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January 27, 2011

MEMORANDUM

TO: Committee Members

FROM: Staff

SUBJECT: Update on RM&E/AP category recommendation development

The Fish and Wildlife Committee had a work session on January 19th, to discuss the approach and schedule for developing project recommendations, and also a high-level discussion on a handful of programmatic issues. Provided below is a summary from the work session.

Approach for developing recommendations

The Committee spent considerable time discussing the approach for how the Council as a whole moves forward with developing recommendations for this category. All agree on moving forward with project recommendations in a timely manner and to work with Bonneville to minimize impact to the contracting process for FY 2012. However, based on the need to resolve some cross-cutting issues for particular groups of projects, or projects with project-specific issues to resolve, the projects are likely to come forward in a staggered approach over the next couple of months. The committee will discuss the staggered approach in more detail at the February committee meeting. Discussions are ongoing in the interim among committee members. Based on these discussions, the committee is working to further define upcoming tasks with the first task being to identify the subset of projects that may be moved forward soon with a funding recommendation.

Programmatic Issues

Staff presented a preliminary list of programmatic issues and the associated projects with each issue. The issues are presented in template form for consistency and outline: the issue, background and staff comments, the ISRP comments, the projects involved, and the funding for that set of projects. The members discussed the format of the template, but not the substance of the issues.

The initial programmatic issue set includes:

- Intended outcomes of the RM&E/AP category review
- Habitat effectiveness monitoring and evaluation
- Sturgeon
- Ocean
- Estuary
- Lamprey
- Artificial Production (new)
- Food web implications
- Tagging (new)
 - Coded-wire tags
 - PIT tags, acoustic tags and radio tags
- A ‘catch all’ document that includes the issues of predation, water transactions, eulachon, enforcement and implications for regional coordination.

Attached are the new or updated issue papers since the January work session. Additional updates or new issue papers will be shared with Committee members and state staff as they are developed.

A programmatic “punch list” was presented that represents a distillation of 40 actions either *suggested* or *recommended* by the ISRP in the Programmatic Issue Report. The items cover everything from identified “gaps” or “must-haves” to “nice-to-haves” and are listed by issue area. While we might address or resolve a subset of these items through this review, it is not intended to be a comprehensive list of actions we need to take or implement at this time. This is a resource we will draw from, along with other information, in shaping the Council's programmatic and project recommendations. An updated version of the “punch list” is attached.

Budget

The Committee is interested to know and understand what percent of the program is spent on research, monitoring and evaluation. Understanding what we currently spend will help to guide any future policy decisions on investments in this particular area. Staff provided a table that summarized the percent and dollar amounts -- current and proposed -- for RM&E work elements in the RM&E / AP portfolio. The proposed funding for FY 12 and beyond-- for this category -- is roughly \$85 million/year. Both the Council and Bonneville are interested in landing on a transparent, replicable number that represents the most accurate account of RM&E funding in the entire program to use a point of reference for decision making in this category. Bonneville and Council staff are working to have a number that best represents RM&E spending in the program by February 8th.

***DRAFT* Programmatic Issue: Habitat Effectiveness RM&E**

Issue:

The Council's Fish and Wildlife Program depends heavily on actions intended to protect or improve habitat characteristics as the way in which the Program will ultimately protect, mitigate and enhance fish and wildlife populations adversely affected by the hydrosystem. So, too, does the FCRPS Biological Opinion. For this reason, monitoring and evaluating the effects of our habitat actions, and using what we learn to adapt the implementation and management of the Program, is probably *the* critical programmatic issue in the RM&E review. Yet all of the elements of the habitat effectiveness monitoring and evaluation effort are in flux or under development -- the precise contours of the status and trend monitoring of habitat and population characteristics, the distinct but related role of the cause-and-effect "intensively monitored watershed" research effort, and especially the analytical methods and procedures that will be used to evaluate all of this information and report on what is being learned. So, the Council still needs clarity and further definition on the monitoring and especially the evaluation and reporting elements of the habitat effectiveness m&e. The Council should not conclude this review without being comfortable that there is place the monitoring and evaluation protocols and methods that give us a reasonable chance of knowing -- in five, ten, twenty years -- whether the region's huge investment in an evolving suite of habitat actions is contributing significantly to the recovery and rebuilding of fish species important to the region.

Background -- detailed description of the issue

The Council's Fish and Wildlife Program is "a habitat-based Program," aiming "to rebuild healthy, naturally producing fish and wildlife populations by protecting, mitigating, and restoring habitats and the biological systems within them." The Program depends heavily on actions in the mainstem, estuary, and tributaries intended to protect or improve habitat characteristics as the way in which the Program will ultimately protect, mitigate and enhance fish and wildlife populations adversely affected by the hydrosystem. The FCRPS Biological Opinion is built on the same conceptual foundation. The analysis supporting the conclusions in the Biological Opinion includes quantitative estimates of the improvements in life-stage survival to be gained from habitat actions in all areas.

More precisely, the Council's Program and the Biological Opinion call for hundreds if not thousands of individual habitat actions (to cost hundreds of millions of dollars) that are intended to improve the physical and biological characteristics of the river relevant to the fish species of interest. We do so with an expectation that these changes in river characteristics will improve the survival, productivity or capacity of the species during the relevant life-stage targeted by the action (spawning, rearing, migration, etc.), with the further expectation that these life-stage improvements in population characteristics will contribute significantly to improvements in the overall productivity, abundance or diversity of the targeted species. Yet every step or relationship in this construct is essentially an informed hypothesis, with particular uncertainty as to the nature and extent of the relationship between changes in habitat characteristics and measurable and predictable changes in population characteristics.

For this reason, monitoring and evaluating the effects of our habitat actions, and using what we learn to adapt the implementation and management of the Program, is *the* critical programmatic issue in the RM&E review. The existing projects and proposals in this review include dozens of projects that are intended to assess whether the habitat work is having the desired impact on fish. These assessments are to occur at the watershed or reach scale depending on the effectiveness they are testing, i.e., cause and effect at the population level (Intensively Monitored Watersheds or IMWs, part of the Integrated Status and Effectiveness Monitoring Program or ISEMP), habitat status and trends which can be correlated to fish status and trend at the watershed scale (the Columbia Habitat Monitoring Program or CHaMP), or project-level impacts (project effectiveness/post-implementation effectiveness). Combined these projects call for investments of tens of millions of dollars in “habitat effectiveness” monitoring, evaluation and research. At the conclusion of this review, the Council and the region have to be comfortable that we have shaped this body of proposed work so as to set in place monitoring and evaluation protocols that give us a reasonable chance of knowing -- in five, ten, twenty years -- whether the region’s huge investment in an evolving suite of habitat actions is contributing significantly to the recovery and rebuilding of fish species important to the region.

The review to date, including the ISRP’ review report, indicates that we still have significant work to do to reach this comfort level. While the key question is whether the habitat m&e framework as a whole is appropriate to allow us to monitor and evaluate the critical relationships between habitat actions and population improvements, important questions along the way include:

- Are analytical methods and procedures (and reporting procedures) in place sufficient to produce meaningful results in terms of understanding the effects of habitat protection and improvement actions? Are the evaluation methods themselves proven or similarly uncertain? Are there actions we can take to improve the reliability or certainty of the evaluation methods, or to spread or dampen the risk of uncertainty?
- Is it clear what parameters at what sites will be chosen for the purpose of monitoring changes in habitat and population characteristics? Do we have sufficient reason to be confident this is the best information to collect for use in evaluating the effectiveness of habitat actions? Are the disparate monitoring efforts properly coordinated and standardized to an appropriate degree?
- What is the appropriate magnitude or scale for the habitat monitoring and evaluation effort? The proposals going forward may ramp up the amount and total cost of habitat monitoring. Will this result in redundant or excessive habitat m&e? How clear are the plans to remove unneeded project-level monitoring once the programmatic approach is implemented?

There are reasons to be concerned about, or at least uncertain about, the answers to any of these questions. The ISRP expressed these concerns well in its programmatic report, concerns that others have identified as well (pp. 26-27):

“A lot of data will be collected, and currently it is uncertain that the analytical methods will be sufficient to produce meaningful results in terms of understanding the effects of habitat restoration actions.”

“Without a more in-depth and thorough review, it is difficult to ascertain whether or not there is redundant or excessive RME effort within these projects.”

“The evaluation component of habitat RME should be emphasized in order to ensure that useful management information is being extracted from the data. What management actions and what positive measurable outcomes can be associated with the habitat status and trend data? With the plethora of data that will be collection from newly planned ISEMP projects, methods of data analysis that can be broadly applied are badly needed. ISEMP has indicated that they are developing these methods.”

“There is comparatively little evidence that habitat effectiveness monitoring is being coordinated in such a way that monitoring programs can take advantage of multiple restoration actions occurring in the same area, at least at the subbasin scale. Perhaps the emergence of the new regional "umbrella"-type projects can facilitate better coordination and more cost-effective monitoring actions.”

At the same time, the basic concepts underlying this suite of proposals are sound, and at least most of the projects are technically sound as well. The challenge in the next few months will be to shape these concepts and the raw material in these proposals into a regional habitat m&e effectiveness framework appropriate to the magnitude and importance of the habitat foundation of the Program.

Background -- projects staff comments, and ISRP recommendation -- further review workshop

The projects identified in the ISRP review report as relevant to habitat effectiveness:

Number	Title	Proponent	Primary Monitoring	Funding
2003-017-00	Integrated Status and Effectiveness Monitoring Program (ISEMP)	National Oceanic and Atmospheric Administration (NOAA)	Fish population status; Tributary habitat conditions and limiting factors; Effectiveness of tributary habitat actions	~\$8.8 million FY 11 ~\$8 million FY 12-14
2010-082-00	PNAMP Integrated Status and Trends Monitoring (ISTM) Demonstration Project	ODFW, OSU, USGS, WDFW, BioAnalysts Inc, Lwr Columbia Fish Recovery Brd, WDOE	None assigned	\$100,000 FY 11 ~\$130,000 FY 12-14
1998-019-00	Wind River Watershed	Underwood Conservation District (UCD), USFS, USGS, WDFW	Fish population status; Tributary habitat conditions and limiting factors; Effectiveness of tributary actions	~\$600,000 FY 11 ~\$700,000 FY 12-14
2010-035-00	Abundance, Productivity and Life History of Fifteenmile Creek Winter Steelhead	Oregon Department Of Fish and	Fish population status	~\$300,000 FY 11-14

		Wildlife (ODFW)		
1996-035-01	Yakama Reservation Watershed Project	Yakama Confederated Tribes	Fish population status; Evaluate tributary habitat conditions and limiting factors	\$250,000 FY 11-14
2010-030-00	Project to provided VSP Estimates for Yakima Steelhead MPG	Yakama Confederated Tribes	Fish population status; Tributary habitat conditions and limiting factors; Selective harvest; Hatchery effectiveness	~\$620,000 FY 11-13 ~\$550,000 FY 14
2010-028-00	Implement a Rotating Panel Sampling of Small Steelhead Streams to Establish Abundance Indices for the Streams	Washington Department of Fish and Wildlife (WDFW)	Fish population status	~\$60,000 FY 11-14
2010-042-00	Tucannon Expanded Pit Tagging	WDFW	Fish population status; Hatchery effectiveness; Hatchery critical uncertainties	\$65,000 FY 11-14
2002-053-00	Asotin Creek Salmon Population Assessment	WDFW	Fish population status; Selective harvest investigations	~\$240,000 FY 11-14
2009-004-00	Monitoring Recovery Trends in Key Spring Chinook Habitat Variables and Validation of Population Viability Indicators	CRITFC	None assigned	~\$950,000 FY 11-14
2010-032-00	Imnaha River Steelhead Status Monitoring	Nez Perce Tribe	Fish population status; Tributary habitat conditions and limiting factors; Selective harvest investigations; Monitor hatchery effectiveness; Hatchery critical uncertainties	~\$600,000 FY 11 ~\$430,000 FY 12-14
2002-068-00	Evaluate Stream Habitat- Nez Perce Tribe Watershed Monitoring and Evaluation (M&E) Plan	Nez Perce Tribe	Tributary Habitat and Limiting Factors	\$760,000 FY 12 ~\$600,000 FY 13-14
2003-022-00	Okanogan Basin Monitoring & Evaluation Program (OBMEP)	Colville Confederated Tribes	Fish population status; Performance within the FCRPS; Coordination	~\$1.45 million FY 11-14
2010-075-00	Upper Columbia Implementation and Action Effectiveness Monitoring	Upper Columbia Salmon Recovery	Evaluate tributary conditions and limiting factors	~\$350,000 FY 11-12 ~\$320,000 FY 13-14
2009-002-00	Status and Trend Annual Reporting	Yakama Confederated Tribes	Fish population status	~\$100,000 FY 11
2010-	Upper Columbia Spring Chinook and	WDFW	Fish population status	~\$750,000

034-00	Steelhead Juvenile and Adult Abundance, Productivity and Spatial Structure Monitoring			FY 11-14
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This project list should be considered a work in progress. Bonneville is working with staff to reorganize or reshape certain of the projects to coordinate similar activities with or under the umbrella projects. We will be reviewing and finalizing the project table at a later date.

In addition, be aware that other projects and actions, in the Program and outside the Program, also contribute monitoring information and evaluation activities to the habitat effectiveness effort.

Next step -- Feb 10 review workshop recommended by ISRP

The ISRP recommended a further review workshop to address in more detail the issues identified with the habitat effectiveness proposals and with the overarching construct. The workshop -- the Columbia Habitat Monitoring Program (CHaMP) and Integrated Status and Effectiveness Monitoring Program (ISEMP) Workshop -- is set for February 10 in the Council’s central offices. Erik Merrill, working with the ISRP and with Council and agency personnel, has developed a tentative purpose statement for the workshop:

Purpose: The ISEMP/CHaMP program holds a great deal of promise for answering the questions: “What is the current status of fish habitat in the Columbia River Basin?” and “Are restoration actions currently being undertaken in the Columbia River Basin having the desired effects on both habitat condition and biological response?” However, the ISEMP/IMW/CHaMP program has expanded significantly in the RME categorical review and clarification and discussion is needed on program protocols, the overall analytical approach, collaboration with CHaMP partners, coordination with other regional RME efforts, and information transfer to managers and decision makers. Key questions are: Understanding that CHaMP is a piece in a larger effort, how is it contributing to answering the critical management questions? What is special about CHaMP – why not an alternative approach? Is this the right level of effort?

Topics tentatively expected to be addresses include:

- Habitat RM&E overview and purpose
- CHaMP program (habitat status and trends monitoring) structure, methods, protocols and collaborators
- Theoretical, policy and scientific underpinnings of the CHaMP effort, with results to date
- Relationship to ISEMP/IMW effort
- Coordination, collaboration and integration of CHaMP effort with other monitoring efforts

Staff recommendations and then final Council deliberations and recommendations on this issue will need to await at least the outcome of that workshop.

DRAFT Programmatic Issue: White Sturgeon

(does not include Kootenai River Sturgeon DPS or Lake Roosevelt Sturgeon)

Issue: The program currently invests in four white sturgeon projects in the lower river (below Chief Joseph Dam on the Mainstem Columbia, and below Lower Granite on the Snake River) that collectively address monitoring and supplementation. Current funding is geared toward stock assessment monitoring and sustaining harvestable populations in the reservoirs and feasibility of hatchery supplementation. The programmatic review of these projects identifies several gaps that need consideration by the Council. While the projects provide useful data about sturgeon, particularly in pools above Bonneville, the data gaps far outweigh our current understanding of sturgeon life history.

- Focused, intensive research on sturgeon is critical now (above and below the dams) as sturgeon numbers are decreasing every year.
- There are clear gaps in the program related to mainstem passage evaluation that are not being addressed.
- Conservation efforts should be taken seriously by all in the basin for research efforts including re-assessing current harvest regulations.

For this review, it may be an area in the program where the Council considers redirecting existing funds (and possibly increasing funds) to fill these critical data gaps. Total proposed funding in this category for four projects: \$1.8 million/year ave.

Sturgeon are anadromous fish and populations above the dams are still highly migratory, but are considered as “resident fish” by the fish and wildlife managers. The sturgeon that still have access to the estuary and ocean likely retain that anadromous life history. Many factors in the decline of sturgeon are easily recognized -- heavy harvest, predation by sea lions (due to poor recruitment to attain sizes large enough to escape predation), bioaccumulation of toxics, and lack of adequate tributary flow that can prevent egg survival -- coupled with the fact that sturgeon are naturally long-lived and take years to reach sexual maturity. We know much less about other aspects of the sturgeon life history -- recruitment, food base, importance of adequate flow in spawning tributaries, dam passage, estuarine habitats, behavior in the river and in the ocean (e.g. migration patterns, energy conservation, “balling” or “shoaling”). Little is known about sturgeon life history both above and below the dams, but the focus above the dams seems to be on harvest and artificial production.

Background and Staff comments:

White sturgeon are anadromous fish and are blocked from migrating up and downstream by the mainstem dams. They grow slowly, and take years to reach sexual maturity and can live up to 100 years old. The only spawning populations occur below Bonneville where they still have access to the estuary and ocean. Sturgeon above the dams do not have good recruitment levels. There is a land-locked subspecies in the Intermountain area of the basin -- Kootenai River -- that is listed as Endangered under the ESA and faces some similar issues, particularly in terms of recruitment.

2009 Program Mainstem Plan:

The 2009 Fish and Wildlife Program included a section for sturgeon in the Mainstem chapter. It calls specifically for studies that evaluate effects and mortality with respect to dam passage and removable spillway weirs. It also calls for an evaluation of the importance of connectivity among populations; assessment of population isolations and evaluation of the feasibility of mitigation. This work should occur prior to investing in additional supplementation efforts.

Biological objectives from SOTR:

The number of populations and their distribution of sturgeon is not well-known. The Status of the Resource Report has limited data on sturgeon populations, abundance and biological or subbasin objectives. In some areas no information is listed and in other areas, biological objectives are expressed in terms of *harvest numbers*. Without having a good understanding of the populations of sturgeon, a harvest targets seem unsupported.

Predation:

Aside from human predation, recent estimates of sea lion predation are increasing sharply. A biologist from WDFW commented to The Columbian newspaper in December 2010 that an estimate of 10,000 sturgeon were killed by sea lions below the dam. Of those, 750 were thought to be of spawning age (a personal account). Of concern is the loss of several young age-classes to predation. The young ones are less likely to survive sea lion attacks at the dam, and the below-dam populations are the considered “linchpins” of the basin for recruitment and reproduction and potentially for supplementation for above-the-dam populations.

Other comments:

Project #2007-155-00 and Project #2008-455-00 are addressing restoration of the sturgeon populations in the reservoirs of the mid-Columbia River and lower Snake River and are collaborating on strategic planning efforts. There is an upcoming sturgeon workshop scheduled to take place in Boardman, OR on January 26-27th. CRITFC is facilitating the workshop (agenda attached). The workshop is focused on strategic planning for sturgeon management in the Columbia River between Bonneville and Chief Joseph dams, and the Snake River downstream from Lower Granite Dam. This will be a useful forum that has potential to propel a coordinated effort for management above the dams. However, this is only part of the equation, and a companion effort is necessary to integrate and consider the naturally spawning anadromous populations below Bonneville Dam.

ISRP Comments/recommendations:

Data Gaps:

1. *Effective basinwide management plan for white sturgeon is lacking and is the most important need for planning future research and restoration.*

- Recover wild fish or maintain fishery via hatcheries?
- Unified vision is lacking in projects (both individual and aggregate).
- Develop plan at Boardman managers meeting (1/2011).
- Effect of hatchery releases on wild populations is poorly understood and needs further M&E.

2. *Specific factors affecting recruitment of white sturgeon are poorly understood.*

- Why is recruitment better below Bonneville Dam?
- Lower river fish “last remaining linchpin” of reproduction and recruitment in the Basin.
- Possible reasons for poor recruitment: contaminants, predation, turbidity, habitat loss, et cetera.

- Need to go beyond monitoring to understanding WHY recruitment is poor above dam. This understanding is more critical than the “White Sturgeon Monitoring Strategy” (WSMS).
3. *Importance of the estuary and ocean in sturgeon production below Bonneville Dam is poorly understood.*
- Examine affect of estuary/ocean on rearing juveniles.
 - Examine movements between estuary/ocean/lower river at various sex, size, and age classes.
 - Acoustic telemetry, tagging, otolith, and fin ray studies may be useful in monitoring sturgeon movement in the lower river.
4. *Productivity of pools above Bonneville Dam for sturgeon is poorly understood.*
- Poor documentation of production levels compared with historical levels.
 - Understand food web implications in upper river pools (see Food Web Report, ISRP).
 - Avoid over stocking hatchery fish in pools/other spatial areas (actual carrying capacity may be lower than estimated).
5. *Consideration of adaptive management approaches should include a review of harvest regulations with the intent of facilitating the efficient, low-cost acquisition of creel data needed for stock assessment.*
- Need to improve effectiveness of monitoring fisheries.
 - Management regulations too static; collecting creel data difficult and expensive.
 - Need to develop meaningful season area restrictions (preferably within a wider basin plan).

Possible Options:

- a. Redirecting funds outside of or within the ODFW contract to move away from a harvest-focus to more sturgeon conservation/evaluation focus
- b. Discuss with accord parties a shift in scope of current work to expand planning to basin-wide; particularly with CRITFC’s current work.
- c. Determine responsibility for the evaluation of Mainstem passage which is unclear; talk to the COE and Bonneville about how we work towards meeting our Mainstem passage requirements for Sturgeon in the program.
- d. Encourage the two managing states -- Oregon and Washington - to revisit and re assess harvest regulations for sturgeon.

Projects included in this programmatic review:

Number	Title	Proponent	Accord	BiOp	Proposed Funding
198605000	Evaluate Sturgeon Populations in the Lower Columbia River	ODFW			\$1.4 m/year Ave
200715500	<i>Develop a Master Plan for a Rearing Facility to Enhance Selected Populations of White Sturgeon in the Columbia River Basin</i>	CRITFC	Y		\$230,000 (2012)
200850400	<i>Sturgeon Genetics</i>	CRITFC	Y		\$43,000 (2012)
200845500	<i>Sturgeon Management</i>	<i>Yakama Confederated Tribes</i>	Y		\$134,000 (2012)

Project-Specific notes to support issue:

198605000 - The ISRP raised a second issue regarding the status of wild white sturgeon below Bonneville Dam: “a vital question is why reproduction and eventual recruitment are occurring below Bonneville Dam and why recruitment is almost non-existent above Bonneville Dam.” The below-dam population is the linchpin of the basin, in terms of recruitment and age structure, and the ISRP recognizes a serious gap in the knowledge of the factors affecting above- and below-dam populations. The ISRP believes the proponent, or

other informed party, should develop a series of reasonable and testable hypotheses to examine the lack of recruitment in the upper pools, with the outcome providing scientific information on recruitment in the pools relevant to dam operations. The specific qualification is that the proponents add one or two hypotheses focused on testing recruitment limiting factors (e.g. flow, habitat, turbidity, etc.) for the below Bonneville population to compare with how those factors may affect populations above Bonneville.

With respect to harvest management, it is clear that regulations have been static for decades. Due to long harvest seasons and broad geographic extent, it is difficult to survey a significant percentage of the harvested stock, and thus vital creel data for the population is not being efficiently collected. It is recommended that harvest be concentrated in space and time, creating a manageable situation in which to collect valuable creel data and establish accurate baseline numbers for number, age structure, and sex distribution for the population. The high value of individual fish provides an easily defensible position from which to create new and progressive harvest practices.

The project proponents have recognized that this study has evolved from research to harvest management, and thus may have overlooked some key data questions. There are many unanswered questions regarding basic life history, such as age-specific year class strengths, sex-specific reproductive periodicity, and periodicity of movements to and from the estuary or near-shore ocean and its impacts on estimated total fish present. Differences between upper and lower river populations are a major data gap, requiring formation and testing of reasonable hypotheses. A species with upwards of 50 recruited year classes requires more complete information than a species with 5 recruited year classes. Therefore, detailed creel sampling is critical, requiring higher percentages than for other fish, and harvest restrictions in space and time.

Preliminary Recommendations:

ISRP PROGRAMMATIC RECOMMENDATIONS “PUNCH LIST”

This list represents a distillation of 45 actions either suggested or recommended by the ISRP in the Programmatic Issue Report. The items cover everything from identified “gaps” or “must-haves” to “nice-to-haves” and are listed by issue area. This is a resource we will draw from, along with other information, in shaping the Council’s programmatic and project recommendations. While we might address or resolve a small subset of these items through this review, it is not intended to be a list of actions we need to take or implement.

The TYPE column is a quick reference for what type of action we might consider it to be. The letters refer to R=research; I=Implementation (project or work element); and M= monitoring; F= follow-up item, and PS= is a project-specific action.

NO.	Title/description	Subcategory	Type	Pg
1	<p>A better understanding of contaminants and their effects on the Basin’s salmon populations and food webs are urgently needed. <i>Some of the emerging contaminants have been shown to alter salmon swimming behavior, predator avoidance behavior, and foraging behavior. The net effect on salmon appears to be increased mortality and probably reduced somatic growth. These contaminants also may alter the food supply for fish. Contaminants can be considered a “wild card” when attempting to understand food web and wildlife-habitat relationships, and as such can cause much confusion if not considered. The available evidence strongly suggests that we need this research.</i></p>	General Observations and Emerging Issues	R	8
2	<p>BPA-sponsored basinwide forum on the effects of climate and ocean conditions on Columbia River Basin fish and wildlife potentially led by NOAA Fisheries. <i>Strengthen the BPA-funded program to make full use of available RM&E information on ocean conditions to guide management actions in freshwater and to distinguish ocean effects from other effects on survival of anadromous fishes (salmonids, sturgeon, and lamprey). Such a forum or workshop would further encourage collaboration among managers and the research community.</i></p>	Ocean and Estuary	I	10
3	<p>Climate and Ocean Conditions forum topics (which might be considered gaps) <i>Life Histories: The current focus on the effects of ocean conditions on survival of juvenile salmon during their first summer-fall in coastal waters is very important, but a broader perspective that includes salmon at other ocean life stages and in other ocean habitats is needed. Density dependence — The ocean studies could take a more experimental approach by looking at differences in wild and hatchery fish in the ocean. While initial migration and survival may be similar, based on early studies, survival of hatchery fish from smolt-to-adult is often 2 to 3 times lower than wild fish. Furthermore, the effect of hatchery fish abundance on wild fish survival remains poorly studied.</i></p>	Ocean and Estuary	R	11

4	<p>Development and improvement of simulation and predictive models to modify harvest or hatchery releases. <i>Improved models of run sizes and timing based on both freshwater and ocean conditions, growth rates, and jack returns could be developed in order to modify harvest or hatchery releases. The development and improvement of simulation and predictive models (e.g., EcoSim, bioenergetics, migration and growth, plume), would help to focus the work required and the collaborations. Model enhancements could include sub-stock structure in more detail, hatchery release time, area comparisons, in-river migration, associated ocean migration, and other factors.</i></p>	Ocean and Estuary	I?	12
5	<p>Better understand how ocean conditions affect growth, survival, and ocean distribution of anadromous fish. <i>Feeding and condition and/or predation; critical conditions that effectively regulate survival in the ocean; different stocks/different migratory paths and feeding grounds. Great progress can be made with CWTs, acoustic tags, otolith chemistry, stock genetic identification, and distribution of ocean catches.</i></p>	Ocean and Estuary	R	12
6	<p>Address key uncertainties associated with hydrosystem passage through the four Lower Snake River dams. <i>Additional experimental approaches like NOAA's delayed mortality project (2003-041-00) could help address some of the key uncertainties; explore further and expand by NOAA Fisheries, the CSS Project, and others.</i></p>	*Hydrosystem	R	14
7	<p>Identify tagging techniques to minimize PIT-tag loss. <i>Unaccounted tag loss can lead to under-estimation of survival. Variable tag loss can confound experiments that rely on tag recovery rates and minimal measurement error. Effort is needed to identify tagging techniques to minimize PIT-tag loss and to account for variable tag loss, and the ISRP also recommends that a sensitivity analysis be conducted to assess how tag loss can bias and alter survival estimates related to hydrosystem passage RME.</i></p>	Hydrosystem	R	14
8	<p>There is a need for an ecosystem program centered on the reservoirs and estuary. <i>Develop program to link the inter-relationships between all the major species (salmonids, sturgeon, lamprey, pike minnows, shad, cyprinids and others) in these relatively well-bounded elements of the system. This could have a food web focus but would need to carefully thought out to make sure it produced results of direct use to managers. Key elements: invasive species (especially shad), food and space limitation/competition, and predation in the context of dispensatory mortality, perhaps all in an umbrella type project examining hydrosystem spill and transport survival estimates through the reservoirs and estuary. Focused research on avian predation in these areas is also needed.</i></p>	Hydrosystem	R	15
9	<p>Develop a comprehensive plan that guides tagging and recovery activities throughout the Basin, especially among CWT operation. <i>Tagging of salmon (coded-wire-tags, PIT tags, acoustic tags, and genetic markers) is a key tool for quantifying stock composition in mixed-stock fisheries and on the spawning grounds, estimating survival rates, describing migration patterns, and testing a variety of other hypotheses.</i></p>	Coded Wire Tag, Harvest and Enforcement	I	16

10	<p>Evaluate the magnitude of mini-jacks among yearling CWT Chinook salmon releases, and record mini-jack data in the RMIS database. <i>Tagging of salmon (coded-wire-tags, PIT tags, acoustic tags, and genetic markers) is a key tool for quantifying stock composition in mixed-stock fisheries and on the spawning grounds, estimating survival rates, describing migration patterns, and testing a variety of other hypotheses.</i></p>	Coded Wire Tag, Harvest and Enforcement	I	16
11	<p>Set up a common structure for data reporting and generation of public education tools in Taurus for enforcement projects.</p>	Coded Wire Tag, Harvest and Enforcement	I	17
12	<p>Impacts of invasive species are poorly understood and more work is needed. <i>Research beyond documenting the number of salmonids taken by predators and the effect of these losses on survival rates is needed, i.e., what is the effect, if any, on the returning adult salmon stocks? Research on predation needs to be better focused and perhaps combined to address the big question regarding effects on returning adult salmon populations after factoring mortality rates in the ocean and estuary. Influence of juvenile salmonid loss to other bird and fish predators on adult salmon return rates; impacts of hatchery practices on predator abundance; what does the adult loss due to sea lions have on the adult return of the various stocks? Can the adult fish stocks taken by sea lions be identified (and take estimated) based upon when the various stocks move through the Bonneville ladders? How do ocean conditions and Columbia River flow and temperatures in the estuary influence forage fish availability to sea birds in the estuary?</i></p>	Predation and Invasive Species	R	18
13	<p>Increase coordination of predation and invasives projects and research. <i>The ISRP recommends that the proponents/investigators of this group of projects increase their coordination to more fully understand the role of predation/competition as a potential impediment to recovery of listed salmonid stocks in the context of reservoir food webs.</i></p>	Predation and Invasive Species	I	18
14	<p>Large-scale life cycle population modeling is in order, with respect to the role of predators as a group, as well as anticipated effects of climate change and the interaction of invasive species. <i>A unique point for this group of projects is that most of the predators of greatest concern are native species, which is an indication that the system has been greatly modified and is out of balance. Further work on anticipated effects of climate change and the interaction of invasive species is warranted. On an individual project basis, some nice work has been accomplished. Some large-scale life cycle population modeling is in order, especially with respect to the role of predators as a group.* A unique point for this group of projects is that most of the predators of greatest concern are native species, which is an indication that the system has been greatly modified and is out of balance. Further work on anticipated effects of climate change and the interaction of invasive species is warranted.</i></p>	Predation and Invasive Species	R	18-19
15	<p>Overall synthesis of results from lamprey restoration projects in the basin. <i>The Inter-Agency Lamprey Technical Working Group would be a possible group of experts that could</i></p>	Lamprey	I	20

	<i>write a basinwide synthesis including major conclusions with supporting evidence, status and trends, and a candid evaluation of whether tributary habitat projects are improving lamprey returns. A draft outline based on comments from this and other reviews, and ISAB suggestions (ISAB 2009-3). The ISAB should review the synthesis.</i>			
16	Develop an effective basinwide management to plan future research and restoration for white sturgeon. <i>It is important that agencies develop a unified, consistent basinwide plan and not just agree to disagree on how sturgeon will be managed. They must also reconcile how proposed hatchery programs upriver will provide adequate protection for the large wild fish population below Bonneville Dam as well as remaining wild fish above Bonneville Dam. Large numbers of hatchery fish released above Bonneville Dam may negatively affect wild fish through diseases and density-dependent growth and survival. Our understanding of these issues for this species is in its infancy. This work should be conducted under a unified proposal to avoid duplication of effort. It is important that the new generation of sturgeon studies address the gaps recognized from the past generation of important studies (i.e., Beamesderfer and Nigro 1993) and not merely repeat the older studies.</i>	Sturgeon	I	21
17	Research and identify specific factors that affect recruitment of white sturgeon. <i>Despite more than a quarter century of research, it is not clearly understood exactly why sturgeon reproduction and recruitment are much greater below Bonneville Dam than elsewhere in the Basin. Overall, poor recruitment of all wild sturgeon is a critical concern worldwide. The fish below Bonneville Dam are the critical remaining linchpin of wild sturgeon reproduction and recruitment (past age-1 and older); they provide the last truly viable fishery of any size in the Basin. The rest of the populations are so depleted and recruitment is so poor that harvest fisheries are marginal and perhaps not sustainable in the long term. It is important that researchers develop, evaluate, and test specific hypotheses about what the limitations are in the pools above Bonneville Dam compared to the river below Bonneville Dam, with the ultimate outcome of providing scientific information on recruitment relevant to dam operations and impacts. Dealing with this data gap is more critical than much of the work outlined in the “White Sturgeon Monitoring Strategy” where efforts are directed at monitoring the lack of recruitment without adequate attention to determining why natural (wild) recruitment is so poor and what can be done about it.</i>	Sturgeon	R	22
18	Study the importance of the estuary and ocean in sturgeon production. <i>Important aspects of estuary and ocean rearing of white sturgeon are poorly understood region-wide. More needs to be known about the amount of production of sturgeon below Bonneville Dam that results from estuary and ocean rearing. Studies need to be conducted to assess the seasonal, annual, and lifetime movements of sturgeon of various sizes and ages to and from estuary, ocean, and lower river habitats.</i>	Sturgeon	R	23
19	Study the productivity of pools above Bonneville Dam for sturgeon. <i>The evidence is not clear that fragmented reservoir habitats can support significant sustainable harvest of sturgeon. Many sturgeon historically harvested upriver may not necessarily have recruited nor reared there. It makes little sense to set a goal resulting in over-stocking sturgeon in upper pools hatchery fish when the actual carrying capacity for the species may be much lower than hoped.</i>	Sturgeon	R	23

20	<p>Review harvest regulations and ways to improve acquisition of creel data. <i>Consideration of adaptive management approaches should include a review of harvest regulations with the intent of facilitating the efficient, low cost acquisition of creel data needed for stock assessment. Harvesters have few requirements placed upon them for reporting catches of these very valuable individual fish. Consider developing meaningful season area restrictions, as has occurred for sturgeon in many other locations. Such outside the box thinking might be pursued in cooperation with other agencies as part of the critically needed sturgeon basinwide plan.</i></p>	Sturgeon	I	24
21	<p>ISRP review of Columbia Habitat Monitoring Program (CHaMP) methods and protocols. <i>The ISRP needs to review theme in detail to ensure they will satisfy the habitat status and trends needs in the Council's Fish and Wildlife Program.</i></p>	IMWs, CHaMP, ISEMP, and Status and Trends Monitoring	I	26
22	<p>The ISRP recommends that the 20+ Intensively Monitored Watersheds be reviewed by the ISRP. <i>This work to be as part of a larger effort that attempts to identify the signature of habitat improvement actions on target species at the watershed scale. Without a more in-depth and thorough review, it is difficult to ascertain whether or not there is redundant or excessive RME effort within these projects.</i></p>	IMWs, CHaMP, ISEMP, and Status and Trends Monitoring	F	26
23	<p>A conference on the results of habitat monitoring -- as a MERR State of the Science workshop. <i>A focused workshop is recommended that utilizes the techniques and protocols of an adaptive environmental assessment approach, where response variables are carefully and selectively chosen, and where simulation models are developed to assess potential outcomes and assist development of the design of field experiments.</i></p>	IMWs, CHaMP, ISEMP, and Status and Trends Monitoring	I	27
24	<p>Expand hyporheic studies to evaluate influences on reach scale thermal refugia along stream margins and side channels. <i>Thermal refugia along stream margins and in floodplains can provide important habitats for salmonids even if hyporheic processes have little influence on mainstem temperatures, and these refugia may become increasingly critical for salmon and trout with climate change.* project-specific*??</i></p>	Misc Habitat RM&E	R PS	28
25	<p>Develop development of compliance, implementation, and effectiveness monitoring protocols for the water transaction program.</p>	Water Transactions	I PS	28
26	<p>Develop experimental design that will lead to a better understanding of the effects of nutrient supplementation for nutrient supplementation projects. <i>The ISRP believes that the effects of nutrient supplementation are not fully understood and any application should be treated as experimental. Careful monitoring of current and future nutrient supplementation projects is essential in order to help us understand whether adding nutrients to streams is having the desired effects.</i></p>	Nutrient Enhancement	R	29

	<i>Such studies may be particularly effective if located in an area where Programmatic Habitat projects are being implemented, such as in the Upper Columbia. Nutrient-related RME projects should address questions and topics on page 29-30 of the report.</i>			
27	Annual meeting to discuss/learn about projects evaluating nutrient supplementation.	Nutrient Enhancement	I	30
28	Further develop methodology for Parental Based Tagging (PBT) of hatchery salmon and steelhead. <i>The final extension of using SNP markers is to develop Parental Based Tagging (PBT) of hatchery salmon and steelhead for use in both harvest and hatchery broodstock management. PBT has the potential to complement or replace CWT management of harvest. The ISRP believes these methods will yield important efficiencies in managing harvest and hatcheries.</i> <i>2 projects – Hagerman and CRITFC; Research – invest when its further developed or treat as innovative?</i>	Hatchery effectiveness, Impacts and Reform (HSRG & HGMPs) – Basinwide: A. Genetics	R	31
29	Develop a comprehensive summary of the current state of implementation of RRS investigations throughout the Basin. <i>There is not a comprehensive summary of the current state of implementation of RRS investigations throughout the Basin. The Columbia River Hatchery Effects Evaluation Team proposal should be encouraged to develop a current summary of these activities which should continue the progress being made within the basin to develop analyses to inform management decisions.</i>	Hatchery effectiveness, Impacts and Reform (HSRG & HGMPs) – Basinwide: B. RSS	PS	32
30	Develop a rationale for chum salmon recovery and restoration. <i>It is important to know what bottlenecks and limiting factors proposed actions are intended to correct and which life stages (e.g., egg survival, fry survival, etc.) the supplementation is expected to overcome. Rationale to include: reviews of the global chum salmon literature and other supplementation experiences -- what do the “successes” with chum hatcheries, especially in other places such as Puget Sound and Asia look like?; Describe importance are size of chum fry (i.e., growth) at a given time (wild fish) or time of release (hatchery fish); Use literature to help build support for the need for supplementation as the best way to mitigate for the losses; hypothesize why Columbia River stocks have declined.</i>	VSP, Hatchery Effectiveness, and Habitat Effectiveness Monitoring – Gaps and Duplications by Species and Geographic Domain A. CHUM	I	34
31	Develop joint research and restoration proposal for chum salmon.	A. CHUM	I	34
32	Produce a comprehensive synthesis of available information, including comparisons with characteristics of viable sockeye populations in other regions. <i>The synthesis should evaluate factors affecting survival during each life stage in order to identify key “bottlenecks” where additional focus may be needed to enhance population viability. Additionally, the SARs outlook for Snake River sockeye salmon should be explored while considering reasonable survival scenarios during smolt migration and ocean rearing.</i>	B. Sockeye-SR	I	34

	<i>This analysis should evaluate what is needed in order to produce a viable, self-sustained population of Snake River sockeye salmon</i>			
33	ASMS Recommendations for Upper Columbia Sockeye: <i>1. Coordinate with Canada on evaluation of hydro acoustic counting of Okanogan juvenile sockeye 2. Improve efficiency of smolt trap at Lake Wenatchee. 3. Determine productivity of Lake Wenatchee sockeye 4. Determine pre-spawning mortality for Okanogan sockeye 5. Investigate predator-prey interactions for Okanogan and Wenatchee sockeye.</i>	B. Sockeye-UC	IRM	36
34	Establish a well defined kelt management research plan <i>before considering the expansion and implementation of kelt reconditioning as an element of steelhead conservation and recovery. Key question: is there is an increase in the natural spawning population abundance in succeeding generations following spawning by reconditioned kelts. The plan should include: modeling to estimate the benefit of kelt reconditioning to VSP status of steelhead at the independent population, MPG, ESU, and basin levels at various rates of survival for each of the kelt management alternatives – passage improvements, transport, short term reconditioning, and long-term reconditioning.</i>	C. Kelt	I	37
35	Develop a comprehensive fish monitoring plan in the Deschutes. <i>The three projects are in various stages of planning and implementation and currently do not appear to be well integrated with one another. Develop the plan and submit as part of the geographic review of habitat projects.</i>	E. Mid Columbia i. Deschutes	I	39
36	As part of the WW River basin M&E project, consider sampling for juvenile abundance.	E. Mid Columbia v. Walla Walla	PS	43
37	Consider development of a summary and synthesis of the Yakima Fisheries projects. <i>The size and complexity of the fisheries projects make it difficult to effectively review efforts in the Yakima. The ongoing and proposed work is important and requires a more comprehensive review, preferably in conjunction with the annual Yakama Nation Fisheries Program Symposium. Much data is being gathered, that it is difficult to interpret and critique the effort without a summary and synthesis focused on whether the program is meeting its objectives.</i>	E. Mid Columbia vi. Yakima River	I	43

38	<p>For Yakima River Fisheries programs, research and assess:</p> <ol style="list-style-type: none"> 1. The factors that impact survival of natural and post-release hatchery origin pre-smolts. 2. Wild population response to supplementation 3. Method for estimating proportions of wild to hatchery fish in reference and treatment streams. 	E. Mid Columbia vi. Yakima River	M	44
39	<p>For the Grande Ronde, develop a succinct summary of the project relationships.</p> <p>Because so many projects contribute to the monitoring, the ISRP recommends that a succinct summary be developed that describes linkages to VSP, and habitat and hatchery action effectiveness monitoring accompany the habitat restoration proposals in the anticipated geographic review.</p>	E. Mid Columbia iii. Grande Ronde, Imnaha MPG	I	48
40	<p>Produce comprehensive management plans for the Salmon and Clearwater Rivers and submit them for geographical review.</p>	E. Mid Columbia iii. Upper Salmon, SFF, MFS, and Clearwater	I	51