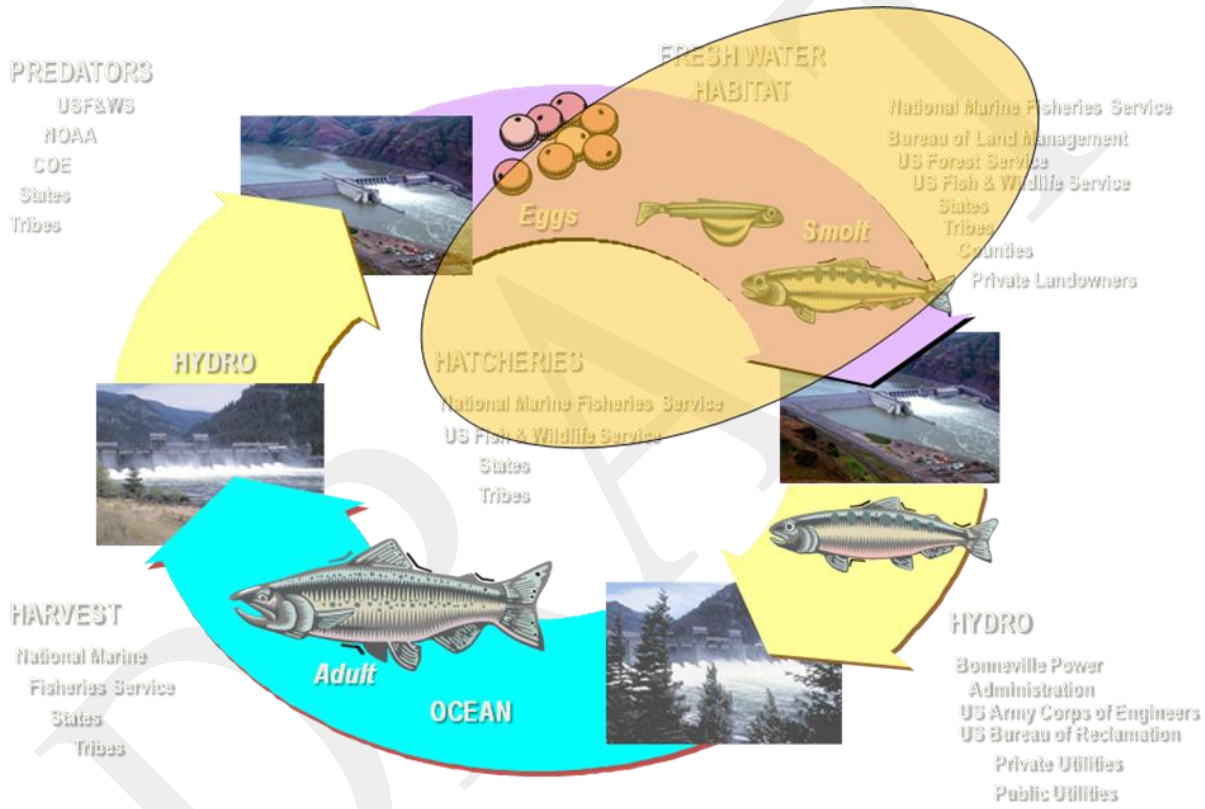
Anadromous Salmonid Monitoring Strategy
Viable Salmonid Population Criteria and Subset of Tributary Habitat and Hatchery Effectiveness



Columbia Basin Coordinated Anadromous Monitoring Workshop

Version 30062010

Table of Contents

1. CONTEXT FOR THE COLUMBIA RIVER BASIN ANADROMOUS SALMONID MONITORING STRATEGY *4*

2. GUIDANCE DOCUMENTS FOR THE DEVELOPMENT OF THE ANADROMOUS SALMONID MONITORING STRATEGY *6*

3. APPROACH FOR DEVELOPING THE COLUMBIA BASIN ANADROMOUS SALMONID MONITORING STRATEGY *8*

4. GENERAL GUIDELINES FOR ANADROMOUS SALMONID MONITORING STRATEGY'S STUDY DESIGN AND QUALITY STANDARDS *10*

4.1. General Viable Salmonid Population **10**

4.2. General Habitat Action Effectiveness **11**

4.3. General Salmonid Hatchery Effectiveness **13**

5. Rationale Guiding Monitoring Approach Decisions Made by each of the four Subregion *14*

5.1. Upper Columbia River Basin **14**

5.2. Mid- Columbia River Basin **15**

5.3. Lower Columbia River Basin **16**

5.4. Snake River **17**

6. BASINWIDE ANADROMOUS SALMONID MONITORING STRATEGY *19*

7. CONCLUSION *20*

8. APPENDIX A: UPPER COLUMBIA RIVER SUB-REGIONAL MONITORING STRATEGY *21*

8.1. Upper Columbia Steelhead MPG Strategy **21**

8.2. Upper Columbia Spring/Summer Chinook MPG Strategy **22**

8.3. Upper Columbia Sockeye MPG Strategy **24**

8.4. Upper Columbia Coho MPG Strategy **24**

9. APPENDIX B: MID-COLUMBIA IVER SUB-REGIONAL MONITORING STRATEGY *25*

9.1. Umatilla-Walla Walla Steelhead MPG Strategy **26**

9.2. John Day Steelhead MPG Strategy **27**

9.3. Yakima Steelhead MPG Strategy **27**

9.4. East Slope Cascades Steelhead MPG: Klickitat River Strategy **28**

9.5. East Slope Cascades Steelhead MPG: White Salmon River Strategy **28**

9.6. East Slope Cascades Steelhead MPG: Deschutes River, Hood River and Fifteenmile Creek Strategy **29**
9.7. Umatilla-Walla Walla Spring Chinook MPG Strategy **30**
9.8. John Day Spring Chinook MPG Strategy **31**
9.9. Yakima Spring Chinook MPG Strategy **31**
9.10. Cascade East Slope Spring Chinook MPG Strategy **32**
9.11. Yakima River Coho MPG Strategy **32**
10. APPENDIX C: LOWER COLUMBIA SUB-REGION MONITORING STRATEGY 34
10.1. Salmon and Steelhead – ODFW and WDFW ISTM Monitoring Guidance Summary **34**
10.2. WDFW Salmon and Steelhead Common Strategy **35**
10.3. ODFW Lower Columbia Steelhead MPG Strategy **36**
10.4. Lower Columbia Spring and Fall Chinook MPG Strategies **38**
10.5. Lower Columbia Coho MPG Strategies **40**
10.6. Columbia River Chum MPG Strategy **42**
11. APPENDIX D: SNAKE RIVER SUB-REGIONAL MONITORING STRATEGY 45
11.1. Snake River Steelhead MPG Strategy **45**
11.2. Snake River Spring-Summer Chinook MPG Strategy **49**
11.3. Snake River Fall Chinook MPG Strategy **52**
11.4. Snake River Sockeye MPG Strategy **53**
12. APPENDIX E: POPULATIONS TARGETED FOR FISH IN/FISH OUT AND HABITAT STATUS AND TREND ***54***
Upper Columbia River Basin Subregion **54**
Middle Columbia River Basin Sub-Region **55**
Lower Columbia River Basin Sub-Region **56**
Snake River Basin Sub-Region **57**
13. APPENDIX F: BASINWIDE ANADROMOUS SALMONID MONITORING STRATEGY FOR VSP, HABITAT EFFECTIVENESS, AND HATCHERY EFFECTIVENESS - CONTRACTS, GAPS, AND FUNDING PRIORITIZATION TABLES *59*

1. CONTEXT FOR THE COLUMBIA RIVER BASIN ANADROMOUS SALMONID MONITORING STRATEGY

The Columbia River Basin (Basin) is the focus of one of the largest and most extensive restoration programs in the world. Considerable efforts by federal, tribal and state fish and wildlife agencies, as well as interstate compacts are focused on actions to increase the abundance of anadromous salmonids. These actions include restoring tributary, mainstem, and estuary habitat, improving passage conditions, using hatcheries to aid in rebuilding some fish runs while supporting harvest, and reducing undesired salmonid predation. All of these actions are being done in a statutorily and ecologically complex setting, underscoring the need to adaptively manage resources to ensure that they are effective.

As partners in the Basin work to mitigate, enhance, and recover anadromous salmonids, it is important to have comprehensive monitoring that provides a foundation to evaluate these efforts, lends transparency to policy decisions, and informs adaptive management. Monitoring should be built upon the adaptive management framework, consisting of these 6-steps: Design, Implement, Assess and Report, Evaluate, and Adjust, to iteratively improve the work conducted to mitigate and conserve species and their habitat in a cost effective manner. The information collected from monitoring should serve to inform and guide decisions addressing basin-wide policy and management questions.

Many federal, state, and tribal programs monitor anadromous salmonids in the Basin. During 2009 federal, state, and tribal fish and wildlife managers collaboratively worked together through a series of sub-regional and regional workshops, collectively referred to as the 2009 Columbia Basin Coordinated Anadromous Monitoring Workshop[1]. The outcome of this collaboration was this coordinated Anadromous Salmonid Monitoring Strategy (ASMS). The focus of the ASMS is to meet the monitoring and adaptive management needs of the Northwest Power and Conservation Council's (NPCC's) Columbia River Basin Fish & Wildlife Program (Program), ESA Recovery Plans, the Federal Columbia River Power System Biological Opinion (BiOp), and federal, state, and tribal fish and wildlife programs in a cost-effective manner. The goal of the ASMS is to provide an efficient and effective monitoring strategy that integrates viable salmonid population (VSP) criteria, habitat effectiveness, and hatchery effectiveness across multiple programs and geographic scales. This goal also serves to partially fulfill the NPCC's Program: 2009 Amendments need to expand a monitoring and evaluation framework to aid in decision-making and in reporting on Program progress. In response to this need the NPCC developed a draft Monitoring Evaluation Research and Reporting Plan (MERR Plan). A component of the MERR Plan is the implementation strategy for anadromous fish, resident fish and wildlife. The

1 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.

ASMS serves to fulfill a component of Anadromous Fish Implementation Strategy for the NPCC's Draft MERR Plan. Several other components of the Anadromous Fish Implementation Strategy remain to be completed such as a monitoring strategy for lamprey.

In developing the ASMS, fish and wildlife manager 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.

Other regional processes that may be incorporated into the ASMS in the future include:

- Hatchery Genetic Management Plans (HGMPs)
- Data Management – Columbia Basin Fish and Wildlife Authority (CBFWA), Pacific Northwest Aquatic Monitoring Partnership (PNAMP), NPCC, Bonneville Power Administration (Bonneville), and CRITFC-lead collaborative process in-development and planned to begin during the summer of 2010. Details on process and timeline will be shared with the region once available.
- Fish Habitat Action Effectiveness metrics - A PNAMP lead Action Effectiveness workshop process which began during May 2010. Contact PNAMP for more details. Recommendations also provided in the revised editions (May or June 2010) of the Action Agencies/NOAA FCRPS Biological Opinion workgroups report posted on http://www.salmonrecovery.gov/Files/BiologicalOpinions/RME%20RPA%20Assessment%20Report%20June%202009%20Draft%20_4_.pdf
- Fish Habitat Status and Trend metrics – A collaborative National Oceanic and Atmospheric Administration-Fisheries (NOAA)-lead and PNAMP-facilitated workshop process that begun in May 2010. Contact PNAMP for more details. Recommendations also provided in the revised editions (May or June 2010) of the Action Agencies/NOAA FCRPS Biological Opinion workgroups report posted on http://www.salmonrecovery.gov/Files/BiologicalOpinions/RME%20RPA%20Assessment%20Report%20June%202009%20Draft%20_4_.pdf Compliance and Implementation monitoring – Bonneville/PNAMP/NOAA workshop, facilitated by PNAMP, that was convened in late 2009. There is ongoing coordination between Bonneville, NOAA, and Pacific Coastal Salmon Recovery Fund state and tribal grantees. Contact PNAMP for more details.
- Tributary research needs – Recommendations provided in the revised edition (June 2010) of the Action Agencies/NOAA FCRPS Biological Opinion workgroups report posted on

http://www.salmonrecovery.gov/Files/BiologicalOpinions/RME%20RPA%20Assessment%20Report%20June%202009%20Draft%20_4_.pdf

- Tributary Habitat Monitoring Approach - a preliminary recommendation from the Integrated Status and Effectiveness Monitoring Program prepared for NOAA-Fisheries and Bonneville Power Authority in 2010 that is entitled: Tributary Habitat Monitoring at the Watershed or Population Scale: preliminary recommendations for standardized fish habitat in the Columbia River Basin and posted on http://www.pnamp.org/sites/default/files/BPA_Habitat_Metrics_Draft_20100601.pdf
- WA Forum - Draft Table of Proposed Protocols/Methods for Recommendation. June 2010. Contact the Washington Forum on Monitoring Salmon Recovery and Watershed Health for updates. Posted on the PNAMP website: http://www.pnamp.org/node/2983
- Mainstem monitoring and research needs - to be determined but will build upon the recommendations provided in the revised editions (May or June 2010) of the Action Agencies/NOAA FCRPS Biological Opinion workgroups report posted on http://www.salmonrecovery.gov/Files/BiologicalOpinions/RME%20RPA%20Assessment%20Report%20June%202009%20Draft%20_4_.pdf
- Estuary monitoring and research needs - to be determined but will build upon the recommendations provided in the revised editions (May or June 2010) of the Action Agencies/NOAA FCRPS Biological Opinion workgroups report posted on http://www.salmonrecovery.gov/Files/BiologicalOpinions/RME%20RPA%20Assessment%20Report%20June%202009%20Draft%20_4_.pdf . This will also be informed by the Estuary Module being developed collaboratively through NOAA's Lower Columbia River ESA recovery planning.
- Hatchery Effectiveness Monitoring Strategy – Action Agencies/NOAA/CBFWA workgroup to recommend how to move forward with implementing the recommendations by the Ad Hoc Supplementation Work Group. Consult the May 2010 or June 2010 revised version of the Action Agencies/NOAA FCRPS Biological Opinion workgroups report that will be posted on http://www.salmonrecovery.gov/Files/BiologicalOpinions/RME%20RPA%20Assessment%20Report%20June%202009%20Draft%20_4_.pdf
- Washington Intensively Monitored Watershed Workshop, in development for 2010, may assist in assessing Intensively Monitoring Watersheds coverage of habitat action types and ecoregion types in Washington, Oregon and Idaho.

Monitoring programs must be transparent and report results in a timely manner. Therefore, these programs require adequate resources for database development and management, analysis, and reporting. This latter requirement is being address through other regional coordination processes mentioned above.

2. GUIDANCE DOCUMENTS FOR THE DEVELOPMENT OF THE ANADROMOUS SALMONID MONITORING STRATEGY

In developing the ASMS several documents providing legal and scientific guidance were incorporated. These include:

- 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.

3. APPROACH FOR DEVELOPING THE COLUMBIA BASIN ANADROMOUS SALMONID MONITORING STRATEGY

The Columbia River Basin is home to many independent populations of anadromous salmonids, and includes populations listed as threatened or endangered as well as non-listed populations. Over 190 extant populations are included in the 13 ESA-listed evolutionarily significant units (ESU) and distinct population segments (DPS). Non-listed ESUs and DPSs include yet-to-be defined populations. Other anadromous species include Pacific lamprey and white sturgeon, which will each be addressed in separate monitoring strategies.

To facilitate development of the ASMS, monitoring strategies were developed for four sub-regions: Snake River, Upper Columbia, Mid Columbia, and Lower Columbia (Figure 1). The Willamette Basin was not included in the ASMS and will need to be addressed in the broader Anadromous Fish Implementation Strategy. Differences among the four sub-regions include number and variety of ESA-listed and non-listed species and populations present (Table 1).

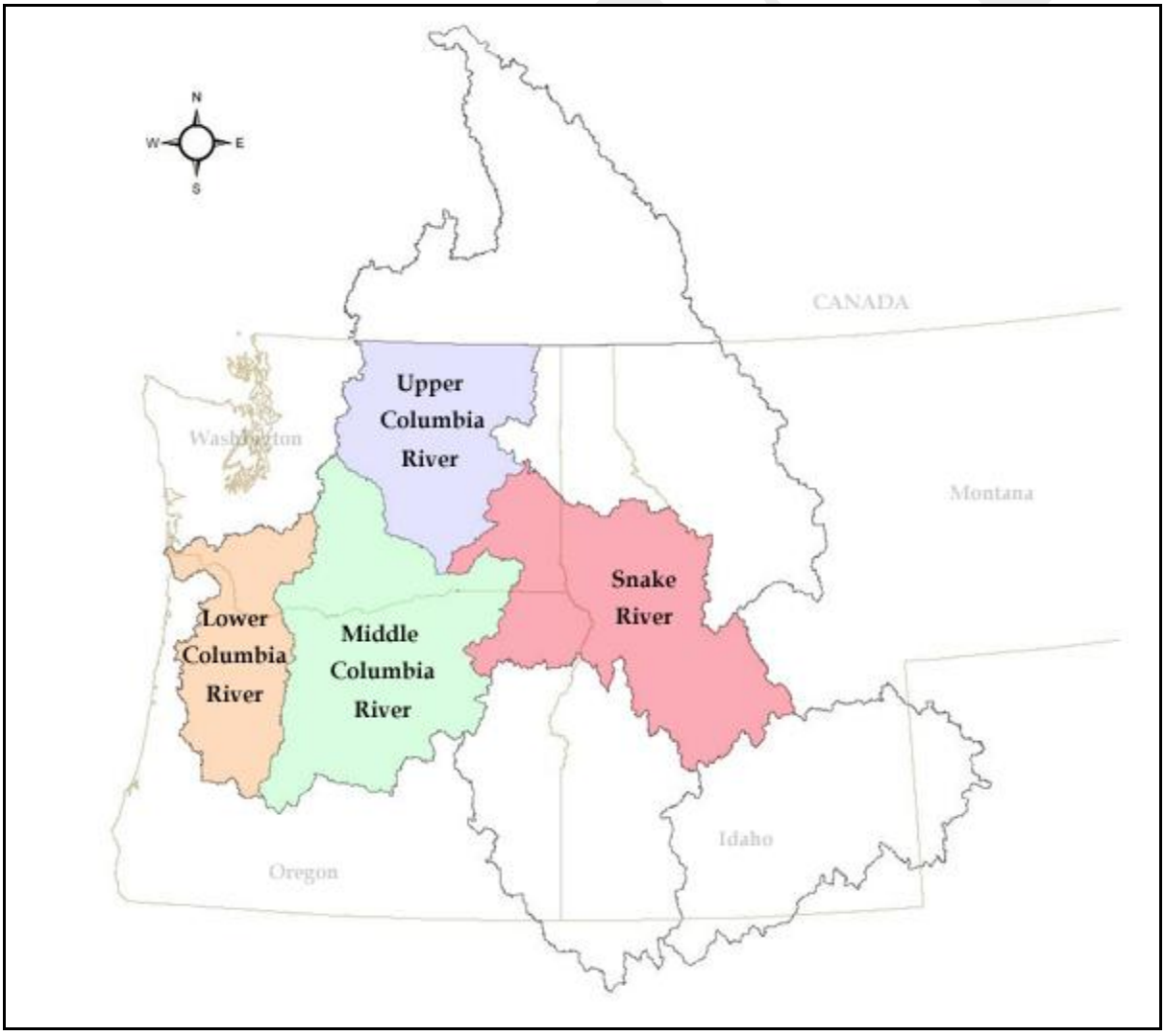


Figure 1. The four sub-regions of the ASMS.

Table 1. ESUs and DPSs by sub-region within the Columbia River Basin.

Sub-region	ESU or DPS	Major Population Groups	Extant Populations[a]
	ESA-listed		
Snake River	Snake River Spring-Summer Chinook	5	31
	Snake River Fall Chinook	1	1
	Snake River Sockeye	1	1
	Snake River Steelhead	5	25
Upper Columbia	Upper Columbia Spring Chinook	1	3
	Upper Columbia Steelhead	1	5
Middle Columbia	Mid Columbia Steelhead	4	19
Lower Columbia	Lower Columbia Chinook	6	32
	Lower Columbia Coho	3	24
	Columbia River Chum	3	17
	Lower Columbia Steelhead	4	23
	Upper Willamette Chinook	1	7
	Upper Willamette Steelhead	1	4
	Non ESA-listed		
Snake River	Clearwater River Spring Chinook	2	6
	Coho	--	--
Upper Columbia	Upper Columbia Summer/Fall Chinook	--	--
	Upper Columbia Sockeye	--	--
	Coho	--	--
Middle Columbia	Middle Columbia Spring Chinook	--	--
	Fall Chinook	--	--
	Coho	--	--
Lower Columbia	Southwest Washington Steelhead	--	--

[a] Population counts may vary depending on categorization of some populations as functionally extirpated.

The four sub-regions collaboratively developed monitoring strategies (Appendices A to D). These four sub-regional monitoring strategies were based on monitoring inventories listing all current monitoring work and comparison tables that illustrated the overlaps and gaps of VSP, habitat effectiveness, and hatchery effectiveness data needs (http://www.cbfwa.org/ams/index.cfm). From these inventories and comparison tables a final

strategy with basin-wide prioritization was developed (Appendix F). The general guidelines for study design and data quality used to develop the four sub-regional monitoring strategies are described in the next section.

4. GENERAL GUIDELINES FOR ANADROMOUS SALMONID MONITORING STRATEGY'S STUDY DESIGN AND QUALITY STANDARDS

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 and were considered when developing the four sub-regional strategies implementing the ASMS (Appendices A to D).

4.1. General Viable Salmonid Population

4.1.1. Monitoring Study Design

To assess population status and trends using the VSP criteria and TRT viability criteria the following general guidelines were considered in the development of each of the four sub-regional strategies. It is important to note that these are suggested guidelines and in some cases may not be applied due to feasibility or the need to increase monitoring for other purposes. The general guidelines are:

- Abundance
    - Annual adult status and trend data should be collected at high intensity monitoring (precision) for *at least* one population per life history type (spring vs summer run) per major population group (MPG). This adult monitoring should be invested in populations with high intensity juvenile and smolt abundance monitoring.
    - Annual adult status and trend data should be collected at lower intensity monitoring for every population within an MPG.
    - The proportion of hatchery-origin fish in each population should be monitored where feasible. If a population cannot be monitored then alternative methods to derive this metric should be developed.
    - Adult monitoring should report abundance and precision (confidence intervals, CI's) on a yearly basis in a manner that will allow abundance (and certainty levels) to be aggregated at larger spatial scales (e.g., MPG and ESU/DPS).
    - Annual estimates of direct harvest and incidental mortality of natural origin adults in mainstem and terminal area fisheries partition by MPG (or population).

- Productivity
    - Annual estimates of adult:adult productivity and CI's for each population.
    - 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

populations with high intensity adult monitoring to calculate smolts per female (or smolts per spawner).
    - 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 VSP analysis the adult:adult productivity estimate is a higher priority than the adult:juvenile (smolt) productivity estimate.
    - Estimate on an annual basis the smolt-to-adult survival rate in at least one wild population per MPG and selected hatchery populations.
    - Estimate on an annual basis the smolt-to-adult survival rate of fish using different passage routes through the hydrosystem.

- Spatial structure
    - 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).

4.1.2. Preferred Quality Standards

Recommendations from the NOAA Guidance document and from the regional workshop that were considered in developing the four sub-regional strategies include:

- 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.

4.2. General Habitat Action Effectiveness

4.2.1. Monitoring Study Design

In general, each of the four sub-regions considered these general study design recommendations when developing their habitat action effectiveness strategy:

- Using BACI designs when possible to assess fish response to restoration actions.

- 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.
- Coordinate and correlate habitat status/trend monitoring with fish in and fish out monitoring wherever possible

Assessing effects of habitat actions on fish will require a combination of several monitoring approaches combined with the use of habitat and fish response models. When developing an assessment approach the below approaches should be considered:

- 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 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.
- 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.

4.2.2. Preferred Quality Standards

Recommendations that may be considered when implementing an IMW monitoring approach within each of the four sub-regions include:

- 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 .

4.3. General Salmonid Hatchery Effectiveness

4.3.1. Monitoring Study Design

Salmonid hatchery programs should assess their effectiveness and adaptively manage to respond to mitigation goals, recovery criteria, and supplementation effectiveness. The four sub-regions considered this three-pronged monitoring approach when developing their strategy:

(1) Investigation of long-term trends in the abundance and productivity of supplemented populations relative to un-supplemented populations;
(2) Conduct a series of relative reproductive success studies to quantify short-term impacts; and,
(3) Implement intensive small-scale studies designed to elucidate various biological mechanisms by which introduction of hatchery-produced fish may influence natural population productivity.

Monitoring hatchery effectiveness should be informed by 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 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.

4.3.2. Preferred Quality Standards

Recommendations from the NOAA Guidance document include:

- Annually determine the percent hatchery origin spawners (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.

5. RATIONALE GUIDING MONITORING APPROACH DECISIONS MADE BY EACH OF THE FOUR SUBREGION

5.1. Upper Columbia River Basin

5.1.1. Rationale

- Assess and maintain population status and trends using VSP criteria and Salmonid Technical Recovery Team (TRT) viability criteria.
- Characterize existing physical habitat related to watershed hydrology and aquatic biotic productivity. Document changes in physical habitat structure/function due to natural processes (climate change) and changes resulting from human manipulation of physical habitat, which includes both degradation and restoration. Validate fish response to habitat changes.
- Assess and adaptively manage hatchery programs to respond to mitigation goals, recovery criteria, and supplementation effectiveness.

5.1.2. Prioritization Criteria

- High precision status and trends in at least one population guideline is being addressed for steelhead within the Upper Columbia River by sampling all populations.
- Habitat effectiveness will be conducted for steelhead within the Upper Columbia River by sampling all populations.
- Determine the hatchery impacts on wild populations of spring Chinook and steelhead throughout the Upper Columbia. This is mostly funded under Habitat Conservation Plan (HCP) and Priest Rapids Coordinating Committee (PRCC).

5.1.3. Approach

Viable Salmon Population Criteria:

- Determine abundance and productivity for all "Primary" populations in the Upper Columbia ESUs with known accuracy and precision.
    - spring Chinook--census redd surveys & carcass recovery
    - steelhead--combination of redd surveys and PIT/Radio tags for mark-recapture validation and bio-data (i.e. origin, age structure, sex ratio)
    - juvenile productivity– smolt traps

- Monitor spatial structure and diversity metrics to provide information for risk assessments consistent with the Interior Columbia Technical Recovery Team (ICTRT) viability criteria.
    - distribution using redd surveys and remote PIT tag arrays
    - phenotypic traits via all of the above (carcasses, broodstock collection, redd surveys, smolt traps) PIT tags allow for refinement and detail not possible with aggregate methods
    - Genotypic diversity through periodic (1-2 generations) sampling within each population.

Habitat Effectiveness Monitoring:

- Habitat Status and Trend (long term, population level, random design)
    - Wenatchee and Okanogan (5-6 yrs of data to-date)
    - Entiat and Methow (proposed)
- Habitat Effectiveness
    - Entiat; IMW experimental design (Reach and Population level)
    - Reach level effectiveness monitoring in the Methow (US Geological Survey /US Bureau of Reclamation)
    - Project/Reach level effectiveness monitoring in the Wenatchee

Hatchery Effectiveness Monitoring:

- Productivity estimated based on Natural Return Ratio (NRR) and abundance that compares treatment (Wenatchee and Methow to un-supplemented reference streams/populations
- Implementing RRS studies in a subset of populations with different Proportionate Natural Influence (PNI) (steelhead)
- Continue RSS for Spring Chinook in Wenatchee long term
- Monitoring for genetic divergence and straying
- Comparing spatial distribution between hatchery and naturally produced fish.

5.2. Mid- Columbia River Basin

5.2.1. Rationale

- Assess and maintain population status and trends using VSP criteria and TRT viability criteria.
- Characterize existing physical habitat related to watershed hydrology and aquatic biotic productivity. Document changes in physical habitat structure/function due to natural processes (climate change) and changes resulting from human manipulation of physical habitat, which includes both degradation and restoration. Validate fish response to habitat changes.
- Assess and adaptively manage hatchery programs to respond to mitigation goals, recovery criteria, and supplementation effectiveness.

5.2.2. Prioritization Criteria

- Focus assessment of habitat action effectiveness where intensive VSP parameter assessments are in place.
- High precision status and trends in at least one population guideline is being addressed for steelhead within the Mid Columbia River by sampling the following populations: Umatilla, Touchet, Middle Fork, South Fork, Toppenish, and Fifteenmile.
- Habitat effectiveness will be conducted for steelhead within the Mid-Columbia River by sampling the following populations: Umatilla, Touchet, Middle Fork, South Fork, Toppenish, and Fifteenmile.

5.2.3. Approach

Viable Salmon Population Criteria:

- Ensure moderate to high precision estimation monitoring approaches are in place for abundance, productivity, spatial structure and diversity. Strengthen salmonid status and trend monitoring in the DPS, improve effectiveness monitoring, and facilitate the implementation of a regionally standardized monitoring and evaluation program.

Habitat Effectiveness:

- Adequately assess habitat status and trends.
- Assess effectiveness of specific habitat *actions* that address key limiting factors.
- Determine the effectiveness of habitat restoration actions and to detect fish response in the IMWs (fish in/fish out).

Hatchery Effectiveness:

- Evaluate the benefits and risks of supplementation by monitoring natural origin abundance, productivity, life history, relative reproductive success and make comparisons of hatchery and natural origin fish**.** Develop a better understanding of origin, abundance and effects of hatchery strays.

5.3. Lower Columbia River Basin

5.3.1. Rationale

- Assess and maintain population status and trends using VSP criteria and TRT viability criteria.
- Characterize existing physical habitat related to watershed hydrology and aquatic biotic productivity. Document changes in physical habitat structure/function due to natural processes (climate change) and changes resulting from human manipulation of physical habitat, which includes both degradation and restoration. Validate fish response to habitat changes.
- Assess and adaptively manage hatchery programs to respond to mitigation goals, recovery criteria, and supplementation effectiveness.

5.3.2. Prioritization Criteria

- Focus assessment of habitat action effectiveness where intensive VSP parameter assessments are in place.
- High precision status and trends in at least one population guideline is being addressed for steelhead within the Lower Columbia River by sampling the Scappoose, Sandy (Cedar Creek) and Hood River populations in Oregon, and the Elochoman, Wind and an additional population to be determined in Washington.
- Habitat effectiveness will be conducted for steelhead within the Lower Columbia River by sampling the Scappoose, Sandy (Cedar Creek) and Hood River populations in Oregon, and the Elochoman, and Wind populations in Washington.

5.3.3. Approach

Viable Salmon Population Criteria:

- Annual surveys of natural and hatchery origin spawner abundance at population scale – facilitates productivity, diversity, & distribution assessment; Annual surveys of juvenile densities and distribution at MPG scale; Life cycle (Fish In/Out) monitoring in at least one sub-watershed per MPG

Habitat Effectiveness:

- Annual Generalized Random Tessellation Stratified (GRTS) based habitat surveys at MPG scale
- Precision & Sample Size Targets - 30% of estimate; 30-40 sites or 30% of sample frame (whichever comes first)
- Effectiveness Monitoring Strategy - Pre- & Post- habitat monitoring at restoration sites; Intensively Monitored Watersheds

Hatchery Effectiveness:

- Segregated and Integrated Programs; coded wire tag (CWT) Program; Relative Reproductive Success; VSP Abundance; Residualism/Ecological Interactions from Juvenile Sampling.

5.4. Snake River

5.4.1. Rationale

- Assess and maintain population status and trends using VSP metrics and TRT viability criteria.
- Characterize existing physical habitat related to watershed hydrology and aquatic biotic productivity. Document changes in physical habitat structure/function due to natural processes (climate change) and changes resulting from human manipulation of physical habitat, which includes both degradation and restoration. Validate fish response to habitat changes.

- Assess and adaptively manage hatchery programs to respond to mitigation goals, recovery criteria, and supplementation effectiveness.

5.4.2. Prioritization Criteria

- Focus assessment of habitat action effectiveness where intensive VSP parameter assessments are in place.
- High intensity life cycle monitoring (adults in, juveniles/smolts out, Smolt-to-Adult Return Ratio) in at least one population per MPG is desired.
- Candidate rivers for high intensity steelhead life cycle monitoring are: Asotin Creek, Upper Grande Ronde River, Imnaha River, Lolo Creek, South Fork Salmon River, Secesh River, Lemhi River.
- Candidate rivers for high intensity Chinook salmon life cycle monitoring are: Tucannon River, Minam River, Imnaha River, Secesh River, Big Creek, Bear Valley Creek, Marsh Creek Complex, Chamberlain Creek, Pahsimeroi River, Upper Salmon River mainstem, and Lolo Creek.
- Candidate rivers for steelhead response to habitat actions are: Asotin Creek, Potlatch River, Upper Grande Ronde River, Catherine Creek, South Fork Salmon River, and Lemhi River.
- Candidate rivers for Chinook salmon response to habitat actions are: Tucannon River, Upper Grande Ronde River, Catherine Creek, South Fork Salmon River, and Lemhi River.
- Implement steelhead hatchery effectiveness monitoring on supplementation programs in the South Fork Clearwater and Lolo Creek.
- Implement Chinook salmon hatchery effectiveness monitoring on select supplementation programs including LSRCP, Northeast Oregon Hatchery, and Johnson Creek. Complete the Idaho Salmon Supplementation Study.
- Conduct implementation and compliance monitoring on every habitat restoration project.

5.4.3. Approach

Viable Salmon Population Criteria:

- Assess population status and trends using VSP metrics and TRT viability criteria of all populations in every MPG.
- For steelhead a two tiered approach is planned. Adult abundance will be estimated at Lower Granite Dam (LGR) using GSI. Results from this method will be compared with abundance estimates obtained from PIT-tagging adults at LGR and subsequent detections at in-stream PIT-arrays in at least two MPG's.
- For Chinook salmon, adult abundance will be estimated at LGR using GSI (MPG level), selected populations using in-stream PIT-arrays, and in all populations using redd surveys.

Habitat Effectiveness:

- Characterize existing physical habitat related to watershed hydrology and aquatic biotic productivity. Document changes in physical habitat structure/function due to natural processes (climate change) and changes resulting from human manipulation of physical habitat, which includes both degradation and restoration. Validate fish response to habitat changes.
- Describe physical habitat condition trends across the entire Snake River basin using a probabilistic sampling approach
- Ensure at least one watershed/population per MPG is monitored across a diversity of ecological regions.

Hatchery Effectiveness:

- Assess and adaptively manage hatchery programs to respond to mitigation goals, recovery criteria, and supplementation effectiveness.
- Implement Supplementation Work Group standardized performance measures for all hatchery programs.
- Determine proportion of hatchery origin spawners and estimate age structure at the MPG or population scale.
- Estimate direct harvest estimates of hatchery origin fish in mainstem and terminal area fisheries.
- Genotype all spawners used in hatchery programs so Parentage Based Tagging (PBT) can be used to identify offspring at any life stage.

6. BASINWIDE ANADROMOUS SALMONID MONITORING STRATEGY

The projects implementing the basin-wide strategy as well as gaps to be addressed and funding prioritization for VSP, habitat effectiveness and hatchery effectiveness monitoring are provided in three final tables (Appendix F). The basin-wide monitoring strategies for steelhead, Chinook, and sockeye found in this appendix are consistent with the guidelines and standards described in the previous sections. Included in these three tables are the list of critical monitoring projects, monitoring strategy statements, prioritized list of monitoring gaps and justification, FCRPS BiOp RPA recommendations[2] to address the monitoring gaps, and prioritized list of current projects to be continued as-is, projects to be modified, and new funding proposals with estimate costs to address the monitoring gaps. A fourth document contains the details for basin-wide funding prioritization for steelhead, Chinook, and sockeye VSP, habitat effectiveness and hatchery effectiveness monitoring.

2 Recommendations for Implementing Research, Monitoring and Evaluation for the 2008 NOAA Fisheries FCRPS BiOp (AA/NOAA/NPCC RM&E Workgroups, May 2010)

7. CONCLUSION

These basin-wide strategies for steelhead, Chinook, and sockeye are meant to be revised as needed to address the monitoring needs for the Basin's ESA listed and non-ESA listed anadromous salmonids. The FCRPS BiOp monitoring priorities identified through the AA/NOAA/NPCC BiOp RM&E Recommendations Report (May 2010) will be updated periodically based on the BiOp Annual and Comprehensive Assessments and associated adaptive management needs. Thus, the ASMS will use versions to denote the most recent strategy. The MERR Plan's Anadromous Fish Implementation Strategy, which will incorporate the ASMS similarly is intended to be revised as needed and not to be treated as a final document.

8. APPENDIX A: UPPER COLUMBIA RIVER SUB-REGIONAL MONITORING STRATEGY

Co-managers that developed the upper Columbia Basin strategy include the Washington Department of Fish and Wildlife (WDFW), Yakama Nation, and Colville Confederated Tribes.

Below is the summary strategy for VSP, habitat action effectiveness and hatchery effectiveness for steelhead, spring-summer Chinook, sockeye, and coho. For more details on the strategies see:

- Additional strategy information provided that is not included in the ASMS such as harvest and hydrosystem (Appendices A-D).
- Populations targeted to receive both habitat status and trend and fish in/ fish out monitoring which will be used to assess habitat action effectiveness on fish (Appendix E).
- Inventory tables of monitoring existing as of 2009 (http://www.cbfwa.org/ams/index.cfm).
- Monitoring priorities (http://www.cbfwa.org/ams/index.cfm).
- Description of monitoring gaps and proposed projects to address these gaps, including gaps for addressing monitoring needs for the FCRPS BiOp as of November 2009 (http://www.cbfwa.org/ams/index.cfm).
- Final master spreadsheet of prioritized projects and associated cost (Appendix F).

8.1. Upper Columbia Steelhead MPG Strategy

8.1.1. Viable Salmonid Population Criteria

- Current strategy for multi-year VSP tracking employs dam counts with spawners parsed out to tributary populations based upon previous radio telemetry studies. Concurrently moving toward annual estimates of adult abundance based on non-random redd surveys based on some measure of precision and accuracy. A variety of approaches varying between full census to index sites. Currently using a variety of approaches until one or more is adopted. Within 3-5 years the co-managers anticipate being able to have a better understanding of which approach is most precise and accurate. They currently use PIT tag arrays to determine PHOS and PNOS.
- Smolt trapping is conducted in all four primary populations. For the most part they enumerate most of the juvenile migrant production in the watersheds.
- The strategy emphasizes the primary populations, but little or no VSP work in smaller tributaries to the Columbia. Distribution estimates rely upon periodic random adult sampling outside of index areas in Wenatchee. The Okanogan is nearly a census survey for adults, and a census is used in the Entiat River.

8.1.2. Habitat Action Effectiveness Monitoring

- The strategy is to use GRTS probabilistic sampling for determining habitat status and trends throughout the Upper Columbia River using Integrated Status and Effectiveness

Monitoring Project (ISEMP) and Okanogan Basin Monitoring & Evaluation Program (OBMEP) as the projects sponsoring this strategy. Aquatic and Riparian Effectiveness Monitoring Program (AREMP) and PACFISH/INFISH Biological Opinion (PIBO) Effectiveness Monitoring Program monitoring has been implemented on Untied States Forest Service (USFS) and US Bureau of Land Management (BLM) lands in the Upper Columbia River for habitat status trends using GRTS probabilistic sampling and remote sensing.

- Conduct water quality and quantity monitoring at appropriate sites for long term status and trend, and effectiveness monitoring. Effectiveness monitoring in upper Columbia is geared toward ISEMP evaluations in the Wenatchee and Entiat. US Bureau of Reclamation (BOR) and US Geological Survey (USGS) effectiveness monitoring in the Methow, and OBMEP effectiveness monitoring in the Okanogan coupled with Washington State Salmon Recovery Funding Board (SRFB) reach scale effectiveness monitoring in selected locations for all the basins co-managers want to identify reference areas and ensure that they are maintained as such and that the monitoring in those areas are continued as a long term data set.
- Conduct monitoring for successful implementation of habitat restoration and protection projects. Make sure the information obtained during monitoring activities are archived in an appropriate data management system. Understand the mortality factors associated with predation and manage predators in a manner consistent with recovery of salmonids and other native species. Quantify and model the relationships between fish productivity and habitat conditions under current and restored scenarios.

8.1.3. Hatchery Effectiveness Monitoring

- Supplementation of Methow, Wenatchee, and Okanogan stocks is needed for both conservation and harvest opportunities. There are no plans at this time to cease supplementation in any of the watersheds based upon AHSWG recommendations. Monitoring for VSP is used to determine hatchery presence. Currently co-managers are using treatment and reference comparisons. The intent is to have reference populations as areas where supplementation is not occurring.
- Relative reproductive success is being tested to determine whether supplemented fish is changing RRS percentage. Kelt reconditioning is being used to increase adult respawners above current rate of 2%. Monitoring will occur at dams and on spawning grounds through PIT tagging.
- Genetic monitoring within and among populations will be conducted every 10 years to detect genetic drift and effective population size.

8.2. Upper Columbia Spring/Summer Chinook MPG Strategy

8.2.1. Viable Salmonid Population Criteria

- WDFW and the tribes estimate adult abundance based on census redd surveys. They would like to develop estimates of precision and accuracy. Use carcass recovery to determine PHOS and PNOS.

- Smolt traps are operated in all three primary populations. For the most part they enumerate most of juvenile migrant production in the watersheds.
- Distribution estimates rely upon adult redd counts in Wenatchee, Entiat and Methow. Juvenile spatial structure uses PIT tag arrays and other methods such as snorkeling. ISEMP uses EMAP approach to juvenile distribution and abundance in Wenatchee and Entiat.

8.2.2. Habitat Action Effectiveness Monitoring

- The strategy is to use GRTS probabilistic sampling for determining habitat status and trends throughout the Upper Columbia River using ISEMP and OBMEP as the projects sponsoring this strategy. AREMP and PiBO implemented on USFS and BLM lands in Upper Columbia River for habitat status trends using GRTS probabilistic sampling and remote sensing.
- Habitat effectiveness monitoring strategy focuses on the Entiat as the location for restoration actions and monitoring of fish response. BOR is proposing to evaluate projects in the Methow for effectiveness. ISEMP is also looking at Wenatchee for action effectiveness monitoring for specific sites. Okanogan and Wenatchee are using a basin-wide approach to monitoring fish in and out in relation to cumulative restoration actions.
- They are conducting water quality and quantity monitoring at appropriate sites for long term status and trend, and effectiveness monitoring.
- They are conducting monitoring for successful implementation of habitat restoration and protection projects. Make sure the information obtained during monitoring activities are archived in an appropriate data management system.
- Co-managers would like to understand the mortality factors associated with predation and manage predators in a manner consistent with recovery of salmonids and other native species.

8.2.3. Hatchery Effectiveness Monitoring

- Co-managers intend to continue supplementation of Methow, Wenatchee, and Okanogan for both conservation and harvest opportunities.
- Monitoring for VSP is used to determine hatchery presence.
- Co-managers are currently using treatment and reference comparisons for experimental design.
- Intent is to have reference populations as areas where supplementation is not occurring.
- Relative reproductive success is being tested to determine whether supplemented fish is changing RRS percentage in Wenatchee.
- Genetic monitoring within and among populations every 10 years to detect genetic draft and effective population size.

8.3. Upper Columbia Sockeye MPG Strategy

8.3.1. Viable Salmonid Population Criteria

- Adult enumeration on Okanogan through dam counts followed up with live and carcass counts on the spawning grounds.
- Okanogan juvenile enumeration done through hydroacoustic sampling by Canadian Department of Fisheries and Oceans.
- In Wenatchee adult enumeration is completed at Tumwater Dam. PIT tags are inserted at the dam to determine percent distribution of spawners to upriver tributaries.
- Smolt trap operated at outlet to Lake Wenatchee to determine total smolt outmigration.

8.3.2. Habitat Action Effectiveness Monitoring

- No specific strategy identified at this time.

8.3.3. Hatchery Effectiveness Monitoring

- No specific strategy identified at this time.

8.4. Upper Columbia Coho MPG Strategy

8.4.1. Viable Salmonid Population Criteria

- Rely upon redd counts and compare with dam counts at major dams.
- Juveniles enumerated at smolt traps.

8.4.2. Habitat Action Effectiveness Monitoring

- Habitat being monitored as part of other accord projects but not specific to coho.

8.4.3. Hatchery Effectiveness Monitoring

- Currently developing local broodstock. Intend to use natural production phase by monitoring PNOS and PNI

9. APPENDIX B: MID-COLUMBIA IVER SUB-REGIONAL MONITORING STRATEGY

Co-managers that developed this strategy include: the Yakama Nation, the Confederated Tribes of the Warms Springs Indian Reservation of Oregon (CTWSRO), the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), WDFW, and the Oregon Department of Fish and Wildlife (ODFW). Below is a summary of co-managers involved in monitoring the different MPGs in this strategy:

- Umatilla-Walla Walla steelhead MPG – Populations are co-managed by the CTUIR, WDFW, and ODFW. The Walla Walla Salmonid Monitoring and Evaluation Project is a collaborative project conducted by CTUIR and WDFW and will include ODFW in the future.
- John Day steelhead MPG – Populations are managed by ODFW and the CTWSRO.
- Yakima steelhead MPG - The Yakama watershed is co-managed by the Yakama Nation and WDFW. The Yakima Klickitat Fisheries Project (YKFP) is a collaborative effort between the Yakama Nation and WDFW that conducts extensive research and monitoring in the Yakima Basin.
- East Slope Cascades steelhead MPG – The Klickitat River population is co-managed by the Yakama Nation and WDFW. The Deschutes River, Hood River and Fifteenmile Creek populations are co-managed by ODFW and the CTWSRO.
- Spring-Summer Chinook- The Walla Walla Salmonid Monitoring and Evaluation Project is a collaborative project conducted by CTUIR and WDFW and will include ODFW in the future

Below is the summary strategy for VSP, habitat action effectiveness and hatchery effectiveness for steelhead, spring-summer Chinook, and coho. For more details on the strategies see:

- Additional strategy information provided that is not included in the ASMS such as harvest and hydrosystem (Appendices A-D)
- Populations targeted to receive both habitat status and trend and fish in/ fish out monitoring which will be used to assess habitat action effectiveness on fish (Appendix E)
- Inventory tables of monitoring existing as of 2009 (http://www.cbfwa.org/ams/index.cfm)
- Monitoring priorities (http://www.cbfwa.org/ams/index.cfm)
- Description of monitoring gaps and proposed projects to address these gaps, including gaps for addressing monitoring needs for the FCRPS BiOp as of November 2009 (http://www.cbfwa.org/ams/index.cfm)
- Final master spreadsheet of prioritized projects and associated cost (Appendix F).

9.1. Umatilla-Walla Walla Steelhead MPG Strategy

9.1.1. Monitoring Summary

Maintain moderate to high precision estimation monitoring approaches that are currently in place for abundance, productivity, spatial structure and diversity.

- The Walla Walla Salmonid Monitoring and Evaluation Project is funded per the 2008 Columbia Basin Fish Accords. This collaborative project is conducted by CTUIR and WDFW and will include ODFW in the future. The purpose of this study is to strengthen salmonid status and trend monitoring in the basin, improve effectiveness monitoring, and facilitate the implementation of a regionally standardized monitoring and evaluation program. Study objectives are to monitor and evaluate salmonid viability, survival and productivity (VSP) in areas of the Walla Walla, Touchet, and Mill Creek drainages. This project estimates adult returns, spawning abundance and smolt production to describe stock status to and trends in relation to VSP needs.

9.1.2. Viable Salmonid Population Criteria

- Maintain VSP information obtained at 3 mile dam for Umatilla adult abundance
- Conduct tributary redd counts to detect spawner distribution.
- Have annual smolt abundance estimates and calculate natural origin Smolt-to-Adult Return Ratio (SAR) for the Umatilla basin to have freshwater productivity data. This is the only mid Columbia steelhead data for productivity and survival rate.
- Diversity information obtained at 3 mile dam and genetic monitoring sampled periodically from juveniles. Adults sampled during broodstock collections.

9.1.3. Habitat Action Effectiveness Monitoring

- Implement habitat monitoring to adequately assess status and trends and evaluate overall habitat actions.
- Determine effectiveness of specific habitat actions unique to the Umatilla limiting factors.

9.1.4. Hatchery Effectiveness Monitoring

- Supplement the Umatilla River steelhead and evaluate the response and compare hatchery and natural origin response. Provide fish for tribal and recreational fisheries
- Continue to evaluate the benefits and risks of supplementation by monitoring natural origin abundance, productivity, life history, and make comparisons of hatchery and natural origin fish and compare Umatilla productivity with John Day natural populations**.**

9.2. John Day Steelhead MPG Strategy

9.2.1. Viable Salmonid Population Criteria

- Maintain ongoing extensive IMW monitoring of Middle Fork and South Fork natural populations
- Improve monitoring of VSP in the other three populations
- Determine potential effects of out of basin straying of hatchery fish on the John Day Populations.
- Improve the information on VSP spatial structure and diversity criteria.
- Maintain ongoing life stage specific survival (e.g., SAR) monitoring for future TRT evaluations.

9.2.2. Habitat Action Effectiveness Monitoring

- Determine the effectiveness of habitat restoration actions within the John Day basin and to detect fish response in the IMWs within the basin.
- Maintain the South Fork as a reference stream for actions in the Middle Fork and Bridge Creek.

9.2.3. Hatchery Effectiveness Monitoring

- Develop better understanding of origin and abundance of hatchery strays in John Day.

9.3. Yakima Steelhead MPG Strategy

9.3.1. Viable Salmonid Population Criteria

- Maintain existing facilities and counts at Chandler and Roza and monitoring component of the Yakama watersheds program and monitoring associated with kelt reconditioning program.
- Explore the potential to PIT tag all handled adults. There may be logistic and permitting issues.
- Build Genetic stock ID capability - Finalize baseline; conduct power analysis/define required sample of run, collect representative sample of MPG at Prosser (will require spring denil samples) and use genetics to make population-specific adult abundance estimates. Adult tracking: Radio-track fish sampled at Prosser to spawning to determine holding patterns, spawning locations and potentially pre-spawn mortality. Use data to ground-truth genetic-based pop estimates; only required on a periodic basis
- Spatial Distribution - Install PIT tag arrays strategically throughout basin. Maintain existing redd surveys in Satus, Toppenish and Ahtanum watersheds; improve distribution info in the Naches basin (maintain/expand redd surveys, periodic aerial survey & tagging studies and Upper Yakima (implement limited redd surveys if feasible; use tagging capacity at Roza and detectors in tributaries to track distribution). Address an estimate of

one population within the Yakima by providing fish in and fish out in Toppenish Creek with exploration of possible future IMW watershed.

- Juvenile productivity - Improve estimates of juvenile productivity for all populations through improvement of smolt enumeration at Chandler, maintain and increase tributary screw traps and PIT-tagging. Understand resident and anadromous steelhead (O*ncorhynchus. mykiss*) relationships.
- Understand factors limiting out migrating smolts in mainstem.

9.4. East Slope Cascades Steelhead MPG: Klickitat River Strategy

9.4.1. Klickitat River – Washington's Viable Salmonid Population Criteria

- Strategy is to continue estimating VSP adult abundance using mark-recapture population estimates via Floy tagging at Lyle Falls adult trap.
- VSP juvenile out-migrant abundance and productivity will rely on development of rotary screw traps.
- Spatial distribution of spawners is monitored via ongoing redd surveys.
- Ongoing genetic sampling and analysis of returning adults is occurring at Lyle Falls adult trap. This sampling has identified subpopulation structure and relative contributions of various spawning tributary habitats.
- PIT tagging of wild and hatchery juveniles is planned for near future (at screw traps and Skamania Hatchery) for SAR estimates.
- PIT tagging of wild juveniles in White Creek watershed (major spawning tributary), along with an instream reader in lower White Creek, is occurring to determine migration patterns, survival, and habitat project effectiveness.
- Some genetic sampling of juveniles has occurred, more could occur in near future.
- PIT tag detection will be built in with planned improvements at Lyle and Castile Falls.
- Radio telemetry monitoring will be occurring soon to determine hatchery vs. wild spawning distribution, winter vs. summer spawning distribution, passage problems.

9.4.2. Klickitat River – Washington's Habitat Action Effectiveness Monitoring

- No specific strategy identified at this time.

9.4.3. Klickitat River – Washington's Hatchery Effectiveness Monitoring

- No specific strategy identified at this time.

9.5. East Slope Cascades Steelhead MPG: White Salmon River Strategy

- Existing habitat conditions and fish populations within the White Salmon River subbasin are to be measured in preparation for salmon and steelhead reintroductions above Condit Dam and before major habitat restoration related to their reintroduction.

- Information regarding the existing salmonid stock composition is needed to make decisions regarding the appropriate strategies for reintroduction.
- This project is a multi-agency effort designed to assess the abundance, spatial structure, and genetics of adult and juvenile salmon and steelhead below Condit Dam and the fish habitat and characteristics of resident salmonids above Condit Dam.

9.6. East Slope Cascades Steelhead MPG: Deschutes River, Hood River and Fifteenmile Creek Strategy

9.6.1. Deschutes River, Hood River and Fifteenmile Creek Strategy – Oregon's Viable Salmonid Population Criteria

- The VSP strategy is to sustain tributary weir trapping and counting at Buckhollow and Bakeoven creeks in the Deschutes for adult abundance.
- Estimate abundance of spawners in the mainstem Deschutes only.
- Determine spatial distribution through radio tagging and tributary weirs.
- Shearers Falls is used as adult abundance counting for natural and hatchery fish for nearly 100% of basin.
- Part of strategy is to be able to know what proportion remain in Deschutes and those that fall back.
- Determine the impact and percentage of resident rainbow to overall production. Determine origin, distribution, and abundance of main-stem spawners in the Deschutes
- Proposed smolt monitoring strategy focuses on collecting migrant data in tributaries at Bakeoven, Warm Springs, Shitike, Buckhollow and Trout Creek tributary where primary spawning takes place.
- Information on life history diversity relies upon old sampling. The desired strategy is to obtain annual age structure and PHOS from adult trapping proposed. Juvenile information would be collected from proposed and ongoing smolt traps.
- Ongoing GSI project should provide important genetic diversity information.
- Current strategy is to determine the change in distribution and abundance/productivity of steelhead based upon reintroductions into previously empty habitat where recovery requires re-establishing production in the unoccupied area of westside population.
- Assess abundance and hatchery proportion of natural spawners.

9.6.2. Deschutes River, Hood River and Fifteenmile Creek – Oregon's Habitat Action Effectiveness Monitoring

- CTWSRO monitors habitat status/trends on the reservation using full census of riparian habitat
- ODFW intent is to extend habitat status/trend data throughout the MPG. Collective impacts of habitat treatments are being evaluated through some project specific monitoring, that looks at changes in limiting factors in the basin and paired with fish response.

9.6.3. Deschutes River, Hood River and Fifteenmile Creek – Oregon's Hatchery Effectiveness Monitoring

- Use the hatchery program as a tool for reintroducing steelhead into unoccupied Westside Deschutes area and Crooked River. Continue harvest augmentation and mitigation roles.
- Assess the success of reintroducing and developing sustained and natural production above the Pelton-Round Butte complex through monitoring of adult and juvenile hatchery production and natural production.
- Mark all hatchery fish and determine the impact of stray hatchery fish on VSP.

9.7. Umatilla-Walla Walla Spring Chinook MPG Strategy

9.7.1. Monitoring Summary

- The Walla Walla Salmonid Monitoring and Evaluation Project is funded per the 2008 Columbia Basin Fish Accords. The purpose of this study is to strengthen salmonid status and trend monitoring in the basin, improve effectiveness monitoring, and facilitate the implementation of a regionally standardized monitoring and evaluation program. Study objectives are to monitor and evaluate salmonid viability, survival and productivity (VSP) in areas of the Walla Walla, Touchet, and Mill Creek drainages. This project estimates adult returns, spawning abundance and smolt production to describe stock status to and trends in relation to hatchery and habitat treatments.
- Maintain moderate to high precision estimation monitoring approaches that are currently in place for abundance, productivity, spatial structure and diversity.
- CTUIR: Continue VSP monitoring for Umatilla River Spring Chinook.

9.7.2. Viable Salmonid Population Criteria

- Video adult and hatchery/wild enumeration at Nursery Bridge Dam (Walla Walla), Bennington Dam (Mill Creek).
- On the Touchet - Dayton weir counts.
- If spring Chinook are enumerated at weir then census redd counts.
- Pit tags natural smolts at 5 rotary traps, four in tribs and one in Lower Walla Walla
- Maintain basin-wide pit tag array network in the nine locations.
- Monitor and evaluate success of re-establishing sustained natural production in the Umatilla River Basin.

9.7.3. Hatchery Effectiveness Monitoring

- In next two to three years implement Umatilla bio-monitoring project. Project includes salmonid production and macros with reach level habitat monitoring to be determined.

9.8. John Day Spring Chinook MPG Strategy

9.8.1. Viable Salmonid Population Criteria

- Maintain ongoing extensive IMW monitoring of MF natural population. Improve monitoring of VSP in the other two populations. Maintain complete census surveys of adult spawners and redds in each of the John Day populations.
- Improve the information on VSP spatial structure and diversity criteria.
- Maintain ongoing life stage specific survival (e.g., SAR) monitoring for future TRT evaluations. Continue PIT tagging of smolts for Comparative Survival Study (CSS). Initiate a trapping and tagging effort for the North Fork population. Maintain current juvenile and smolt abundance and life history studies to estimate freshwater productivity as smolts per spawner.

9.8.2. Habitat Action Effectiveness Monitoring

- Determine the effectiveness of habitat restoration actions within the John Day Subbasin and to detect fish response in the IMWs within the basin.

9.8.3. Hatchery Effectiveness Monitoring

- Develop a better understanding of the origin and abundance of hatchery strays in the John Day.

9.9. Yakima Spring Chinook MPG Strategy

9.9.1. Viable Salmonid Population Criteria

- Adult abundance: Video monitoring at Prosser , >95% of fish counted (high water conditions and equipment problems sometimes preclude counts); trapping and enumeration of 100% of return at Roza (including hatchery and wild proportions so PNI is known); comprehensive redd counts and harvest monitoring.
- Juvenile abundance: subsampling at Roza and Chandler; working to develop total and subpopulation outmigration estimates with confidence intervals using flow/entrainment expansions and DNA sampling.
- Productivity: Adult to adult productivity known with high confidence for Upper Yakima; medium to high confidence for Naches/American. Juvenile (smolt to adult) productivity being developed (see previous bullet) – presently aggregate estimates are developed with medium to low confidence using PIT tag data and Chandler juvenile and river mouth adult estimates. Relative reproductive success studies are ongoing In both the Cle Elum Hatchery spawning channel and using Roza DNA samples.
- Spatial Distribution: comprehensive redd counts by Yakama Nation (YN) and NOAA. This includes use of global positioning system (GPS) for collecting redd data in Upper Yakima, census ~2002.

- Diversity: Genetic (Upper Yakima) is monitored with DNA samples at Roza; Biological is monitored through physical samples from Roza trap and spawner carcass surveys – good size-at-age and sex composition data.

9.9.2. Habitat Action Effectiveness Monitoring

- Many projects have been implemented; effectiveness monitoring will be part of overall project analysis.

9.9.3. Hatchery Effectiveness Monitoring

- PNI is known; comprehensive monitoring program is in place.

9.10. Cascade East Slope Spring Chinook MPG Strategy

9.10.1. Washington's Viable Salmonid Population Criteria

- Klickitat mark-recapture population estimates (for returning adults) are available for recent years (via Floy tagging at Lyle Falls adult trap).
- Klickitat juvenile outmigration estimates still under development (rotary screw traps). Klickitat spatial distribution of spawners monitored via redd surveys.

9.10.2. Washington's Hatchery Effectiveness Monitoring

- Ongoing genetic sampling and analysis of Klickitat returning adults is occurring at Lyle Falls adult trap and Klickitat Hatchery.
- PIT tagging is occurring for Klickitat Hatchery juveniles to provide SAR estimates. PIT tagging of Klickitat wild juveniles is planned for near future (at screw traps) for SAR estimates. Klickitat PIT tag detection will be built in with planned improvements at Lyle and Castile Falls.
- Klickitat Radio telemetry monitoring occurring soon to determine hatchery vs. wild spawning distribution, passage problems.

9.11. Yakima River Coho MPG Strategy

9.11.1. Monitoring Summary

- Restoration program using combination of local and out-of-basin hatchery-origin brood and releasing fish at various life stages including adult, parr, and pre-smolt from various tributaries and acclimation sites above the confluence of the Naches and Yakima Rivers.

9.11.2. Viable Salmonid Population Criteria

- Adult abundance - Video monitoring at Prosser (hatchery- and natural-origin recorded from marks), >95% of fish counted; redd counts
- Juvenile abundance - subsampling at Roza and Chandler; working to develop outmigration estimates with confidence intervals using flow/entrainment expansions
- Productivity - Adult to adult productivity for natural-origin fish known with medium-high confidence since ~2000. Juvenile (Chandler smolt to Prosser adult) productivity being developed (see previous bullet) – presently estimates are developed with medium to low confidence using PIT tag data.
- Spatial Distribution - redd surveys by Yakama Nation, targeting areas of release and known spawning areas; some telemetry work
- Diversity - DNA collected from sub-sample at Prosser Denil; Biological is monitored through physical samples from Prosser Denil trap and spawner carcass surveys.

9.11.3. Habitat Action Effectiveness Monitoring

- Many projects have been implemented; effectiveness monitoring will be part of overall YKFP project analysis.

9.11.4. Hatchery Effectiveness Monitoring

- Hatchery- and natural-origin escapement and use in local brood stock is known

10. APPENDIX C: LOWER COLUMBIA SUB-REGION MONITORING STRATEGY

The WDFW and the ODFW conduct monitoring in somewhat different ways. Therefore this strategy is divided along those lines where each bank of the lower Columbia is described separately. However, the PNAMP Integrated System Monitoring program now ongoing is an attempt to combine the two approaches into one holistic approach that can resolve some of the differences.

Below is the summary strategy for VSP, habitat action effectiveness and hatchery effectiveness for steelhead, spring and fall Chinook, coho, and chum in the sub-region. For more details on the strategies see:

- Additional strategy information provided that is not included in the ASMS such as harvest and hydrosystem (Appendices A-D).
- Populations targeted to receive both habitat status and trend and fish in/ fish out monitoring which will be used to assess habitat action effectiveness on fish (Appendix E).
- Inventory tables of monitoring existing as of 2009 (http://www.cbfwa.org/ams/index.cfm).
- Monitoring priorities (http://www.cbfwa.org/ams/index.cfm).
- Description of monitoring gaps and proposed projects to address these gaps, including gaps for addressing monitoring needs for the FCRPS BiOp as of November 2009 (http://www.cbfwa.org/ams/index.cfm).
- Final master spreadsheet of prioritized projects and associated cost (Appendix F).

10.1. Salmon and Steelhead – ODFW and WDFW ISTM Monitoring Guidance Summary

- ISTM Statement - The goal of the Integrated Status and Trends Monitoring (ISTM) project is to develop a coordinated VSP monitoring program that addresses key regional monitoring questions and to develop study designs of sufficient quality and quantity to determine the status of Lower Columbia River salmon and steelhead. In this process we will provide entities tasked with monitoring fish populations with a roadmap of the steps needed to develop an integrated, scientifically sound monitoring program that meets the needs of regional decision makers and managers. The objectives include:
    - Identify and prioritize decisions, questions, and objectives;
    - Evaluate extent to which existing programs align with these decisions, questions, and objectives;
    - Identify most appropriate monitoring design to inform priority decisions;
    - Use trade off analysis to develop specific recommendations for monitoring based on outcomes of objectives 1-3 and;
    - Recommend implementation and reporting mechanisms. The result of this project for application by ODFW and WDFW to current monitoring approaches is projected for 2011.

- The Lower Columbia River Fish Recovery Board plans to integrate the recovery planning process results into their study.

10.2. WDFW Salmon and Steelhead Common Strategy

10.2.1. Viable Salmonid Population Criteria

- Maintain and modify VSP monitoring to meet recovery plans, management needs, address critical uncertainties, and support integrated status and trends monitoring program.
- Washington has a statewide monitoring strategy for listed salmon and steelhead recovery. Strategy includes juvenile and adult abundance for one primary population per MPG associated with habitat evaluations.
- Lower Columbia Fish Recovery Board has a monitoring plan associated with the Recovery Plan that is being implemented.
- Adult abundance is estimated mostly using redd surveys with a few weirs, and mark-recapture programs.
- Adult productivity is determined by cohort analysis from sex ratio, origin, and age-structure of spawners from traps on Cowlitz, Toutle, Kalama, Lewis, and Wind.
- Wild steelhead release for all Lower Columbia River fisheries but impacts are not monitored. Juvenile productivity is estimated from one primary population per strata (Coast= Grays, Cascade= Coweeman, and Gorge= Wind) but is complicated by the inability to distinguish winter and summer steelhead smolts in the Wind, and the Wind is a subpopulation of the Upper Gorge population.
- Juvenile productivity is also estimated from IMW project, Cowlitz Falls juvenile sampling is for aggregate, and Mayfield trap efficiency is over 40 yrs old.
- Adult spatial distribution is monitored for high use areas and periodically for lower use areas.
- Adult diversity is monitored by spawning time from redds. VSP monitoring should be consistent with NOAA monitoring guidance. WDFW is participating in the ISTM project and will to the extent practical implement recommendations obtained from that project.

10.2.2. Hatchery Effectiveness Monitoring

- Maintain and modify hatchery programs to meet recovery plans, mitigation requirements, and address critical uncertainties, and support integrated status and trends monitoring program.
- WDFW is implementing hatchery reforms based on the recommendation of the Hatchery Scientific Review Group (HSRG).
- Hatchery monitoring should be consistent with NOAA monitoring guidance
- WDFW is participating in the ISTM project and will to the extent practical implement recommendations obtained from that project.

10.2.3. Habitat Action Effectiveness Monitoring

- Develop habitat monitoring program to support an integrated status and trends monitoring program, which includes a component to validate fish response to habitat restoration.
- An IMW was implemented in the Lower Columbia in 2003 and is now having habitat restoration treatments. This IMW should be continued until results are available. Funding is through the NOAA-Pacific Coastal Salmon Recovery Fund (PCSRF) and Washington Salmon Recovery Funding Board (SRFB).
- Habitat monitoring should be consistent with NOAA monitoring guidance.
- WDFW is participating in the ISTM project and will to the extent practical implement recommendations obtained from that project.

10.2.4. Hydrosystem Monitoring

- Maintain and modify hydro monitoring programs that estimate adult and juvenile survival, collection efficiencies, address critical uncertainties, and to validate fish responses to hydro improvements. Includes mainstem Columbia River dams, and Cowlitz, Lewis, and White Salmon River dams.
- Hydro monitoring should be consistent with NOAA monitoring guidance
- WDFW is participating in the ISTM project and will to the extent practical implement recommendations obtained from that project.

10.2.5. Data Management and Access

- Maintain, modify, and standardize secure web accessible databases for integration, analysis, and reporting.
- Database development and management should be consistent with NOAA monitoring guidance.
- WDFW is participating in the ISTM project and will to the extent practical implement recommendations obtained from that project.

10.3. ODFW Lower Columbia Steelhead MPG Strategy

10.3.1. Viable Salmonid Population Criteria

- ODFW will conduct GRTS-based redd surveys for annual spawner abundance estimates in each of the four populations within the Coast MPG with a precision of $\pm$ 30% or better (not currently funded). Surveys will also provide information on productivity, distribution, and some aspects of diversity (primarily spawn timing).
- Counts of fish passed above existing fish passage/counting facilities (Lewis & Clark River Vaki counter and North Fork Klaskanine hatchery weir, Big Creek hatchery weir, North Fork Scappoose Bonnie Falls fish ladder) and potentially new adult trapping/fish counting facilities (Clatsop Economic Development Council, hatchery water diversion

weir on South Fork Klaskanine, fish ladder at RM 10 Clatskanie River) to obtain census-based steelhead escapement estimates that could, given appropriate funding, be compared to separate GRTS-based surveys above these census locations to evaluate the accuracy of GRTS-based surveys for spawning steelhead. These sites could also be used to obtain genetic and other diversity information that requires fish handling.

- GRTS-based snorkel surveys at the MPG scale to provide annual estimates of an index of abundance (density) of juvenile steelhead. Data from these surveys can also be used to evaluate aspects of productivity (juveniles density per spawner density), and distribution.
- In at least one sub-watershed in the Coast MPG (currently North Fork Scappoose), ODFW traps adults in and juveniles out to provide estimates of marine and freshwater productivity (i.e. Life Cycle Monitoring sites).
- Due to poor water clarity as a result of glacial till, the accuracy of GRTS-based spawning surveys is questionable in a considerable portion of the range of steelhead within the Hood population area. After the removal of Powerdale Dam a temporary floating weir and trap is proposed for East Fork Hood River. This trap will provide estimates of winter steelhead escapement, hatchery fraction, and other diversity metrics for a substantial portion of the Hood River population area.
- Counts of fish passed above the East Fork Hood River weir can be compared to separate GRTS-based surveys above the weir to evaluate the accuracy of GRTS-based surveys for spawning steelhead.
- GRTS-based snorkel surveys at the MPG scale (currently conducted at the combined Cascade and Gorge MPG scale). Surveys provide annual estimates of an index of abundance (density) of juvenile steelhead. Data from these surveys can also be used to evaluate aspects of productivity (juveniles density per spawner density), and distribution. Because of the problem of poor water visibility in Hood River due to glacial till, many of the survey sites in the Hood River population area are not amenable to snorkel counts.
- In at least one sub-watershed in the Gorge MPG (proposed for East Fork Hood River), trap adults in and juveniles out to provide estimates of marine and freshwater productivity (i.e. Life Cycle Monitoring sites).

10.3.2. Habitat Action Effectiveness Monitoring

- Status and trend in habitat conditions in wadeable streams (physical instream and riparian) via GRTS-based surveys annually at the MPG scale and every 5 years at the population scale. This is currently conducted annually at the MPG scale.
- GRTS-based sampling of macro-invertebrates at the MPG scale as an indicator of water quality conditions (not currently funded).
- Pre- and post- habitat surveys of 15 habitat restoration projects within the ESU annually.
- Implementation of IMWs where feasible, and strategic.

10.3.3. Hatchery Effectiveness Monitoring

- No current plan or strategy to monitor the abundance or distribution of stray hatchery origin steelhead in the Coast MPG.

- Monitoring of the ecological impacts of hatchery fish releases.
- Carcasses recovered during GRTS-based spawning surveys provide PHOS for the Lower and Upper Gorge populations. It will also be evaluated for fish arriving at the floating weir planned for EF Hood River. Monitor of the ecological impacts of hatchery fish releases.

10.4. Lower Columbia Spring and Fall Chinook MPG Strategies

10.4.1. Monitoring Summary

- **ODFW**
  - Implement the two RM&E plans that have been written for the estuary that outline VSP monitoring and action effectiveness monitoring. Implement a sustaining monitoring program in the lower estuary
  - Determine the link and relationship of survival effects in the estuary as it relates to the entire Columbia River system and adult and juvenile survival.
  - Evaluate the effectiveness of habitat restoration actions in the estuary per RPA 37, RPA 60 which called for convening an expert panel to assess the impacts of habitat restoration on salmon survival.
  - Evaluate the effects of bird predation on juvenile survival.
  - Evaluate the density dependent relationships between species and hatchery-wild components.

- **WDFW**
  - Develop an integrated status and trends monitoring program for fish and habitat.

10.4.2. Viable Salmonid Population Criteria

- **ODFW**
  - Conduct GRTS-based spawning surveys for annual spawner abundance estimates in each of the four populations within the Coast MPG with a precision of + 30% or better. Surveys will also provide information on productivity, distribution, and some aspects of diversity (primarily spawn timing)
  - Counts of fish passed above existing fish passage/counting facilities (North Fork Klaskanine hatchery weir, Big Creek hatchery weir) and potentially new adult trapping/fish counting facilities (CEDC hatchery water diversion weir on South Fork Klaskanine, fish ladder at RM 10 Clatskanie River) to obtain census-based fall Chinook escapement estimates that can be compared to separate GRTS-based surveys above these census locations to evaluate the accuracy of GRTS-based surveys for spawning fall Chinook.
  - Juvenile out-migrant (JOM) trapping at downstream end of hatchery fish exclusion areas (North Fork and South Fork Klaskanine that can be combined with adult trapping to provide estimates of marine and freshwater productivity (i.e. Life Cycle Monitoring sites).

- **WDFW**
    - Maintain and modify VSP monitoring to meet recovery plans, management needs, address critical uncertainties, and support integrated status and trends monitoring program. Adult abundance is estimated with a variety of methods: 1) mark/recapture, 2) fish counts (weir counts, dams, surveys), 3) aerial redd surveys and 4) peak count expansion. Adult productivity is determined by cohort analysis from sex ratio, origin, and age-structure of spawners collected on spawning ground surveys or at traps.
    - Juvenile productivity is estimated from 2 populations in the coastal stratum (Grays in 2008: Mill 2004-present) and 1 population in the Cascade stratum (Upper Cowlitz/Tilton at Mayfield Cam), but Mayfield trap efficiency data is not current.
    - Adult spatial distribution is monitored for high use areas and periodically for lower use areas via stream surveys and redd counts.
    - Species diversity is monitored by collecting spawn timing, run timing, sex ratio, age and length data from stream surveys and adult traps.

10.4.3. Habitat Action Effectiveness Monitoring

- **ODFW**
    - Status and trend in habitat conditions in wadeable streams (physical instream and riparian) via GRTS-based surveys annually at the MPG scale and every 5 years at the population scale. Currently conducted annually at the MPG scale.
    - GRTS-based sampling of macro-invertebrates at the MPG scale as an indicator of water quality conditions (not currently funded). Pre- and post- habitat surveys of 15 habitat restoration projects within the ESU annually.
    - Implementation of IMWs where feasible, and strategic. Monitoring of the ecological impacts of hatchery fish releases.

- **WDFW**
    - Develop habitat monitoring program to support an integrated status and trends monitoring program, which includes a component to validate fish response to habitat restoration.
    - An IMW was implemented in the Lower Columbia in 2003 and is now having habitat restoration treatments. This IMW should be continued until results are available. Funding is through the PCSRF and Washington Salmon Recovery Funding Board.
    - Habitat monitoring should be consistent with NOAA monitoring guidance.

10.4.4. Hatchery Effectiveness Monitoring

- **ODFW**
    - Sampling of carcasses found during GRTS-based spawning surveys provide PHOS. Monitoring of the ecological impacts of hatchery fish releases.

- **WDFW**
    - Maintain and modify hatchery programs to meet recovery plans, mitigation requirements, and address critical uncertainties, and support integrated status and trends monitoring program.
    - WDFW is implementing hatchery reforms based on the recommendation of the HSRG
    - Hatchery monitoring should be consistent with NOAA monitoring guidance.

10.4.5. WDFW Hydrosystem Monitoring

- Maintain and modify hydro monitoring programs that estimate adult and juvenile survival, collection efficiencies, address critical uncertainties, and to validate fish responses to hydro improvements. Includes mainstem Columbia River dams, and Cowlitz, Lewis, and White Salmon River dams. Hydro monitoring should be consistent with NOAA monitoring guidance.

10.5. Lower Columbia Coho MPG Strategies

10.5.1. Viable Salmonid Population Criteria

- **ODFW**
    - GRTS-based spawner surveys for annual spawner abundance estimates where feasible (both populations within the Cascade MPG) with a precision of + 30% or better. Surveys will also provide information on productivity, distribution, and some aspects of diversity (primarily spawn timing).
    - Counts of fish passed above existing fish passage/counting facilities (PGE facilities at Clackamas North Fork Dam) and potentially new adult trapping/fish counting facilities (above Sandy Fish Hatchery on Cedar Creek) to obtain census-based coho escapement estimates that can be compared to separate GRTS-based surveys above these census locations to evaluate the accuracy of GRTS-based surveys for spawning coho.
    - GRTS-based snorkel surveys at the MPG scale. This is currently conducted at the combined Cascade and Gorge MPG scale. Surveys provide annual estimates of an index of abundance (density) of juvenile steelhead. Data from these surveys can also be used to evaluate aspects of productivity (juveniles density per spawner density), and distribution.
    - In at least one sub-watershed in the Cascade MPG (proposed for Cedar Creek, and Sandy River), trap adults in and juveniles out to provide estimates of marine and freshwater productivity (i.e. Life Cycle Monitoring sites).

- **WDFW**
    - Maintain and modify VSP monitoring to meet recovery plans, management needs, address critical uncertainties, and support integrated status and trends monitoring program.

- Adult abundance is not estimated for most populations. Abundance is estimated for some populations using weir or redd counts.
- Adult productivity is determined by cohort analysis from sex ratio, origin, and age-structure of spawners from carcass surveys or traps on Elochoman, Cowlitz, Toutle, Lewis, and Wind Rivers. Fisheries for Lower Columbia River coho are selective but impacts are not monitored.
- Juvenile productivity is estimated from 1 primary population per strata (Coast=Grays, Cascade= Coweeman, and Gorge=Wind) but few fish are caught in the Wind due to limited distribution. Juvenile productivity is also estimated from IMW project: Cowlitz Falls, and Tilton.
- Adult spatial distribution is monitored in a few populations including Mill and Coweeman.
- Adult diversity is monitored by spawning time from stream surveys, and age, length, and run timing from traps. Baseline genetic (DNA) has been collected from most populations.
- WDFW is participating in the ISTM project and will to the extent practical implement recommendations obtained from that project. VSP monitoring should be consistent with NOAA monitoring guidance.

10.5.2. Habitat Action Effectiveness Monitoring

- **ODFW**
  - Status and trend in habitat conditions (physical instream and riparian) via GRTS-based surveys annually at the MPG scale and every 5 years at the population scale. (Currently conducted annually at the combined Cascade and Gorge MPG scale).
  - GRTS-based sampling of macro-invertebrates at the combined Cascade and Gorge MPG scale as an indicator of water quality conditions (not currently funded).
  - Pre- and post- habitat surveys of 15 habitat restoration projects within the ESU annually. Implementation of IMWs where feasible, and strategic.

- **WDFW**
  - Develop habitat monitoring program to support an integrated status and trends monitoring program, which includes a component to validate fish response to habitat restoration.
  - An IMW was implemented in the Lower Columbia in 2003 and is now having habitat restoration treatments. This IMW should be continued until results are available. Funding is through the PCSRF and Washington Salmon Recovery Funding Board.
  - Habitat monitoring should be consistent with NOAA monitoring guidance. WDFW is participating in the ISTM project and will to the extent practical implement recommendations obtained from that project.

10.5.3. Hatchery Effectiveness Monitoring

- **ODFW**
  - Carcasses collected during GRTS-based spawning surveys provide PHOS for coho. PHOS is also currently estimated for coho passing over North Fork Dam on the Clackamas.
  - Monitoring of the ecological impacts of hatchery fish releases.

- **WDFW**
  - Maintain and modify hatchery programs to meet recovery plans, mitigation requirements, and address critical uncertainties, and support integrated status and trends monitoring program.
  - WDFW is implementing hatchery reforms based on the recommendation of the HSRG.
  - Hatchery monitoring should be consistent with NOAA monitoring guidance. WDFW is participating in the ISTM project and will to the extent practical implement recommendations obtained from that project.

10.5.4. WDFW Hydrosystem Monitoring

- Maintain and modify hydro monitoring programs that estimate adult and juvenile survival, collection efficiencies, address critical uncertainties, and to validate fish responses to hydro improvements. Includes mainstem Columbia River dams (Bonneville), and Cowlitz, Lewis, and White Salmon River dams.
- Hydro monitoring should be consistent with NOAA monitoring guidance. WDFW is participating in the ISTM project and will to the extent practical implement recommendations obtained from that project.

10.6. Columbia River Chum MPG Strategy

10.6.1. Viable Salmonid Population Criteria

- **ODFW**
  - Monitoring will focus on the Scappoose and Clatskanie where research will be conducted on ways to re-establish natural origin chum. Experimental reintroductions into Scappoose and Clatskanie basins using supplementation from Grays River stock coupled with habitat improvement projects within the chum utilization zones to extend into former range will require additional future monitoring.
  - Census based spawning surveys to determine natural and hatchery origin abundance of chum spawners in research (i.e. treated and untreated) areas. Treatments will be habitat improvement and hatchery fish supplementation.
  - Chum spawners observed during GRTS-based fall Chinook surveys and coho surveys will be recorded and should provide reasonable information on the spawning escapement of chum in areas outside of the two research areas.

- JOM trapping for chum fry migrating out of research areas.

- **WDFW**
  - Maintain and modify chum VSP monitoring to meet recovery plans, management needs, address critical uncertainties, and support integrated status and trends monitoring program.
  - Current strategy determines adult abundance as peak count/mile for index reaches within selected streams. Since 2004 mark-recapture estimates are used to develop peak count expansion factors, observer efficiency, and residence time for Grays and Lower Gorge populations only.
  - Adult chum productivity of sufficient time series is only available for Lower Gorge tributaries, and Grays River.
  - Juvenile productivity is estimated from 1 population in the costal strata (Grays) in 2008.
  - Strategy uses spawner density in high use areas and periodically for lower use areas to determine adult spatial distribution.
  - Adult diversity is monitored by stream surveys including spawning time, age, & length. All hatchery chum salmon are thermally mass marked, and otolith decoding is used to estimate origin. Baseline genetic data has been collected but not fully analyzed.
  - Chum BiOp project 200871000 will develop a monitoring and evaluation (M&E) plan for chum salmon in Washington and coordinate with Oregon. WDFW is participating in the ISTM project and will to the extent practical implement recommendations obtained from that project. VSP monitoring should be consistent with NOAA monitoring guidance.

10.6.2. Habitat Action Effectiveness Monitoring

- **ODFW**
  - Census-based surveys will be used to assess instream habitat and riparian conditions in chum re-establishment research areas. (i.e. Scappoose and Clatskanine).
  - The temporal and spatial scale of these surveys is to be determined (TBD). For the entire ESU, status and trend in habitat conditions (physical instream and riparian) via GRTS-based surveys annually at the MPG scale and every 5 years at the population scale. Currently conducted annually at the combined Cascade and Gorge MPG scale.
  - GRTS-based sampling of macro-invertebrates at the MPG scale as an indicator of water quality conditions (not currently funded).

- **WDFW**
  - Develop habitat monitoring program to support an integrated status and trends monitoring program, which includes a component to validate fish response to habitat restoration.
  - An IMW was implemented in the Lower Columbia in 2003 and is now having habitat restoration treatments. This IMW should be continued until results are

available. Funding is through the PCSRF and Washington Salmon Recovery Funding Board. Habitat monitoring should be consistent with NOAA monitoring guidance.
    - WDFW is participating in the ISTM project and will to the extent practical implement recommendations obtained from that project.

10.6.3. Hatchery Effectiveness Monitoring

- **ODFW**
    - Scale and otolith analysis will be used to determine PHOS from carcasses recovered during census-based and GRTS-based spawning surveys.
    - Monitor in-hatchery performance and adult returns at Big Creek and Hunt Creek as directed by standards identified in Section 11 of the HGMP's for those facilities.

- **WDFW**
    - Maintain and modify hatchery programs to meet recovery plans, mitigation requirements, and address critical uncertainties, and support integrated status and trends monitoring program.
    - WDFW is implementing hatchery reforms based on the recommendation of the HSRG. The goal for the current chum salmon hatchery program is salmon recovery.
    - Hatchery monitoring should be consistent with NOAA monitoring guidance.
    - WDFW is participating in the ISTM project and will to the extent practical implement recommendations obtained from that project.

10.6.4. WDFW Hydrosystem Monitoring

- Maintain and modify hydro monitoring programs that estimate adult and juvenile survival, collection efficiencies, address critical uncertainties, and to validate fish responses to hydro improvements. Includes mainstem Columbia River dams (Bonneville), and Cowlitz, Lewis, and White Salmon River dams.
- Hydro monitoring should be consistent with NOAA monitoring guidance.

11. APPENDIX D: SNAKE RIVER SUB-REGIONAL MONITORING STRATEGY

Co-managers that developed this strategy include: Idaho Department of Fish and Game; Nez Perce Tribe; Oregon Department of Fish and Wildlife; Confederated Tribes of the Umatilla Indian Reservation; Washington Department of Fish and Wildlife, and Shoshone-Bannock Tribe.

Below is the summary strategy for VSP, habitat action effectiveness and hatchery effectiveness for steelhead, spring-summer Chinook, fall Chinook, and sockeye. For more details on the strategies see:

- Additional strategy information provided that is not included in the ASMS such as harvest and hydrosystem (Appendices A-D).
- Populations targeted to receive both habitat status and trend and fish in/ fish out monitoring which will be used to assess habitat action effectiveness on fish (Appendix E).
- Inventory tables of monitoring existing as of 2009 (http://www.cbfwa.org/ams/index.cfm).
- Monitoring priorities (http://www.cbfwa.org/ams/index.cfm).
- Description of monitoring gaps and proposed projects to address these gaps, including gaps for addressing monitoring needs for the FCRPS BiOp as of November 2009 (http://www.cbfwa.org/ams/index.cfm).
- Final master spreadsheet of prioritized projects and associated cost (Appendix F).

11.1. Snake River Steelhead MPG Strategy

11.1.1. Viable Salmonid Population Criteria

- The co-managers will assess and maintain population status and trends using VSP criteria and TRT viability criteria.

- **High Intensity Life Cycle Monitored Watersheds**
    - High intensity status and trend data (includes adults in, juveniles/smolts out, SAR's) will be implemented in at least one population per MPG. Estimate adult and juvenile abundance for life cycle monitoring (SAR, smolts per spawner, adult productivity). Co-managers intend to strive for accurate annual estimates with target CVs of 15% or less. Due to population specific sampling challenges high intensity/precision sampling opportunities are limited.
    - Co-managers will select populations for life cycle monitoring based on maximum synergy between BiOp RPA requirements; TRT must have populations, IMWs (habitat effectiveness monitoring), accord monitoring, hatchery effectiveness monitoring, representativeness of MPG populations, and multiple species coverage.

- Initial recommendation for candidate streams are: Asotin Creek, Upper Grande Ronde River, Imnaha River, Lolo Creek, South Fork Salmon River, Secesh River, Lemhi River.

- **<u>Lower Granite Dam Sampling to Support VSP parameter estimates</u>**

  - There is a need for high precision estimation of fish reaching Lower Granite Dam via run-reconstruction estimates generated from sampling fish at the Lower Granite Dam fish trap. This will allow for:
    - Estimation of adult and juveniles for life cycle monitoring (SAR, smolts per spawner, adult productivity) at the DPS scale (aggregate SAR for Snake Basin) with a CV of 15% or less.
    - Genetic sampling of adults and smolts (see next section).
    - Pit-tagging adults (see next section).
    - Scale collection for adult and smolt aging (see next section)
    - Estimation of wild and hatchery origin adults.
  - Snake River Basin annual run-reconstructions of hatchery returns, harvest, and escapement to known and unknown population areas to provide timely annual run-reconstruction (abundance and age structure) of steelhead escapement to Lower Granite Dam; including description of ultimate disposition of hatchery steelhead upstream of Lower Granite dam. Ultimate disposition alternatives for hatchery-origin fish include; harvest, hatchery rack collections, spawners to known areas, and spawners to unknown areas. Analyses and integrates data collection from numerous ongoing projects

- **<u>DPS/MPG Abundance and Productivity Estimates</u>**
  - Co-managers will strive for obtaining status and trend data in every population per MPG. However, logistical constraints will not allow us to enumerate adult steelhead on the spawning ground in every population. As an alternative, adult abundance estimates can be obtained with (1) Genetic Stock Identification (GSI) and (2) strategically placed PIT tag arrays.
  - Adult abundance estimates (and CI's) will be made by sampling adults at LGR and partitioning the Lower Granite Dam escapement to MPGs (and populations as able) using GSI. Scale samples will be collected to estimate age structure at the MPG and population scale. Productivity estimates (adult to adult) can be made at the MPG and population scale.
  - The co-managers will make an adult abundance estimate using a PIT tag array in at least two MPGs. Results from GSI and PIT-tagging will be compared for accuracy, precision, and cost.
  - Co-managers will continue the existing index reach redd surveys until results from GSI and PIT-arrays are evaluated. These surveys are limited to streams in NE Oregon and Washington.
  - Smolt abundance estimates (and CI's) will be made by sampling smolts at LGR and partitioning the estimate of total smolts arriving at Lower Granite Dam to MPGs (and populations as able) using GSI. Scale samples will be obtained to

estimate age structure at the MPG and population scale. Productivity estimates (adult to smolt) can be made at the MPG and population scale.

11.1.2. Habitat Action Effectiveness Monitoring

The loss of habitat has been a key factor in the reduction of steelhead, the listing under the ESA and in lost opportunities for harvest. The following strategies should be employed to track habitat conditions and effectiveness of habitat restoration actions.

- Characterize existing physical habitat related to watershed hydrology and aquatic biotic productivity. Document changes in physical habitat structure/function due to natural processes (climate change) and changes resulting from human manipulation of physical habitat, which includes both degradation and restoration. Validate fish response to habitat changes.
- Describe physical habitat condition trends across the entire Snake River basin using a probabilistic sampling approach.
- Ensure at least one watershed/population per MPG is monitored across a diversity of ecological regions conducted in areas with fish in/out monitoring.
    - Establish ESU wide remote sensing data on landscape vegetation, riparian area and stream channel morphology.
    - Maintain water quantity and quality monitoring in all populations and migration corridors,.
    - Maintain contemporary (15 year or less) watershed assessments for the entire Snake River basin at the 5th hydrologic unit code (HUC) level. Watershed assessments include: road networks, passage barriers, land use, water quantity and quality, riparian condition, basin hydrology including water withdrawals, channel morphology, and human demographics.
- Conduct implementation and compliance monitoring on <u>every</u> habitat restoration project.
    - Conduct small scale studies assessing reach specific response to unique habitat restoration action types.
    - Physical habitat response measures include: riparian vegetation, sedimentation, large woody debris, water temperature, habitat complexity, water quality, floodplain function, and fish presence -absence.
- Conduct habitat restoration project effectiveness monitoring in terms of fish in/out response using intensively monitored watersheds (IMWs) (ISEMP plus key BiOp gaps areas) and physical habitat condition.
- Select populations based on large survival gaps to be filled by habitat restoration actions and maximum synergy between BiOp RPA requirements, TRT must have populations, IMWs (habitat effectiveness monitoring), accord monitoring, hatchery effectiveness monitoring, representativeness of MPG populations, and multiple species coverage.
- Candidate rivers for steelhead response to habitat actions are: <u>Asotin Creek, Potlatch River, Upper Grande Ronde River, Catherine Creek, South Fork Salmon River, and Lemhi River.</u>

11.1.3. Hatchery Effectiveness Monitoring

Hatchery programs are essential for recovery meeting treaty rights and to provide non-treaty harvest opportunities. In order to monitor hatcheries, the following tasks have been identified.

- Assess and adaptively manage hatchery programs to respond to mitigation goals, recovery criteria, and supplementation effectiveness.
- Implement the AHSWG standardized performance measures in all hatchery programs.
- Conduct implementation and compliance monitoring per AHSWG guidelines 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; LSRCP, South Fork Clearwater and Lolo Creek, and new/reformed supplementation programs with formal study designs.
- Conduct RRS studies on at least six populations of steelhead throughout the Columbia Basin.
- Integrate and assess hatchery effectiveness results across programs throughout the Pacific Northwest.
- Implement the genotyping of all hatchery spawners so PBT may be used to identify progeny at any life stage.

11.1.4. Harvest Monitoring

- Estimate direct harvest and incidental mortality of natural origin adults in mainstem and terminal area fisheries.
- Estimate direct harvest 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.

11.1.5. Hydrosystem Monitoring (see also mainstem process strategy)

- Monitor and describe juvenile and adult steelhead survival, SAR's, migration timing, and response to dam passage strategies and experience.
- Utilize Snake Basin aggregate and one index population per MPG to estimate mainstem system-wide survival (upriver PIT tags), reach/project specific passage and survival (upriver PIT tags, and dam tagging), avian predation, adult survival, latent mortality, SAR's. Quantify survival relative to BiOp performance Standards. PIT tag numbers and distribution should follow target numbers described in CBFWA's NPCC Fish and Wildlife Program amendment recommendation.
- Coordinate this effort with the on-going CSS project.

11.1.6. Data Management and Access

- Maintain up-to-date, secure, web accessible databases that utilize standardized performance metrics.

11.2. Snake River Spring-Summer Chinook MPG Strategy

11.2.1. Viable Salmonid Population Criteria

- Assess and maintain population status and trends using VSP criteria and TRT viability criteria.
- Initiate high intensity life cycle monitoring (includes adults in, juveniles/smolts out, SAR's) in at least one population per life history type (spring vs. summer run) per MPG. Estimate adult and juvenile/smolt abundance and CI's for life cycle monitoring (SAR, smolts per spawner, adult productivity). Strife to obtain a CV of 15% or less for abundance estimates. Select populations based on maximum synergy between BiOp RPA requirements, TRT must have populations, IMWs (habitat effectiveness monitoring), accord monitoring, hatchery effectiveness monitoring, representativeness of MPG populations, and multiple species coverage.
- Initial candidate rivers for high intensity life cycle monitoring are: Tucannon River, Minam River, Imnaha River, Secesh River, Big Creek, Bear Valley Creek, Marsh Creek Complex, Chamberlain Creek, Pahsimeroi River, Upper Salmon River mainstem, and Lolo Creek.
- Estimate adult abundance (with CI's) in all other populations every year. Obtain estimates of abundance and spatial structure on all populations via multi-pass extensive area redd counts and carcass surveys (maintain existing index reach redd surveys). Where feasible and practical, overlay entire basin with GRTS sampling; post hoc analysis of GPS recorded redds within extensive area surveys and 25 – 1km reaches surveys outside of extensive area surveys. Non-index area reaches may be surveyed with post spawning single pass. Use rotating panel design to correlate redd-based indices to escapement. Remote areas requiring aerial surveys may use post spawning single pass.
- Develop high precision estimates of fish reaching Lower Granite Dam via run-reconstruction estimates generated sampling fish at the Lower Granite Dam fish trap. Estimate adult and juvenile abundance for life cycle monitoring (SAR, smolts per spawner, adult productivity) at the ESU scale (aggregate SAR for Snake Basin) with a target CV of 15% or less.
- Develop alternative approaches/techniques to partition adult escapement at Lower Granite Dam to MPGs. Adult abundance estimates (and CI's) can be obtained by (1) sampling adults at LGR and partitioning Lower Granite Dam escapement to MPGs (and populations as able) using GSI. Scale samples will be obtained to estimate age structure at the MPG and population scale. Productivity estimates (adult to adult) can be made at the MPG and population scale. (2) The co-managers will make an adult abundance estimate using a PIT tag array in at least two MPGs. Results from GSI and PIT-tagging will be compared for accuracy, precision , and cost.
- Smolt abundance estimates (and CI's) can be achieved by sampling smolts at LGR and partitioning Lower Granite Dam escapement to MPGs (and populations as able) using

GSI. Scale samples will be obtained to estimate age structure at the MPG and population scale. Productivity estimates (adult to smolt) can be made at the MPG and population scale.

- Establish Snake River Basin annual run-reconstruction of hatchery returns, harvest, and escapement to known and unknown population areas to provide timely annual run-reconstruction (abundance and age structure) of Chinook salmon escapement to Lower Granite Dam; including description of ultimate disposition of hatchery Chinook salmon upstream of Lower Granite dam. Ultimate disposition alternatives for hatchery-origin fish include; harvest, hatchery rack collections, spawners to known areas, and spawners to unknown areas. Analyzes and integrates data collection from numerous ongoing projects.
- Monitor genetic and life history diversity of all populations within ESU. Genotype wild populations on a rotating five year basis to maintain genetic baseline for GSI and to evaluate genetic population structure and diversity.

11.2.2. Habitat Action Effectiveness Monitoring

- Characterize existing physical habitat related to watershed hydrology and aquatic biotic productivity. Document changes in physical habitat structure/function due to natural processes (climate change) and changes resulting from human manipulation of physical habitat (includes both degradation and restoration). Validate fish response to habitat changes.
- Describe physical habitat condition trends by high precision monitoring across select populations in the Snake Basin based on BiOp large survival gap/Habitat improvements, restoration funding, or existing data sets. Use probabilistic sampling approach with appropriate and coordinated protocols to document changes in physical habitat structure/function due to human manipulation (includes both restoration and degradation) and natural processes (ex. floods, fire, climate change). Implementation and compliance monitoring on every habitat restoration project. Habitat restoration project effectiveness monitoring in terms of fish in/out response on select projects (ISEMP plus key BiOp gaps areas). Conduct studies assessing reach specific response to unique habitat restoration action types
- Conduct implementation and compliance monitoring on every habitat restoration project. Conduct small scale studies assessing reach specific response to unique habitat restoration action types. Physical habitat response measures include: riparian vegetation, sedimentation, large woody debris, water temperature, habitat complexity, water quality, floodplain function, and fish presence -absence.
- Conduct habitat restoration project effectiveness monitoring in terms of fish in/out response using intensively monitored watersheds (IMWs) (ISEMP plus key BiOp gaps areas) and physical habitat condition. Select populations based on large survival gap to be filled by habitat restoration actions and maximum synergy between BiOp RPA requirements, TRT must have populations, IMWs (habitat effectiveness monitoring), accord monitoring, hatchery effectiveness monitoring, representativeness of MPG populations, and multiple species coverage.

- Initial recommendations for candidate rivers to measure fish response (fish in/out) include: Tucannon River, Upper Grande Ronde River, Catherine Creek, South Fork Salmon River, and Lemhi River.

11.2.3. Hatchery Effectiveness Monitoring

- Assess and adaptively manage hatchery programs to respond to mitigation goals, recovery criteria, and supplementation effectiveness. Require utilization of Ad Hoc Supplementation Work Group standardized performance measures. Conduct implementation and compliance monitoring per AHSWG guidelines 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; LSRCP, Northeast Oregon Hatchery, Johnson Creek, and Idaho Salmon Supplementation and new/reformed supplementation programs with formal study designs. Conduct RRS studies on at least six populations of spring/summer Chinook salmon 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 using CWT and/or PBT. Integrate and assess hatchery effectiveness results across programs throughout the Pacific Northwest.
- Genotype all hatchery spawners so PBT may be used to identify progeny at any life stage.

11.2.4. Harvest Monitoring

- Estimate direct harvest and incidental mortality of natural origin adults in mainstem and terminal area fisheries.
- Estimate direct harvest 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.

11.2.5. Hydrosystem Monitoring (see also mainstem process strategy)

- Monitor and describe juvenile and adult spring/summer Chinook salmon survival, SAR's, migration timing, and response to dam passage strategies and experience.
- Utilize Snake Basin aggregate and one index population per MPG to estimate mainstem system-wide survival (upriver PIT tags), reach/project specific passage and survival (upriver PIT tags, and dam tagging), avian predation, adult survival, latent mortality, SAR's. Quantify survival relative to BiOp performance Standards. PIT tag numbers and distribution should follow target numbers described in CBFWA FWP amendment recommendation.
- Coordinate this effort with the on-going CSS project.

11.2.6. Data Management and Access

- Maintain up-to-date, secure, web accessible databases that utilize standardized performance metrics.

11.3. Snake River Fall Chinook MPG Strategy

11.3.1. Viable Salmonid Population Criteria

- Assess and maintain population status and trends using VSP criteria and TRT viability criteria. High precision estimation of fish reaching Lower Granite Dam via run-reconstruction estimates generated from sub-sampling (trapping) fish in the Lower Granite Dam adult ladder.
- Estimation of adults and juveniles for life cycle monitoring (SAR, smolts per spawner, adult productivity) is conducted at the ESU scale (currently a single population) with a CV of 15% or less. Escapement estimates downstream of Lower Granite Dam are accounted for via direct counts at Lyons Ferry Hatchery trap and expanded redd counts for Tucannon River, and dam tailraces.
- Establish Snake River Basin Annual run-reconstruction of hatchery returns, harvest, and escapement to provide timely annual abundance and age structure of Chinook salmon escapement to Lower Granite Dam; including description of ultimate disposition of hatchery Chinook salmon upstream of Lower Granite dam. Ultimate disposition alternatives for hatchery-origin fish include; harvest, hatchery rack collections, spawners to known areas, and spawners to unknown areas.
- Goal is to have low/moderate precision status and trend data in every population per MPG (including populations with high precision monitoring). Monitor redd distribution and relative abundance in Major Spawning Areas throughout entire population via multi-pass extensive area redd counts.

11.3.2. Hatchery Effectiveness Monitoring

- Assess and adaptively manage hatchery programs to respond to mitigation goals, recovery criteria, and supplementation effectiveness. Require utilization of Ad Hoc Supplementation Work Group standardized performance measures. Conduct implementation and compliance monitoring per AHSWG guidelines 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.
- Conduct Relative Reproductive Success (RRS) study.
- 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 using CWT and/or PBT.

- Integrate and assess hatchery effectiveness results across programs throughout the Pacific Northwest.
- Monitor and adaptively manage hatchery programs to respond to recovery criteria, evaluate supplementation and mitigation objectives.

11.3.3. Harvest Monitoring

- Monitor directed harvest and incidental mortality of natural origin adults in mainstem and terminal area fisheries.

11.3.4. Hydrosystem Monitoring

- Utilize natural production, general hatchery production, and surrogate hatchery production to study efficacy of dam operation and passage strategies.

11.4. Snake River Sockeye MPG Strategy

11.4.1. Viable Salmonid Population Criteria

- Estimate the annual adult and juvenile abundance for Sawtooth Basin sockeye to use in life cycle monitoring (SAR, smolts per spawner, adult productivity). Co-managers intend to strive for accurate annual estimates with target CVs of 15% or less. Enumerate residual spawning populations in Sawtooth Basin lakes

11.4.2. Hatchery Effectiveness Monitoring

- Transition from the current gene conservation program to a species-recovery program by producing 500,000 to 1,000,000 sockeye smolts annually.
- Continue genotyping all spawners used in the program so PBT may be used to identify progeny at any life stage.

11.4.3. Hydrosystem Monitoring

- PIT-tag sockeye juveniles for SAR estimates, smolt and adult run-timing through the hydrosystem, and collection efficiency at LGR. Implement studies to estimate survival from LGR to Stanley Basin lakes and to indentify where losses occur.

11.4.4. Harvest Monitoring

- Monitor all fisheries (sport, tribal, commercial) and estimate incidental harvest of Snake River sockeye using PBT and GSI.

12. APPENDIX E: POPULATIONS TARGETED FOR FISH IN/FISH OUT AND HABITAT STATUS AND TREND

Upper Columbia River Basin Subregion

Table taken from Table 5 of the FCRPS Biological Opinion and shows the targeted changes in productivity estimated to occur by 2018 for steelhead (SH) and spring-summer Chinook (CH) and where the regional strategy also calls for fish in/fish out and habitat status/trend monitoring.

Domain	Major Population Group	Population	BiOp Targeted Spring-Summer Chinook Habitat Quality % Improvement of 2007-20018 Actions	BiOp Targeted Steelhead Habitat Quality % Improvement of 2007-20018 Actions	Targeted For Fish-In/Fish-Out Monitoring	Targeted For Habitat Status/trend Monitoring?
Upper Columbia	Upper Columbia - Below Chief Joseph	Entiat River	**22**	**8**	**CH, SH**	**Yes**
		Methow River	**6**	**4**	**CH, SH**	**Yes**
		Okanogan River	**0**	**14**	**CH, SH**	**Yes**
		Wenatchee River	**3**	**4**	**CH, SH**	**Yes**

Middle Columbia River Basin Sub-Region

Table taken from Table 5 of the FCRPS Biological Opinion and shows the targeted changes in productivity estimated to occur by 2018 for steelhead (SH) and where the regional strategy also calls for fish in/fish out and habitat status/trend monitoring.

Domain	Major Population Group	Population	BiOp Targeted Spring-Summer Chinook Habitat Quality % Improvement of 2007-20018 Actions	BiOp Targeted Steelhead Habitat Quality % Improvement of 2007-20018 Actions	Targeted For Fish-In/Fish-Out Monitoring	Targeted For BiOp Habitat Status/trend Monitoring?
Middle Columbia Steelhead	Cascades Eastern Slope Tributaries	Deschutes River - eastside	**0**	**1**		
		Deschutes River - Westside	**0**	**<1**		
		Fifteen mile Creek	**0**	**<1**		**Yes**
		Klickitat River	**0**	**4**	**SH**	**Yes**
	John Day River	John Day River lower mainstem	**0**	**<1**	**SH**	**Yes**
		John Day River upper mainstem	**0**	**<1**	**SH**	**Yes**
		Middle Fork John Day River	**0**	**<1**	**SH**	**Yes**
		North Fork John Day River	**0**	**1**	**SH**	**Yes**
	Umatilla and Walla Walla River	Touchet River	**0**	**4**		
		Umatilla River	**0**	**4**	**SH**	**Yes**
		Walla Walla River	**0**	**4**		**Yes**
	Yakima River Group	Naches River	**0**	**4**		
		Satus Creek	**0**	**4**		
		Toppenish Creek	**0**	**4**	**SH**	**Yes**
		Yakima River Upper	**0**	**4**		

Lower Columbia River Basin Sub-Region

This table taken from Table 5 of the FCRPS Biological Opinion and show the targeted changes in productivity estimated to occur by 2018 for steelhead (SH), spring-summer Chinook (CH), and coho, and where the regional strategy and/or BiOp Work Group recommendations call for fish in/fish out and habitat status/trend monitoring.

Domain	Major Population Group	Population	BiOp Targeted Spring-Summer Chinook Habitat Quality % Improvement of 2007-20018 Actions	BiOp Targeted Steelhead Habitat Quality % Improvement of 2007-20018 Actions	Targeted For Fish-In/Fish-Out Monitoring	Targeted For BiOp Habitat Status/trend Monitoring?
Lower Columbia	Gorge	Wind River & Hamilton Cr	**0**	**0**	**SH, Coho**	**Yes**
		Hood River	**0**	**0**	**CH**	**Yes**

Snake River Basin Sub-Region

This table taken from Table 5 of the FCRPS Biological Opinion and show the targeted changes in productivity estimated to occur by 2018 for steelhead (SH) and spring-summer Chinook (CH) and where the regional strategy also calls for fish in/fish out and habitat status/trend monitoring.

Domain	Major Population Group	Population	BiOp Targeted Spring-Summer Chinook Habitat Quality % Improvement of 2007-20018 Actions	BiOp Targeted Steelhead Habitat Quality % Improvement of 2007-20018 Actions	Targeted For Fish-In/Fish-Out Monitoring	Targeted For BiOp Habitat Status/trend Monitoring?
Snake River	Grande Ronde/Imnaha	Catherine Creek	**23**		**SH, CH**	**Yes**
		Minam			**CH***	
		Lostine Walla Walla	**2**			
		Grande Ronde Upper Mainstem	**0**	**4**	**CH**	**Yes**
		Grande Ronde Lower Mainstem	**0**	**<1**		
		Joseph Cr	**0**	**4**		
		Wallowa	**0**	**<1**		
		Imnaha	**0**	**0**	**SH, CH***	**Yes**
	Middle Fork Salmon	Big Creek	**1**	**<1**	**SH*, CH**	**Yes**
		Lower MF Mainstem	**0**	**2**		
		EF Salmon R	**0**	**2**		
	South Fork Salmon	Secesh River	**1**	**6**	**SH, CH**	**Yes**
		SF Salmon River Mainstem	**<1**	**1**	**SH, CH**	**Yes**

	Lower Snake	Tucannon River	**17**	**5**	**CH**	**Yes**
		Asotin Creek	**0**	**4**	**SH**	**Yes**
	Upper Salmon	East Fork Salmon River	**1**	**2**		
		Lemhi River	**7**	**3**	**SH, CH**	**Yes**
		Pahsimeroi River	**41**	**9**	**CH**	**Yes**
		Salmon River lower mainstem below Redfish Lake	**1**	**1**		
Snake River	Upper Salmon	Salmon River upper mainstem above Redfish Lake	**14**	**6**	**CH***	
		Valley Creek	**1**			
		Bear Valley Cr	**0**	**0**	**CH***	
		Marsh Cr	**0**	**0**	**CH***	
		Yankee Fork	**30**	**0**	**CH**	**Yes**
	Clearwater	Potlatch			**SH*, CH***	
		Lolo			**SH, CH**	**Yes**

*Not identified in BiOp Work Group Report or BiOp RPAs.

13. APPENDIX F: BASINWIDE ANADROMOUS SALMONID MONITORING STRATEGY FOR VSP, HABITAT EFFECTIVENESS, AND HATCHERY EFFECTIVENESS - CONTRACTS, GAPS, AND FUNDING PRIORITIZATION TABLES

There are three documents addressing the gaps and funding prioritization for steelhead, Chinook, and sockeye VSP, habitat effectiveness and hatchery effectiveness monitoring projects. Included in these documents are the list of critical monitoring projects, monitoring strategy statements, prioritized list of monitoring gaps and justification, FCRPS BiOp RPA recommendations to address the monitoring gaps or consolidations, and prioritized list of current projects to be continued as-is, projects to be modified, and new funding proposals with estimate costs to address the monitoring gaps. The three documents are titled:

- Table 1 Critical Steelhead Contracts and Identified Gaps Final Version 1-29-2010 Available at: http://www.cbfwa.org/ams/FinalDocs.cfm
- Table 2 Critical Spring Chinook Contracts and Gaps Final Version 1-29-2010 Available at: http://www.cbfwa.org/ams/FinalDocs.cfm
- Table 3 Critical Sockeye Contracts and Gaps Final Version 1-29-2010 Available at: http://www.cbfwa.org/ams/FinalDocs.cfm

There is one document summarizing the basinwide funding prioritization for steelhead, Chinook, and sockeye VSP, habitat effectiveness and hatchery effectiveness monitoring. This excel document consists of a tab for each of the subregions and is available at http://www.cbfwa.org/ams/FinalDocs.cfm.

Under each tab, the following items are addressed:

- Salmonid MPG or domain is listed along with the FCRPS BiOp RPA monitoring recommendations and priority funding recommendation;
- Current or proposed monitoring contractor;
- Monitoring project description;
- Identification of Bonneville project number, contract number, current and future budget
- Identification of Bonneville monitoring project as to whether they are associated with a Fish Accor and whether they were scheduled to undergo fast track scientific review prior to the NPCC's 2010 RME Categorical review
- Identification of which FCRPS BiOP RPA the monitoring project addresses
- Identification of whether the project is used or will be used to generate salmonid Technical Recovery Team findings;
- Explanation for the essential monitoring needs being addressed by the project it other than a FCRPS BiOp RPA
- Identification of whether the project addresses a AHSWG recommendation
- Identification of whether the project provides opportunity for an IMW approach