Anadromous Salmonid Monitoring Strategy

Note: this earlier version of the ASMS attempts to address the managers’ request to modify the draft long version drafted (draft asms – march 2012) to attempt to respond to the ISRP/ISAB comments (see [ISRP/ISAB 2011-1](http://www.nwcouncil.org/library/report.asp?d=37)); comments from a subset of managers and Bonneville consultants have been incorporated. This draft does not represent a final draft and this is not a draft supported by the Columbia River Basin managers.

Viable Salmonid Population Criteria and Subset of Tributary Habitat and Hatchery Effectiveness



**Columbia Basin Coordinated Anadromous Monitoring Workshop**

**Version 07 Sept 2012**

Executive Summary

The Anadromous Salmonid Monitoring Strategy (ASMS) is a strategy developed by Columbia River Basin fish managers to coordinate the monitoring and evaluation of tributary lifecycle metrics of all wild and hatchery salmonids and their habitat in the Columbia River Basin. This strategy focuses on what information is needed to evaluate management decisions and inform future policy formulation and direction. The strategy is developed by the fishery co-managers[[1]](#footnote-1) and is a coordinating component within the draft Northwest Power and Conservation Council’s (Council) Monitoring Evaluation Research and Reporting (MERR) Plan’s Anadromous Fish Research Monitoring and Evaluation Implementation Strategy. Other components of the MERR Plan’s Anadromous Fish Implementation Strategy will coordinate additional lifecycle monitoring as well as information on needs for other anadromous fish.

The ASMS strategy does not summarize the current knowledge of these fish, such as, conservation status, or the basic biological habitat requirements, or, habitat impairments and limiting factors, a\s these are summarized within the Northwest Power and Conservation Council’s subbasin plans and in individual project reports.

The ASMS addresses a portion of the salmonid monitoring needed to inform management questions, policy decisions, and reporting needs of the Council’s Fish and Wildlife Program (Program), National Oceanic and Atmospheric Administration (NOAA) Pacific Coast Salmon Recovery Funding (PCSRF), and NOAA’s Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp), and the individual needs of state and tribal fish managers. Specifically, the ASMS describes the coordinated strategy for collecting and sharing data needed to assess status and trend of viable salmonid population parameters (abundance, population growth rate/productivity, population spatial structure, and diversity), status and trend of freshwater habitat, the effectiveness of habitat actions at different spatial scales (project level, population and hatchery effectiveness monitoring. As some components of the ASMS are evolving the strategy for each monitoring component varies in level of details, as well as the strategy for data sharing and evaluation of commonly reported metrics and indicators. The ASMS is not a fully funded strategy but serves to inform funding decisions by providing the contextual background of implemented and proposed projects.

Table of Content

Contents

[Executive Summary 2](#_Toc348602259)

[Regional Context for the Anadromous Salmonid Monitoring Strategy 4](#_Toc348602260)

[Legal Environment 4](#_Toc348602261)

[Scope of the ASMS 7](#_Toc348602262)

[Processes used to Develop the ASMS and Supporting Data Sharing Infrastructure 9](#_Toc348602263)

[Basinwide Guidance for the ASMS 12](#_Toc348602264)

[Adaptive Management Approach 12](#_Toc348602265)

[Monitoring Approach and Data Quality 12](#_Toc348602266)

[General Viable Salmonids Population 12](#_Toc348602267)

[General Habitat Action Effectiveness 15](#_Toc348602268)

[General Salmonid Hatchery Action Effectiveness 16](#_Toc348602269)

[Prioritization of Monitoring 17](#_Toc348602270)

[Implementation of the ASMS- 2009 and ongoing 17](#_Toc348602271)

[Bibliography 19](#_Toc348602272)

Regional Context for the Anadromous Salmonid Monitoring Strategy

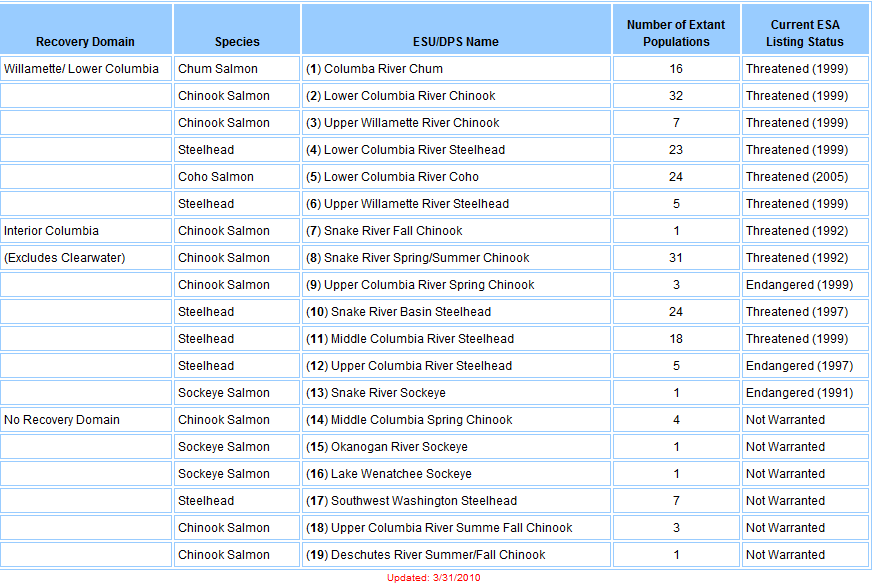
The Columbia River Basin (Basin) is home to many independent populations of anadromous salmonids, which have a complex life history, hatching in freshwater, migrating to the ocean as juveniles, growing there to adulthood and returning to the place of their birth; in some cases to streams that are hundreds of miles inland and thousands of feet above sea level, to spawn and die. Through their travels, anadromous salmonids rely on a diversity of habitats spanning from the Basin’s tributaries, mainstem, and estuary. Adding to this complexity are the multiple jurisdictions managing these salmonids and their habitat as well as the competing needs associated with the Basin, including flood control, irrigation, hydroelectric dam power generation, recreational, tribal and commercial fishing, navigation, recreation, and fish and wildlife.

The Federal Columbia River Power System (FCRPS) projects are operated by the US Army Corps of Engineers (ACOE) and the Bureau of Reclamation (USBR) on the Columbia, Snake and Willamette rivers for multiple purposes including flood control, fish and wildlife, power generation, navigation, irrigation, and recreation. Bonneville Power Administration (BPA) markets and distributes the power generated by the FCRPS. The presence and operations of these dams affect upstream and downstream fish passage resulting in mitigation actions being implemented at the dams and throughout the Basin. Mitigation actions are funded and implemented by federal, tribal and state fish and wildlife agencies, as well as interstate compacts and other inter-governmental forums such as the Northwest Power and Conservation Council’s (Council) Fish and Wildlife Program (Program), the National Oceanic and Atmospheric Administration’s (NOAA) Endangered Species Act (ESA) listed salmonid recovery teams, and the ACOE Anadromous Fish Evaluation Program (AFEP). As partners in the Basin work to mitigate, enhance, and recover anadromous salmonids, it is important to have comprehensive monitoring that provides the capability to evaluate these efforts, lends transparency to policy decisions, and informs adaptive management.

Legal Environment

Two of the basinwide statutory obligations that guide a large component of mitigation efforts are the ESA and the Northwest Power Act (ACT). The ESA is administered by the US Fish and Wildlife Service (USFWS) and NOAA to ensure that no species go extinct. The Council was created from the ACT which calls for a balance of cost-effective energy via the FCRPS and adequate protection, mitigation, and enhancement of fish and wildlife. Thirteen evolutionarily significant units (ESU) and distinct population segments (DPS) which include over 190 extant anadromous salmonid populations are ESA-listed (Table 1, Figure 1). The ESA calls for conservation assessments for each ESU and DPS (NOAA 2010b). The assessments describe what steps have been taken to address a species’ conservation needs including pre-listing, ongoing, and post-listing measures (NOAA 2010b). Related to this need, in May 2008 NOAA Fisheries issued a Biological Opinion (BiOp) on the operation of the dams that compose the FCRPS (NOAA 2008A) and in 2010 the related Adaptive Management Implementation Plan (AMIP) was added through the 2010 Supplemental BiOp (NOAA 2010a). The BiOp includes over 100 RME sub-actions that are to be implemented to support adaptive management and performance tracking of the listed populations.

Table 1. The ESA listing status for ESUs and DPSs by recovery domain within the Columbia River Basin ([SOTR website](http://sotr.cbfwa.org/HLI_Summary.cfm?mnu=HLI#1a1) accessed February 2013)



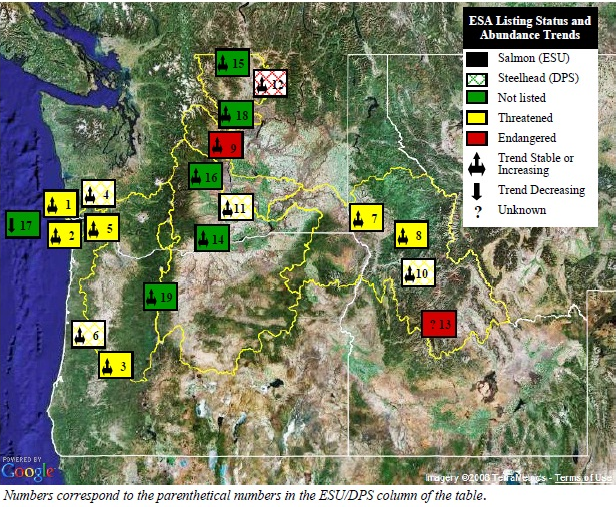


Figure 1.The ESA listing status for ESUs and DPSs by recovery domain within the Columbia River Basin (SOTR website accessed February 2013)

Under the ACT, the Council is to prepare, and periodically amend, the Program to protect, mitigate, and enhance fish and wildlife populations, and related their habitat, that have been affected by the construction and operation of any hydroelectric project in the Basin. The ACT directs the Administrator to use the Bonneville Power Administration fund and applicable laws to protect, mitigate and enhance fish and wildlife of the Columbia River and its tributaries in a manner consistent with the Fish and Wildlife Program (ACT 1980). The 2009 Program committed the Council to expand the Program’s monitoring and evaluation framework to ensure that the Program goals, objectives, and actions are monitored, evaluated, and reported in a manner that allows assessment and reporting of Program progress. This resulted in the [2010 draft Monitoring, Evaluation, Research and Reporting (MERR) plan](http://www.nwcouncil.org/fw/merr/Default.asp) and its subsequent versions that are intended to evolve with the Program.

The Anadromous Salmonid Monitoring Strategy (ASMS):

* Informs the adaptive management and performance tracking needs of the BiOP and AMIP for which the BPA, USBR, and ACOE (together referred to as the Action Agencies) are responsible to implement and report to NOAA;
* Provides the monitoring data to inform the viable salmonid population (VSP) parameters used by NOAA in assessing salmonid populations and ESUs under the ESA;
* Fulfills a portion of the draft MERR’s RME implementation strategy for anadromous fish (Anadromous Fish Implementation Strategy) which serves to describe the RME conducted in the Basin, for what purpose and how coordinated, and identifies gaps in RME coverage.; and,
* Provides monitoring data to inform progress made towards the Program's vision, goals, and objectives and facilitates reporting on the Council’s High Level Indicators (NPCC 2009) for both ESA and non-ESA-listed salmonids.

Several other legal requirements affect the Basin’s fish. These include the fish management responsibilities shared by three states (Idaho, Oregon and Washington) and 6 sovereign tribes (Confederated Tribes and Bands of the Yakama Nation, Confederated Tribes of the Colville Reservation, Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes of the Warm Springs Reservation of Oregon, Nez Perce Tribe, and Shoshone-Bannock Tribes). There are also several legal mandates overseeing the use of hatchery salmonids in the Basin that need to be considered with mitigation actions.

Scope of the ASMS

Monitoring of anadromous species in the Basin involves numerous complexities, as previously mentioned, including those associated with the anadromous lifecycle, the Basin’s numerous management jurisdictions, multiple and often conflicting uses, and legal mosaic. Due to these complexities it is not feasible to attempt coordinating monitoring for all life stages and relevant habitats at the same time. Therefore, the ASMS narrowly focuses on the Columbia River Basin tributary habitats and life stages of anadromous salmonids. Monitoring of the other lifecycle components of anadromous salmonids and associated habitats in the mainstem, estuary, and ocean will be addressed in separate coordinated strategy documents, some of which are in-development as a response to the Council’s recommendations for the RME and artificial production project category review completed in June 2011.

The ASMS aims to provide an efficient and effective monitoring strategy that integrates multiple monitoring programs and different geographic scales. The ASMS focuses on three categories of monitoring data for Columbia River Basin tributary habitats and life stages of anadromous salmonids: (1) fish status and trend, (2) habitat status and trend, and (3) effectiveness of habitat actions and hatchery actions at the project and population level.

The data collected by these three categories of monitoring are in varying stages of being identified. The data compiled by fish status and trend monitoring focuses on the four VSP parameters, consisting of abundance, population productivity, spatial structure and diversity (NOAA 2000). Those compiled to assess habitat status and trend parameters are in the pilot stage but should soon be confirmed. Parameters to assess habitat and hatchery effectiveness are in the early stage of development and will be discussed once more information is known. The focus of the ASMS on these monitoring categories for fish, habitat, and hatchery reflects commonality among anadromous fish objectives of state, tribal, federal, and interstate compact monitoring programs, which focus generally on increasing the abundance and condition of anadromous salmonids and their habitat (e.g., Council’s subbasin plans and draft management questions, and NOAA’s Pacific Coastal Salmon Recovery Fund Program and FCRPS BiOp). The monitoring data collected will serve to inform this general objective and related management questions and indicators that inform management and policy decisions.

The ASMS defers the responsibility of conducting implementation and compliance monitoring to individual funding agencies but recognizes its importance especially for informing effectiveness monitoring. Furthermore, although there are unknowns in salmon mitigation and recovery (i.e., the “critical uncertainties” that make management decisions much harder (NOAA 2007)), these research uncertainties are not addressed in the ASMS document at this time. Research uncertainties have been identified in the Council’s Program (NPCC 2009), the Council’s Research Plan (NPCC 2006), FCRPS BiOP (Federal Caucus No-date), NOAA’s Adaptive Management for ESA-Listed Salmon and Steelhead Recovery: Decision Framework and Monitoring Guidance (2007), and by Columbia River Basin fish managers (CSMEP: http://www.cbfwa.org/csmep/web/Content.cfm?ContextID=1, PATH).

The ASMS relied on the Monitoring Guidance for Pacific Northwest Salmon and Steelhead provided by NOAA (Crawford and Rumsey 2011), the Recommendations for Implementing Research, Monitoring and Evaluation for the 2008 NOAA Fisheries FCRPS BiOp (AA/NOAA/NPCC RM&E Workgroup 2010), the AHSWG recommendations (AHSWG 2008), NOAA’s Adaptive Management for ESA-Listed Salmon and Steelhead Recovery: Decision Framework and Monitoring Guidance (NOAA 2007), and the MERR (NPCC 2010) for informing basinwide monitoring guidance. Furthermore, In developing the ASMS, fish and wildlife managers took into account these key concepts:

* Scale integration: data collected can be used at multiple scales of interest for decisions. For example, ESUs for viability analysis, population level for local management.
* Integration across separate monitoring programs: information gathered serves multiple functions and thus reduces costs. For example, using the same Passive Integrated Transponder (PIT) tagged fish used for multiple evaluations.
* Integration of policy and technical domains: precision of data fits time frames and acceptable risks for decisions.
* Integration across life history stages: evaluation of survival and habitat requirements throughout the life cycle.
* Species integration: collection of data for multiple species in an efficient manner.
* Adequate sample size: sample sizes are statistically adequate to discern differences among populations, across spatial distributions, and across temporal scales relative to varying human-induced and natural environmental stressors.

Projects funded under the Program regularly undergo rigorous scientific review. This includes projects contributing to the implementation of the MERR Plan’s RME Implementation Strategy, including the ASMS, which describes, at a broad scale, the current status of RME. For details on the scientific assessment and recommendations for improvements of individual projects consult past Council recommendations, ISRP reviews, and the project proposal that are available at [www.cbfish.org](http://www.cbfish.org).

Processes used to Develop the ASMS and Supporting Data Sharing Infrastructure

The approach used for developing a coordinated basinwide tributary monitoring strategy differed for fish status and trend, habitat status and trend, habitat effectiveness, and hatchery effectiveness due to the differing status of existing commonalities among entities gathering this monitoring information. All monitoring topics were discussed with state and tribal fish and wildlife managers during the 2009 sub-regional and regional workshops, collectively referred to as the 2009 Columbia Basin Coordinated Anadromous Monitoring Workshops[[2]](#footnote-2) (also known as the “Skamania Workshop”).However, the details for the monitoring of habitat status and trend and the effectiveness of habitat and hatchery actions conducted by entities in the Basin were not finalized during the 2009 workshops and instead are being developed through processes described below.

Two approaches to coordinated basinwide habitat status and trend and hatchery effectiveness monitoring were proposed to the Council’s Independent Scientific Review Panel’s (ISRP) project review for *Research, Monitoring, Evaluation and Artificial Production plus* (RME/AP+) category projects during 2010-2011: (1) The Columbia River Habitat Monitoring Program (CHaMP) and (2) The Columbia River Hatchery Effects Evaluation Team (CRHEET). CHaMP received a Council recommendation to be implemented initially as a pilot to allow modifications for improvements. CRHEET received a ‘meets scientific review criteria’ from the ISRP during the Council’s RME/AP+ category project review process and is undergoing further development with the goal of being implemented in the next few years. The status of these projects will be updated pending further Council recommendations and BPA funding decisions, and as they evolve.

A coordinated basinwide approach to monitoring habitat effectiveness is being discussed at both the reach/project and watershed scales. Habitat monitoring at the reach/project scale is being addressed through a subgroup of the Pacific Northwest Aquatic Monitoring Partnership (PNAMP) Effectiveness Monitoring Coordination and Assessment project (http://www.pnamp.org/project/3137), and their suggested approach is described in a subsequent section, although it has not yet received basinwide or Council approval. Effectiveness monitoring at the watershed scale is proposed to be addressed by models that would incorporate data from the fish status and trend, habitat status and trend, and habitat effectiveness monitoring.

The ASMS component, most fully developed during the 2009 Workshop, is the coordinated basinwide approach for conducting salmonid fish status and trend monitoring in tributaries. This monitoring component was most ripe for basinwide discussion as most entities already collect salmonid abundance and productivity data and collaborate with NOAA to collect data for ESA-listed salmonid fish status assessments.

During the 2009 Columbia Basin Coordinated Anadromous Monitoring Workshops[[3]](#footnote-3) (also known as the “Skamania Workshop”) tribal and state strategies for monitoring anadromous salmon and steelhead status and trend in tributaries were combined into four subregional strategies: Snake River, Upper Columbia, Middle Columbia, and Lower Columbia (Figure 1). These four subregions differed from the entities involved and in the number and variety of ESA-listed and non-listed species and populations present (Table 1). To aid in standardizing the subregional strategies, each followed guidelines for study design and data quality that are used by managers and that are described by the NOAA (Crawford and Rumsey 2011). Once the four subregional strategies were completed, a basinwide strategy that assessed the adequacy of the combined sub-regional monitoring strategies and monitoring priority was agreed upon (described in following sections).

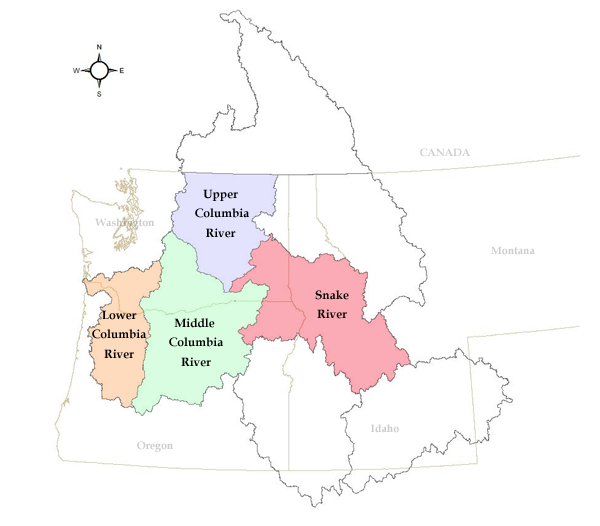


Figure 2. The four sub-regions of the ASMS.

A follow-up, and critical component, of the ASMS is a basinwide data-sharing strategy to easily share and compile information needed to address questions at different scales, e.g., local to subregional to basinwide. This need is being addressed by the Coordinated Assessment for Salmon and Steelhead Project (CA Project)[[4]](#footnote-4) with an initial focus on facilitating data sharing for VSP parameters basinwide. This effort includes state, tribal and action agencies in the Basin who work together in developing integrated data sharing for anadromous fish with an initial focus on three VSP parameters: natural spawner abundance, smolt to adult return, and recruit per spawner. As this work progresses, data sharing of derived variables for habitat and hatchery effectiveness assessments will also be addressed. As more information becomes available from this effort, it will be included in future ASMS versions.

Lastly, efforts to improve the data quality collected for monitoring salmon and steelhead are ongoing, such as the work being done under PNAMP’s Integrated Status and Trend Monitoring (ISTM) project. The ISTM[[5]](#footnote-5) project is developing random master sample tool, comparing protocols, and has developed an approach to assure the data quality by using a scoring system tool developed by Rawding & Rodgers that allows documentation and comparison of current monitoring against established priorities.

Basinwide Guidance for the ASMS

Adaptive Management Approach

To successfully achieve the goals and objectives of salmonid mitigation and recovery for the Basin, an adaptive management approach informed by monitoring and evaluation is critical. Adaptive management allows for adjusting future actions based on information gathered about the effect of implementing a previous action (NOAA 2007). Most importantly, given the length and complexity of the salmonid life cycle and the uncertainties involved in improving salmonid survival and status, adaptive management allows for prioritization of alternative strategies for achieving the same effect when there is uncertainty regarding which strategy and action to implement. Monitoring and evaluation data informs adaptive management decision making by providing information on a topic of interest, such as change observed in a habitat limiting factor, that is needed to make decisions about whether a given action should be implemented or modified given the proposed change (Yaffe et al. 2004 cited in NOAA 2007). A basinwide monitoring approach should be built upon an adaptive management framework to iteratively improve the work conducted to mitigate and conserve species and their habitat in a cost-effective manner.

Monitoring Approach and Data Quality

The NOAA Guidance provides recommendations for study design and data quality for conducting VSP, habitat effectiveness, and hatchery effectiveness monitoring. The Ad Hoc Supplementation Monitoring and Evaluation Workgroup (AHSWG) made recommendations for monitoring hatchery effectiveness and is referred to in the NOAA Guidance document. The below guidelines serve to guide the overall ASMS strategy. The approach considers the utility of identifying watersheds that can be sampled more intensively than other watersheds. In these watersheds, there is a clearer analytical path to evaluate action effectiveness and apply adaptive management.

General Viable Salmonids Population

1. Approach

* Intensively Monitored Watersheds (IMW’s):
* Abundance
  + For *at least* one population per life history type (example: adult run-timing; spring vs summer run) per major population group (MPG), funding priority should be given to monitoring adult escapement, with sampling intensity sufficient to detect annual status at a predefined confidence level (precision; as determined by needs for annual management decisions). Choice of candidate watersheds/populations should consider relative population status and recovery goals, representativeness, and coincidence/feasibility of high intensive abundance monitoring for juvenile lifestage.
* Productivity
  + Annual estimates of juvenile and smolt migrants and CI’s for at least one population per MPG. Juvenile and smolt monitoring should be done in intensively monitored watersheds/populations to calculate smolts per female (or smolts per spawner).
  + Estimate on an annual basis the smolt-to-adult survival rate in at least one wild population per MPG and selected hatchery populations.
* For every other population within an MPG (less intensively monitored watersheds)
  + Abundance
    1. adult status and trend data should be collected at lower levels of annual precision or broader levels of spatial or temporal inference (example: 30% precision at 5-year abundance estimate)
    2. The monitoring design for annual abundance and precision of adult escapement (confidence intervals, CI’s) should support scalability for aggregating population estimates (and error terms) to larger spatial scales (e.g., MPG and ESU/DPS)
  + Productivity.
    1. Annual estimates of adult:adult escapement as the metric for total life-cycle productivity and CI’s for each population.
    2. Productivity estimates should report precision (CI’s) that will allow the results to be aggregated at larger spatial scales (e.g., MPG and ESU/DPS).
* .For both intensively and less intensively monitored populations/watersheds
  + Factors for Productivity
    1. For VSP analysis the adult:adult productivity estimate is a higher funding priority than the adult:juvenile (smolt) productivity estimate. However, when evaluating effectiveness of tributary habitat actions, smolt productivity (as an indicator of juvenile survival) is a more direct metric.
    2. Estimate on an annual basis the smolt-to-adult survival rate of fish using different passage routes through the hydrosystem.
    3. The proportion of hatchery-origin spawners (pHOS) among total spawners in each population should be monitored where feasible, at a precision level that can inform effectiveness monitoring and adaptive management. If pHOS cannot be feasibly monitored to this level then alternative methods to assess the hatchery risk should be developed.
    4. Annual estimates of rates for direct harvest and incidental mortality of natural origin adults in mainstem and terminal area fisheries partition by MPG (or population).
* For both intensively and less intensively monitored populations/watersheds
  + Factors for Productivity
    1. For VSP analysis the adult:adult productivity estimate is a higher funding priority than the adult:juvenile (smolt) productivity estimate. However, when evaluating effectiveness of tributary habitat actions, smolt productivity (as an indicator of juvenile survival) is a more direct metric.
    2. Estimate on an annual basis the smolt-to-adult survival rate of fish using different passage routes through the hydrosystem.
    3. The proportion of hatchery-origin spawners (pHOS) among total spawners in each population should be monitored where feasible, at a precision level that can inform effectiveness monitoring and adaptive management. If pHOS cannot be feasibly monitored to this level then alternative methods to assess the hatchery risk should be developed.
    4. Annual estimates of rates for direct harvest and incidental mortality of natural origin adults in mainstem and terminal area fisheries partition by MPG (or population).
* Spatial structure
  + Using probabilistic sampling approach or a randomized geospatially referenced tessellated, conduct periodic surveys of adult and juvenile distribution at the population and/or MPG scale to allow an assessment of the spatial structure and changes.
* Diversity
  + Periodic sampling of populations for genetic diversity. Sample wild populations on a rotating five year basis to maintain genetic baseline for genetic stock identification (GSI) and to evaluate genetic population structure and diversity.
  + Periodic monitoring of population phenotypic diversity (e.g., juvenile outmigration timing, adult run timing, spawn timing, age distribution, age at maturity, fecundity, sex ratio, size and weight).

2. Data Accuracy and Precision

* For spawner abundance, calculate the average coefficient of variation for all adult natural origin spawner databases.
* For spawner abundance, strive to have adult spawner data with a coefficient of variation (CV) on average of 15% or less.
* For productivity, the goal for all populations monitored for juvenile migrant is to have salmon data with a CV on average of 15% or less and steelhead data with a CV on average of 30% or less.
* For spatial distribution, determine whether adults are spawning in all major and minor spawning areas on an annual basis. Develop surrogates for adult spatial distribution in areas where spawning surveys are not feasible.

General Habitat Action Effectiveness

1. Approach

* Using BACI designs when possible to assess fish response to restoration actions.
* Intensively Monitored Watershed (IMW) research should be implemented where cumulative effects of an action or actions are assessed at a population scale through monitoring population productivity and associated habitat conditions. The monitoring sub-framework should ensure that the network of IMWs reflects the variety of habitat action types, ecoregions, species, and life history types.
  + One to two studies should be implemented per habitat action type.
  + Preference should be given to IMW programs that focus on multiple species as they are more cost-effective than single species programs.
* IMW and large-scale habitat status and trend monitoring (below) should include appropriate designs and metrics to detect impacts of climate change.
* Watershed-scale monitoring similar to IMWs, but implemented at a sub-population scale, should be used where a more extensive population level IMW approach is impractical.
* Using probabilistic sampling approach or a randomized geospatially referenced tessellated habitat status/trend monitoring program that incorporates appropriate and coordinated protocols to document changes in physical habitat structure/function due to human manipulation. This includes both restoration and degradation, and natural processes such as floods, fire, and climate change.
* In non-IMW subbasins, coordinate and correlate habitat status/trend monitoring with fish in and fish out monitoring wherever possible
* Project-based monitoring measuring physical and biological effects of individual habitat actions should be implemented at a reach or appropriate scale.
  + Two to three studies should be implemented per category of project type.
* Large scale status and trend monitoring of population productivity and habitat condition should be implemented to assess effects of habitat actions through correlation of productivity change to habitat condition
  + Fish-in and fish-out monitoring with habitat condition monitoring should be implemented for at least one population per MPG.
  + Physical habitat condition trends should be described by high precision monitoring across the Columbia River basin using a probabilistic sampling approach.
* Habitat-fish response models will use the various populations, watershed and project level monitoring to estimate and extrapolate fish and habitat responses expected from various actions.

2. Data Accuracy and Precision

* From the NOAA Guidance document: IMWs should have a power analysis completed early in the project to determine the amount of the watershed required to be treated in order to detect a 30-50% change in fish response.
* From the PNAMP Effectiveness Monitoring Workgroup: See “Evaluation of Effectiveness Monitoring Projects” (Hillman and O’Neal March 2009) at http://www.pnamp.org/node/1770

General Salmonid Hatchery Action Effectiveness

1. Approach

* Conduct critical uncertainty research to help scope the best approach for protecting natural productivity in basins with hatchery releases
* Investigate long-term trends in the abundance and productivity of supplemented populations relative to un-supplemented populations;
* Conduct a series of relative reproductive success studies to quantify short-term impacts; and,
* Implement intensive small-scale studies designed to elucidate various biological mechanisms by which introduction of hatchery-produced fish may influence natural population productivity.
  + The Ad Hoc Supplementation Monitoring and Evaluation Workgroup (AHSWG). Recommendations of the AHSWG include developing a large scale treatment/reference design to evaluate long term trends in the abundance and productivity of supplemented populations. This could be incorporated into a subset of IMW’s that have hatchery programs.
  + This approach could be incorporated into each ESU and DPS containing supplementation hatcheries and should be coordinated across broader geographic scales such as the Pacific Northwest recovery domains, Columbia River and Puget Sound basins.
  + The AHSWG specific recommendations include (Galbreath 2008):Standardized performance measures.
  + Conduct implementation and compliance monitoring on every hatchery program.
  + Determine proportion of hatchery origin spawners and estimate age structure at the MPG or population scale.
  + Implement high intensity hatchery effectiveness monitoring on select supplementation programs with formal study designs.
  + Conduct Relative Reproductive Success (RRS) studies on at least six populations of spring/summer Chinook salmon; at least six populations of steelhead, at least 3 populations of ocean type (summer/fall) chinook salmon and three reintroduced populations throughout the Columbia Basin.
  + Estimate direct harvest estimates of hatchery origin fish in mainstem and terminal area fisheries.
  + Sample sport, tribal, and commercial fisheries in the Columbia and Snake rivers to estimate contribution of each hatchery stock.
  + Integrate and assess hatchery effectiveness results across programs throughout the Pacific Northwest.

2. Data Accuracy and Precision

* Annually determine the percent hatchery origin spawners among total spawers (pHOS) and natural origin spawners (PNOS) for each population changes of ± 5% with 80% certainty.
* Mark 100% of hatchery releases with internal or external marks detectable by standard equipment at fishways, spawning ground surveys, and hatchery racks without sacrificing the fish.
* Strive for larger sampling fraction of the population
* see other guidelines being established by PNAMP under ISTM for fish

Prioritization of Monitoring

In a world of finite resources, choices must be made about what to monitor and with what intensity of efforts. Consideration of data needs for management and policy decision making when designing individual habitat restoration monitoring efforts can help inform the priority and adequacy of the sampling effort. Ultimately, prioritization of monitoring is determined by the managers, and ideally the prioritization process is documented for transparency and repeatability. PNAMP has supported a pilot program for development of integrated monitoring of status and trend (ISTM) that has prioritization principles which could be leverage in the future to inform ASMS prioritization. The ISTM prioritization consists of five steps identified by Rawding et al:

1. Identify and prioritize management decisions, questions, and objectives.

2. Evaluate the extent to which existing programs align with these management decisions, questions, and objectives.

3. Identify the most appropriate monitoring design(s) to inform priority management decisions, questions, and objectives.

4. Use trade-off analysis to develop specific recommendations for monitoring based on outcomes of objectives 1-3.

5. Recommend implementation and reporting mechanisms

Implementation of the ASMS- 2009 and ongoing

The ASMS is implemented through numerous projects funded by Bonneville, CRITFC, NOAA, WDFW, ODFW, IDFG, Confederated Tribes of the Colville Reservation, Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes of the Warm Springs Reservation of Oregon, Nez Perce Tribe, Shoshone-Bannock Tribes, and the Confederated Tribes and Bands of the Yakama Nation. The ASMS, however, is not fully implemented at this stage as limitations of resources require a prioritized approach to its implementation. As a way to move forward, the ASMS should consider coordinating with PNAMP on prioritization concepts and assess the appropriateness of regionally developed tools to enhance monitoring and data sharing, such as produced by the Integrated Status and Trend Monitoring (ISTM) project facilitated by PNAMP and Coordinated Assessment process..

The implementation plan for ASMS related projects is intended to be up-dated at least every 5-years and provides information on the subregional approach to implementing the ASMS guidance, current projects, monitoring gaps and funding prioritization for salmon and steelhead VSP, habitat effectiveness and hatchery effectiveness monitoring projects. The 2009 implementation plan is described in the ASMS version 30062010’s Section 5, Appendices A to E and in the supporting excel tables (available: <http://www.cbfwa.org/ams/FinalDocs.cfm>). More recent update on the monitoring of salmon and steelhead in the Lower Columbia River have applied the ISTM project guidance and tools as a pilot implementation of these under PNAMP (available: <http://www.pnamp.org/project/3132> )

The process of updating the implementation plan should consider these aspects:

1. Five year evaluations by sub-basin managers to evaluate their progress toward the plan with a written report back to the Council on progress, obstacles, and any proposed changes to the basin plan.
2. Council staff develops a combined report that includes all basins and identified obstacles and proposed changes.
3. A basin-wide summit meeting is convened to discuss the report content, its impacts to the anadromous program and a prioritization of any new or altered monitoring proposed.
4. Co-managers develop proposals for funding for ISAB review and consideration.

Bibliography

* NOAA-Fisheries, Northwest Region’s Guidance for Monitoring Recovery of Pacific Northwest Salmon and Steelhead, draft version 12 June 2009. This document provides recommendations on monitoring needs and level of certainty needed for salmonid recovery.
* Available http://www.nwCouncil.org/dropbox/Anadromous%20Monitoring%20Strategy%202009/NOAA%20M&E%20Guidance/Draft-RME-Guidance\_06-12-2009.pdf
* The NOAA Fisheries’ Reasonable and Prudent Alternative Table of Actions for the FCRPS BiOP. This document provides information on the monitoring needs and the targeted performance standards.
* Available http://www.nwCouncil.org/dropbox/Anadromous%20Monitoring%20Strategy%202009/FCRPS%20RPA%20Table/FCRPS%20Biological%20Opinion%20-%20RPA%20Table.pdf
* Beasley et al’s Recommendations for Broad Scale Monitoring to Evaluate the Effects of Hatchery Supplementation on the Fitness of Natural Salmon and Steelhead Populations, Ad Hoc Supplementation Monitoring and Evaluation Work Group. This document provides recommendations for monitoring hatchery supplementation.
* Available http://www.west-inc.com/reports/FinalReportAHSWG.pdf
* Columbia River Basin Fish & Wildlife Program: 2009 Amendments. This document provides general guidelines for monitoring in the Basin as well as outlines the needs to develop a Monitoring Evaluation Research and Reporting Plan (MERR Plan).
* Available: http://www.nwCouncil.org/library/2009/2009-09/Default.asp
* Recommendations for Implementing Research, Monitoring and Evaluation for the 2008 NOAA Fisheries FCRPS BiOp (AA/NOAA/NPCC RM&E Workgroups, June 2009 and May 2010). This document provides recommendations on research, monitoring and evaluation (RM&E) that is needed to meet FCRPS BiOp RM&E Strategies and reasonable and prudent alternatives (RPAs).
* Available: http://www.salmonrecovery.gov/ResearchReportsPublications.aspx
* Collaborative Systemwide Monitoring and Evaluation Project (CSMEP) - Marmorek, D.R., M. Porter, D. Pickard and K. Wieckowski (eds.). 2007. Snake River Basin Pilot Study: Volume 1. Prepared by ESSA Technologies Ltd., Vancouver, B.C. on behalf of the Columbia Basin Fish and Wildlife Authority, Portland, OR. 2007. Collaborative Systemwide Monitoring and Evaluation Project (CSMEP) Snake Basin Pilot Report. Prepared by ESSA Technologies Ltd., Vancouver, B.C. on behalf of the Columbia Basin Fish and Wildlife Authority, Portland, OR. 47 pp.
* Collaborative Systemwide Monitoring and Evaluation Project (CSMEP) - Marmorek, D.R., M. Porter, D. Pickard and K. Wieckowski. 2007. Collaborative Systemwide Monitoring and Evaluation Project (CSMEP) Snake River Basin Pilot Study: Volume 2. Prepared by ESSA Technologies Ltd., Vancouver, B.C. on behalf of the Columbia Basin Fish and Wildlife Authority, Portland, OR. 216 pp.
* U.S. vs Oregon 2008- 2017 Management Agreement. May 2008.

1. Managers in this document refer to the state and federal fish and wildlife agencies and tribes within the Columbia River basin. [↑](#footnote-ref-1)
2. A regional workshop was convened by Bonneville, CBFWA, NOAA and NPCC during October 20-21, 2009 and November 3-5, 2009 in Skamania Washington to develop Basin Coordinated Anadromous Monitoring Strategy. The purpose of the Regional Workshop was to reach agreement among participants on an efficient and effective framework and project specific implementation strategy for anadromous salmon and steelhead monitoring to assess (1) Viable Salmonid Population (VSP) criteria, (2) habitat effectiveness and (3) hatchery effectiveness in the Columbia Basin. The agreed-upon framework and strategy will address the needs of the NPCC’s Fish and Wildlife Program, meet the needs of the Federal Columbia River Power System (FCRPS) BiOp (at a minimum), and contribute to the monitoring needs of ESA recovery planning and other regional fisheries management needs. [↑](#footnote-ref-2)
3. A regional workshop was convened by Bonneville, CBFWA, NOAA and NPCC during October 20-21, 2009 and November 3-5, 2009 in Skamania Washington to develop Basin Coordinated Anadromous Monitoring Strategy. The purpose of the Regional Workshop was to reach agreement among participants on an efficient and effective framework and project specific implementation strategy for anadromous salmon and steelhead monitoring to assess (1) Viable Salmonid Population (VSP) criteria, (2) habitat effectiveness and (3) hatchery effectiveness in the Columbia Basin. The agreed-upon framework and strategy will address the needs of the NPCC’s Fish and Wildlife Program, meet the needs of the Federal Columbia River Power System (FCRPS) BiOp (at a minimum), and contribute to the monitoring needs of ESA recovery planning and other regional fisheries management needs. [↑](#footnote-ref-3)
4. Coordinated Assessments for Salmon and Steelhead. Pacific Northwest Aquatic Monitoring Partnership. Available at: http://www.pnamp.org/project/3129 [↑](#footnote-ref-4)
5. Integrated Status and Trend Monitoring project, this is a pilot effort with uncertain future funding. http://www.pnamp.org/project/3132 [↑](#footnote-ref-5)