# 2004 – 2014 MONITORING PROGRAM

December 2015

**Washington Salmon Recovery Funding Board**

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# Executive Summary

In 2003, a *Draft Monitoring Strategy for Habitat Acquisition and Restoration Projects* was created along with protocols and criteria for evaluating Salmon Recovery Funding Board (SRFB) restoration projects. View the strategy here: www.rco.wa.gov/documents/monitoring/SRFB_Monitoring_Strategy.pdf. In addition, compliance monitoring, the creation, and implementation of Intensively Monitored Watersheds (IMW), along with the support of status and trends were determined to be critical components.

Tetra Tech, Inc. was selected to conduct independent project effectiveness monitoring on behalf of the SRFB beginning in 2004, and has completed the first 10 years of monitoring and evaluation as envisioned. The Washington Department of Ecology (WDOE) was selected to oversee the IMW program and the Washington Department of Fish and Wildlife (WDFW) was contracted to support status and trends monitoring (referred to as Fish In – Fish Out).

The categories of projects for effectiveness monitoring included fish passage, diversion screening, in-stream structures, riparian plantings, livestock exclusions, channel connectivity, gravel placements, constrained channels, and habitat acquisitions. After a few years, the category of gravel placements was dropped because there were not enough proposed projects. Some changes to the field protocols for other categories were made in 2010 and implemented in 2011. Among those changes was the combination of the constrained channel and channel connectivity protocols into a joint protocol for the monitoring of floodplain restoration projects. In the combined floodplain enhancement protocol, a topographic survey method was included as an alternative option to the standard thalweg profile and stream habitat assessment. This survey approach was adopted to allow comparison of changes in both the channel and floodplain topography to better quantify the effects of floodplain restoration project in terms of creating and maintaining off-channel habitat and floodplain reconnection. The topographic survey also allows detection of changes in habitat conditions, such as pool area, depth, and channel capacity over time. In 2011, the topographic survey method was conducted at several floodplain enhancement sites. View the 2011 Annual Progress Report for additional information: www.rco.wa.gov/documents/monitoring/2011Report.pdf

Findings to date indicate that design criteria were met for each category monitored for effectiveness Fish passage demonstrated a statistically significant increase in fish species upstream of the barriers after barrier removal. Habitat showed an overall positive response for riparian planting with percent woody cover increasing significantly by 2014. For in-stream structures, all the habitat parameters measured have shown statistically significant positive improvement as of 2014. However, for livestock exclusions and acquisitions, many of the parameters are statistically significant in producing the desired positive response to stream bank vegetation, erosion, and other factors. Fish use of in-stream structures, acquisitions, and floodplain enhancements showed increases that were statistically significant for steelhead and Coho but not for Chinook. In 2014, both Coho and Chinook increased significantly from floodplain enhancement projects. It is believed that for some projects, insufficient time has occurred for the restoration actions to reach their full effectiveness. Additional monitoring was approved in 2012 for in-stream structures and floodplain enhancement projects. The first funding was approved for this by the SRFB in 2012, and these were officially made part of the program in 2014.

IMW projects were established in Washington through the SRFB and by other entities elsewhere in the Pacific Northwest over the past decade. The objectives of these monitoring projects were to demonstrate that the cumulative restoration actions within specific watersheds were increasing fish abundance and productivity. There are five IMW complexes in Washington currently supported by the SRFB. Four IMWs have been operating since 2004 are located in western Washington.

It was estimated at the time of original funding that it would take at least 10 years to detect significant changes. Although annual reports were written tracking progress, results just now are beginning to become evident. The fifth IMW was initiated in Asotin Creek in the Snake region in 2007 and became eligible for funding for monitoring purposes by the SRFB in 2014.

Preliminary results show that certain restoration actions in the Skagit estuary IMW have increased juvenile age-0 Chinook densities, compared to untreated areas. It is now needed to determine if the observed increases in juveniles leads to increases in returning adults. The Strait of Juan de Fuca IMW Complex has not demonstrated to date that its treatments were effective, or whether they may have treated the wrong limiting factor. They did demonstrate that Coho juveniles were immigrating to the sea in the fall and that some of these smaller fish have returned to contribute to adult spawners. However, no overall increase in Coho have been observed. The Hood Canal IMW Complex has been able to demonstrate a significant increase in Coho in one of the treatment streams, but more treatments are needed in the other treatment streams to be able to demonstrate significant changes in those streams. The Lower Columbia Fish Recovery Board (LCFRB) has not implemented sufficient restoration projects to be able to expect to detect a change in fish abundance. A side experiment using adult carcass analog fertilization netted no response by the watershed.

The SRFB committed $2 million in 2014 for restoration projects within the IMWs, and will commit up to an additional $2 million both in 2015 and in 2016. This commitment may provide the needed changes in the watersheds to effect a measurable response in fish numbers.

Status and trend monitoring assesses changes in the condition of a metric important for tracking progress in a population or a listing factor. The SRFB has funded monitoring of selected juvenile migrant abundance estimates for specific rivers where the need for smolt-to-adult survival (SAR) is crucial for informing whether habitat restoration projects have been increasing the abundance of migrants. This Fish In – Fish Out strategy identified in the framework document produced by the *Forum on Monitoring Salmon Recovery and Watershed Health* and was implemented in certain watersheds funded.

In 2013, the SRFB hired Stillwater Sciences to review the SRFB monitoring program. Recommendations include:

1. Evaluate and communicate monitoring results according to specific, scientifically rigorous reporting requirements.
2. Project design and management decisions should stem from monitoring results.
3. Coordinate with other regional monitoring programs (e.g. Bonneville Power Administration, Pacific Northwest Aquatic Monitoring Partnership, U.S. Fish and Wildlife Service)
4. Establish an Independent Science Review (Monitoring) Panel to support SRFB restoration and monitoring needs.

5. Identify an effective process and entity to coordinate fish monitoring and habitat actions, and ensure effective integration of their respective program results to inform adaptive management inspired adjustments to future program emphasis.
6. Limit IMW funding to watersheds that have restoration projects that are implemented in a timely manner, and identify the explicit ties between fish monitoring and habitat restoration.
7. Establish an adaptive management program.

View the Stillwater Sciences Report for additional information:
www.rco.wa.gov/documents/monitoring/SRFB_MonitoringStrategyFinal.pdf

As a result, the SRFB revised the SRFB strategic plan in March 2014.

The SRFB Monitoring Panel also was established in 2014, in response to recommendation Number 4 from the Stillwater Report. This was to ensure that the adaptive management process is functioning properly to inform management decisions about the results and conclusions of monitoring into the future. The Monitoring Panel also is tasked with providing guidance and recommendations to the SRFB for changes to the program over time.

The Monitoring Panel constituents were selected from a Request for Qualifications and Quotations (RFQQ) generated by the Recreation and Conservation Office in 2014. Following interviews and reference checks, five consultants were placed under contract with one selected as Monitoring Panel Chair. Six months later two additional members were added who possessed subject matter expertise that was expected to enhance the assessments, evaluations, and subsequent discussion(s) resulting in the memo development for recommendations to come to the SRFB in October 2015.

The Panel was also provided additional resources and expanded scope of work to review regional-based monitoring proposals, following a SRFB decision in February 2015 to allow monitoring as an eligible project for Board funding. The Panel reviewed these proposals in autumn of 2015 and provided status (including conditions) of these projects for Board consideration at the December 2015 SRFB meeting.

This Panel is anticipated to be supported contingent upon PCSRF funding availability. An RFQQ is expected to be advertised December 2015 for Panel participation with continuing and refining the review process and implementing feedback mechanisms associated with an adaptive management structure. Such a process is expected to proceed with the collaborative effort of a SRFB Monitoring Sub-committee.

# Overview

The purpose of this report is to describe the current SRFB habitat and fish abundance monitoring program. It also tracks the progress of the monitoring program from its beginning in 2004 to 2014 and identifies developments that have shaped the program and key findings to date. It is not intended as an in depth scientific analysis of each project or IMW. Those evaluations have been provided through annual progress reports and other publications that are available and accessible at www.rco.wa.gov.

## Introduction

The U.S. Department of Commerce National Oceanic and Atmospheric Association's National Marine Fisheries Service (NOAA Fisheries) listed multiple salmon species as at risk of extinction under the federal Endangered Species Act of 1973. Under the act, the definition of an endangered species is one *"in danger of extinction throughout all or a significant portion of its range."* NOAA Fisheries further expanded the definition to include Evolutionary Significant Units, which are populations of organisms considered distinct for purposes of conservation. This term can apply to any species, sub-species, geographic race, or population. A Distinct Population Segment (DPS) is the smallest division of a taxonomic species permitted to be protected under the Endangered Species Act. On the Pacific Coast, it usually is applied to steelhead populations rather than salmon populations. Initial listings of salmon and steelhead species in Washington were as follows:

| Year Listed | Salmon Species | Listing Category |
|---|---|---|
| **1991** | Snake River sockeye | Endangered |
| **1992** | Snake River spring-summer Chinook | Threatened |
| **1992** | Snake River Snake River Fall Chinook | Threatened |
| **1997** | Upper Columbia River steelhead | Endangered |
| **1997** | Snake River steelhead | Threatened |
| **1998** | Snake River steelhead | Threatened |
| **1999** | Hood Canal summer chum | Threatened |
| **1999** | Columbia River chum | Threatened |
| **1999** | Mid Columbia steelhead | Threatened |
| **1999** | Upper Columbia River spring Chinook | Endangered |
| **1999** | Lower Columbia River fall Chinook | Threatened |
| **1999** | Puget Sound Chinook | Threatened |
| **1999** | Ozette Lake sockeye | Threatened |
| **2005** | Lower Columbia River Coho | Threatened |
| **2007** | Puget Sound steelhead | Threatened |

In 1998, the Washington State Legislature passed the Washington State Salmon Recovery Act[1] in response to these massive listings of salmon and steelhead species in Washington. It set up a structure to deal with the economic, administrative, and political impacts of these federal actions. It created:

- The Salmon Recovery Funding Board to administer grants for salmon recovery
- Lead entities as local organizations to propose and prioritize restoration actions at the watershed level for each Water Resource Inventory Area
- Independent Science Panel (ISP) to review the science being used
- Governor's Salmon Recovery Office (GSRO) to develop a statewide approach
- A biennial *State of the Salmon in Watershed* report.

At the same time, in 1999, the U.S.-Canada Pacific Salmon Treaty negotiations, which had been in discussion for numerous years, concluded with a new 10-year agreement. Part of the agreement called for the establishment of the Pacific Coastal Salmon Recovery Fund. This fund was designed to help recover listed salmon populations that were declining because of habitat degradation and was mostly targeted at the stocks south of the US/Canadian border, which were part of the treaty and were harvested in both Canada and Alaska. Agencies receiving these funds were required to report whether they were making progress toward recovery.

The National Oceanic and Atmospheric Administration (NOAA) Fisheries, which administers the Pacific Coastal Salmon Recovery Fund, required the Washington State Salmon Recovery Funding Board, Oregon Watershed Enhancement Board, California Fish and Game, and other funding recipients to report on environmental metrics, such as miles of stream treated and acres of trees planted, as well as whether these projects improved habitat for listed salmon.

In 1999, the SRFB began awarding grants to the watersheds for restoration and protection projects as well as feasibility studies and watershed assessments. Initially, grant recipients could designate a portion of their grant for monitoring. At that time, there were no guidelines as to *how* monitoring would occur.

Also in 1999, the Governor's Salmon Recovery Office published the *Statewide Strategy to Recover Salmon: Extinction is Not an Option* and included a call for monitoring. The state Legislature asked the Independent Science Panel to make recommendations on monitoring by December 2000. The panel (2000) recommended the following criterion:

- Goals, objectives, and questions that need to be addressed must be clearly articulated.
- Statistical designs need to be appropriate to the objectives.

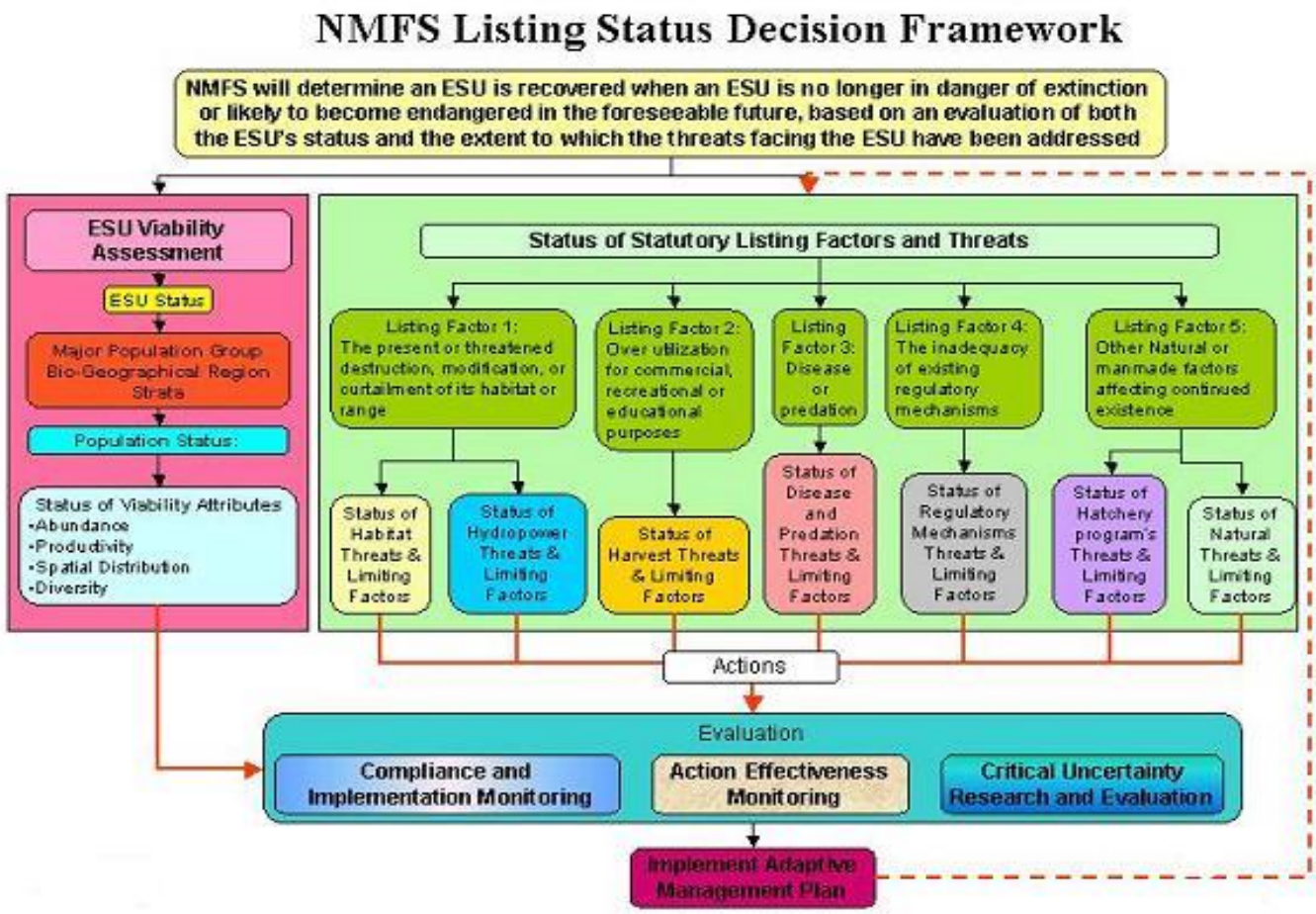
Indicators and variables need to be defined by objectives and the appropriate geographical, temporal, and biological scales. Measuring the same indicators in the same way is essential when data are to be combined from different areas, agencies, or times to provide replicability. Interpretation of indicators,

[1] Revised Code of Washington 22.85

indices, or statistics calculated from monitoring data from different areas, however, cannot be standardized.

- Monitoring protocols need to be standardized to allow comparison among locations, times, or programs (consistent with design needs).
- Procedures need to be developed to ensure quality assurance and quality control of all data used to monitor salmonid recovery and recovery actions
- Data management systems need to allow easy access, sharing, and coordination among different collectors and users.
- Funding needs to be stable and adequate. Cost of monitoring will depend on the degree to which decision-makers wish to be certain that management actions are having an anticipated response.
- Decision support systems need to help integrate monitoring information into decision-making.

**Figure 1: NMFS Fisheries Listing Status Decision Framework. Shows the major factors killing salmon populations and the relationship of monitoring to the listing process.**



In 2000, the Washington State Legislature passed Senate Bill 5637 creating a Monitoring Oversight Committee tasked with developing a statewide strategy by 2002 for monitoring watershed health with an emphasis on salmon recovery. Mr. William Ruckelshaus, chair of the SRFB, and Dr. Curtis Smitch, Governor Locke's Chief of Staff for Natural Resources, were selected as co-chairs of the Committee. In 2002, the committee published the *Washington Comprehensive Monitoring Strategy and Action Plan for Watershed Health and Salmon Recovery*. Some of the key recommendations included:

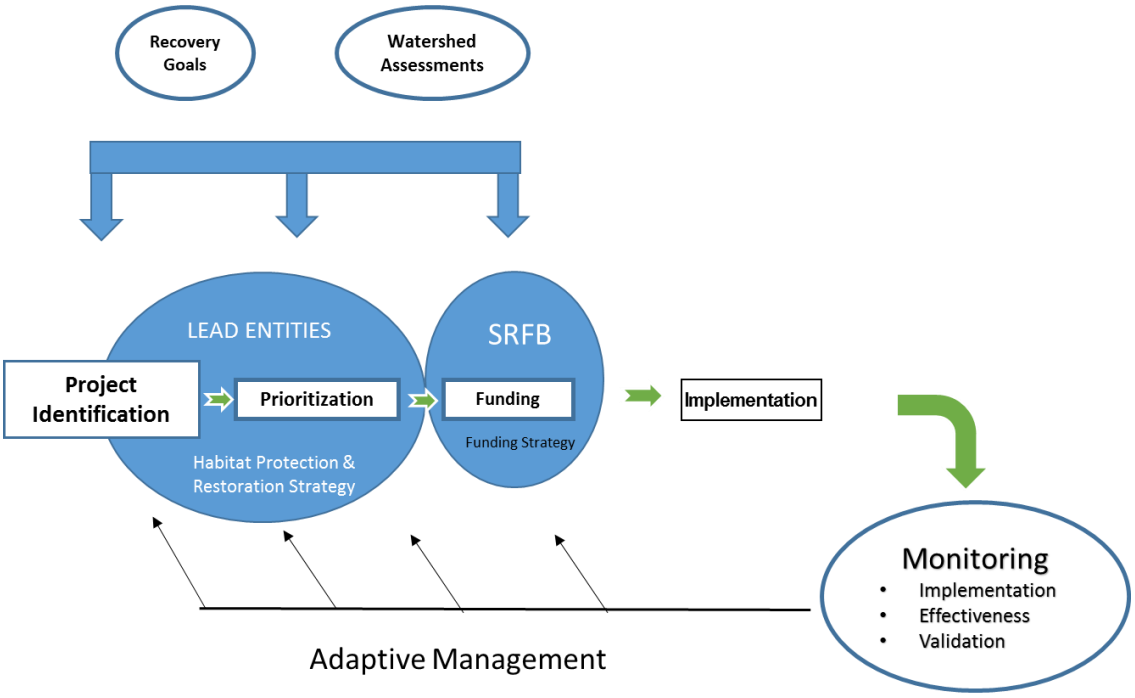
- Create a permanent monitoring coordination committee.
- Adopt monitoring protocols for indicators.
- The SRFB and Northwest Power and Conservation Council should set aside a percentage of funds for a sampling program that measures *effectiveness* of the funded projects in accomplishing their habitat improvement goals.
- Create one or more IMWs.
- Cluster selected habitat restoration projects by SRFB and Northwest Power and Conservation Council into IMWs in order to be able to detect a significant change in fish productivity.

## SRFB Guiding Principles

The Monitoring Oversight Committee developed guiding principles to provide the best approach to monitoring salmon recovery actions. These principles were transferred by Chair Ruckelshaus to the SRFB:

- Resolve scientific, policy, and management questions using an adaptive management process.
- Ensure that monitoring information is accessible to the public and all levels of government.
- Evaluate and account for the state's investments in watershed health and salmon recovery.
- Determine trends in fish, water, and habitat conditions.

**Figure 2: SRFB Adaptive Management Cycle 2003. Demonstrates how monitoring would be incorporated into SRFB decisions.**



# 2003 SRFB Monitoring Strategy

In 2003, Chair Ruckelshaus asked the RCO to evaluate ongoing SRFB monitoring and bring recommendations to the SRFB. A quick evaluation of more than 50 completed projects indicated that the information from monitoring performed by project managers might not be consistent or helpful. As a result, Taylor and Associates were contracted to take a comprehensive look at the monitoring performed from 1999 to 2003 and report back to the SRFB. In its report consultants found that, *"Relatively few projects appeared to be associated with monitoring programs complex enough to begin to address the effectiveness of the project in meeting habitat-based outcomes. No projects appeared to have collected effectiveness monitoring data to support assessment of local fish abundance or complete validation monitoring."* (Taylor and Associates, Cascadia Consulting Group, and R2 Resource Consultants, 2003)

Because of this inconsistency in monitoring efforts of the SRFB-funded projects, a more comprehensive monitoring strategy was developed.

## Habitat Restoration: A Nested Hierarchy

Habitat restoration projects typically have a "nested hierarchy" of interrelated objectives and outputs. Projects individually operate at the site and reach scale, and when rolled up, operate at the watershed scale. There is also a "nested hierarchy" associated with monitoring at each level. For example, a large wood placement project might have the following series of hypotheses, objectives, and associated levels of monitoring. The hypothesis is: Decreased stream channel complexity is a limiting factor for salmon and steelhead in this stream: consequently, the placement of large wood structures in the stream will restore stream channel complexity and thereby increase the survival and productivity of the targeted populations. The hierarchy is as follows:

**Level 0** Was the project <u>implemented</u> according to approved plans? Large wood placement.
- **Level 1** <u>Design Effectiveness</u>. Was design criteria met over time? How long did the large wood placement persist?
  - **Level 2** <u>Project Habitat Effectiveness</u>. Did the habitat actually improve? How long did it take to see a response?
    - **Level 3** <u>Project Fish Effectiveness</u>. Did the target fish use the jam?
      - **Level 4** <u>Watershed Validation</u> Did overall target juvenile fish production increase (IMW)?

The following four definitions are excerpted from the Washington comprehensive monitoring strategy executive summary:

- **Status and Trends (Extensive) Monitoring** – The purpose of this type of monitoring is to estimate the status of fish populations and to track over time indicators of habitat, water quality, water quantity, and other factors that impact watershed health. The spatial scale is large and varies from Water Resource Inventory Areas (WRIA) to salmon recovery regions to the entire state. Status and trends monitoring cannot demonstrate cause-effect relationships between actions and outcomes, but it will assess the actual condition of the environment. It is fundamental and complements other types of monitoring.

- **Project Effectiveness Monitoring** – Most salmon or watershed projects are implemented at a small scale, with defined sets of actions intended to protect or enhance specific habitat features or habitat-forming processes. An enhancement technique may be difficult to implement properly but very effective or, conversely, easy to implement but rarely effective. Both implementation and effectiveness monitoring are necessary to evaluate specific projects or classes of projects. Implementation monitoring is determining whether an action was implemented. It is a yes or no answer and does not require environmental data. It is usually a low cost monitoring activity. Effectiveness monitoring measures environmental parameters to ascertain whether the actions implemented were effective in creating a desired outcome. For example, did the planted trees produce shading for the stream?

- **Validation (Intensive) Monitoring** – This type of monitoring is the only type of monitoring that can establish cause and effect relationships between fish, habitat, water quality, water quantity, and management actions. It is the evaluation of projects and programs that conduct, promote, or regulate activities meant to protect or enhance habitat, water quality, or fish production. One example of intensive monitoring might be a case study of a watershed that examines the cumulative impacts of total maximum daily loading requirements for various water users on the overall water quality of the basin. Another example might study the impacts of categories of riparian habitat projects on salmon in a specific stream. The common theme of these studies is to develop an understanding of the link between management actions and the numbers of fish produced. These studies are the most complex and technically rigorous, and often require measuring many parameters to detect the variable affecting change. Once determined, the relationship between restoration actions and the numbers of fish produced may or may not be directly extrapolated to other watersheds and is dependent on the strength of the information obtained. However, intensively monitored watersheds can be assumed to represent the overall responses of other nearby watersheds to the same restoration treatments.

- **Implementation (Compliance) Monitoring** – This type of monitoring tracks whether a management action was implemented according to a plan or specifications or is in compliance with established laws, rules, or benchmarks. Compliance monitoring most often is associated within the specific strategies associated with the Clean Water Act (CWA) and the Endangered Species Act (ESA).

**Figure 3: Monitoring's Four-Legged Stool**

## Implementation (Compliance) Monitoring

Implementation monitoring determines whether an action was implemented. It answers the monitoring question:

> ***Did the project sponsor implement the program as proposed where they proposed and in compliance with all requirements of the SRFB?***

The Washington State Recreation and Conservation Office (RCO)[2] staff conducts implementation (compliance) monitoring on all SRFB-funded projects to ensure they are implemented according to specifications approved by the SRFB and the SRFB's Review Panel of technical experts. RCO grants managers work with the grant recipients and inspect the projects for completion. Results are entered into the agency's databases, PRISM and Habitat Work Schedule. Final project funding is not released until the project has been inspected to ensure that all elements were implemented and all milestones were met according to grant contract.

In 2013, the SRFB passed changes to the monitoring chapter in the Washington Department of Fish and Wildlife's *Stream Habitat Restoration Guidelines* to improve the guidance for implementing monitoring projects either by grant recipients or during RCO final inspections.

[2]RCO provides staff support to the SRFB and administers' the Pacific Coastal Salmon Recovery Fund in Washington.

Implementation monitoring is related to project effectiveness monitoring, which in turn is related to validation monitoring. Doing one without the other would limit seriously the SRFB's ability to determine if projects have met restoration goals and are cost-effective.

## Project-Scale Effectiveness Monitoring

As a result of Pacific Coastal Salmon Recovery Fund requirements, in 2003, the SRFB asked staff to develop, a *Monitoring and Evaluation Strategy for Habitat Acquisition and Restoration Projects* (Washington Salmon Recovery Funding Board, 2003)**.** The strategy included protocols and criteria for evaluating SRFB-funded restoration projects in nine different categories and called for the creation of intensively monitored watersheds (IMWs). The SRFB, through Resolution 2003-13, approved funds to begin a systematic, science-based effectiveness monitoring program as detailed in the monitoring and evaluation strategy and staff's October board presentation.[3]

The monitoring and evaluation strategy's experimental design was based on evaluating those categories of SRFB projects that had the quickest potential response time, were most popular as treatments proposed by the watersheds, and potentially had some of the greatest improvements to habitat per (Roni, et al., 2002).

### SRFB Monitoring Questions

Based on recommendations from the Independent Science Panel and the Monitoring Oversight Committee, project effectiveness monitoring was developed to answer the most important questions the SRFB and NOAA Fisheries wanted to know at that time.

1. What categories of projects are effective in restoring salmon habitat?
2. If they are engineered solutions, are the design criteria effective?
3. Did the habitat respond to the restoration actions?
4. What categories of projects are used by fish?
5. Are they cost-effective?

### Project Categories

- **Fish Passage Projects** – Included culverts, fishways, logjams, bridges, and dam removal projects.
- **In-stream habitat Improvement Projects** – Included channels, deflectors, weirs and large wood placements.
- **Riparian Plantings** – Restoration of native forest trees and shrubs in the riparian zone
- **Livestock Exclusion Projects** – These projects excluded livestock from the riparian zone and enabled vegetation to re-establish and stream banks to heal from the effects of livestock.
- **Constrained Channel Projects** – These projects removed or opened up dykes, levees, road beds, riprap, and fill to allow the stream to re-establish natural meanders and flow regimes.

[3]See Appendix 1 for the full resolution document.

- **Channel Connectivity Projects** – These projects re-connected side channels, oxbows, and wetlands that had been isolated from the main stream channel and created winter hiding cover and juvenile rearing
- **Spawning Gravel Placement Projects** – These projects attempted to increase the amount of spawning gravel by importing gravel at selected locations.
- **Diversion Screening Projects** – These projects were in eastern Washington and targeted irrigation diversions in the Columbia River basin that were not adequately screened to protect juvenile migrant salmon and steelhead from being deposited onto a wheat field or other farmland.
- **Habitat Acquisitions** – These projects purchased important habitat at risk of being developed and degraded to protect it into the future. No restoration actions were enacted for many of these.

**Note:** Although it was discussed with Puget Sound nearshore staff and the SRFB, no categories of estuarine-nearshore projects were proposed for SRFB monitoring because it was expected that the newly formed Army Corps of Engineers-sponsored Puget Sound Nearshore Ecosystem Restoration Project (PSNERP) would monitor the nearshore components.

## Experimental Design

The Board decided effectiveness monitoring would be applied on approved protocols to a sample of projects over set periods. The sampled projects would be tested using a "Before/After – Control/Impact" design. The design would use paired control and impact areas for each sampled project. Results would be tested using accepted statistical tests. The specific components are described below.

- To the extent possible, the projects were set up using a "Before/After – Control/Impact" experimental design where the treatment stream was paired with a control stream and data was collected at both the locations before and after the project was enacted. This helped insure that the differences observed at the treatment site were due to the treatment. If a control and treatment occurred in the same stream, the control was placed upstream so that no project treatment impacts would influence the control area.
- There was at least 1 year of *before* data, and *after* data was collected up to either 5 or 10 years after the project depending upon the type of project. It was desirable to have more than 1 year of pre-project data but this was difficult to achieve due to the speed at which projects were identified and then implemented.
- The protocols written were based on the U.S. Environmental Protection Agency's Environmental Monitoring and Assessment Program (EMAP). The EMAP and process reviewed the existing data and identified the indicators that exhibited the best signal-to-noise ratio, lowest variance, and highest power to detect change. The protocols were based upon information shared through the Pacific Northwest Aquatic Monitoring Partnership (PNAMP), where the best protocols at that time were identified as:
    a. Environmental Monitoring and Assessment Program administered by the Environmental Protection Agency.

b. PACFISH/INFISH Biological Opinion administered by the U.S. Forest Service.

c. Aquatic and Riparian Effectiveness Monitoring Program administered by the U.S. Forest Service.

- Monitoring the specific subset of projects funded in each category was based upon the calculated sample size needed to obtain statistically significant information in the shortest amount of time. If there were insufficient projects funded to obtain a proper sample size in any year, then replicates of the design were used in multiple years until the sample size was reached. The SRFB hired a statistician, Leska Fore of Statistical Design, to estimate the sample size and time period needed to detect a statistically significant 20 percent change. The statistical analyses of (Kaufmann, Levine, Robison, Seeliger, & Peck, 1999) and habitat data from Oregon Department of Fish and Wildlife (ODFW) for its coastal Coho evaluations were used to estimate variance for the analysis.

**Table 1: Analysis for Environmental Monitoring and Assessment Program metrics used to determine sample size and length of monitoring needed.**

| Data Source | Variable Name | Habitat Variable | Year | Site xyr | Residual Pool depth | Base Line | 20% Change | Detect 20%/y |
|---|---|---|---|---|---|---|---|---|
| Environmental Protection Agency | Pools/100 m | RP100 | 0.94 | 0.39 | 9.6 | 1.5 | 0.3 | 10 sites in 12 years; or 30 sites in 9 years |
| Oregon Department of Fish and Wildlife | Large woody materials volume | log10 V1WM100 | 0.003 | 0.202 | 0.429 | 29.000 | 5.8 | |
| Oregon Department of Fish and Wildlife | Percent shade | XCDENBK | 3.425 | 16.858 | 80.22 | 13.000 | 2.6 | 10 sites in < 6 years |
| Environmental Protection Agency | Bankfull depth | XBF_H | 4.52 | 9.5 | 36.2 | 3 | 0.6 | 10 sites in 12 years; or 40 sites in 9 years |
| Environmental Protection Agency | Bankfull width | XBF_W | 0.052 | 0.019 | 1.379 | 4.4 | 0.88 | 10 sites in 3 years |
| Environmental Protection Agency | Embeddedness | XEMBED | 17.44 | 4.72 | 90.18 | 18 | 3.6 | 10 sites <5 years |
| Environmental Protection Agency | Percent fines | PCT_FN | 5.82 | 0 | 128.25 | 12 | 2.4 | 10 sites 6 years |

## Process for Selecting Projects

SRFB staff established a random program for the PRISM database to select projects to monitor. PRISM selected projects in the selected categories from around the state every year to avoid a biased sample size. The selection process ensured projects were monitored on different schedules based on when the before data was collected. The monitoring costs varied from year to year depending on the schedule for implementation. Following is a table developed in 2007 projecting monitoring into the future.

- Habitat changes were considered successful when a statistical test showed that the SRFB could be 95 percent certain that the data demonstrated at least a 20 percent positive change in the habitat parameters measured.

Fish abundance changes were considered successful when a statistical test showed that the SRFB could be 95 percent certain that the data demonstrated at least a 20 percent positive change in the fish abundance for the target species counted for that category of project.

**Table 2: Example of a schedule guiding when project categories were due to be field sampled and the overall estimated annual cost to sample. Note that in 2007, 54 projects were scheduled.**

| Category | FY-05 | FY-06 | FY-07 | FY-08 | FY-09 | FY-10 | FY-11 | FY-12 | FY-13 | FY-14 | FY-15 | FY-16 | FY-17 | FY-18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| Fish Passage | 3 | 10 | 11 | 8 | 5 | 3 | 5 | 4 | 1 | 0 | 0 | 0 | 0 | 0 |
| Instream Structures | 4 | 8 | 9 | 7 | 4 | 5 | 6 | 3 | 2 | 0 | 3 | 4 | 2 | 1 |
| Riparian Plantings | 4 | 8 | 8 | 4 | 8 | 3 | 7 | 1 | 0 | 0 | 3 | 7 | 0 | 0 |
| Channel Connectivity | 2 | 3 | 2 | 7 | 7 | 1 | 1 | 4 | 4 | 0 | 0 | 0 | 0 | 0 |
| Constrained Channels | 1 | 2 | 4 | 7 | 7 | 3 | 5 | 2 | 5 | 0 | 1 | 0 | 3 | 4 |
| Livestock Exclusions* | 1 | 3 | 3 | 2 | 7 | 6 | 2 | 2 | 0 | 0 | 1 | 2 | 2 | 0 |
| Gravel Placements | 0 | 2 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 0 | 0 | 0 | 1 | 2 |
| Diversion Screening | 0 | 2 | 3 | 8 | 7 | 2 | 1 | 7 | 0 | 0 | 0 | 0 | 0 | 0 |
| Acquisitions | 9 | 1 | 0 | 9 | 0 | 1 | 9 | 0 | 1 | 9 | 0 | 1 | 9 | 0 |
| **Total # projects** | **24** | **39** | **43** | **54** | **47** | **25** | **38** | **24** | **15** | **9** | **8** | **14** | **17** | **7** |
| **Estimated Cost** | **$326,000** | **$569,000** | **$486,500** | **$552,113** | **$ 552,034** | **$371,450** | **$620,392** | **$391,359** | **$305,083** | **$271,783** | **$206,008** | **$263,763** | **$384,178** | **$265,038** |

## Degree of Certainty and Confidence Levels

SRFB members were asked how confident they wanted to be in the outcome, as it would dictate sample size and costs to monitor the project categories. The SRFB ultimately were comfortable with:

- Design was considered successful if 80 percent or more of the category projects maintained their design specifications during the sampling years.

## Databases Used

SRFB staff approved the establishment of a database at Tetra Tech Inc. to input all of the data until it could be summarized and shared with the SRFB. Tetra Tech continues to hold all of the data measurements. Tetra Tech's summarized data was provided to RCO and PRISM in annual reports.

PRISM continues to track the implementation of SRFB projects and the Pacific Coastal Salmon Recovery Fund metrics. NOAA Fisheries has required updates during the past 10 years with the latest changes in 2010 focused on reporting effectiveness monitoring metrics.

At the beginning of the project effectiveness monitoring, RCO created a PRISM monitoring workbench that allowed for the random selection of projects to monitor from the list of SRFB-approved projects each year. Figure 4 is an example of the PRISM workbench results for a random selection of fish passage projects for Grant Round 4. The workbench also provided for entering summarized results for treatment and control areas for the various projects as reported by Tetra Tech.

Figure 4: Example of PRISM project selection workbench

| Project # | Sponsor | Project Name | Worksite Name | Funded | Status | Monitoring |
|---|---|---|---|---|---|---|
| 02-1447R | Chehalis Basin FTF | Wynoochee #4 Barrier Correction | Wynoochee #4 Barrier Correction | 03/07 | Active | Selected |
| 02-1483R | South Puget Sound SEG | Perkins Creek Fish Passage | Perkins Creek Fish Passage Project | 03/05 | Active | Selected |
| 02-1494R | Kittitas Co Conservation Dist | Coleman Creek Fish Access | Coleman Creek Fish Access | 03/05 | Active | Selected |
| 02-1527R | North Yakima Conservation Dist | Diversion 14 Fish Screen - Ahtanum Cr. | Diversion #14 | 03/05 | Active | Selected |
| 02-1530R | Quinault Indian Nation | Salmon River Trib 21-0143 CulvertBarrier | South Fork Salmon River | 03/07 | Board Fundec | Selected |
| 02-1574R | South Puget Sound SEG | Malaney Creek Fish Passage Project | Malaney Creek Fish Passage Project | 03/05 | Active | Selected |
| 02-1579R | Pierce Co Conservation Dist | Foothills Trail Culvert Replacement | Foothills Trail Fish Passage | 03/05 | Active | Selected |
| 02-1602R | Dept of Fish & Wildlife | Donkey Creek Culvert | Donkey Creek Culvert | 03/05 | Active | Selected |
| 02-1614C | Cowiche Canyon Conservancy | Snow Mtn Ranch Acq & Barrier Removal | Snow Mtn. Ranch Acq. & Barrier Remova | 03/07 | Active | Selected |
| 02-1656R | Kittitas Co Conservation Dist | Dry/Cabin Crk Fish Passage & Screening | Dry/Cabin Crk Fish Passage & Screening | 03/05 | Active | Selected |
| 02-1591R | South Puget Sound SEG | Little Skookum Valley, Phase I: Passage | Little Skookum Valley Fish Passage | 03/05 | Active | Not Selected |

## Quality Control and Quality Assurance

To determine whether the sampling crews were consistent with their results and to have some idea of the variance around the measurements due to human error, a second crew was used to sample the same locations for some selected projects early in the monitoring process.

## Summary of Effectiveness Monitoring Results 2004-2014

### Effectiveness of Projects in Meeting Engineering and Design Criteria

Many projects use design specifications intended to benefit fish, particularly salmonids. Design specifications typically have a life expectancy factored into the cost analysis. Over time, environmental or other circumstances can affect how well a project originally built to meet design criteria continues to meet those criteria. Projects for which engineering design criteria are used can be monitored to determine how well those criteria are achieved by the project over time. For example, fish passage projects involving culverts, weirs, and dams are only effective as long as debris, floods, and other factors have not rendered an engineered solution ineffective. Tetra Tech, on behalf of the SRFB, monitored fish passage structures, in-stream structures, riparian plantings, livestock exclusions, channel modifications, and diversion screening projects to see how well they continued to meet their engineering and design criteria.

Results indicate that the project category designs were effective at least through their first 3 years (Table 2). The SRFB determined that it wanted to end the evaluation of fish passage design and diversion screening design earlier than originally proposed. Based on these results; grant recipients who use the accepted guidelines from the SRFB for these categories of projects can be confident that they have effective design and engineering and are using Best Management Practices (BMPs).

**Table 3: Projects tested for meeting specific SRFB design criteria 2004-2013. Green are statistically significant.**

| 2004-2013 Monitored Category | Design Criteria | Conclusions |
|---|---|---|
| Fish Passage Projects | ≥80% functional by year 5 | 100% still functional by Year 54 |
| Diversion Screening | ≥80% functional by year 5 | 88.6% still functional by Year 25 |
| Riparian Plantings | ≥80% functional by year 10 | 89% still functional by Year 3 |
| In-stream Habitat Placements | ≥80% functional by year 10 | 91% still functional by Year 3 |
| Livestock Exclusions | ≥80% functional by year 10 | 81.8% still functional by Year 3 |
| Floodplain Enhancement | ≥80% functional by year 10 | 87.5% still functional by Year 5 |

**Table 4: Project categories monitored from 2004 to 2013, along with habitat trends observed. An asterisk indicates that the metric was statistically significant. Red color denotes current status contrary to desired output.**

| Monitored Category | Habitat Effectiveness Metric | Desired Output | Current Status |
|---|---|---|---|
| Riparian Plantings | % eroding banks | Decrease | Decreasing |
| | Canopy density | Increase | Increasing |
| | Vegetative structure | Increase | No Change |
| | Percent fines | Decrease | Decreasing |
| In-stream Habitat Placements | Residual pool area | Increase | Increasing |
| | Mean depth | Increase | Increasing |
| | Large wood volume | Increase | Increasing |
| Livestock Exclusions | % eroding banks | Decrease | Decreasing* |
| | Canopy density | Increase | Increasing* |
| | Riparian vegetative structure | Increase | Increasing |
| | Percent fines | Decrease | Decreasing |
| Habitat Acquisitions | Residual pool area | Increase | Decreasing |
| | Mean depth | Increase | Increasing |
| | Large woody materials volume | Increase | Decreasing |
| | Coniferous area | Increase | Increasing* |
| | Deciduous area | Increase | Decreasing |
| | Coniferous density | Decrease | Decreasing* |
| | Deciduous density | Increase | Increasing* |
| | Actively eroding banks | Decrease | Decreasing |
| | Percent fines | Decrease | Decreasing |
| | Percent embeddedness | Decrease | Decreasing |
| | Mean canopy density | Increase | Decreasing |
| | Riparian vegetation structure | Increase | Increasing |
| | Non-native herbaceous absolute cover | Decrease | Decreasing |
| | Non-native herbaceous relative cover | Decrease | Decreasing |
| | Non-native shrub absolute cover | Decrease | Decreasing |
| | Non-native shrub relative cover | Decrease | Decreasing |
| Floodplain Enhancement | Pool area | Increase | Increasing* |
| | Residual depth | Increase | Increasing* |
| | Canopy density | Increase | Decreasing |

[4]Decision by the SRFB to end the monitoring earlier than the scheduled 5 years for all projects monitored.
[5]Decision by the SRFB to end the monitoring earlier than the scheduled 5 years.

## Effectiveness of Freshwater Habitat Projects in Improving Habitat

In 2004, Tetra Tech monitored categories included:

- In-stream fish passage structures
- In-stream structures
- Riparian plantings
- Livestock exclusions
- Expansion of constrained channels
- Restoration of connectivity to side channels
- Gravel placement projects
- Diversion screening projects
- Habitat acquisition projects.

In 2003, very little information was available on the effectiveness of habitat restoration projects in improving habitat and in creating more salmon. As a result, the main monitoring questions were focused not on individual projects, but on these categories of projects to determine which categories were most effective in restoring habitat and in minimizing costs. It also was believed and discussed with the SRFB that it would be very costly to monitor all projects for effectiveness, and was not necessary once certain categories had been demonstrated to be effective.

Habitat acquisition projects were popular and have long-lasting effects because they prevent direct destruction of riparian and in-stream characteristics. Acquisitions also were justified on the basis of large wood recruitment. Habitat was acquired for a variety of reasons and contained a spectrum of habitat types within the properties. As a result, more parameters were measured to evaluate the various habitat types within the property. Acquisitions also could not be subjected to a "Before/After – Control/Impact" design because there was no control of comparable condition to compare and there were no treatments. Habitat acquisition projects were to be monitored for 12 years. The total number of projects to be monitored was based on a sample size of 10 projects for each category or 90 projects statewide.

Project effectiveness monitoring is used to evaluate habitat outputs or changes, which are directly affected by the project. The relationships between the project and higher-level outcomes (more fish) are usually less direct. Watershed processes occurring upstream or upslope from the project increasingly influence higher-level outcomes. Outcomes not directly influenced by the project are best addressed at the watershed scale through validation (IMW) monitoring. Most projects monitored for project effectiveness were implemented at a small scale, with defined sets of actions intended to protect or enhance specific habitat features or habitat-forming processes. Enhancement techniques may be difficult to implement properly but very effective or, conversely, easy to implement but rarely effective.

Based on the first 10 years of monitoring, the SRFB, in 2013, concluded that in-stream structures should be monitored longer to allow enough time for habitat changes to take effect. The SRFB also decided to increase the sample size for floodplain enhancement projects. The additional monitoring, known as Module 2, will continue until about 2020.

## Effectiveness of Habitat Projects on Local Fish Abundance

Most restoration and funding entities are interested in evaluating projects' abilities to increase the numbers of Fish In the project area. Current literature shows a wide variety of results in the ability to link individual projects with changes in fish abundance. Some studies have been unable to detect statistically significant changes in abundance in the project area after several years, while others have been able to show increases. As noted by the Independent Science Panel (2002) and others, detection of more fish at the project or reach level should not be interpreted to mean that overall abundance or productivity of the stream (e.g. smolt abundance) at the watershed scale also has increased. The linkages to smolt production can be done only through validation monitoring in IMWs. Tracking juvenile migrant and adult abundance are key to Endangered Species Act (ESA) de-listing.

The SRFB, through its contractor Tetra Tech, monitored fish abundance at the project level for fish passage structures, in-stream structures, acquisitions, and flood plain enhancements from 2004 through 2014. At acquisition sites, Macro-invertebrate Biotic Index and Fish Index of Biotic Integrity also were collected to evaluate the overall health of the stream fauna and are included here along with the fish information. The results are as follows:

**Table 5: Project categories monitored from 2004 to 2013, along with fish abundance trends observed. Asterisk indicates that the metric was statistically significant. Red color denotes current status contrary to desired output.**

| Monitored Category | Fish Abundance Metric | Desired Output | Current Status |
|---|---|---|---|
| Fish Passage Projects | Chinook juveniles | Juveniles upstream of barrier | Juveniles increasing upstream of barrier |
| | Coho juveniles | Juveniles upstream of barrier | Juveniles increasing upstream of barrier* |
| | Steelhead juveniles | Juveniles upstream of barrier | Juveniles increasing upstream of barrier* |
| | Chinook adults | Adults upstream of barrier | Adults decreasing |
| | Coho adults | Adults upstream of barrier | Adults increasing upstream of barrier* |
| In-stream Habitat | Chinook juveniles | Increased densities | Juveniles decreasing* |
| | Coho juveniles | Increased densities | Juveniles increasing |
| | Steelhead juveniles | Increased densities | Juveniles increasing* |
| Flood Plain Enhancements | Chinook juveniles | Increased densities | Juveniles increasing |
| | Coho juveniles | Increased densities | Juveniles increasing* |
| | Steelhead juveniles | Increased densities | Juveniles increasing |
| Acquisitions | Chinook juveniles | Increased densities | Juveniles increasing |
| | Coho juveniles | Increased densities | Juveniles increasing |
| | Steelhead juveniles | Increased densities | Juveniles increasing |
| | Macro-invertebrate Biotic Index | Improved Index | Decreasing |
| | Fish Index of Biotic Integrity | Improved Index | Decreasing |

## Early Coordination with Other Effectiveness Monitoring Efforts

In 2003, SRFB directed staff to coordinate closely with the efforts underway on the Columbia River through the Northwest Power and Conservation Council and the states of Oregon and Idaho. A meeting was held with staff from the Oregon Watershed Enhancement Board, (OWEB) one of the main architects of the Oregon Monitoring Plan for ESA listed Oregon Coastal Coho, and with the project manager for the U.S. Forest Service's Aquatic and Riparian Effectiveness Monitoring Program (AREMP). These collaborators pledged to work together to help implement effectiveness monitoring as consistently as possible throughout their jurisdictions. In addition, a meeting was held with the Northwest Power and Conservation Council staff to discuss working more closely together.

These meetings resulted in the formation of a coordination group that met periodically, with the Bonneville Power Administration monitoring staff and the NOAA Fisheries' Northwest Regional Office attending as well. These meetings were finally formalized and became the Pacific Northwest Aquatic Monitoring Partnership. On April 29-30, 2004, a joint meeting was held with the Oregon Watershed Enhancement Board and the SRFB in Vancouver, Washington. The agenda included discussion of ongoing effectiveness monitoring by the two states and how they could better collaborate. This meeting led to a cooperative approach in monitoring livestock exclusions under the SRFB protocol in both states resulting in having a larger sample size in less time and less cost for both.

## Chronology of Major Project Effectiveness Monitoring Events

### 2003

- Taylor and Associates is contracted to take a comprehensive look at the monitoring performed by grant recipients from 1999 to 2003 and report back to the SRFB.
- A draft *Monitoring and Evaluation Strategy for Habitat Acquisition and Restoration Projects* is written by SRFB staff and presented to the SRFB.
- SRFB approves up to $326,000 for Fiscal Year 2004 and $569,000 for Fiscal Year 2005 for monitoring project scale-effectiveness.
- A Request for Proposals is issued in 2003 for implementation of the monitoring program. Tetra Tech is the successful bidder.

### 2004

- First field monitoring begins with Tetra Tech.
- Grant recipients and lead entities are notified when their projects are selected for monitoring. Approval must be obtained before Tetra Tech can proceed.
- 35 projects are selected for monitoring from Grant Round 4 projects approved by the SRFB.
- Early in the Pacific Coastal Salmon Recovery Fund granting rounds (about 2004), NOAA Fisheries writes into the grant application process the requirement that at least 10 percent of grant funds is to be used for effectiveness monitoring.

2007

- Economic analysis of SRFB projects to date is attempted and reported.

2008

- The 2008 Pacific Coastal Salmon Recovery Fund grant includes a placeholder of $50,000 for development of estuary monitoring protocols. This is not implemented.

2012

- The new 2012 Pacific Coastal Salmon Recovery Fund priorities are provided to the states and include effectiveness monitoring at the watershed scale or larger for listed salmon or status monitoring projects that directly contribute to population viability assessments for listed salmon.

2013

- October meeting Stillwater Sciences presents *Developing a Monitoring Investment Strategy* to the SRFB. The report evaluates ongoing project effectiveness monitoring, IMWs, and status and trends monitoring and recommendations for future SRFB monitoring actions

2014

- SRFB approves the support of a Monitoring Panel; RCO releases an RFQQ and contracts
- SRFB supports funding IMW restoration treatments at $2 million per year for three years

## Intensively Monitored Watersheds (IMWs)

Early in the Pacific Coastal Salmon Recovery Fund granting process, Congress in its joint Senate and House comments stated (House Report 109-118 for FY2006), *"The Committee continues to be concerned about the lack of effective performance measures for this program. The assessment last year noted that performance measures have still not been developed, that project effects on Pacific salmon stocks are still unknown, and that the program has not been able to allocate funds based on recovery needs of specific salmon populations."*

As a result, monitoring projects were established in Washington through the SRFB and in Oregon through Oregon Watershed Enhancement Board, both of which have received Pacific Coastal Salmon Recovery Fund grants. The objectives of these monitoring projects were to test the effectiveness of restoration actions and to determine if the cumulative restoration actions were increasing fish abundance.

An IMW is the only type of monitoring that can validate cause and effect relationships between fish, habitat, water quality, water quantity, and management actions. It operates at the watershed scale to evaluate projects and programs that conduct, promote, or regulate, activities meant to protect or enhance habitat, water quality, and impact fish production. As an example, one might study the impacts of categories of riparian habitat projects on salmon in a specific stream. The common theme of these studies is to develop an understanding of the linkages between management actions and the numbers of fish produced.

IMWs are the most complex and technically rigorous, which often requires measuring many parameters to detect the variable affecting change. Counting juvenile and adult fish is essential as the ultimate outcome. IMWs can be assumed to represent the overall responses of watersheds with similar characteristics and

limiting factors to the same restoration impacts. Validation monitoring (or as termed here, IMWs, are the only way this can be achieved (ISP 2002).

An entire chapter of the comprehensive monitoring strategy was devoted to the need and criteria for establishing IMWs in Washington. See page 345: www.rco.wa.gov/doc_pages/other_pubs.shtml#salmon

The state Legislature was receptive to exploring the tie between fish abundance and habitat and funded both the Departments of Ecology and Fish and Wildlife to jointly monitor water quality and fish populations in five "index" watersheds. In that effort, Ecology monitored water quality, quantity, temperature, and benthic invertebrate variables in five streams (Summers, 2001), and the Department of Fish and Wildlife monitored smolt production. The goal was to integrate analyses to clarify relationships between water quality factors and smolt production. However, the Office of Financial Management was not pleased with their reports because they did not collaboratively write one report but each wrote their own report based on their data. As a result, the Office of Financial Management removed funding for index watersheds and directed the departments to petition the SRFB for replacement funding. The debate over the fate of the index watersheds led to the presentation by the IMW Steering Committee to the SRFB in 2002.

The IMW Steering Committee determined that the risks associated with the completion of an IMW were significant and that history had shown that few fisheries studies had been supported long enough to obtain usable results (Bayley, 2002). The committee provided the following guidelines, which the SRFB used to select IMWs.

### Guidelines for Selecting IMWs

- **Significant Freshwater Residency** – Use a species that has a significant freshwater residency that will reflect freshwater survival conditions. Because freshwater habitat degradation has been identified as a major Endangered Species Act listing factor for salmon and steelhead in Washington, it is important to be able to maximize the ability to show survival impacts by using a salmonid with significant freshwater rearing as a component of their life history. The committee had recommended the studies focus on Coho salmon and steelhead due to their 1-year and 2-year respective average freshwater residency time.

- **Small Watersheds** – Use smaller watersheds where the placement of projects will have a proportionally greater impact on the total juvenile production of the stream. Typical restoration projects may be only a few hundred meters in length. Therefore, smaller watersheds should be able to have a significant change in habitat with a reasonable number of projects rather than having numerous smaller projects or very large projects covering miles of stream.

- **Target Major Limiting Factor** – A careful analysis of the habitat components limiting fish production is key to success. Treating a component of the habitat that is not limiting may either show no fish response or a very weak response that may not be detectable given the normal annual variability in fish populations.

- **Accurate Fish In and Fish Out Data** – The currency for success in an IMW is fish migrating out of the stream. Migrants reflect the productivity of the stream. Therefore, accurate data must be obtained for both the initial potential recruitment based on adult spawners and the ultimate final survival of recruits 1 or 2 years later as they exit the stream. The data should have coefficients of

variance calculated for both adults and juveniles. In order to obtain variance information, multiple years of *before* treatment estimates must be made.

- **Secure Funding for Monitoring** – At minimum, an IMW must exist for 10 years before any usable conclusions can be drawn. Data would be available for 3 generations of Coho and 2.5 generations for steelhead. If policy forming administration are not willing to invest in the long term, then the IMW should not be implemented.
- **Secure Funding for Projects** – It does no good to provide funding for monitoring of habitat and fish if the required number of treatment projects are not inserted into the study streams. As stated above, the size and number will depend upon the size of the study watershed and the variance in the fish abundance numbers. If policymakers fail to fund these crucial investments, then the IMW is highly likely to result in failure. This can be either due to monitoring fatigue or because the restoration actions are spread over such a long period of time that it is difficult to detect a significant change in fish numbers that can be attributed to the treatments.
- **Local Political Support** – The ability to sample the stream relies upon the good nature of the landowners. In urban environments, this could mean hundreds of individuals. In watersheds where there are only a few landowners, access can be restricted or denied if the perception is that the study will harm the property owner. The monitoring team and the administrators must work with landowners on a continual basis to completion of the IMW. If broad support is not available, the IMW should be placed elsewhere.

The Independent Science Panel reviewed the IMW proposals in 2006. (Currens K. , Li, McIntyre, Megahan, & Reiser, August 31, 2006). Its findings were as follows:

> *"Based on our current and past reviews of Washington's monitoring and knowledge of other monitoring efforts, we conclude that the SRFB-funded IMW program is designed as a comprehensive watershed scale effort that could represent the beginning of a state of-the-art intensive monitoring program of salmon habitat improvement. It is one of only a few studies to address this issue (e.g., Ward et al. 2002; 2003; 2006). The strengths of the project include a solid scientific conceptual framework, a basically robust study design, and a well-qualified team of scientists. Weaknesses include (1) potential lack of coordination between how treatments (i.e., the habitat improvement actions) are selected and funded as it affects the implementation of the IMW statistical design, sampling, and analysis; (2) uncertainty about whether the IMW program will continue long enough to reap the benefits of the experimental design; and (3) the limitation of opportunities for selecting optimal study watersheds or complexes. In addition, the study plan lacked detailed descriptions of the procedures and analytical designs for the specific study components or complexes. The draft study plan adequately provides the basic scientific description of the project but we noted a number of situations where more detail would strengthen it."*

## Current Status of SRFB Sponsored IMWs

The following descriptions of the IMWs sponsored by the SRFB are provided to give the reader an overall perspective of the location, experimental design(s), problems encountered (and remedied), and the overall status of results after the first ten years. At the time of this summary completion (July 2015), all of the IMWs have been presented by the principle investigators (PIs) to the SRFB Monitoring Panel and at the 2015 Salmon Recovery Conference. Following the presentations, the reviews of draft documents were provided to the PIs and five (5) IMW Final Study plans submitted summer of 2015.

Treatment proposals for IMWs are expected to be submitted to RCO for consideration in summer 2015. These proposals will undergo review by the SRFB Technical Review Panel, the SRFB Monitoring Panel for technical soundness and adherence to study plans. If necessary, the IMW Technical Oversight Committee will assist with prioritizing and ranking to determine the allocation of limited resources.

It should be noted 2015 is the second year of a three- year program of restoration treatment support specifically identified for IMWs by the SRFB. Up to $2million per year was approved by the SRFB in 2014. At the time of this writing one year remains (2016) for the SRFB to awarding IMW restoration treatment support. Appendix 4 the IMW summary page taken from the Habitat Work Schedule (HWS) which in turn has hyper-links to all IMWs. The summary page is available via:
http://waconnect.paladinpanoramic.com/Project/10/39805

## Strait of Juan de Fuca IMW Complex

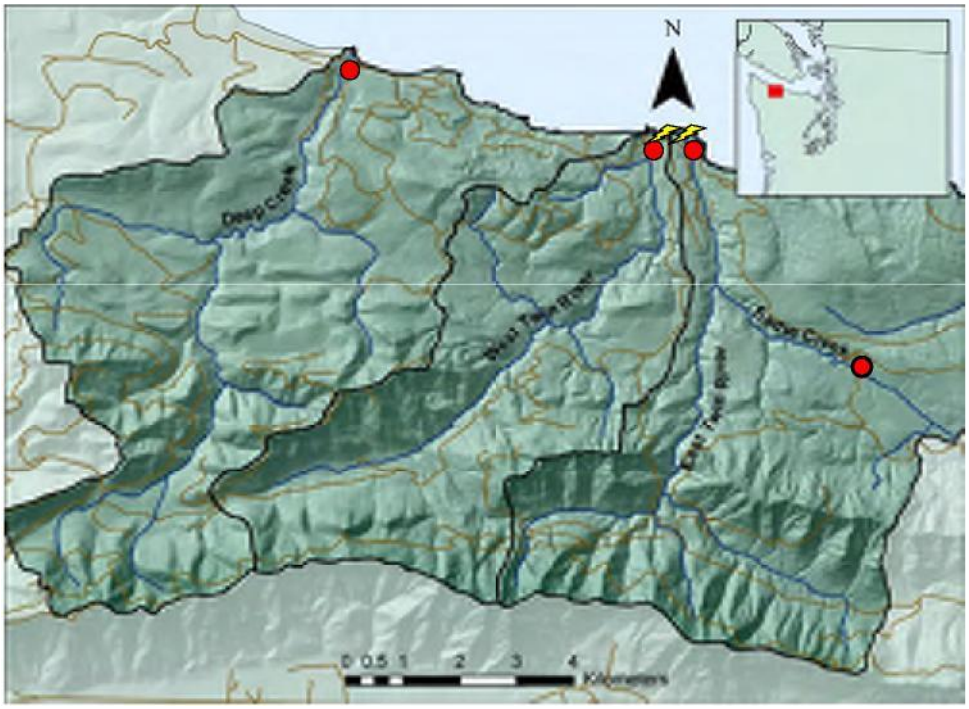
### Background

The Strait of Juan de Fuca background information is drawn from a 2007 study plan (Ehinger, et al., 2007). The Deep Creek, West Twin River, and East Twin River watersheds are on the northwestern Olympic Peninsula and cover a combined area of about 27,922 acres (Figure 5). Individual basin areas are 11,119 acres, 8,154 acres, and 8,648 acres, respectively. These watersheds drain directly into the Strait of Juan de Fuca. The headwaters of the stream systems begin in the Olympic Mountains and flow into gradually broadening river valleys. Stream channels generally flow northeasterly in the upper watershed and then turn northerly to the Strait of Juan de Fuca. Elevations in the watershed range from sea level to 1,142 meters (3,746 ft) atop Mount Mueller in the headwaters of the East Twin and West Twin Rivers. The targeted species are Coho and steelhead. Partners in this IMW included Cooperative Monitoring, Evaluation, and Research (**CMER**) Committee. Lower Elwha S'Klallam Tribe, NOAA's Northwest Fisheries Science Center, U.S. Forest Service, Washington Department of Ecology, Washington Department of Fish and Wildlife, Washington Department of Natural Resources, and the Weyerhaeuser Company.

The Strait of Juan de Fuca IMW complex was integrated into the SFRB's IMW program in 2004. The Deep Creek, West Twin River, and East Twin River watersheds were impacted severely by forestry practices that resulted in a loss of in-stream large woody materials and huge increases in sediment delivered to the stream due to slope and road failures.

The Strait of Juan de Fuca IMW complex uses a control and impact study design. Smolt monitoring began in Deep Creek in 1998 and in East Twin River and West Twin River in 2001 with restoration of Deep Creek and East Twin River beginning at about the same time. West Twin River serves as the control watershed with no restoration planned.

**Figure 5: Juan de Fuca IMW Complex, East Twin and West Twin Rivers and Deep Creek**




Total anadromous habitat, that area accessible to salmon spawners, in East Twin River is estimated at 10.5 miles, of which, 3.5 miles (33 percent) has been adequately restored by projects that have placed large woody materials in the river, replaced culverts, and improved the riverbanks. East Twin restoration began in 2002 and was concluded in 2011.

Total anadromous habitat in Deep Creek is estimated at 15.5 miles, of which, 5.5 miles (35 percent) has been adequately restored, primarily by adding large tree root wads and logs to stream channels. While the Lower Elwha S'Klallam Tribe has placed large quantities of wood in each of the treatment watersheds, these amounts do not replicate the spatial distribution and volumes present before watershed alterations. The last funded project in Deep Creek was completed in 2012.

### Juan de Fuca Coho and Steelhead IMW[6] Preliminary Findings (Funded by SRFB)

Habitat monitoring, using Timber Fish and Wildlife TFW protocols, (a collaborative and accepted co-management process) began in 1992 in Deep Creek and 2002 in East Twin River. A preliminary analysis of several of habitat data sets from Deep Creek suggested treatments should:

- Increase the pool surface area, frequency, and residual depth
- Increase area of side channels
- Decrease the ratio of bank-full width to depth ratios
- Reduce peak and average water temperature
- Reduce substrate size (from cobble to gravel)

Spring (May-June) Coho smolt counts have been completed in Deep Creek since 1998 and in East and West Twin Rivers since 2001. It was discovered that a large outmigration of juvenile Coho occurred each fall and winter, in addition to the normal spring (May-June) smolt migration. It previously was thought that early migrants were either surplus, beyond the carrying capacity of the stream, or were competitively inferior and were forced out. The fate of these "nomads" was unknown and they were assumed to be lost to the population.

IMW results indicate that the fall migrants do return as adults; over the course of this project the fall migrants have comprised 37 percent of the adult escapement. These adults return in two forms, those that spend 1 year at sea and return the following fall and those that spend 2 years at sea before returning. The other 63 percent exhibit the typical life history of Coho, emigrating in the spring and returning after 6 months at sea, as jacks, or after 18 months, as adults.

Tagging information indicates that there is a greater chance of survival if the juvenile Coho is 70 millimeters or greater in August or September, regardless of whether it leaves in the fall or spring. While the mean length of the fall smolts is less than those that overwinter, it appears that only the larger individuals of the fall migrants return as adults. In years where the proportion of Coho is greater than or equal to 70 millimeters survival-to-adult return was higher.

IMW conclusions at this time indicate that the treatments have not increased the number of Coho heading to the sea. This conclusion may indicate that either in-stream structure, mainly large wood materials, was not the limiting factor but some other component of the stream, such as off- channel rearing areas in the lower river, were needed. Questions remain as to whether this IMW failed to demonstrate that habitat restoration would increase salmon production, which was the goal of the IMW. If so, it points to the need for correctly diagnosing the limiting factors and then applying the proper restoration treatments at the proper level of intensity. On the other hand, it may mean that insufficient time has passed for the habitat changes to take effect. The purpose was to demonstrate that the sum total of restoration actions was producing more juvenile migrants and subsequently more adult spawners

[6]Juan de Fuca IMW description was taken from the presentation given by Phil Roni at the Pacific Northwest Aquatic Monitoring Partnership IMW Workshop in Portland, Oregon on March 20, 2013.

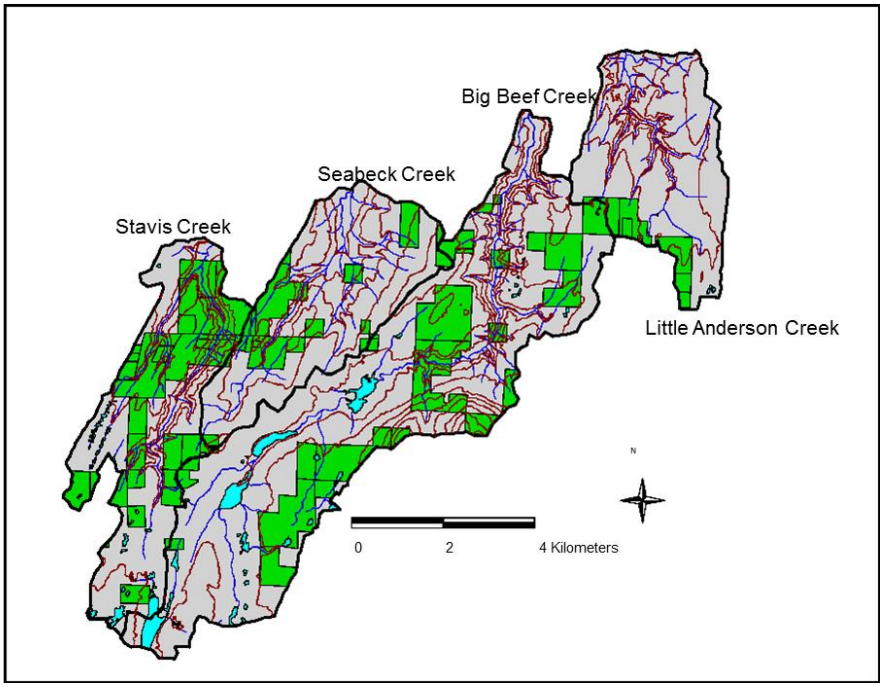
The Lower Elwha S'Klallam Tribe has studied steelhead as part of the IMW but has not provided a specific report on the success. A subsequent Straits comprehensive and updated IMW plan (June 2015) can be found in Appendix 4 and via: **Strait of Juan de Fuca IMW Complex**

## Hood Canal IMW Complex

### Project Description

The Hood Canal Complex background information is drawn from the 2007 study plan (Ehinger, et al., 2007). The targeted species are Coho and steelhead. The Hood Canal IMW complex includes three treatment basins and one watershed, Stavis Creek, serving as a reference site, where no restoration projects will be implemented during the study. There is extensive pre-treatment smolt production data available to assess the relationship between treated and untreated watersheds, but little habitat or water quality data. Smolt production has been measured concurrently at all Hood Canal streams since 1993, except that no data were collected in 1996 at Seabeck, Stavis, or Little Anderson Creeks and no estimate is available for Little Anderson Creek in 1998. Assuming an equal number of years of monitoring pre- and post-restoration, the analysis shows that there was an increase in smolt production in Big Beef Creek equal to 65 percent of mean production (mean production was about 26,000 smolts a year) after 6 years using a Before-After analysis. At 12 years, the detectable difference is reduced to 43 percent. Use of the "Before/After – Control/Impact" design results in a detectable increase in production of 51 percent and 34 percent at 6 and 12 years, respectively. The results using Seabeck Creek data were similar. Detectable changes of 49 percent and 33 percent at 6 and 12 years, respectively, were calculated using a Before-After design. Use of the "Before/After – Control/Impact" design reduced this to 35 percent and 23 percent at 6 and 12 years. The addition of significant covariates to the "Before/After – Control/Impact" analysis reduced this further to 27 percent and 18 percent. Based on this analysis, it is highly likely that if the proper number of restoration projects are completed, the number of fish will increase.

Figure 6: Hood Canal IMW complex

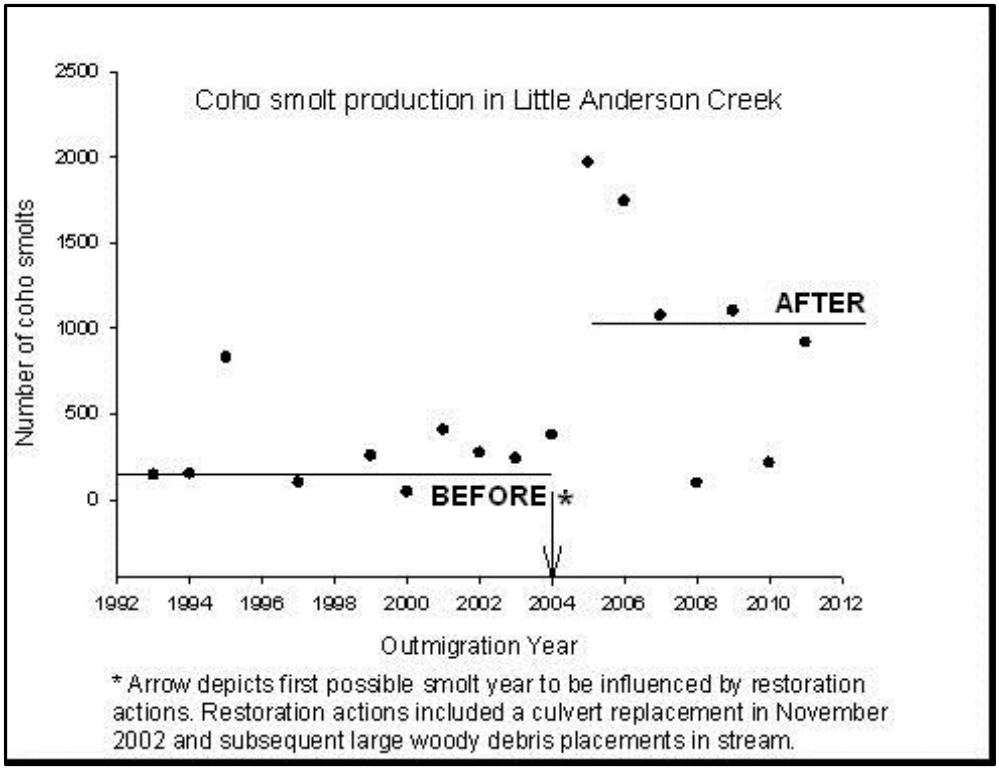



## Preliminary Findings (Funded by SRFB)

Little Anderson Creek is one of the treatment streams. A series of restoration actions in lower Anderson Creek that targeted in-stream structure such as large wood was constructed during the past 5 years. In addition, a barrier to upstream passage was removed. Stavis Creek was used as the control stream. There, no restoration actions were taken but it was monitored for Coho salmon adult abundance and juvenile migrant smolt abundance. In Figure 7, the smolt migrants averaged around 100 a year before treatment then jumped to an average of 1,000 smolts a year after restoration in Little Anderson Creek. In contrast, Stavis Creek showed a down turn in smolts in the "after" time period. This demonstrates that in streams with limited hiding structure and poorly developed pools and riffles, habitat restoration can have a major impact on increasing fish numbers.[7] However, this complex has not received all of the needed restoration actions.

[7]Graphs provided by Mara Zimmerman, Washington Department of Fish and Wildlife

**Figure 7: Little Anderson Creek treatment results with increase in Coho smolts after in-stream treatments. Figures 7 and 8 provided by Mara Zimmerman, Washington Department of Fish and Wildlife.**




Recent Coho salmon analyses, in this basin study, have shown that when juvenile Coho abundance reaches stream carrying capacity, it has occurred at the younger life stages (egg to parr life histories) but not older life stages (parr to smolt), as observed in freshwater. In addition, parr to smolt survival trends within each of the four sites tended to track each other through time, suggesting there may be a regional climate signal that was shared among the study populations. Such observations suggest patterns of freshwater survival may be governed early in life by habitat availability, but are controlled later in life by density independent factors such as precipitation and stream discharge.

A subsequent Hood Canal comprehensive and updated IMW plan can be found in Appendix 4 and via: **Hood Canal Intensively Monitored Watershed Complex**

## Skagit River Estuary Complex IMW

### Project Description

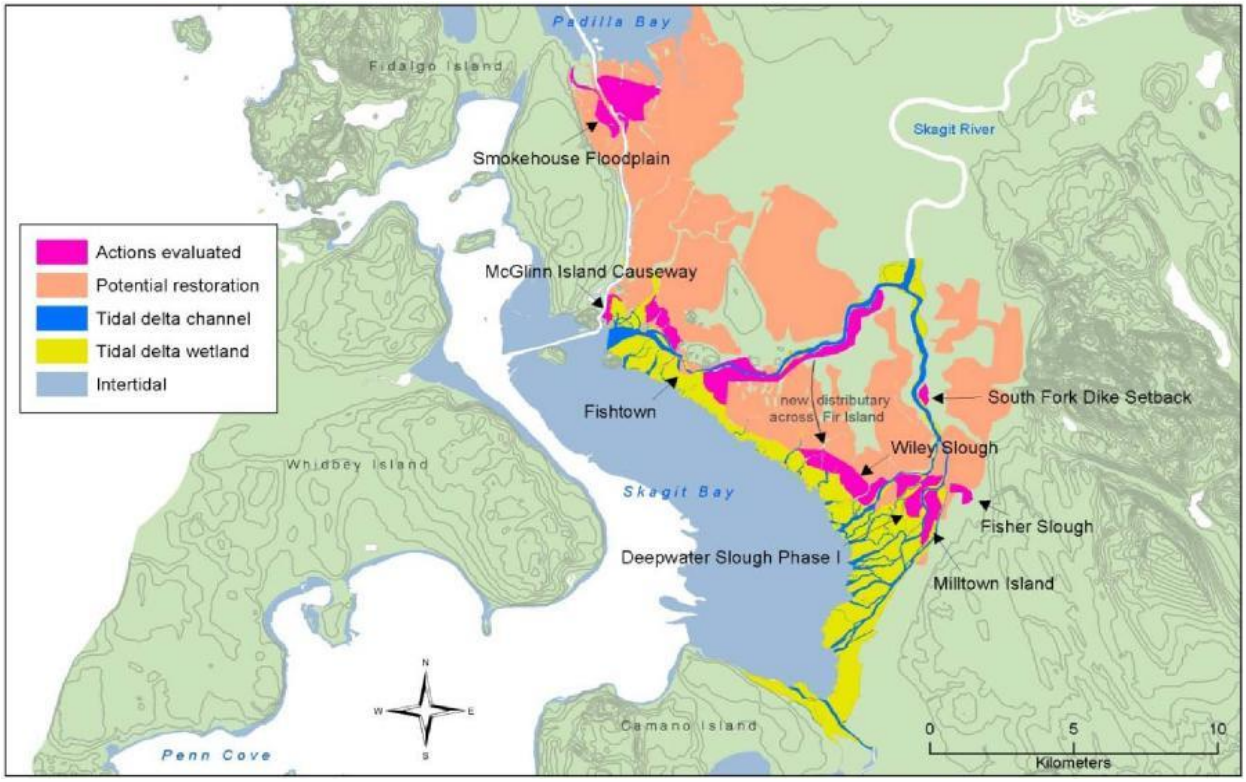
The Skagit River Estuary IMW background information is drawn from the 2007 study plan (Ehinger, et al., 2007). The goal is to understand changes in population characteristics (e.g., abundance, productivity, survival, and life history diversity) of wild Chinook salmon in response to reconnection and restoration of estuarine habitat. It requires examining the effects of restoration for the entire population of Chinook salmon rearing in the estuary. The Skagit estuary includes wetlands of the tidal delta as well as nearshore and offshore zones of Skagit Bay. The targeted species is Chinook salmon late juvenile rearing

in the marine nearshore estuary. The estuarine study sites consisted of blind tidal channels within the Skagit River tidal delta and of shoreline and nearshore (subtidal neritic) areas of Skagit Bay.

The Skagit estuary was modified during the past century with much of the intertidal marshes and wetlands drained and diked for farming. It is estimated that 73 percent of the tidal delta was disconnected from the floodplain and 24 percent of the Skagit Bay shoreline was armored. It was hypothesized that if the estuary was restored to more historic conditions, there would be improvements in estuary habitat and an increase in survival and numbers of newly emerged Chinook fry (age 0s ) using the estuary as a nursery.

In this IMW, treatment areas were compared to reference areas where restoration actions have not taken place.

**Figure 8: Skagit River Estuary IMW Complex**




## Preliminary Findings for the Skagit Estuary Complex

Since the year 2000, more than 757 acres were restored; another 557 acres are planned for restoration. The goal is a 60 percent increase in capacity. Once the planned restoration is completed, the IMW restoration will be at 28 percent.

Results show that local restoration such as at Deepwater Slough has improved the number of juvenile Chinook in treated portions of the estuary compared to untreated areas, and that carrying capacity has been increased in the restored South Fork channels compared to the untreated North Fork channels (Beamer & Greene, 2011). With the continuing improvements in the estuary, this limiting factor is being addressed and should lead to greater returns of adult Chinook in the coming years. This is the first IMW in

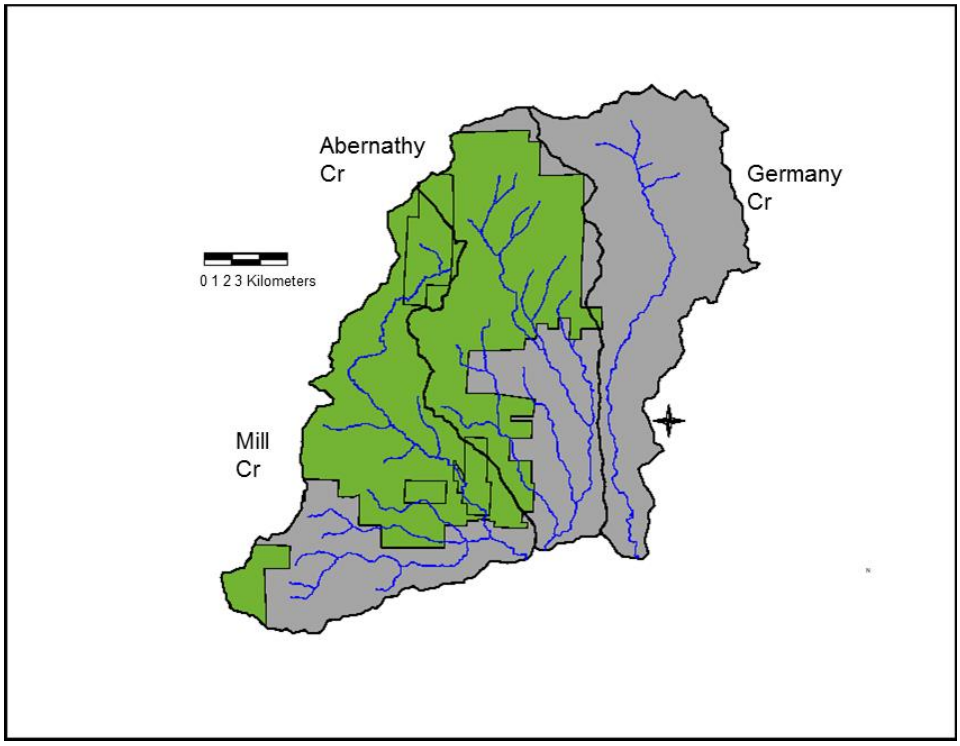
the estuary to demonstrate that improvements to juvenile Chinook densities can be obtained when estuaries used as nurseries are restored. These data and additional data need more analysis before it can be concluded that restoration improves overall marine survival and subsequent adult returns.[8] A subsequent Skagit comprehensive and updated IMW plan (June 2015) can be found in Appendix 4 and via: **Skagit Intensively Monitored Watershed Complex**

## Lower Columbia River IMW Complex

### Project Description

The Lower Columbia River IMW Complex information is drawn from the 2007 study plan (Ehinger, et al., 2007). An update of this plan is due May 2015. The project began in 2004 and uses PIT tags and tag array detectors in conjunction with migrant screw traps, spawner surveys, and snorkel counts to determine Chinook, Coho, and steelhead abundance, distribution, survival, and habitat use in the Germany, Mill, and Abernathy Creeks tributaries to the lower Columbia River in southwest Washington. Habitat evaluation has used EMAP protocols coupled with permanent stream flow and temperature gauges. Much of the complex is forested. Most forestland in Germany Creek is privately owned, while Washington Department of Natural Resources manages a large share of the Mill Creek and Abernathy Creek watersheds. Some residential development exists in the lower portions of these watersheds, interspersed with agricultural land use in the lower end of Abernathy Creek and Germany Creek.

**Figure 9: Lower Columbia River IMW Complex**




[8]Presentation to the SRFB February 2013 by Correigh Greene

Chum escapement currently is not monitored in these basins. Smolt monitoring has been conducted in the Lower Columbia River Complex since 2001. Average Coho smolt production per square kilometer of watershed area in the three streams ranged from 89 in Abernathy Creek to 130 in Germany Creek (Table 5). These levels are substantially lower than those found in the Hood Canal complex. For example, Stavis Creek in the Hood Canal IWM produced 489 Coho smolts per square kilometer during the same 2 years. The low level of Coho production in the Lower Columbia River Complex may because of steeper streams, poor habitat condition, and too few adult Coho escapements, which have only been measured since 2005. Wild steelhead smolt production per square kilometer of watershed averaged 20 in Mill Creek, 108 in Abernathy Creek, and 130 in Germany Creek. The steep streams likely provide habitat conditions more favorable to steelhead than Coho salmon.

The watersheds are lower elevation streams affected by farming and logging. A restoration treatment plan was completed in 2007. Pre-treatment baseline information has been underway since 2004. It is expected that this project will provide effectiveness monitoring of the estimated $2.5 million in restoration resources of the Abernathy Creek complex and implement about 15 projects. Germany Creek received a carcass analog nutrient enhancement treatment. The third stream, Mill Creek, is a control stream. Funding has been slow for restoration projects due to these watersheds being in competition with high priority watersheds for SRFB funding. This project is funded by the SRFB and one of the two Pacific States Marine Fisheries Commission (PSMFC)-funded IMWs in the Columbia River Basin.

The Washington Department of Fish and Wildlife has operated a screw trap to count outmigrants on all three creeks since 2001. In 2005, the outmigrant trapping was expanded to include Chinook outmigrants (January to June). In all watersheds, adult abundance and distribution surveys of the entire anadromous stream network are conducted weekly through the spawning season. All spawning fish and redds encountered during the stream surveys are counted and location is noted for later entry into a mapping database. The purpose of the surveys is to generate abundance estimates of spawning fish for each watershed and to assess spawner distribution.

Parr abundance is determined each summer. Fish are collected at 10 randomly selected reaches (site selection based on Environmental Monitoring Assessment Program (EMAP) protocols) in each complex by one-pass electroshocking surveys. Catch per unit effort (time) is used to provide an indication of parr distribution and relative abundance of young of the year (age-0) trout. Total watershed abundance of Coho and one year old parr (age-1) steelhead parr is estimated using a mark-recapture method. The adipose fin is removed from all Coho and age-1 steelhead parr captured. Marks are noted during smolt trapping the following spring, enabling an estimate of the survival of marked fish from summer through smolting. Total parr abundance in each watershed the previous summer is then estimated from the survival rate and the proportion of marked to unmarked fish captured in the smolt trap.

This project has completed 7 years of “before” information in a “Before/After – Control/Impact” design. Treatments began in 2010 for analog nutrient enhancement in Germany Creek. Treatments in Abernathy Creek have been limited to riparian planting but some restorations were funded for summer of 2012. PIT tagged juvenile steelhead and monitored population abundance and migrant numbers for steelhead, Coho, and Chinook as well as distribution survival and growth.

### Preliminary Findings Lower Columbia IMW Complex Washington (Funded by SRFB)

These watersheds are relatively large and thereby require more projects than Juan de Fuca and Hood Canal complexes to influence enough of the basins to be able to detect change in fish production. Most of the anadromous zone (70 percent to 80 percent) are in logging areas. The estimated total cost of project restorations in the watersheds is $6.5 million. While work has been ongoing in the creeks for a longer period, IMW-specific restoration work as occurred only since 2009.

Recently, Germany Creek was used as a carcass analog treatment site as an alternative to placing identified restoration projects in the watershed as planned. IMW staff were looking at the isomers (retained isotopes) nitrogen 15 and carbon 13 ($N^{15}$ or $C^{13}$) contents as a tracer. Data in 2013 for analog treatment for Coho and steelhead did not show a change in fish abundance or growth. Uptake of Nitrogen 15 was not detected in the fish indicating that the analogs did not help the productivity of the two species most often found in the watershed. Before this experiment, there was no background work that indicated that nutrients were a limiting factor and nutrients were not identified in the restoration plan as a limiting factor. Mara Zimmerman[9] reviewed results at the 2013 SRFB meeting for Coho, steelhead, and Chinook. She concluded with the following preliminary findings:

- No increase in smolt production or growth following nutrient enhancement in Germany Creek.
- No trend in smolt production or growth in Abernathy Creek. Additional restoration needed.
- Life stage analysis for Coho salmon demonstrates growth and survival bottlenecks in summer and overwinter habitats.

Additional data analysis is anticipated by the IMW staff in the future. A subsequent Lower Columbia comprehensive and updated IMW plan (June 2015) can be found in Appendix 4 and via: **Lower Columbia Intensively Monitored Watershed Complex**

## Asotin Creek IMW

### Project Description

The following description of the Asotin Creek IMW study design is drawn from (Bennett, Camp, Trahan, & Bouwes, DRAFT February 9, 2012).

Asotin Creek is a small tributary that enters the Snake River directly at the town of Asotin. The watershed straddles the Columbia Plateau and Blue Mountains. The terrain is steep with deep narrow canyons in a basalt-dominated lithology, surrounded by semi-arid sagebrush steppe at lower elevations and open conifer-dominated forests at higher elevations. An extensive watershed assessment in the early 1990s identified stream temperature, riparian condition, fine sediment, lack of large woody materials and pool habitat, and fecal coliform as limiting factors.

Extensive upland and management improvements and riparian fencing in the late 1990s and early 2000s are thought to have decreased sediments entering the streams. The IMW is being implemented in the lower 7.2 miles (12 km) of three tributaries to the main stem Asotin Creek: Charley Creek, North Fork

[9]Washington Department of Fish and Wildlife fisheries research biologist

Asotin Creek, South Fork Asotin Creek (hereafter the study streams collectively and Charley Creek, North Fork, and South Fork individually). Asotin Creek in southeast Washington was chosen as a site to develop an IMW in 2008. The IMW is being implemented in an adaptive management approach and as such, the overall design and monitoring efforts have been revised in response to new information and ongoing analysis. Several logistical and political issues required adaptations to the original IMW design.

An analysis of several experimental designs and monitoring schemes was completed to assess the original IMW design. The analysis showed that, under anticipated levels of variance in juvenile abundance and pool frequency, all designs would be able to detect a 25% change in abundance after restoration. However, if variance was higher than anticipated then an alternate design would be used in which restoration was implemented in all three study streams. Based on the analysis results, the experimental design was revised.

The Asotin Creek IMW has a hierarchical-staircase experimental design where the lower 7.2 miles (12 km) of each study stream is divided into three, 4-km long sections, one section of each creek is treated, and the remaining sections are controls. Treatments are staggered over 3 years with one section treated each year starting in 2012. A total of 12 km have been treated. The staggered implementation of the restoration (i.e., staircase design) provides explicit opportunities to refine and adapt implementation and monitoring specifics as may be necessary.

To maximize understanding of the effectiveness of the restoration and the causal mechanisms of changes in steelhead production and habitat change, a multi-scalar Biophysical Framework using map-referenced data has been constructed. To build this framework, aerial and ground-based Light Detection and Ranging (System) LiDAR, aerial photography, and map layers on soils, geology, stream networks, and topography were acquired and are being used to derive landscape units, slope classes, and other products at multiple scales within the Asotin Creek watershed.

To complement these watershed-scale, biophysical data sources, existing and newly installed discharge and temperature monitoring stations have been positioned throughout Asotin Creek and its tributaries, and Fish In – Fish Out monitoring at a Washington Department of Fish and Wildlife adult weir and smolt trap and historic redd counts and juvenile abundance estimates going back to the 1980s also have also been used. A set of permanent fish (12) and habitat (36) monitoring sites across the three study streams have been established to assess abundance, growth, survival, and production of juvenile steelhead. The two-pass mark-recapture and passive integrated transponder (PIT) tagging procedures are used to assess fish and the Columbia Habitat Monitoring Protocol is used to monitor stream habitat at the permanent sites. Mobile PIT tag surveys and rapid habitat assessments along the entire length of the study streams are used to compliment the site-scale monitoring.

To allow detection of adults and juveniles leaving and entering the watershed and the study streams and to estimate movement between study streams, PIT tag interrogation sites were set in Asotin Creek at the mouth, upstream of George Creek on the Asotin Creek main stem, and near the mouths of Charley Creek, North Fork, and South Fork. From these monitoring efforts, a variety of fish and habitat metrics can be calculated to determine the biological and physical responses to restoration at a section of stream. Fish metrics include smolts/spawner, juveniles/spawner, juvenile abundance (fish/square mile), growth (g/day), survival rates (season), and movement rates (m/day, season, year). Habitat metrics include pool frequency, large woody material count and volume, habitat unit density (i.e., number of units/100 square

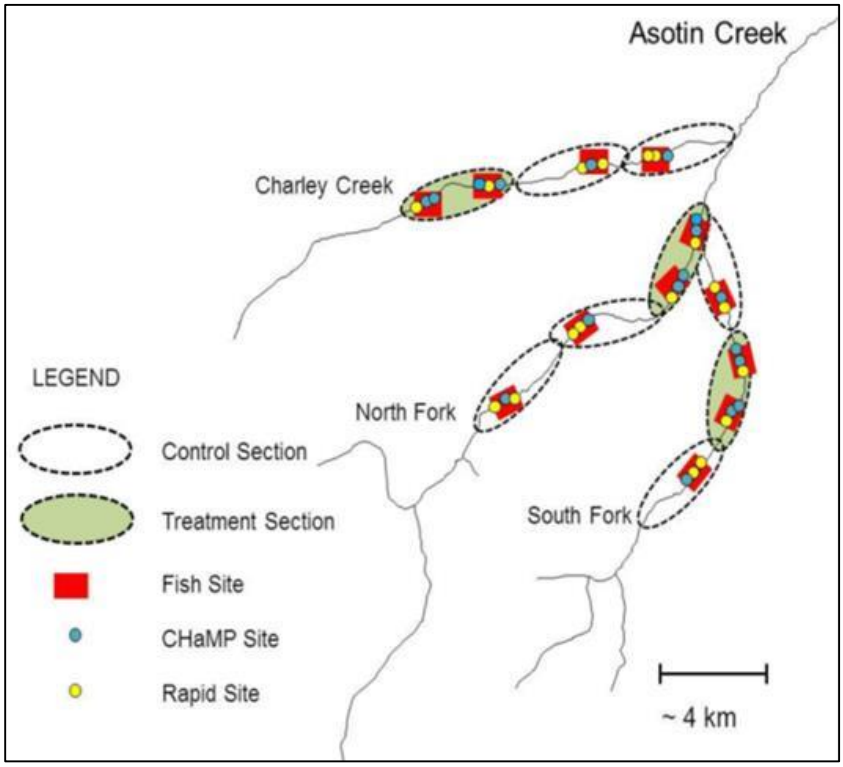
meters), sediment budgets (deposition and erosion rates and volumes). Fish and habitat characteristics are being integrated into models of carrying capacity using temperature, flow, and topographic data to determine changes in the total carrying capacity of treatment and control areas.

Estimates of smolt production and adult escapement are available from 2004 and 2005, respectively and watershed-scale productivity estimates will be available for the pre and post period of the IMW (i.e., 2008-2012 and 2012-2018). Annually, an average ~ 36,000 smolts have out-migrated and 654 adult steelhead have returned to Asotin Creek since 2004 and 2005 respectively. The majority of steelhead smolts are age 1 and 2, and the majority of returning adults spend 1 to 2 years in the ocean. The Washington Department of Fish and Wildlife PIT tagged 15,324 juvenile steelhead at the smolt trap and an additional 12,512 juveniles have been PIT tagged at the fish sites within the study streams. Juvenile steelhead abundance, growth, movement, and survival have been estimated in the study streams using mark-recapture, interrogation site detections, and mobile PIT tag surveys. There is relatively high variability between population metrics across sites, streams, and years; however, control and treatment sites have similar trends across years, which will improve detection of population changes due to restoration. On average, South Fork had higher densities of juvenile steelhead, North Fork and South Fork had higher growth, and all streams had minimal movement of juveniles within and between sites. True survival was highest in Charley Creek and South Fork. Juvenile steelhead from the study streams (i.e., tributaries) are using the main stem of Asotin Creek for up to a year to continue rearing before out-migrating. Total juvenile production averaged 12.1 g/ha/day (SD = 24.7, Min = -11.1, Max = 145.5) across all sites and showed high variability between time periods, streams, and sites. Preliminary analysis found no strong correlations between production and common habitat metrics (e.g., frequency of pools and wood), though there was weak correlation with production and average daily sun hours at a site.

This IMW is designed and operated by Eco Logical Research. It has been tested for its ability to detect change in steelhead abundance and other components. It uses a “Before/After – Control/Impact” design based on tributaries of Asotin Creek. It has strong support from the Snake River Salmon Recovery Board and is in a small enough watershed to demonstrate changes in steelhead production based upon changes in in-stream habitat. This watershed study uses the Columbia Habitat Monitoring Program CHaMP habitat evaluation protocol.

Funding is through NOAA Fisheries as a pass through from the Pacific States Marine Fisheries Commission (PSMFC) to RCO, leveraging support from the SRFB. The PSMFC has supported both the Asotin IMW in the Snake region as well as the Abernathy Creek IMW complex in the Lower Columbia region since 2007.

**Figure 10: Asotin Creek IMW showing control treatment units**




The upper watershed has been selected for habitat treatment, fish, and habitat monitoring. Lower Asotin and George Creeks are not part of the IMW, although the Washington Department of Fish and Wildlife adult and juvenile fish detection stations are used to track Fish In – Fish Out basinwide. Each tributary has been stratified into three sections indicated by the dashed ovals. In each tributary, one of the section (shaded green) has been identified as treatment reach that will undergo habitat restoration. The remaining two sections are controls where no active restorations will be conducted during the study. Within all sections, fish monitoring (indicated by red rectangles) and habitat monitoring (blue and yellow dots) is being conducted annually. The project uses PIT tags and tag array detectors in conjunction with migrant traps and spawner surveys to determine steelhead abundance, distribution, survival, and habitat use in three major forks of Asotin Creek. Large tree root wads and logs will be placed in the treatment streams, their shorelines will be planted, and their meanders restored.

The treatment section of South Fork was restored in 2012 (after summer mark-recapture and habitat surveys). A total of 196 large wood structures were built consisting of 585 pieces of large (> 0.1 m diameter and > 1.0 m in length). The large wood structures were built mostly by hand using wooden fence posts driven into the stream bottom to secure them in place. These structures consisted of deflector, mid-channel, spanners and debris jams, and key piece structures. In 2013, the treatment section of Charley Creek was restored in a similar manner to the South Fork and a total of 207 large woody structures were built using 497 pieces of large wood. In 2014, the treatment section of North Fork was restored. A total of 135 large woody structures were built and 568 pieces of large wood were added to the North Fork.

Preliminary assessments of the treatment response suggest a significant increase in juvenile steelhead in the treated streams compared to the control sections. Survival estimates are being recalculated and will be available in future reports. Both hydraulic and geomorphic changes were observed due to the restoration structures and significant changes in erosion and deposition and habitat unit diversity were observed. A synthesis of the habitat and fish responses conducted using net rate of energy modeling suggested that the overall carrying capacity for juvenile steelhead was increased by the restoration structures from 2012 to 2013. An estimate of smolts-per-spawner will be presented in future reports for the study creeks and compared to smolts-per-spawner estimates from the Washington Department of Fish and Wildlife's Fish In – Fish Out monitoring of the Asotin watershed. These data and continued monitoring the Asotin Creek IMW are expected to provide valuable information on the response of wild steelhead to large woody materials additions and how to improve the effectiveness of restoration actions in other watersheds (Bennet & Camp, January 2015).

A subsequent Asotin comprehensive and updated IMW plan (July 2015) can be found in Appendix 4 and via: http://waconnect.paladinpanoramic.com/project/10/40265

# Chronology of Major IMW Events

2002

- An IMW steering committee is developed by interested scientists within the Pacific Northwest and as a follow-up to the findings of the Monitoring Oversight Committee.

2003

- A SRFB presentation of the IMW group, provided at the July 2003 meeting, details the benefits, risks, and requirements for establishing an IMW. The IMW criteria for selection is carefully presented so that the reasoning for the proposed sites are evident.
- Three options are provided to the SRFB for consideration: Fund one IMW, two to four, or none. Staff note the letters from the Independent Science Panel and University of Washington and recommends full funding of the IMW program and the Smolt Monitoring Program. After much discussion, the SRFB provides $650,000 for a IMWs feasibility assessment and $250,000 for Smolt Monitoring activities, water quality, and quantity monitoring by the Washington Department of Fish and Wildlife and Ecology, respectively, and a report. The IMWs selected are Strait of Juan de Fuca Complex, Hood Canal Peninsula Complex, and Lower Columbia River Complex.

2004

- The SRFB passes Resolution 2004-05 at the June 2004 meeting. It increases the IMW grant beginning in Fiscal Year 2005 to $1.09 million to pay for additional IMW monitoring in the Skagit River Complex.

2005

- At its July 18 2005 meeting, the SRFB is reminded that it has not provided for the clustering of projects in IMW watersheds for Grant Round 6 funding and that placing enough projects in the IMWs is critical for success.
- At the October 2005 SRFB meeting, Bill Ehinger, of the Department of Ecology, presents a memo outlining concerns with projects that are key to intensive monitoring but may not be on the lead entities' lists. After considerable discussion, the SRFB decides not to add IMW restoration projects generated by the IMW researchers to the lists of approved projects by the lead entities.

2006

- At the May 19, 2006 SRFB meeting, a memo from Bruce Crawford to the SRFB describes the problem that IMW projects have no standing in the lead entity scoring and ranking process. He warns that IMW investments are in danger of being compromised. Sufficient numbers of restoration projects are needed in the IMW treatment watersheds to be able address the limiting factors and cause a detectable response in fish numbers. A table is provided that outlines the costs for the Hood Canal and Lower Columbia IMWs. It is recommended that either the IMW restoration projects come automatically off the top of the first increment before allocation to lead entities or the SRFB should provide a certain amount of programmatic funding to accommodate some IMW projects each year until the necessary treatments are made. The SRFB approves $350,000 programmatic funds for restoration in Little Anderson Creek and $300,000 for Lower Columbia River restoration.

- Also in 2006, SRFB staff requires that the IMW draft study plans be presented to the Independent Science Panel for review before proceeding identifying areas for improvement but approve the overall structure and approach (Washington Independent Science Panel, 2006). Results were presented to the SRFB.

### 2007

- NOAA Fisheries decides to bolster the IMW effort by funding monitoring in at least one other IMW in the Columbia River Basin in Idaho, Oregon, and Washington. This effort begins in 2007 and is continuing. Those streams include Asotin Creek in Washington, Middle Fork John Day River in Oregon, and the Lemhi and Potlatch Rivers in Idaho. Money also is provided to Washington to begin an IMW in the Yakima River basin but this is not pursued by the Middle Columbia Salmon Recovery Region.

- A July 13, 2007 memo to the SRFB from Bruce Crawford identifies clustering of restoration projects in IMWs as the key need for success.

- In September 2007, the SRFB, through Resolution 2007-02, increases operating costs for IMWs from $1.09 million to $1.47 million providing that the Washington Departments of Ecology and Fish and Wildlife present a summary of findings no later than 2009. The increase in funding was because the IMWs were being funded at $100,000 less than the actual cost of the monitoring and IMW staff was asked by RCO to include Chinook in the Lower Columbia River IMW Complex. This meant extending the smolt monitoring by 4 months and the red and spawner surveys by several months. The SRFB passes the resolution with the caveat that funding for the lower Columbia IMW is for 1 year and that the SRFB will work with the Lower Columbia Fish Enhancement Board to determine funding for future restoration actions. This results in a plan with identified restoration projects equaling $6.5 million.

### 2012

- NOAA Fisheries surveys all IMWs in the Pacific Northwest it funded and sends letters to each states with concerns about various aspects of the IMW programs.

### 2013

- In January, RCO issues Request for Quotations and Qualifications to provide an independent review of the SRFB's three major monitoring programs, project effectiveness monitoring, IMWs, and juvenile salmon status and trend monitoring. Contract is awarded to Stillwater Sciences, Portland, Oregon.

- Stillwater Sciences provides its findings to the SRFB.

### 2014

- SRFB approves $2 million for restoration projects in the lower Columbia, Hood Canal, and Juan de Fuca IMW complexes. (SRFB considers funding for the Asotin IMW in the Snake region)

- SRFB Monitoring Panel is formed and begins to function

### 2015

- SRFB Monitoring Panel adds subject matter expertise to panel and expands scope

It has now been 10 years since many of the projects were established. With the concerns expressed by the Puget Sound tribes (Treaty Indian Tribes In Western Washington, 2011) that habitat continues to be degraded faster than it can be restored, the germinal questions posed in IMWs remain central to Pacific Northwest interests and continued funding. There also remains the unanswered question: *Are we losing habitat faster than we are restoring it?*

# Status and Trends Monitoring

Status and trends monitoring assesses changes in a metric important for tracking progress in a population or a listing factor. This monitoring determines the biological condition of the species and the status of specific listing factors and threats. For the SRFB, this implies monitoring of juvenile migrant salmon and steelhead abundance, and the overall status of watershed habitat and its trend.

The Washington Forum on Monitoring Salmon Recovery and Watershed Health was created in 2004 and provided another venue to prioritize and coordinate monitoring statewide. Some members of the SRFB also served on the forum, and their dual membership helped to ensure information was shared between the two bodies.

## Habitat Status and Trends Monitoring

The forum addressed the recommendations of the Monitoring Oversight Committee and developed a monitoring framework (Washington State Framework for Monitoring Salmon Populations Listed under the Federal Endangered Species Act and Associated Freshwater Habitats, March 2007) where habitat and fish status and trends could be combined into a coordinated program. This was developed through the combined efforts of the Washington Departments of Ecology and Fish and Wildlife, and NOAA Fisheries.

At the July 2005 SRFB meeting, a presentation was made concerning the *Watershed Health and Salmon Recovery Framework* developed by the monitoring forum. Ecology asked for a $154,000 grant to develop a quality assurance plan for monitoring habitat status and trends and including densified, randomized sample sites for all watersheds. The SRFB approved this request. The quality assurance plan produced a randomized draw of stream sampling data points statewide for coordinated habitat and fish monitoring.

During the 2007-09 Budget submittal to the Legislature, the Washington Department of Fish and Wildlife submitted a proposal for $2.1 million for juvenile migrant monitoring. The Washington Department of Ecology proposed implementation of a statistically valid sampling program to answer the ongoing requirements of a variety of high-level reports requiring performance measures for a variety of water quality and habitat investments across Washington State (e.g. the *State of Salmon in Watersheds* Report, *Puget Sound Update*, and Environmental Protection Agency's National Performance Measures as required in a Performance Partnership Grant). Thirty sites per Salmon Recovery Region (SRR 2SRRs/year at a cost of $427,000.

The Washington Department of Fish and Wildlife request was denied but the Ecology request was approved.

The monitoring forum submitted 2008 Supplemental Budget recommendations for funding to the Governor and legislative committee chairs recommending that funding be provided for the three following urgent items.

Implementing habitat and water quality status trend monitoring at the regional and watershed levels so that the state can demonstrate that degraded salmon habitat and statewide water quality has improved. This recommendation is consistent with the Comprehensive Monitoring Strategy (CMS), which prioritized this as Number 6 among 76 recommendations.

Filling gaps in our knowledge of freshwater salmon recovery by funding additional juvenile migrant traps in selected primary watersheds where no Endangered Species Act juvenile salmon data exists. This recommendation is consistent with the CMS, which prioritized this as Number 11 and 18 among 76 recommendations.

Consolidating lake, river, and stream digital map layers residing at the Washington Departments of Ecology, Fish and Wildlife, and Natural Resources. Consolidating the map layers will improve coordination and comparison of water-related data with state, federal, and local governments and avoid duplication. This recommendation is consistent with the CMS.

Subsequently, the Legislature funded the evaluation of salmon habitat in each of the six salmon recovery regions of Washington as identified by the Governor's Salmon Recovery Office. This became the Department of Ecology's Watershed Health and Salmon Recovery Monitoring Program. The program has been sampling two salmon recovery regions in the state every year since 2009 with a rotation of 4 years for repeat sampling because 30 sites are randomly selected in each salmon recovery region based upon the Quality Assurance Plan (QAP) randomized draw funded by the SRFB. The sites sample both anadromous and non-anadromous stream locations.

There continues to be a need to expand the habitat status and trends monitoring down to the watershed level in order to obtain greater resolution. (See King County WRIA 8 reports for examples.)

## Juvenile Migrant Status and Trends Monitoring

The Washington Department of Fish and Wildlife's and the tribes' Fish In – Fish Out programs provide essential information on important life history traits such as the spawning timing of adults, the age structure of adults, juvenile rearing strategies, and juvenile migration timing. These traits vary substantially between Evolutionary Significant Units, between populations within those units, and between years within a population. These data, when combined with the abundance estimates, allow the state and tribes to look for answers to a variety of different conservation and management questions. Not all of these goals or objectives are directly relevant to the SRFB's needs, but they are important applications of the data.

At the December 2005 SRFB meeting, the Washington Department of Fish and Wildlife provided an overview and background on its juvenile migrant monitoring program and presented a proposal for $300,000 to continue ongoing juvenile migrant monitoring needs.

The SRFB members were hesitant to fund a program it felt should be funded by the Legislature. The SRFB also could not determine what migrant programs were most important and complimented habitat restoration actions. The SRFB approved $215,000 for juvenile migrant monitoring with the caveat that the Washington Department of Fish and Wildlife, with assistance from SRFB staff, bring back a complete list of all juvenile migrant trap sites in the state (See Table 7), which organization funded them, and their importance to the program. At the September 2007 meeting, the Washington Department of Fish and Wildlife returned with the requested material and the SRFB approved $208,000 to fund sites identified in the monitoring forum's framework but withheld money for non-framework juvenile monitoring. Sites approved included: Green, Dungeness, Cedar Creek, and part of Mill Creek that was in the IMW.

**Table 6: Juvenile migrant trap sites presented to the SRFB in 2007 for review. Green indicates approval by the SRFB. Gray indicates the status was not part of the monitor forum's framework.**

| Salmon Recovery Region | Targeted Primary Watersheds for Juvenile Trapping | Number of Primary Populations within the Watershed | 2007 Juvenile Trapping Status |
|---|---|---|---|
| Puget Sound | Nooksack | 2 | Yes – Tribal |
| | Skagit | 6 | Yes – Department of Fish and Wildlife |
| | Stillaguamish | 2 | Yes – Stillaguamish Tribe |
| | Skykomish | 1 | Yes – Tulalip Tribes |
| | Snoqualmie | 1 | Yes – Tulalip Tribes |
| | Green | 1 | Yes – SRFB |
| | White | 1 | No |
| | Nisqually | 1 | No – State budget request |
| | Skokomish | 1 | No |
| | Dosewallips | 2 | No – State budget request |
| | Hamma | 1 | Yes – U.S. Fish and Wildlife Service funded |
| | Elwha | 1 | Yes – Lower Elwha Tribe |
| | Dungeness | 1 | No – State budget request |
| Washington Coast | Ozette | 1 | Yes – Makah Tribe |
| Lower Columbia River | Grays | 3 | No – State budget request |
| | East Fork Lewis | 5 | No – State request |
| | Cedar Creek-North Fork Lewis | 2 | Yes – Ongoing SRFB Funding |
| | Kalama | 4 | Yes – Department of Fish and Wildlife federal Funds |
| | Cowlitz | 3 | Yes – Tacoma City Light |
| | Coweeman | 3 | No – Northwest Power and Conservation Council proposal |
| | Toutle | 4 | No |
| | Mill | 1 | Yes – SRFB |
| | Wind | 2 | No – Northwest Power and Conservation Council proposal |
| | Duncan Creek | 1 | No – Northwest Power and Conservation Council proposal |
| Middle Columbia River | Klickitat | 1 | Yes – Tribal/Bonneville Power Administration |
| | Yakima | 3 | Yes – Tribal/Bonneville Power Administration |
| | Touchet | 1 | No – State request |
| Upper Columbia River | Wenatchee | 2 | Yes – Public Utility District-Federal |
| | Entiat | 2 | Yes – U.S. Fish and Wildlife Service |
| | Methow | 2 | Yes – Public Utility District |
| | Okanogan | 1 | Yes – Tribal/Bonneville Power Administration |
| Snake River | Tucannon | 2 | No – Northwest Power and Conservation Council proposal |
| | Walla Walla | 1 | Yes – Confederated Tribes of the Umatilla Indian Reservation |
| | Asotin | 2 | No – Northwest Power and Conservation Council proposal |
| | Grand Ronde | 4 | No – State budget request |
| **Total** | **34** | **70** | **15 Traps Need Funding** |

# Coordination with Other Monitoring Efforts

The SRFB has, from the beginning of its existence, strived to be aware of and cooperate with other entities in the Pacific Northwest who are involved with salmon recovery, restoration, and monitoring. Following are some the major programs or partners that contribute to SRFB successful monitoring of habitat and the Endangered Species Act-listed fish involved.

## NOAA Fisheries Regional Monitoring Guidance

NOAA Fisheries has published recommendations for monitoring Endangered Species Act-listed populations (Crawford & Rumsey, Guidance For Monitoring Recovery of Pacific Northwest Salmon and Steelhead Listed under the Federal Endangered Species Act, 2011). The guidance document is designed specifically to assist states and tribes in prioritizing monitoring and in selecting proper sampling designs and protocols. SRFB funding for monitoring through the Pacific Coastal Salmon Recovery Fund is tied to evaluation of data quality based on this guidance.

## Puget Sound Partnership

The Puget Sound Partnership has statutory responsibility for recovery of listed salmon and steelhead in Puget Sound as well as other listed species such as Orca. As a result, the SRFB monitoring program will directly inform the determination of the status of Endangered Species Act-listed populations in Puget Sound. Close coordination is needed to ensure that reporting of progress by the Governor's Salmon Recovery Office through its *State of Salmon in Watersheds* report and by the partnership through its *State of the Sound* report, is linked and based on the same monitoring information. It is also important that monitoring protocols and designs recommended by the Puget Sound Recovery Implementation Technical Team and the Puget Sound Ecosystem Monitoring Program are as much in sync with the protocols used in monitoring the SRFB's IMWs, project effectiveness monitoring, and habitat status and trends monitoring.

The Puget Sound Recovery Implementation Technical Team completed *A Common Framework for Monitoring the Recovery of Puget Sound Chinook Salmon and Adapting Salmon Recovery Plans* (Bartz, et al., 2014). This is designed to provide consistency in approach to watershed recovery plans and monitoring.

Two Puget Sound Ecosystem Monitoring Program (PSEMP) reports have direct recommendations for monitoring viable salmonid populations (VSP) parameters and habitats that should be considered by the SRFB in any monitoring program (Crawford B. A., 2012). (Crawford B. , 2013).

## Federal Columbia River Power System

### Fish and Habitat Status Trends

The ongoing series of biological opinions, and the resultant court proceedings, have placed requirements upon the Columbia River participants in Washington, Oregon, and Idaho. The federal government has provided funding for monitoring and a monitoring structure is being put in place throughout the Columbia River basin. Protocols and methods used in the Columbia River basin should be coordinated. For example, SRFB-funded monitoring uses the Environmental Monitoring Assessment Program (EMAP) protocol for much of its data collection while most of the Columbia River BiOp sponsored monitoring, as well as the Asotin Creek IMW, now are using the Columbia Habitat Monitoring Program protocol. The

recommendation is where it makes sense and where it allows for drawing better conclusions over a large geographic area, comparable protocols should be used.

The biological opinions work groups for both tributary habitat and fish made recommendations to the federal government under Reasonable and Prudent Alternatives that have been carried out in many watersheds (Groups, 2010). One of the Reasonable and Prudent Alternative called for Chinook salmon, steelhead, sockeye salmon, and Coho salmon populations to be monitored for population (Fish In – Fish Out) status and trends.

The Federal Columbia River Power System's Work Group recommended that one or more populations per major population group (MPG) should be monitored for habitat status and trends. The recommended populations were identified as those with relatively large habitat and survival gaps identified in the Federal Columbia River Power System biological opinions and those that have, or will have, Fish In – Fish Out monitoring (identified in Reasonable and Prudent Alternative). This information was requested because it would help evaluate expected benefits of habitat actions. It recommended that, at a minimum, habitat monitoring focus on measuring the metrics associated with the habitat impairments identified. They were used because local biologists identified these impairments as limiting factors.

The subsequent Columbia Habitat Monitoring Program, funded by the Bonneville Power Administration, has been implemented in numerous watersheds identified by the biological opinions work group.

### Habitat Restoration Project Effectiveness

The Northwest Power and Conservation Council and the Independent Scientific Review Panel recommended that the Bonneville Power Administration and its partners develop an approach for evaluating habitat actions implemented by the Washington Department of Fish and Wildlife Program. The Bonneville Power Administration is implementing a coordinated, programmatic action effectiveness monitoring program to meet this need.

The program is an adaptation of the SRFB project effectiveness monitoring and will help increase sample sizes for categories of projects already under evaluation by the SRFB monitoring program.

Tetra Tech has been selected to conduct the "Before/After – Control/Impact" study with project partners across the basin helping to collect data. During the next few years, they will be adding 45 floodplain sites in three subgroups (levee modification, channel re-meandering, and channel reconnection – 15 each) and those will be sampled using the Columbia Habitat Monitoring Program protocol (CHAMP).

Tetra Tech also will be adding ten more fencing sites and ten partial barrier sites, all using the SRFB protocols. It also may look at ten more habitat protection projects using SRFB protocols.

In the coming years, some project categories will be sampled using an Extensive Post Treatment design and NOAA will be sampling these sites. These sites would be for large woody materials placement, engineered logjams, or larger constructed and engineered projects, planting projects, and full fish passage barriers (sampled in 2014). Large woody materials and engineered logjams will use the Columbia Habitat Monitoring Program protocol. Planting projects will use SRFB protocols and full barriers will use an adapted SRFB protocol and electrofishing. That effort constitutes a major addition of projects that support the SRFB effort. Coordination started in 2013.

## Pacific Salmon Commission and Pacific Fishery Management Council

These two federal panels provide the modeling and monitoring of salmon harvest coast-wide from Alaska to California. Their information is necessary to ensure that the effect of habitat improvements on populations of salmon is not masked by failure to address harvest issues and ensuring appropriate escapements to restored streams. An in depth report to the SRFB should be requested annually to ensure that Washington harvest impacts are well understood.

## Lead Entities and Salmon Recovery Regions

Lead entities and salmon recovery regions are most interested in monitoring that can help answer whether their restoration priorities are working and that can prove whether their strategies are effective. This often conflicts and competes for limited monitoring funds with the needs of federal and state agencies that have to demonstrate that the dollars invested in salmon recovery are showing a positive benefit. To the extent practical, SRFB monitoring should inform both local restoration entities and the larger scale questions as well.

# 2013 Stillwater Sciences Report

Several factors led to the SRFB's decision to conduct an assessment of its monitoring strategy.[10]

In 2012, NOAA introduced its own priorities for monitoring. This prioritization is an important factor for the SRFB to consider in its allocation decisions because the use of the Pacific Coastal Salmon Recovery Fund must be consistent with NOAA guidance and with the specific state application.

Specifically, NOAA articulated that one of its top four priorities would be: (1) "Effectiveness monitoring of habitat restoration actions at the watershed or larger scales for ESA-listed anadromous salmonids; (2) Status monitoring projects that directly contribute to population viability assessments for ESA-listed anadromous salmonids; or (3) Monitoring necessary for the exercise of tribal treaty fish rights or native subsistence fishing on anadromous salmonids."

The Council of Regions (COR - regional salmon recovery organizations, among others, expressed both interest in, and concerns about how monitoring is funded.

At the June and August 2012 SRFB meetings, members expressed concern about how the monitoring efforts, in particular the IMW program, fit with the project selection process and with the implementation of regional recovery plans.

As a result, the SRFB commissioned a report *Monitoring Investment Strategy for the Salmon Recovery Funding Board* (Stillwater Sciences, December 2013), to evaluate its monitoring program during the previous 10 years and to make recommendations for improvements. The evaluation included an extensive document review, structured interviews with key stakeholders and others with longstanding knowledge of salmon-enhancement monitoring in Washington State, and three meetings with an RCO-convened steering committee. Four criteria were used to evaluate the SRFB monitoring program, based on underlying monitoring goals as articulated in the *SRFB Strategic Plan*:

1. What has been accomplished by SRFB-funded activities?
2. Have the monitoring results been used to inform future management decisions?
3. What is the time frame for generating new information useful for management; can monitoring results actually be used and useful?
4. Does the monitoring support a regional context to enhance the interpretation of other monitoring results?

[10]Presentation by Brian Abbott to the SRFB at the October 2014 meeting.

Following the evaluation, the following report recommendations were provided and later developed into a final set of SRFB-based recommendations (March 2014):

1. Update of *SRFB Strategic Plan*
2. Create a SRFB monitoring panel
3. Update and finalize the SRFB monitoring strategy
4. Create a functional adaptive management program
5. Implement projects within IMWs
6. Coordinate with other statewide monitoring

**Recommendation 1** was accomplished in March 2014 with review and revision of the *SRFB Strategic Plan*.

**Recommendation 2** above was to establish an independent Monitoring Review Panel. That panel has been established and is assist with assessments and evaluations in oversight of the monitoring program.

**Recommendation 3** was partially completed by a 10 year status review which is this summary document. The balance of the recommendation will manifest in the overall strategy development presented to SRFB.

**Recommendation 4** similar to above

**Recommendation 5** IMW treatments are being implemented with SRFB direction

**Recommendation 6** Coordination with other state, and regional, monitoring is underway as evidenced by RCO/ GSRO participation in the Puget Sound Ecosystem Monitoring Program, Pacific Northwest Aquatic Monitoring Partnership, and implementation of EPA-sponsored Exchange Networks with co-managers.

## Purpose and Duties of the SRFB Monitoring Panel

Created in 2014, the SRFB Monitoring Panel[11] is charged with:

- Creating a functional adaptive management framework with clearly written expectations and a process for timely implementation.
- Evaluating, by component, the performance of the SRFB's monitoring program, providing guidance, and funding recommendations to the SRFB.
- Reviewing project effectiveness monitoring and IMW monitoring results to recommend changes in policy or funding criteria.
- Comparing and sharing monitoring results to see if lessons learned in other monitoring efforts could be applied to SRFB programs.

The monitoring panel should ensure that monitoring conducted by the SRFB is scientifically valid, transparent, and cost-effective for the years beyond 2014.

At this time, the monitoring panel is anticipated to expand its scope by reviewing the IMW treatment proposals as well as the regional monitoring proposals, both new initiatives supported by the SRFB. Recommendations for the latter are expected to be presented for funding considerations by the Board.

## Acknowledgements

I would like to thank Joe Anderson, Steve Bennett, Nick Bouwes, Dennis Dauble, Keith Dublanica, Bill Ehinger, Jody Lando, Jennifer O'Neal, Marnie Tyler, and Micah Wait for their thoughtful comments and edits to this summary paper.

[11] According to the March 2014 SRFB meeting Memo 7A

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# Appendix 1 SRFB RESOLUTION #2003-13

## Project Effectiveness Monitoring

WHEREAS, SRFB is committed to be able to identify and report the results and outcomes of projects selected for grants through the system of lead entities; and

WHEREAS, SRFB's goal is to support project lists and individual proposals thereon that are cost effective and have the greatest potential for benefit to threatened, endangered, and depressed salmonids; and

WHEREAS, to date SRFB has awarded grants which include various monitoring expenses estimated to average $500,000 per year; and

WHEREAS, SRFB intends to modify its approach to effectiveness monitoring to improve scientific credibility and to report results in the shortest time possible,

NOW, THEREFORE BE IT RESOLVED, that the Salmon Recovery Funding Board approves not to exceed $326,000 for FY 2004 and $569,000 for FY 2005, to begin a systematic science-based effectiveness monitoring program (including 4th Round approved projects where possible) as detailed in the SRFB "Monitoring and Evaluation Strategy" and staff presentation of 10-29-03, and

BE IT FURTHER RESOLVED, that the Director be authorized to execute any and all project agreements necessary to facilitate prompt implementation of monitoring.

Resolution moved by: _____Steve Tharinger____

Resolution seconded by: _____Jim Peters_____

Adopted _X__ Defeated ___ Deferred___

Date: October 29, 2003

# Appendix 2 SRFB RESOLUTION #2004-05

## Funding for Intensively Monitored Watersheds

**WHEREAS;** Congress, the State Legislature, the Independent Science Panel, the *Comprehensive Monitoring Strategy,* and numerous other reports have indicated the importance of monitoring the effect of salmon recovery efforts on salmon and salmon habitat; and

**WHEREAS,** intensively monitoring select watersheds is necessary, along with project effectiveness monitoring and status and trends monitoring, to monitor the effect of salmon recovery efforts on salmon and salmon habitat; and

**WHEREAS,** the SRFB provided the Washington Department of Ecology funding for intensive watershed monitoring for FY2004; and

**WHEREAS,** a long-term commitment to intensively monitored watersheds is necessary to obtain the desired results; and

**WHEREAS,** adding the Straits of Juan de Fuca and the Skagit to the basins being intensively monitored will provide with a mix of fish species and land-use types that will allow extrapolation of monitoring results to other watershed in the state;

**NOW, THEREFORE BE IT RESOLVED,** that the SRFB provide a grant of $1,090,000 to the Department of Ecology to continue intensive watershed monitoring in FY2005 in partnership with the Department of Fish and Wildlife; and,

**BE IT FURTHER RESOLVED,** that the Departments of Ecology and Fish and Wildlife are urged to coordinate this project with ongoing effectiveness monitoring, proposed status and trends monitoring, and related monitoring efforts being undertaken by the State of Oregon and by federal agencies in the Pacific Northwest.

Jim Peters – Moved / Brenda McMurray – Seconded

MOTION CARRIED / FAILED

# Appendix 3 SRFB RESOLUTION #7A

## Resolution 7A: Salmon Recovery Funding Board Monitoring Subcommittee Recommendations (March 2014)

1. ### Update of Salmon Recovery Funding Board Strategic Plan
   Move to approve the revised strategic plan language included in Attachment C of the board materials, including new statements on the three components of monitoring, the establishment of a monitoring panel, and the inclusion of an adaptive management program.

2. ### Create a Salmon Recovery Funding Board Monitoring Panel
   Move to approve $50,000 and the creation of the Salmon Recovery Funding Board Monitoring Panel.

3. ### Update and Finalize the Salmon Recovery Funding Board Monitoring Strategy
   Move that the Monitoring Panel *(if created by motion #2 above)* update and finalize the board's draft monitoring strategy.

4. ### Create a Functional Adaptive Management Program
   Move that the Monitoring Panel *(if created by motion #2 above)* develop an adaptive management program per the recommendations of the subcommittee

5. ### Implement Projects within Intensively Monitored Watersheds (IMWs)
   Move that the board adopt the recommendations outlined in Memo 7A (#5) to implement projects within three Intensively Monitored Watersheds (Skagit, Straits, and Hood Canal) by allocating up to $2 million of returned funds per year over three years.

**-OR-, to adopt individual recommendations:**

A. (No motion needed; Addressed in D below)
B. Move that the board develop a budget request for additional funds in the State salmon capital budget for the 2015-17 biennium by June 2014.
C. Move that the board ask the Puget Sound Partnership to consider utilizing unobligated Puget Sound Acquisition and Restoration (PSAR) funds to complete projects within the Skagit, Straits, and Hood Canal IMWs.
D. Move that the board spend $6 million over the next three years with a maximum investment of $2 million per year for the Lower Columbia, Straits, and Hood Canal IMWs.
E. Move that the board waive its match requirement for project sponsors implementing the new projects in a board-funded IMW.
F. Move that the board direct GSRO/RCO to utilize the existing board grant round process to review projects proposed within each IMW. Projects would be reviewed by the Salmon Recovery Funding Board Review Panel and considered for board approval at the September 2014 meeting.

## 6. Coordination with other Statewide Monitoring

Move that the board adopt the recommendations outlined in Memo 7A (#6) to advance the overall recovery monitoring needs for the board and the regional recovery delisting requirements be enacted.

## 7. Other Monitoring Related Issues Recommended by the Subcommittee

A. Move that the board align all monitoring funding or program decisions with the federal fiscal year.
B. Move that the board explore making monitoring an eligible grant round project type.

# Appendix 4 Habitat Work Schedule (HWS) IMW Summary

http://waconnect.paladinpanoramic.com/Project/10/39805

Washington State Habitat Work Schedule

## Intensively Monitored Watersheds Program (IMW)

Active
Started on Jan 31, 2004 | Ends on Jul 12, 2050

*SKA IMW*

The Intensively Monitored Watersheds program asks the question: Is restoration working to increase salmon numbers? Intensively Monitored Watersheds monitoring compares the number of salmon from streams where habitat restoration was done to similar streams nearby without such actions. This shows if changes in fish survival and productivity are due to restoration efforts or to other factors not related to stream restoration.

The IMW watersheds were selected to provide meaningful comparison, and there are four IMW watershed complexes (sets of control and treatment watersheds) that differ in physical characteristics, land use patterns, climate and salmon relative abundance. Differences among watershed complexes enhances our ability to generalize results to other watersheds; these differences also provide opportunities to address a range of factors that contribute to habitat degradation.

The IMWs in western Washington focus on coho salmon, and steelhead and cutthroat trout. These are the Strait of Juan de Fuca, Hood Canal, and the Lower Columbia, which are conducted in freshwater habitat. A fourth IMW program is conducted in Skagit River estuary by the Skagit River Systems Cooperative and National Marine Fisheries Service. Study plans for a fifth complex, the Asotin, are currently underway and will be included when they have been completed.

The Intensively Monitored Watershed program has led to scientific findings about salmon life strategies and habitat needs and helps improve designs of restoration projects.

Click on the Complex folders below to learn about each complex and projects associated with them.

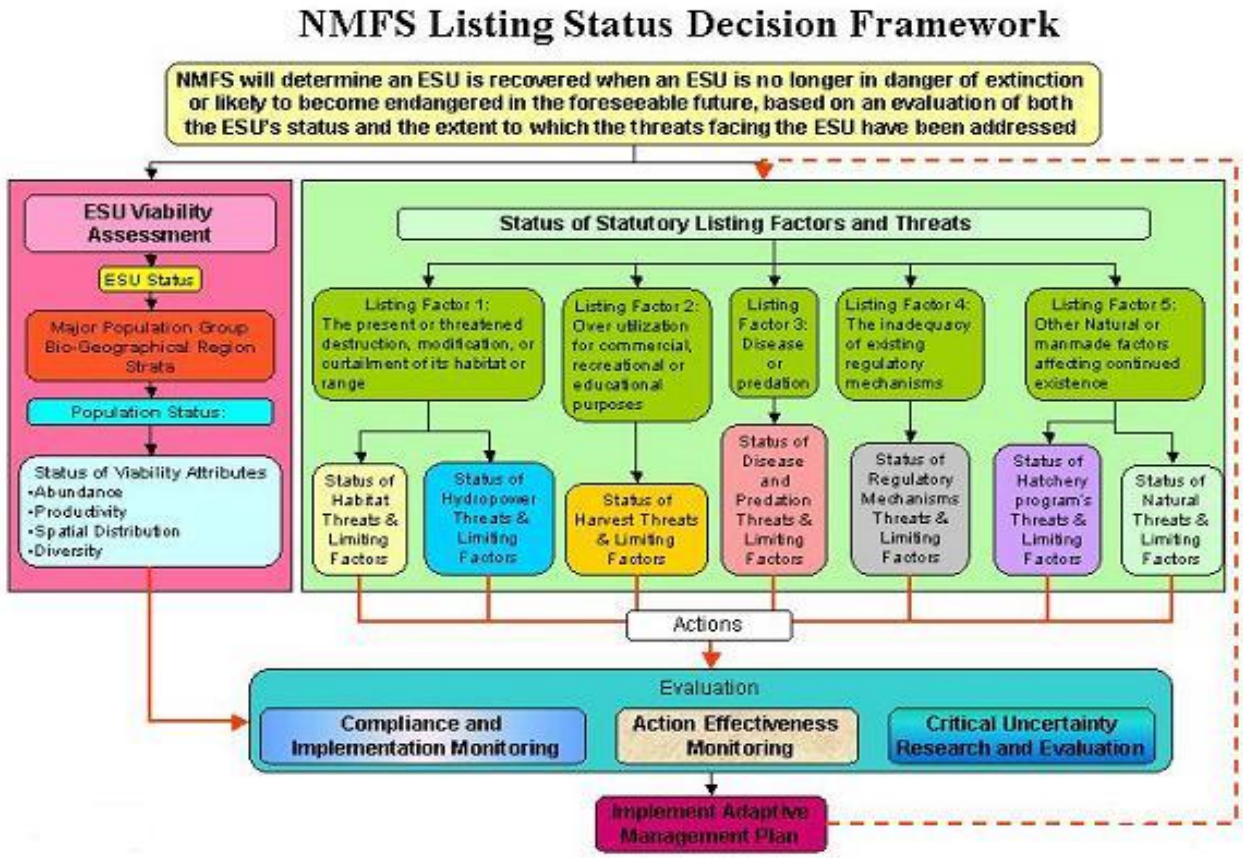
Click here to watch a two minute video on the IMW Program.

Photos courtesy of Wahoo! Films, map courtesy of Washington Dept. of Fish and Wildlife.

**Category**

Restoration Projects (3 projects)

**Level 2 Projects**

Asotin Intensively Monitored Watershed Complex
Hood Canal Intensively Monitored Watershed Complex
Lower Columbia Intensively Monitored Watershed Complex
Skagit Intensively Monitored Watershed Complex
Straits of Juan de Fuca IMW Complex

# Appendix 5 NMFS Listing Status Decision Framework