# Regional Hatchery Management Strategies

*The purpose of this regional strategy on hatchery management is to address issues that are common to multiple watersheds or that have not been adequately addressed within an individual watershed plan as identified by the Puget Sound Technical Recovery Team (TRT). This strategy does not replace actions or strategies identified within an individual watershed plan.*

*Each individual watershed chapter identifies factors and conditions necessary to achieve recovery. In some limited cases additional factors or conditions have been identified by the TRT as noted in the watershed profiles contained in this plan. Together these factors and conditions are considered to be based on the best available science for recovery in the individual watershed. This regional strategy does not replace or substitute the conditions or actions necessary in an individual watershed as defined by that watershed chapter in this plan. If there is a conflict between the recommendations of this regional strategy and the individual watershed chapter, the individual watershed chapter shall take precedence.*

*"Hatcheries can be useful as part of an integrated comprehensive approach to restoring sustainable runs of salmon, but by themselves they are not an effective technological solution to the salmon problem."*

*National Research Council, 1996*

Photo by Eileen Palmer for the Hood Canal Salmon Enhancement Group.

Hatchery management has continually changed in the face of advances in scientific information and husbandry practices, evolving community goals, and realization of the long term impacts that the hatcheries themselves may engender. Chapter 3 on hatchery factors described the history of hatchery management in the Puget Sound region, the ways that hatcheries have been used to attempt to mitigate for habitat loss in some watersheds, and the growing awareness of threats as well as benefits. Hatcheries may be used to promote community economic and cultural goals for harvest and as a tool to conserve and recover threatened populations of salmon and steelhead. However, long term awareness of issues such as loss of fitness and genetic diversity, ecological impacts to naturally spawning populations through predation and competition, disease transfer, and the habitat disruption of the facilities themselves have led to a number of hatchery reform efforts in recent decades.

Institutional and operational changes to hatchery management have occurred over the last 20 years in response to declining populations and growing awareness of risks. Hatchery production, wild stock management needs and harvest objectives were central issues in the 1985 Puget Sound Salmon Management Plan (PSSMP) between WDF and Puget Sound tribes. Several other co-manager initiatives have advanced such as disease control policies and procedures, wild salmonid policies and a systematic analysis of the benefits and risks of hatchery programs.

The Puget Sound and Coastal Washington Hatchery Reform Project was launched in 2000 by the U.S. Congress and created an independent review panel, the Hatchery Scientific Review Group. The Project reviewed all Puget Sound hatchery programs, made recommendations for reform, created scientific tools to help implement recommendations, and created principles to make hatchery reform operational and ongoing. It also provided funding for related studies, hatchery operational changes, and some funding for modifications to facilities where appropriate. (www.hatcheryreform.org)

In 2004, WDFW and Puget Sound treaty tribes completed the hatchery component of the Comprehensive Chinook Resource Management Plan (RMP), building upon other assessments submitted to NMFS in response to the listing of Puget Sound Chinook under the Endangered Species Act. The Hatchery RMP contains 42 specific Hatchery Genetic Management Plans designed to limit adverse impacts to threatened populations of salmon from hatchery programs and operations.

The next segment of this paper describes principles and strategies for hatchery management that have evolved from the series of hatchery reviews and reforms that were conducted in recent decades. The last segment describes the Hatchery RMP, expressing the commitment that state and tribal co-managers have made to utilize hatcheries as a tool for rebuilding salmon populations to sustainable harvestable levels, and to ensure that hatchery production is not a threat in itself. Additionally the watershed chapters contain information provided by local watershed groups and hatchery managers relevant to proposed recovery actions.

## Guiding Principles for Hatchery Management

Hatchery reform is the ongoing, systematic application of scientific principles to improve hatcheries for recovering and conserving naturally spawning populations and supporting sustainable fisheries (HSRG, 2004). Several common principles for hatchery management have evolved from scientific reviews and discussions between state and tribal co-managers, federal agencies and independent science panels in recent years. These principles generally reflect the shift in perspective away from viewing hatcheries primarily in terms of production objectives, to a broader view of the role of hatcheries within the larger ecosystem and their function in supporting multiple community and ecosystem goals. The principles are also intended to gear hatchery operations to reduce the risk to threatened populations of salmon, and to be responsive to specific watershed conditions and needs.

### Productive natural habitat is essential for healthy, harvestable salmon populations and successful hatchery programs.

Healthy habitat provides the greatest biological certainty, as it contains the core functions that sustain salmon populations over the long term. When habitat strategies are designed to protect existing intact ecological functions, they have a greater certainty of maintaining or restoring viable salmon populations than strategies that rely on artificial substitutions (NRC, 1996). However, habitat conditions in some watersheds are already substantially degraded, and restoring and protecting habitat to the extent necessary to achieve population restoration and harvest may take several decades.

While natural populations are recovering, hatchery

programs will provide important opportunities for rebuilding and harvest.

Social, economic or funding constraints may make it infeasible for some salmon populations to be provided with the necessary habitat conditions to meet biological and social objectives. In watersheds where these constraints severely limit conservation and harvest objectives, hatchery programs that use careful operational strategies and complementary habitat actions may be appropriate. Scientific decision support tools developed by the co-managers, Hatchery Scientific Review Group, and others can help identify scientifically defensible combinations of habitat improvements, harvest constraints, and hatchery program types and sizes that are consistent with policy objectives and limitations, and are coupled with consistent, long-term monitoring, evaluation and adaptive management programs.

Despite the improvements in hatchery management, hatchery production can never fully replace the benefits of natural production. Healthy, abundant habitat is also essential to the success of hatchery programs. The size and health of natural populations and the habitat on which they depend controls what hatcheries can do to boost natural spawning and meet harvest objectives (WDFW & PSTT, 2004; HSRG, 2004).

### Hatchery programs must operate under the legal framework defined by U.S. v Washington.

Providing harvest opportunities consistent with treaty fishing rights and conservation is an important, legally defined role for hatcheries. Hatchery programs are managed by the state, tribes, and federal government under the Puget Sound Salmon Management Plan and other plans and agreements prepared under the legal umbrella of U.S. v Washington. The PSSMP identifies tools for making changes to hatchery programs including, 1) descriptions of operational modes such as goals, production objectives, description of facilities, species cultured, broodstock source, hatchery protocols, and contingency plans; 2) annual review of operational plans; 3) regional coordination of co-manager activities and priorities; 4) information systems for the exchange of technical information and analyses; and 5) dispute resolution. (WDF & PSIT, 1985)

The harvest of salmon is intrinsically linked to the identity of Pacific Northwest tribes, but fishermen cannot presently rely on naturally spawning populations to fulfill their cultural, subsistence and economic needs. It is through hatchery fish that the tribal communities can likely retain the knowledge of how to fish during the years it will take to restore natural production.

*"The hatchery program at the Stillaguamish Tribe was created to help provide current tribal members and future generations with the opportunity to continue their spiritual and cultural connections to salmon through fishing. However, even with this program in place, tribal members and their children will lose the legacy of Chinook without the commitment and dedication of the community to salmon habitat recovery."*

*Kip Killebrew, Stillaguamish Tribal Fisheries Biologist*

### Hatcheries designed, operated, and evaluated in an ecosystem perspective are more likely to provide harvest and conservation benefits with reduced risks to natural populations.

Rather than viewing a hatchery as an isolated fish production factory, numerous scientific reviews have recommended that hatchery programs should be integrated and evaluated as part of the environmental and ecological systems in which they operate (NRC, 1996; Brannon et al., 1999; HSRG, 2004). Managers have been encouraged to view hatcheries in a manner similar to an additional watershed tributary, and examine their fish culture practices as a broad investigation of demographic, ecological, evolutionary and fishery interactions (Williams, et al., 2003).

**A hatchery program is "successful" when it provides a more favorable balance of benefits to risks when evaluated relative to watershed-specific objectives.**

*"Hatcheries are by their nature a compromise, a balancing of benefits and risks to the target stock, other stocks, and the environment affected by the hatchery program. A hatchery program is the right solution only if it is better, in a benefit/risk sense, than alternative means for achieving the same or similar goals." (HSRG, 2004)*

Hatchery programs can provide substantial economic, cultural and conservation benefits, but potentially they can also pose risks to natural populations of salmon. The risks and benefits of a hatchery program should be evaluated relative to the ability of the habitat in that watershed to support viable natural populations and other policy objectives. Consequently, the characteristics of a successful program will differ among watersheds because of the varying status of natural populations and policy decisions regarding the rapidity and extent of habitat protection and recovery. As habitat is restored and populations approach their recovery goals, the benefits of a hatchery program are lower relative to the potential genetic, ecological and demographic risks. A plan with successful integration of strategies across management sectors will result in the concomitant modification of hatchery programs to reduce their potential risks. The hatchery program may be visualized as following a trajectory from the current operation to the expected operation at recovery, with the level of acceptable risk declining as the population approaches recovery (figure 6.5).

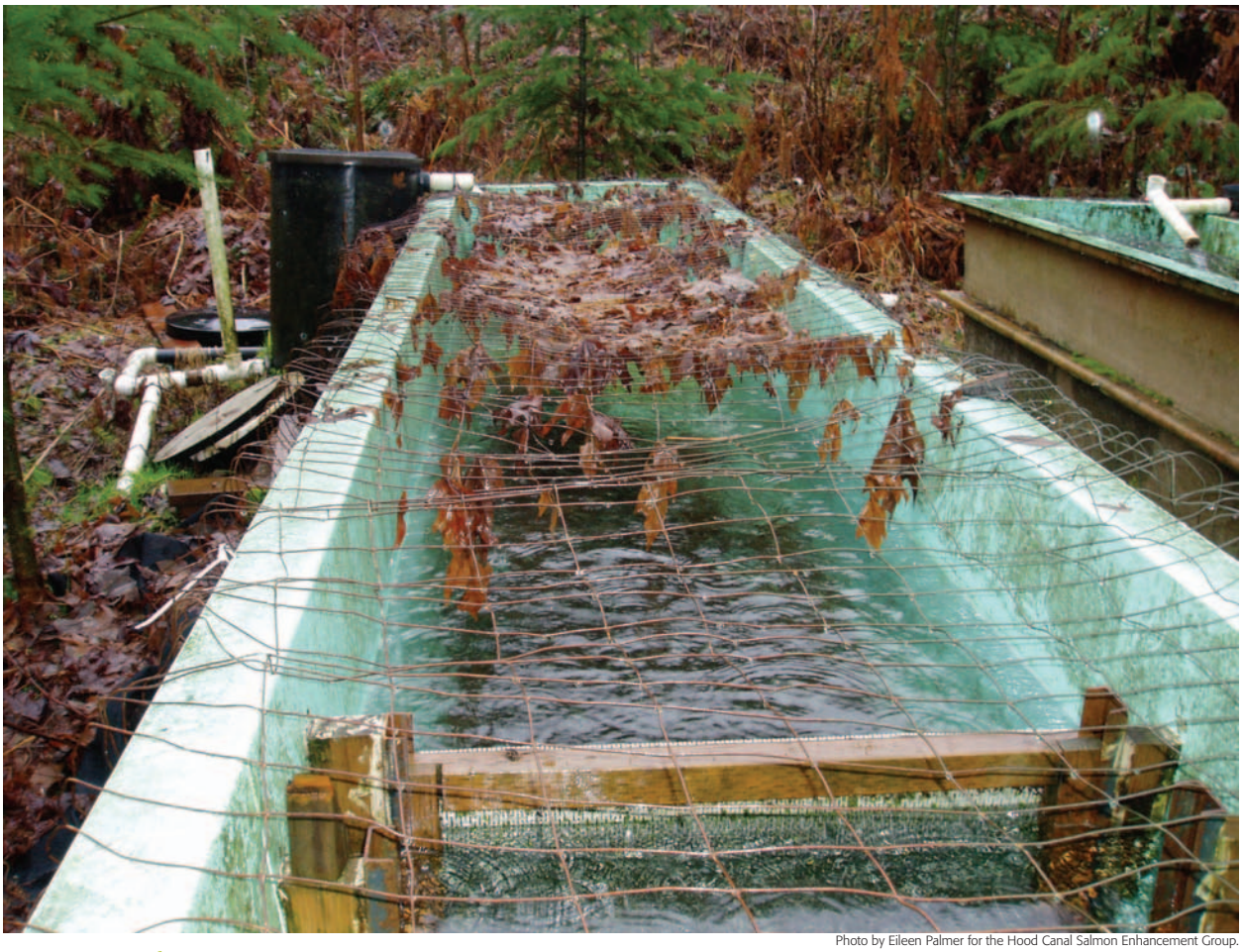


Photo by Eileen Palmer for the Hood Canal Salmon Enhancement Group.

**Hama Hama Hatchery.**


represents a spawning population of salmon

*Risk tolerance must be evaluated for the unique spatial and diversity characteristics of a given population as well as population abundance and productivity.

**Figure 6.5 Conceptual relationship between habitat quality and quantity, population abundance and productivity, and risk tolerance for hatchery programs. (Adapted from Currens & Busack, 2005)**

**The design of a successful program begins with the identification of a program goal and the careful selection of either an integrated or an isolated hatchery strategy.**

The selection of goals for each hatchery program drives the protocols for program design and operation. The primary management goals of hatchery programs are: 1) to promote rebuilding and recovery of populations at risk; and 2) to provide opportunities for harvest. Selection of goals depends on the conditions specific to each watershed, such as the status of the natural population and habitat. Strategy selection is program and watershed specific, and depends on the status of the natural population and habitat, the ability to collect natural-origin broodstock, the ability to control the number of hatchery-origin adults in natural spawning areas, and other factors.

Integrated programs are designed and operated with the intent that fish of natural and hatchery origin will become fully reproductively integrated as a single population. The selection of this strategy will always require that natural origin adults are incorporated into the broodstock for the hatchery program. Isolated programs intend for the hatchery population to represent a distinct population that is reproductively isolated from naturally-spawning populations (figure 6.6).

The selection and management of an integrated or isolated production strategy is intended to prevent the negative effects of gene flow, which can lead to the loss of population identity or fitness over time. Integrated programs

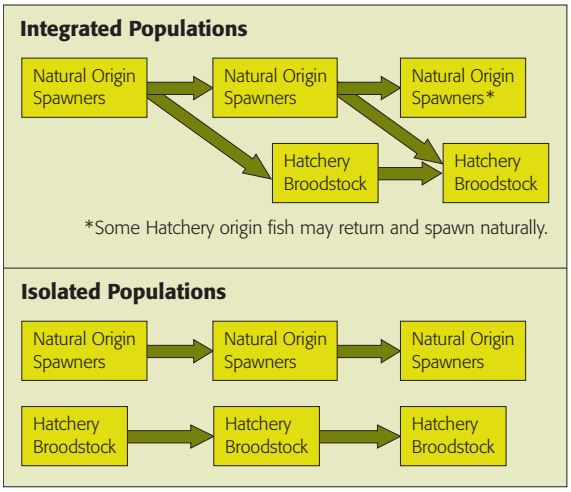



**Figure 6.6 Conceptual representation of the extent of reproductive interaction in integrated and isolated hatchery programs.**

ultimately need sufficient numbers of natural origin spawners that can be incorporated into the hatchery broodstock. The intent of an integrated program is for the genetic make-up of hatchery-origin fish to be the same as that of the underlying natural population, and that natural selection in the wild drives the fitness of both components of the population (HSRG, 2005).

Habitat is of critical importance to any type of hatchery operation, as hatchery programs can only be successful if habitat conditions are conducive to the survival of salmon throughout their entire life cycle. However, this is particularly true for programs relying on an integrated strategy, since natural-origin broodstock must be incorporated into the hatchery in each generation.

In general, integrated hatchery programs can be operated to increase the number and distribution of natural spawners, increase the productivity of the composite population, and provide fishing opportunities. Isolated hatchery programs can be operated to provide fishing opportunities while minimizing interactions with natural populations (Figure 6.7).

Hatchery operating protocols should be consistent with the management objective and the strategy. The protocols describe the daily operation of the hatchery program, and include the program size, broodstock source and collection procedures, rearing conditions, and time, size and location of release. Guidelines for hatchery protocols are described in the findings and recommendations of the Hatchery Scientific Review Group (2004) and in the co-manager Hatchery Resource Management Plan (RMP) (PSTT & WDFW, 2004). The Hatchery RMP contains lists of hatchery programs in Puget Sound, their objectives (recovery, harvest, research) and their program type (isolated, integrated).

| Primary Management Objective | Demographic Relationship to Natural Population(s) in Watershed | |
|---|---|---|
| | Integrated Production | Isolated Production |
| Recovery | • Prevent extinction<br>• Increase natural origin recruits using the local stock<br>• Reintroduction<br>• Research | • Prevent extinction<br>• Create 'reserve' population in case other recovery options fail<br>• Gene banking until reintroduction<br>• Research |
| Harvest | • When isolated approach is not feasible<br>• Maintaining local stocks<br>• During rebuilding<br>• Mitigation<br>• Research | • Create new or enhance existing fishing opportunities<br>• Mitigation<br>• Allocation<br>• Research |

**Figure 6.7 Artificial production strategies and their primary uses (from PSTT & WDFW, 2004).**

### Successful hatchery programs are characterized by clear goals and operational plans.

During their review of hatcheries in Puget Sound in 2002-2004, the HSRG found several examples of Puget Sound hatchery Chinook programs that are presently: 1) helping to recover and conserve naturally spawning populations; or 2) supporting sustainable fisheries. Such programs were generally characterized by key principles of successful hatchery operation, including, "clear goals, scientifically defensible programs, and informed decision-making" that can be monitored and adapted over time. (HSRG, 2004).

**Principles of Successful Hatchery Programs:**

- **Well-defined goals:** If the goals for each hatchery population are well defined, quantified where possible, and expressed in terms of community objectives (harvest, conservation, research, etc.) the ability of hatchery managers to evaluate the benefits and risks of a program are greatly improved.
- **Scientifically Defensible Programs:** A clearly articulated scientific rationale for a hatchery program provides the foundation for decision making and strategies for the achievement of goals. Hatchery strategies must be consistent with current scientific knowledge at the initial planning and operational stages. Assumptions, hypotheses and uncer-

tainties should be spelled out in a comprehensive management and operational plan.

- **Informed Decision Making:** Management decisions must be informed and modified by continued evaluation of existing programs and assimilation of new information. Communication across regional hatchery programs and the relationship of hatchery management actions to habitat and harvest are essential elements of successful adaptive management.

The HSRG found that, while a given individual hatchery program may be successful in broodstock collection and other operational considerations, it might not be adequately taking into account the risks to other stocks or the environment, benefits to the target population, or the relationship of hatchery production to habitat availability over time. During the review of individual watershed recovery plans in 2004-2005, the Puget Sound Technical Recovery Team observed that substantial progress has been made, but identified additional steps that are needed to integrate hatchery programs with habitat and harvest.

### Hatchery strategies must be integrated with harvest and habitat.

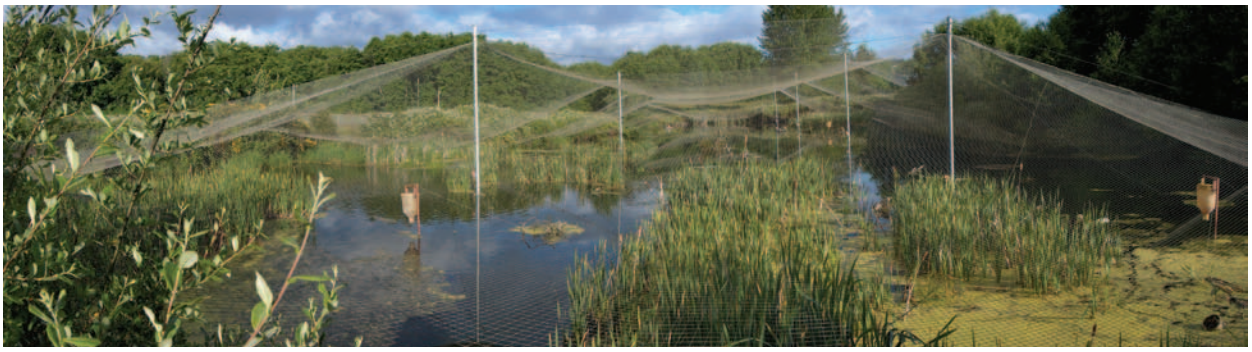
While natural populations are recovering, hatchery programs will provide important harvest opportunities. This allows all groups to maintain the knowledge and culture of fishing and, in particular, provides treaty tribes with the ability to retain a portion of the treaty-reserved fishing rights in the face of habitat degradation. Because harvest opportunities on hatchery fish are only available in restricted times and places, they cannot fully make up for the harvest that would be available from restored natural populations. Hatcheries will provide a necessary source of harvest opportunity while natural populations recover, but restoration of habitat function is required to restore natural production, which in turn is necessary for harvest and other benefits.

Clear consistent communication is also needed across the hatchery, harvest and habitat sectors. Hatchery programs must be designed and operated to consider the availability of habitat quality and quantity, with appropriate timing and sequencing as habitat conditions are improved. Harvest programs must consider the production objectives, capabilities and needs of hatchery programs. More information on all H-Integration is included in the next section of this chapter.

## Puget Sound Chinook Salmon Hatcheries, a Component of the Comprehensive Chinook Salmon Resource Management Plan (Hatchery Resource Management Plan (RMP))

State and tribal co-managers have indicated their commitment to implement hatchery management strategies that will assist in the recovery of Puget Sound Chinook, consistent with all measures and actions described in the Hatchery Resource

**Gene Enick, Tulalip Hatchery technician, collects Chinook eggs at the Samish WDFW hatchery. Photo by Steve Young, Tulalip Hatchery Manager.**



**The Natures Rearing Pond at the Lower Elwha Tribal Hatchery: Hatchery managers have developed new techniques to improve hatchery productivity by integrating elements of natural ecosystems into hatchery operations.**

Management Plan (WDFW & PSTT, 2004). This Plan defers to and relies upon the hatchery management strategies and actions described in the Chinook Hatchery Resource Management Plan and in the individual Chinook salmon Hatchery and Genetic Management Plans proposed by the co-managers in 2004 and 2005 for implementation through the NMFS ESA 4(d) Rule limit 6 evaluation and determination process. The general principles of the plan are directed at minimizing the risks to natural populations while rebuilding weak and threatened populations and providing opportunities for harvest. Protocols are described to manage risks associated with fish health, broodstock collection, spawning, rearing, and release of juveniles; disposition of adults; and catastrophes within the hatchery. The Hatchery RMP was completed in response to the Endangered Species Act, and was an expansion of the biological assessment of tribal hatchery programs submitted by the Bureau of Indian Affairs as a requirement of Section 7 of the ESA. The Hatchery RMP also incorporates management alternatives developed by the tribes and the National Marine Fisheries Service, and draws from the recommendations of the Hatchery Scientific Review Group.

*"The overall strategy for managing hatcheries at the ESU [Evolutionarily Significant Unit] scale is based on the observation that the risk of extinction to ESU and potential for recovery are different in different watersheds of the Puget Sound. The Puget Sound includes areas where the habitat can still support some sustainable natural production, areas where habitat for natural production has been irrevocably lost, and areas where Chinook salmon were never self-sustaining, independent populations." (WDFW & PSTT, 2004)*

### Operational Changes to Hatchery Management in Puget Sound

Operational changes have already been implemented that emphasize rebuilding wild populations and reducing negative impacts with wild fish. These actions are described in the Hatchery RMP as follows:

- "Reduction of cross-basin transfers of salmon stocks: Once a common practice, this management method has been dramatically reduced to protect local genetic adaptations and to reduce the risk of disease."
- "Reduction of fry plants: Until the 1960s, fry plants were the primary release strategy but they are used today only where it is ecologically and genetically appropriate."
- "Establishment of fish health programs: Building on the fish disease policy, WDFW and the tribes have developed extensive fish health monitoring and treatment programs to ensure the health of hatchery fish."
- "Development of improved release strategies: Improved release strategies focus on increasing survival by releasing fish at physiologically

appropriate stages and minimizing competition and predation on wild fish."

- "Reduction in total releases of Chinook: Releases of Chinook salmon increased during the late 1970s and 1980s, with the peak of approximately 76 million Chinook occurring in 1990... Recent annual release levels have been about 50 million Chinook. Further reductions are being considered."
- "Implementation of recovery programs using hatcheries: Beginning with the White River program in 1977, geneticists and fish culturists have been improving techniques for using artificial propagation to prevent extinction and to maintain genetic diversity."
- "Development of genetic baselines to distinguish specific stocks: During the 1980s and 1990s, and continuing to the present, genetic profiles for most Chinook stocks have been developed, providing specific information useful for harvest analysis and hatchery operations."
- "Development of the coded wire tag and resultant data: This has allowed fishery managers to acquire information pertaining to stock contribution and distribution in fisheries in marine and freshwaters areas." (WDFW & PSTT, 2004)

Hatchery operations will undergo a transitional period for the next several years as new information comes in. Chinook salmon released from hatcheries may take up to six years to return, and modifications to program facilities depend on funding. Although key strategies to minimize the risk to wild populations will be applied across the ESU, programs and objectives will vary in different watersheds.

Photo by Eileen Palmer for the Hood Canal Salmon Enhancement Group.

**Juvenile hatchery Chinook.**

The specific details for each Chinook hatchery program are contained in 42 Hatchery Genetic and Management Plans developed by state and tribal fisheries managers. (see the Puget Sound Chinook Hatchery RMP (WDFW and PSTT 2004) and individual HGMPs.) Additionally, nearly all of the watershed chapters attached to this recovery plan carry forth information provided in the HGMPs and RMP regarding specific aspects of hatchery management that are relevant to ESU recovery. For those watersheds where proposed hatchery management strategies and actions have not been described in the Plan, the Plan defers to the individual HGMPs proposed to operate within each watershed, as well as the Chinook Hatchery RMP, for descriptions of proposed hatchery actions.

## Adaptive Management

Hatchery reform is a continuing process, with program modifications occurring in response to research, monitoring, and evaluation results and funding availability. The adaptive management framework developed by the co-managers for Puget Sound hatchery plan implementation and modification combines passive adaptive management and evolutionary problem solving. The approach proposed will help reduce uncertainty regarding future hatchery responses. New data available through the research, monitoring, and evaluation programs included in the co-manager hatchery plans will be used as the basis for making adjustments in hatchery actions. These adjustments will be made in concert with local watershed plan implementation under this Plan. The intent is to ensure that hatchery program modifications are based on the best available science, and that

any modifications made are consistent with habitat and harvest management actions taken for population and/or ESU recovery purposes. The adaptive management framework for Puget Sound hatcheries has seven key elements:

- An integrated strategy for the ESU
- Defined goals and objectives for hatchery programs
- A framework of artificial production strategies for reaching goals and objectives
- Strategy-specific guidelines for operating hatchery programs
- Scientific tools for evaluating hatchery operations, including statistical analyses, risk-benefit assessments, and independent scientific review
- A decision-making framework for considering in-season, annual, and long-term changes in hatchery objectives and standard operating modes described in HGMPs and resolving disputes
- Implementation using available resources

Scientists from WDFW and Puget Sound tribes are working with the HSRG and NMFS on research, monitoring and evaluation tools to guide the future changes of hatchery programs. Plans call for additional research in the Puget Sound region that will help indicate the genetic, ecological, and demographic effects of hatchery programs on the survival and productivity of listed and non-listed salmonid populations at various life stages. The integration of hatchery, harvest and habitat recovery activities will be the focus of additional work in individual watersheds and across the ESU. These efforts support the goal of the 1997 Wild Salmonid Policy adopted by the Washington Fish and Wildlife Commission and several Puget Sound tribes to:

> *....protect, restore and enhance the productivity, production and diversity of wild salmonids and their ecosystems to sustain ceremonial, subsistence, commercial, recreational fisheries, non-consumptive fish benefits, and other related cultural and ecological values.*
>
> *Final Joint WDFW/ Tribal Wild Salmonid Policy, 1997*