Northwest **Power** and **Conservation** Council

November 6, 2018

DECISION MEMORANDUM

TO: **Fish and Wildlife Committee members**

FROM: **Staff**

SUBJECT: Research Progress Review: Discussion and recommendations

PROPOSED ACTION: Committee recommendation to the Council on implementation of 25 research projects and associated programmatic issues as recommended by staff

SIGNIFICANCE: This review of 25 Program-funded projects that are primarily research in nature, focuses on results to date and evaluates implementation of the Council's Fish and Wildlife Program Strategy for Research and the 2017 Research Plan and is a follow up from the 2011 Council Recommendation for the Research, Monitoring & Evaluation Review, Programmatic Issue on Research Projects.

BUDGETARY/ECONOMIC IMPACTS

Annual funding for this set of research projects is approximately $11.6 million based on FY 2018 budgets or start of year budgets for FY 2019 where available.

BACKGROUND

In 2018, the Council initiated a research project inventory to identify all the research funded under the Fish and Wildlife Program (Program), including projects with small research components as well as project that were primarily research. Twenty-five of the inventoried projects focus primarily on research that address critical research uncertainties as defined in the 2017 Research Plan.

The purpose of the progress review is 1) to identify what level of research is occurring, 2) understand what we are learning and how it contributes to implementation of the Program, and 3) determine if research is focused on the Program's critical uncertainties. In addition, the outcome of the review and follow-on programmatic issues will help inform other parts of the program.

The 2018 Research Project Progress Review began June 5, 2018. The information packet shared with sponsors included background, schedule, and instructions for the review. Summary results reports were submitted by sponsors on August 13, 2018 for Independent Scientific Review Panel (ISRP) and Council review. The Council and the ISRP received project presentations from sponsors for project presentations over two days in August. The ISRP's Report on the Research Project Status Review (ISRP document 2018-8) was complete on Sept 28, 2018. No public comments were received during a public comment period on the ISRP Report. All background information on the 2018 review process details can be found on the Council's website.

DISCUSSION and RECOMMENDATIONS

Part 1: DISCUSSION OF REVIEW

A. Identify what research is occurring

Over several months, Council staff, with input from project sponsors, identified the list of 25 research projects. This began with a research project inventory to identify all the research funded under the Program, based largely on work elements. This effort included research from all projects; those with small research components as well as projects that were primarily research. For this Research Project Status Review, staff focused on projects that were *primarily* research (>60%). Thus, other smaller research components are not included in this progress review.

Research furthers the understanding of critical uncertainties, which are questions concerning the validity of key assumptions implied or stated in the Program (Table 1). Critical uncertainties research includes action effectiveness, new methodologies and technologies, and addresses questions that have broad applicability or the potential for broad applicability. Ultimately, the research projects included in this status review had 60% or more of their work focused on research elements.

As Council and staff have discussed previously, drawing a clean line between monitoring and research is challenging because monitoring data are often used to address critical uncertainties; therefore, some of the projects in this review contain monitoring elements. The 25 reviewed projects focused on research with broad applicability and address critical research uncertainties as defined in the 2017 Research Plan.

Table 1. Research definitions from the 2017 Research plan

Research Term	**Definition**
Critical uncertainties	Critical research uncertainties are questions concerning the validity of key assumptions implied or stated in the Program.
Critical Uncertainties research	For the purposes of the research plan, research furthers the understanding of critical uncertainties, including action effectiveness, new methodologies and technologies. Consistent with the Program, research projects contain a clearly stated hypothesis, beginning and end dates, and results and conclusions.
Effectiveness	Assesses whether certain actions and projects are having the intended effect and contribute to overall mitigation, protection and recovery efforts in the basin. This may require establishing a causal relationship or a correlation between the action and change observed; i.e. statistical cause-and effect and correlation relationships. This can be at one of two scales -- to detect a localized effect (project or stream reach level effect), and to detect a watershed level effect (intensively monitored effect) -- and can be either research or monitoring.

In the ISRP's Final Report, Table 2 (ISRP 2018-8) categorizes the 25 projects within general topic and sub-topic areas.

Table 2. General topic areas covered by the 25 research projects reviewed by the ISRP

General Topic	Sub-Topic	Project
Evaluating Fish & Wildlife	Evaluating Survival, Migration Rates, Movements Among Habitats, & Growth	• New Marking and Monitoring Techniques • Ocean Survival of Salmonids • Avian Predation on Juvenile Salmonids • Snake River Fall Chinook Salmon Life History Investigations • ISEMP • Restoration of Bull Trout Passage at Albeni Falls • Genetic Assessment of Columbia River Salmonid Stocks • Basinwide Supplementation Evaluation • Freshwater Mussel Research and Restoration
	Measuring the Genetic Diversity of Populations	• Sturgeon Genetics • Influence of Environment and Landscape on Salmonid Genetics
Evaluating Habitat	Single Factor Effects on Habitat Suitability	• Hyporheic Flow Assessment in Columbia River Tributaries • Twin Lakes Enhancement
	Habitat Restoration Effects at Different Scales	• Monitoring Recovery Trends in Key Spring Chinook Habitat…. • Biomonitoring of Fish Habitat Enhancement • BPA Action Effectiveness Monitoring • ISEMP/CHaMP
Fish Propagation	Improving Hatchery Culture Methods	• Advance Hatchery Reform Research • Growth Modulation • Evaluate the RRS of Hatchery-origin & Wild Steelhead…Hood River • Natural RS and Demographic Effects of Hatchery-Origin Steelhead…Abernathy Cr. • Basinwide Supplementation Study • Study RS of Hatchery and Natural Origin Steelhead in the Methow

	Evaluating the Genetic Effects of Supplementation	• Genetic Monitoring and Evaluation Program for Salmon & Steelhead • Monitor and Evaluate RRS of Spring Chinook in the Wenatchee • Natural RS and Demographic Effects of Hatchery-Origin Steelhead…Abernathy Cr. • Basinwide Supplementation • Study RS of Hatchery and Natural Origin Steelhead in the Methow

B. What we are learning with this research

"*Research that is occurring in the basin is innovative and often leads the way for other similar studies around the world,"* (S. Schroder, ISRP Chair). Below are some highlights of results and findings from this review:

- Evaluating Fish and Wildlife Populations

Highlights of findings and results for projects that evaluate fish and wildlife populations run the gamut from the ocean to better migration detection and advances in genetics.

Ocean investigations suggest that salmon survival in the ocean is sensitive to timing of juvenile fish outmigration. It is now possible to use evidence of low survival in the nearshore-ocean as an early warning of extremely low salmon return abundance as exemplified in 2016-2017. Researchers have developed a 'stop-light chart' comprised of a suite of physical, biological, and ecological indicators of ocean conditions that are useful qualitative predictors of salmon survival that are now being used by managers as early-warning indicators of recent ocean conditions. Researchers can relate the growth and condition of juvenile salmon to the environmental conditions in the Columbia River plume and nearshore ocean, which are influenced by river discharge and wind. Findings indicated that these conditions make a big difference in fish survival. A greater emphasis on long term, high quality monitoring of ocean conditions and assessment of changes in the ocean ecosystem that affect juvenile salmon survival is essential.

PIT-Tag Detection has decreased in the mainstem by nearly 50%. Research shows that increases in spill diverts fish away from detectors. Sponsors are working to develop new technologies to increase fish detection in PIT arrays in challenging or difficult conditions. Examples include the use of flexible antennae, different locations such as barges, spillways, vertical arrangements of equipment for greater coverage or use of satellite modems.

Genetic monitoring methods are advancing rapidly and discoveries in new single nucleotide polymorphism (SNPs) markers gives more accurate genetic assignments for anadromous salmonids, lamprey, sturgeon and other species. Most recently, researchers are working on a non-invasive method to determine sturgeon sex at any age. If successful, this will have broad application in the basin and beyond. Other genetic findings include the link between genetics and adaptation to local habitat conditions, important when straying or reintroduction of species are considered. Recent

results indicate that precipitation, elevation, and temperature are important environmental factors that drive adaptive genomic divergence in salmonids, important factors when future land use and climate change are considered. Studies continue that are examining the genetic basis for run-timing, age-at-maturity, disease resistance, and thermal adaptation.

Understanding the distribution and ecology of ***mussels*** and their use as a sentinel species to track environmental conditions has led to best management practices for restoration project planning and could be applicable to other parts of the basin and beyond.

- Evaluating Habitat and the Effectiveness of Restoration Actions

Research that is helping to guide conservation efforts by predicting ***resilience of stocks*** to certain environmental factors such as precipitation, elevation and temperature is helping us understand how environmental factors drive genetic differences. Assessing the effects and benefits of using beaver dam analogs has demonstrated that some of the most striking improvements in habitat and fish populations have been achieved from lower costs projects that focus on natural-process, such as small-scale structures and beaver activities, not just from larger more expensive projects.

Large-scale habitat effectiveness evaluation has led to the development of new approaches and methods to:(a) estimate juvenile salmon and steelhead abundance based on the production of benthic algae, (b) analyze mark-recapture data using the Barker Model, (c) relate fish abundance to habitat using the Quantile Regression Forest Model, and, (e) to improve effectiveness of measuring habitat across a wide area by determining that measuring more sites at intermediate levels (e.g., once every 3-years) is more effective than annually sampling fewer sites, (f) map floodplains, (g) assess thermal regime, and, (h) model hyporheic flow.

- Fish Propagation and Effectiveness of Supplementation

One important ***Relative Reproductive Success*** (RRS) finding is that estimates of RRS obtained by counting juvenile offspring per spawner closely predict those obtained by counting adult progeny per spawner. Measuring this way offers the benefit of larger samples and earlier results and appears to be comparable to that based on adult returns. The factors influencing relative reproductive success are both environmental and genetic. Results also indicate that steelhead appear to be more susceptible to inadvertent hatchery domestication than Chinook, and that the exclusive use of natural-origin broodstock appears to reduce domestication effects, at least in Chinook salmon. Reduction in RRS occurs during spawning or early juvenile rearing, not during ocean residence or migration to or from the ocean.

Genetics are an important area of work as well, and candidate genes for several of traits have been identified in both steelhead and Chinook. As these genes have been discovered, SNP markers from these regions are being incorporated into standard genotyping panels enabling the genetic variation in these traits to be assessed in large

numbers of individual fish. As global climate change continues to affect the Basin, the results of this study will help guide conservation efforts by indicating the evolutionary flexibility of the Basin's stocks to changes in precipitation, temperature, and other environmental factors.

Precocious Male Chinook (Mini-jacks) produced from the Basin's Chinook hatcheries production is likely in the millions annually. Research show that approaches such as low lipid diets, photoperiod manipulations, and use of food additives can be used to reduce early maturation rates. Releasing large numbers of fish that become residuals or minijacks has consequences for both fisheries' management and population recovery.

Effects of hatchery conditions on juvenile steelhead such as the use of underwater feeders, overhead cover, and low rearing densities are being evaluated to reduce selection for aggressive and surface-oriented juvenile steelhead. Research shows that these behaviors appear to be selected for in steelhead hatcheries that use traditional rearing methods. If heritable, those behaviors are not advantageous traits.

Growth trajectories of juvenile steelhead show differences in juvenile migration rates, tolerance to saltwater, marine residency, and adult behavior exist between the different growth trajectories. Some hatchery steelhead grow rapidly and become smolts (age-1) after a year of rearing. Others are slower growing and take two years (age-2) to become smolts. During different parts of the life cycle, growth and survival advantages will favor one or the other type of smolt.

C. Assess 2017 Research Plan's critical uncertainties addressed by these projects

It is not an easy task to answer key questions like are *we doing enough research*, *are we doing the right research* and *where are the gaps?* The Program has come a long way in identifying research questions that are or should be addressed through projects we fund. Since the ISAB/ISRP completed the Critical Uncertainties Report in 2016, the Council refined the list of uncertainties and themes. The staff cross-walked the projects that address uncertainties in the research plan (from the initial ISAB/ISRP report) and now will be able to better track research in the Program (Figure 1).

As part of the Review, we asked sponsors to verify the critical uncertainties connected with their work – both directly and indirectly. Connecting the projects with questions, is not always a one-to-one relationship and projects may contribute directly or indirectly to questions and may address multiple questions. The research topics addressed by these 25 projects cover 13 of the 14 themes in the 2017 Research Plan. Staff will continue to update the database to reflect sponsor and ISRP verification of uncertainties.

Some of the research investigations funded under the Program are long-term research work. Research projects with results that have the capability to influence management decisions or best practices (e.g. hatchery effectiveness) often evolve over time when results point to a new line of evidence. Many projects are implementing the FCRPS

BiOp requirements and Accords. The Council's greatest opportunities for influence are in Program development through the upcoming program amendment process and through project implementation. Project review improves the quality of implementation and creates regional dialogue that results in improving best practices, collaboration, information sharing and increase focus on addressing management questions. We discuss specific examples of this in our Programmatic Issues section below.

Part 2: PROGRAMMATIC ISSUES

Committee recommendations are divided into three Parts. Part 2 covers programmatic issues and recommendations. Part 3 covers project-specific assessment and recommendations for some individual projects. The individual project recommendations are also summarized on the attached spreadsheet – Part 4. The Council expects Bonneville and the sponsors to apply final Council recommendations contained in Parts 2-4 during continued implementation and future contract development.

The ISRP identifies several programmatic issues from this review, some of which include specific recommendations for the Council to consider. The Council also identifies overarching or programmatic issues, some of which overlap with the ISRP's issues. The Council summarizes four Council Programmatic issues below and outlines recommended path forward for each issue:

1. Habitat
2. Hatcheries
3. Information Sharing
4. Funding considerations and expectations

The Council's recommendations on programmatic issues are to be accorded the same weight as the project-specific implementation recommendations. In many cases the Council's programmatic recommendations are included as conditions for projects or used as part of a project's recommendation.

1. Habitat Programmatic Issue:

This review includes several projects long-term research and monitoring projects that aim to inform management decisions and guide restoration projects. Some of these projects focus on advancing our understanding of the effectiveness of actions at the project scale as well as at the watershed and population scale. The ISRP recognizes that these efforts are complex and could benefit from a coordinated habitat monitoring and evaluation approach that assesses and informs the region's investment in habitat actions. In late 2017, Council staff began working with the fish and wildlife managers, Bonneville, and NOAA to define a habitat monitoring and evaluation strategy. A BPA-NOAA-Council steering committee was formed to focus on habitat research, monitoring and evaluation. To ensure that the Program's information needs are addressed and that its habitat projects are informed and guided by this strategy, the Council will initiate a dialogue about forming a workgroup.

This strategy and workgroup would provide a regional approach to guide habitat actions, inform the region on habitat action effectiveness, and support Program progress assessment. The regional approach would provide the programmatic context for Program funded habitat projects, both RM&E and action implementation work, addressing the ongoing need identified by the Council during the 2012 RM&E project review and subsequent Council follow-up requests during 2013 and 2015 (read Council July 2017 memo for more background information). The strategy and the workgroup guidance will inform the 2020 Resident Fish and 2021 Anadromous Habitat and Hatchery category reviews.

Council Recommendation:
Continue supporting the RM&E steering committee's effort to define a habitat research, monitoring and evaluation strategy with the fish and wildlife managers. The Council will initiate a dialogue about forming a workgroup, which combined with the RM&E strategy would provide the regional approach needed as well as inform the 2020 Resident Fish and 2021 Anadromous Habitat and Hatchery category reviews.

2. Hatchery Programmatic Issue:

The ISRP highlights in its Programmatic comments the importance of fostering communication among researchers, managers, and decision-makers to provide information applicable to management issues. The ISRP identifies among the research projects involving fish propagation of salmonids two important topics that have broad applicability in the basin: (1) the effects of genetic and environmental factors on in-hatchery growth, maturation rates, and post-release behavior and survival; and (2) the effectiveness of hatcheries as a conservation tool for supplementing natural populations. The region could benefit from more information sharing related to the research findings with broad applicability and regional coordination on research priorities. Over the years, the Council has also recognized the need for a regionally coordinated approach for guiding hatchery monitoring and reporting on hatchery effects and effectiveness.

The Council recommends that a regional dialogue be initiated to discuss the creation of a workgroup to focus on addressing research needs related to fish propagation in the basin. This workgroup should develop an approach to assist in prioritizing research questions, to better align ongoing effectiveness project in the program, and serve to inform the 2021 Anadromous Habitat and Hatchery category review. The Council recommends that the workgroup include in their discussion topics the below three specific topics areas that continue to catch our attention and that are being addressed by these research projects:

1. Precocious Maturation (Mini and micro jacks): Production of minijacks creates challenges and consequences for fish managers and for population recovery. Minijacks are not smolts, but they are misreported as smolts in hatchery release statistics which causes corresponding errors in estimates of SAR, SAS, and R/S,

leading to erroneous conclusions about trends in smolt survival and the contribution of hatchery smolts to overall production. Minijacks also represent a substantial loss of anadromous adults that can contribute to harvests and recovery efforts, had they not matured precociously. The ISRP asserts that a single strategy to reduce minijack rates is not realistic based on the uniqueness of each facility and that individualized approaches should be developed. The Council understands that this issue is not new and there are many studies highlighting the issue of minijack production. The Council recommends that a regional dialogue with the hatchery managers and relevant research project sponsors (e.g., 200203100 and 200900900) be initiated through the anticipated workgroup to better understand the issues. Factors identified through research that can reduce early maturation rates may lead to tools and investment strategies to reduce minijack production.

2. Supplementation: This is a tool widely used as a conservation tool for fish populations in the Basin. It typically involves collecting local wild fish for hatchery broodstock and allowing adults produced from these integrated hatcheries to spawn naturally. However, there are continuing concerns about domestication selection and the effect of physiological, behavioral, morphological, and demographic differences between hatchery-origin (HO) and natural-origin (NO) fish. The Program is supporting a robust research effort to evaluate how modifications in broodstock origin, feeding and growth profiles, and the hatchery environment may reduce the degree of inadvertent domestication in cultured salmonids and other undesirable differences. The Council suggests that current research findings on this issue be shared broadly perhaps through a webinar meeting or as part of the anticipated workgroup. Some of the findings to-date show that during different parts of the life cycle growth and survival advantages will favor distinct pattern of growth trajectories of juvenile steelhead that may not be desirable. Sharing these research findings will advance understanding and could inform hatchery management decisions such as releases.

3. Relative Reproductive Success: This is an ongoing critical uncertainty that the Program identifies in its 2017 Research Plan and that has been the focus of several ongoing studies. Some of these research projects have found that the relative reproductive success of hatchery Chinook adults produced from natural origin parents is comparable to wild counterparts, if the fish spawn in the same locations and during the same time periods. Other studies focused on steelhead relative reproductive success have found causes linked to genetics, indicating that steelhead appear to be more susceptible to inadvertent hatchery domestication. Additionally, both genetic and environmental factors were found to influence the reproductive success of hatchery steelhead and Chinook when they spawn in nature. Disentangling the relative importance of these factors remains a daunting challenge but is key to redesigning hatchery operations that can minimize adverse and unintended effects. The Council believes that engaging in a regional dialogue through a workgroup would contribute to improved information sharing and coordination of work focused on advancing RRS knowledge.

Council Recommendation:
The Council recommends that a regional dialogue be initiated to discuss the creation of a workgroup to focus on addressing fish propagation in the basin. This workgroup[1] should develop an approach to assist in prioritizing research questions, to better align ongoing effectiveness of fish propagation projects in the program and serve to inform the 2021 Anadromous Habitat and Hatchery category review.

3. Information Sharing
To advance the region's understanding of critical uncertainties, research projects have an obligation to share their findings in a manner that can best inform regional efforts and the Council's Program Strategies and measures. This is particularly true for research with broad applicability – those that can inform broad sets of work (e.g. hatchery genetics). The ISRP made note, collectively across projects, and within individual project comments on the number of peer-reviewed publications in top-tier journals by these projects. They also noted where there was excellent collaboration among scientists and partners, and when methods and results of work are of importance both within and outside of the Basin. While many projects received high marks in this area, several of the projects received comments indicating the sponsors needed to make their findings more easily available.

The Council concurs with the ISRP's comments and provides guidance and measures for information sharing, consistent with the 2017 Research Plan, the Program and the Public Engagement Strategy. Best-available science should inform projects and contribute to having the most cost-effective work being implemented. Therefore, opportunities to collaborate and learn must be enhanced. To this end, the Council highlights some of the guidance from the Research Plan:

- Support publication and presentation of results to diverse audiences
- Facilitate sharing information such as through webinars, topic-based workshops, and forums
- Requests topic-based synthesis to inform management
- Annual reports completed using Bonneville's RM&E reporting template[2], and are up-to-date and publicly accessible online

Furthermore, the Council continues to emphasize the need to improve tacking of research to understand gaps and assess progress in resolving critical uncertainties.

Council recommendation:

[1] Workgroup should consider the Council's June 2011 RM&E/Artificial Production Project Review recommendation for Programmatic Issue #4 and build from the 2008 Ad Hoc Supplementation Monitoring and Evaluation Workgroup (AHSWG) as well as all available emerging research results.
[2] Information provided in annual reports and progress reports should state clear hypotheses, methods, timelines including the expected end-date.

1. *The Council recommends that annual project reports be submitted using Bonneville's reporting template[3], and these should be made publicly available.*

2. *The Council will, as necessary, sponsor forums, workshops, or conferences for review and synthesis of topics; request ISAB synthesis for certain topics; or request syntheses from project researchers. In their critical uncertainties report, the ISRP and ISAB highlighted the need for multi-entity partnerships to develop collaborative approaches to evaluate or to evaluate data from multiple projects and sources.*

3. *The Council encourages the sponsors and Bonneville to support participation in key scientific conferences, particularly for research projects that have with broad applications. This precipitation contributes to the collective capacity, knowledge and advancement of fish and wildlife researchers and restoration in the Basin.*

4. *The Council recommends that Bonneville, working with the Council and other program participants, identify, organize and track all research within Bonneville's project database. When projects include both research and monitoring and evaluation elements, the research components should be tracked as part of these coordinated research efforts. Additionally, the Council will continue updating the 2017 Research Plan Uncertainties Database to track progress in resolving uncertainties and identify gaps.*

4. Funding considerations and expectations

The Council's recommendations for projects in this review set do not include individual project budgets or annual budgets. Recommendations for implementation assume continued funding until the Council makes a recommendation otherwise. Bonneville has the flexibility to negotiate with sponsors through contracting to finalize work and budget, but that should result in maintaining project integrity as reviewed by ISRP. Bonneville may identify areas for cost savings through budget efficiencies, project mergers or project transition.

***Council Recommendation**:*
The Council's multi-year implementation recommendation includes the following general expectations:

1. *Bonneville will work with the Council to track and follow-up on items or project conditions that require the sponsor to deliver products as part of the recommendations.*

2. *Bonneville will work with sponsors to address ISRP qualifications and other conditions during contracting when and as recommended by the Council.*

[3] In its 2014 Fish and Wildlife Program, the Council called on Bonneville to require all research projects in their annual report to address hypotheses and critical uncertainties and provide an electronic summary of their results and interim findings, including benefits to fish and wildlife.

3. *Bonneville will provide adequate funding to maintain the integrity of the project as reviewed by the ISRP and recommended by the Council.*

4. *If budget actions from this set of project close-outs, mergers, or efficiencies occur and result in a contract savings of $50,000 or more, the Council expects that the savings be directed to the Cost Savings pool for funding emerging priorities.*

5. *The Council is in the process of amending the Fish and Wildlife Program and anticipates finalizing the program in the fall of 2019. Should there be significant changes in the existing program that would suggest or require changes in recommendations adopted by the Council; the Council may choose to revisit these recommendations through its normal public processes.*

6. *As the Council engages in regional discussions on programmatic issues on Habitat and Hatcheries, current priorities may change. Based on new regional guidance, priorities or direction, the Council may choose to revisit these recommendations through its normal public processes.*

Part 3: INDIVIDUAL PROJECT RECOMMENDATIONS

This section includes additional discussion and recommendations for a subset of individual projects, beyond the recommendation summary in Part 3. Spreadsheet.

Individual projects that require further discussion are discussed below:

- *Habitat Assessment in Blocked Areas – Project # 201600300*

The Council's 2014 Program includes a strategy for anadromous fish mitigation in blocked areas with a measure specific to exploring the feasibility of reintroducing salmon and steelhead above Grand Coulee and Chief Joseph dams. This project is a response to that measure and was completed with limited funds (~$125,000 from Program funding and ~$50,000 from the Colville Accord). The ISRP found this project to meet its objective and the methods to be scientifically sound. Both the project proponents and the ISRP identified areas that need further exploration, such as an analysis of the uncertainty of the Ecosystem Diagnosis and Treatment model outputs and additional Phase 1 pieces that are being conducted by other entities and with non-BPA funds. The project reviewed was complete based on what was contracted for with Program funding and represents part of the work required to complete Phase 1 investigation as described in the Council's program.

Recommendation: The Council encourages all parties involved in the completion of Phase 1 to consider the ISRP comments for future work. The Council recommends that the comprehensive set of Phase 1 results, as well as successive phases, receive science review by the ISRP to ensure the assessment of potential for the reintroduction continues to be scientifically sound.

- *Ocean Survival of Salmonids - Project # 199801400*

The Council's research and monitoring efforts related to the marine environment for anadromous fish began in 1998 in response to the 1996 amendment to the Northwest Power Act which calls on the Council to consider ocean conditions when making project funding recommendations. The Council's 2014 Fish and Wildlife Program recognizes the ocean environment as an integral component of the Columbia River ecosystem. Measures in the Program support monitoring the ocean conditions and in-river restoration actions to determine those actions of greatest benefit, to separate the effects of ocean-related mortality from that caused in the freshwater park of the life cycle, and to assess salmonid survival and evaluate restoration potential given variable ocean conditions. In 2012 the ocean program was reduced in implementation from two projects to one (60% program reduction), and the remaining project budget has been reduced by 53%.

The ISRP noted that the Ocean Survival of Salmonids project is an example of an excellent long-term monitoring project investigating factors that influence the early ocean distribution, timing, and survival of salmonids. The key finding is that ocean conditions are enormously influential and highly predictive of salmon returns, conditions that can conceal the effects of local restoration actions. These findings are important in the development of models that are used to investigate the impact of different proposed management actions (e.g., additional spill or habitat restoration actions) over the entire life cycle.

The project sponsor has indicated that at the current funding level, the project may need to be further reduced in scope in 2020. Changes in federal contracting requirements will not permit the project to contract with the research vessel that has been used for the last decade and cost increases are associated with a replacement vessel. In addition, reductions in the project budget will not be able to be absorbed while maintaining current researcher salary and effort. While the ISRP found that the project fully meets scientific review requirements and methods are sound, they could be improved. For example, methods currently used could be enhanced to strengthen estimates of salmon survival and estimating the abundance or biomass of salmon predators and prey. New fisheries-oceanographic ecosystem survey designs and methods could be considered.

Recommendation: The sponsor is requested to submit an updated proposal during the 2019 Mainstem/Program Support review and will undergo full review if there are scope changes. Consider ISRP comments as appropriate.

- *The Avian Predation Project – Project # 199702400*

The ISRP asserts that predation should be considered on a larger scale, considering the relative impacts of fish, bird and mammal predation at all stages in salmonid life history. And, that the critical question to be addressed is whether predation at

successive stages is compensatory, depensatory, or additive. While system-wide predation issues are beyond the scope of the Avian Predation project, regional discussions on systemwide predation are occurring now. These questions may be considered in that regional context.

Recommendation: The Avian Predation project should address ISRP qualifications and questions with respect to avian predators.

- *Sturgeon Genetics – Project # 200850400*

This project is key to supporting work associated with Project #2007-155-00, Sturgeon Strategic and Hatchery Master Plan and Project #2008-455-00, Sturgeon Management. There are several objectives in the project including: (a) evaluate population differentiation and migration (gene flow) among reservoirs; (b) determine relatedness, mean productivity, and number of spawners within each reservoir; and (c) characterize broodstock by identifying origins (i.e., reservoir or population) and degree of relatedness among candidate broodstock fish, (d) quantify adaptive variation within and among the sampled populations, and (e) search for a sex-linked marker that can be used to sex sturgeon at any age. This project continues to an important sturgeon support project that assists managers in the basin, regarding sturgeon management and evaluation.

Recommendation: Continue to review the components of this work in context with the other sturgeon project reviews, the sturgeon master planning process and research component progress reviews as they occur. In addition, the Council would like to see a progress or final report by the end of 2019 on the recently funded expansion (through cost-savings) on the genomic sequencing to find a sex identification methodology for sturgeon.

- *Relative Reproductive Success - Projects 200303900, 200305400, 200306300 and 201003300.*

This set of projects went through a policy review in 2017, and this review by the ISRP for progress. Studies to date have revealed that RRS between hatchery and naturally spawning fish can be reduced in a variety of ways. Because of this complexity, a more detailed conceptual framework is needed to predict how different species or populations will respond to hatchery supplementation and to allow managers to make better case-specific decisions. The ISRP believes that an updated synthesis similar to Christie et al. (2014) is needed to make progress toward such a framework. They suggest that any new effort to synthesize results across the RRS studies should consider the history of hatchery influence prior to and during each study. Many of the projects reviewed are expected to report their most valuable results over the next few years. At that time, an updated synthesis of findings will be especially valuable. The ISRP is reassured that the RRS studies are on track and that proponents are collaborating and sharing information effectively.

Recommendation: Bonneville to work with the sponsors on a coordinated reporting of results as a "synthesis" review. Bonneville and the sponsors are requested to present

this progress report/results to the Council and ISRP in summer of 2020; close to when these projects will be wrapping up, and ahead of the 2020 Anadromous Habitat and Hatchery Review.

Research Project Progress Review

ID	Title	Project Proponent	Meets ISRP Criteria?	Recommendations for Implementation	Recommended Next Review Cycle	Accord	End Date (w/ link to narrative)	SOY FY 2018 Budget or 2019 (when available)
Ocean Research, Monitoring, and Evaluation								
199801400	Ocean Survival of Salmonids	National Oceanic and Atmospheric Administration	Yes	Recommendation: Sponsor is requested to submit an updated proposal during the 2019 Mainstem/Program Support review and will undergo full review only if there are scope changes. Consider ISRP comments as appropriate.	2019 - Mainstem/Program Support (update proposal form only)	No	No set end point	$1,019,325
Avian Predation								
199702400	Avian Predation on Juvenile Salmonids	Oregon State University, Real Time Research	Qualified	Recommendation: Sponsor is requested to submit an updated proposal for future work in the 2019 Mainstem/Program Support Review. This update should also address the ISRP qualification related to the additive and compensatory avian predation effects only.	2019 - Mainstem/Program Support	No	No set end point	$535,341
Snake River Fall Chinook Life History								
200203200	Snake River Fall Chinook Salmon Life History Investigations	Pacific Northwest National Laboratory, University of Washington, US Fish and Wildlife Service (USFWS), US Geological Survey (USGS)	Qualified	Recommendation: Bonneville and the sponsor have agreed to merge this project with project #1991-029-00. The Sponsor is requested to submit a proposal in 2019 Mainstem/Program Support review for the newly combined project under the project number 1991-029-00. The proposal should address the ISRP comments for this research project regarding adaptive management and public outreach and any unaddressed ISRP from previous reviews for project # 1991-029-00 as appropriate. See programmatic issues for Information Sharing and Hatcheries.	2019 - Mainstem/program Support	No	No set end point.	$1,065,569
Fish Tagging Technology Development								
198331900	New Marking and Monitoring Technologies	National Oceanic and Atmospheric Administration	Qualified	Recommendation: Sponsor is requested to submit an updated proposal in 2019 Mainstem/Program Support review and address ISRP qualifications on reporting results, outreach, and prioritizing work. See programmatic issue for Information Sharing, Habitat and Hatcheries.	2019 - Mainstem/Program Support	No	Not specified.	$867,216
Reintroduction of Anadromous Fish to Blocked Areas								

201600300	Habitat assessment in blocked areas	Spokane Tribe	N/A	Recommendation: This project is complete and this was a results-review only. The Council encourages all parties involved in the completion of Phase 1 to consider the ISRP comments for future work. The Council recommends that the comprehensive set of Phase 1 results, as well as successive phases, receive science review by the ISRP to ensure the assessment of potential for the reintroduction continues to be scientifically sound.	N/A	No	Complete	$0
Habitat Status and Restoration Effectiveness Research and Monitoring								
201600100	BPA Project Action Effectiveness Monitoring (AEM) Programmatic	Cramer Fish Sciences, Natural Systems Design	Qualified	Recommendation: This project has never submitted a proposal for ISRP reivew and recommendation by the council. The project sponsor is requested to submit a project proposal in the 2019 Mainstem/Program Support Review that addresses all ISRP qualifications from this review. The sponsor may be asked to submit an updated proposal in the 2021 Anadromous Habitat and Hatchery Review pending outcome of current Habitat Effectiveness framework. See Programmatic Issue for Habitat.	2019 - Mainstem/Program Support	No	No set end point	$1,089,988
200301700	Integrated Status and Effectiveness Monitoring Program (ISEMP)	National Oceanic and Atmospheric Administration	N/A	Recommendation: Project is closing out. Bonneville should ensure that all data, methods and tools that were developed from this project, along with metadata and documentation, are properly archived and made easily findable through a publicly accessible website.	N/A	No	Complete	$0
201100600	Columbia Habitat and Monitoring Program - (CHAMP)	National Oceanic and Atmospheric Administration	N/A	Recommendation: Project is closing out. Bonneville should ensure that all data, methods and tools that were developed from this project, along with metadata and documentation, are properly archived and made easily findable through a publicly accessible website.	N/A	No	Complete	$0
200900400	Monitoring Recovery Trends in Key Spring Chinook Habitat Variables and Validation of Population Viability	Columbia River Inter-Tribal Fish Commission (CRITFC)	Qualified	Recommendation: Sponsor is requested to submit an updated proposal for the 2021 Anadromous Habitat and Hatchery Review that addresses all ISRP qualifications. See Habitat Programmatic Issue.	2021 - Anadromous Habitat and Hatchery	Yes	2022	$990,081
200725200	Hyporheic Flow Assessment in Columbia River Tributaries	Umatilla Confederated Tribes (CTUIR)	Qualified	Recommendation: Sponsor is requested to submit an updated proposal for the 2019 Mainstem/Program Support review that addresses all ISRP qualifications. See Habitat Programmatic Issue.	2019 - Mainstem/Program Support	Yes	10 years	$179,563

200901400	Biomonitoring of Fish Habitat Enhancement	Umatilla Confederated Tribes (CTUIR)	Qualified	Recommendation: The sponsor is requested to submit an updated proposal in the 2021 Anadromous Habitat and Hatchery Review addressing ISRP qualifications on providing a project framework that describes the research and monitoring path for future activities, and that includes clear, quantitative objectives and an adaptive management strategy. See Habitat Programmatic Issue.	2021 - Anadromous Habitat and Hatchery	Yes	10+ years	$365,686
Freshwater Mussels								
200203700	Freshwater Mussel Research and Restoration	Umatilla Confederated Tribes (CTUIR)	Qualified	Recommendation: The sponsor is requested to submit an updated proposal to the 2019 Mainstem/Program Support Review that addresses ISRP qualifications.	2019 - Mainstem/Program Support	Yes	Not specified.	$393,000
Resident Fish Habitat Enhancement and Passage								
200811100	Twin Lakes Enhancement	Colville Confederated Tribes	N/A	Recommendation: Project closing out. Council encourages sponsor to publish results and disseminate to a broad audience.	N/A	Yes	Complete	$14,013
200724600	Restoration of Bull Trout Passage at Albeni Falls Dam	Kalispel Tribe	Qualified	Recommendation: The sponsor is requested to submit an updated proposal for the 2020 Resident Fish Review that addresses all the ISRP qualifications.	2020 - Resident Fish and Sturgeon	Yes	2024	$599,542
Fish Genetics, Salmonid Supplementation, and Hatchery Reform								
200850400	Sturgeon Genetics	Columbia River Inter-Tribal Fish Commission (CRITFC)	Yes	Recommendation: Sponsor is requested to submit an updated proposal during the 2010 Resident Fish and Sturgeon review and will undergo full review only if there are scope changes. The updated proposal will be reviewed in context with the sturgeon projects (contextually) and in context with the sturgeon Master Plan process. Consider ISRP comments as appropriate. The Council also requests a progress or final report by the end of 2019 on the 2017/2018 solicitation expansion for genome sequencing to discover a sex-linked marker for gender ID.	2020 - Resident Fish and Sturgeon (update proposal form only - contextual review)	Yes	No set end point	$43,675
200890700	Genetic Assessment of Columbia River Stocks	Columbia River Inter-Tribal Fish Commission (CRITFC)	Yes	Recommendation: This project to be reviewed as part of the 2021 Anadromous Habitat and Hatchery Review. Consider ISRP comments in proposal as appropriate. See programmatic issue on Fish Propagation.	2021 - Anadromous Habitat and Hatchery	Yes	No set end point	$930,938
200900500	Influence of Environment and Landscape on Salmonid Genetics	Columbia River Inter-Tribal Fish Commission (CRITFC)	Yes	Recommendation: This project to be reviewed as part of the 2021 Anadromous Habitat and Hatchery Review. Consider ISRP comments in proposal as appropriate. See programmatic issue on Fish Propagation.	2021 - Anadromous Habitat and Hatchery	Yes	No set end point	$152,863

200900900	Basinwide Supplementation Evaluation	Columbia River Inter-Tribal Fish Commission (CRITFC)	Yes	Recommendation: This project to be reviewed as part of the 2021 Anadromous Habitat and Hatchery Review. Consider ISRP comments in proposal as appropriate. See programmatic issue on Fish Propagation.	2021 - Anadromous Habitat and Hatchery	Yes	2022	$775,000
198909600	Genetic Monitoring and Evaluation (M&E) Program for Salmon and Steelhead	National Oceanic and Atmospheric Administration	Qualified	Recommendation: Sponsor is requested to submit an updated proposal in the Mainstem/Program Support Review, including a timeline for completing current research. Consider ISRP comments in proposal as appropriate. See programmatic issue on Fish Propagation.	2019 - Mainstem/Program Support	No	No set end point	$487,842
199305600	Advance Hatchery Reform Research	National Oceanic and Atmospheric Administration	Yes	Recommendation: Sponsor is requested to submit an updated proposal in the Mainstem/Program Support Review, including a timeline for completing current research. Consider ISRP comments in proposal as appropriate. See programmatic issue on Fish Propagation.	2019 - Mainstem/Program Support	No	2024	$590,897
200203100	Growth Modulation in Salmon Supplementation	National Oceanic and Atmospheric Administration, University of Washington	Yes	Recommendation: Sponsor is requested to submit an updated proposal in the Mainstem/Program Support Review, including a timeline for completing current research. Consider ISRP comments in proposal as appropriate. See programmatic issue on Fish Propagation.	2019 - Mainstem/Program Support	No	2022	$356,678
Relative Reproductive Success (RRS)								
200303900	Monitor and Evaluate (M&E) Reproductive Success and Survival in Wenatchee River	National Oceanic and Atmospheric Administration, Washington Department of Fish and Wildlife (WDFW)	Yes	Recommendation: Implement current work through end of FY 2020. Consider ISRP comments as appropriate. Sponsors are requested to participate in a RRS results review in summer on 2020. The sponsors are encouraged to work on a joint synthesis with Bonneville and other RRS projects (200303900, 200305400, 200306300 and 201003300) for the 2020 synthesis review. See programmatic issue on Fish Propagation.	RRS Results Synthesis Review Summer 2020	No	2021	$496,743
200305400	Evaluate the RRS of Hatchery-Origin and Wild-Origin Steelhead Spawning Naturally in the Hood River	Oregon State University	Yes	Recommendation: Implement current work through end of FY 2020. Consider ISRP comments as appropriate. Sponsors are requested to participate in a RRS results review in summer on 2020. The sponsors are encouraged to work on a joint synthesis with Bonneville and other RRS projects (200303900, 200305400, 200306300 and 201003300) for the 2020 synthesis review. See programmatic issue on Fish Propagation.	RRS Results Synthesis Review Summer 2020	No	2020	$301,526

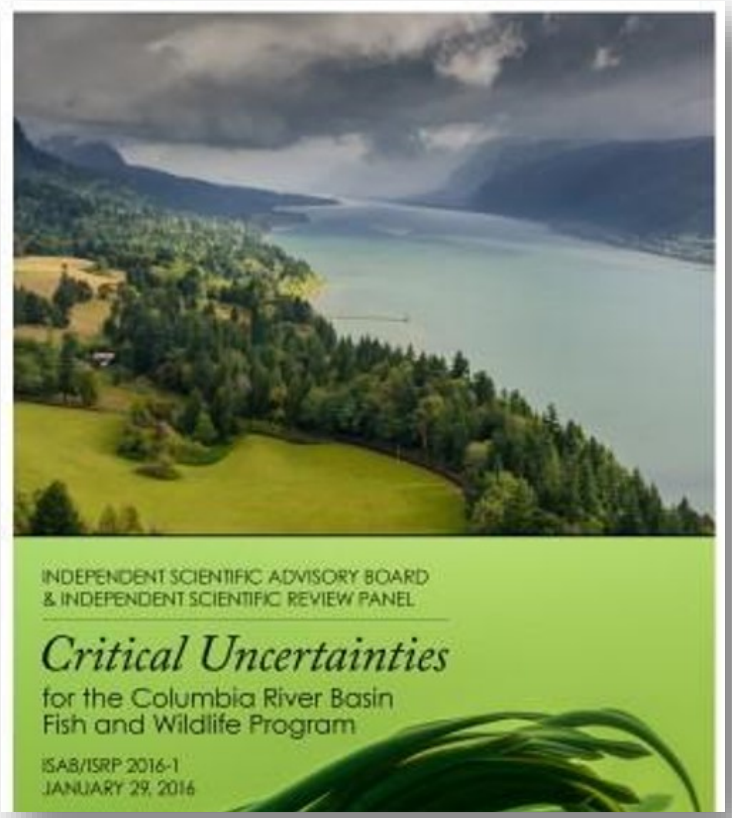
200306300	Natural Reproductive Success and Demographic Effects of Hatchery-Origin Steelhead in Abernathy Creek, Washington	US Fish and Wildlife Service (USFWS)	Qualified	Recommendation: Implement current work through end of FY 2020. Consider ISRP comments as appropriate. Sponsors are requested to participate in a RRS results review in summer on 2020. The sponsors are encouraged to work on a joint synthesis with Bonneville and other RRS projects (200303900, 200305400, 200306300 and 201003300) for the 2020 synthesis review. See programmatic issue on Fish Propagation	RRS Results Synthesis Review Summer 2020	No	Complete	$146,549
201003300	Study Reproductive Success of Hatchery and Natural Origin Steelhead in the Methow	Washington Department of Fish and Wildlife (WDFW)	Yes	Recommendation: Implement current work through end of FY 2020. Consider ISRP comments as appropriate. Sponsors are requested to participate in a RRS results review in summer on 2020. The sponsors are encouraged to work on a joint synthesis with Bonneville and other RRS projects (200303900, 200305400, 200306300 and 201003300) for the 2020 synthesis review. See programmatic issue on Fish Propagation	RRS Results Synthesis Review Summer 2020	No	2025	$233,529
								$11,635,564

2018 Research Project Progress Review

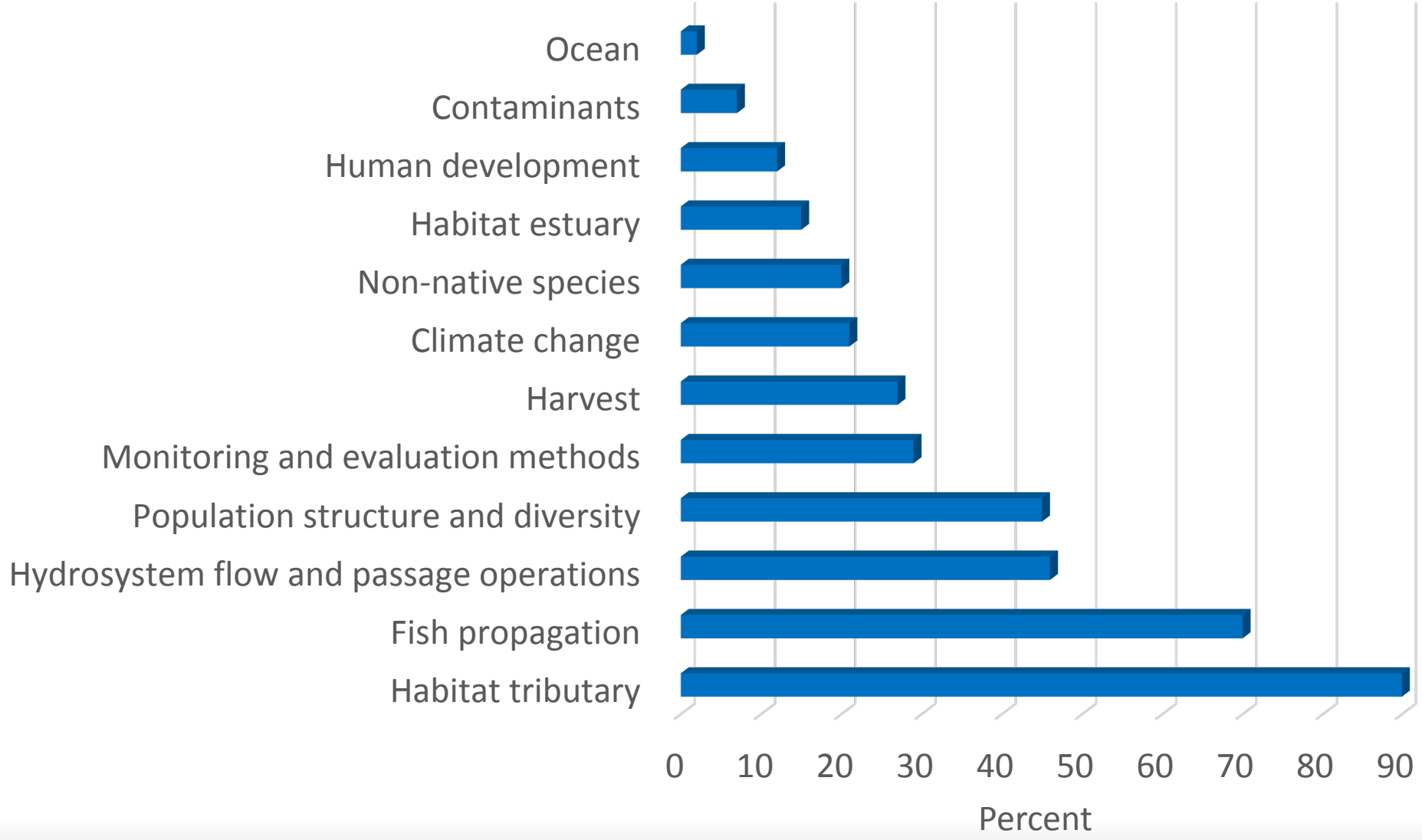
Overview, ISRP Assessments, Scientific Results Highlights, and Recommendations

Guidance for research progress review

- 2014 Fish and Wildlife Program
  - Called for updating the 2006 Research Plan
- 2016 ISAB/RP Critical Uncertainties Report



Percent 2006 Themes Coverage by All Projects with Research Elements

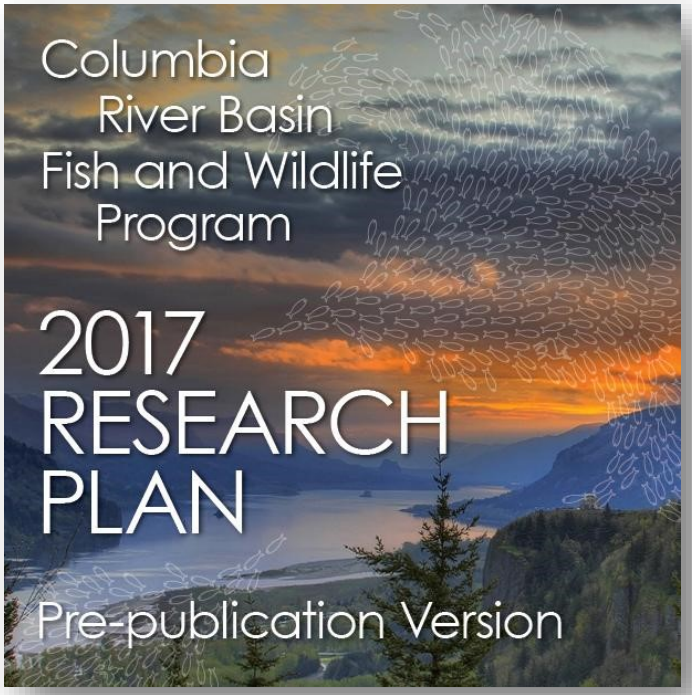


Note Data from ISAB/RP 2016 Critical Uncertainties Report. Themes do not match the revised 2017 Research Plan Themes (e.g., Public Engagement and Mainstem Habitat)

Guidance for research progress review

2017 Research Plan applies to:

- projects that are exclusively research,
- effectiveness monitoring projects, and
- projects that contain research elements



Guidance for research progress review

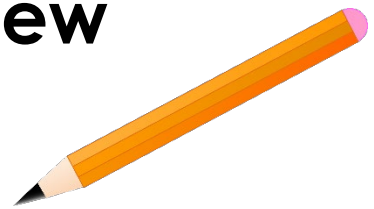
- 2018 Research Project Inventory - results

175 projects reviewed

25 Big R projects

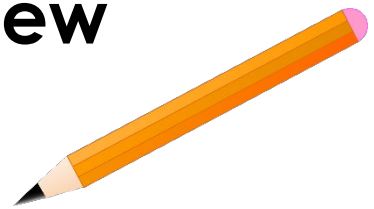
>65 projects with research components

Research Project Progress Review



- Summer review
- Focused on results and findings
- Narrative, annual reports, published papers
- Critical uncertainties check
- Presentations

Research Project Progress Review Outcomes



- Help improve individual projects
- Inform the upcoming larger category reviews
- Update critical uncertainties database
- Track ongoing research in the program
- Support and facilitate sharing of results
- Programmatic issues--program improvements / improved understanding

Commendations from the ISRP

- Appropriate diversity of critical uncertainties
- Valuable results to the Program
- Collaboration among researchers
- Numerous peer-reviewed publications
- Well-designed studies and advancing knowledge
- Forward thinking and innovative

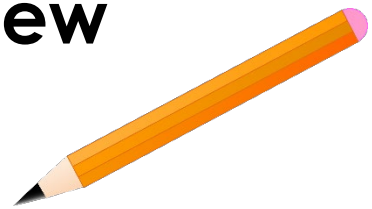
25 projects reviewed primarily research

General Topic	Sub-Topic	Project
Evaluating Fish & Wildlife	Evaluating Survival, Migration Rates, Movements Among Habitats, & Growth	• New Marking and Monitoring Techniques • Ocean Survival of Salmonids • Avian Predation on Juvenile Salmonids • Snake River Fall Chinook Salmon Life History Investigations • ISEMP • Restoration of Bull Trout Passage at Albeni Falls • Genetic Assessment of Columbia River Salmonid Stocks • Basinwide Supplementation Evaluation • Freshwater Mussel Research and Restoration
	Measuring the Genetic Diversity of Populations	• Sturgeon Genetics • Influence of Environment and Landscape on Salmonid Genetics

General Topic	Sub-Topic	Project
Evaluating Habitat	Single Factor Effects on Habitat Suitability	• Hyporheic Flow Assessment in Columbia River Tributaries • Twin Lakes Enhancement
	Habitat Restoration Effects at Different Scales	• Monitoring Recovery Trends in Key Spring Chinook Habitat…. • Biomonitoring of Fish Habitat Enhancement • BPA Action Effectiveness Monitoring • ISEMP/CHaMP

General Topic	Sub-Topic	Project
Fish Propagation	Improving Hatchery Culture Methods	• Advance Hatchery Reform Research • Growth Modulation • Evaluate the RRS of Hatchery-origin & Wild Steelhead…Hood River • Natural RS and Demographic Effects of Hatchery-Origin Steelhead…Abernathy Cr. • Basinwide Supplementation Study • Study RS of Hatchery and Natural Origin Steelhead in the Methow
	Evaluating the Genetic Effects of Supplementation	• Genetic Monitoring and Evaluation Program for Salmon & Steelhead • Monitor and Evaluate RRS of Spring Chinook in the Wenatchee • Natural RS and Demographic Effects of Hatchery-Origin Steelhead…Abernathy Cr. • Basinwide Supplementation • Study RS of Hatchery and Natural Origin Steelhead in the Methow

Research Project Progress Review
ISRP Final Report



- Projects meeting ISRP scientific review criteria
  - 10 meets
  - 11 qualified
  - 4 completed or phasing out
- ISRP Programmatic Issues
  - vary in detail and purpose.
  - issues flagged for additional attention or research

ISRP Programmatic Issues

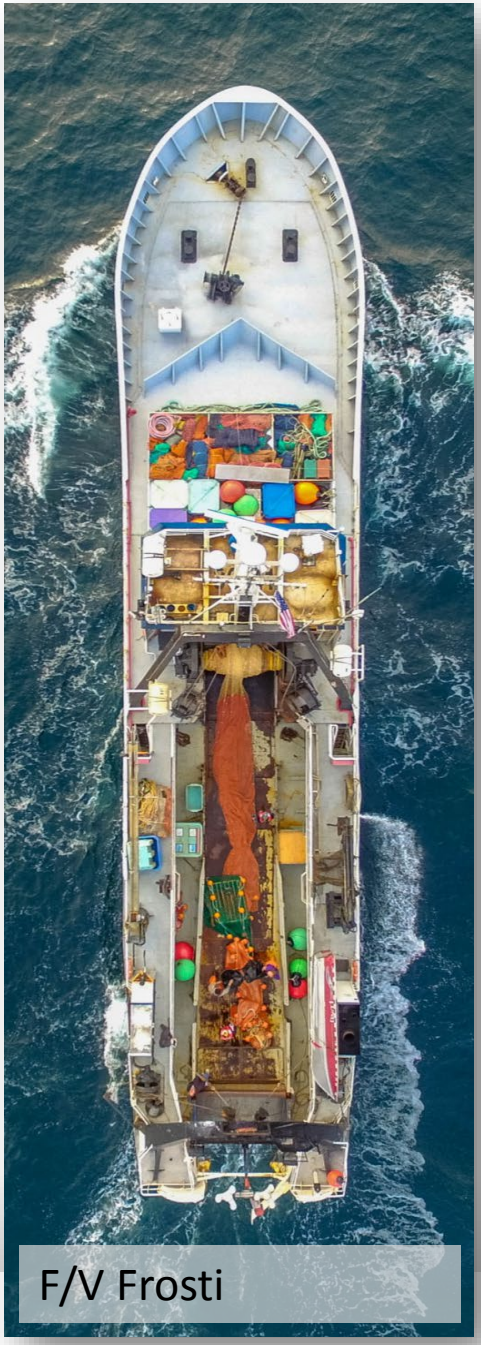
1. Information sharing
2. Need for long-term monitoring complex ecosystems
3. Predation: avian and ecosystem wide
4. Value of Molecular Genetics labs
5. Expanding PBT and GSI tagging
6. Climate change
7. Reintroduction of anadromous fish – blocked areas
8. Design of future habitat effectiveness monitoring
9. Supplementation
10. Precocious maturation in hatchery-reared Chinook
11. RRS studies – Synthesizing results to date

What are we learning?
Fish and Wildlife Populations

Highlights

Genetic monitoring methods are advancing rapidly, improving accuracy of genetic assignments and detecting link between genetics and adaptation to habitat conditions.

Ocean conditions are enormously influential and **highly predictive of salmon returns,** conditions that can hide the effects of local restoration.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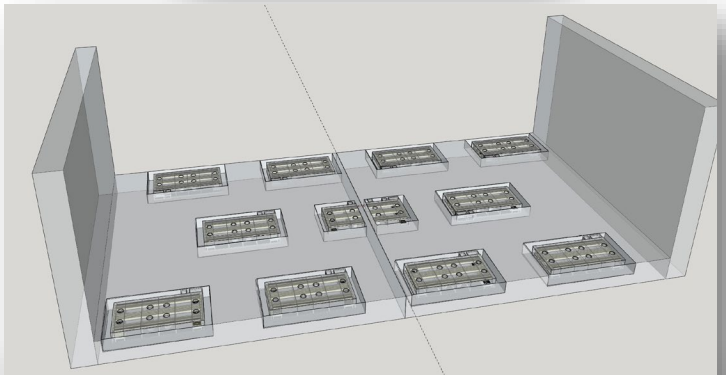
What are we learning?
Fish and Wildlife Populations

Highlights

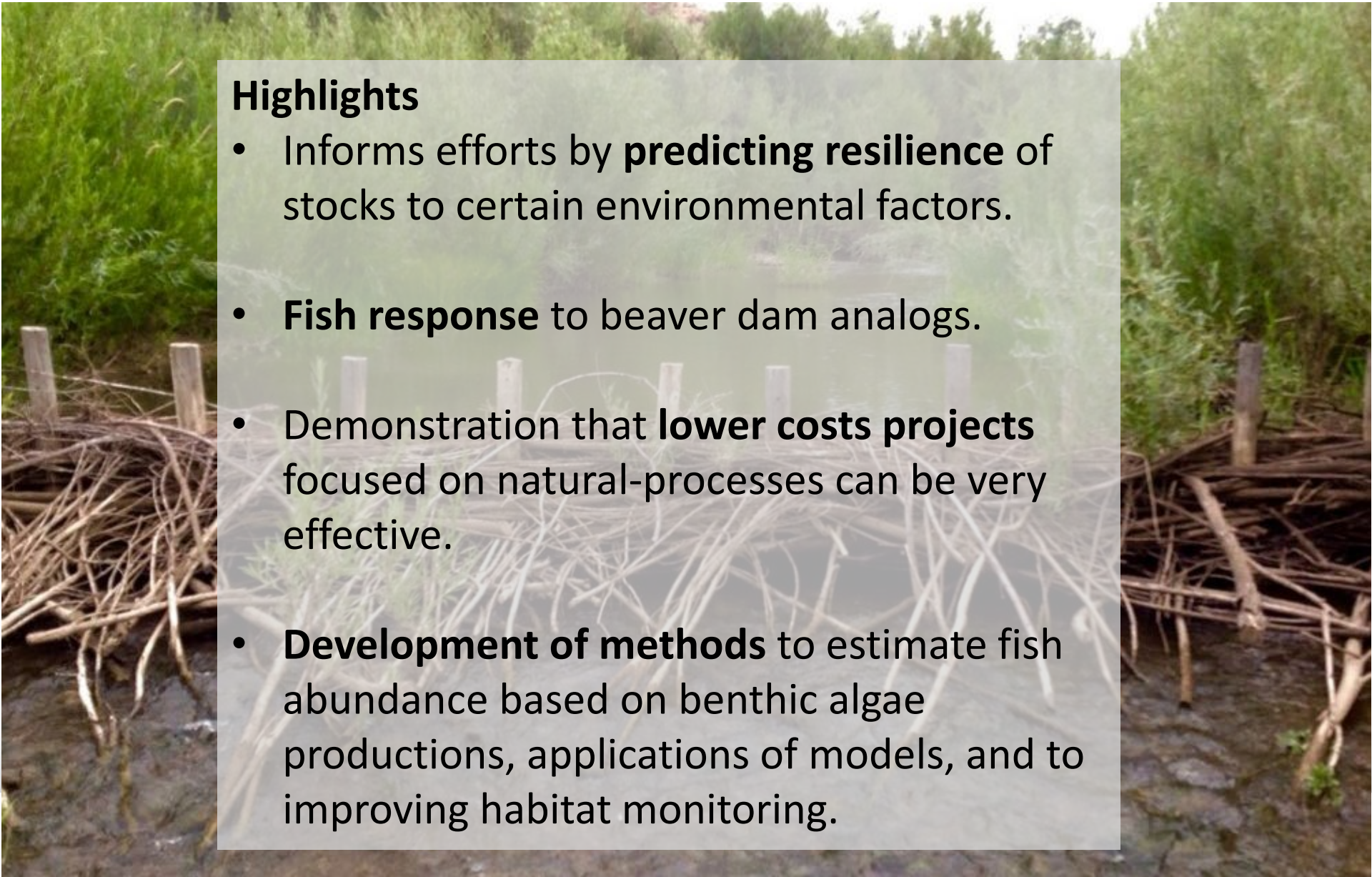
Research on **native mussels** is advancing our understanding of their ecology, distribution, and use as sentinel species.



Spillway PIT Tag Detector Array

PIT-Tag detection has decreased in the mainstem by about 50%, requiring **new technologies** to improve fish detection in PIT arrays.

What are we learning?
Evaluating Habitat and Effectiveness of Actions



Highlights

- Informs efforts by **predicting resilience** of stocks to certain environmental factors.
- **Fish response** to beaver dam analogs.
- Demonstration that **lower costs projects** focused on natural-processes can be very effective.
- **Development of methods** to estimate fish abundance based on benthic algae productions, applications of models, and to improving habitat monitoring.

What are we learning?
Fish Propagation: Effectiveness/Supplementation

Highlights

Relative Reproductive Success (RRS) - steelhead appear more susceptible to inadvertent hatchery domestication than Chinook

Genetics - identified steelhead and Chinook genes for several traits show ability to respond to changes in environmental factors.

Precocious male chinook (Mini-jacks) - low lipid diets, photoperiod manipulations, and use of food additives can reduce early maturation rates.

Programmatic Issue: **Habitat**

ISRP:

- Long-term R&M projects to inform decisions/restoration
- Use existing protocols and monitoring sites as foundation
- Proper scaling of approaches
- Complex work can benefit from regional guidance

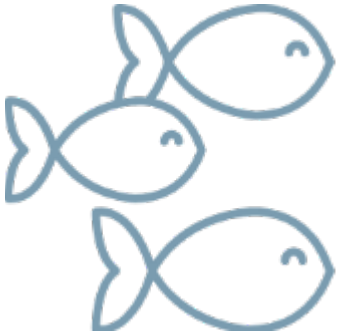
Committee Recommendation:

- Continue current effort of Council-NOAA-BPA Steering Committee on habitat RM&E for a regional approach
- Expand to form workgroup with Managers

Programmatic Issue: **Hatcheries**

ISRP:

- Supplementation
- Precocious Maturation of Chinook
- RRS studies



Committee Recommendation:

- Initiate a dialogue with F&W Managers and Hatchery managers on prioritizing questions and tools to address some of these issues. (Consistent with past recommendations)

Programmatic Issue:
Information exchange

ISRP:

- Support publication, presentation of results, accessibility
- Topic-based synthesis to inform management
- Future topic based webinars, workshops and forums

Committee Recommendation:

- Continued research work tracking & timely reporting
- Support sharing of research results
- Continued topic or issue focused exchanges

Project Specific Recommendations

- 4 projects closing
- 10 projects
  - address recommendations during Mainstem/Program Support category review (2019)
- 4 RRS projects
  - Results synthesis review summer 2020
- 2 projects
  - Address recommendations during Resident Fish/Sturgeon category review (2020)
- 5 projects
  - Address recommendations during Anadromous category review (2021)