

CHAPTER 7

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Adaptive Management and  
Monitoring for the Puget  
Sound Salmon Recovery Plan

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# Adaptive Management for the Puget Sound Salmon Recovery Plan

## Purpose and Need

The Draft Puget Sound Salmon Recovery Plan represents an unprecedented effort to construct a recovery plan for a culturally and commercially important species listed under the Endangered Species Act across a large urban and urbanizing region. The geographic area is vast; the legal, biological, and political issues are complex and interdependent; the information is incomplete; and the recovery planning process is new in some places, and evolving.

Despite these challenges, the plan represents thousands of hours of technical and policy work by watershed and regional planning groups. As a result of these efforts, the plan is based on the best available scientific information about salmon and their freshwater and marine habitats within the Puget Sound. With this foundation, strategies and specific actions to recover Chinook salmon have been carefully outlined. Additionally, the plan reflects the different legal authorities and management organizations able to take actions to recover salmon.

Puget Sound watershed and regional salmon recovery groups can proceed with confidence based on the above characteristics. Adding to this confidence is the explicit recognition that the plan's key political and biological assumptions, which are unproven, can be tested as recovery moves forward. The plan calls for us to check assumptions, improve our knowledge, monitor our progress, and adjust our plans and our actions as we go. This will be accomplished through adaptive management.

## Adaptive Management

Adaptive management is the process of making decisions, implementing them, learning from the results of implementation, and adjusting decisions as necessary. In so doing, the certainty of achieving society's goals improves.

Adaptive management provides the ability to:

- Integrate science and policy in making decisions;
- Use systematic processes for improving future management actions by learning from the outcomes of implemented actions;
- Use rigorous, transparent processes to set and assess goals and timeframes;
- Reduce uncertainty over time;

- Increase accountability and reduce risk of insufficient investment and misdirection of funding;
- Take action in the face of uncertainty;
- Communicate information to the public in order to build understanding;
- Learn from unexpected events and capitalize on “crisis;”
- Distinguish mistakes from failures.



**Figure 7.1 Adaptive Management: A framework for learning and adjusting during plan implementation.**

## Adaptive Management and Salmon Recovery

Adaptive management for salmon recovery has many elements in common with the way adaptive management is applied in other natural resource management issues. For example, collection of environmental data in salmon habitats, research on habitat function, monitoring clean water and flows, access to analyses and data, allocation of sufficient resources, and many elements of decision making structures already exist. Adapting these to assess the goals and measures of success for achieving viable salmon populations and ESU recovery, however, is unique to salmon recovery. The key distinguishing factor of salmon recovery is

that success is determined by the overall status of populations in the ESU, which is a reflection of the individual abundances, population growth rates and trends, diversity characteristics, and habitat distributions of the different salmon populations.

The multifaceted recovery requirements for salmon mean that adaptive management must be applied at multiple geographic levels. As a result, there are three obvious levels at which adaptive management must occur:

- **Watersheds and populations.** The recovery plan builds on watershed specific action plans to protect and recover specific populations within each watershed. Each population has separate goals, assumptions, actions, and expected results.
- **The Evolutionarily Significant Unit (ESU).** The status of the ESU depends on the status of the individual populations across the Puget Sound as they relate to ESU recovery goals, the assumptions that those goals are based upon, actions, and expected results. In addition, certain recovery actions lend themselves to regional or ESU-wide solutions.
- **Multiple ESUs.** Some factors affecting Chinook populations occur or are managed at geographic scales larger than the Puget Sound. Harvest management of Puget Sound Chinook salmon, for example, involves monitoring, analysis, and negotiations between different states and countries.

### Key questions that an Adaptive Management Program must Address

The implementation and design of this recovery plan raises a number of key questions that must be addressed in order for the recovery plan to be successful at the population and ESU levels. Adapted management programs for all three levels listed above will need to address each of the following questions:

1. *Who are the key decision makers with the authority to affect the implementation of recovery strategies and actions?* These are the groups to whom information should be provided (at the population or ESU scale), and whose decisions can be adjusted as necessary to adapt the plan over time.
2. *What are the salmon goals the plan aims to achieve?* These goals at the population scale are expressed as abundance, productivity, diversity and spatial structure targets or as objectives for the ecological functions and habitat conditions or processes a watershed will provide. At the ESU scale, the plan aims to achieve a negligible risk of extinction of the ESU and sustainable harvest.
3. *What are the key hypotheses for which salmon life stages and habitat, hatchery or harvest factors (“H” factors) are limiting recovery?*
4. *How are individual actions for each H factor and their cumulative effects addressing the key life stage(s) and H factors limiting recovery?*
  - How are specific and combined effects of actions contributing to achieving changes in H factors?
  - How in turn are changes in H factors contributing to achieving the VSP goals?
  - What measures best assess the overall effectiveness of the actions?
5. *How does data collection support the measures to assess effectiveness?*
6. *How does communication occur at all levels about the results of actions to improve knowledge?*
7. *Are there sufficient resources to carry out each element over the necessary time period and geographic area?*
8. *What is the organizational (decision-making) structure that defines roles and responsibilities for each element?*

9. *What are the commitments to implement the plan and its actions?*

### **A Strategic Focus**

Because the list of questions that an adaptive management program must address is long, issues should be strategically prioritized and tracked. Examples of priorities are: the key life stages or H factors limiting recovery within watersheds, actions that will have the most uncertain effects on key factors or life stages, or the populations within the Puget Sound ESU whose improvements in status are critical to ESU recovery.

In addition to determining priorities, adaptive management must also be applied to the solutions that have been proposed to address “gaps” across watersheds. These gaps are key uncertainties in the plan that could not be addressed by individual watersheds during the planning period. Gaps occurred because 1) legal or policy issues affecting salmon recovery in a key population could not be resolved during this timeframe, but can be resolved over longer periods and 2) building the regional plan solely on individual watershed recovery plans would have ignored issues that need cross-watershed coordination to fully address. Because these gaps reflect important regional issues, the ultimate success of the plan depends on how well adaptive management will succeed in filling these gaps.

### **The “cross-watershed” issues include:**

- The importance of habitat protection strategies and the need to assess the results for fish from the combination of protection tools available,
- The need to develop H-Integration strategies or where they are included to move them further down the integration continuum over time,
- The need to develop or complete a robust adaptive management and monitoring program,
- The need to reconcile local nearshore strategies and actions with the regional nearshore chapter,

- The need to address water resources, both water quality and water quantity,
- The need to link the effects of land use to habitat-forming processes and to habitat conditions.

## Gathering Information

Gathering and analyzing information on the success of various strategies and decisions is an essential component of adaptive management. Strategies and decisions affecting salmon recovery almost always involve the need to balance policy and scientific considerations — in other words, deciding what we want for fish and people given what is scientifically effective and politically tolerable.

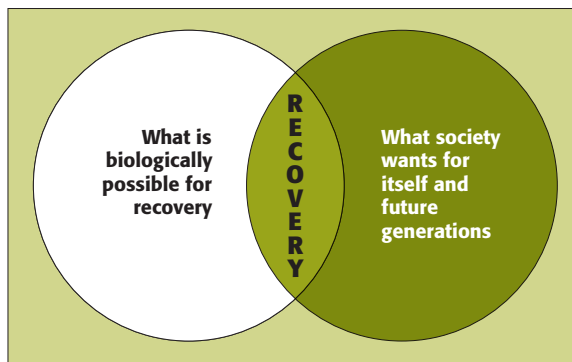


FIGURE 7.2

This means that if adaptive management is to be applied to learn what works for salmon recovery, it must encompass two objectives: understanding what is biologically possible, and understanding how to implement strategies to recover salmon that are politically feasible. Understanding what is biologically possible for recovery requires improving scientific knowledge, such as assessments of habitat status, the key processes affecting habitat status, the biological response of salmon in different habitats, and the effects and efficiency of restoration efforts. Understanding what society wants for itself and future generations, given what is biologically possible for recovery, means gathering better information on how to gain public support

for habitat protection, restoration and rehabilitation.

Monitoring efforts for salmon recovery should correlate the scale and precision of monitoring with the purposes and uses of the information (2003 Washington Comprehensive Monitoring Strategy and Action Plan for Watershed Health and Salmon Recovery). Monitoring for adaptive management and salmon recovery purposes will require a multi-tiered approach, addressing monitoring needs both within respective watersheds and across the ESU.

At all levels (watershed and population, ESU, multiple ESU's) for which information is collected and analyzed it generally needs to address four types of questions:

- Implementation monitoring — Were the proposed actions implemented? If not, why not?
- Effectiveness monitoring — are the recovery actions, such as regulatory programs or restoration projects, having the desired effect?
- Validation monitoring — were our assumptions used in developing the recovery plan correct?
- Trend/status monitoring — What are the status and trends of important indicators (i.e. habitat quality, habitat quantity, water quality, VSP parameters, etc...) at a watershed level?

## Watershed Level adaptive management

The Draft Puget Sound Salmon Recovery Plan is based largely upon watershed specific plans that have been developed over the past several years by local watershed groups. Each plan varies in terms of its content, scientific basis and background, level of certainty, analysis tools used to develop the plan, level of participation and commitment by watershed stakeholders, as well as other factors.

While many factors affecting Chinook are common across watersheds (habitat loss and degradation, harvest impacts, hatchery effects), there are many differences in how these factors have manifested themselves within each watershed and how they interact with the particular fish popula-

tions in each watershed. Thus, each watershed plan will have a slightly different set of specific questions and uncertainties to address through adaptive management.

**Examples of general watershed level questions include:**

- What goals do we want to achieve within the watershed?
  - Biological goals
  - Habitat goals
  - Policy goals
  - Funding goals
- What effects do we want to see from our actions and what effects do we actually see (effectiveness monitoring)?
  - Restoration projects
  - Protection actions
  - Policy actions
- What are the critical uncertainties in the watershed plan and how should they be filled or tested? Have we taken the actions we proposed in the plan (implementation monitoring)?
- Are the effects occurring fast enough and are they significant enough to lead to recovery and accomplishment of goals (trend/resource monitoring)?
- Were the assumptions used to develop the plan good ones (validation monitoring)? Were the right factors of decline identified and the right actions to address them?
- What changes are needed to assure adequate progress to plan implementation and resource recovery?

Watershed level adaptive management must ask these questions in the context of specific fish populations, critical habitat types, conditions within that particular watershed. The questions must be applied to each of the H's (hatchery, harvest, habitat and hydro).

In addition, there are H-Integration questions in each watershed. These questions relate to understanding the interactions between harvest, hatcheries, and habitat in each watershed for each population. These are among the most important sets of questions to answer through adaptive management, both at the watershed and ESU levels. To date, scientific tools for understanding these interactions are relatively new and still being developed. Furthermore, the interactions are complex, resulting in high uncertainty of planned management actions to integrate the H-factors.

The watershed level adaptive management programs must have some common elements across watersheds to allow "rolling up" information to the ESU level. Watershed level monitoring could include some common elements across watersheds to address ESU adaptive management questions.

**ESU Level Adaptive Management**

Many of the same basic questions asked at the watershed level also apply at the ESU level; however answering these questions requires information from all of the watersheds.

**Example questions include:**

- What goals do we want to achieve at the ESU level?
  - Biological goals (e.g., how many low-risk populations and how many are improving in status but not yet at low risk for all 4 VSP parameters?)
  - Habitat goals
  - Policy goals
  - Funding goals
- What effects do we want to see from our actions and what effects do we actually see at the ESU level (effectiveness monitoring)?
  - Restoration projects
  - Protection actions
  - Policy actions

- What are the critical uncertainties in the ESU Plan and how do we fill them or test them?
- Have we taken the actions we proposed in the plan (implementation monitoring)?
- Are the effects occurring fast enough and are they significant enough to lead to recovery and accomplishment of goals (trend/resource monitoring)?
- Were the assumptions we used to develop the plan good ones (validation monitoring)? Did we identify the right recovery criteria (the number of fish needed for viability and VSP)? Did we identify the right Factors of Decline and the right actions to address them?
- What changes are needed to assure adequate progress to plan implementation and resource recovery?

There are a number of “cross watershed” issues that may be best addressed at the ESU level, including but not limited to:

- Nearshore habitat protection and restoration – what is the role of nearshore habitats for multiple watersheds and stocks?
- Instream flow protection (state program).
- The effect of protection mechanisms on fish populations and VSP parameters.
- Puget Sound water quality issues such as Hood Canal and South Puget Sound.
- Integration of all the H’s between watersheds.

### Beyond the ESU

There are a number of technical and policy issues that also must be addressed at a scale larger than either the watershed or ESU level. For example:

- Harvest management goals and actions are developed in the context of a complex management scheme that encompasses the entire West Coast of the United States and Canada. Adaptive management at this broad scale will need to be integrated into the management

system for Puget Sound Chinook recovery efforts.

- Treaty Trust Responsibilities involve a special relationship between the United States and Treaty Indian Tribes. This relationship cannot be comprehensively defined at the watershed or ESU levels.
- Many factors affecting the salmon are linked to statewide issues, such as water management, shoreline management, water quality protection, critical areas protection, and growth management that are largely defined by state law and actions.

As the adaptive management program is further developed and implemented, it will need to be synchronized with other management and monitoring programs that extend beyond the Puget Sound ESU.

### Next Steps

During the first phase of implementation of the Draft Puget Sound Salmon Recovery Plan, it will be necessary for watersheds to refine and give further definition to watershed and regional adaptive management programs. In addition, a parallel regional approach will also need to be detailed.

During the first year of implementation, participants in the Puget Sound Recovery Plan will:

1. *Convene watersheds to confirm, refine or develop an adaptive management program that allows them to make scientifically and politically defensible decisions that lead to salmon recovery in the watersheds.*
2. *Convene a regional group to identify regional adaptive management issues that cross watersheds and develop a plan. The regional group should involve representatives from each of the watershed groups.*
3. *Watershed and regional groups will use ESU goals to identify metrics, performance standards for ESU roll up and the decision-making*



Photo courtesy the WASHINGTON State Salmon Recovery Funding Board.

**Fish biologists monitor salmon in the Stillaguamish River.**

*feedback to individual watersheds or regional adaptive management processes.*

*4. The groups will conduct a gap analysis that identifies existing monitoring programs, provides habitat, population, or policy information and identifies where data collection or monitoring are not occurring.*

*5. The groups will secure commitments to prioritize key monitoring needs to fill existing gaps and implement those programs.*

During the May 2005 review of watershed chapters and regional plan elements, the Technical Recovery Team and an interagency committee identified a preliminary list of issues that have high uncertainty and need to be incorporated into the adaptive management plan.

**Technical issues identified include:**

- **Interactions between hatchery and wild fish in certain watersheds, estuaries, and Puget Sound.** General interactions such as competition, interbreeding, straying, and disease transmission are well known; however, the specific interactions in a particular watershed or habitat are less well documented in many

cases. Improving our understanding of these interactions, quantitatively and qualitatively, is essential for "H integration" over time.

- **Juvenile Chinook use/survival in different freshwater, estuarine and marine habitat types.** While general habitat requirements and use by Chinook are known, the specific importance of specific habitats is not well understood. Increasing our knowledge of the use and survival of specific habitats is necessary to help validate models such as EDT that were used in some watersheds and could be applied in other watersheds in the future.
- **Effects of freshwater and marine water quality on VSP parameters.** The role of water quality on Chinook production and survival is poorly understood. Significant water quality problems exist in the region in both fresh and marine waters, however the importance of these relative to salmon recovery needs further research and assessment.
- **Lack of a robust landscape based process model for determining land use effects on freshwater habitat and VSP parameters.** Future patterns of human population growth

and development in the Puget Sound region could have profound effects on the survival and recovery of Chinook and other salmonids. The impacts of this growth and development within watersheds and the region are not well monitored or assessed. This is a major source of uncertainty in the Recovery Plan and must be addressed in the detailed adaptive management plan.

- **H-Integration in each watershed and within Puget Sound.** A variety of questions related to interactions among the ‘H-factors’ need to be addressed in the adaptive management program. Questions range from the need to understand how these interactions affect VSP parameters over the long term to the effect of harvest on diversity and spatial structure. The adaptive management program needs to improve our quantitative understanding of these interactions in order to adjust management over time.
- **Water quantity and instream flows.** This is an important issue in every salmon watershed. Identifying instream flows, or flow regimes, that will support salmon recovery in each watershed represents a difficult technical challenge. There are numerous scientific tools to help identify these flows but there is significant scientific uncertainty of the efficacy of these tools. There is also a growing scientific consensus that we need to move away from identifying “minimum flows” and move towards identifying flow regimes that will support not only the biological needs of salmon, but also support the habitat forming processes necessary to maintain habitat quality and quantity over time.
- **Nearshore protection.** Scientists are recognizing the role and importance of nearshore marine habitats to Chinook salmon recovery. Because salmon are part of an ecologically complex web and different authorities and regulations affect these habitats, it is difficult to predict precisely the effects of different protection and restoration actions.

- **Effectiveness of regulatory habitat protection.** All watersheds identified provisions of the Shoreline Management Act and Growth Management Act as mechanisms for protecting habitat, but no watersheds proposed evaluating the implementation and effectiveness of these regulations, or other habitat protection measures, for salmon. The adaptive management plan needs to identify a program for assessing the effectiveness of protection measures in each watershed and within the region.
- **The potential impacts of climate change on salmon recovery.** Climate change, both natural and induced, could have significant effects on Chinook salmon and other salmonids in the Puget Sound region and beyond. Possible effects include alteration of the hydrologic cycle resulting in changes in low and high flow patterns, changes to habitat forming processes, changes in terrestrial and riparian vegetation that affect habitat forming processes, changes in erosion patterns, and impacts to water quality. Significant research on this topic is being conducted in the region, however none of the watershed plans have proposed means of monitoring climate change or its impacts. This is a significant uncertainty in the Puget Sound Recovery Plan and should be addressed through the detailed watershed and regional adaptive management plan.
- **Nearshore.** Uncertainties surrounding the habitat processes, conditions, population and ESU responses in the nearshore result in significant uncertainties regarding the effectiveness of the entire ESU recovery plan. There needs to be an increased scientific understanding of the relationships between the viability of salmon and bull trout populations, nearshore and marine habitat conditions, and habitat management actions. This might be measured over a 10 year timeframe to develop and use quantitative models of the effects of habitat alterations on salmon population viability.



Photo courtesy the WAshington State Salmon Recovery Funding Board.

**Biologists from the Stillaguamish Tribe gather smolts from a smolt trap.**

### **Identifying research needs in support of salmon recovery in Puget Sound**

As exemplified in this plan, recovering salmon in Puget Sound will involve implementation of actions and a well-designed adaptive management and monitoring program to track outcomes and make adjustments when needed. The proposed recovery strategies in habitat, hatchery and harvest management are based on our best understanding of the integrative effects of actions in each of these sectors. The process of designing recovery strategies has illuminated some key gaps in our scientific understanding that, if addressed, will

greatly improve our ability to target recovery actions where their benefits will be greatest.

Key scientific uncertainties identified in individual watershed plans range from insufficient understanding of where juvenile salmon rear in lower rivers, estuaries, and in the nearshore to uncertainties in the cumulative effects of protection measures on habitat, and in turn, on salmon. Similarly, important gaps in biological information at the regional scale include the relative importance of different nearshore habitats to specific salmon populations and how many salmon can be supported by nearshore and marine habitats.

The individual watershed, nearshore and regional plans identified important gaps in our scientific knowledge, as illustrated in the previous paragraph. Prioritizing these research needs is a critical next step that is being initiated for Puget Sound by a group of scientists and policy-makers. A draft of a research needs document for ecosystem-based management in Puget Sound will be available for public comment later in the fall of 2005. Such a broadly agreed-upon research plan will help guide funding for research such that our scientific focus is strategically geared towards providing information that will improve the likelihood of salmon recovery.

### **Policy issues that have been identified include:**

- **Identification of key decision makers and responsible parties for implementing actions.**
- **The need to describe the implementation process beyond the first 10 years.**
- **Implementation monitoring of habitat protection measures.** There is currently no monitoring or evaluation system in place in the region for tracking the implementation and effectiveness of habitat protection measures for salmon recovery. It will be important to conduct an assessment to learn how effective various protection mechanisms are for achieving results for fish.
- **Achieving instream flows within Puget Sound watersheds.** There are significant policy and legal hurdles to achieving instream flows, once these are set or identified. A variety of approaches, from voluntary to regulatory, are being pursued in the region. The adaptive management program should track these approaches and inform changes to them to achieve the goal of providing instream flow regimes that will support salmon recovery.