodology was based on a similar effort which had been successfully conducted elsewhere. It was assumed, furthermore, that the managers and operators were the most knowledgeable about the purposes and goals of the fish stocks in the programs for which they are responsible. The managers and operators were not asked to make decisions or draw conclusions about the purposes and goals of the programs; they were simply asked to report their understanding of them. It was recognized that there would be errors in the process, but it was felt that, through the on-line review and editing capability, those errors would be detected and corrected over time—as indeed they have been. Some errors on individual programs may still exist; however, the purpose of the initial exercise was to grasp the "big picture" and this goal has been achieved. All of the conclusions reached by the APRE are still valid. The database established by APRE is in place and available for use by interested persons. It is expected that, over time, the data base will evolve and will become more accurate and useful.

As scientific and technical knowledge has advanced, some hatchery programs have instituted changes to make their operations more effective and less environmentally risky. These efforts are applauded by the Council. There was no conscious attempt to ignore the successes that have occurred and are continuing to occur. However, it was clear that, for whatever reason, these efforts are still in the minority within the basin. The ultimate goal of the Council's effort, of which this report is a part, is to increase the benefits of all hatchery programs while reducing or eliminating risks.

Comments by some reviewers addressed a perceived anti-hatchery bias in the draft report. This was certainly not the intention of the Council and the draft has been reviewed to ensure that any wording that could be misinterpreted has been removed or changed. Reviewers should, however, understand that criticism of hatchery programs in an effort to recognize weaknesses and design improvements cannot be viewed as anti-hatchery bias.

Some reviewers did not understand that this document is not the report to Congress. That report is still forthcoming and will be based on the Basin-level report and the issues paper.

Finally, many reviewers submitted corrections, clarifications, and updated information. This information has been incorporated into the final version of the report.

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