Independent Scientific Review Panel

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Review of the Collaborative Systemwide Monitoring and Evaluation Project (CSMEP)

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I. Introduction

This Independent Scientific Review Panel (ISRP) review of the Collaborative Systemwide Monitoring and Evaluation Project (CSMEP) reflects the latest of several independent scientific reviews by the ISRP dating back five years. The ISRP conducted this scientific review at the Northwest Power and Conservation Council's request.

The overall goal of CSMEP is to improve agency monitoring and evaluation of fish populations in the Columbia Basin. CSMEP represents a major commitment towards regionally integrated monitoring and evaluation. The approach is to collaboratively strive to improve the quality and consistency of fish population and habitat data. The Columbia Basin Fish and Wildlife Authority (CBFWA) administers CSMEP with participation of federal, state, and tribal fish and wildlife agencies along with several independent entities. The project was initiated in October 2003 through a multi-agency collaborative process that led to a successful proposal for FY2004-06 funding under the Mainstem and Systemwide envelope of projects. CSMEP submitted a proposal to continue the project in the FY2007-09 funding period. The proposal received a positive review from the ISRP:

> "The proposal presented a thorough and detailed explanation of the background and need for the project, as well as a scientific overview of the challenges of large-scale monitoring. The problem created by inadequate data and the challenges to obtaining them in a large setting like the Columbia basin is well presented. The continuation of the ongoing project should be useful in establishing better monitoring and evaluation programs systemwide."

The ISRP found that the proposal met scientific criteria and recommended Fundable (Qualified) with the caveat that:

> "As the elements of CSMEP move from planning to implementation the ISRP or ISAB should be used to review these elements. Some workgroups are further along than others; the questions they are asking, and how they are being approached is still under development. Independent peer-review at timely intervals will help ensure that the analyses will serve the regional management needs."

As a consequence of the ISRP review, and with CSMEP's encouragement, the Council requested a science review by the ISRP:

> "Interim funding at reduced level pending further Council consideration of regional monitoring and evaluation framework. Fund for only 2 years (07-08); Council expects a report for Council and science review, delivered by the end of FY 08."

CSMEP has suggested that a review would be useful at this time because the Council is currently focusing much attention on the development of a coordinated regional M&E framework, the amendment process for the Fish and Wildlife Program, and M&E recommendations flowing out

of the Federal Biological Opinion on the Federal Columbia River System. Also because CSMEP has just completed a pilot study on the Snake Basin, a review at this time would provide valuable feedback on CSMEP methods and products to the Council and to scientists in the basin responsible for monitoring and evaluation of fish populations.

In addition to the ISRP's primary criteria employed for all scientific reviews, the ISRP added three questions in consultation with CSMEP. These questions are consistent with the primary review criteria and emphasize review of the systemwide features of CSMEP.

Science Review Questions:

1. Has CSMEP made satisfactory progress towards the objectives set out for the project in its 2002 and 2006 proposals?

2. Has CSMEP provided scientifically rigorous work products and processes useful to regional fish and wildlife agencies, and in particular for assessing the effectiveness of the Council's Fish and Wildlife Program?

3. Does CSMEP provide a useful function and forum in moving the region towards a cost-effective, coordinated regional monitoring and evaluation framework for fish populations?

The current review is presented in four parts:

- ISRP Recommendation for the remainder of the FY 2007-09 funding cycle
- Response to science review questions
- Section by section specific comments for the CSMEP team
- Overall conclusions and recommendations

To complete this review, the ISRP received a very informative briefing on CSMEP by the project sponsors at the ISRP's December 2007 meeting. CSMEP provided extensive text and electronic based material to facilitate the review.

II. ISRP Recommendation for the remainder of the CSMEP FY 2007-09 funding cycle

The ISRP concludes that the CSMEP proposal (200303600) Meets Scientific Review Criteria (Qualified – for some components). The ISRP feels that some elements of this large project are making good progress (e.g., tributary habitat) while others (e.g., hatchery and harvest effectiveness monitoring) will require additional planning.

Proposal Background

The FY 2007-09 CSMEP proposal identified four objectives.

1) Interact with federal, state, and tribal programmatic and technical entities responsible for monitoring and evaluation of fish and wildlife, to ensure that work plans are well integrated with ongoing work by these entities, and prevent any duplication of effort.
2) Document, integrate, and make available existing monitoring data on listed salmon, steelhead, bull trout, and other fish species of concern.
3) Critically assess strengths and weaknesses of these data for answering key monitoring questions
4) Collaborate with programmatic entities in the Columbia Basin to design, implement, and review improved monitoring and evaluation methods.

ISRP Comments

The ISRP's comments made during the hectic time of the 2007-09 project reviews still apply. The proposal gives an excellent overview of the tasks, description of products, and timing for each of the work elements. The list of collaborating entities is quite useful. Details of each objective were cleanly laid out in an organized fashion. There is an extensive list of work elements described. However, these were not always supported with enough detail to allow a complete assessment. Some of the methods are ongoing, while others await development among collaborators, but the methods are well described in general and appropriate to their particular settings. We note that progress on each of the many tasks is not uniform; e.g., the hatchery action effectiveness work is perhaps not quite as far along as some of the habitat or status and trend monitoring.

This scientific review provides an opportunity for the ISRP to more fully comment on the many strong areas of the CSMEP project as well as make suggestions for strengthening other areas. General comments and suggestions will be structured as responses to the science review questions in the next section while specific comments to the CSMEP team will follow later in the review.

III. Response to Science Review Questions

As described above the ISRP is using three science review questions to structure our response.

1. Has CSMEP made satisfactory progress towards the objectives set out for the project in its 2002 and 2006 proposals?

Similar to the ISRP review of the 2007-09 project proposal, we find that the history of the project is effectively described objective by objective. The summary of how CSMEP has addressed each of its early goals is well done. This project has made much progress in a relatively short time.

2. Has CSMEP provided scientifically rigorous work products and processes useful to regional fish and wildlife agencies, and in particular for assessing the effectiveness of the Council's Fish and Wildlife Program?

There is some variation in the rigor and usefulness of the CSMEP work products and processes depending on the M&E category (status and trends, hydrosystem, hatchery, habitat, harvest, and integration). It is clear that CSMEP is still a work in progress with progress being made at different rates by the various subgroups. It is not clear if there is an overarching program that links the various components of CSMEP and oversees rates of progress of the subgroups. Integration of existing M&E efforts across subgroups, and modification of existing M&E, into recommendations for monitoring that will serve the needs of various managers including assessing the effectiveness of the Fish and Wildlife Program will be a critical future step that will require both scientific review and administrative oversight. At the CSMEP website there is a plethora of documents. Some are simply memos among CSMEP members that are not particularly useful for the interested public. Other topics, for example the strengths and weakness analysis of existing M&E efforts, had many documents with little explanation, and no clearly identified document that explained that whole process.

3. Does CSMEP provide a useful function and forum in moving the region towards a cost-effective, coordinated regional monitoring and evaluation framework for fish populations?

There is some evidence that CSMEP is providing benefits to fish management agencies and other organizations in the region, but there does not seem to be an organized method to quantify the contribution CSEMP is making towards a regionally-coordinated monitoring program. More documentation is needed showing that significant regional coordination and collaboration with other large monitoring groups such as the Pacific Northwest Aquatic Monitoring Project (PNAMP) or the Anadromous Fish Evaluation Program (AFEP) program has taken place, and what the outcome of this coordination/collaboration has been. Users in action agencies should provide documentation of benefit as part of future reviews of CSMEP. The ISRP notes that a panel of users from several agencies (WDFW, IDFG, ODFW, Colville Confederated Tribes, CRTFIC, and Nez Perce Tribe) provided testimony as to the benefits of CSMEP at the ISRP's December 2007 meeting. In addition, an information sheet was provided that listed some examples of the use of CSMEP products, ideas, and processes.

IV. Specific Comments for CSMEP subgroups

1) Status and trends

Recently the CSMEP Status and Trends Subgroup has focused on completing a simulation model for evaluating alternative designs (low, medium, high) for monitoring status and trends of Snake River spring/summer Chinook at the population, major population group (MPG) and evolutionary significant unit (ESU) scales. CSMEP modeling uses the Interior Columbia-Technical Recovery Team (IC-TRT) viability criteria for abundance, productivity, spatial structure, and diversity as a framework for assessing alternative monitoring strategies. The goal

is to evaluate the sensitivity of the IC-TRT viability criteria to changes in the quality of the monitoring data that would be provided by monitoring design alternatives. The simulation model assesses the variability in data used to measure abundance, productivity, spatial structure, and diversity and determines the misclassification rates in assigning risk levels for each of the monitoring design options. The result is a comparison of the reliability of status quo monitoring vs. alternative designs.

Strengths of the work are the demonstrated flexible approach reflecting an understanding of the constraints and needs of various subbasins and entities. The low, medium, high evaluation of monitoring and costs is promising. The particular simulation model developed provides a good example of a tool that CSMEP is proposing to managers for assessing current monitoring programs and evaluation of alternative monitoring strategies.

Some decisions made in simulating test data sets should be better justified to increase confidence that conclusions resulting from application of the simulation model are valid as well as to inform future users concerning what considerations are necessary in applying the model. For example, why is a run year abundance of 5% (page 12, Volume 2) of the time series average used to determine if productivity should be calculated? That is, how much bias was there in the distribution of the metric at 5% versus other potential abundance values? Similarly, how were the principles for generating the data set (Page 12, Volume 2) established?

In general, the material describing the application of the simulation models in Volume 2 is quite good, for example, the caution concerning using cost estimates as relative and conservative rather true costs needed to answer specific status and trend questions. Assumptions used to derive relative costs are provided.

A very close examination/review of the simulation model may be appropriate because this model (developed by the Status and Trends Group) has been used to generate the M&E design used by the other subgroups for their recovery monitoring designs.

2) Harvest

The work of this subgroup is not as far along as some other groups. In fact, CSMEP recommendations in Volume 2 of the Snake River Pilot Study make this point.

Recommendations
• *Include estimates of precision in vital estimates.*
• *Develop new analytical techniques for preseason and in-season abundance forecasts.*
• *Continue to evaluate new technologies/techniques for stock identification and composition estimates (PIT tags, GSI).*
• *Evaluate and refine methods for estimating number of fish released from selective fisheries.*
• *Evaluate the potential development of an indicator stock to represent Snake River spring/summer Chinook in in-river fisheries.*
• *Improve coordination between entities collecting fisheries monitoring and evaluation information.*

The ISRP found the website regarding CSMEP's inventories of fish performance measures and web-accessible metadata difficult to use. It appears, based on comments in the discussion forum on the data inventory website, that frequent users also have problems such as difficulty entering and saving data. Keywords should be provided for searching metadata for harvest monitoring information. The inventory design (re: Appendix A in CSMEP's FY 2004 Annual Report) is deficient with respect to information on harvest metadata.

There was some anecdotal information on the quality of harvest data scattered throughout earlier annual reports. However, a thorough critical assessment of the strengths and weaknesses of existing harvest data for answering key monitoring questions should be available in the CSMEP annual reports. The hyperlinks to assessments conducted to data in the FY07 annual report do not appear to work.

CSMEP is evaluating in-season estimates of run size and escapement and comparing these to preseason estimates, rather than directly evaluating the strengths and weaknesses of existing harvest monitoring programs. The Harvest subgroup is also trying to determine what the target and non-target harvests are and when these harvests are projected to meet allowable levels. The CSMEP process used for developing improved M&E designs is qualitative and somewhat difficult to follow. The demonstration of CSMEP's design process (Snake Basin Report) provided no new insights.

CSMEP recommendations for improvements to harvest monitoring in the Snake Basin are already well-known, universal needs that could have been provided without further evaluation, i.e., the need for variance estimates on point estimates, the need for new analytical techniques of preseason and in-season abundance forecasts, the need to evaluate new techniques/technologies for stock identification, and the need to improve coordination between agencies collecting fisheries harvest monitoring and evaluation data.

3) Hydro

The CSMEP hydro workgroup used the Snake River Basin Pilot Study data (primarily CSS study data) to evaluate alternate monitoring and evaluation designs. The ability to use the CSS study data (i.e. SARs, TIRs, etc.) has allowed the hydro workgroup to estimate various cost-effectiveness/precision tradeoffs for the various design levels (status quo, low, medium and high). The ISRP notes that issues raised in the joint ISAB/ISRP Review of the CSS Ten Year Retrospective Study are relevant to the use of CSS as a tool for CSMEP. For example, concerns about using upstream/downstream comparisons to infer mortality due to the hydrosystem or estimation of delayed mortality remain.

The long time series of SAR data from the CSS has indicated that the status quo monitoring design is a sufficient for determining if the SAR target for wild spring-summer Chinook is being met. Increasing the number of tags per year will improve the precision of annual and seasonal estimates, but for transportation evaluations a very large increase in tags would be required to make substantial improvements over the status quo, and is likely not cost-effective. Therefore, the medium or high design options are not warranted.

The CSMEP hydro subgroup has made reasonable progress in achieving project objectives described in the 2006 proposal. Despite this, CSMEP has only provided products at a very broad level and should include monitoring spreadsheets and analyses of additional metrics at finer scales (e.g., reach survival, dam passage survival, spill passage efficiency, forebay delay, travel time, etc.) to make the work products truly useful. Furthermore, documentation is necessary to illustrate that substantial regional coordination and collaboration has taken place such as with PNAMP and AFEP programs.

The ISRP believes the exercise of combining data from multiple years to obtain alternative estimates of precision associated with estimates of SARs is useful. However, this does not mean that methods to improve precision of estimation within a year should receive less attention. The ISRP appreciates the candor in the report where approximate estimates of the change in precision with numbers of PIT tags are clearly identified as approximate and where tenuous assumptions are identified and approaches to improve the situation are proposed. The evaluation of different management attitudes to the transportation of fish is a creative way of examining the effect of different monitoring designs on decision-making.

Results suggesting that increasing the number of tagged fish does not necessarily equate to increasing the probability of correct decisions (p. 86, Volume 2) is counter-intuitive. The discussion of the conditions under which increasing tag numbers is, or is not, beneficial is helpful and illustrates the benefit of creative use of simulation models. Nevertheless, the conditions under which increasing tagging is not beneficial must be clearly articulated to be credible. The cautionary statements that managers need to take into account when deciding on tag numbers for both short and long term objectives is clearly illustrated in the simulation results.

4) Habitat

CSMEP's Habitat Subgroup has done an admirable job of going beyond the development of a general M&E template to the formulation of a pilot habitat restoration evaluation project where the costs and benefits of different restoration monitoring strategies can be assessed. The ISRP is unaware of any other effectiveness monitoring projects in the Columbia River Basin where scheduled implementation of restoration actions and alternative monitoring procedures are being experimentally tested at this spatial scale (Lemhi River). We hope the work continues to be funded and the stakeholders currently participating in the effort will continue to do so.

We agree that the "question clarification" process was a useful exercise that helped focus the different types of monitoring and the questions that would (or wouldn't) be answered. This exercise (Table 5.1 and 5.2, pages 94-99) provides an instructive departure point for subbasin planners who, having completed their subbasin analyses and subbasin plans, are asking – now what? Organizing the problem according to specific questions, target species, stakeholders, non-technical issues, and conceptual approaches helped identify the critical knowledge gaps regarding habitat in the Lemhi River watershed and provided the basis for designing the "status quo", "low", "medium", and "high" effectiveness monitoring plans.

CSMEP Approach

Currently, the Lemhi River watershed contains a number of tributaries to the river's mainstem that could provide good Chinook salmon, steelhead, and bull trout spawning and rearing habitat. During summer, many of these tributaries are inaccessible to salmonids as a result of agricultural dewatering and pushup dams. The CSMEP pilot study proposes to reconnect many of the tributaries in the upper Lemhi watershed with the mainstem to improve both spawning and rearing. Tributaries to the lower mainstem will not be reconnected, as conditions in the largely channelized lower mainstem are not favorable for salmonids. Additionally, one major Lemhi R. tributary (Hayden Cr.) will serve as an unrestored reference site. The primary focus of the restoration effectiveness monitoring efforts will be on Chinook salmon.

The ISRP appreciates that CSMEP developed very specific questions with regard to the performance of different life history stages, although their management questions (Table 5.3, page 102) do not actually specify what the population performance targets are. For example, a key management question for juvenile Chinook survival asks whether the restoration actions have increased parr-smolt survival by "X%, +/- specified precision", without actually giving what the target percentage is. Presumably this is related to some lack of management agreement on what the appropriate target should be. However, inability to specify the desired magnitude of biological response to restoration does constrain any power analysis of how long, and at what intensity, effectiveness monitoring should be carried out. Until managers agree on the desired level of biological response, it will be difficult to determine how long monitoring should take place.

Performance Measures

CSMEP focuses primarily on the development of fish population monitoring programs while the Pacific Northwest Aquatic Monitoring Partnership (PNAMP) emphasizes aquatic habitat monitoring; therefore, the majority of CSMEP's effectiveness monitoring metrics for the Lemhi River pertain to Chinook salmon and bull trout parameters. The CSMEP pilot study is examining spatial distribution, abundance, migratory timing, redd counts, spawning adults, and two survival measures: smolts per redd and parr-to-smolt survival. The ISRP strongly endorses these measurements, especially the two survival metrics, as it is likely that any benefits of tributary habitat reconnection will be expressed in improved life-stage survival and abundance.

Physical habitat and water quality parameters will be measured at the reach scale and include the usual list of habitat features included in many monitoring programs. The actual type and frequency of habitat measurements will depend on which monitoring alternative (status quo, low, medium, or high) is selected. Project sponsors state that some habitat variables will not respond directly to tributary reconnection but rather will be used as "explanatory" parameters (page 104) to help interpret observed fish population changes. Because the explanatory value of different habitat parameters is not yet known, the pilot project reserves the option to make mid-course adjustments in what is being measured and how often it is sampled or surveyed. This seems like a sensible approach.

The ISRP notes that primary and secondary production is proposed for sampling at the reach scale. We assume that this does not mean actual primary and secondary production measurements, which are very time consuming and usually involve *in-situ* production/respiration devices. Rather, we are guessing that project sponsors will measure the standing crop of chlorophyll from artificial or natural substrates, coupled with macroinvertebrate samples from representative riffles. We believe caution should be exercised before undertaking such measurements. They can be quite valuable if properly collected, but the high spatial and temporal variability in periphyton and macroinvertebrate densities at the reach scale demands intensive sampling, and costs can be great. Few low-level periphyton or macroinvertebrate sampling programs yield data useful for interpreting restoration effects, and for this reason the ISRP cautions against committing to such measurements unless the sampling program has been carefully reviewed by an aquatic ecologist.

On the other hand, the ISRP feels that some measure of the effects of the tributary reconnection on food availability in the Lemhi River system would be very useful, and project sponsors should consider letting measurements of the fish themselves serve as indicators of trophic conditions. Although many of the juvenile fish surveys will be conducted by snorkeling, there will be opportunities to handle individuals at smolt traps, and during electrofishing or seine surveys. Fish can be measured and weighed for information on growth and physiological condition, assuming that these metrics will reflect on the relative abundance of food resources. Direct estimates of reach-specific fish growth as a way of inferring the effects of tributary reconnection on food availability will likely be less prone to sampling variability than estimating periphyton and macroinvertebrate densities, and the cost will be much lower.

Sampling Design

The rather short description on page 105 of sampling design (where, when, and for how long monitoring takes place) acknowledges that sampling intensity will depend on desired statistical accuracy and precision, as well as available funding and the selection of a particular monitoring alternative. At present, questions of how sampling should occur for different population and habitat parameters remain unanswered but will become clearer as the pilot project proceeds. The ISRP understands that it is premature at this time to conduct power analyses for most variables. However, we believe that this should be completed as soon as it is feasible to do so. This will have important implications for project costs and the ability to interpret monitoring results.

Design Alternatives

The report does an excellent job of summarizing the type and location of current monitoring programs in the Lemhi River, as well as the improvements that would be associated with each of the low, medium, and high monitoring options. The ISRP appreciates the detail that is presented in the descriptions of the various monitoring options and in the table comparing specific activities directed at answering the key questions in Table 5.4, pages 113-114.

Cost estimates for the monitoring alternatives are presented in Table 5.6, page 115. It is noteworthy that estimates for low, medium, and high monitoring differed according to whether costs were figured on a “per project” basis (a top-down estimate based on project costs and

contracting history) or on a "cost per unit time per person" basis (a bottom-up estimate figured as the product of the number of samples and the cost of obtaining and processing a sample). The more intensive the monitoring, the greater the difference was between the estimates, and the ISRP suspects the bottom-up approach to be the more accurate of the two cost estimate techniques.

Finally, the project sponsors have done a thoughtful job in describing how the results of the Lemhi River pilot project will be used in developing formal cost-effectiveness tools for decision-makers who have to make hard choices regarding how much to invest in habitat restoration effectiveness monitoring (CSMEP Integrated Cost Database Tool) on pages 115-118. Additionally, they acknowledge some of the difficult problems such as lack of adequate controls, which must be overcome in many monitoring situations, and stated they will address these problems in future work.

The efforts to date represent a major advance in development of a systemwide monitoring and evaluation project. However, as the project sponsors note, many remaining problems must be overcome before full implementation. For example, specification of population performance targets (increase in parr-smolt survival) is necessary before power analyses can be used to identify the intensity and duration of monitoring necessary. Also uncertainty related to the variation in estimation of food availability should be justified in lieu of direct estimates of reach-specific fish growth as an indication of the effect of tributary reconnections.

Specific comments on the habitat section of Snake River Report (Volume 2, Section 5)

p. 92 "The mechanistic linkages between habitat change and fish response are often poorly understood."– it is not clear how the cost effectiveness of habitat restoration can be assessed if the mechanistic linkages (presumably this means cause and effect) are unknown. Note this question is also posed in Table 5.1

p. 92 "Management objectives are often not clearly articulated and the results of habitat actions can therefore be difficult to quantitatively evaluate.8 (Footnote 8 on this page –"For example many Habitat Conservation Plans (HCPs) lack specific biological criteria for success"). – If policy makers do not give objectives how can results be evaluated or metrics chosen for monitoring? Note this question is also posed in Table 5.1.

p. 110, Table 5.1 – It is not clear why the DQO scheme is being followed when on page 108 it is stated that the DQO process was too general and that the "question clarification" process was followed instead. Comments on Table 5.2:

- It is not clear how policy affects many of the technical elements in CSEMP.
- The concept of adaptive management is buried in the table under Step 2, but this is the overarching concept of CSEMP.
- Performance measures are mentioned under Step 3 as a key item and clearly a lot of the sampling effort and costs are dependent on their choice. The document would be improved by a review of performance measures. Are they used elsewhere in the Columbia River Basin? Performance measures are only appropriate when the workings of

the system are very well understood (Performance Measures are really an engineering/factory tool). Judging from the frequent reference to needed research and casual factors it is likely the foundation for performance measures is weak.
- Boundary definitions in Step 4 do not consider downstream and estuary/ocean linkages.
- Are the Critical Action Levels described in Step 5 the performance measures described in Step 4?

p.113, Table 5.2 (specific to Lehmi River):

- Under Step 2 (identify Principal Questions) there is no mention of restoring Chinook life history patterns to historical conditions yet this is a specific goal for the Columbia River Basin in general (according to various NOAA documents)

- Inputs under Step 3 exemplify the problem with performance measures (e.g., What IS the optimum or desired or required spatial distribution of Chinook redds?)

p.118, Table 5.3 (developed after "question clarification) has similar issues to those in Table 5.2 especially re: performance measures.

p.118, Table 5.3 – the list of "clarified management questions" is weak on biological factors such as density dependence, non resident species concerns, and ecosystem questions.

p. 119 Section 5.3.3 – apparently there is overlap between PNAMP and CSMEP in habitat monitoring. Are many members in common between the two groups? The nature of the coordination between PNAMP and CSMEP should be clearly summarized here.

p.116, Section 5.5 – According to this section, statistical models, cost models, and standard methods for summarizing and presenting the results of these analyses to decision-makers are still required before implementation. The cost of this work is not mentioned.

p. 131, Section 5.5 - Apparently only the "High" design will reveal causality. But do the members of CSMEP actually want to address causality – this is very much a research question but are there researchers who will be motivated and have the mandate to publish their findings? Would this research overlap with work done in IMWs?

In addition, research is mentioned as a required component at several other places in the document, but the cost of research is not analyzed.

5) Hatcheries

Chapter 6 of the CSMEP Snake River Basin Pilot Study expands on themes introduced in the CSMEP 2005 and 2006 annual reports. The CSMEP hatchery workgroup subdivided artificial propagation programs into three primary uses: harvest augmentation, supplementation, and conservation. The document further identified 11, 25, and 5, questions of management interest for these programs, respectively. CSMEP states that these questions are answered using 65

metrics, however these are not provided or linked to the specific questions (this could be done easily with a single table or matrix).

As early as the 2005 annual report, CSMEP identified that they had (or were in the process) of reviewing existing RM&E for hatcheries and had concluded that if funded and implemented the existing RM&E for individual programs should address most evaluation needs. Based on this conclusion, CSMEP focused attention on data and metrics not likely to be covered by the individual programs. The CSMEP hatchery subgroup believed these additional evaluation questions would require implementation of a stratified and representative study design spanning the entire Columbia River Basin.

The CSMEP hatchery subgroup identified "*What is the distribution and relative reproductive success of hatchery origin adults in target and non-target Columbia River Basin populations?"* as the highest priority inquiry amenable to systemwide M&E.

CSMEP then identifies that monitoring and evaluating this question requires:

1. *estimates of the relative abundance of strays in salmon population*, and

2. *estimates of the reproductive success of hatchery origin adults relative to natural adults in target and non-target populations*.

The document proceeds to identify specific monitoring and evaluating activities that these questions require.

Stray-rate Estimates

In the CSMEP – Snake River Basin Pilot Study, the hatchery workgroup summarizes the strengths and weaknesses of coded wire tag (CWT) and adipose fin clip data for estimating stray-rates from hatcheries. They include appendices with CWT tagging rates for most basin hatchery programs, specific instructions on how to query the RMIS database to get the information to calculate stray rates, and a subbasin by subbasin summary of stray-rate estimates for spring and summer Chinook in the Snake and upper Columbia regions.

They conclude that the information in RMIS is not sufficient owing to a lack of effort to recover tags from the spawning grounds and because data do not appear to be reported consistently and in standard format to the database, and that the *status quo* estimates of straying are too imprecise for sound management decisions. This begs the question, is the sampling standardized to effort and with sufficient intensity to give accurate and precise estimates?

They then go on to describe the precision of stray rates using coded wire tag data, and propose three (low, medium, and high) sampling schemes to improve stray-rate estimates. Only qualitative assessments (excellent, very good, good, fair, poor, and unknown) are applied to the different alternative evaluation designs, so the ISRP is unable to assess the full sufficiency of the improvement over the status quo.

Relative Reproductive Success Estimates

Section 6.2.2 (page 139) initiates a discussion of the potential impacts of hatchery-origin adults from either harvest augmentation or supplementation programs on the *per capita* productivity of natural-origin adults in a mixed population and proposes to evaluate this uncertainty using molecular genetic technologies that permit determining how many adult progeny are produced by individual parents in the preceding generation. These investigations are referred to as RRS estimates (Relative Reproductive Success). The experimental framework proposed on page 140 is to "*directly estimate the amount of production that can be attributed to individual naturally spawning hatchery origin adults relative to individual natural origin adults"* and then to use this contrast as "*a direct evaluation of the impacts of hatchery origin adults on per capita productivity."*

The CSMEP hatchery workgroup categorizes the potential influence of hatchery fish on natural salmon populations using the "proportion of natural influence" index (PNI) developed by the Hatchery Scientific Review Group (HSRG 2004) and suggests conducting RRS studies in populations systematically across the range of PNIs observed in the basin. The report (page 143, table 6.8) identifies six stream-type Chinook populations with ongoing relative reproductive studies. The ISRP is aware that the population in the Wenatchee River is also being evaluated, (*Monitor Repro in Wenat/Tuc/Kal*, project # 200303900). They identify that, in 2008, CSMEP will evaluate whether these studies are suitable to contribute to a basin-wide analysis.

CSMEP proposes three alternative designs to pursue RRS studies: a low design that will evaluate juvenile production in six streams that are intentionally supplemented with hatchery fish; a medium design that will evaluate both juvenile and adult production in six streams that are intentionally supplemented with hatchery fish; and a high design that will evaluate both juvenile and adult production in six streams intentionally supplemented with hatchery fish and another six population that are "non-target" populations where the presence of hatchery fish are strays. The CSMEP hatchery workgroup recommends implementing the medium alternative.

ISRP Hatchery Section Conclusions

The ISRP concludes that this element is incomplete and needs further development before being considered for implementation.

The stray-rate information is likely needed for management decisions and evaluations, but the presentation is insufficient to determine whether the design will actually improve the existing estimates. It is clear from the summaries that the *status quo* is inadequate, but as yet to be quantified improvement could be realized from improved field protocols and more timely reporting of CWT data to the RMIS database. No review is provided of stray-rate estimates other than CWT data. It would be useful to compare stray-rates identified in the NOAA status reviews and other TRT documents, and to confirm other possible sources of information that have been used in the past.

The implication of this section is that hatchery adult stray-rates and RRS in natural populations is an approach to hatchery impact evaluation on a basin-wide scale. This viewpoint misses the

important information this provides to evaluating the viability of populations and that this should be a subcomponent of the status and trends monitoring. The Cumulative Risk Initiative (CRI, circa fall 1999) recognized that estimating the extinction probabilities of salmon populations required estimating the proportion hatchery fish that were straying into the population and the production from those hatchery fish. The CRI estimated extinction likelihood bracketed by hypothetical hatchery stray-rates and productivities. The absence of data for these parameters was recognized in the 2000 FCRPS Biological Opinion, and RPA 182 directed the action agencies to initiate studies to determine the relative reproductive performance of hatchery adults spawning naturally. These studies have been designed to understand the demography of natural population that includes a mix of hatchery and natural fish. The purpose is to be able to account for production from hatchery immigrants when estimating lambda for the natural population.

The type of RSS investigations proposed appear to be more suitable for partitioning the demography of the populations than evaluating the effect hatchery fish have on the productivity of natural fish. Presumably this later effect would be owing to interbreeding between natural and hatchery fish, and the effect needs to be evaluated by contrasting natural fish with different histories of hatchery influence in their pedigrees. A contrast of hatchery and natural fish is not suitable to evaluate that phenomenon.

The demography of the natural component of mixed populations is important in evaluating the status of populations under the Endangered Species Act. Thus the effort is worth pursuing, but it needs to be clear what the investigations can actually be expected to yield. For this purpose RRS evaluations should take place in non-target populations affected by fish from harvest augmentation programs, if those are relevant to the ESA evaluations. Both the stray-rate and RRS efforts need to be integrated into the status and trends domain.

It is not clear how “stray-rate” alone can act as a metric to evaluate hatchery program impacts. None-the-less, improving the estimates of the stray rates to provide a baseline would be valuable.

The ISRP understands that CSMEP is contributing to an Ad Hoc Supplementation Workgroup that is working on a design to evaluate both the demography of supplemented populations, and the long-term fitness effects of interbreeding, that has a planed release for 2008. The ISRP looks forward to reviewing that effort.

ISRP has previously recommended in the basin that reference streams be included in hatchery program evaluation (e.g., Idaho Supplementation Study, Yakima hatchery program). Inclusion of appropriate reference streams permits the exclusion of other variables that would lead to demographic increases that would mask or confound treatment responses. Therefore, unless there are clearly articulated measurements (reduced bias, increased accuracy, precision, etc.) to support the choice of medium intensity, it is prudent to invest additional funds to give a more useful and rigorous answer.

Lastly, some of the expected variables derived from this M&E are specifically important to other domains (i.e., status and trends, harvest) requiring integration with those M&E actions.

6) Integrated Monitoring

The need for implementation of a consistent, long-term integrated monitoring program is clearly stated. Challenges to full integration are identified including the need to address multiple objectives, appropriate use of existing monitoring sites, coordination across agencies, and program infrastructures. Identification of several dimensions requiring consideration including spatial integration, temporal integration, life history integration, species integration, and programmatic integration provides a useful perspective on the challenges to integrated monitoring.

The CSMEP integrated monitoring efforts are in the exploratory stages. The Snake River Basin pilot study should provide useful information to benefit others in the Columbia River Basin. It appears that to date the CSMEP proposed iterative process has identified general strategies for integration and has begun to identify opportunities. It is unclear how sets of Low, Medium, and High designs will be integrated across all five M&E domains.

It would be useful for the ISRP to have current information on the status of products and processes currently under development in support of integrated management such as analytical tools and simulation models; evaluation of marking and monitoring techniques other than PIT-tagging; and the Integrated Cost Database Tool and accompanying User Guide.

The ISRP understands and appreciates the challenges to successful integrated monitoring. The brief explanation of considerations and strategies in this section of the Snake River Basin Pilot Report represents a good start on this important task.