IV. Core Elements

➢ HATCHERIES

Hatchery Management to Meet the Needs of Wild Fish

I. Current Situation: *Where are we now?*

Background

To understand why hatcheries are operated and managed as they are today, one must understand the role hatcheries have played in the past, currently play and will play in the future. As the management objectives have varied, so have hatchery practices. The two, although different, cannot be thought of separately. For example, practices which have been used to produce legal size trout for opening day, which require over one year of rearing, have always been very different from those used to rear fall chinook, which are released after only 90 days of rearing. While the trout may have an average life expectancy of only a few days after being released, the salmon may live four or five years and travel thousands of miles from its hatchery of origin. Different expectations for the product of a hatchery require different hatchery practices.

The lack of basic life history information and an understanding of the stock concept (e.g., adaptive differences between stocks, homing behavior, the lack of understanding about carrying capacities, rudimentary knowledge of fish behavior and poorly developed culturing practices), resulted in many of the transplants failing; others had various levels of success. Those that were successful, no doubt had some negative effects on any naturally spawning populations existing in the same habitat. During this time, hatcheries were promoted as effective substitutes for natural fish habitat, leading to complacent attitudes about habitat conservation and large-scale habitat degradation.

As scientific knowledge expanded to include the stock concept and the values of biological diversity, the importance of wild salmonid stocks became more recognized and attention was focused on specific hatchery practices (and related fish management objectives). The genetic changes that can result from various hatchery practices and the value of local adaptation of stocks received increased attention. The ecological impacts of large-scale hatchery releases also began to be understood. The effects of not allowing salmon above hatchery racks, which had always been justified on the basis of protecting the hatchery population from disease, were questioned.

In general, hatchery programs and the fish management objectives that guided them received increased scrutiny. Overall health and related fish production of the ecosystem became increasingly more

important than considering hatchery production alone. Not to be forgotten however, was the dilemma still faced by fishery managers B a majority of the traditional constituents demanded to use the resource for consumption and, in fact, believe that was why the Department of Fish and Wildlife (WDFW) existed in the first place. This is a fundamental assumption of many citizens, although it is secondary to the stewardship of the state=s natural resources. Whether people fish for steelhead, bass, walleye, salmon or trout, or whether they fish in fresh or saltwater, the ability to catch and keep fish for consumption is the basic reason many participate in their sport.

Summary of Recent Activities

One important indication of how the Statewide Strategy to Recover Salmon will be implemented for hatcheries to improve protection and recovery of wild stocks can be seen from recent actions already taken to implement new policy directives. A sampling of these actions is summarized below:

1. WDFW is currently conducting a comprehensive evaluation of the hatchery program. Three major areas of statewide emphasis are to:

   Manage hatcheries in a manner that is consistent with wild salmon protection.
   Release locations are being reviewed to increase access to hatchery fish by fishers while reducing interbreeding with wild fish. Locations that have good water quality for rearing eggs and juveniles are not necessarily good locations for adult broodstock recovery and harvest. External marking, such as the removal of the adipose fin, will be used as a tool to increase harvest and identify interactions with wild fish.

   Increase the survival and contribution of cultured fish to fisheries.
   Wild broodstock development and stock recovery efforts have been expanded. Mass marking by adipose fin removal is now being proposed for most hatchery chinook salmon to complement ongoing steelhead and coho marking. Experimental programs to return hatchery fish to Columbia River locations largely isolated from wild fish have allowed select area terminal fisheries, producing a threefold increase in survival and a tenfold increase in fishery contribution.

   Increase compatibility of operations with wild fish.
   Excessive interbreeding of hatchery fish that stray and mix with wild fish can result from inadequate harvest and poor homing to the release location. Negative ecological interactions at juvenile life stages can be lessened by releasing actively migrating smolts and sizing hatchery programs appropriately for the amount of available habitat.

2. Statewide, Multi-regional, Long-term or Programmatic Activities: Many of the following activities were cooperative with federal, state, tribal co-managers, and/or involved public citizen groups. They include:

- Discontinued Department releases of hatchery origin coho fry into Puget Sound (Nooksack, South Sound tributaries), Strait of Juan de Fuca and Washington Coastal tributaries. These fish would have competed with naturally produced Awild@ fry in those streams. Some low-number fry plants by co-op educational groups continue.

- The success of mass marking of hatchery steelhead in providing differential harvest and facilitating spawning grounds stock assessment has led to mass marking of other species:

  (1) Coho mass marking: Over 30 million brood 1997 Puget Sound, Coastal and Columbia River hatchery coho have been mass marked. Instream assessments of marked fish on the spawning grounds are being conducted, and Washington=s first selective ocean fishery on mass marked hatchery coho was held in 1998, and selective fisheries have been expanded in 1999.

  (2) Chinook mass marking: WDFW, in cooperation with treaty tribes and the state of Oregon, has implemented mass marking of Washington hatchery chinook. This action will allow exploitation of marked hatchery fish while increasing protection to depleted natural populations, and will also provide a tool for assessment of hatchery straying onto natural spawning grounds.

- Stock Rebuilding Plans completed or under development:

  White River spring chinook
  Skagit spring chinook
  Yakima spring chinook
  Dungeness chinook
  Nooksack Watershed Plan for chinook
  Green River chinook and coho
  Lake Washington chinook and steelhead
  Upper Columbia River chinook and steelhead
  Snake River fall chinook
  Snake River spring chinook
  Nisqually fall chinook
  Hood Canal/Strait of Juan de Fuca summer chum conservation (recovery) plan
  Bull trout
  Lower Columbia River Steelhead Initiative
  Puget Sound chinook comprehensive hatcheries plans, to be applied toward NMFS ESA compliance

- Yakima Fisheries Project has been ongoing for more than ten years. Focused on spring chinook supplementation and species interaction, it will also provide information about supplementation that will be of value throughout the entire Columbia Basin.

- Shifted releases of some hatchery fall chinook to sites downstream from naturally rearing fish to minimize return of adult hatchery spawners into areas used by native chinook.

- Analyzed trends in life history characteristics of hatchery reared salmonids over time. This information was reported in AStock Characteristics of Hatchery-Reared salmonids at Washington Department of Fish and Wildlife Columbia River Hatcheries@ Annual Report #H98-03.

- Conducted research on post-release residualism and migration speed of hatchery reared salmonids in the Elochoman River and Ringold Hatchery, and their related behavior to type of release. This information is reported in AMitchell Act Hatcheries Evaluation: Annual Report H97-04.@

- Adjusted the timing of release for Hood Canal hatchery chum salmon to avoid potential ecological interactions with wild summer chum salmon smolts.

- Eliminated direct catchable trout plants in the Quilcene and Hamma Hamma Rivers that may be impacting wild stocks.

- Continued Dungeness River chinook salmon rebuilding project. It includes an eight-year captive broodstock program, identification and corrections of limiting habitat and/or harvest constraints as well as a successful out-planting strategy.

- With the Jamestown S'Klallam Tribe, reduced coho yearling plants into the Dungeness River because large annual coho surpluses could be impacting other critical salmon stocks in the system.

Current Applicable Policies

In addition to information provided in section I. B. of the harvest chapter, WDFW hatcheries must follow some more specific guidance:

1. Additional Federal Requirements Relevant to Hatcheries

- *U.S. v. Washington*
  - $ Hood Canal Production Plan 1985/89
  - $ Squaxin Island Agreements (3)
    - Pre-1982 Fisheries Advisory Board Settlement
  - $ 1985 South Sound Fall Chinook Agreement

- Mitigation Agreements
  - Mitchell Act
  - Tacoma Public Utilities
  - PacifiCorp
  - Douglas County PUD
  - Chelan County PUD
  - Grant County PUD
  - Clark County PUD
  - Lower Snake River Compensation Plan (USFWS)
  - James River Corporation
  - Lewis County PUD
  - Puget Sound Energy (Baker Spawning Beaches)
  - Seattle City Light (Marblemount Improvements)
  - Cowlitz County PUD
  - Washington Water Power
  - BPA - Lake Roosevelt
  - Quileute Agreements
  - USFWS/NMFS ESA Operation Authority
  - Puyallup Lands Settlement
  - Administering Aquaculture Disease Control Regulations

2. State Statutes Specific to Hatcheries and Artificial Production

RCW 75.08.010

The Department of Fish and Wildlife with the Department of Agriculture will develop regulations which provides for the inspection and control of diseases and pests that may affect private aquaculture products and wildstock fisheries. The Hatcheries Program has primary responsibility for implementing and administering private aquaculture disease control regulations.

RCW 75.08.285

The director of the Department of Fish and Wildlife may prohibit the introduction, transportation, or transplanting of fish, shellfish, organisms, material or equipment which in the director=s judgement may transmit any disease or pests affecting fish or shellfish. The Hatcheries Program has primary responsibility for implementing and administering public fish disease control regulations.

RCW 75.08.230

Sales of Salmon and Eggs. Proceeds exceeding estimates in the budget approved may be allocated as unanticipated receipts. Allocations under this subsection shall be made only for hatchery operations, financed by sources other than state general revenue.

RCW 75.08.255

The director of the Department of Fish and Wildlife may take or remove any species of fish or shellfish from the waters or beaches of the state. The director may sell food fish or shellfish caught or taken during department test fishing operations. The director shall not sell inedible salmon for human consumption. Edible salmon and carcasses may be given to state institutions, schools or economically depressed people, salmon not fit for human consumption may be sold for other purposes. A portion of surplus salmon sold from state hatcheries may be required to be processed and returned by the purchaser to the state for distribution.

RCW 75.20.090

If a fishway is impractical, fish hatchery or cultural facility may be provided in lieu. This is to compensate for fish loss due to the construction of dams or other hydraulic projects.

RCW 77.12.440

The Department of Fish and Wildlife shall establish, conduct, and maintain fish restoration and management projects as outlined by the Federal Fish Restoration Act (64 Stat. 430; 16 U.S.C. Sec 777). The agency director shall comply with the act and related rules, adopted by the Secretary of the Interior.

RCW 75.50.030

Salmon enhancement plan. The Department of Fish and Wildlife shall develop a detailed salmon enhancement plan with proposed enhancement projects. Maximum opportunity for the public to participate in the development of the salmon enhancement plan shall be provided. Joint or cooperative enhancement projects shall be considered for funding.

RCW 75.52.150

Cedar River spawning channel. The legislature hereby declares that the construction of the Cedar River Sockeye Spawning Channel is in the best interest of the state of Washington. The policy committee will continue its oversight until the policy committee concludes that the channel is meeting the production goals.

RCW 75.08.420

State purchase of private salmon. The Agency may purchase quality salmon smolts for release into public waters if all fish rearing facilities are operating at full capacity. This is to explore opportunities to cooperatively produce more salmon for the public fisheries without incurring additional capital expenses.

RCW 75.50.100
All revenue from the sale of salmon carcasses and eggs that return to Regional Fishery Enhancement Group (RFEG) facilities shall be deposited into the regional fisheries enhancement account. This revenue is to be used by the group which produced the surplus.

RCW 75.54
Recreational Salmon and Marine Fish Enhancement. The Hatcheries Program has primary responsibility for salmon enhancement activities.

3. Other Legal Requirements Relevant to Hatchery Operations

- $ Federal – Endangered Species Act (Production/genetic standards)
- $ Federal – Clean Water Act (Effluent Standards)
- $ Federal – Occupational Safety and Health Act (Personnel safety)
- $ Federal – Fair Labor Standards Act (Personnel/Safety/Labor)
- $ State/County – SEPA and Shorelines permits

The joint State/Tribal Wild Salmonid Policy, and Washington Fish and Wildlife Commission Additional Guidance to Agency Staff. (See section III.)

II. Goal and Objectives: *Where do we want to be?*

Goal:
Protect, restore, and enhance the productivity, production, and diversity of wild salmonids and their ecosystems to sustain ceremonial, subsistence, commercial, and recreational fisheries, non-consumptive fish benefits, and other related cultural and ecological values.

Objectives:

- Hatcheries will use stable, cost-effective programs to provide significant fishery benefits
- Wild spawner escapement will be provided
- Genetic diversity will be conserved
- Wild salmonid stocks will be maintained at levels that naturally sustain ecosystem processes

III. Solutions: *What is the route to Success?*

Policy Guidance - Highlights of the Wild Salmonid Policy (WSP)

The blending of new scientific knowledge and traditional assumptions about the use of fishery resources has forced managers to examine and change both hatchery practices and management objectives. Hatchery programs and the harvest management regimes which they support are being reviewed for compatibility with naturally self-sustaining wild salmonid populations, as set forth in the WSP. Successful programs will be expanded and others will be reformed based on a comprehensive hatchery review that is currently underway. But, this effort is challenged by the continual loss of the habitat that supports the naturally spawning fish resource and an ever increasing human population.

Whether the purpose of the hatchery is mitigation for lost habitat, a desire by users to catch fish, or the need to restore or save some stocks from extinction, statewide salmon and steelhead hatchery production plans are now reviewed annually by WDFW and the Treaty Tribes, the result of which is a document called the Future Brood Document. This review process ensures there is general agreement among cooperating managers on the need for a specific program.

The Wild Salmonid Policy is the blueprint for ensuring fish population management (harvest and hatcheries) and habitat management meet the needs of wild fish. Managers and biologists immediately after its adoption by the Fish and Wildlife Commission began incorporating the guidance of the WSP into daily management decisions. *The Wild Salmonid Policy, and additional guidance to WDFW staff, although not included in their full detail here, are fully incorporated in the Statewide Salmon Recovery Strategy by their reference here. The complete text of the WSP and Additional Guidance to WDFW Staff can be found on the WDFW web .*

The WSP is comprised of two documents. One contains policy provisions developed jointly with many Western Washington Treaty Tribes. The second part is a complementary document that contains additional Department of Fish and Wildlife Commission policy guidance to WDFW staff on deferred issues to be resolved at the watershed level throughout Washington. Although the Treaty Tribes have not formally "signed on," the policy is being integrated into the regular management forums with individual tribes. Implementation at the local watershed level with comanagers and local governments is the level where significant progress is being made, and this is the level at which deferred issues in the Additional Guidance are being resolved.

Note: The Wild Salmonid Policy adopted by the WDFW=s Fish and Wildlife Commission contains not only fish population management (harvest and hatcheries) policies, but also includes habitat elements essential for salmon restoration. The policies contained in the WSP were developed to work in concert across the elements, i.e., habitat, harvest, hatcheries and hydropower - Discussing those policies that pertain directly to hatchery production does not imply that these actions alone can recover and maintain healthy wild salmonid populations.

Joint Policies Relating to Hatcheries and Artificial Production (identified by Policy Number)

1. Framework for Implementation of joint policy for fish populations, escapement, harvest management, and hatcheries: The fishery and hatchery management principles that are stated in this joint policy shall be implemented by affected signatory tribal parties and WDFW, who shall consult with its affected stakeholders, according to federal court processes including Puget Sound Management Plan, Hoh v. Baldridge plan, in the context of existing court ordered or approved planning processes and other places where fisheries are cooperatively managed by WDFW and affected tribes utilizing applicable law and best science.

2. *Spawner Escapement Policy*: The wild populations or management units to which this spawner escapement policy applies will be defined on a comprehensive, statewide, or regional basis, recognizing scientific uncertainty, in accordance with policy statement #1. The parties will review existing court orders, joint agreements, and management plans to determine if modifications are necessary to meet the goals of this plan. Within this context, sufficient escapement of appropriate naturally spawning fish will be provided to encourage local adaptation and maximize long-term surplus production that sustains harvest, and to provide for recreational opportunities and ecological benefits. Exceptions to this general policy may be developed on a regional basis through agreement of WDFW and affected Tribes to provide for recovery and rebuilding of wild stocks or where natural productivity is low.

Hatchery Fish and Spawner Abundance: Where hatchery fish are cultured to augment the naturally produced population in a stream, spawning of hatchery origin adults beyond what is needed for broodstock will be evaluated through a case by case analysis of the effects on the naturally spawning stock characteristics. However, the goal would be to develop harvest strategies that optimize harvest on the hatchery production and hatchery production strategies that are consistent with section 6 of this Policy and protect naturally spawning populations.

3. Conserving Genetic Diversity Policy: Genetic diversity within and among stocks will be maintained or increased to encourage local adaptation and sustain long-term productivity. Conditions will be created that allow natural patterns of genetic diversity and local adaptation to occur and evolve.

4. Ecological Interactions Policy: Wild salmonid stocks will be maintained at levels that naturally sustain ecosystem processes and diverse indigenous species and their habitats. Healthy populations of other indigenous species will be maintained within levels that sustain or promote abundant wild salmonid populations and their habitats.

5. Cultured Production/Hatcheries Policy: Use programs of stable, cost-effective artificial production to provide significant fishery benefits while having no significant adverse impacts on the long-term productivity of naturally spawning salmon and their ecosystems.

6. Water Quality and Sediment Quality, Delivery and Transport Policy: Provide for water and sediments of a quality that will support productive, harvestable, wild salmonid populations, unimpaired by toxic or deleterious effects of environmental pollutants.

7. Fish Access and Passage Policy: Provide and maintain safe and timely pathways to all useable wild salmonid habitat in fresh and marine waters, for salmonids at all life stages.

8. Continued Public Input and Science Upgrades: This policy reflects WDFW and Tribal Parties= consideration of the best science and public input that could be agreed to and incorporated at this time. WDFW and Tribal governments believe that this Policy identifies important Fish Management and Habitat parameters and frameworks that will lead to rebuilding of salmonid stocks. However, WDFW and Tribal parties intend that this Policy be a living document, to be updated with improved science as it is developed.

Summary of additional population management guidance

The Wild Salmonid policy is intended to adapt to new science and information over time, and WDFW is committed to such review, including specific forums and workshops that could facilitate analysis of specific policy elements. It is expected that, over time, the differences between the state and tribes= joint policy and the Commission=s additional policy guidance to WDFW staff, will narrow based on information gained through implementation of the policy and other evaluation, research and monitoring activities.

In addition to this joint commitment to updating the policy with improved science, the additional staff guidance further recognizes the need to work through potential policy differences with tribal and other managers, as well as emphasizing the need to work closely with the public. The implementation of the policy and additional staff guidance clearly is expected to occur through thoughtful, collaborative processes and *not* as a result of unilateral approaches - in fact, much of the Additional Guidance speaks directly to the process of implementing, in specific watersheds and regions, additional directives or prescriptions relevant to particular situations. The current record of implementation activities indicates a significant measure of success in meeting this intent.

Following is a partial list of topics relevant to hatcheries and population management covered in the Additional Guidance.

1. Marking of all hatchery-origin fish: Encourages marking, prescribes marker, provides for specific exemptions from this directive, and allows for alternative marking means for pink, chum and sockeye salmon.
2. Gene banking: Limits use of Agene banking@
3. Supplementation: Prescriptions for use of supplementation.

4. Gene Flow: Provides limitations on proportion of naturally spawning population that is of hatchery origin based on genetic similarity between native fish and hatchery fish.
5. Resolving Conflicts Between and Within Species and Stocks: Prescribes priorities between and among stocks and species based on origin.

Hatchery Tools, and Hatcheries as Tools, in the Toolbox

1. Stock Restoration

The current programs for chinook restoration (Dungeness, White River, Nooksack, Tucannon, and upper Columbia) as well as summer chum recovery in Hood Canal and pink salmon recovery in the Strait of Juan de Fuca point to the continuing future of hatcheries to help rebuild wild populations. These programs may include captive brood rearing for very critical stocks, or the more traditional forms of hatchery supplementation like taking eggs and planting either fry or smolts from carefully collected wild broodstock.

These hatchery efforts are always intended to take place as part of a larger coordinated effort between other agencies, tribes and local governments/citizens. Those coordinated efforts can include such activities as habitat protection or restoration projects, additional fish harvest controls, and other culture techniques. In the next two years, as many as 13 population groups of salmon and trout in Washington likely will be listed as either threatened or endangered by the National Marine Fisheries Service (NMFS) or U.S. Fish and Wildlife Service (USFWS) under the Endangered Species Act (ESA). Given the present status of wild salmonids and their habitats, it should be clear that the conservation role of hatcheries likely will increase in the future.

2. Disease Control

Fish and egg transfers are becoming increasingly restricted to prevent disease transmission (Co-Manager=s Disease Policy). Better rearing conditions and less reliance on antibiotics are now used to control fish diseases. Preventing disease by improving rearing conditions (such as reducing density), diets, and feeding practices is becoming more commonplace. These strategies help reduce the operating costs needed for disease treatment and often increase survival to adult, but they also increase the production cost per fish produced by requiring more ponds to grow the same number of juvenile fish.

3. Genetic Issues

The value of wild fish as a genetic storehouse and the role of locally adapted populations are now better understood by fish resource managers. Stock transfer guidelines and hatchery spawning guidelines were developed by Washington Department of Fisheries in the early 1980s. The spawning guidelines direct field staff on operational issues such as: using equal number of males and females when spawning; taking eggs from throughout the run rather than on only a few days; and utilizing methods of fertilization that

help preserve as much genetic variation as possible in hatchery brood stocks. The stock transfer guidelines help preserve the diversity and fitness of existing stocks by limiting transfers of non-local hatchery strains. Genetic risk assessment methods are currently being developed and refined as scientific knowledge advances.

4. Ecological Interactions

Minimizing the competition between hatchery and wild fish is beneficial to both. The planting of fish at some hatcheries is now delayed in order to prevent overlap with the out-migration of local native populations. Most often this is done at hatcheries that produce coho and steelhead on streams that have naturally producing steelhead, pink or chum salmon. This helps prevent predation on pink, chum and steelhead fry. Studies are now in progress to better understand interactions and behavioral differences between fish of the same species produced in a hatchery and in the wild (critical for addressing ESA issues).

Returning hatchery salmon carcasses to the stream to provide nutrients is an example of how scientific research has pointed hatcheries in a different direction. This idea, long supported by theory, recently has been supported by scientific research. In Washington, ten pilot projects were started in 1996. The future will include more of these projects as hatcheries become more a part of the natural cycle of aquatic life in the Northwest. In a sense, wild and hatchery fish themselves will increasingly be viewed as an integral habitat component.

5. Fishery Enhancement

New tools are being developed and implemented to make programs designed to produced hatchery fish for harvest more compatible with protecting wild populations. For example, the marking of all hatchery fish so they can be visually identified by fishers. Managers then can require fishers to release wild fish, while permitting retention of hatchery fish that are intended for harvest. In this way wild and hatchery fish may be harvested at different rates, based on their differing levels of allowable harvest. Use of sterilized hatchery fish to support fisheries and prevent interbreeding with wild fish is also being evaluated. It is clear that maintaining fisheries for coho, chinook salmon, and steelhead (especially in marine areas) will depend on our ability to selectively harvest hatchery-origin fish.

6. Public Outreach

The public has always shown an insatiable thirst and keen interest in Washington=s fish and watershed resources by placing a high value on knowledge and information. Hatcheries have and will continue to play a vital role as a place where citizens can become educated and involved with the fish resource. Volunteer groups often acquire fish, fish food and advice from local hatcheries (123 groups currently do so now). Thousands of school children get to touch their first salmon by visiting local hatcheries or by being involved in classroom incubation projects (over 300 exist throughout the state). Because hatcheries are located across the state and usually in remote areas, they often serve as important contact

points with the public. In this role, hatcheries will increasingly serve as places for sharing information regarding natural resources and conservation efforts.

7. Accountability Issues

Whether in a stock restoration role or fishery utilization context, it is important to know the extent to which hatchery resources are being effectively managed. Making WDFW and the tribes more accountable for their hatchery production, as in making all government programs more accountable, has been an area of emphasis in the recent past. By reviewing and refining specific management objectives and the hatchery production that supports them, accountability is more clearly defined. As new scientific techniques are developed, it has/will become possible to identify hatchery fish when encountered in the wild (e.g., mass marking/tagging machine and genetic analysis).

Mass marking of hatchery steelhead (via the adipose fin clip) has been occurring for almost 10 years. Mass marking of hatchery coho and chinook salmon, recently required by the Washington State Legislature, will readily allow field identification of hatchery fish. Information generated by mass marking/tagging can be used to more accurately estimate the number of adults (and thereby the benefit/cost of those adults) produced by our hatcheries.

Mass marking hatchery fish also allows managers to monitor the straying of hatchery fish and their potential interbreeding with wild fish. The high harvest rates on hatchery fish can help minimize the number of hatchery strays and marked fish can also be removed from populations at fish weirs before spawning.

Continued Implementation Activities and Timelines:

Continuing implementation actions to improve hatchery operations and compatibility with wild stocks can be viewed in short-term and long-term timeframes. The longer term actions are those that require improvements to facilities or other capital investments, while the shorter-term efforts reflect those changes that can and will be made immediately as indicated through a variety of program reviews, recovery planning and risk assessment.

1. Short-Term: Several short and long-term (continuing) activities will contribute to changes in hatchery practices and programs, for example: The comprehensive programmatic review of all hatchery programs; research aimed at refining practices that reduce ecological interaction with wild fish; comprehensive harvest management planning activities such as regional/watershed planning exercises and revision to state/tribal management plans; review of all hatchery activities, including supplementation and hatchery-aided stock recovery programs, concurrent with ESA authorization. Continuation and expansion of mass marking of hatchery fish will provide a major tool with which to evaluate the ecological effects of hatchery fish on wild fish, as well as to provide a directed selective-harvest opportunity on marked hatchery fish.

Long-Term: Various planning and review efforts will identify hatchery implementation actions that require significant capital investment. Examples of such actions would be construction of lower tributary release, acclimation and adult return sites that could be used to minimize interbreeding of hatchery and wild fish. Modifications to weirs or trapping facilities to allow sorting of hatchery and wild fish would be another example, as would be retrofitting existing hatchery facilities to accomplish objectives such as better support stock rebuilding efforts, improve brood stock management and improve homing. These longer-term activities will be identified and prioritized according to opportunity and risk, with a schedule developed for various regions and watersheds over the next two years. It should be realistic to expect that these kinds of changes could be completely implemented over a 5 to 10-year period once funding sources are identified.

IV. Monitoring and Adaptive Management: *Are we making progress?*

A critical component of adaptive hatchery management is effective monitoring and evaluation. For a more detailed discussion of how monitoring and evaluation is integrally tied to adaptive management and risk assessment, refer to part V of the Statewide Salmon Strategy. WDFW must monitor and evaluate the influences of hatchery operations on ESA listed and naturally-produced fish to ensure either no jeopardy or positive benefits occur to the populations. There is an expectation that an enhanced level of information is necessary to ensure compatibility of hatcheries with wild salmonid populations.

Monitoring and evaluation of hatcheries are comprised of three primary objective categories: Implementation, Strategy Effectiveness, and Validation. Implementation addresses the extent to which actions have been taken as planned. Strategy Effectiveness addresses how well the actions undertaken are effective in meeting explicit objectives or criteria. Validation involves examining the appropriateness of assumptions critical to the strategy itself. This objective is usually associated with research efforts focused on key priority questions linking relationships between strategy components and fish populations, or linking changes in habitat parameters and fish populations. It is usually the best approach to use to assess cause and effect relationships.

The hatchery programmatic review will address many aspects of WDFW=s fish culture operations. The key components related to hatchery monitoring and evaluation are to: 1) identify the need and appropriateness for each fish culture activity; 2) evaluate genetic and ecological impacts to wild stocks through a thorough risk evaluation process; and 3) provide the ability to track recovery and health of wild stocks. The primary method to accomplish these components is the ability to identify hatchery origin fish. These tasks need to be coordinated with habitat monitoring locations and activities.

Monitoring Implementation

Implementation progress can be monitored by comparing future actions with management changes outlined in the programmatic review. Additional ways include comparing future actions with species plans, specific recovery plans, and the future brood document. Species plans and specific recovery plans are in various states of development, but the future brood document is developed annually. Other documents detailing WDFW hatchery operations are the Hatchery Operation Plans and Performance summaries, which are published periodically.

For recovery programs, implementation progress would consist of beginning recovery actions in a timely manner, adhering to the size of the project as designed (for example, taking the appropriate number of eggs), and gradually ending the project as recovery occurs. For production programs, implementation progress would consist of creating and following the time lines for determining competition and other negative interactions with wild stocks, and ensuring progress to identify all hatchery fish, especially the expanded mass marking of coho and chinook.

Strategy Effectiveness

This monitoring category focuses on how well specific conservation and production programs achieve their intended results. In many cases, results will be assessed at more immediate response levels or scales that ultimately determine success at not impacting long-term productivity or fitness of wild stocks. Three main areas to focus on include identification of hatchery fish, genetic interactions, and ecological interactions.

1. Identify hatchery origin salmonids in marine areas, freshwater, and fisheries.

The abundance of wild salmonids in many areas remains unknown because the presence and number of commingled hatchery fish cannot be determined. This Amasking@ of wild stock abundance is problematic because the effectiveness of recovery actions, responses to operation and management changes, and even the need for hatchery recovery programs can be obscured. In some forums such as ESA, the inability to verify (lack of direct evidence) the origin of salmonids on the spawning grounds has lead to the presumption that fish are of hatchery origin or the progeny of hatchery fish which spawned in the wild.

The presence of hatchery adults in freshwater and the magnitude of hatchery releases have been enough to cause NMFS to postulate that wild stocks could be much less abundant than measures indicate in some areas. The state has contributed to this perception through its management and proliferation of small enhancement projects.

The preponderance of mixed stock origin and composite production in the Salmon and Steelhead Stock Inventory (SASSI) is one important example of why there is concern about the uncertainty of true status of wild populations due to the contribution of hatchery-origin spawners. SASSI had a mixture of stock status designations where the ratio of hatchery and wild fish were unknown. The risk assessment

approach being developed in species and recovery plans has to be based on the ability to identify hatchery and wild fish in natural spawning habitat to be effective.

Another key evaluation need is determining whether or not specific hatchery programs are necessary. In some cases harvest data indicate large numbers of hatchery fish are released without meaningful contributions to fisheries. An unknown component of this result is the amount of unreported by-catch and under reporting of landed catch due to non-compliance with landing laws. More often, the effectiveness of the hatchery operation is unknown because hatchery returns cannot be differentiated from wild fish. This can lead to unfounded claims of success or failure of hatcheries without substantiated information.

There is a need to evaluate the current natural production prior to initiating recovery actions, especially in areas and for species that are not easily assayed for population abundance. This is especially true with turbid, glacier fed streams; with species such as coho salmon that tend to Adisappear@ into a watershed; and for other salmonids that do not die after spawning. The past existence of Ahatchery harvest management zones@ for one or more anadromous species throughout various parts of the state has led to a perception that an insufficient number of naturally spawning wild adults returned to adequately seed available habitat. Subsequent attempts to mitigate for assumed over-harvest often occurred without any assessment of existing natural populations.

In addition, habitat problems including the increase in flood events; popularized the stocking of hatchery fry and smolts (often mis-referred to as supplementation), and the use of egg incubation devices to increase egg-to-fry survival. Many efforts to increase natural production have been initiated without determining the abundance of wild fish without evaluation as to their effectiveness or impact on the natural populations. Such efforts will be critically reviewed and modified or discontinued through implementation of the Wild Salmonid Policy.

2. Genetic interactions

Evaluating and monitoring genetic interactions involves identifying changes to within and among stock genetic diversity that can occur through interbreeding and reduced population sizes. Genetic tools have proven to be very useful in understanding the historical genetic population structure of salmonids and also the effects of past fish management practices. Genetic technology continues to improve and is allowing further insights into the interactions of wild and hatchery salmonids.

In addition to molecular measures of genetic variation, quantitative genetic characteristics and heritable life history traits are also important to document. Characteristic traits such as spawning time, size, and age structure have developed in stocks because those individuals that were successful at completing their life cycle passed their characteristics to progeny in subsequent generations. Some hatchery programs need the hatchery fish to be similar to nearby wild stocks, especially if the hatchery fish are

part of a rebuilding program and are expected to be successful at spawning naturally. In some cases objectives are harvest oriented with a desire to minimize interactions with hatchery fish. Being able evaluate the outcomes of each type of program is an important part of genetic monitoring and evaluation. In both cases the monitoring objective is to measure whether exchange in genetic characteristics and performance of wild fish is being impacted.

3. Ecological interactions

Evaluating and monitoring ecological interactions involving hatchery salmonids has come under increased scrutiny during the past decade. Ecological risks may extend to many species whereas genetic risks typically extend to only individuals of the same species or hybridization with a closely related species. The goal for ecological monitoring and evaluation is to select management and research actions that are contingent upon ecological risk tolerance levels.

Ecological interaction risk assessment requires five tasks: 1) determine non-target taxa objectives including taxa of concern, status of taxa of concern, and determining the acceptable impact level; 2) determine or hypothesize spatial-temporal overlap of target taxa with taxa of concern at various life stages including overlap between released salmonids and returning hatchery adults; 3) determine or hypothesize ecological interactions that might occur and the likely magnitude of those interactions (strong, weak); 4) assess ecological risk by weighing the positive and negative interactions that might occur; and 5) determine the scientific uncertainty of the overall assessment.

Specific types of interactions can be classified as beneficial or negative. Beneficial ecological interactions include nutrient enrichment, and, prey and predator swamping. Negative interactions include competition for resources that would be used by wild fish in the absence of hatchery salmonids, direct predation or through increasing the abundance and awareness of predators, behavioral anomalies, pathogenic interactions, and nutrient mining by removal of carcasses into the hatchery for broodstock.

4. Tracking recovery

Effective monitoring and evaluation must track performance in relation to meeting a goal. Defining the specific performance measures to monitor and evaluate is one of the fundamental principles of the statewide recovery plan. Increased local adaptation through a reduction in the levels of hatchery fish breeding in the wild, a decreased reliance of supplementation and hatchery-assisted stock recovery programs, and lessening negative interactions are all ultimate objectives of wild salmonid recovery. One important monitoring approach will be to track the progress of meeting desired objectives through SASSI. Progress would be to increase the number and distribution of wild production types and reduce the number of non-native and mixed origin stocks in each ESU. Biological data such as the abundance and overlap of hatchery origin fish on the spawning grounds, and genetic measures of stock diversity and relatedness of hatchery and naturally spawning populations will be used to improve the information used to arrive at the SASSI classifications. In addition, the decline of risks and hazards

identified in the artificial production components of recovery and comprehensive management plans are specific measurable criteria that will be used to track rate of progress and level of recovery.

Validation

The adaptive management process requires learning from past results. Understanding whether or not the observed changes and outcomes were produced by the specific management actions that were taken require validation monitoring. Defined studies using the scientific method coupled with the appropriate statistical design and testing need to be used to differentiate between random outcomes and those produced intentionally. An example of the need for this type of evaluation is to determine if the recovery actions are responsible for an increased abundance, if it is just the result of increased ocean survival, or both. Other major monitoring areas include examining the reproductive success of adults produced through recovery programs and determining if modified release and adult capture efforts reduce wild and hatchery overlap.

Default Actions

Specific implementation actions for each hatchery operation will be developed as part of the programmatic hatcheries review. Reforms to hatchery operations such as moving release locations away from natural production areas, modifying rearing and adult attraction water to improve homing, and changes to production levels will occur when hatchery production has impacted wild stocks negatively through genetic interactions, ecological interaction or excessive harvest. The species and stocks cultured at a facility may be changed.

As a default, hatchery closures will occur when negative impacts cannot be corrected or where there is inadequate funding for necessary modifications. In addition, hatcheries will be reprogrammed or discontinued where the contribution to fisheries is poor and uneconomical. The time lines and funding requirements for the various implementation strategies will be outlined in specific reviews and recovery plans.

If wild stocks cannot be maintained at healthy levels, the use of hatcheries to mitigate for habitat destruction will have to be greatly reduced unless mitigation production levels are restructured to meet specific population rebuilding needs under a formal supplementation or gene pool preservation program. Supplementation programs intended to increase the natural spawning population will be programmed for a limited time and will be part of a larger program to restore the habitat to a level that will allow the natural population to become self sustaining. Conversion of supplementation programs to harvest production hatcheries will be opposed unless they are compatible with the recovered wild stock.

ESA Compliance Strategy

Hatchery releases from state and tribal facilities likely will occur under some form of ESA incidental take permits or take allowances under section 4(d) rule for a large share of the state (Columbia River, Puget

Sound and portions of the coast) beginning in 1999. This will require rigorous program reviews, risk assessments and changes to hatchery programs that will be specifically outlined in take applications or sections of recovery plans. In addition specific monitoring provisions will be required under these take provisions. Recovery plans will identify different phases of actions that will be taken over time according to risk of inaction and implementation costs.