Northwest Power and Conservation Council



May 31, 2007

# MEMORANDUM

**TO:** Council

**FROM:** Steve Waste, Manager for Program Analysis and Evaluation

**SUBJECT:** Progress Report of the ISAB Ad Hoc Supplementation Workgroup

## Background

In their report Monitoring and Evaluation of Supplementation Projects (2005-15), the Independent Scientific Review Panel (ISRP) and Independent Scientific Advisory Board (ISAB) noted the possibility that the advantages of the demographic contribution from a supplementation program could be counteracted by longer term negative impacts on reproductive fitness of the natural population. The report concluded that:

> *Monitoring and evaluation of supplementation projects is critically important. For the monitoring to be effective, a very rigorous design is needed, and the scale and logistics of implementation will carry costs that are significant. The scientific issues underlying the definitions of performance metrics and the necessary controls in the design are genuinely complicated. Some of the scientific tools for measuring performance are new, and involve a level of knowledge of population and molecular genetics which until recently has not been part of the standard fisheries curriculum.*
>
> *The consequences of not conducting these studies and continuing to assume no deleterious impacts from supplementation, and being wrong, are much greater than short-term changes in salmon abundance. The natural populations that may be lost if supplementation actually decreases their fitness are irreplaceable. On the other hand, if supplementation proves an aid to natural population during distress, further application may be warranted. Both outcomes remain uncertain without adequate monitoring and evaluation, which will likewise guide best management practice and cost effectiveness.*

Consequently, the ISRP and ISAB recommended that a comprehensive evaluation be conducted of the use of supplementation as a recovery tool for depressed salmon/steelhead populations in the Columbia River basin that would:

- identify the critical uncertainties of supplementation

- outline monitoring data needed to evaluate supplementation

- provide options for coordinating projects throughout the basin to produce an experimental design sufficient to resolve these uncertainties

In response to this recommendation, the Columbia River Intertribal Fish Commission (CRITFC) and NOAA-Fisheries (Northwest Fisheries Science Center) sponsored an ad hoc workshop of a limited number of fisheries managers and researchers to examine how a coordinated evaluation might be organized. On September 6th, 2006 a letter and report describing the results of this first workshop were sent to the Council (Report I is available at: http://www.cbfwa.org/csmep/web/documents/Documents.cfm?searchstring=supplementation)

**Progress to Date**

A second meeting of the Ad Hoc Supplementation Workgroup held on February 14 and 15, 2007, in Portland, Oregon (Report II is attached for your review). The purpose of the second meeting was to clarify objectives identified in the first meeting, and to assign tasks to a smaller working group to develop a report to be submitted to the Council, NOAA Fisheries, and CRITFC. The purpose of the report is to provide a consensus view on the information and analytical design required to quantitatively evaluate the benefits and impacts of hatchery supplementation of natural populations, as called for by the ISRP/ISAB. Development of the report will require:

- that remaining uncertainties are clearly articulated

- that existing hatchery monitoring has been reviewed relative to the ability to provide adequate information to address these uncertainties

- that designs to address uncertainties using these data have been constructed

- that gaps in the required information can be addressed by products solicited under such an request for proposals

The final report will provide the basis for a request for proposals to coordinate ongoing efforts and initiate additional studies to meet the information needs.

On behalf of the Ad Hoc Supplementation Workgroup, Peter Galbreath of CRITFC will brief the Council to provide an update on progress to date.

**Attachment: Report II**

# Meeting Summary - Supplementation Monitoring and Evaluation Workshop II

February 14-15, 2007
NOAA
Portland OR

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**Report of the Supplementation Monitoring and Evaluation Workshop II**

February 14-15, 2007
NOAA, Portland OR

## Introduction

For a century, salmon and steelhead have been produced and released by hatchery programs in the Columbia River basin as a means to mitigate for diminished harvest levels resulting from excessive harvest in previous years, freshwater habitat alteration and changes to the hydro-system associated with dam construction. Over the past 20 years, there has been a shift in hatchery management objectives for some programs from harvest augmentation to supplementation – the release of fish for the purpose of increasing the number of spawning adults in natural populations, whose abundance had fallen to low levels relative to prior years on record. Several independent study groups have reviewed the practice of supplementation since it gained acceptance as a management action to recover and maintain depressed natural populations of salmon/steelhead. Supplementation has been shown to lead to increased numbers of returning adults, and is generally presumed to result in increased production of juveniles. However, it remains uncertain whether this is indeed generally the case, and more importantly, whether supplementation might in fact have a deleterious effect on long term productivity of the natural population. These study groups consistently recommended that projects institute well designed monitoring and evaluation (M&E) activities in conjunction with hatchery supplementation actions, by which to assess project effectiveness.

Beyond these calls for evaluating the effectiveness of hatchery programs on an individual basis, the ISAB (2003) recommended coordinating the design and monitoring of supplementation programs into a "basinwide adaptive management experiment" (p.xvii). The resulting comprehensive analysis would provide a strengthened assessment of supplementation as a class of actions for recovering depressed salmon/steelhead populations – an assessment which would provide science-based guidance to the Council for use in evaluation of ongoing Fish & Wildlife Program projects, and in the review process for new proposals.

In their joint memo "Monitoring and Evaluation of Supplementation Projects", the ISAB and ISRP (2005) recommended holding an *ad hoc* workshop of a limited number of fisheries managers and researchers from across the breadth of concerned agencies, to examine how a coordinated evaluation might be structured. In 2006, an initial Supplementation Monitoring and Evaluation Workshop was organized. Reviews were presented on activities of several ongoing projects, and discussions held on how to design a basinwide evaluation of supplementation. The group concurred that an appropriate assessment should involve a combination of two approaches. The first would analyze a limited number of population abundance parameters from a large number of supplemented and potential reference streams throughout the basin, with emphasis on streams for which a time series of data for previous years already exists. The second approach would complement the first with data from a smaller number of intensively controlled and monitored systems, incorporating pedigree analysis using molecular genetic techniques, in order to provide information on relative reproductive success (RRS) of hatchery origin and natural origin fish.

Discussions in the first workshop were continued in a second Supplementation Monitoring and Evaluation Workshop, held in the offices of NOAA, Portland OR, February 14-15, 2007. This workshop began with opening remarks by workshop organizers Mike Ford and Phil Roger, followed by remarks on the behalf of NOAA from Rob Walton (Salmon Recovery Division). A series of six brief slide presentations were made to provide background information, then open discussion proceeded on the two Workshop Objectives. These objectives concerned the two approaches for evaluation of the effects of supplementation identified in the first workshop: 1) a long-term comparison of supplemented versus reference streams, and 2) a shorter term evaluation of RRS calculated through molecular genetic pedigree analysis. The following is a summarization of the principal ideas communicated during these presentations and discussions.

## I Workshop Presentations

Report of the Supplementation Monitoring and Evaluation Workshop, Portland OR, April 6-7, 2006 (Peter Galbreath)

- Summary presentation of the report on the first *Ad Hoc* Supplementation M&E Workshop; for which the primary observations and conclusions included:

- Agreement on the current lack for a means to make a collective (basinwide) assessment of effects of supplementation (and hatchery programs in general) on natural populations.

- Need to categorize hatchery programs/streams beyond simply harvest augmentation versus supplementation.

- Existence of a serious deficiency in data collected on reference (non-supplemented) streams against which data from treated streams may be compared, and concern whether the status of streams as references can be maintained over a sufficient time period for proper evaluation

- RRS studies using pedigree analysis offer valuable data which is difficult to obtain through supplemented versus reference comparisons, but which is limited to direct evaluation of effects over only 1-2 generations – with the possible exception of highly controlled small-scale experiments.

- Need to organize a second workshop to outline a design for both an appropriately stratified basinwide analysis of supplemented and reference streams, as well as for relative reproductive studies.

Where are we going and how are we getting there? Establishing a guiding framework (map) for regional monitoring and evaluation of hatchery/supplementation programs. (Jay Hesse)

- Several persons from across various agencies, including Northwest Planning and Conservation Council (heretofore, the Council) members, were queried as to their expectations of the Workshop and how it might address continued uncertainty regarding the effects of hatchery releases on natural population status.

- There was a general consensus for:
  1) the need for integration of ongoing and new projects within an M&E framework which would enable comprehensive analysis
  2) the need for assurance that effects of hatchery programs on natural populations, if not beneficial, are at least benign
  3) that the framework for a collective analysis should provide guidance to the Council and BPA for the project selection process
  4) that recommendations could be enacted in a cost effective manner

- It was proposed that the following decisions be adopted by the Workshop participants:
  1) adoption across the basin of hatchery program labels – harvest augmentation (segregated), supplementation (integrated), and conservation
  2) categorization of programs according to PNI – e.g., 4 groups: PNI = 0.0 to 0.3, 0.3 to 0.5, 0.5 to 0.7 and 0.7 to 1.0
  3) adoption of the RASP definition of supplementation
  4) adoption of the standardized list of management objectives, and the list of performance measures and definitions, as developed by CSMEP hatchery subgroup
  5) adoption of four levels for hatchery evaluation (from least to most intensive) – Implementation and compliance monitoring, Local hatchery action effectiveness monitoring, Regional hatchery action effectiveness monitoring, Critical uncertainty research

- It was also proposed that the CSMEP hatchery subgroup be chosen as the nucleus (and administrative structure) around which to form the Workshop working group which will elaborate the proposed framework.

Collaborative Systemwide Monitoring and Evaluation Project (CSMEP) Hatchery Subgroup Designs (Chris Beasley)

- Provided a review of the previous 2 years' activities of the hatchery subgroup.

- Initial work identified a large (50+) number of specific questions related to assessing hatchery effectiveness.

- Subsequent categorization limited the number to 16 High Priority questions.

- Decision was then made to focus current efforts of the subgroup on 2 major questions:
  1) How to assess the magnitude of straying of hatchery-reared fish into supplemented (target) and natural (non-target) populations and enable estimation of stray ratios in a representative manner?, and
  2) How to assess RRS of hatchery-origin fish in target and non-target populations, while controlling for potential changes in productivity that might occur even in the absence of differential RRS?

- For both questions, descriptions are being developed of Status Quo monitoring, and of Low, Medium and High intensity M&E designs for addressing these questions at increasing levels of detail and certainty.

Preliminary Index of Supplementation Treatments for Designing and Evaluating Hatchery Programs (Craig Busack and Todd Pearsons)

- A major hurdle in developing a proper means to assess effects of supplementation hatchery programs is the difficulty in stratifying them into like groups, so that data may be analyzed collectively The difficulty is related to the wide variation in the features characterizing these programs, e.g., species, broodstock selection and mating protocols, hatchery-rearing protocols, size and characteristics of the natural salmonid population, stream characteristics and stream carrying capacity, etc.

- A supplementation program has a potential demographic benefit for a natural population, which can be evaluated as the proportion increase in average population abundance from pre-supplementation years, to the estimated carrying capacity of the system - "Supplementation Potential as % of Increase in NORs" (carrying capacity for this calculation was estimated through the use of the EDT model).

- There is also an expectation for a domestication effect from supplementation programs (characterized by a shift in the genotype/phenotype of a natural population towards that for a population maintained in a hatchery program), the strength of which can be expressed quantitatively by the program's Proportion of Natural Influence (PNI), calculated as: pNOB/(pNOB + pHOS), where pNOB = percent of natural origin fish in the hatchery broodstock, and pHOS = the percent of hatchery origin fish among the naturally spawning adults.

- Graphing the PNI values corresponding to each supplementation program places the programs in positions relative to each other, allowing comparison between programs with regard to the degree of anticipated hatchery influence.

- Together, these values can be used to calculate an index value for each hatchery program, which can be used to categorize the programs for collective analysis.

Monitoring and Evaluating a Hatchery Program in the Upper Columbia River (Chuck Peven, Andrew Murdoch and Tracy Hillman)

- The Habitat Conservation Plan (HCP) for the Mid-Columbia region obligates the Chelan, Grant and Douglas County PUDs to financially support salmon hatchery programs and habitat restoration efforts within their areas of impact.

- In a collaborative effort of the PUDs, Yakama Nation, Colville Tribes, WDFW, USFWS and NMFS, a Conceptual Plan (2005) and a Statistical Design (2006) were developed for M&E of Mid-Columbia salmon hatchery programs.

- The M&E plan describes the various metrics which are to be monitored, classified under the demographic, genetic or ecological objectives of the programs.

- 2006 was the first year of implementation of the HCP and the defined M&E activities.

- Success of the effort to assess effects of the hatchery programs on natural populations through this M&E process will be contingent on identification of appropriate reference stream(s).

- The process to identify appropriate reference streams is ongoing (see Hays et al. 2007); alternatives to the treatment-reference comparison methodology are also being investigated

- Preliminary power analyses indicate that power to detect differences in natural replacement rate (NRR) between supplemented and references streams will be relatively low; an example matrix was developed to classify percent changes in NRR (within 1,2, 3, 4 and 5 broodyears) relative to three management risk categories – no concern, warning and concern.

- Also, provided a summary of initial (3 years) results on the Wenatchee River spring Chinook RRS study, which is to run from 2004 to 2014. No strong trends were observed as yet between hatchery origin and natural origin fish. Differences in run timing and size at age were detected. Although differences in spawn timing, fecundity, egg weight and egg retention of hatchery and naturally produced age-4 females was not observed in more than 1 out of 3 years.

Idaho Supplementation Study (ISS) (Dave Venditti)

- Presentation provided a review of the structure and history of the ISS project.

- The project will enter Phase III after the adult returns in 2007, during which supplementation will cease and post-treatment production and productivity data will be gathered.

- Analysis of Phase I (pre-supplementation) and Phase II (during supplementation) data with split-plot ANOVA (Lutch et al. 2003) demonstrates significant increase in natural population abundance associated with supplementation, and with straying.

- Analysis using a regression design (Lutch et al. 2005) produced similar results.

- Accounting for the effects of strays in the analyses still presents problems – currently, analysis presumes similar productivity of strays versus non-strays within years, though this may not be a valid assumption.

- Provided that monitoring is maintained over the coming years through Phase III, future analyses should be able to account for various fixed and random effects on productivity measures, including straying, providing a sound assessment of post-supplementation effects.

- Researchers suspect that density dependent effects may already be decreasing recruits per spawner rates in some supplemented streams.

- Additionally, tissue samples have been collected for microsatellite DNA parentage analyses, in order to calculate RRS of hatchery origin and natural origin adults for the 2002-2006 broodyears in the Pahsimeroi River, and will continue for the remainder of the project. Additionally, adult and juvenile DNA has been collected from the upper Salmon River (above Sawtooth Hatchery) for the same brood years and will be collected for the remainder of the program. However, additional funding will likely be needed to analyze these samples.

**II** **Objective 1:** To produce the outline of a design for a basinwide evaluation of the long-term effects of supplementation on salmon/steelhead population abundance and productivity - calculated relative to population trends in reference streams. Then, to identify a work group to fully develop the design, to accumulate existing relevant data sets, and to perform initial analyses to assess power of the design.

- The group concurred with the ISAB (2003), the ISAB/ISRP (2005) and the various independent scientific review groups concerning the need for a coordinated large scale assessment of uncertainties relative to long term effects of supplementation (and of hatchery releases in general) on fitness of natural salmon/steelhead populations. And, they acknowledged the Council's need for such an assessment to provide guidance for evaluating Fish & Wildlife Program ongoing projects and project proposals which utilize supplementation.

- Such a "grand experiment" (ISAB 2003, pp. xx and 118) could take various forms, ranging from a fully controlled, manipulative hypothesis-testing experiment in which 'treatments' and 'controls' are created and monitored over the term of the experiment and resulting data analyzed within a unified statistical design, to less rigid designs which coordinate monitoring of supplemented and non-supplemented populations at varying levels of intensity and control, depending on the metric, followed by estimation of effects using a statistical model appropriate to each analysis.

- The group agreed that a fully controlled, manipulative experiment has the attraction of greater statistical power to discern effects over a full range of biological and management variables. Although, they recognized that it would be extremely challenging to implement - variance in a variety of biological and environmental parameters at the temporal scale (several salmon/steelhead generations) and spatial scale (the Columbia River basin) required would be very difficult to control. Also, a unified experiment would require modification of some projects to align themselves to a chosen standardized design, and a significant amount of administrative and management coordination between agencies and across projects - not the least of which would involve agreement to forego implementation of other habitat restoration and fisheries management actions in treated and reference areas which are not part of the study design. Additionally, commitment to the experiment would necessarily have to extend over several salmon generations, and would require continued financial commitment.

- However, the group also agreed that evaluation of the uncertainties surrounding supplementation and the guidance sought by the Council do not necessarily require this high level of coordinated design and statistical power across all variables. Larger scale effects on abundance and productivity can be sufficiently assessed through coordinated monitoring efforts across the various relatively independent projects, and their respective supplemented and non-supplemented ('reference') populations, with the populations being appropriately stratified according to basic treatment and stream characters. On the other hand, finer scale effects, e.g., reproductive success, life stage survival, etc., can adequately be assessed at the level of multiple intensively monitored regional projects, such as the ISS, YKFP, NEOH, Upper Columbia program, etc., where the within-project biological and environmental variance is reduced, and administrative and management control greater. Similarity in results from across these intensive studies will permit generalization of observations to the basin. This approach is consistent with the range of potential approaches outlined by the ISAB (2003) and ISRP (2005).

- The increased emphasis on monitoring and evaluation that has occurred over the past years (e.g., though institution of the Three Step Review Process) has already resulted in supplementation projects gathering more data on similar sets of metrics. Regional analyses will be facilitated by further standardization and coordination of M&E activities across projects.

- A number of intensively monitored regional programs, such as the ISS and the Upper Columbia Project (see above), and the Yakima-Klickitat Fisheries Project (YKFP), the Northeast Oregon Hatchery (NEOH) projects (see Galbreath 2006) also have many commonalities in their M&E designs, and each has established designs for statistical analysis.

- The participants agreed that a small working group should be created to elaborate a report describing the uncertainties to be addressed, the appropriate performance metrics to be monitored, and the framework for an analytical design, including identification of the particular projects and their respective treatment and reference populations to be integrated into the design.

- The Workshop report should provide the Council with a clear and realistic explanation of the technical and logistical limits which define the extent to which information from projects across the basin can be combined into collective analyses, and of the time frame within which such analyses can be envisioned.

- It is important for policy makers to understand that the time frame for reaching conclusions on some of these issues could be on the order of several salmon generations (20 or more years).

- However, the participants were cautioned, again, that the Council remains in need of guidance within a much shorter time frame.

- There was consensus that the regional monitoring and evaluation framework document originally developed for the NEOH program, and further elaborated by CSMEP (see Hesse presentation above), be adopted as the basis for the framework to be described in the final Workshop report. The framework would incorporate elements of the analytical designs from the M&E plans of existing intensive projects.

- After finalization of the report, it will be submitted to the Council for scientific review (ISAB and ISRP), as well as to NOAA, BPA, PUDs, Tribes, IDFG, ODFW, WDFW.

- A list of M&E actions and protocols have been defined by CSMEP; this list will be reviewed by the working group, and adopted with revisions as necessary within the proposed framework.

- There was consensus that the framework can be expanded to include an assessment of not just the effects of fish released from the range of different integrated supplementation programs, but also the effects of strays from segregated harvest augmentation programs.

- The report should provide a brief summary of supplementation programs across the basin, to identify areas where current M&E activities are deemed as providing sufficient data, as well as areas where data gaps still exist - which will need to be addressed by expanded monitoring.

- Insufficient data collection from non-supplemented reference streams remains a serious problem, and current programs and new proposals need to address this deficiency.

- The hatchery programs will need to be categorized to facilitate collective analysis. In addition to species and ESU, there was a consensus to adopt PNI (or to consider some modification of the PNI-Supplementation Potential index described by Busack and Pearsons) as the primary criterion by which to stratify programs.

- There was support for organization of additional meetings/workshops, each focused on a particular topic within the larger issue of hatchery M&E, to facilitate sharing of ideas and experience acquired from projects being conducted across the Columbia basin. The NWFSC has an ongoing program of meetings/workshops, each organized around a particular fisheries management theme. Likewise, the Council has plans to reinstate a program of meetings/workshops (issue-oriented, as opposed to a simple series of project summary presentations as performed in the past), to provide opportunities for collective sharing and review of information from F&W Program funded projects.

- Persons identified to participate in the Ad Hoc Supplementation Workgroup (AHSWG) include: (*current CSMEP hatchery subgroup members)
  Chris Beasley*
  Tim Dalton*
  Dave Fast
  Peter Galbreath*
  Jay Hesse*
  Lyman McDonald*
  Andrew Murdoch
  Chuck Peven
  Phil Roger
  Michael Ford

- Chris Beasley will produce an initial draft outline for the Workshop report by Feb. 20, for distribution first to workshop organizers; an edited draft will then go out to the full list of workshop participants within 2 weeks, with attached, associated documents previously produced by the CSMEP Hatchery Subgroup.

- Completion of the report is envisioned by mid-year 2007, in order that recommendations may be incorporated into:
  1) a F&W Monitoring Plan currently under development by the Council, and
  2) the F&W Program amendment process, scheduled to take place in the fall of 2007

- Incorporation of Workshop recommendations into these processes will help to "lock in" these recommendations, making financial commitment to M&E proposals that much more defensible.

- The Workshop Report needs to link back to ISAB/ISRP Monitoring and Evaluation of Supplementation Projects report (2005), whose recommendation for an Ad Hoc interagency meeting instigated creation of this Workshop.

**III** **<u>Objective 2</u>:** To identify existing and proposed projects from within (and without) the Columbia basin which are measuring RRS of supplementation hatchery-origin versus wild naturally-spawned salmon/steelhead (e.g., from pedigree studies using microsatellite DNA analyses). Then, to identify a work group interested in designing a synthesis/meta-analysis of project results.

- Pedigree analyses can provide quantified comparisons of RRS over 1-2 generations - a much shorter time frame than is possible from comparisons between supplemented and reference populations that utilize non-genetically based measures of productivity.

- Pedigree analyses can provide information useful for estimating other parameters of interest, e.g., effective population size, variance in measures among individuals of smolts-per-spawner and of recruits-per-spawner, correlation between these two productivity measures, and correlation between these productivity measures and other phenotypic traits, etc.

- However, projects involving pedigree analyses can<u>not</u> provide direct information on long term changes in fitness (RRS) - the primary uncertainty of interest regarding effects of hatchery supplementation - unless combined with data obtained in parallel from reference streams, or in controlled experiments involving multiple streams subjected to supplementation at a range of PNI values.

- There is an insufficient effort within the basin to obtain estimates for RRS from non-supplemented (reference) streams, against which RRS values for natural origin fish in supplemented populations can be compared (to account for changes in productivity of the latter over time).

- There was a consensus that a review document is needed which clarifies the kinds of information which pedigree analysis can and cannot offer. This report would provide summary descriptions of the logistical requirements and the basic protocols for implementing a project utilizing pedigree analysis, and the kinds of conclusions that can deduced from these analyses.

- Mike Ford volunteered to produce an initial draft for such a report, which will go out for comment by the AHSWG, and then by workshop participants. The report will be finalized before the F&W Program Amendment process begins in the fall of 2007.

- A subsequent report which collectively reviews data from current Columbia basin programs utilizing pedigree analysis to calculate RRS of salmon/steelhead populations could follow later; this report could possibly be the product of a workshop (see previous section) organized around this specific topic.

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**Appendix A - Workshop Participants**

| Name | Affiliation/Agency | Telephone/Email |
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