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December 10, 1998

The Honorable John A. Kitzhaber
Governor of Oregon
State Capitol
Salem OR 973 10

The Honorable Brady Adams
Oregon Senate President
State Capitol
Salem OR 97310

The Honorable Lynn Lundquist
Oregon House Speaker
State Capitol
Salem OR 973 10

Gentlemen:

Enclosed is the technical report of the Independent Multidisciplinary Science Team on the Oregon Hatchery Program. The Team is sending the report to you, the appointing authority for the Team, and by copy of this letter to the Joint Legislative Committee on Salmon and Stream Enhancement, and to Mr. Roy Hemmingway, Manager of the Oregon Plan for Salmon and Watersheds. I am also providing copies Friday, December 11 to the Coastal Salmon Restoration and Production Task Force at their meeting in Salem. GWEB is making arrangements for further production and distribution of this report.

This report is on phase I of our longer-term project dealing with hatcheries. It focuses on the consistency of the Oregon Plan hatchery program with the recommendations of three independent hatchery review panels that have concluded their work in recent years. Recommendations or perspectives that were common across these panels were accepted by MST has having a high degree of scientific validity, and should in our opinion be adequately reflected in the Oregon Plan. We plan other reports on various elements of hatchery practices and management. III keep you appraised of these plans as they develop.

The IMST is pleased to have this opportunity to be of service to the people of Oregon.

Sincerely yours,

Logan A. Norris, Chair
Independent Multidisciplinary Science Team

LAN:grs

Enclosure

cc: JLCSSE, with enclosure

REVIEW OF THE HATCHERY MEASURES IN THE OREGON PLAN FOR SALMON AND WATERSHEDS

Part I: Consistency of the Oregon Plan with Recommendations from Recent Scientific Review Panels

Report 1998-1

A report of the
Independent Multidisciplinary Science Team,
Oregon Plan for Salmon and Watersheds

December 10, 1998

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EXECUTIVE SUMMARY

This is the first report on the Independent Multidisciplinary Science Team's review of the hatchery-related measures in the Oregon Plan for Salmon and Watersheds (Oregon Plan). This first report focuses on the consistency of the Oregon Plan with issues common to the findings of three independent scientific panels regarding hatchery management. The key question addressed by IMST in this report is: Does the Oregon Plan recognize the concerns common to the three science panels, and do the measures in the Oregon Plan adequately address those concerns? Other reports by IMST will address various aspects of hatchery programs and management.

The three scientific panels were:

- **National Fish Hatchery Review Panel.**
- **Up Stream: Salmon and Society in the Pacific Northwest.**
- **Return to the River: Restoration of Salmonid Fishes in the Columbia River Ecosystem.**

The three panels were in agreement on four important issues. The IMST describes these issues, determined the consistency of the Oregon Plan with them, and makes recommendations where improvements are needed.

Issue 1. Hatchery programs have failed to meet their objectives. Most hatcheries were built to mitigate for habitat lost during the development of rivers by replacing native fish with hatchery-produced fish. In spite of some examples of success, they generally have not achieved that goal.

The IMST concludes *that the Oregon Plan is not adequately addressing the question of hatchery effectiveness.*

Issue 2. Management of hatchery programs has impacted wild stocks. Hatchery management such as broodstock selection, mixed stock fisheries, and interbasin transfers are perceived to be generally detrimental to wild stocks of salmon and has failed to conserve salmon biodiversity. Since these problems are largely related to hatchery management they should be solvable.

The IMST concludes *that the Oregon Plan recognizes the issue because it has adopted measures designed to address at least two elements of the issue. However, the Oregon Plan does not include procedures to determine effectiveness, relying on indirect measures such as the ratio of wild to hatchery fish on spawning beds. ODFW's annual report of hatchery operations states that this monitoring strategy "… documents the presence and abundance of hatchery fish but not interactions between hatchery and wild fish*." (Oregon Plan for Salmon and Watersheds. Annual Report. 1998. Governor's Natural Resources Office. Salem, OR. (503) 378-3548). *The ratio of wild to hatchery*

fish is one useful measure of the potential for interaction, but it is insufficient as a basis for evaluating the impact of such interactions, and therefore the degree to which hatchery management actions are addressing the concern in issue 2.

Issue 3. Monitoring of hatchery programs is inadequate. Hatchery programs have not been adequately monitored. This lack of monitoring has made it difficult to determine why hatcheries have failed to meet their objectives, and to identify and correct the genetic and ecological risks that hatcheries pose to wild stocks.

The IMST concludes *that the Oregon Plan recognizes the need to monitor the hatchery program. However, the program described in the Oregon Plan is not adequate.*

Issue 4. Hatchery programs need fundamental change in order to support recovery of wild stocks. This issue is a logical outcome of the first three. All three panels recognized the need for fundamental change in the hatchery programs. They generally acknowledge that hatchery programs can support the restoration of natural production, but as currently managed they do not.

The IMST concludes *that the Oregon Plan recognizes the need for change in the hatchery program, as evidenced by two measures (1) fully implementing ODFW's Wild Fish Management Policy, and (2) reducing the number of hatchery fish released into coastal streams. The IMST's assessment of change in the hatchery program will be hampered until measure II.A.3 has been completed (adoption of objectives and management guidelines – see issue 1).*

Other changes may be needed in hatchery management, but these changes will require additional information from research or monitoring. The IMST recommendations are directed at obtaining this information.

Based on our findings, ***IMST recommends*** *that:*

1. *ODFW give measure II.A.3 (development of management objectives for each hatchery program, including genetic guidelines) of the Oregon Plan higher priority and complete the development and adoption of objectives and management guidelines for each coastal coho hatchery as quickly as possible.*
2. *ODFW establish and implement a specific program to determine if its coastal coho hatcheries are meeting their objectives, and the process by which management will be adapted if they are not.*
3. *ODFW develop and implement a program of research that determines the effects of wild-hatchery fish interactions.*
4. *Based on research findings (see recommendation 3), ODFW develop monitoring measures that can be used to judge the operational effectiveness of hatchery management programs with respect to their adverse impact on wild fish stocks.*

5. *ODFW develop a strategy that will be useful in quantifying and reducing the impact of mixed stock fisheries on the recovery of depressed OCN stocks.*
6. *ODFW determine the impact of hatchery release practices on predation of hatchery and wild fish. This should be coordinated with the ODFW Action Plan to assess avian and pinniped predation*
7. *ODFW use hatcheries as important tools in research that supports monitoring programs.*
8. *ODFW establish explicit coordination between hatchery programs and monitoring programs to help them ensure that they accomplish management and research objectives.*

REVIEW OF
THE HATCHERY MEASURES IN THE
OREGON PLAN FOR SALMON AND WATERSHEDS

Part I: Consistency of the Oregon Plan with Recommendations from Recent Scientific Review Panels

INTRODUCTION

The Independent Multidisciplinary Science Team is addressing the hatchery measures in the Oregon Plan for Salmon and Watershed (Oregon Plan) in several parts. Part I determines the consistency of the Oregon Plan with recommendations from three recent scientific reviews of hatchery programs with respect to Oregon coastal coho, and is the subject of this report. Other parts will address various aspects of hatchery practices and management.

In this report, the IMST determines the consistency of the hatchery measures contained in the Oregon Plan with the conclusions reached by three scientific panels regarding hatchery management. The IMST's summary of the findings from the three reviews is in Appendix A to this report. The three panels were:

1. **National Fish Hatchery Review Panel.**

2. **Up Stream: Salmon and Society in the Pacific Northwest.**

3. **Return to the River: Restoration of Salmonid Fishes in the Columbia River Ecosystem.**

Our report proceeds as follows:

1. Briefly summarize the history and types of hatchery programs
2. Identify the key question to be addressed.
3. Summarize the recommendations regarding hatchery operations that are common to the work of the three independent panels.
4. Identify and summarize the hatchery-related measures in the Oregon Plan.
5. Determine the consistency of the Oregon Plan's hatchery measures with the recommendations of the three panels. The fundamental question is: Does the Oregon Plan adequately consider and take into account the relevant concerns raised by the three panels?
6. Recommendations of IMST
7. Literature cited
8. Appendix A – Summary of findings of the three science panels.

In April 1998 Mr. Rich Berry, Oregon Department of Fish and Wildlife (ODFW), briefed the IMST on the Department's hatchery program, and Dr. Reg Reisenbichler of the U. S. Geological Survey briefed us on hatchery supplementation.

Brief History of Hatcheries in Oregon's Coastal Rivers

Spencer Baird, the U. S. Fish Commissioner, established the first Pacific salmon hatchery in the Sacramento Basin in 1872. Five years later he responded to a request from a group of cannery operators in Oregon and Washington and helped them build and operate a hatchery on the Clackamas River (Hayden 1930). In that same year R. D. Hume sold his cannery on the Columbia and moved to the lower Rogue River where he built another fishing and canning operation. He also built a hatchery on Indian Creek, a tributary to the Lower Rogue River. It was the first hatchery on one of Oregon's coastal rivers. By the turn of the century, many of Oregon's major coastal watersheds had operating hatcheries. Hatchery production rapidly increased and in 1905, 23 million fry and fingerling salmon and steelhead were released in coastal watersheds (Cobb 1930) (Figure 1).

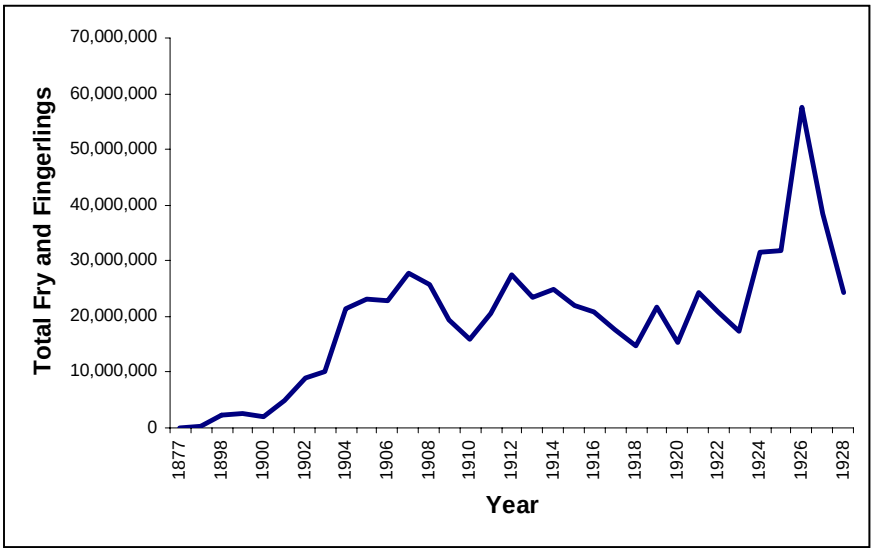

Figure 1. Total of salmon fry and fingerlings released into Oregon coastal streams, 1877-1928. (Source: Cobb 1930)

The early decades of artificial propagation are characterized by extravagant claims of success and no monitoring or evaluation to verify the actual contribution hatcheries made to total production (Lichatowich et al. 1996). It is now generally accepted that few salmon fry survived after release from hatcheries prior to about 1960 and hatcheries contributed little to the total abundance of adults (CBFWA 1990). By 1960, research initiated in the 1930s began to produce nutritious diets, disease treatments and improved hatchery practices. These advances in hatchery technology and science, combined with improving

ocean conditions, dramatically increased the survival of salmon to the adult stage. For example, by the mid-1970s, coho salmon harvests were approaching and even exceeding historical harvest levels and most of those fish were of hatchery origin.

Hatchery technology has continuously changed over the past 120 years. Hatchery design has been improved, the nutritional value of feeds has been increased, disease treatments have been developed, tagging technology has allowed more effective monitoring of survival and contribution, control over hatchery environments such as water temperature and pathogens has increased, and geneticists have improved animal husbandry practices.

Many of the problems that plagued early hatchery operations have been resolved or controlled. But there is a distinction that needs to be made between hatchery operations and the management of hatcheries and the fisheries, which harvest adult salmon of hatchery origin. It is the latter, Campton (1995) argues, that is the source of most genetic effects of hatcheries on wild stocks. Hatchery management is also the major source of ecological impacts on wild stocks. Ecological impacts of hatcheries include loss of carcasses and the nutrients they release to the stream, competition between hatchery and wild juveniles for rearing space in the stream and estuary, diminished life history diversity and over harvest of wild salmon in fisheries on mixed hatchery and wild stocks. Hatchery fish generally exhibit poor survival after release (White et al. 1995) and at least part of the reason can probably be attributed to hatchery management. This distinction between the hatchery operations and management will be an important consideration in the second report of the IMST's hatchery evaluation of coastal hatcheries, i.e., the focus will be on management.

Today, the state of Oregon operates 11 hatcheries in coastal watersheds (Table 1). These hatcheries released 11.7 million salmon and steelhead in 1995 (ODFW 1998).

Table 1. Fish hatcheries located on Oregon's coastal streams (Source: ODFW 1998).

Hatchery	**River**	**Salmon and Steelhead Species**
Alsea	Alsea	Steelhead
Fall Creek	Alsea	Fall chinook, steelhead
Salmon River	Salmon	Coho, fall chinook, steelhead
Butte Falls	Rogue	Coho, fall chinook
Cole Rivers	Rogue	Coho, fall chinook, spring chinook, steelhead
Elk River	Elk	Fall chinook, steelhead
Rock Creek	Umpqua	Coho, fall chinook, spring chinook, steelhead
Cedar Creek	Nestucca	Spring chinook, steelhead
North Nehalem	Nehalem	Coho, fall chinook, steelhead
Trask	Trask	Coho, fall chinook, spring chinook, steelhead
Bandon	Coquille	Coho, fall chinook, steelhead

While modern hatcheries have similar physical appearance—rearing ponds, spawning facilities, incubation trays, etc.—they are operated to achieve widely different purposes. Before addressing the main purpose of this report, a description of the various kinds of hatcheries is in order.

TYPES OF HATCHERY PROGRAMS

Hatcheries are used to achieve several different management purposes:

- **Mitigation.** The mitigation hatchery attempts to replace natural fish production lost because of habitat degradation with hatchery produced fish. The National Research Council (NRC) (1996) defined mitigation hatcheries as the attempt "to lessen the impact of human actions through the definition of a socially acceptable altered state." The altered state is the acceptance of the loss of habitat and the concomitant loss of natural production in exchange for artificial propagation. Most of the hatcheries built in this century are for mitigation purposes (NRC 1996). Mitigation hatcheries are usually the product of formal, legal agreements tied to specific development activities such as dams.

  On the Oregon coast, Cole Rivers Hatchery (Rogue River) was constructed to mitigate for habitat removed from anadromous salmonid production by Lost Creek Dam. Most of the hatcheries in the Columbia River Basin mitigate for the construction and operation of the hydroelectric system.

- **Harvest Augmentation.** This type of hatchery program seeks to increase sport and/or commercial harvest opportunities by releasing artificially propagated salmon. Harvest augmentation is probably the oldest use of artificial propagation and it is being proposed again in new and innovative programs in the Columbia River. In some cases, the programs are designed to target a specific fishery in a specific location to minimize interaction with wild populations. The Young's Bay program in the lower Columbia River is an example of a harvest augmentation program. Many of Oregon's coastal hatcheries are of this type (the Nehalem Hatchery, for example).

- **Supplementation.** The term supplementation has been used to describe such a wide range of propagation and enhancement activities that the National Research Council recommended dropping the use of the word (NRC 1996). However, when restricted to a narrow set of activities, supplementation can be a useful term. The generally accepted definition of supplementation was developed by the Regional Assessment of Supplementation Project (RASP). Specifically "*Supplementation is the use of artificial propagation in the attempt to maintain or increase natural production while maintaining the long-term fitness of the target population, and keeping the ecological and genetic impacts on non-target populations within specified biological limits"* (RASP 1992). RASP (1992) concluded this definition of supplementation imposes several constraints on the use of hatchery fish: 1) The objective is to increase natural production. That implies habitat is of sufficient quantity and quality to sustain natural production. 2) The population being supplemented must retain its long-term fitness. 3) Allowable ecological and genetic impacts

on non-target populations must be specified ahead of time. These constraints imply that extensive monitoring programs will accompany attempts to supplement natural production.

The Oregon Department of Fish and Wildlife is considering the use of supplementation to increase natural production in coastal streams. The hatchery programs in the Grande Ronde and Imnaha Rivers are examples of current supplementation programs.

- **Restoration.** This type of hatchery program attempts to reestablish salmon or steelhead populations in habitat from which they were previously extirpated. In Oregon, the hatchery program in the Umatilla River is an example of restoration.

- **Conservation.** The listing or potential listing of several species/stocks of salmon and steelhead under the Endangered Species Act has generated the newest purpose for artificial propagation. The conservation hatchery attempts to work in concert with other restoration activities to prevent extinction of threatened or endangered stocks. The concept of a conservation hatchery is new and its scope and constraints are still being developed. In the Columbia River and Puget Sound, hatchery programs with conservation objectives are using new technology such as the captive broodstocks on a large scale. Captive broodstock programs basically attempt to circumvent natural smolt-to-adult mortality by keeping the salmon in the hatchery throughout their entire life cycle from hatching until they mature. Conservation hatcheries may play an important role in preventing extinction, but we caution that the concept is still experimental and not a proven methodology.

The Key Question

The key question addressed in this report is:

> Does the Oregon Plan recognize the concerns common to the three science panels, and do the measures in the Oregon Plan adequately address those concerns?

The validity of this question rests on the critical assumption that agreement among three different groups of scientists establishes the scientific validity of the issues and the recommendations that come from them. This report emphasizes recognition of the issues by the Oregon Plan. Other reports will address various aspects of hatchery programs and management.

Independent Reviews of Hatcheries

Three panels recently reviewed the use of artificial propagation in fisheries management.

National Fish Hatchery Review Panel (NFHRP 1994). The National Fish and Wildlife Foundation, private companies and other foundations funded this panel. The panel had 17 members consisting of scientists, managers and administrators working in fisheries throughout the country. The federal hatchery program was the focus of the panel's work. While the panel focused on federal hatcheries nationwide, many of their findings are relevant to State of Oregon hatchery programs for coastal coho as well.

Up Stream: Salmon and Society in the Pacific Northwest (NRC 1996). This panel was convened by the National Research Council and consisted of 15 scientists. The status of Pacific salmon in the Pacific Northwest was the panel's focus; however, it gave particular emphasis to the Columbia River. The report includes a chapter on hatcheries. While the NRC panel did not specifically focus on Oregon coastal hatcheries, its findings had general relevance to the Oregon facilities.

Return to the River: Restoration of Salmonid Fishes in the Columbia River Ecosystem (ISG 1996). The Independent Science Group was a panel of nine senior scientists charged with scientific oversight of the salmon restoration program in the Columbia River. Their report, Return to the River, is a general review of the science underlying salmon restoration. That report includes a chapter on hatcheries. As with the findings of the previous two panels, the ISG's work has relevance to Oregon coastal hatcheries.

The three scientific panels were in agreement on four important issues (Table 2):

Issue 1. Hatchery programs have failed to meet their objectives. Although there are some examples of successes, hatcheries have generally failed to meet their objectives. Most hatcheries were built to mitigate for habitat lost during the development of rivers by replacing the numbers of natural fish with hatchery-produced fish. They have not achieved that goal.

Issue 2. Management of hatchery programs has impacted wild stocks. Hatchery management (brood stock selection, mixed stock fisheries, and inter-basin transfers) has been detrimental to wild stocks of salmon and has failed to conserve salmon biodiversity. Since these problems are largely related to hatchery management they should be solvable.

Table 2. IMST summary of key areas of agreement among three panels (NFHRP 1994, NRC 1996 AND ISG 1996) regarding the need for change, effectiveness, monitoring, and problems in hatchery programs.

Report	Effectiveness in Meeting Objectives	Impacts on Wild Stocks	Adequacy of Monitoring	Need for Change
Upstream (NRC 1996)	Hatcheries have failed to mitigate for lost salmon production due to habitat degradation. The program failed to determine why it failed to achieve its mitigation goals.	Despite some successes, hatchery programs have been partly or entirely responsible for detrimental effects on some wild runs of salmon. Hatcheries have not favored the conservation of biodiversity.	The lack of effective monitoring of hatcheries meant their managers did not learn to use them effectively through adaptive management.	Assumptions underlying the use of hatcheries will have to change if they are to play an important role in salmon management in the future.
Return to the River (ISG 1996)	Artificial propagation failed to mitigate for natural production lost through habitat destruction.	Hatchery operations including broodstock selection, interbasin transfers and release practices have contributed to the decline of natural production and loss of locally adapted stocks in the Columbia Basin.	In the 120-year history of artificial propagation in the Columbia Basin, the program has never been subjected to a comprehensive evaluation.	There is a role for hatcheries in the management and restoration of Pacific salmon. It remains to be seen if there is a role for large-scale production hatcheries. New directions and visions for the hatchery program are clearly needed.
NFHR (NFHRP 1994)	Mitigation based solely in artificial propagation has not been successful and the program has failed to address why mitigation hatcheries have failed.	The stocking of hatchery fish has been detrimental to native fishes. There are safe uses for hatcheries if they are used in support of ecosystem management.	Specific objectives should be developed for each hatchery and monitoring should be implemented for all hatchery programs.	There is a need for a change in the status quo in fisheries management, specifically the hatchery system. In the future, hatcheries should be managed to support ecosystem management.

Issue 3. Monitoring of hatchery programs is inadequate. Hatchery programs have not had adequate monitoring programs. This lack of monitoring has made it difficult to determine why hatcheries have failed to meet their objectives and to identify and mitigate the genetic and ecological risks that hatcheries pose to wild stocks.

Issue 4. Hatchery programs need fundamental change in order to support recovery of wild stocks. This issue is a logical outcome of the first three. All three panels recognized the need for fundamental change in the hatchery programs. They generally recognized that the hatchery programs should support the restoration and recovery of wild stocks and natural production.

Hatchery Measures in the Oregon Plan for Salmon and Watersheds (Oregon Plan)

The Oregon Plan describes two seemingly contradictory roles for the state's coastal hatchery program. On one hand they are identified as a risk agent and on the other they are viewed as part of the solution. The contradiction disappears if the risk factors associated with hatcheries are ascribed to past practices and the role of hatcheries as part of the solution is viewed in terms of their future management.

As risk factors - the Oregon Plan (pages 2-13) attributes responsibility for a portion of the current depressed levels of natural production of coho salmon to "*…all management activities pertinent to the use of artificial propagation….*" Decisions regarding brood stock selection, numbers stocked, stocking location, changes in the size of the program, and criteria for smolt sizes all pose some degree of risk, as does straying or transfer of hatchery produced adults to natural spawning areas. In aggregate these factors result in

- Loss of genetic adaptation of wild populations from interbreeding with genetically dissimilar (less fit hatchery fish).
- Competition with hatchery fish
- Reduced levels of nutrients (carcass nutrient cycle) from depressed runs.

As part of the solution - The ODFW work plan (Volume 3 of the Oregon Plan, Measure ODFW-II.B.1) will "assess the effectiveness of using hatchery production to reintroduce or rebuild depressed wild coho populations." Measure II.B.1 acknowledges that this use of hatcheries is experimental and it emphasizes the need to employ adaptive management —learn by doing—while testing the concept. Hatcheries will not be used in a widespread supplementation effort until the methodology has been proven effective on a smaller scale. Unfortunately, the ODFW work plan focuses on the potential benefits of hatcheries without reference to the risks discussed in other parts of the Oregon Plan.

In the following section, we repeat key parts of the Oregon Plan dealing with the ODFW work plan related to artificial propagation (Oregon Plan Vol. 2 Section 17a and Vol. 3 Section 17c). We have retained the format and steps in the Oregon Plan. Specifically, this first identifies a Factor for Decline of coastal salmon, second establishes a Biological Objective that is intended to reduce or eliminate the factor for decline and third lists the specific Measures or actions proposed to achieve the objective listed. The Factor for

Decline, Biological Objective and Measures are repeated verbatim from the text of the Oregon Plan. In some cases, the IMST summarized the additional information describing individual measures.

Factor for Decline: *Loss of genetic adaptation of wild populations from interbreeding with genetically dissimilar, less fit hatchery fish.*

Biological Objective. Reduce the genetic risk to wild populations by reducing the percentage of hatchery fish to less than 10% of the total population spawning in the wild.

Measures.

ODFW-I.D.1 Use of volunteers

Expand emphasis and scope of volunteers to help implement Oregon Coastal Salmon Recovery Initiative restoration actions, including assistance with spawning ground surveys to determine ratios of hatchery and wild fish and to assist with broodstock collection.

ODFW-II.A.1 Implement wild fish management strategies.

Fully implement the Wild Fish Management Policy strategies for coastal coho salmon as approved by the Oregon Fish and Wildlife Commission. Actions include:

- Incorporation of wild fish into hatchery broodstocks (consider temporary use of captive broodstocks developed from wild juveniles if wild runs are insufficient).
- Reduce the percentage of hatchery fish spawning with wild fish through the use of acclimation sites or altering release locations.
- Reduce the number of hatchery fish released.
- Improve adult capture facilities at hatcheries and fish ladders.

ODFW-II.A.2 Reduce coastal hatchery coho smolt releases.

ODFW will reduce coastal hatchery coho smolt releases from 6.4 million in 1990 to 2.3 million by 1998.

Biological Objective. To clearly describe the purpose and conduct of all coastal hatchery programs.

Measures.

ODFW-II.A.3 Develop management objectives for each hatchery program, including genetic guidelines.

ODFW will:

- document the specific purpose for each hatchery program,
- ensure consistency with sound genetic principles,
- evaluate effectiveness, and
- determine economic efficiency.

Biological Objective. To facilitate differentiation of hatchery fish from wild fish on spawning grounds.

Measures.

ODFW.II.A.4 Mark all hatchery coho.

All hatchery coho will be given an external mark prior to release as smolts. Marking will help ODFW monitor the occurrence of hatchery fish on the spawning grounds, aid in the development of new broodstocks based on wild fish, and facilitate the potential development of selective fisheries.

The IMST notes that monitoring for this entire group of measures is limited to a determination of the ratio of hatchery to wild spawners on the spawning grounds.

Factor for Decline: *Competition with hatchery reared fish.*

Biological Objective. Reduce the potential for competition between juvenile hatchery and wild coho by decreasing the number of hatchery fish released.

Measures.

ODFW-II.A.2 Reduce coastal hatchery coho smolt releases. (Described above)

ODFW-II.A.3 Develop management objectives for each hatchery program, including genetic guidelines (Described above).

The IMST notes that monitoring for this group of measures is limited to keeping records of the number of hatchery fish released at specific locations.

Factor for Decline: *Low-density reproductive failure of wild populations.*

Biological Objective. Evaluate the potential and effectiveness of using hatchery production to rebuild or restore critically depressed wild populations of coastal coho salmon.

Measures.

ODFW-I.D.1 Use of volunteers (Described above)

ODFW-II.B.1 Utilize hatcheries to rebuild wild runs.

ODFW will develop a plan to utilize hatchery production derived from wild parents to aid restoration of depleted wild runs including:

- develop broad implementation strategies to utilize hatchery production to assist in rebuilding wild runs,
- identify locations where wild populations may be aided by hatchery fish and develop site specific implementation strategies before stocking, and
- monitor and evaluate stocking programs using adaptive management approaches to evaluate and refine the program.

The IMST notes that monitoring is recognized as important and it will be developed with the program plan.

Factor for Decline: *Reduced nutrients (carcass nutrient cycle) from depressed runs.*

Biological Objective. Increase the growth and survival of juvenile coho salmon in a set of streams where spawner abundance is depressed by increasing the abundance of adult salmon carcasses in spawning areas during and shortly after the spawning season.

Measures.

ODFW-I.D.1 Use of volunteers (Described above)

ODFW-IV.B.4 Use hatchery carcasses to increase coho production.

ODFW will attempt to restore benefits to juvenile salmonid production through placement of hatchery salmon carcasses in priority stream reaches.

Monitoring includes several elements:

- pathologists will screen carcasses to eliminate disease risks,
- the number of carcasses planted will be tracked,
- the retention of carcasses will be monitored, and
- a research program to compare treated and control streams will be initiated.

Consistency of the Oregon Plan Hatchery Program with the results of the Three Science Panels

In this section, the IMST determine if the four issues common to the three panels were adequately addressed in the Oregon Plan relative to the State of Oregon coastal hatchery program for coho.

Issue 1. Hatchery Programs Have Failed to Meet Their Objectives. Determining hatchery effectiveness has a critical first step. It is to establish objectives for each hatchery in terms that provide clear, measurable performance criteria, with specific management guidelines by which the objectives will be achieved. The Oregon Plan recognizes the importance of hatchery objectives and has addressed it in Measure II.A.3. Specifically: *Develop management objectives for each hatchery program, including genetic guidelines*.

Objectives are in final or draft form for only two of the 11 coastal hatcheries of the State of Oregon. A report has been completed for Cole Rivers Hatchery on the Rogue River and a draft report on the Nehalem Hatchery is under review. Measure II.A.3 was scheduled for completion by the end of 1997. Hatchery effectiveness cannot be determined until measurable objectives and management guidelines for each hatchery are developed and adopted.

The second step in the evaluation of hatchery effectiveness is to determine if the objectives are being met. This is part of issue 3 dealing with monitoring.

If hatchery objectives are not being met, the reasons for the failure need to be established by analysis of the available information against testable hypothesis. Evaluation of the results of this analysis should lead to program improvements. However, the first critical step in this process is the development and adoption of measurable objectives and guidelines.

The IMST concludes *that the Oregon Plan is not adequately addressing the question of hatchery effectiveness.*

IMST recommends *that:*

1. *ODFW give higher priority to measure II.A.3 (development of management objectives for each hatchery program, including genetic guidelines) of the Oregon Plan and complete the development and adoption of objectives and management guidelines for each coastal coho hatchery as quickly as possible.*
2. *ODFW establish and implement a specific program to determine if its coastal coho hatcheries are meeting their objectives, and the process by which management will be adapted if they are not.*

Issue 2. Hatchery Management has Impacted Wild Stocks. The Oregon Plan clearly recognizes the negative impacts that hatchery management has had on wild populations of coho salmon and has distilled those impacts into two general issues:

1) Loss of genetic adaptation of wild populations from interbreeding with genetically dissimilar, less fit hatchery fish.

2) Competition with hatchery reared fish.

The Oregon Plan recommends steps to correct these problems. Whether or not those steps are adequate will be addressed in the second IMST report on the hatchery program.

The IMST concludes *that the Oregon Plan recognizes the panels' concern regarding the problems created by hatchery management and it has adopted measures designed to address that. The adequacy of those measures will be reviewed in a future report. However, a preliminary conclusion is in order. Monitoring of hatchery and wild interactions is limited to determining the ratio of hatchery and wild fish on the spawning grounds. This will not be sufficient to measure or evaluate the interactions between hatchery and wild fish. As ODFW's annual report of hatchery operations states regarding the current monitoring program: "This documents the presence and abundance of hatchery fish but not interactions between hatchery and wild fish*." (Oregon Plan for Salmon and Watersheds. Annual Report. 1998. Governor's Natural Resources Office. Salem, OR. (503)378-3548).

The IMST recommends *that*

3. *ODFW develop and implement a program of research that determines the effects of wild-hatchery fish interactions.*
4. *Based on research findings (see recommendation 3), ODFW develop monitoring measures that can be used to judge the operational effectiveness of hatchery management programs with respect to their adverse impact on wild fish stocks.*

Issue 3. Monitoring of hatchery programs is inadequate. The Oregon Plan describes four monitoring programs directly related to the coastal hatchery program.

1) All hatchery-reared coho salmon will be marked, and the ratio of hatchery and wild salmon on the natural spawning grounds and in the hatcheries will be determined.

2) ODFW will keep records of the location and number of hatchery fish released into coastal streams.

3) The use of salmon carcasses from hatcheries to increase marine derived nutrients in coastal streams will be monitored. Specific tasks in that monitoring program include: monitor carcasses for pathogens to minimize the risk of disease transmission, keep track of the number of carcasses placed in the streams, determine the retention time of carcasses and compare treated and untreated streams.

4) The use of hatcheries to rebuild natural production will require additional monitoring, but that program has not been designed.

The monitoring of hatchery and wild salmon on the spawning grounds is important, however, the monitoring program as described in the Oregon Plan will not adequately provide the information needed to adaptively manage the hatchery program. For example, the current program attempts to reduce competition between juvenile salmon of hatchery and wild origin, but only monitors' numbers of hatchery fished released at various locations. That is not an adequate measure of competition between hatchery and wild juveniles. At best it measures the potential for interactions. Other questions that will not be addressed include the following: To what extent are hatchery and wild fish interbreeding? Has the genetic structure of the wild populations been altered through interbreeding? To what degree is there a loss of adaptation as a result of this interbreeding? Have life history traits, such as the timing of the spawning migration of wild fish, changed? Some of these are questions more for research than for operational monitoring. However, we believe the relationships developed in the research will identify the parameters that can be used to address these questions in operational monitoring programs.

The IMST concludes *that the Oregon Plan recognizes the need to monitor the hatchery program. However, the program described in the Oregon Plan is not adequate.*

The IMST Recommends *the same recommendations identified for issue 2. Specifically that:*

3. *ODFW develop and implement a program of research that determines the effects of wild-hatchery fish interactions.*
4. *Based on research findings (see recommendation 3), ODFW develop monitoring measures that can be used to judge the operational effectiveness of hatchery management programs with respect to their adverse impact on wild fish stocks.*

Issue 4. Hatchery programs need to change in order to support recovery of wild stocks. The need for change stems from the recognition that hatchery management is in part responsible for the decline of wild salmon stocks. All three panels strongly recommended fundamental changes in the hatchery programs. Those changes should reflect a stronger emphasis on ecosystem management. For example, hatchery operations using local stocks need to take into consideration the life history responses of the native stock to the environmental conditions in the watershed. This will influence rearing practices and the timing of or manner of release of juveniles. Other ecological considerations include differential predation and competition between hatchery and wild fish.

The Oregon Plan acknowledges the need for change in the hatchery program, and addresses that change primarily through two measures. It is beyond the scope of this first report to address whether the current measures in the Oregon Plan are adequate. For example, the current measures may not adequately address some hatchery management issues such as competition between hatchery and wild fish, and increased predation on wild stocks resulting from hatchery release practices.

The use of hatcheries in well-designed experiments should also be considered, for instance, in monitoring ocean survival of hatchery fish as a surrogate for survival of wild fish, and in assessing avian and pinniped predation. In some cases, specific hatcheries could be operated primarily in a research mode if they are not meeting their objectives. This will require a coordinated program of work. As an example of what we mean, see recommendation 8 of the Northwest Power Planning Council Scientific Review Team Report "Review of Salmonid Artificial Production in the Columbia River Basin" (NWPPC 1998).

The IMST concludes *that the Oregon Plan recognizes the need for change in the hatchery program, as evidenced by two measures (1) fully implementing ODFW's Wild Fish Management Policy, and (2) reducing the number of hatchery fish released into coastal streams. The IMST's assessment of change in the hatchery program will be hampered until measure II.A.3) has been completed (adoption of objectives and management guidelines – see issue 1).*

Other changes may be needed in hatchery management, but these changes will require additional information from research or monitoring. The IMST recommendations are directed at obtaining this information.

The IMST recommends *that:*

5. *ODFW develop a strategy that will be useful in quantifying and reducing the impact of mixed stock fisheries on the recovery of depressed OCN stocks.*
6. *ODFW determine the impact of hatchery release practices on predation of hatchery and wild fish. This should be coordinated with the ODFW Action Plan to assess avian and pinniped predation.*

7. *ODFW use hatcheries as important tools in research that supports monitoring programs.*
8. *ODFW establish explicit coordination between hatchery programs and monitoring programs to help them ensure that they accomplish management and research objectives.*

Summary Answer to the Key Question

> The key question is: Does the Oregon Plan recognize the concerns common to the three science panels, and do the measures in the Oregon Plan adequately address those concerns?

The IMST concludes that the major issues identified by the three panels are recognized and reflected in the Oregon Plan. However, determining hatchery effectiveness has not been given enough priority and the measures that are proposed to address the other concerns are not entirely inadequate. Of primary concern is the lack of direct monitoring of hatchery and wild interactions either on the spawning grounds or in the juvenile rearing areas and migration routes.

Recommendations

Following are the specific recommendations of IMST related to the Oregon Plan for Salmon and Watersheds as it relates to Oregon coastal coho hatcheries.

Recommendation 1. ODFW give higher priority to measure II.A.3 (development of management objectives for each hatchery program, including genetic guidelines) of the Oregon Plan and complete the development and adoption of objectives and management guidelines for each coastal coho hatchery as quickly as possible.

Recommendation 2. ODFW establish and implement a specific program to determine if its coastal coho hatcheries are meeting their objectives, and the process by which management will be adapted if they are not.

Recommendation 3. ODFW develop and implement a program of research that determines the effects of wild-hatchery fish interactions.

Recommendation 4. Based on research findings (see recommendation 3), ODFW develop monitoring measures that can be used to judge the operational effectiveness of hatchery management programs with respect to their adverse impact on wild fish stocks.

Recommendation 5. ODFW develop a strategy that will be useful in quantifying the impact of mixed stock fisheries on the recovery of depressed OCN stocks.

Recommendation 6. ODFW determine the impact of hatchery release practices on predation of wild fish.

Recommendation 7. ODFW use hatcheries as important tools in research that supports monitoring programs.

Recommendation 8. ODFW establish explicit coordination between hatchery programs and monitoring programs to help them ensure that they accomplish management and research objectives.

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APPENDIX A

Summary of findings from the three hatchery review panels

The following summaries were prepared by the IMST. They contain the information from the three reports that is relevant to the IMST evaluation of Oregon coastal coho hatcheries.

National Fish Hatchery Review Panel

The National Fish Hatchery Review limited its scope to the federal hatchery systems. Many of its conclusions and recommendations apply specifically to the federal programs with little direct relevance to Oregon's coastal hatchery program. However, several conclusions and recommendations are relevant and they are summarized here.

The panel recognized the continuing decline in aquatic resources and called for a change in the status quo in fisheries management programs. More specifically, it recognized the need to change programs, personnel and facilities within the hatchery system to support ecosystem management. In the past resource managers responded to the decline in abundance of Pacific salmon by increasing hatchery programs and the number of juveniles they released. The panel concluded that the continuing degradation of habitat was the primary cause for the declines in abundance of Pacific salmon and that mitigation based solely on hatchery production is not working.

The panel concluded that the stocking of hatchery fish has been viewed as the solution to all problems. This led to the allocation of significant levels of funding out of the fisheries resource budgets to hatchery programs leaving little funding for alternative approaches such as ecosystem management or the restoration and protection of habitat. According to the panel, a shift to an ecosystem perspective will lead to an internal conflict within fisheries management. The conflict centers on this question: How much habitat should be set aside for total ecosystem management and how much habitat should be used for enhanced fishing opportunities? While the two are not mutually exclusive, they present the managers with complex new management challenges. For example, excessive harvest of mixed hatchery and wild stocks is encouraged by overstocking and can be detrimental to both native fish populations and the goals of ecosystem management.

The panel suggested changing the way budgets are prepared. The budgeting focus should be on priority ecosystems. A hatchery's funding level should be determined by its role in supporting ecosystem management in a priority watershed. This approach to budgeting would, the panel believed, give more flexibility to redistribute funds to higher priorities.

The panel concluded that, as a whole, the stocking of hatchery fish has been detrimental to native fishes. However, it also agreed that technologies and scientific understanding of the problem can, if applied consistently and in support of ecosystem management,

provide safe use of artificial propagation in management. To develop a safe hatchery program two factors must be considered:

- the use of an inappropriate product (the fish themselves) and
- the way the product is used (how the hatchery-reared fish are incorporated into the management programs).

Hatcheries can support the recovery of ESA listed stocks, but artificial propagation should be viewed as a tool of last resort which must be accompanied by a vigorous program to restore habitat or remove the factor threatening the stock. The panel did stipulate that hatchery support for ESA stocks should be terminated if the program cannot produce self-sustaining populations in 3 to 5 years or if it is determined that the habitat cannot be restored. As with all hatchery programs it is critical to define specific objectives and implement an effective monitoring program.

The panel discussed the use of hatcheries to mitigate for lost habitat. In a sense most hatcheries are attempting to mitigate for salmon production lost through the general degradation of habitat. Some hatcheries are legally mandated to mitigate for habitat lost as a result of specific actions, usually dams. (In Oregon's coastal basins, I can only think of one official mitigation hatchery and that is Cole Rivers Hatchery on the upper Rogue River.) In general the panel concluded that hatchery mitigation had failed. It also concluded that the present mitigation program fails to address the basic problems of why hatchery mitigation has failed.

Upstream: Salmon and Society in the Pacific Northwest

Chapter 12 of the report by the NRC was devoted to a discussion of the effectiveness and effects of hatcheries. Historically, the intended goal of most hatchery programs has been mitigation. In some cases, mitigation was for specific and narrowly defined purposes and in other cases, hatcheries were built to mitigate generally for deteriorating habitat conditions or excessive harvest. Throughout their history, most hatchery programs were not evaluated to determine if their goals were being realized. The lack of any effective monitoring makes it impossible to determine how much damage hatcheries have done to wild populations of salmon. The panel concluded, however, that hatcheries have had detrimental effects on some populations. Furthermore, the lack of effective monitoring meant that salmon managers did not learn how to use this tool effectively. Hatcheries have had some successes, nevertheless the assumptions underlying the hatchery programs and the ways they are used will have to change if they are to play an important role in salmon management in the future.

The NRC identified and discussed problems associated with hatcheries in six areas: demographic risks, genetic and evolutionary risks, problems due to behavior, health status, physiology, and ecological.

The NRC discussed the question: What roles do hatcheries have in the rehabilitation of Pacific salmon? It concluded, hatcheries are a tool that managers can use when appropriate. However, before artificial propagation is employed the managers must formulate appropriate objectives. For example, artificial propagation has been employed to stabilize production and the fishery. However, natural fluctuations are a normal part of the marine and freshwater ecosystems so management has to recognize the inevitability of those fluctuations and gear its programs to deal with them rather than pursue the futile attempt of eliminating them through hatcheries.

The panel concluded that hatcheries have not "mitigated" for salmon production lost due to habitat degradation. Managers have to abandon the idea that hatcheries are an alternative to healthy freshwater habitats. The constraints on production created by habitat degradation will also prevent hatcheries from increasing or maintaining salmon abundance. Under the worst case conditions, the use of hatcheries to mitigate lost production could contribute to further decline. Artificial propagation not only may not mitigate for lost production, but it is a long-term commitment of resources that might be better used to protect or restore habitat.

The NRC outlined two broad strategies for the restoration of Pacific salmon. One relies on the continued massive use of human inputs to control production and to counter deteriorating ecosystem conditions. The other approach relies on the restoration of the natural regenerative capacity of the salmon ecosystems. Major hatchery reforms are required with either option. The NRC panel generally favored the rehabilitation approach as more likely to be successful in the long run. Under the rehabilitation option, the use of hatcheries would be limited and their role would have to be more refined. Recovering natural regenerative capacity requires the congruence of each human intervention (including hatcheries) with the natural ecological, genetic and evolutionary processes.

Under the rehabilitation option, two general principles should guide the use of artificial propagation:

- The hatchery program should be only one component of a comprehensive rehabilitation strategy designed to remove or substantially reduce the human-induced causes of decline.
- All hatchery programs should be implemented in a way that maintain the genetic resources that exist in naturally spawning and hatchery populations.

The NRC listed five conclusions and four recommendations regarding hatcheries.

Conclusions:

1) Despite some successes, hatchery programs have been partly or entirely responsible for detrimental effects on some wild runs of salmon.

2) Hatchery use has not favored conservation of biological diversity.

3) Goals, specific objectives, and methods of past hatchery programs were not critically reviewed for scientific validity and practical feasibility.

4) Over-reliance on hatcheries also discouraged development of institutional arrangements and behaviors that would accommodate natural large-scale fluctuations in salmon abundance.

5) Hatchery programs have lacked proper monitoring and evaluation (i.e., there has been no adaptive management).

Recommendations:

1) The approach to hatchery operations should be changed in accordance with the goal of rehabilitation and the ecological and genetic ideas that inform that goal.

2) All hatchery programs should adopt a genetic-conservation goal of maintaining genetic diversity that exists between and within hatchery and natural spawning populations.

3) All hatchery fish should receive identifiable marks.

4) Decision making about uses of hatcheries should occur within the context of fully implemented adaptive-management programs that focus on watershed management, not just on the fish themselves.

Return to the River: Restoration of Salmonid Fishes in the Columbia River Ecosystem

Return to the River (ISG 1996) examined the history of artificial propagation in the Columbia River Basin (Chapter 8). As part of that examination the panel identified the assumptions that historically led to the massive use of artificial propagation including:

- Natural production in pristine rivers is inherently inefficient. Eggs and fry of salmon are subjected to large mortality that can be reduced by fertilizing, incubating and hatching the eggs in the protected environment of the hatchery.
- Once salmon reproduction was placed under the control of humans, the total production of adults could be increased dramatically.
- Production systems were primarily limited by natural mortality in the egg and fry stages. Limits imposed by carrying capacity were not considered or they were considered trivial, i.e., carrying capacities were so large it was possible to achieve nearly unlimited increases in abundance.
- Technology in the form of hatcheries could replace production lost because habitat was destroyed.

The early hatcheries were quick to claim success, however, that success was not documented through scientific studies or monitoring. The assumptions underlying hatchery programs and the overly optimistic claims of success led early salmon managers to trade habitat for artificial propagation and to forgo any evaluation of the consequences of that trade. Hatcheries contributed little to total production of adult salmon until the 1960s when disease treatments and nutritious feeds were developed. However, as salmon from hatcheries began surviving, they contributed to the harvest and they created a new set of problems. Over harvest of wild salmon in mixed hatchery-wild stock fisheries and direct and indirect genetic interaction that reduce the fitness and survival of wild stocks are two of the consequences of the "success" of hatchery programs.

The panel concluded that for the Columbia River, in spite of a massive hatchery program, artificial propagation failed to mitigate for natural production lost through habitat destruction. The report agreed with the NRC (1996) and NFHRP (1994) that the future role of hatcheries should be much smaller and it will have to be consistent with the ecology of the individual watersheds where hatcheries are located. In spite of 120 years of experience with artificial propagation, we still lack the information to determine if it's possible to integrate natural and artificial production systems in the same basin to achieve sustainable long-term productivity. The possibility of integrated natural-artificial production systems remains an uncertainty.

The panel recognized three new uses of artificial propagation: supplementation, the conservation hatchery, and captive brood technology. The use of artificial propagation to restore depleted salmon populations should be approached with extreme caution and must be accompanied with a well designed and adequately funded monitoring and evaluation program.

The ISG reached ten specific conclusions and made ten specific recommendations regarding the use of artificial propagation.

Conclusions:

1) Artificial propagation has failed to achieve the objective of replacing natural production lost because of habitat degradation in the basin.

2) Belief in the efficacy of artificial propagation led to disproportionate budgets for hatcheries and habitat protection and restoration.

3) In the 120-year history of the artificial propagation in the Columbia Basin, the program has never been subjected to a comprehensive evaluation.

4) The ecological, behavioral, and energetic interactions of hatchery fish with native species (including wild salmon) and fish assemblages of the Columbia River ecosystem have not been evaluated. In the operation of hatcheries, those interactions are generally assumed to be inconsequential or benign.

5) The extent to which the artificial propagation program has implemented relevant research, particularly where the interaction between natural and artificially propagated fish is concerned, has been slow.

6) Hatchery operations including broodstock selection, interbasin transfers and release practices have contributed to the decline of natural production and loss of locally adapted stocks in the basin.

7) Management of fisheries on mixed hatchery and wild stocks has contributed to the decline of natural production in the Columbia Basin.

8) Because of the declining natural production in the Columbia Basin, those fisheries that still harvest Columbia River salmon are largely supported by the hatchery program.

9) Hatchery practices are one of the factors that have altered the genetic structure of stocks in the basin.

10) In instances where hatchery broodstock have been derived from local wild stocks that are presently severely depressed, the hatchery stock may contain a significant portion of the genetic diversity of the indigenous stock. If so, these populations need to be evaluated to address these concerns, and the hatchery population may be an essential element for rebuilding abundance and natural production in the depressed indigenous stock.

Recommendations:

1) Use of artificial propagation to restore depleted salmon populations should be preceded by an assessment of the risks, and supplementation applications must be accompanied with a well designed and adequately funded monitoring and evaluation program.

2) There are three questions that need to be answered in evaluating the hatchery program:

   - Do the artificially propagated fish contribute to the fishery and/or escapement and is the economic benefit of that contribution greater than its cost?
   - Has the program achieved its objective; i. e., has it replaced lost natural production if it is a mitigation hatchery?
   - Has the operation of the hatchery incurred costs to natural production? The first and the third questions are related in that a meaningful cost-benefit analysis should include ecological costs.

   Most evaluations of hatchery programs, when they have been carried out, attempted to answer the first question. Information needed to answer the

second and third questions was in most cases not collected or has been of poor quality.

3) Hatchery programs in the Columbia Basin should be subjected to a valid comprehensive evaluation. The evaluation should cover the entire 120-year history of the program and include direct and indirect, positive and negative effects. For example, the evaluation should include a discussion of the role that heavy reliance on hatcheries has had on habitat degradation in the tributaries and mainstems and the contribution of hatcheries to the extinction and depletion of naturally producing stocks in the basin. The comprehensive evaluation should also include an assessment of the adequacy of existing monitoring to answer ecological questions.

4) A separate comprehensive evaluation of the mitigation hatcheries in the basin should be undertaken. What were their objectives, did they achieve their objectives, and if not, why not?

5) The region needs to develop an interim policy governing hatchery operations including harvest of hatchery fish. The interim policy should be designed to minimize the ecological costs of the hatchery until evaluations can be carried out.

6) The objectives of each hatchery need to be evaluated and redefined if necessary. The objectives should be established within the contexts of the subbasin where the hatchery operates with particular reference to rebuilding of populations and metapopulations. The hatchery's objectives need to be integrated and defined by the rebuilding objectives of the subbasin. The objectives should consider non-target species and the existence of metapopulation structure of the target species.

7) Artificial propagation must be treated as an experiment, with hypotheses related to uncertainties, experimental design, analysis, and integration of results with available knowledge consistent with adaptive management.

8) The decision about when and where to use supplementation programs should take into account the principles of the metapopulation concept.

9) Existing hatchery populations may prove to be valuable genetic resources in the future and may prove useful in programs that attempt to rebuild salmon populations and metapopulation structure in the basin.

10) Hatchery populations should be evaluated for evidence of selection and changes in fitness or genetic diversity associated with residence in the hatchery environment.