Section 10. Narrative

Project ID: 2003-036-00

Title: CSMEP – Collaborative Systemwide Monitoring and Evaluation Project

A. Abstract

The Collaborative Systemwide Monitoring and Evaluation Project (CSMEP) is a coordinated multi-agency effort to improve the quality and consistency of fish population and habitat data to answer key monitoring and evaluation (M&E) questions relevant to major decisions in the Columbia River Basin. CSMEP has made considerable progress in improving access to subbasin data as well as in the collaborative design of improved M&E methods. **Data** work products include metadata inventories of fish data for subbasins in Washington, Oregon and Idaho, rigorous assessments of the strengths and weaknesses of these data for addressing key questions about fish populations, and web-accessible databases for both the metadata and assessments. **Design** work products have been developed through a rigorous Data Quality Objectives process. This process has generated sampling, response and evaluation designs which improve the reliability of management decisions related to the status and trends of fish populations and to the evaluation of the effectiveness of habitat, harvest, hatchery and hydrosystem recovery actions, building on the subbasin data assessments. CSMEP's design work to date has focused on a pilot project for Idaho's Snake River Basin, which has fed into both the NOAA-F/BPA Salmon River Basin Pilot Study and the Lemhi River HCP. CSMEP is evaluating the tradeoffs associated with alternative designs for the Snake Pilot, and proposes additional pilot projects in Oregon and Washington, catalyzing implementation of improved M&E throughout the Columbia Basin. CSMEP and StreamNet will continue metadata inventories for additional Columbia River subbbasins, using these results to test the applicability of pilot project monitoring designs to salmon, steelhead, bull trout and other resident fish species of concern. CSMEP will continue to collaborate with PNAMP and other RME entities to ensure that CSMEP's analytical expertise is effectively utilized within ongoing monitoring programs.

B. Technical and/or scientific background

Overview of CSMEP

The goal of the Collaborative Systemwide Monitoring and Evaluation Project (CSMEP) is to collaboratively improve the quality, consistency, and focus of fish population and habitat data to answer key monitoring and evaluation questions relevant to major decisions in the Columbia Basin. CSMEP is a major commitment of the Council towards regionally integrated M&E across the Columbia River Basin, and is a critical element of

the Pacific Northwest Aquatic Monitoring Partnershipm (PNAMP). The relationship of CSMEP to PNAMP and other programs is discussed further in section D.

CSMEP grew out of the monitoring guidance provided by NOAA Fisheries, the USFWS, the NWPCC and others in February 2002 (Jordan et al. 2002). The project's sponsors recognized that much of the monitoring and evaluation in the Basin is completed by state and tribal fish and wildlife agencies. Both the sponsors and the ISRP recognized the need for a collaborative, systematic approach to monitoring and evaluation (M&E) to ensure that federal, state and tribal fish and wildlife agencies:

1) actively interact with both decision makers and leading innovators in M&E in providing the information required for management decisions;
2) develop consistent sampling designs, monitoring protocols and evaluation approaches, permitting aggregation and comparison of data across multiple spatial scales, agencies and regions;
3) build on the strengths (and overcome the weaknesses) of each region's existing monitoring infrastructure and data;
4) build on recent technical advances in probability-based sampling designs (e.g. Stevens 2002)
5) systematically evaluate the cost-precision and other tradeoffs associated with alternative monitoring/evaluation designs; and
6) move forward with the pilot implementation of improved M&E methods, leading ultimately to systemwide advances.

The project's design was developed through a multi-agency collaborative process that began in April 2002 and concluded with the actual start of the project in October 2003 (FY04). Key documents describing CSMEP's focus and accomplishments include:

1) CBFWA's original proposal and presentation to the ISRP, and responses to the ISRP's initial comments, on CBFWA's website;
2) the initial (Aug. 2 2002), and final (Nov. 5, 2002) ISRP reviews of CSMEP ;
3) CSMEP Statements of Work for FY04, FY05, and FY06; and
4) CSMEP Annual Reports for FY04 and FY05.

In summary form, CSMEP's objectives are to: 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 developed and executed under this project 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 (listed in Appendix 1); and 4) collaborate with programmatic entities in the Columbia Basin to design, implement and review improved monitoring and evaluation methods.

CSMEP is administered by the Columbia Basin Fish and Wildlife Authority (CBFWA), with the collaborative participation of key federal, state and tribal fish and wildlife

agencies in the Basin, as well as several independent experts[1]. It is this broad participation which is the strongest feature of CSMEP – since ultimately most of the monitoring of fish populations in the Basin is conducted by state and tribal agencies. The project is led by a core group of six people from the participating agencies, and facilitated by a team from ESSA Technologies. Over the first two and a quarter years of the project (FY04, FY05, first quarter of FY06), about 40 fisheries scientists and biometricians from these agencies have worked efficiently together to generate many useful work products to make progress towards the project's ambitious goal. These work products are described and hyperlinked in Section E of this proposal. The CSMEP Annual Report for FY05 provides a much more detailed summary of recent work, and is the best reference for reviewers who would like a deeper understanding of work product content. The FY05 Annual Report will be submitted independently of this proposal for review by the ISRP.

This proposal is for the second phase of CSMEP, to cover fiscal years 2007 to 2009. Continuing to fund this project will allow the strong team of CSMEP scientists to further advance the ability of the region to grapple with some difficult challenges in monitoring and evaluation, described in the following section.

The Need for CSMEP

The original CSMEP proposal submitted in June 2002 included a summary of policy, technical and field challenges to development of an effective status monitoring program, from Jordan et al. (2002) (Table **b1)**. We have extended this table to include challenges associated with action effectiveness monitoring.

During the last four years considerable progress has been made, by many entities, on understanding, and beginning to address, many of the technical challenges in Table **b1**. Over this period various groups both within and outside the Basin have provided useful guidance for both status and trend monitoring, and action effectiveness monitoring (e.g. Jordan et al. 2003; CSMEP 2004, 2005*;* NWPCC 2005; ISAB 2003, 2005; ISRP 2005; ISRP/ISAB 2005a, 2005b; Marmorek et al. 2004a*;* Paulsen and Fisher 2003*;* Porter and Marmorek 2004, 2005*;* Roni et al. 2005; Bradford et al. 2005*).* Pilot projects in the Upper Columbia, John Day, and Salmon subbasins (Jordan et al. 2003, Hillman 2004), as well as the Oregon Plan coastal coho monitoring (Stevens 2002), are exploring the effectiveness of alternative sampling designs and monitoring protocols. The State of Washington's Governor's Forum on Monitoring has developed guidelines for monitoring (WA Dec 2005) and implemented a project to assess the effectiveness of a representative subset of different types of habitat restoration projects at a reach scale (SFRB 2003b).

[1] **Agencies**: NOAA Fisheries, US Fish and Wildlife Service (USFWS), Columbia Fish and Wildlife Authority (CBFWA), Columbia River Intertribal Fish Council (CRITFC), Bonneville Power Administration (BPA), Oregon Department of Fish and Wildlife (ODFW), Washington Department of Fish and Wildlife (WDFW), Idaho Department of Fish and Game (IDGF), StreamNet, Nez Perce Tribe, Confederated Tribes of the Colville Reservation, Yakama Indian Nation, , Confederated Tribes of the Umatilla Indian Reservation (for FY07-09)

Consultants: ESSA Technologies Ltd. (Facilitators), Eco Logical Research, Quantitative Consultants, Paulsen Environmental Research, KWA Ecological Sciences, Western EcoSystems Technology, Inc. (for FY07-09)

PNAMP is currently reviewing fish monitoring protocols (Johnson and O'Neal, in prep) building on similar work for habitat protocols (Johnson et al. 2001), and is facilitating agency field comparisons of protocols for assessing habitat attributes.

Each of the above efforts has developed various tools and insights valuable to the long term development of effective M&E programs. With such a rapidly evolving landscape and a patchwork quilt of entities, coordination and co-evolution is critical. CSMEP work plans, tasks and products have been carefully designed to build on, complement and interact with other ongoing M&E efforts. CSMEP seeks opportunities to engage with existing efforts and established forums to maximize both our learning from their experience, and the catalytic benefits of our work to others. Together with these other efforts, CSMEP work products have made major contributions towards addressing many of the technical challenges in Table **b1**, as described in Section E.

On the policy side of the table, the development of the PNAMP Charter has begun a process of collaboration on M&E issues at the policy and programmatic level amongst some of the key entities in the Pacific Northwest. The development of subbasin plans, led by the NWPCC, has catalyzed cooperation *within* many subbasins, though much stronger levels of coordination both within and *among* subbasins will be required for effective design and implementation of systemwide M&E programs.

Table b1: Policy, technical and field challenges to development of an effective **systemwide** status and action effectiveness monitoring program (adapted from Jordan et al. 2002, CSMEP 2002). Challenges which CSMEP began to address in Phase 1 (FY04-FY06) are indicated by a "*". These challenges, plus those indicated with a "+", will be addressed in Phase 2 (FY07-09).

Policy / Programmatic Challenges	Technical and On-the Ground Challenges
• Unspecified level of acceptable uncertainty for decision making, and lack of clear decision criteria • Cooperation of necessary private, local, state, tribal, and federal jurisdictions is difficult to achieve* • Entities have different scopes of responsibility and authority, and different priorities for monitoring information* • Entities often have no mandate for supporting regional programs • Different entities and programs operate at different spatial and temporal scales, from project-scale evaluations to high level indicators at provincial scales* • Perceived high cost * • Insufficient technical feedback to policy makers* • Inaccurate perception that effects of management actions are well understood by	• Existing monitoring efforts are not catalogued* • Quantitative information on data quality (accuracy and precision) often is unavailable. • No concise, clearly described basin-wide monitoring program presently exists • Non-random index sites for trend monitoring precludes inferences to larger scales* • Specific monitoring responsibilities need to be assigned to, and accepted by, multiple entities* • Data management technology is evolving rapidly; various entities have different levels of ability and available resources. • Lack of integration of monitoring designs across spatial scales, life history stages, and M&E domains (i.e. status and trend, action effectiveness of habitat, hatchery, harvest and hydro actions)* • No systematic process for evaluating the tradeoffs among different monitoring designs for meeting competing M&E objectives* • Coordinating field crews from multiple agencies

Policy / Programmatic Challenges	Technical and On-the Ground Challenges
scientists and project implementers* • Lack of coordination in regional implementation of management actions and highly constrained management regimes results in low contrasts in actions, and poor ability to evaluate effectiveness + • Tension of bottom-up, local implementation of restoration actions vs. more top-down regional implementation to maximize rate of learning +	is operationally difficult • No common protocols / manuals for collecting field data • Field crews often do not have time for data entry and QA/QC activities • Lack of documentation of actual implementation of habitat restoration actions • Poor inferences on action effectiveness due to inadequately framed hypotheses, insufficient spatial/temporal contrast in management actions (effect sizes), insufficient duration of monitoring and inability to account for confounding covariates.* • Non-random allocation of management actions in space and time limits inferences on action effectiveness; +

Despite the considerable progress made over the last several years by both CSMEP and other entities, there remain considerable challenges to be overcome, on both the technical and policy sides of Table **b1**, before the Basin has implemented an effective and affordable M&E program. The Columbia Basin is a huge area with a very complex set of jurisdictions and entities. The most feasible strategy for making progress on these challenges is to incrementally learn from successive pilot projects on sub-basin or ESU scales, while at the same time addressing M&E issues that operate on larger scales (e.g. tracking survival through successive life stages for understanding both limiting factors and action effectiveness). This has been called a "tile the basin" strategy. Sub-basin and ESU scales are large enough to force consideration of various integration issues, yet small enough to develop a good working effort among participating agencies. Each pilot project provides insights that build knowledge for subsequent efforts.

CSMEP has made significant progress in tackling the joint set of issues in Table b1 through its work in the Snake River Basin. Here we applied EPA's rigorous 7-step Data Quality Objectives or DQO process (EPA 2000) to develop M&E designs that serve status and trend, habitat, hatchery, hydro, and harvest management decisions (*ref CSMEP DQO docs;* see section E). Results of this work will have general benefits systemwide. Over the next three years, we propose to extend this work in the Snake River Basin to integrate across multiple dimensions, and to better consider resident fish species, both bull trout and other species. Including resident fish is important to enable integrated monitoring designs, to reflect the direct effects of management actions on fluvial forms of resident fish and to recognize ecosystem interactions between anadromous and resident species. We also propose pilot projects in Washington and Oregon, to build upon and complement existing pilot projects in the Upper Columbia and John Day regions, and Intensively Monitored Watersheds. Existing pilot projects of particular relevance to CSMEP are shown in Figure **b1**.

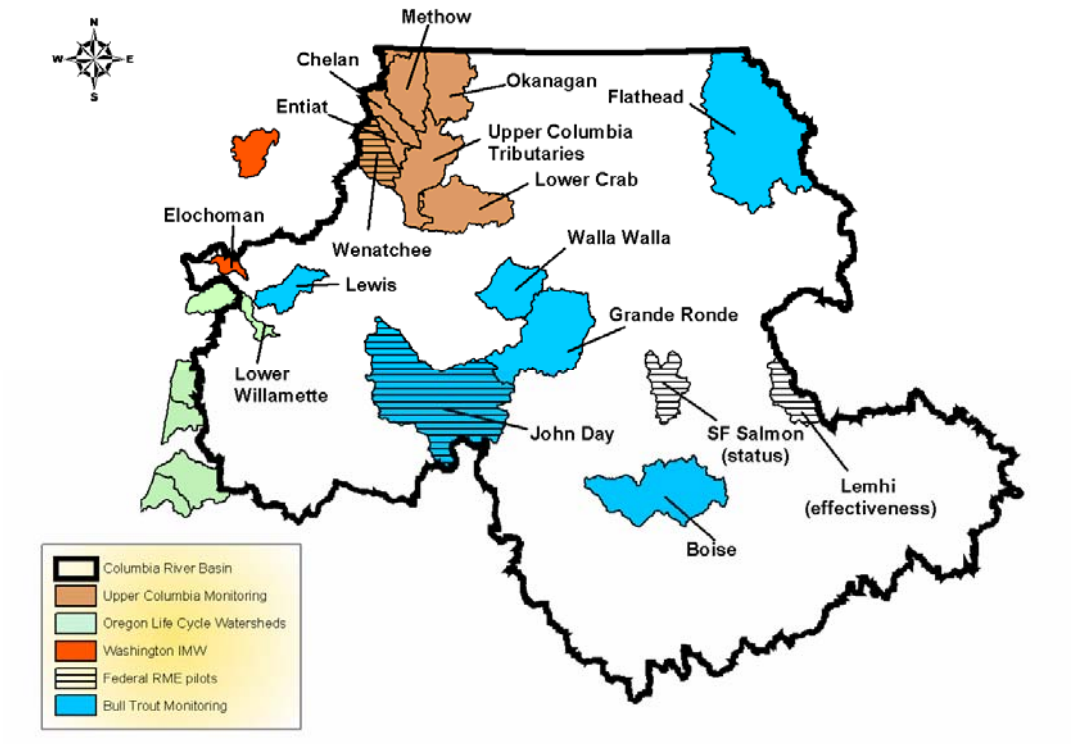

Figure b1. Location of some of the intensively monitored watersheds and pilot projects that are providing valuable templates and insights for M&E designs. See Appendix A for a map of the locations of other Intensively Monitored Watersheds.

A continuing policy challenge is the differing agency priorities for monitoring and evaluation information. Different entities have laid out lists of M&E questions that they believe are important (e.g., NMFS 2003; Jordan et al. 2002; NWPCC Research Plan 2005; PNAMP 2005; CSMEP 2004, 2005), and some of these documents also outline the performance measures required to address these questions, the scales of interest, and the fish species of interest. While there are some strong overlaps in the questions, scales and performance measures in these documents, to date there hasn't been a clear assessment of each fish and wildlife entity's priorities. We simply don't know how many resources each entity would be willing to contribute towards monitoring the performance measures necessary to answer different questions at different scales, for each fish species. Furthermore, as discussed at a recent CSMEP workshop in July 2005 (*Chris Jordan, presentation*), question-driven monitoring is a start, but it isn't enough. One also needs to know how the data will be used to answer the question, and who will make what decision with the resulting analyses. Beginning with the decisions of interest yields a more cost-effective and targeted M&E program.

While there are certainly overlapping interests, relative priorities for M&E differ among entities given the range of agency mandates and jurisdictional responsibilities. For example, NOAA's National Marine Fisheries Service (NOAA-F) needs to make decisions about the listing or delisting of anadromous fish species under the Endangered Species Act. It is unrealistic to expect NOAA-F to place as high a priority on monitoring resident fish as anadromous fish. Other federal, state and tribal fish and wildlife agencies

(e.g. USFWS, Montana, Kootenai, Coeur d'Alene) have a much greater need for monitoring information on bull trout and other resident fish species.

CSMEP has developed a set of strategies and principles to meet this challenge of multiple M&E objectives, which we describe in more detail in Section E:

1) involve federal, state, tribal and local entities in the collaborative development of M&E designs for multiple scales, questions and species, closely coordinating to ensure no duplication of effort;
2) survey managers and policy people to ascertain their relative priorities for different questions, scales, and species;
3) use *decisions* as the starting point for developing sampling, response and evaluation designs[2], rather than *questions*, which permits a more rigorous assessment of the exact inputs and level of precision required in monitoring data, and the risks of making different types of decision errors (Marmorek et al. 2005); and
4) recognize that M&E designs inevitably involve tradeoffs across a number of design objectives and evaluation criteria, and address these tradeoffs explicitly.

Ultimately, all M&E decisions involve tradeoffs and a balancing of risks. Insufficient M&E risks repeated implementation of management actions that are actually ineffective, or else not detecting that certain actions actually are effective. Either outcome wastes money and potentially incurs increased risk to fish populations by not expending limited resources more efficiently. For example, at least $14 billion has been spent since 1990 on stream and river restoration projects across the Continental United States, yet only a small fraction of these projects have been monitored for their effects (Bernhardt et al. 2005). On the other hand, unnecessary or excessive M&E wastes money that could otherwise be spent on implementing actions that are known to be effective in recovering fish populations. Decision analysis has been shown to be a powerful tool for the design of large-scale monitoring and experimental programs (e.g., Parnell 2002, MacGregor et al. 2002, Walters and Green 1997, Keeley and Walters 1994, Peterman and Antcliffe 1993, Antcliffe 1992, McAllister and Peterman 1992a, b). These studies often show that the optimal design, when the tradeoffs between objectives and across alternatives are considered, is not necessarily the design with the highest statistical power for detecting change or trend in important indicators. CSMEP is applying a systematic decision analysis approach to the generation and filtering of their alternative M&E designs based on a suite of criteria which includes: 1) high inferential ability, 2) strong statistical performance, 3) reasonable cost, 4) practical application, and 5) environmental impact.

Why does the Fish and Wildlife Program need CSMEP? CSMEP has made and will continue to make substantial progress on the technical and programmatic challenges in Table **b1**, working closely with the other entities in PNAMP. CSMEP has strong

[2] *Sampling designs* refer to the selection of locations and times to sample, *response designs* to what is monitored (and how) at those locations and times, and *evaluation designs* to the analytical methods used on the data to make a decision or answer a question which feeds into a decision.

leadership, a proven track record of work products, effective teams of highly skilled people that believe in the process and enjoy working together, and strong buy-in from the federal, state and tribal agencies who conduct M&E activities. With continued funding, CSMEP will be able to move the region much closer to an effective, affordable, balanced M&E program for both anadromous and resident fish populations.

C. Rationale and significance to regional programs

Section C of CSMEP's original proposal (June 2002) outlined in detail the significance of CSMEP to various regional programs. We described the significance of CSMEP for the NWPCC Fish and Wildlife Program, the NOAA-F and USFWS Biological Opinions, the Federal Caucus Basin-Wide Recovery Strategy, NOAA-F Recovery Planning, the Sub-Basin Planning Process and EDT. We noted how CSMEP responded to guidance documents provided by the ISAB/ISRP. These descriptions are still relevant, and we refer the reader to this previous document rather than copying that text to here.

Section E of this proposal (and the CSMEP FY05 Annual Report) describes the means by which CSMEP has continued to ensure that its activities and products remain relevant to these evolving regional programs and new independent scientific advice. More recent documents, including the Federal RME Plan (Jordan et al. 2003), the PNAMP Strategy (2005), as well as the NWPCC draft Research Plan (2005) and recent ISAB/ISRP review of it (ISRP/ISAB 2005-20) all strongly reinforce the continuing relevance of CSMEP's thrust towards systematic design of *systemwide* M&E that integrates across agencies, scales, species, and different types of monitoring (i.e. status and trend and action effectiveness monitoring). Other ISAB/ISRP reports (ISAB 2003, ISAB 2005, ISRP/ISAB 2005) confirm the importance of the questions addressed by CSMEP in its design work.

The 2002 CSMEP proposal did not include work on hatchery effectiveness. Since that time CSMEP recognized the importance of integrating monitoring related to the effects of hatcheries with other monitoring components at a broad regional scale. We therefore created a Hatchery Effectiveness Subgroup, which focused on issues at scales larger than individual hatcheries. This regional thrust is supported by recent NWPCC and ISAB/ISRP publications. The Artificial Production Effectiveness section from the NWPCC Draft Research Plan (2005) notes that:

> "Monitoring the effects of artificial production on population health is an issue that has long lacked a regional forum, but has recently been addressed by CSMEP. Such work is currently conducted project-by-project, yet constitutes a significant component of the current monitoring budget. Some ongoing artificial production projects have monitoring planning or research elements embedded in them and are coordinating their development with programmatic RME activities, e.g., Northeast Oregon Hatchery (NEOH), ISS, Umatilla, Yakima Fishery Project, and the Nez Perce Tribal Hatchery. When these elements address monitoring questions or needs relevant to the region such projects should no longer be viewed

> solely as hatchery projects, but should be identified as dedicated monitoring or research projects warranting long-term funding commitments."

In their report Monitoring and Evaluation of Supplementation Projects, the ISRP/ISAB (2005) concluded that monitoring and evaluation of supplementation projects is critically important, and that:

> "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."

D. Relationships to other projects

As for Section C, our original 2002 proposal outlined the relationships between CSMEP and various projects (Regional Data Management efforts, Technical Recovery Teams, USFWS RMEG, Harvest Managers, Subbasin Planning, CBFWA Coordination Contract, ESSA Innovative Project[3]) which still remain relevant. CSMEP has worked very closely with StreamNet on data inventory and data management issues, and several of the work elements we describe in section F depend on funding for StreamNet from a separate contract (Table F1). CSMEP has also coordinated closely with the State of Salmon initiative to inventory salmon data sets across the Pacific Rim, encouraging them to build on the inventory work that CSMEP has completed.

Subbasin Planning

Subbasin plans developed for the NWPCC Fish and Wildlife Program vary widely in the scope of their aquatic research, monitoring and evaluation (RM&E) components. Many subbasin plans have concentrated on a 'bottom-up' approach, in accordance with the initiative provided in the *Technical Guidance for Subbasin Planners* (NWPCC 2001) which treats M&E largely at the project scale e.g., in support of individual habitat projects. However, a number of the subbasin plans have moved beyond this (e.g. Salmon, John Day, Grande Ronde, etc.) and are taking a more 'top-down' approach to coordinate RM&E efforts at the regional or programmatic level. These plans have recognized that 'bottom-up' M&E undertaken within the subbasins will have a higher likelihood of generating meaningful results if they reflect regional scale M&E strategies. This is more consistent with the current NWPCC guidance to move M&E from project to regional and programmatic scales.

Approaches being developed within the federal pilot projects and a suite of comprehensive state and tribal monitoring initiatives allow broader integration and

[3] completed in March 2004, but the findings are still significant for the CSMEP Habitat Action Effectiveness Subgroup.

synthesis of M&E information. General guidelines required to develop this 'top-down' RM&E framework are evolving through the Pacific Northwest Aquatic Monitoring Partnership (PNAMP). CSMEP is working with PNAMP to resolve the multitude of technical design elements required to make this framework a reality, and allow effective integration of subbasin plan monitoring into the broader regional framework. CSMEP's ongoing Snake Basin Pilot Project overlaps with five Columbia subbasins (Salmon, Grande Ronde, Imnaha, Asotin and Clearwater), providing an initial test opportunity to employ information from existing subbasin plans to help develop broader integrated M&E designs for Status & Trends and 4 H effectiveness monitoring across multiple subbasins.

NOAA Fisheries and Action Agencies Pilot RME Projects

CSMEP participants include many key individuals involved in planning/coordination of the Wenatchee, John Day and Upper Salmon federal Pilot Projects. These individuals are providing insights from development and implementation of these pilot projects that directly affect CSMEP M&E designs. The Wenatchee Pilot Project is an experimental application of the Upper Columbia Monitoring Strategy that provides CSMEP analysts a working example of an integrated status/trends and effectiveness monitoring program at the subbasin scale. The Wenatchee pilot is providing opportunities to determine the most powerful indicators for effectiveness monitoring at a range of spatial and temporal scales, as well as representing a real-world example of use of EMAP designs for status and trends monitoring (i.e., interaction between the theoretical and the field application). The John Day Pilot Project provides an opportunity to explore alternative statistical designs for effectiveness monitoring and is a unique testing ground for the use of remote sensed approaches (e.g. GIS analyses employing FLIR, LIDAR, TMDL models, etc.) to monitor habitat changes at multiple spatial scales resulting from mitigation actions. The Upper Salmon Pilot Project (to which CSMEP has been directly contributing) provides an opportunity to explore approaches for both status and trends monitoring (SF Salmon River) and effectiveness monitoring (Lemhi River). The SF Salmon work is not only exploring different methods and designs for status/trends monitoring but is also exploring how to integrate M&E programs across species, across agencies, and across monitoring tiers. The effectiveness monitoring in the Lemhi is intended to inform how monitoring data collected across subbasin restoration projects can best be linked into adaptive management planning.

PNAMP and the Federal RME Program

In the last four years an increasing number of entities have become engaged in work related to monitoring and evaluation. Hence, definition of CSMEP's niche, as distinct from such entities as PNAMP and the Federal RME Plan, is very important to avoid confusion or duplication of effort. Table D1 outlines the various policy, programmatic and technical roles involved in developing and implementing monitoring programs. CSMEP operates entirely in the technical domain, but interacting with programmatic and occasionally policy levels. By contrast, the Federal RME Program and PNAMP have decision making authority at both the policy and programmatic levels. The PNAMP

charter offers a tremendous opportunity for distributing CSMEP work products, and obtaining interagency buy-in across the Pacific Northwest for consistent and effective monitoring.

Federal RME and PNAMP scientists also work on technical products (e.g. PNAMP review of fish monitoring protocols, tests of habitat monitoring protocols, watershed condition work). The participating and charter entities in PNAMP have a strong interest in land management (Figure D1), and have therefore taken the lead on habitat monitoring technical work, whereas CSMEP has focused on fish monitoring. While the overarching goals of PNAMP and CSMEP are similar (Table D2), there are considerable differences in the work elements and products incorporated into annual and quarterly work plans. To avoid duplication of effort, all of CSMEP's proposals and work plans, including this proposal, are closely coordinated with PNAMP and the Federal RME Plan. Methods of coordination include: overlapping membership of technical fisheries scientists across the three entities; coordinated development of quarterly work plans; annual workshops for presentation of results; and joint technical meetings. These 4 steps ensure no duplication of effort in work products, despite an obvious and healthy overlap in goals. All of these groups are working towards grappling with the challenges outlined in Table **b1**; there's more than enough work to go around.

Table D.1 Definition of policy, programmatic and technical roles in developing and implementing monitoring programs. The second row lists examples of entities fulfilling each of these roles (not comprehensive). CSMEP is focused on the tasks in the *technical* column, as well as *interactions with programmatic entities*. The roles and tasks are not listed in order of priority. Source: Adapted from CSMEP FY04 Work Plan.

Policy / Leadership	⇔	**Programmatic**	⇔	**Technical**
PNAMP Executives; Federal RME Program; WA Governor's Forum on Monitoring; Senior Policy Levels of federal, state, and tribal fish and wildlife agencies; Northwest Power and Conservation Council	⇔	Program managers within federal, state and tribal fish and wildlife agencies, including PNAMP agencies, Federal RME Program	⇔	**CSMEP** fish biometricians and scientists within federal, state and tribal fish and wildlife agencies; PNAMP, federal, state and tribal scientists
• Identify and prioritize management decisions and associated information needs. • Make well-informed decisions about M&E issues, acting within purview of each agency, but with knowledge of all entities' needs) • Do reality check on what is achievable/realistic; scope • Set goals driven by outcomes (not too proscriptive). • Assure consistency in methods used to evaluate success of M&E • Identify and secure appropriate sources of funding. • Perform conflict resolution and make final decision for issues elevated from programmatic level. • Formalize/endorse programmatic level agreements. • Oversee timely management of programmatic group's deliverables • Ensure implementation of accepted sampling designs and monitoring protocols, maximizing consistency while recognizing agency jurisdictions	⇔	• Provide guidance on management priorities to technical level based on dialogue with policy level • Select and implement preferred sampling designs and monitoring protocols based on technical level evaluations of options. • Define population management units and scales of interest for monitoring information. • Identify RME issues requiring management decisions, e.g. - Performance metrics - Action effectiveness hypotheses - Critical uncertainties to be evaluated • Assess ongoing work for gaps. • Define options for scope/resource management. • Do project management. • Establish peer review protocol.	⇔	1. Coordinate with other M&E programmatic and technical entities. 2. Catalog existing work. 3. Make datasets available to others. 4. Assess strengths and weaknesses of existing data. 5. Explore and evaluate improved monitoring protocols and sampling designs for consideration at Programmatic Level. 6. Implement sampling design and collect data following Programmatic Level approval. 7. Evaluate monitoring program results; perform data analyses for programmatic team interpretation

Figure D1. Relationship of CSMEP to PNAMP partner agencies.

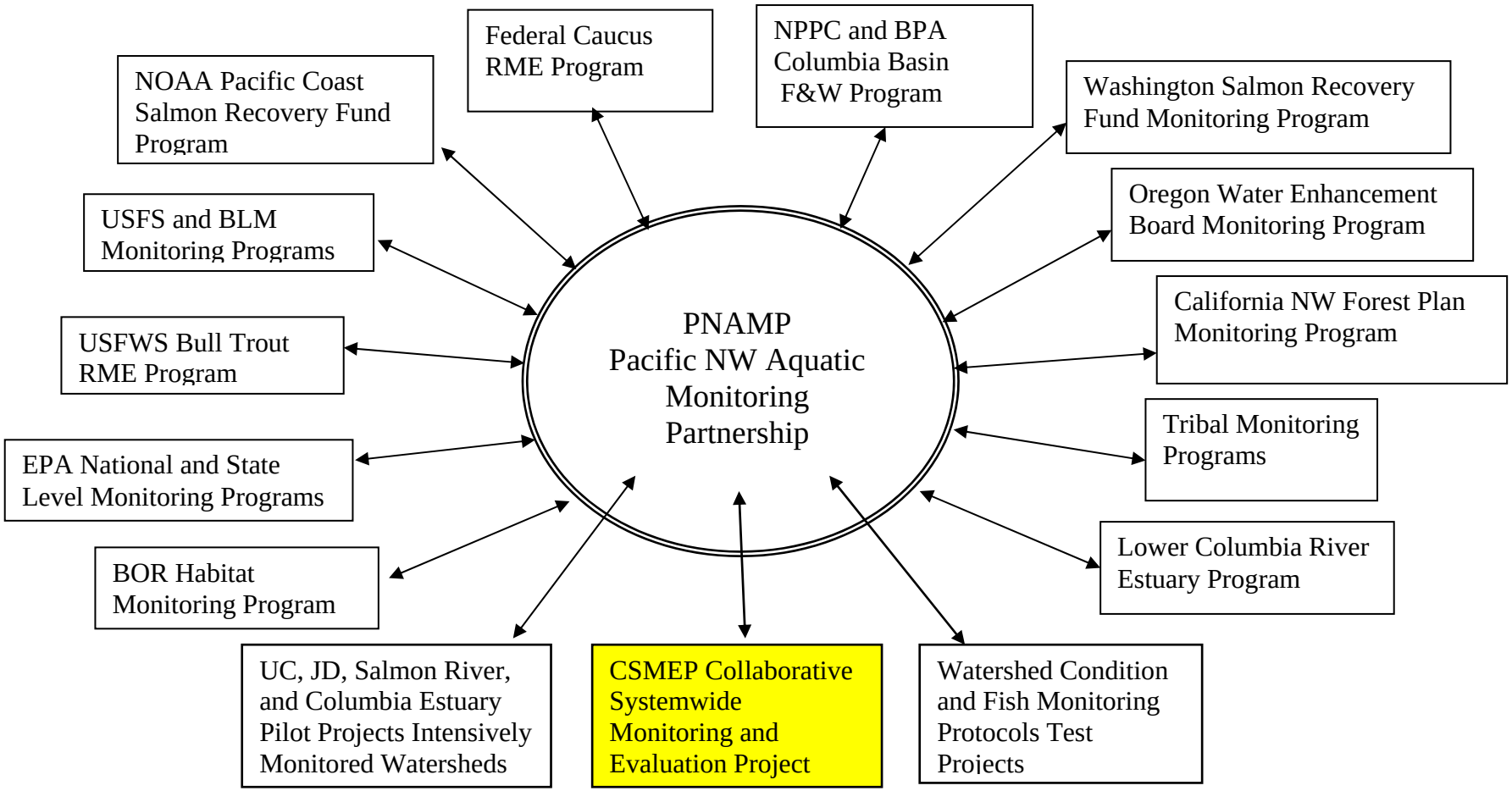

Table D2. Comparison of PNAMP, CSMEP, and FRMEP. Differentiation of M&E niches occurs through development of distinct work plans and products.

Attribute	**Pacific Northwest Aquatic Monitoring Partnership (PNAMP)**	**Collaborative Systemwide Monitoring and Evaluation Project (CSMEP)**	**Federal RME Plan (FRMEP)**
Foundation of Initiative	Federal Caucus RME Coordination needs and a request by Governors of WA, OR, ID, and Montana to develop a regionally coordinated monitoring system. Prior AREMP effort under the North-west Forest Plan for monitoring on Federal lands.	Response to NMFS/USFWS document (Feb 2002) describing needs for M&E. Recommended for funding by ISRP, NWPCC, CBFWA, BPA for FY04-f06 under Mainstem/Systemwide Solicitation.	Federal Caucus All-H Salmon Recovery Strategy and NOAA 2000 Biological Opinion on FCRPS (Being updated in 2006 to include Recovery Plan RM&E, 2004 FCRPS BiOp and Remand Process)
Geographic Scope & Species / Habitats	Northern CA, WA, OR, ID All fish species?	Columbia Basin FY04-06: Salmon, steelhead, bull trout FY07-09: Salmon, steelhead, bull trout and other resident fish species of concern	Columbia Basin Salmon and steelhead (2006 update to include bull trout)
Composition	*Scientists, managers and executives* within USFS, BLM, NWPCC, **FRMEP**, WA SRFB, OWEB, CA NW Forest Plan Monitoring Program, **CSMEP,** BOR, EPA , PCSRF, NED	*Scientists* within CBFWA, WDFW, IDFG, ODFW, NOAA, USFWS, CRITFC, Yakama, Colville, Nez Perce, BPA, StreamNet; ESSA, Eco Logical Research, Quantitative Consultants, PER, KWA.	*Scientists, managers, and executives* within the Federal Caucus including NOAA, USFWS, USFS, BLM, EPA and Action Agencies (BPA, BOR, A COE), and technical consultants
Primary Goals	Coordinate and improve consistency of approaches and protocols used by member entities for monitoring watershed condition, fish populations and project effectiveness. Share advances in M&E among member entities, and promote adoption of improved M&E methods to inform resource management decisions.	Thorough inventory and assessment of existing fish monitoring data. Rigorous development of M&E designs to improve fish monitoring information for important regional decisions on 4 H's and ESA listings. Coordination with PNAMP and other entities to encourage implementation of these designs.	Development and implementation of Federal Caucus Agency RM&E programs that support Columbia Basin Salmon and Bull Trout Recovery and FCRPS Biological Opinions. Includes regional coordination and integration with other federal, state and tribal monitoring programs.
Organizational obligations	Open participation, non-binding commitment to coordinate	Funded entities agree to complete tasks developed in annual and quarterly work plans. Implementation of developed M&E designs by member organizations is voluntary.	Statutory mandates of Federal Caucus Agencies. All-H Salmon Recovery MOU.

Attribute	Pacific Northwest Aquatic Monitoring Partnership (PNAMP)	Collaborative Systemwide Monitoring and Evaluation Project (CSMEP)	Federal RME Plan (FRMEP)
Policy Level Responsibilities	**Executive** partners provide policy direction and support to **PNAMP** through the **Steering Committee**	No policy responsibilities. But get policy makers required input to M&E designs (e.g. relative importance of different species, questions, scales; risk tolerance; cost)	Decide on scope and funding of Federal Caucus M&E needs.
Programmatic Level Responsibilities	Develop and Maintain a coordination and management structure for PNAMP Coordinate peer review of PNAMP technical products. Provide Executives with coordinated programmatic approaches that integrate watershed and fish monitoring, action effectiveness monitoring, and data management. Select and implement preferred sampling designs and monitoring protocols in the fresh water aquatic environment. Coordinate regional efforts in watershed status/trend monitoring, effectiveness monitoring and data management.	No programmatic responsibilities. But present M&E designs for consideration and feedback to Programmatic Levels in PNAMP and CSMEP entities.	Measure progress toward recovery of ESA-listed anadromous fish populations. Identify and prioritize actions that are the most effective towards meeting fish population performance objectives. Implement RME identified in the Federal Caucus RME Plan which includes Federal Recovery Plan needs, the Action Agencies Annual Implementation Plans under the FCRPS BiOp, and other Federal Agency BiOps.
Coordination of Technical Responsibilities	Methods of coordination include: overlapping membership of technical fisheries scientists across the three entities; coordinated development of quarterly work plans; annual workshops for presentation of results; and joint technical meetings. These 4 steps ensure **no duplication of effort in work products**, despite an obvious overlap in goals.		
Technical Level Responsibilities	Coarse scale inventories of existing watershed and fish population monitoring. Develop and adopt a standardized set of reporting metrics, monitoring protocols and sampling designs to assess watershed condition and fish population status and trends Develop standardized regional fish population monitoring efforts Develop and adopt a standardized set of fish population metrics and compatible	Detailed inventory of existing fish monitoring data; metadata available on Internet. Assess strengths and weaknesses of existing data for answering key questions related to major decisions; Develop improved M&E designs for making important decisions, building on strengths of existing M&E and results of ongoing pilot projects; Systematic evaluation of alternative M&E designs across multiple objectives, species and scales	Develop alternative M&E designs and coordinated programs for meeting Federal Caucus RME responsibilities including tributary monitoring, habitat action effectiveness, hydro action effectiveness, and data management.

Attribute	Pacific Northwest Aquatic Monitoring Partnership (PNAMP)	Collaborative Systemwide Monitoring and Evaluation Project (CSMEP)	Federal RME Plan (FRMEP)
	protocols for sampling designs and data collection Develop and implement pilot projects for testing monitoring approaches.	Implement sampling and collect data following Programmatic approval; Evaluate monitoring program results and perform data analyses for programmatic levels.	

E. Project history (for ongoing projects)

CSMEP was originally numbered as 35033 when first proposed in 2002, and is now numbered as 200303600. The table below outlines past budgeted and actual expenditures. Underspending in FY2004 was due to lags in hiring staff, as funding was only approved in September 2004.

Fiscal Year	Budgeted Amount	Amount Actually Spent
FY 2004	$968,802	$675,904
FY 2005	$968,802	$931,6278
FY 2006	$968,802	- in progress -

CSMEP is focused on the issue of systemwide monitoring and evaluation of fish status, addressing requirements of NOAA-F and USFWS biological opinions and recovery plans as well as the NWPCC Fish and Wildlife Program. This has involved an integrated, collaborative effort by fisheries scientists and biometricians within CSMEP to fulfill seven objectives:

1. *Interact with federal, state and tribal programmatic and technical entities* responsible for monitoring and evaluation of fish and wildlife, to ensure that quarterly work plans developed and executed under this project are well integrated with ongoing work by these entities.
2. *Collaboratively inventory existing monitoring data* that bear on the problem of evaluating the status and trend of salmon, steelhead, bull trout and other species of regional importance across the Columbia Basin, including the Okanagan Basin in Canada.
3. Work with existing entities (e.g. StreamNet, NOAA Fisheries, NWPCC) to *make a subset of existing monitoring data available through the Internet*, recognizing the continuing evolution of data management in the Columbia Basin.
4. *Critically assess the strengths and weaknesses of existing monitoring data and associated evaluation methods* for answering key questions at various spatial scales concerning the state of ecosystems and fish habitat, as well as fish distributions, stock status and responses to management actions.
5. *Collaboratively design improved monitoring and evaluation methods* that will fill information gaps and provide better answers to these questions in the future, by providing state and tribal fish agency participation and work products for multi-agency development of regionally coordinated monitoring programs.
6. Coordinate state and tribal participation and work products for regionally coordinated, multi-agency *implementation* of pilot projects or large scale monitoring programs.
7. *Participate in regional forums* to evaluate new monitoring program results, assess new ability to answer key questions, propose revisions to monitoring approaches, and coordinate proposed changes with regional monitoring programs.

Progress on each of these seven objectives is described below:

E1. Objective 1: Communicate and coordinate monitoring and evaluation activities

Since project initiation CSMEP participants have collaboratively developed work plans in close consultation with other programmatic and technical entities to ensure that analyses and monitoring designs explored as part of the project are consistent with the overarching objectives of Columbia Basin monitoring agencies. The document "Relationship of the CBFWA collaborative system-wide monitoring and evaluation project to other research, monitoring and evaluation and data management efforts in the Columbia Basin" outlines CSMEP's nested role. Table E.1 provides a summary of CSMEP interactions with agency representatives throughout FY 2004 and FY 2005. CSMEP representatives have also regularly participated in PNAMP meetings and workshops and a number of CSMEP participants are also PNAMP members. CSMEP also includes members of the bull trout Recovery Monitoring and Evaluation Group (RMEG) (see presentation and 5 page summary of RMEG activities), which ensures development of consistent monitoring approaches for this listed species. CSMEP/PNAMP have initiated planning for a shared workshop early in FY 2006 among four of the key monitoring groups in the Basin: PNAMP, CSMEP, Federal RME program, and NED to further clarify M&E niches across the groups.

CSMEP gave a presentation at the NWPCC Council meeting in June, 2005 and received Council feedback on CSMEP's ongoing process. CSMEP also convened a workshop in Bonneville in July 2005 to present CSMEP's analytical results to date and solicit input from invited agency managers. A summary report of this July 2005 workshop is provided on the CSMEP website. CSMEP has developed a survey form that can be used to consistently identify the key monitoring questions (across species and spatial scales) of most relevance to different regulatory agencies. CSMEP was discussed at the August 30, 2005 MAG meeting and completion of this survey was assigned to group members as an agenda item. CSMEP has refined the questionnaire since that time and is pursuing completion of this matrix by agency managers and PNAMP members as a key item in FY 2006. Responses to date for the CSMEP Survey of Monitoring Questions are available on the CSMEP Website. The results of this questionnaire will help reshape as necessary CSMEP inventory and design efforts over FY 2006.

Table E.1. CSMEP programmatic and technical interactions in FY 2004 & 2005.

Entity	Purpose of Interaction
Pacific Northwest Aquatic Monitoring Partnership (PNAMP)	Explain CSMEP tasks, continue to refine project / program descriptions, harmonize PNAMP and CSMEP workplans. Use PNAMP as conduit to get programmatic support from above for various agencies' staff (e.g. BLM, USFS, DEQ, EPA) to assist StreamNet staff with Task 2
AREMP; PIBO; OWEB	Explain CSMEP tasks; more clearly define CSMEP's role in fish habitat monitoring; obtain information on habitat monitoring for integration with our Snake Basin pilot designs
EMAP (ODFW); EPA EMAP (Corvallis)	Explain CSMEP; clarify exactly what they're doing; get inventory and design documents (or URLs) regarding habitat / fish monitoring; initiate collaboration on EMAP designs for Snake Basin pilot
NOAA Fisheries Habitat Group	Explain CSMEP; clarify exactly what they're doing; get inventory and design documents (or URLs) regarding habitat monitoring; work collaboratively on DQO process
NOAA – Action Agency RME Group	Explain CSMEP; clarify current status (beyond RME plan); get inventory and design documents (or URLs) regarding habitat / fish monitoring; coordinate work plans and priority M&E questions
NOAA – Pilot Projects under 35019; Chris Jordan	Explain CSMEP; clarify exactly what they're doing; get inventory and design documents (or URLs) regarding habitat / fish monitoring pertaining to watersheds of interest:; obtain information on products from RME studies in John Day (OR), Wenatchee, Methow & Okanagan (WA) ,and Salmon (ID); contribute to pilot project design
Technical Recovery Teams (TRTs) for the Interior and Lower Columbia, Willamette	Explain CSMEP; get input on needs of decision-makers clarify exactly what they're doing; get inventory and design documents (or URLs) regarding approaches to monitoring and recovery evaluations; obtain TRT documents and GIS products for Snake Basin design work; get input from TRT to inform S & T designs
USFWS Bull Trout Recovery Monitoring and Evaluation Group (RMEG)	Explain CSMEP; clarify exactly what they're doing; get RMEG inventory and design documents regarding approaches to monitoring and recovery evaluations of bull trout

In FY 2006 CSMEP will further integrate with federal, state and tribal programmatic and technical entities responsible for monitoring of fish and wildlife in the Columbia Basin. CSMEP quarterly workplans will be developed in conjunction with BPA and PNAMP representatives to ensure that CSMEP analyses synchronize with, supplement and support broader regional RME needs. CSMEP products will be provided to the ISAB for review.

E2. Objectives 2 and 3: Inventory existing monitoring data/make it accessible

CSMEP subbasin inventories describe, in a systematic manner, the kinds of information currently available on the abundance, productivity, spatial distribution and diversity of salmon, steelhead and bulltrout. To evaluate the range of data quality that exists within the Columbia Basin, CSMEP has selected pilot subbasins that included both data rich and data poor areas. For each of these pilot subbasins, StreamNet staff and CSMEP biologists jointly completed an inventory of the information available for each of the key performance measures for each of the target fish species. In FY 2004 CSMEP, with the assistance of StreamNet staff, completed inventories of existing fisheries monitoring data for six pilot subbasins in Washington (Lewis, Yakima), Oregon (Lower Columbia, Imnaha) and Idaho (South Fork Salmon River and Selway River drainages). During FY

2005, CSMEP biologists and StreamNet conducted detailed inventories of fish data for seven additional pilot subbasins selected in Washington (Okanagan, Methow, Kalama), Oregon (Deschutes, Grande Ronde) and Idaho (Middle Fork Salmon, Upper Fork Salmon). The locations of these CSMEP pilot subbasins (as well as the Federal RME pilot subbasins) are provided in an overview map on the CSMEP website.

To focus their subbasin data inventories, CSMEP began with a set of 16 specific monitoring and evaluation questions adapted from Jordan et al. (2002), and a set of 45 performance measures for viable salmonid populations, adapted from McElhany et al. (2000). This original set of questions was subsequently expanded by CSMEP workgroups to more comprehensively cover the key M&E questions at multiple tiers perceived of relevance to decision makers in Columbia fish and wildlife agencies (see Appendix E1 for definition of tiers). At the Tier 1 level, we developed short summaries of various large scale databases of interest, including IBIS, ICBEMP, Upper Columbia EDT and BC/DFO fisheries databases, as well as Columbia Basin habitat data servers so that state and tribal biologists could quickly be informed on the potential uses of such data for broadscale assessments of fish distribution and ecosystem status. The CSMEP Table C1 metadata inventories were targeted at Tier 2 information for Status and Trends. Information applicable to Tier 3 action effectiveness questions was also solicited, but such information is limited due to the historic paucity of well designed action effectiveness programs. Tier 3 evaluations that have been undertaken by CSMEP (C4 Tables) are available on the CSMEP Website.

Definitions for the data descriptors and performance measures developed by CSMEP for the subbasin metadata inventories (CSMEP C1 tables) are provided in the document "Revised Table C1 structure and definitions for data descriptors (columns) and performance measures (rows) to guide development of the CSMEP inventory database and data input system". As part of process to develop consistent performance measures CSMEP representatives also led a meeting of Columbia Basin genetics experts to work toward Snake River Chinook salmon and *O. mykiss* genetics standardization. A summary of Technical Recovery Team (TRT) progress in delineating fish populations in the Interior Columbia was developed by CSMEP to ensure that the information summarized in the metadata inventories (C1 Tables) would be aggregated into the population units of interest to the TRTs.

The results of the Tier 2 subbasin metadata inventories (C1 tables) undertaken by CMSEP to date are now served up through a web-based meta-database developed, hosted, and maintained by the Oregon Department of Fish and Wildlife's Natural Resource Information Management Program (NRIMP). As of the end of FY 2005 there were more than 1450 fish inventory records on this CSMEP data server and there have been over 36,000 hits on the web server to date. This CSMEP meta-database is proving useful to fisheries biologists operating within the confines of the pilot subbasins inventoried to date. It is also providing information to a broader range of analysts who can query the growing CSMEP dataset to develop overviews and comparisons of the varied monitoring techniques, design approaches, analytical assumptions etc. that are

being applied for M&E across the region. A recent StreamNet report outlines further steps that could improve overall data management of the CSMEP inventories.

CBFWA has also developed a publicly accessible CSMEP Website for coordination amongst CSMEP members, communication of CSMEP goals and products to a larger audience, and the storage of important reference materials.

In FY 2006 CSMEP will undertake metadata inventories for new subbasins still to be selected in the three member states (ID, OR, WA). StreamNet will continue to maintain the CSMEP web data server and will work with CSMEP to improve data delivery by developing expanded hyper-links to the data sources identified in the subbasin inventories, as well as supporting materials identified in the QA/QC and Strengths and Weaknesses assessments of those data (e.g., reports, databases, maps showing where data collected).

E3. Objective 4: Assess the strengths and weaknesses of existing monitoring data.

Throughout FY 2004 and FY 2005 CSMEP biologists critically assessed the strengths and weaknesses of each pilot subbasin's meta-data and associated evaluation methods for answering the key CSMEP questions (at various spatial scales) concerning the state of ecosystems and fish habitat, as well as fish distributions, stock status and responses to management actions (CSMEP B2 tables – see template). CSMEP biologists reviewed the strengths and weaknesses of these data for addressing Tier 2 status and trend questions, and considered opportunities for using these data to answer Tier 3 action effectiveness questions (see Appendix 1). The strengths and weaknesses reviews (Table E.2) completed to date are identifying areas where fish monitoring is being done well, in addition to uncovering inferential weaknesses and data gaps that will be important to address in CSMEP's monitoring design work. A supporting document "Comparative summary of the statistical and cost properties of different methods for estimating CSMEP fish performance measures" was developed within CSMEP to support this task. Though excellent fish population monitoring does exist in many subbasins, a common weakness is the fact that sampling sites were not typically chosen through a rigorous process that allows generalization to larger spatial scales. A preliminary overall synthesis of strengths and weaknesses across the pilot subbasins is available on the CSMEP website. The strengths and weaknesses overview tables for spring chinook and sockeye are also available on the CSMEP website. This synthesis will be further developed in FY 2006 (i.e., are there strengths and weaknesses in regards to monitoring of particular fish performance measures that are common *across* the subbasins?)

Table E.2. Data strengths and weaknesses analyses completed in FY 2004/05 by subbasin and species (hyperlinked to the Table B2 summaries on the CSMEP website).

State	Subbasin	Species
Idaho	South Fork Salmon River	spring/summer chinook

State	Subbasin	Species
	Clearwater, Selway River	chinook (spring, summer) steelhead (summer) bull trout
Oregon	Imhaha	chinook (spring) steelhead (summer)
	Lower Columbia	fall chinook
Washington	Lewis	chinook (spring, tule and bright fall) steelhead (summer, winter)
	Yakima	coho fall chinook spring chinook steelhead (summer)
	Methow	Chinook (spring, summer) Steelhead (summer)

In FY 2006 CSMEP will complete the Strengths and Weaknesses assessments of all subbasins inventoried in the three years of the project, and finalize the synthesis of the general "lessons learned" as to the effectiveness of current M&E protocols across the Basin. This synthesis report will describe the implications of the CSMEP Strengths and Weaknesses assessments for M&E design in the Columbia River Basin, and will be reviewed by PNAMP and the ISAB.

E4. Objective 5: Collaboratively design improved M&E methods

Significant progress has been made on CSMEP's goals of collaborative design of improved M&E methods. Six multi-agency monitoring design workshops have been held (three workshops in FY 2004 and three workshops in FY 2005) to explore how best to integrate the most robust features of existing monitoring programs with new approaches (e.g., Federal RME pilot studies, EPA EMAP). (see Design Workshop summaries: 07/09-11/2004, 08/21-22/2004, 08/20-21/2005, all PowerPoint presentations from Design Workshops are also available on the CSMEP Website). CSMEP is exploring the ability of these approaches to answer the questions in Appendix E1, and is attempting to lay out a structured approach to evaluating the costs, benefits and tradeoffs of different M&E strategies. Through the use of EPA's Data Quality Objectives process (DQO) CSMEP is developing general 'design templates' for monitoring the status and trends of fish populations and the effectiveness of habitat, harvest, hatchery and hydrosystem recovery actions within the Columbia River Basin. The CSMEP design process is outlined in the document "Proposed evaluation and design of preliminary design templates" available on the CSMEP website.

CSMEP's focus on developing its M&E designs employing EPA's DQO process is intended to emphasize iterative learning within an adaptive management loop. CSMEP's overall design process involves the following steps:

1. initial problem *assessment* to make explicit our current understanding of the system, clarify our understanding of management goals in the Columbia Basin, and identify the key uncertainties in evaluating agency management actions;
2. careful *design* of monitoring to evaluate management actions and reduce the key uncertainties;
3. *monitoring* of key performance measures to test key management hypotheses and assess progress towards management goals;
4. *evaluation* of monitoring results against the goals defined in the assessment phase; and
5. *adjustments* in our understanding of the system and the effects of management actions; and proceed back to step 1.

In FY 2005, five CSMEP subgroups (Status and Trends, Habitat, Harvest, Hydro and Hatcheries) have been applying the 7-step EPA Data Quality Objectives (DQO) process to develop a set of robust M&E designs for evaluating both the status and trends of fish populations and the effectiveness of habitat, harvest, hatchery and hydrosystem recovery actions in the Columbia Basin. As a pilot example of this design process, CSMEP has focused their efforts to date principally on the Snake River Basin spring/summer/fall chinook ESU (see map of the Columbia River subbasin areas encompassed by the CSMEP pilot). This pilot exercise is however intended to illustrate the collaborative processes that will be required for further development of an integrated monitoring program across the entire Columbia River Basin (see "Guidance in applying EPA's DQO process to CSMEP's FY 2005 Design Task").

E4.1 Status and Trends Subgroup

CSMEP's Status and Trends Subgroup has focused on identifying monitoring design elements necessary to adequately address one of the most important management decisions in the Snake River Basin: has there been sufficient improvement in population status of a listed Snake River S/S Chinook ESU to justify delisting and allow removal of ESA restrictions? This decision is based on the abundance, productivity and spatial structure & diversity of SRSS chinook salmon over the prior 10 years (IC-TRT 2005). The Status and Trends Subgroup's summary of the design elements (DQO steps 1-7) for status and trends monitoring that are required to answer this question is provided on the CSMEP Website. A full description of the Status and Trends Subgroup's work on DQO steps 1-5 for the Snake River Pilot is presented as a chapter in Marmorek et al. 2005. A brief PowerPoint presentation describing the Status and Trends Subgroup's DQO steps 1-5 is also provided on the CSMEP website.

In FY 2005 as part of its work on DQO steps 6 and 7, the Status and Trends Subgroup began development of a simulation model that can be used for evaluating alternative designs for monitoring fish at the population, major population group and ESU scales; this tool will be further refined in FY 2006. These design alternatives are intended to describe: 1) the location and temporal pattern of measurements ("sampling design"); 2) the specific types of measurements that are to be made ("response design"); and 3) the analyses to be performed to make a decision ("evaluation design"). Alternative design templates will be compared in terms of cost (dollars/yr) and probability of error in

decisions that are associated with individual templates. The immediate objective of this simulation is to evaluate alternative design templates for determining the status of SRSS Chinook salmon. The ultimate objective is to develop a tool that can be adapted for monitoring designs in other basins and for other species. A draft document outlining the Subgroup's DQO steps 6-7 approach is provided on the CSMEP Website, as is a preliminary version of the alternative design spreadsheet that will inform their model. Viability datasets for Idaho have been assembled to assist in the task. Maps of alternative monitoring designs for the Snake Basin pilot area (current vs. CSMEP low, medium, high designs) are available on the CSMEP website. PowerPoint presentations on the subgroup's approach to DQO steps 6-7 (Presentation1, Presentation2) are provided on the CSMEP website.

E4.2 Hydro Subgroup

CSMEP's Hydro Subgroup took on a subset of hydro management questions across several scales: individual projects, survival by different passage routes through the hydrosystem, and overall life cycle survival. These different scales relate to a variety of decisions: operations at individual projects (e.g. spill, bypass, removable spillway weirs); overall operations (e.g. when to transport fish within season, compliance with hydrosystem biological opinions), longer term hydrosystem decisions (e.g. flow management, effectiveness of transportation over multiple years, system configuration); and adequacy of hydrosystem operations for stock recovery. The choices that are available to improve the quality of information for hydrosystem decisions, and reduce the risks of making incorrect decisions, include: the number of years of data collected, the magnitude of tagging effort, the number of stocks that are monitored, the ability to filter out year to year natural variation and isolate the signal of management actions, and implementation of deliberate manipulations of hydrosystem operations to reduce uncertainty in effectiveness evaluations. For many of these questions, CSMEP has developed low, medium and high alternative designs and explored the strengths and weaknesses of each approach.

The Hydro Subgroup's summary of the design elements (DQO steps 1-7) for hydro monitoring are provided on the CSMEP website. A full description of the Hydro Subgroup's work on DQO steps 1-5 for the Snake pilot is presented as a chapter in Marmorek et al. 2005. A full report on the Hydro Subgroup's current progress on DQO steps 6-7 is provided on the CSMEP Website, as are PowerPoint presentations for the Hydro Subgroup's DQO steps 1-5 and DQO steps 6-7 (Presentation1, Presentation2)

E4.3 Habitat Subgroup

Habitat actions are considered a cornerstone of recovery strategies for Columbia River Basin fish stocks but there is a need to more clearly determine the effectiveness of these actions for increasing salmonid survival rates and production. Monitoring designs for evaluating the effectiveness of habitat actions must be able to reliably detect two linked responses:

1. the effect of habitat actions on fish habitat; and
2. the effect of changes in fish habitat on fish populations.

The Habitat Subgroup's summary of the general design elements (DQO steps 1-5) for Habitat monitoring that can help address these questions is provided on the CSMEP website. A full description of the Habitat Subgroup's current work on DQO steps 1-5 for the Snake River Pilot (at both intensive and extensive scales) is presented as a chapter in Marmorek et al. 2005.

The Habitat Subgroup has recognized, however, that there are serious challenges to the development of a generic template for habitat effectiveness monitoring. These include:

1. Habitat conditions vary greatly across subbasins in terms of their natural biogeoclimatic regimes, the status of their fish populations, the degree of human impact and management, and the number and nature of restoration actions that have been implemented, or are being considered for implementation within them.
2. Habitat effectiveness questions encompass different scales of inquiry, which imply different scales of monitoring.

The Subgroup is instead attempting to develop a consistent "question clarification process" that can be applied to development of individual monitoring designs dependent on the particular situation. They are piloting this approach within the Lemhi River Subbasin. A summary of the Habitat Subgroup's detailed DQO steps 1-7 for the Lemhi River Subbasin is provided on the CSMEP website, as is a full Habitat report for the Lemhi River Subbasin. PowerPoint presentations for the Habitat Subgroup's DQO steps 1-5 and DQO steps 6-7 (Presentation1, Presentation2) are also available on the CSMEP Website.

E4.4 Hatchery Subgroup

Throughout the FY 2005 contract period, the Hatchery Subgroup identified a number of questions important to the evaluation of hatchery management, and has reviewed numerous existing and proposed hatchery research, monitoring, and evaluation (RME) plans within the Columbia River Basin. Following this review, the Hatchery Subgroup has concluded that existing and proposed hatchery RME plans (if fully implemented) are likely to address the majority of the management questions identified by the Subgroup. However, the Hatchery Subgroup has also concluded that a number of questions regarding the *effectiveness* of hatcheries as a class of actions are unlikely to be adequately addressed by existing and proposed hatchery RME. These hatchery effectiveness questions (identified in the Hatchery Subgroup's Summary on the CSMEP website) will likely be efficiently and comprehensively addressed only through the implementation of a stratified and representative study design that spans the entire Columbia River Basin. With appropriate stratification, this diversity can be leveraged to identify the mechanistic linkages of individual programs to broader monitoring questions that evaluate the overall *effectiveness* of hatchery strategies at the regional scale. These broader-scale hatchery program effectiveness questions (as opposed to individual hatchery operation questions) will become the focus of CSMEP designs intended to address larger scale multi-hatchery questions that can be stratified across the region.

The Hatchery Subgroup has focused much of their initial efforts on developing alternative monitoring designs that could help answer two of these critical questions relating to hatchery effectiveness:

1. What is the magnitude and distribution of hatchery strays into natural populations, and
2. What is the relative reproductive success of naturally spawning hatchery fish and natural origin fish?

Insights into approaches gained from the CSMEP analyses required to address these two questions will provide a foundation for tackling additional hatchery questions in a prioritized manner in FY 2006. The Hatchery Subgroup's summary of the design elements (DQO steps 1-7) for hatchery monitoring that are required to answer these and other questions are provided on the CSMEP website. A full description of the Hatchery Subgroup's work on DQO steps 1-5 for the Snake pilot is presented as a chapter in Marmorek et al. 2005. A report on the Hatchery subgroup's current progress on DQO steps 6-7 is provided on the CSMEP website, as are PowerPoint presentations for the Hatchery Subgroup's DQO steps 1-5 and DQO steps 6-7.

E4.5 Harvest Subgroup

Targeted fisheries on salmon are managed by setting allowable catch, catch allocations and open periods for each fishery prior to opening a fishery (considering escapement goals and preseason/updated run predictions) and then adjusting those regulations as runs develop. However, both mark-selective and non-selective fisheries can exert mortality on non-targeted stocks of anadromous, adfluvial, and resident species that are incidentally intercepted. Removal of fish in fisheries can potentially affect spawners, life history diversity and the spatial structure of populations. The Harvest Subgroup has therefore been focused on developing alternative monitoring designs that can answer two general classes of Harvest questions:

1. What are the inseason estimates of run size and escapement for each stock management group (target and non-target) and how do they compare to preseason estimates?
2. What is the target and nontarget harvest and when is it projected to reach allowable levels?

The Harvest Subgroup's summary of the design elements (DQO steps 1-7) for harvest monitoring required to answer these questions is provided on the CSMEP website. A full description of the Harvest Subgroup's work on DQO steps 1-5 for the Snake pilot is presented as a chapter in Marmorek et al. 2005. A report on the Harvest Subgroup's current progress on DQO steps 6-7 is provided on the CSMEP Website, as are PowerPoint presentations for the Harvest Subgroup's DQO steps 1-5 and DQO steps 6-7 (Presentation 1, Presentation2).

E4.6 Integration of monitoring across the CSMEP subgroups

A CSMEP Monitoring Integration Group has been formed to explore the integration of the individual RME component parts within a larger monitoring framework (i.e., generate improved efficiencies through integrated designs) for the Snake River Basin pilot design. This integration effort across scales and monitoring efforts is a challenge faced by all subbasins; hence the results will be of general benefit basin wide. The Integration Group has begun to develop a matrix of shared performance measures and data interdependencies across the different CSMEP subgroups. This evolving Looking Outward Matrix (LOM) is available on the CSMEP Website. The matrix is providing a starting foundation for identifying the priority performance measures for monitoring and the relevant spatial scale(s) of these data for varied subgroup monitoring needs. The Monitoring Integration Group is also pursuing a simulation analysis to assess the cost/benefit of a large integrated PIT-tagging program designed to address a range of key monitoring questions across the subgroups. The ultimate intent is to evaluate what intensities of basin-wide PIT-tagging (and at what life-stages) would/would-not-be sufficient to achieve adequate statistical power and at reasonable cost to address the suite of Subgroup questions at various spatial scales. Initial analyses for this exercise are presented as a draft report (PIT tag V4 12-14-05.doc) on the CSMEP Website. The Integration Group will be working to further quantify this analysis in FY 2006 and intends to extend this approach into other sampling protocols that have the potential for integration across the monitoring subgroups.

In FY 2006 CSMEP design subgroups will consolidate their work on the Snake River pilot designs and refine the tools that can be used to explore tradeoffs across alternative M&E design options (e.g.. low, medium, high) for different questions, at different scales of interest (e.g., project, population, MPG, ESU, CRB). CSMEP has also begun to explore the full integration of EPA's new EMAP Idaho Master Sample (see example map of pre-selected EMAP sample points for the South Fork Salmon River MPG) into their design work for the Snake Basin Pilot Project, beginning with a targeted technical workshop on this topic in early FY 2006. Subgroup products will be summarized in a report on M&E recommendations for the CSMEP Snake River Basin Pilot Project, which will be externally reviewed and shared with Federal Action Agencies and NOAA pilot project workgroups. CSMEP will begin to expand from the Snake River Basin pilot area and start to develop broader M&E recommendations that can be applied to other subbasins in the Columbia River Basin. Development of these expanded design analyses are intended to follow a range of directions (e.g., applying Snake River Basin derived design templates to CSMEP inventoried subbasins or NOAA pilot projects to test how transferable designs are; consideration of high-level integration of M&E across multiple subbasins (e.g., incorporation of contrasts in stock status and productivity); evaluating options for designs across the entire CRB by building on level of current monitoring infrastructure in different subbasins (as determined by Subbasin Plan descriptions and CSMEP metadata inventories). Analytical results from CSMEP products in FY06 are intended to help provide general M&E guidance that can feed into the NWPCC Rolling Review process.

E5. Objective 6: Assist implementation of pilot projects/large scale monitoring programs

CSMEP's ongoing work on the Snake Basin Pilot Project is directly feeding into the NOAA-F/BPA Salmon River Subbasin Pilot Study, and has assisted in the early development of M&E designs for the Lemhi River Subbasin Habitat Conservation Plan (HCP).

In FY06 CSMEP intends to convert recommendations from their Snake River Basin Pilot Project into a practical plan for the Salmon River Subbasin Pilot Study (cross-fertilization as CSMEP people are involved in this Pilot Study). CSMEP has also been tasked (tentatively) by the Council's Members Advisory Group (MAG) to facilitate the development of improved multi-agency approaches to hydrosystem monitoring for application to fall chinook in the Columbia Basin.

E6. Objective 7: Evaluate new monitoring program results and propose revisions to monitoring approaches

CSMEP workshops throughout FY 2004 and FY 2005 have provided continuing opportunities for biologists and biometricians from across the region to meet and discuss recent advances in M&E approaches (e.g. EMAP sampling frames, results from federal pilot projects, IMW strategies, etc.). CSMEP thus represents a unique forum for the cross-fertilization of M&E ideas among federal, state and tribal fish agency staff. Ideas expressed at these workshops are being incorporated into the developing CSMEP M&E designs. Workshop presentations given by participants at the CSMEP monitoring design workshops in FY 2004 and FY 2005 are provided on the CSMEP Website. An equally important focus of CSMEP has been our efforts to work closely with managers to bridge the gap between science and policy, and support better management decisions

CSMEP has grown into a cohesive team of analysts and biometricians with a clear understanding of the issues involved in developing more efficient, integrated approaches to M&E for fish and wildlife across the Columbia River Basin and with the technical expertise to make real progress in this regard. The suite of hyperlinks within this document provides an indication of the range of technical products directed towards the improvement of regional M&E that have already been developed by CSMEP in the first two years of the project (FY 2004 and FY 2005). Progress in FY 2006 is expected to continue in all areas of the project and will build from the strong foundation established during the first two years. CSMEP's PISCES Statement of Work Report for FY 2006 is available on the CSMEP Website.

F. Proposal biological objectives, work elements, and methods

CSMEP's objectives are described at the beginning of section E of this proposal, and are therefore not repeated here. These overarching objectives remain unchanged for FY07-09, though the work elements have been adapted to reflect past progress and emerging priorities. Table **F1** summarizes the work elements and products associated with each objective (summarized in abbreviated form), indicates the time period over which they will be completed, and notes other entities collaborating with CSMEP. Following table **F1** we provide a narrative description of each work element, including background information and methods for the more complex work elements. The intended outcomes of CSMEP's work, and indicators by which to evaluate them, are described in Table **F5** at the end of this section.

Table F1. Summary of proposed CSMEP work elements and products by objective, including collaborating entities.

Objectives and Work Elements	Description of Work Products	Timing	Entities Collaborating w CSMEP
1. Develop Work Plans / Interact with Programmatic Entities			
1.1 Develop CSMEP Quarterly Workplans	Collaboratively prepared quarterly workplans to maximize integration and efficiency, avoid duplication of effort.	quarterly	PNAMP, BPA, NWPCC, StreamNet
1.2 Quarterly Progress Reports	Quarterly reports by objective and work element to ensure close contract monitoring.	quarterly	BPA
1.3 Preparation of Draft and Final Annual Reports	3-level annual reports: 2-pg. exec. Summary; ~25-pg. overview w ~75-pg. appendices; hyperlinked detailed reports	annual	internal
1.4 CSMEP conference calls, meetings and workshops	Biweekly Calls: Track progress, review products, coordinate efforts. Workshops: Present results, get technical/programmatic feedback, brainstorm next steps in subgroups	biweekly calls; workshops 3X/yr	Calls: internal Workshops: Programmatic and Policy Feedback for part of meeting
1.5 Coordination w PNAMP on joint activities and work products	Joint PNAMP/CSMEP workshop in spring each year with managers and policy makers; Annual work planning; Synthesis of work products	annual joint workshop; planning mtgs 2X /yr	PNAMP Steering Committee
1.6 Present CSMEP progress at various Columbia Basin forums	Give presentations to inform region CSMEP outcomes and products, and to integrate with others' efforts	2-3 times / yr	NWPCC, TRTs, PNAMP, WA DOE, AFS, EPA
2. Inventory existing data relevant to questions			
2.1 QA on StreamNet Inventory Work for ID, WA, OR pilot projects	Review StreamNet's metadata inventories for CSMEP pilot areas in ID, WA and OR, including salmon, steelhead, bull trout and other high priority resident fish	FY07-FY09	StreamNet (separate contract); fed/state/tribal agencies with data
2.2 Inventory Sockeye; Bull Trout; Other Resident Fish of Special Concern	Update metadata inventory of Okanagan sockeye, add Wenatchee and Redfish Lake stocks. Improve inventory coverage of bull trout and resident fish of high concern.	FY07	DFO, Okanagan Nation Alliance, StreamNet, CBFWA Resident Fish Committee

Objectives and Work Elements	Description of Work Products	Timing	Entities Collaborating w CSMEP
	Develop common inventory data standards for Sockeye stocks.		
3. Organize subset of data into accessible form			
3.1 Continue to improve CSMEP web-based metadata application	Add hyper links from CSMEP database to on-line databases housed by agencies collecting/maintaining data	FY07-FY09	StreamNet (separate contract); fed/state/tribal agencies with data
3.2 CSMEP website improvement	Provide user-friendly summaries of CSMEP products in hierarchical form to communicate to multiple audiences	FY07-FY09	CBFWA web master Amy Langston
3.3 Database design	Develop standards for performance measures, data types, and data sharing protocols	FY07-FY09	StreamNet, NED, PNAMP
4. Evaluate ability to answer key questions with existing data			
4.1 Organization of existing data for Snake Basin pilot design	Detailed review of CSMEP inventories and strengths & weaknesses assessments; GIS overlays of existing sampling sites with EMAP master sample to refine sampling designs for status & trend	mostly in FY06; some work in FY07	USFS, BLM, OR Aquatic Inventory, OWEB, ID DEQ, PCSRF, BoR, EPA, others
4.2 Organization of existing data for OR pilot design	As above for work element 4.1 for areas of OR pilot (Grande Ronde and Imnaha)	FY07 and FY08	USFS, BLM, OR Aquatic Inventory, OWEB, OR DEQ, PCSRF, BoR, EPA, others
4.3 Organization of existing data for WA pilot design	Area of WA pilot includes salmon recovery regions in Lower, Middle and Upper Columbia.	FY07 and FY08	USFS, BLM, WA SRFB, WA DEQ, PCSRF, BoR, EPA, DFO, others
5. Collaborative monitoring program design			
5.1 Consolidate Snake River Pilot M&E design and PrOACT tradeoff analysis	Demonstrate cost-precision and other tradeoffs associated with alternative integrated designs that attempt to meet information needs for key decisions in recovery assessment and 4 H's.	mostly in FY06; some work in FY07	Interact with programmatic/policy entities with responsibility for decisions in recovery assessment and 4 H's to fine tune design, costs.
5.2 Complete three pilot M&E projects at provincial / ESU scales in ID, OR, WA 5.2a ID pilot project 5.2b WA pilot project 5.2c OR pilot project	Develop and present three ESU / provincial scale fish and habitat M&E plans that integrate across issues, questions, species and agencies to meet identified priorities. Involve CBFWA Resident Fish Committee in all three projects. Work towards implementation of these plans.	ID (FY06-07); OR (FY07-09); WA (FY07-09)	as for work element 5.1. Build on insights gained from NOAA-AA pilot projects, WA GSRO, CSMEP survey of M&E priorities.
5.3 Extend application of CSMEP insights and tools to other parts of CRB and PNAMP entities	Generalize qualitative and quantitative tools developed in CSMEP DQO process for use throughout CRB. Present general implications to managers and scientists.	FY07-09	Market existence of tools and results through CBFWA, PNAMP, NWPCC websites and newsletters
5.3a Status & Trends	Extend tools for assessing M&E designs to detect recovery status (more VSP criteria, species); publish/present results.	FY07-09	Technical Recovery Teams, ISRP/ISAB
5.3b Hydro	Complete DQO steps 6-7 for hydrosystem decisions and publish/present results for feedback. Extend findings to other regions (i.e. Mid/Upper Columbia).	FY07-09	AFEP, NOAA-Hydro, PUDs, ISRP/ISAB

Objectives and Work Elements	Description of Work Products	Timing	Entities Collaborating w CSMEP
5.3c Habitat	Work with restoration managers across multiple watersheds on implementation / M&E methods that will maximize learning on restoration effectiveness at various scales.	FY07-09	PNAMP entities, restoration managers, NOAA-AA pilot projects, ISRP/ISAB
5.3d Hatchery	Complete M&E designs for large scale hatchery / supplementation questions (i.e. hatchery straying into wild populations, relative reproductive success) and present recommended plans	FY07-09	Hatchery managers, ISRP/ISAB
5.3e Harvest	Complete M&E designs for improving data for harvest pre-season and in-season decisions	FY07-09	Harvest managers (e.g. TAC, US v. OR, PST, CTC), ISRP/ISAB
5.4 Feed M&E results into NWPCC Provincial Review Process	Interact with CBFWA / NWPCC managers to provide insights for project approval and M&E guidelines	FY07-09	NWPCC, CBFWA
5.5 Get feedback from CRB entities on various M&E designs	As described above under 5.2 and 5.3, but beyond immediate areas of pilot studies	FY07-09	As for work element 5.1.
6. Multi-agency implementation of monitoring programs.			
6.1 Provide input to conceptual plan for M&E implementation across CRB	Participate in collaborative efforts building on knowledge developed from CSMEP, NOAA and other pilot projects.	FY07-09	As for work element 5.1.
7. Multi-agency evaluation of results of new monitoring pgms.			
7.1 Collaborative review of federal RME projects, WA SRFB Effectiveness Monitoring Projects, and other recent pilot projects	Review results of Wenatchee, John Day and Salmon pilot projects as they are made available and incorporate into next set of designs.	FY07-09	NOAA-AA pilot projects

F1. Objective 1: Develop Work Plans / Interact with Programmatic Entities

The six work elements listed under this objective in Table F1 continue existing practices that CSMEP has established over the last two years, described in section E1 of this proposal. Quarterly work plans permit flexibility in adapting CSMEP work tasks to emerging priorities.

F2. Objective 2: Inventory existing monitoring data

The metadata inventories previously conducted by StreamNet and CSMEP for thirteen subbasins (described in section E2) will be extended in two dimensions:

Work Element 2.1: ensure proper coverage of the areas that are the focus of the three pilot studies described under Work Element 5.2; and

Work Element 2.2: extend the inventories to include more information on sockeye and bull trout, and potentially other resident fish species of high concern. Develop common inventory data standards for Sockeye stocks.

This work relies on StreamNet to conduct the preliminary inventory work (funded under a separate StreamNet contract), with CSMEP staff conducting quality assurance reviews under the CSMEP contract. The number of subbasins and species that can be inventoried by StreamNet staff within each year is a function of the funding allocated to this task in the StreamNet contract. Members of CBFWA's Resident Fish Committee will assist with inventories of resident fish species of high concern (such as westslope cutthroat trout and redband rainbow trout), so that large scale monitoring designs which build on these inventories can consider both anadromous and resident fish.

F3. Objective 3: Organize subset of data into accessible form

Work Element 3.1: The web-based meta-database developed for CSMEP by StreamNet staff at ODFW (see section E2) will be maintained, and records added from the inventory work conducted under objective 2. As fish and wildlife agencies make more of their data available on websites during the performance period, these datasets will be hyper-linked directly from the metadata descriptions. Again, the focus will be on those areas that are the subject of the pilot studies described under work element 5.2. Other possibilities for improvements to the meta-database include geo-referenced displays of data locations though this work will depend on StreamNet funding and prioritization.

Work Element 3.2: The prolific production of work products under CSMEP has made it difficult for those outside of the project to easily find guidance materials on the main CSMEP website. Working with the CBFWA webmaster, CSMEP will restructure the website to facilitate understanding of CSMEP activities and products. This could use a hierarchical structure similar to the structure of CSMEP's FY05 annual report or section E of this proposal. That is, the website would have an overall menu summarizing major CSMEP activities and 1-page overviews of each activity for managers, which in turn link to 5-10 page summaries of key findings, that in turn link to detailed work products and tools for technical staff.

Work Element 3.3: The Council and ISRP have highlighted the need to facilitate data sharing across the region. Sharing of data for many populations, and performance measures that are collected across a large ecologically diverse geographic area by many agencies with diverse management needs will require extensive collaboration and standardization. Hence, as pilot design templates for status and trend and effectiveness monitoring are developed for Snake River Chinook and steelhead and subsequently adapted and applied to other sub-basins and ESU's it will be essential that standards for performance measures, data types, and data sharing protocols be considered as part of the design. While it is not the intent of CSMEP to design or maintain regional databases or links between data sets, it will be important that CSMEP include guidance with respect to data standards as part of M&E design templates. CSMEP's Monitoring Integration subgroup will work closely with the Status and Trends, Harvest, Hydro, Habitat, Hatchery sub-groups to insure that their respective design templates are compatible with respect to the types, formats, and structures of data sets that they are likely to generate. A

key role for the Monitoring Integration sub-group will be to work closely with database design, implementation, and management entities such as Streamnet, NED, and PNMAP to promote compatibility of data generated by CSMEP design templates with data generated by other regional M&E efforts. Initially this process will begin by examining data sharing requirements within the pilot design templates for Salmon River Chinook salmon and then will expand to include data sharing needs for integration with a design templates in another pilot area.

F4. Objective 4: Evaluate ability to answer key questions with existing data

Work Element 4.1: Assessment of existing data for Snake Basin pilot design: The previous work in assessing the quality of existing data (described in section E3) will be extended from spring/summer chinook to include more detail on steelhead, bull trout and other resident fish species of concern, as well as considering ongoing habitat monitoring by various agencies. The objective of these assessments is to provide the foundation for a sampling design for consistent status and trend monitoring across multiple agencies, scales and species. The pilot area includes the Mountain Snake and Blue Mountain provinces, which include the Salmon, Clearwater, Grande Ronde, Imnaha, and Asotin subbasins.

Work Element 4.2: Assessment of existing data for OR pilot design: Assessment work will focus on completing the assessment of steelhead data in the Grande Ronde subbasin, and building on past CSMEP assessments of steelhead in the Imnaha subbasin. The objective is to both support the OR pilot design (Work Element 5.2c) and elucidate general principles with applicability to steelhead populations in other ESUs.

Work Element 4.3: Assessment of existing data for WA pilot design: WDFW staff participating in CSMEP will work with regional recovery groups in assessing the quality of data for assessing salmon recovery, building on both CSMEP's detailed assessments for selected regions and the broader assessment recently completed for the Governor's Forum on Monitoring (Crawford et al. 2003).

F5. Collaborative monitoring program design

Work Element 5.1: Consolidate Snake River Pilot M&E design and PrOACT tradeoff analysis

Background: The Snake Basin pilot study is summarized in section E of this proposal. Methods for PrOACT analysis are described in detail in the CSMEP FY05 Annual Report and associated references. This work element will yield several valuable outcomes:

- integrating monitoring designs for simultaneous assessment of questions regarding status and trend and hydro / hatchery / habitat / harvest action effectiveness;

- integrating monitoring designs for simultaneous assessment of multiple species (salmon, steelhead, bull trout, and other resident fish of concern); and
- expanding CSMEP tools and analysis from the Snake River basin pilot spring/summer Chinook work to other basins and other species.

Work Elements, Methods and Products

Work product 5.1a: Cost-precision and other tradeoffs

- The Status and Trends subgroup will add an annual cost component to the L/M/H/current monitoring designs to demonstrate cost-precision tradeoffs. Initially, this will be done using estimates for implementing the L/M/H designs in the Snake Basin. Other tradeoffs and logistical constraints to implementing specific monitoring programs in the Snake River basin will be evaluated using the criteria shown in Table b2. Another task will be to generate realistic estimates of precision and accuracy obtained for each of these designs. This latter step can involve significant investment in quantitative analyses using historic datasets, and is discussed further under Work Element 5.2a-i.

Work product 5.1b: Re-assess quality of information for key decisions using input from policy-level personnel.

- The Status and Trends subgroup will evaluate the ability of alternative monitoring designs to provide information on the species/questions/spatial scales prioritized in the Survey of Monitoring Questions that was completed by policy-level staff at agencies and tribes. The subgroup will obtain feedback from programmatic and policy personnel regarding feasibility and strong/weak attributes of alternate monitoring programs.

Work Element 5.2: Complete three pilot M&E projects at provincial / ESU scales in ID, OR, WA

Each of the following pilot projects were developed to fit the needs of both the lead agencies (i.e. IDFG, ODFW, WDFW), as well as the overall M&E needs of the Columbia Basin as a whole. The differences in level of description reflect the different amount of time available to develop the study concepts: the ID Snake Pilot has been under development for more than a year; the WA pilot study is building on existing recovery planning processes; and the OR pilot study is a new endeavor.

Work product 5.2a: Snake Basin Pilot Project

We recommend that the following work products be completed during FY06 and FY07:

Work product 5.2a-i: Convert general templates into practical plans. This is a key work product for demonstrating that CSMEP is a process that will provide direct benefit to resource managers in the Columbia basin. The H, M, and L design templates, as described to date, must be thought of as general templates. In current form, these generalized templates do not describe specific, "on-the-ground"

monitoring activities. The cost and the levels of precision and accuracy that are associated with H/M/L templates vary, and depend upon target species, site characteristics (e.g., access, flow conditions) and population abundance. Translating general templates into specific templates that describe on-the-ground monitoring at the provincial or ESU scale requires tailoring of the general templates using site-specific information. Specific monitoring designs for a province or ESU require information (probably provided by regional program mangers) about the target species, site characteristics and general expectations of population abundance. Within these constraints, design templates can be tailored to individual provinces and ESUs. Below, we outline the work required to tailor H/M/L templates to a practical plan for monitoring the status of Snake River spring/summer Chinook salmon:

- **Sensitivity analyses with simulation model.** In the pilot M&E designs, the Status and Trends subgroup is assessing monitoring programs for describing status of Snake River spring/summer Chinook. The H/M/ L design templates describe monitoring scenarios with high, medium and low levels of precision and accuracy. Sensitivity analyses with the simulation model can be used to investigate how the rate of error in the decision ("to delist or not to delist") varies according to prescribed uncertainty in data on abundance, productivity, spatial structure, and diversity of specific populations within the ESU. Thus, the sensitivity analyses will be used to demonstrate where the decision is most sensitive to uncertainty in monitoring data.
- **Calibration studies.** Where uncertainty in monitoring data strongly affects rates of error in decisions, focused calibration studies can better parameterize the levels of precision and accuracy that are associated with specific monitoring activities. These estimates are site specific, and the ability to do calibration studies depends upon simultaneous implementation of multiple monitoring methods in the same population. In many cases, these data currently are not available. CSMEP representatives can recommend implementation of monitoring that will enable calibration studies for classes of data where uncertainty is unknown and where decisions are sensitive to quality of data inputs.
- **Translate general template to specific monitoring plans.** As described above, translating general templates into specific templates that describe physical, on-the-ground monitoring at the provincial or ESU scale requires tailoring of the general templates using site-specific information. We recommending completing this work for SRSS Chinook as a demonstration project. Work currently being done by the TRT, NOAA-F, IDFG, NPT and others in the basin is timely and will enable completion of this task (e.g., Hassemer's identification of "viability scenarios" using TRT rules and site specific info, NPT/IDFG proposal to implement monitoring where there are gaps and to implement calibration study opportunities within each MPG).

Work product 5.2a-ii: Integrate across issues, questions, species and agencies to meet identified priorities.

- **Integrate monitoring templates**. Members of the Integration subgroup will work with each of the other subgroups (S&T, 4Hs) to combine the optimal

monitoring template from each subgroup into a single, unified vision for monitoring at broader scales. Cost will be adjusted within the unified plan to describe where multiple groups rely on the same monitoring activity or data input. The Looking Outward Matrix developed to integrate across subgroups will be useful in this exercise, as will recent work on integration of PIT-tagging across multiple functions (see section E4.6).

- **Continue design work on identifying life stage-specific survival using PIT tags.** In this ongoing analysis, the questions, species that are addressed, and roles of various agencies in monitoring and cost-sharing, as well as other issues with implementation, will be examined.
- **Consider how to extend the design to accommodate steelhead, bull trout and other resident fish species of concern.** This work will build on the results of investigations by the USFWS RMEG (Porter and Marmorek 2005) and others. Extensions of the Snake Pilot principles to the mid-Columbia and upper-Columbia are discussed below under Work Product **5.3a-iii**.

Work Element 5.2b: Washington Pilot Project

The Washington Department of Fish and Wildlife (WDFW) proposes a CSMEP pilot project that will both enhance Washington's efforts to implement salmon recovery monitoring plans and inform the CSMEP entities of progress made in Washington. The Washington pilot will refine completed monitoring plans at the regional scale (largely coincidental with ESU boundaries within the state), strive for comparability in monitoring data across regions, develop data storage and access provisions, and troubleshoot problems encountered during monitoring implementation. WDFW will seek to incorporate the tools developed through the CSMEP process wherever possible. The lessons learned in this process will benefit CSMEP and other states in the process of developing recovery plans and monitoring strategies, and will serve to partially fulfill the CSMEP's goal of ensuring that CSMEP products are integrated with ongoing efforts. This process will also inform the development of a basinwide M&E strategy through the NWPCC.

Background: Washington is unique among participating CSMEP states in that it has already developed a statewide monitoring framework, and has developed region-specific salmon recovery and monitoring plans. The Washington Comprehensive Monitoring Strategy includes an action plan with full implementation scheduled for June 30 2007 (SRFB 2002) The regional salmon recovery plans, which include monitoring chapters, are now being implemented and further work is underway to refine the monitoring components so that recovery progress can be quantified. The plans were developed by locally driven regional groups with representation from local citizens and governments, tribes, state and federal agencies, and other interested parties. The Washington Governor's Salmon Recovery Office (GSRO), formed in 1998, assisted regional groups in developing the plans. WDFW has worked closely with GSRO and the regional recovery boards throughout this effort. The four regional groups in the Columbia Basin submitted recovery plans, including monitoring chapters, to the GSRO on or before June 30, 2005, which can be accessed via the Internet. The Lower Columbia plan has already been published as a draft recovery plan in the Federal Register. The Middle Columbia

and Snake plans have been submitted to NOAA-F and USFWS (the federal services) for review but are not yet published in the federal register. The Upper Columbia plan has not yet been submitted to the federal services.

Work Elements, Methods and Products

Washington Department of Fish and Wildlife (WDFW) proposes a CSMEP pilot project that will build upon and refine the monitoring plans that regional recovery groups have already completed. This will be accomplished through a collaborative process between the Governor's Forum on Monitoring (Forum) and the regional recovery groups. The Forum is co-chaired by WDFW and includes representation from other Washington state agencies, the federal services, NWPCC, Tribes and other interested parties. NOAA-F has been particularly involved at the federal level, providing guidance on what criteria will be used in making determinations about changes in listing status. The monitoring plans that have been developed by the regional boards vary widely in their degree of specificity, ranging from general descriptions of the type of monitoring that needs to occur, to detailed schedules outlining monitoring activities by basin, species and level of effort.

The goal of the pilot will be to assist each region in refining their monitoring plan to achieve a high level of specificity in the actions necessary for tracking and reporting salmon recovery progress. As WDFW works with the regional groups we will build upon their previous work and the tools developed through the CSMEP process, in particular the products, analyses and insights gained from the CSEMP Snake River Basin Pilot Project. This will be achieved through ongoing workshops, development of guidance documents and continued WDFW participation in CSMEP. The Forum has already hosted two such workshops with regional boards and NOAA-F, resulting in the initial Forum guidance "Recommendations to Regions", which provides preliminary guidance on statewide priorities for monitoring abundance, productivity, diversity, spatial distribution, and listing factors and threats. These guidelines will continue to evolve as implementation occurs.

Subsequent workshops will address data comparability, data sharing and access, and monitoring implementation. WDFW anticipates continuing workshops and work product development throughout the 07-09 fiscal years. Work products will include **guidance documents** from the Forum to the Washington salmon recovery regions, which will incorporate various CSMEP analyses, tools and insights, as required. WDFW will also summarize in written reports the key **statewide monitoring priorities** identified by the Forum, to feed into CSMEP's efforts to tailor systemwide M&E approaches to identified priorities. Finally, WDFW will work with the CSMEP Habitat Subgroup (Work Element 5.3c) to characterize what sets of restoration actions will be evaluated in Washington's Intensively Monitored Watersheds, the extent to which these findings may apply to similar ecoregions within other parts of the Columbia Basin, and the comparability of designs / methods used in the CSMEP Lemhi River Pilot Study.

Work Element 5.2c: Oregon Pilot Project

Background: The intent of the OR pilot project is to develop a formal monitoring and evaluation (M&E) plan for Snake River Basin steelhead in the Grande Ronde and Imnaha subbasins with applicability to steelhead populations in other ESUs, building on the

steelhead inventory work completed under CSMEP (objectives 2-4), the DQO work completed by the CSMEP Status and Trend Group, and work completed by Steelhead Technical Recovery Teams.

Work Elements, Methods and Products: The plan will specifically describe methods for gathering and maintaining the data needed to annually, or periodically, describe the abundance, productivity, spatial distribution, and diversity for this ESU in these areas. The M&E plan will describe expected accuracy and precision at prescribed levels of effort for monitoring information (standardized redd counts, adult fish/redd estimates, annual age composition, adult fish sex ratios, hatchery:wild fish ratios, estimates or indices for juvenile out-migrant abundance, and tagging programs). The plan will address the needs for out-of-subbasin information on hydrosystem and harvest mortality. It will examine how precision level in these broader estimates affects precision of estimates at the subbasin scale. The M&E plan will present alternative mixes of sampling effort to describe population status and trends.

The ODFW CSMEP staff (working closely with ODFW's Regional and District staff and tribal co-managers) will serve as the coordinators to guide the Plan's development and ensure appropriate parties are participating. The ODFW CSMEP staff will assemble data and prepare written products for review by planning participants.

Work Element 5.3: Extend application of CSMEP insights and tools to other parts of Columbia Basin and PNAMP entities

Work Element 5.3a: Status & Trends Subgroup

Background: The Status & Trends Subgroup has made major progress on rigorously investigating the implications of different monitoring approaches for assessing the recovery status of spring/summer chinook populations, applying decision rules developed by the Interior TRT. Once this work is completed in FY07 (Work Elements 5.1 and 5.2a) it will be important to make the results widely available to other regions, and extend it to other species, notably steelhead, but also considering bull trout and other resident species of concern. That is the focus of the following three work products outlined below.

Work Elements, Methods and Products

Work Product 5.3a-i:

- ODFW has recently invested considerable time into retrospective analyses of 10 Oregon populations in the Mid-Columbia River steelhead ESU. In this process a set of spreadsheets and documentation has been developed for describing trends in abundance and productivity of these populations. These tools will serve as templates for additional populations and a more generalized template to be used on a broad-scale. They also help define the minimum set of information that needs to be included in these analyses. This work product will develop the framework and identify the means to maintain abundance and productivity data sets for Columbia River Basin salmonid ESUs, through:

  1) Prioritized list of ESUs and populations to address.

2) Example datasets (spreadsheets) and output (analyses).
3) A system to prompt adequate documentation for strengths, weaknesses, and applicability of the data.
4) Template datasets for ESUs currently lacking standard run reconstruction data bases. Use the priority list to determine sequence for templates; and
5) An online location for these data sets.

Work product 5.3a-ii: Extend tools for assessing M&E designs

- During FY 04-06, the Snake River Pilot design for status and trends focused principally on monitoring for Chinook salmon. The simulation tool was designed to investigate the effect of uncertainty in monitoring data on the rate of error in assessing status of Snake River spring/summer Chinook salmon. The model uses viability criteria developed by the Interior Columbia Technical Recovery Team. Other listed ESU's within the scope of the ICTRT include: Upper Columbia River Spring Chinook (Endangered); Snake River Spring/Summer Chinook (Threatened); Snake River Fall Chinook (Threatened); Upper Columbia River Steelhead (Endangered); Mid-Columbia River Steelhead (Threatened); Snake River Steelhead (Threatened); Snake River Sockeye (Endangered). Thus the viability criteria are the same and the tool can be applied to these other ESUs. We propose to extend this tool first to Mid-Columbia steelhead, which has 17 extant and 2 or more extirpated populations in 4 MPGs. The decision rules for aggregating population-scale data to MPGs and ESUs, and for translating data into decisions are the same; thus, the model coding will remain essentially the same. However extension to steelhead will require some adaptation (new input datasets, assessment of uncertainty associated with monitoring data for Mid-Columbia steelhead - which likely differ from Snake River spring and summer Chinook salmon).

Work product 5.3a-iii: General extension of qualitative and quantitative tools for use throughout CRB.

- During FY07-09 effort will first be focused on Middle Columbia ESUs, and, subsequently, Upper Columbia ESUs. Effort will focus on simultaneous assessment of and optimizing monitoring programs for multiple species, including salmon, steelhead, bull trout and other resident species of concern. As part of the analytical work, a basin-wide framework to obtain comparable egg-smolt survival and (for anadromous species) SAR data will be developed.

Work Element 5.3b Hydro Action Effectiveness Subgroup

Background

As discussed under work elements 5.1, 5.2a and 5.3a, the CSMEP Snake River Pilot Project for spring/summer chinook should broaden to other regions and species and increase the integration among the H's and status/trends. This would include mid-Columbia River chinook (not-listed) and steelhead (listed), constructing a basin-wide

M&E framework to obtain comparable egg-smolt survival and SAR data among regions within species and run-type. The hydro subgroup portion of this would be in-river survivals and SARs (and transport SARs, where applicable) for populations within the mid-Columbia (Klickitat to Yakima and Walla Walla rivers), and between region/population comparisons. The mid-Columbia is the next logical region for investigation because it necessarily involves most agencies participating in CSMEP.

A recovery planning product should be available by spring 2006, summarizing status for each interior Columbia ESA listed salmon/steelhead population, the current abundance/productivity and spatial structure/diversity ratings and available data used in the ratings. The status reports should be useful in initial design work across and within regions to help identify key datasets and data gaps, and data for the viability simulations across species and regions. SARs covary among populations within a region and between regions; quantifying the covariation may prove useful to optimize efficiency of M&E design for both hydro action effectiveness and status and trend monitoring, especially for lightly sampled populations.

Work Elements, Methods and Products

As described in section E4.2 and the CSMEP FY05 Annual Report, the Hydro Subgroup made substantial progress on M&E designs for addressing various hydrosystem decisions. The next logical steps would include:

- Begin to construct a basin-wide M&E framework to obtain comparable SAR data (to augment egg-smolt, spawner-to-spawner, spawner-to-preharvest recruit data) among regions within species and run-type
- Increase emphasis on PIT tag integration example, working among subgroups. Explore the feasibility of increasing or re-allocating PIT tag numbers among populations and major population groups to meet alternative M&E design objectives.
- Expand Snake River spring/summer chinook hydro section for steelhead and fall chinook
- Incorporate ongoing Snake River fall chinook transport evaluation proposal planning and design elements within CSMEP M&E framework
- Initiate hydro DQO steps 1-5, 6-7 to address in-river survival and SAR estimates (in-river and transport, where applicable) for mid-Columbia spring chinook, steelhead and fall Chinook (FY07).
- Initiate hydro DQO steps 1-5, 6-7 to address in-river survival and SAR estimates (in-river and transport, where applicable) for upper Columbia spring chinook, steelhead and summer chinook. (as time allows in FY07).

Work Element 5.3c Habitat Action Effectiveness Subgroup

Background

As summarized in section E4.3, the Habitat Subgroup made substantial progress on developing a general ‘question clarification process’ to effectiveness monitoring, and a

specific application of this process to creating a design for intensive monitoring of a large scale restoration project in the Lemhi subbasin; the CSMEP design has been further revised and is in the process of being implemented. The subgroup concluded that the question clarification process had general relevance to other efforts at monitoring restoration effectiveness, and should receive widespread regional distribution, which we expect to occur in FY06. However, the subgroup also concluded that individual designs for monitoring project action effectiveness are very site-specific, and not appropriate targets for a 'design template'. Rather than tackle the design of another intensively monitored watershed, the best focus for the Habitat Subgroup during FY07-09 is to move to regional scales (subbasin, ESU, province) at which the programmatic effectiveness of habitat restoration actions can be assessed, a clear priority of the NWPCC.

This work will build on the design efforts of the Federal RME program (Jordan et al. 2003), and the results of a large project funded by BPA under the Council's Innovative Projects fund, led by ESSA Technologies, with the assistance of about 80 scientists and managers (Marmorek et al. 2004a) The ESSA project retrospectively analyzed the effects of restoration 'treatments' at nested spatial scales across a set of watersheds in the Yakima, Wenatchee, Clearwater, and Salmon subbasins, using a variety of salmon performance measures (indices of parr/spawner, smolts/parr, smolts/spawner, recruits/spawner). Four key conclusions of this work point the direction for further efforts by the Habitat Subgroup. First, PIT-tagged based estimates of parr to smolt survival have a relatively greater precision than other indices for estimating the effects of restoration actions on salmon survival. Second, evaluation of action effectiveness is critically dependent on creating deliberate and strong contrasts in restoration actions over space (different reaches or watersheds are treated differently) and time (before/after monitoring), so as to maximize the ability to detect changes in fish survival indices. Third, achieving such contrasts requires a much greater level of regional coordination in the implementation of actions than has occurred to date. Fourth, it is essential to monitor multiple covariates, so as to filter out the signal created by habitat restoration actions from the effects of spatial and temporal variation in other factors affecting fish survival (e.g. spatial variation in productivity, year to year fluctuations in climate).

Past statistical power analyses from PATH (Paulsen and Hinrichsen, 2002; Paulsen and Fisher, 2003) suggested using model based methods that it might be possible to design studies to detect the effects of habitat actions within relatively short periods of time on both adult recruits per spawner and on parr-to-smolt survival, respectively. For example, by use of five control sites and three randomly assigned treatment sites, Paulsen and Fisher (2003) showed that it is theoretically possible to detect a 30% increase in parr-to-smolt survival rates within 7–9 years at a power of 80% and a significance level of 5%. More recently, work initiated under the ESSA innovative project (Paulsen and Fisher 2005, Parnell in Marmorek et al 2004a) showed that the effects of past actions on survival could indeed be detected with real data on survival rates or parr production. Paulsen and Fisher (2005), however, chose a very simple metric: the total number of actions that affected each study site, a very crude measure of action intensity. Never-the-less, they demonstrated the measure to have a fairly strong association with parr-to-smolt survival.

Given the magnitude of public and private spending on habitat restoration, it would be desirable to greatly extend these studies to additional areas, species, and better measures of restoration actions. Under this task, CSMEP will interact with local restoration managers at the subbasin or provincial scale to help design both habitat action implementation, monitoring, and data analysis to help detect the effects of actions on ESA-listed salmonid survival rates. This effort would logically build on the Snake River Basin pilot study, given the concentration of effort by CSMEP in this region. The results however would be of general application.

Work Elements, Methods and Products

We will work with the leaders of subbasin plan development for the subbasins in the Snake Basin pilot region (i.e. Salmon, Clearwater, Grande Ronde, Imnaha, and Asotin subbasins). We hope to convince these planners to explore the implementation of new management actions in a quasi-experimental framework, based on the results of previous work which demonstrates that coordinated multi-watershed implementation and monitoring can improve the cost-effectiveness of both restoration actions and associated monitoring. High-level support from the NWPCC may assist us in this endeavor.

Assuming that we obtain the buy-in of at least a core group of restoration managers, we will design appropriate monitoring strategies to estimate the actions' collective effects on listed fish survival rates. Success of a quasi-experimental framework will be enhanced if multiple subsets of sites can be located with relatively similar physical variables used to characterize each site. Possible subsets of sites include: wilderness sites, tributary sites on BLM land, private land on relative large order reaches, etc. Ideally physical variables on these sites would not change over time. We propose to use the same suite of variables as used by Paulsen and Fisher (2005), namely those developed by the Interior Columbia Basin Ecosystem Management Project (ICBEMP; Quigley and Arbelbide 1997), e.g., elevation, stream density, average climatic conditions, land use, and vegetation cover (see Table 2 in Paulsen and Fisher (2005)). Within each subset of sites, success of the regression type modeling depends on a wide range of management actions – from sites with relatively few management actions (or untreated control areas) to intensively treated areas receiving the most restoration attention.

Under this task, we will meet with local subbasin planners, regional biologists, and other interested parties, to obtain current information on past, ongoing, and planned habitat actions. As part of the workshops, we will demonstrate, using models similar to those referenced above, how it might be possible to detect the survival effects of habitat actions if those actions are planned with effectiveness studies in mind. In addition, we will update the CSMEP data inventories if new information is uncovered in the meetings/workshops. The statistical methods proposed in these analyses (advanced linear modeling used by both Paulsen and Fisher (2005) and Marmorek et al. (2004a) have recently received review and endorsement by the Northwest Power and Conservation Planning Council's Independent Scientific Review Panel (ISRP 2005).

Work products will include will include a series of workshops for subbasin planners and regional biologists, simulation models to estimate the statistical power of different methods to detect the effects of habitat actions on survival rates and/or productivity, a pilot update of the Paulsen and Fisher (2005) models using expanded measures of habitat management actions for one subset of sites, reports describing the results of the workshops and analyses (including short summaries for the CSMEP website), and presentations of these findings at the annual CSMEP/PNAMP workshop as well as other forums (e.g. AFS conferences, condensed results for the NWPCC).

Work Element 5.3d: Hatchery Action Effectiveness Subgroup

Background

The CSMEP Hatchery Subgroup identified a number of questions critical to the evaluation of hatchery management, and reviewed numerous existing and proposed hatchery Research, Monitoring, and Evaluation (RME) plans within the Columbia River Basin to determine whether they have the potential to generate the information necessary to address those questions. Following this review, the subgroup concluded that existing and proposed hatchery RME plans (if fully implemented) are likely to address the majority of the management questions identified by the subgroup. However, the subgroup also concluded that a number of questions regarding the *effectiveness* of hatcheries as a class of actions are unlikely to be adequately addressed by existing and proposed hatchery RME. These effectiveness questions (listed below in Tables **F3** and **F4**) will likely be efficiently and comprehensively addressed only through the implementation of a stratified and representative study design that spans the entire Columbia River Basin.

The study designs to address these questions are best developed within a collaborative process that can rely on the expertise of the multiple tribal, state, and federal agencies with operational jurisdiction and familiarity with implementation of artificial production and artificial production facilities. These findings and recommendations are similar to and consistent with recent ISRP/ISAB conclusions (ISRP 2005-14, ISRP/ISAB 2005-15, the 2005 NWPCC Draft Research Plan (Sections III and IV), and the recent ISRP/ISAB condensation of that plan (ISRP/ISAB 2005-20; pages 5-6)). The required regional collaboration and technical expertise exists within CSMEP. This expertise has proven useful in assimilating the high level of diversity represented by individual programs to identify pertinent questions that are not currently addressed (representatively) by existing hatchery RME projects. With appropriate stratification, this diversity can be leveraged to identify the mechanistic linkages of individual programs to broader monitoring questions that evaluate the effectiveness of hatchery strategies, as a class of management actions, at the regional scale. These broader-scale hatchery program effectiveness questions (as opposed to individual hatchery operation questions) will become the focus of CSMEP designs intended to address larger scale multi-hatchery questions (listed below) that can be stratified across the region. The order of the questions within the tables does not reflect a prioritization, as all questions presented below were deemed to be high priority.

Table F3. Harvest Augmentation Hatcheries: To what extent can hatcheries be used to assist in meeting harvest management goals while keeping impacts to natural populations within acceptable limits?

	Regional Question	Priority
1	What are annual harvest contributions and catch distribution of hatchery produced fish?	H
2	To what degree does the hatchery program meet harvest objectives?	H
3	What is the distribution of hatchery strays into natural populations?	H
4	What are the proportions of stray hatchery fish in non-target natural populations?	H
5	What is the relative reproductive success of hatchery origin adults relative to natural origin adults?	H
6	What are the disease agents and pathogens in hatchery fish, to what degree are these agents transmitted to natural fish, and what are the impacts of such transmissions?	H
7	What are the impacts of hatchery strays on non-target populations?	H

Questions relevant to harvest augmentation hatcheries follow a logical progression; assuming that these programs are intended to augment harvest, presumably lost as a result of habitat modification (e.g., hydropower development), they should provide a demonstrable contribution to harvest (questions 1 and 2). The contribution to harvest must be large enough to offset the potentially deleterious effects of the operation of such facilities. This requires an assessment of the effects of harvest augmentation hatcheries on the viability of natural populations. The degree to which harvest augmentation hatcheries are expected to effect natural populations is assessed at a coarse scale by the distribution (question 3) and magnitude (question 4) of hatchery strays. Given an understanding of stray rates, the impacts of hatchery strays on the viability of natural populations (question 7) is a function of their reproductive success (question 5, which then dictates the magnitude of expected ecological interactions between juveniles with hatchery ancestry and natural origin juveniles as well as the genetic impacts of introgression) and the potential for disease transfer (question 6).

Table F4. Supplementation Hatcheries: To what extent can hatcheries be used to enhance viability of natural populations while keeping impacts to non-target populations within acceptable limits?

	Regional Question	Priority
1	What are the status and trends of habitat targeted by supplementation projects and what is/are the life-stage specific factors that limit productivity?	H
2	What is the reproductive success of naturally spawning hatchery fish relative to natural origin fish in target populations?	H
3	What are the disease agents and pathogens in hatchery fish, to what degree are these agents transmitted to natural fish, and what are the impacts of such transmissions?	H
4	What are the relative effective population sizes and genetic diversity of hatchery supplemented vs. un-supplemented populations?	H
5	What proportion of hatchery origin juveniles return as adults to target versus non-target populations?	H
6	Do hatchery origin juveniles from supplementation programs stray at a greater rate than their natural origin conspecifics?	H
7	What are the proportions of natural spawning stray hatchery fish in non-target natural populations and their impact on the viability of natural populations?	H
8	What is the reproductive success of naturally spawning hatchery fish relative to natural origin fish in non-target populations?	H
9	What are the effects of hatchery supplementation on the productivity, abundance, and viability of non-target natural and hatchery-influenced populations?	H

Supplementation hatcheries act as refuge to offset mortality in early life-history stages. The ability of hatcheries to decrease early life-history mortality, though not ubiquitous (Miller 1990), is well supported (Hard et al. 1992), and a routine metric considered in many of the monitoring and evaluation programs that accompany hatcheries. Juveniles from supplementation programs are typically released into habitats to which they are expected to return and spawn, thereby potentially increasing natural production. Thus a common metric of the supplementation hatcheries is a comparison of the parent per progeny ratios of the hatchery relative to natural production. Because this has been a key

metric of numerous monitoring and evaluation projects, the ability of hatcheries to achieve a higher adult to adult return rate, relative to natural production – again not ubiquitous, is well established (Waples et al. 2001). Given that supplementation programs can successfully increase escapement relative to natural spawning, it follows that targeted habitat must be capable of supporting increased escapement. Monitoring and evaluation activities that accompany numerous supplementation projects have illustrated that targeted streams are underseeded, suggesting that "excess capacity" is available for production (e.g., Arnsberg et al. 1992). Nonetheless, it has also been shown that spawning and early rearing (i.e., egg to emigrant) habitat is not the limiting factor for many populations that are supplemented (Petrosky et al. 2001), and the status and trends of habitat at the life-history stages that limit survival may or may not be known (e.g., mainstem, estuary, and marine). Thus, question 1 seeks to determine which habitats limit productivity, the life history stages that are expressed in those habitats, and the status and trends of habitat(s) that limit productivity.

Assuming that supplementation programs increase survival from the juvenile to adult life-history stages, achieving the goal of increasing natural production requires that hatchery origin adults successfully reproduce and that their progeny are viable and survive at rates similar to their conspecifics that do not have hatchery ancestry. Given that their natural origin conspecifics might be expected to exhibit optimal reproductive success, it is reasonable to compare the reproductive success of hatchery origin adults to their natural origin conspecifics (question 2). Likewise, the survival of juveniles with hatchery ancestry can be meaningfully compared to their conspecifics that lack hatchery ancestry.

Assuming that supplementation provides a demographic benefit from the perspective of productivity (as measured by question 2), hatchery origin juveniles have the potential to serve as disease vectors, potentially offsetting otherwise positive demographic benefits (question 3). Broodstock collection, mortality within the hatchery, and post-release mortality can potentially decrease genetic diversity of targeted populations (Hard et al. 1992); likewise, the implementation of specific breeding protocols, decreased genetic drift owing to reduced random mortality, and increased abundance potentially resulting from supplementation can maintain or increase genetic diversity (Hedrick and Hedgecock 1994). Question 4 evaluates the variance among the effective population sizes of hatchery and conspecific natural populations to evaluate whether supplementation, as a class of recovery actions, is most likely to have a positive or negative effect on the maintenance of genetic variation.

Despite the fact that supplementation programs strive to produce juveniles that are genetically, behaviorally, and functionally identical to their natural origin conspecifics, the fact remains that straying of hatchery origin adults can potentially have deleterious consequences for natural origin populations (e.g., Grant 1997). Therefore, the distribution and magnitude of straying of hatchery origin adults originating from supplementation programs is of interest (question 5). Because supplementation is a key component of multiple recovery plans it is also meaningful to determine whether the stray rates of adults originating from supplementation programs is greater than their natural origin conspecifics (question 6); particularly given that changes in the life-history stage of

released juveniles, release timing, and method of release can potentially decrease stray rates (Quinn1993; Unwin and Quinn 1993; Hard and Heard 1999). At a coarse scale, the impacts of hatchery strays is a function of the magnitude of straying (question 7), the reproductive success of strays (question 8), and the resulting effects on the viability of non-target populations (question 9).

Work Elements, Methods and Products

Study design alternatives to address the questions identified in the previous sections will be addressed at the scale of the Snake River Basin in 2006. Design templates formulated at the scale of the Snake River Basin in 2006 will enable the designs to be efficiently expanded and tested during the 2007 through 2009 contract period by the inclusion of at least one priority subbasin in both Washington and Oregon. Finally, during the 2007-2009 contract period revised designs and strata will be expanded to representatively cover the Columbia River Basin. In addition to expanding the spatial scale of hatchery study designs, the hatchery subgroup likewise will increase collaboration with the ISRP, ISAB, and the Federal Caucus RME workgroup. The ISRP/ISAB (2005-15) has similarly recommended the convening a collaborative process of select ongoing supplementation evaluation programs and we suggest here CSMEP to house and facilitate such a process. Closer collaboration with these entities is anticipated to increase the rigor of work products, and ensure that designs are focused on key questions of regional significance. Work performed in the 2007 to 2009 contract period will address specific information needs, including:

1. a review of existing effort and the compilation of alternative designs to provide a coordinated marking and mark recovery strategy, at the scale of the Columbia River Basin, for hatchery and natural origin juveniles that can provide mark recoveries with known efficiency and expansion rates based on known mark effort;
    a. relevant to harvest
    b. relevant to the calculation of stray rates for index hatchery and natural populations
2. a compilation of the distribution and frequency with which communicable diseases occur at all hatcheries operating in the Columbia River Basin and a probabilistic (status) and fixed frame (trend) survey of disease prevalence and presence in natural populations, with a specific focus on how the transmission of pathogens (vertical versus horizontal) can or cannot be addressed with common study design alternatives;
3. a stratified[4] sampling effort to evaluate the relative reproductive success of hatchery origin adults, under natural conditions, via genetic assay;
4. a stratified[5] sampling effort to evaluate the effects of hatchery origin adults on the metrics that relate to viability (e.g., VSP criteria; McElhany et al. 2000).

[4] Strata to be evaluated include proportion of broodstock composed of natural origin adults, duration of the hatchery project, effective population size of the aggregate (hatchery and natural) population.

[5] Strata should include populations with varying degrees of hatchery influence – both target and non-target populations for supplementation programs, and locations where inadvertent escapement of augmentation hatchery origin adults might be expected to have a range of demographic impacts.

a. abundance
b. productivity
c. spatial structure
d. diversity

For each work element, data will be collected from existing RME projects and reduced to describe the current state of information. Stratification will be evaluated using simulations based on existing data, and gaps in existing information will be identified relevant to the following tasks:

1. Evaluate the ability of existing RME to **representatively** populate strata relevant to marking effort and mark recovery efforts within the Columbia River Basin.
2. Compile hatchery disease records, accumulate data from diseases surveys of natural populations, evaluate gaps in existing information, and identify strata appropriate to fill monitoring gaps across species, hatchery programs, and the spatial extent of the Columbia River Basin.
3. Identify "sentinel" locations that are representatively stratified throughout the Columbia River Basin (possibly a subset of locations identified in question 1) to evaluate the proportion of total escapement composed of strays, evaluate relative adult reproductive success, monitor trends in productivity and life-history diversity, and evaluate trends in habitat.

For each task, a summary report will evaluate:

1. whether existing data can provide an unbiased evaluation of the key metrics;
2. a comparison of the statistical power and assumptions associated with alternative study designs; and
3. a suite of recommended alternatives ranked as incremental gains in precision versus cost.

Work Element 5.3e Harvest Action Effectiveness Subgroup

Background: The subgroup will build on its previous work (summarized in section E4.5) and complete their M&E designs for improving data for harvest pre-season and in-season decisions. These designs will be incorporated into the three pilot studies in ID, WA, and OR under work element 5.2.

Work Elements, Methods and Products

- A description of the overall cost for harvest monitoring as the sum of costs for discrete elements or performance measures (for example: the cost to estimate age composition in the Lower Columbia River spring/summer chinook fisheries).
- Complete low, medium and high harvest monitoring designs.
- Describe the relative benefits and additional costs related to expanded monitoring or tagging effort (CWT and PIT) in quantifying accuracy and precision in harvest and take estimates.
- Investigate and assess the merit of incidental mortality study designs to quantify drop-off and post release mortality rates in specific fisheries.

- Investigate and describe alternative methods to estimate (and improve the accuracy of) preseason run forecasts using retrospective analyses and additional correlations.

Work Element 5.4: Feed M&E results into NWPCC Provincial Review Process

Much of the work already completed by CSMEP, as described in the CSMEP FY05 Annual Report, could be helpful to the ISRP, NWPCC and CBFWA in the current round of provincial reviews, particularly given the emphasis of the NWPCC on moving from project-scale to regional scale evaluations of program effectiveness. Over the FY07-09 period, CSMEP will be delivering a stream of work products with significant implications for M&E at multiple scales, as described in the previous parts of this section. CSMEP will summarize the aggregate implications of this work for the NWPCC and CBFWA fish and wildlife managers.

Work Element 5.5: Get feedback from CRB entities on various M&E designs

Each of CSMEP's design work elements involves interaction with regional fish managers to assess the tradeoffs between different M&E designs that have varying levels of precision, error risks and costs. In addition, work element 1.6 (presentations at various Columbia Basin forums) will provide an opportunity to obtain feedback on the overall relevance of CSMEP products.

F6. Multi-agency implementation of monitoring programs.

Work Element 6.1: Provide input to conceptual plans for M&E implementation across CRB

CSMEP will work with PNAMP, the NWPCC, and the Federal RME program to provide insights and recommendations towards the collaborative development of M&E across the Columbia Basin. At this point it isn't clear which single entity has responsibility for the development of such a plan.

F7. Multi-agency evaluation of results of new monitoring programs

Work Element 7.1: Collaborative review of federal RME projects, WA SRFB Effectiveness Monitoring Projects, and other recent pilot projects

CSMEP participants will continue to interact with scientists implementing the above pilot projects, so as to maximize the application of insights gained therein to CSMEP's work. We will continue to invite these scientists to CSMEP workshops to present the results of their work, and to participate in other conferences to present progress by CSMEP.

F8. Monitoring and Evaluation of CSMEP

CSMEP can be evaluated at both the work element or activity level (Did we complete identified work elements?) and the outcome level (Did we make a difference to fish and wildlife populations?). Monitoring of CSMEP's completion of work elements and products is done through the mechanisms outlined under section F1 (i.e. biweekly conference calls, quarterly work plans and progress reports), as well as careful scrutiny of all invoices by the CBFWA project manager (in consultation with others) to ensure that billed time and work completed are consistent. As both interim and final work products are placed on CSMEP's website, they are available for all to review. Equally important to these tracking mechanisms, CSMEP has developed a culture of rigor, creativity and productivity, which has generated an excellent set of integrated work products. These methods have proven to be very effective in ensuring work element completion.

At the outcome level, CSMEP's work does not directly result in greater numbers of fish or improved habitat. However, there are a number of indirect ways that CSMEP can have significant beneficial outcomes to fish and wildlife populations in the region, as well as improving the cost effectiveness of M&E expenditures. These outcomes, and indicators to measure them, are summarized in Table **F5.**

Table F5. CSMEP outcomes and indicators by which they can be evaluated, with reference to Reasonable and Prudent Actions (RPAs) in the NMFS 2000 Biological Opinion on the Federal Columbia River Power System.

	-
Outcomes	- improved ability to monitor status and trends of fish populations in ID, OR and WA, by providing large scale, integrated monitoring designs, with improved consistency across monitoring programs (RPAs 180, 190, 193, 196, 197) - improved ability to monitor RPA effectiveness (Tier 3) through development of explicit experimental frameworks, integration with status and trend information, and placement of focused effectiveness monitoring in larger geographical context (RPAs 183 to 189,191,192,194,195) - catalyst for sharing information and improving coordination and communication among monitoring programs (RPA 198) - improved guidance for future research proposals leading to much stronger proposals and monitoring plans - improved project selection by funding/review agencies - more cost effective expenditures of FWP funds for given environmental benefit, as better M&E and adaptive management leads to discontinuing ineffective management actions and implementing actions with proven effectiveness - reduction / elimination of weaknesses of existing M&E programs inventoried under objective 2 - more cost-effective M&E through integration across agencies, objectives, and species

Indicators to Assess CSMEP Outcomes	Examples of indicators to assess benefits of CSMEP / StreamNet inventory and assessment activities (objectives 2, 3, 4): - improved access to fish monitoring metadata and data - improved ability to compare existing information on key performance measures across jurisdictions - elucidation of the strengths and weaknesses of existing fish monitoring data in different subbasins, providing guidance for improving M&E programs Examples of indicators to assess benefits of CSMEP activities to design, implement and evaluate new monitoring programs (objectives 5, 6, 7): - progress on implementing improved monitoring designs within the Columbia Basin - use of CSMEP products by scientists in CRB and PNAMP agencies that implement fish M&E activities - clarity provided to programmatic and policy levels in fish and wildlife agencies (NWPCC, PNAMP) regarding implications of different choices in M&E, and inherent tradeoffs - statistical power to detect trends in environmental and population indicators (Tier 1 and 2) - reduction in uncertainty in performance standards used in decision-making under ESA, and for hydro, habitat, harvest and hatchery decisions - ability to generate performance standards at appropriate spatial scales for decision making

G. Facilities and equipment

There is no special equipment required to conduct this work. Facilities will be required to convene a series of RME workshops during each year of the project. These may be held in a variety of locations to stimulate interagency cooperation.

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WA IMW (Intensively Monitored Watershed). 2004. Evaluating watershed response to land management and restoration actions: intensively monitored watershed (IMW) progress report. Prepared by: The IMW Scientific Oversight Committee. Submitted to: Washington Salmon Recovery Funding Board, July 2004

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I. Key personnel

CBFWA Staff {cost shared through CBFWA Coordination Contract and Foundation funding}**:**

Jann Eckman, President (0.125 FTE)
Neil Ward, Resource Coordinator (0.5 FTE)
Kathy Titzler, Fiscal Contract Administrator (0.125 FTE)
Amy Langston, Webmaster (0.125 FTE)
Margaret Filardo, Biologist (0.1 FTE)
Thomas Berggren, Biometrician (0.2 FTE)
Henry Franzoni, Data System Manager (0.2 FTE)

NOAA-Fisheries Staff {cost shared}**:**

Chris Jordan, Head, Monitoring and Evaluation, Corvallis, OR (periodic participation in CSMEP Status and Trend subgroup as part of NOAA-F responsibilities)
Russell Scranton or Kim Kratz (periodic participation in CSMEP Habitat Effectiveness subgroup as part of NOAA-F responsibilities)

USFWS Staff {cost shared}:
Paul Wilson (0.25 FTE)

EPA Staff {cost shared}
Phil Larsen (periodic participation in CSMEP Status and Trend subgroup as part of EPA EMAP extension work)

State Agency Staff:

IDFG: Claire McGrath (1.0 FTE); Sam Sharr (0.1 FTE – cost shared); Charlie Petrosky (0.2 FTE – cost shared); Tim Copeland (0.1 FTE – cost shared)

WDFW: Pete Hahn (0.25 FTE), Kris Ryding (0.25 FTE), Kirk Krueger (0.2 FTE), New Hire (0.4 FTE)

ODFW: Tom Rien (0.16 FTE), Eric Tinus (0.75 FTE), Tim Dalton (0.25 FTE), Office Specialist (0.1 FTE)

Tribal Agency Staff:

Nez Pearce: Jay Hesse (0.45 FTE) and Chris Beasley (Quantitative Consultants, 0.45 FTE)
CRITFC: Earl Weber (0.5 FTE) and Saang-Yoon Hyun (0.5 FTE)
Yakama: Dave Fast and Bill Bosch (0.125 FTE)
Colville: Keith Wolf, KWA on behalf of CCT (0.25 FTE)
Umatilla: Jesse Schwartz (0.125 FTE)

Canadian Government Staff:

DFO: Kim Hyatt (0.1 FTE + 0.25 FTE cost share)

Independent Experts:

Staff from **ESSA Technologies Ltd**. (David Marmorek (0.25 FTE), Marc Porter (0.41 FTE), Darcy Pickard (0.28 FTE)) have the following roles:

- technical facilitation of meetings and conference calls;
- consolidation of results from CSMEP meetings into quarterly work plans;
- coordination of input and technical assistance with work products, particularly experimental designs and monitoring protocols

Lyman McDonald, **WEST Inc. –** Senior Statistician; 0.1 FTE

Charlie Paulsen, **PER** – Senior Statistician; 0.1 FTE + BPA Cost Share (0.25 FTE)

Nick Bouwes, **Eco Logic** – Technical Analyst; 0.15 FTE

Table I1. Anticipated participants in each of the CSMEP M&E design subgroups during FY07-09. Leads for each group are bold italicized.

I) **Status and Trends** of Listed Species/Stocks for Extinction Risks and Recovery Evaluations: ***Claire McGrath (IDFG), Sam Sharr (IDFG),*** Neil Ward (CBFWA), Charlie Petrosky (IDFG), Paul Wilson (USFWS), Chris Jordan (NOAA-F), Jay Hesse (NP), Chris Beasley (NP-Quantitative Consultants), Eric Tinus (ODFW), Peter Hahn (WDFW), Paul Wilson (USFWS), Charlie Paulsen (Paulsen Environmental Research), Nick Bouwes (Eco Logical Research), Robert Al-Chokhachy (Eco Logical Research), Timothy Dalton (ODFW), Phil Larsen (EPA), Kim Hyatt (DFO), Lyman McDonald (Western EcoSystems Technology), Neil Ward (CBFWA), David Marmorek (ESSA), Darcy Pickard (ESSA)
II) Effects of **Habitat** Restoration Actions: ***Marc Porter (ESSA),*** Keith Wolf (KWA-Colville.), Chris Beasley (NP-Quantitative Consultants), Charlie Paulsen (Paulsen Environmental Research), Russell Scranton or Kim Kratz (NOAA-F), Tim Copeland (IDFG), Kirk Krueger (WDFW), Nick Bouwes (Eco Logical Research), Lyman McDonald (Western EcoSystems Technology), Marc Porter (ESSA)
III) Effects of **Hydrosystem** Operations: ***Charlie Petrosky (IDFG),*** Earl Weber (CRITFC), Paul Wilson (USFWS), Charlie Paulsen (Paulsen Environmental Research), Nick Bouwes (EcoLogical Research), Tom Berggren (CBFWA), Kristen Ryding (WDFW), Saang-Yoon Hyun (CRITFC), David Marmorek (ESSA)
IV) Effects of **Hatchery** Operations: ***Jay Hesse (NP),*** Chris Beasley (NP-Quantitative Consultants), Peter Galbraith (CRITFC), Dave Fast (YN), Bill Bosch (YN), Jay Hesse (NP), Pete Hahn (WDFW), Timothy Dalton (ODFW), Marc Porter (ESSA)
V) Effects of **Harvest** Management Decisions: ***Tom Rien (ODFW),*** Eric Tinus (ODFW), Jeff Fryer (CRITFC), Kristen Ryding (WDFW), Saang-Yoon Hyun (CRITFC), Jesse Schwartz (Umatilla), Marc Porter (ESSA)
VI) **Monitoring Integration:** ***Sam Sharr (IDFG),*** Charlie Paulsen (Charlie Paulsen (Paulsen Environmental Research), Lyman McDonald (Western EcoSystems Technology), Claire McGrath (IDFG), Charlie Petrosky (IDFG), Jay Hesse (NP), Annette Hoffman (WDFW), Jeff Fryer (CRITFC), Earl Weber (CRITFC), Phil Roger (CRITFC), Tom Rien (ODFW), Jesse Schwartz (Umatilla), Richard Stone (WDFW), Dick OConnor (StreamNet), Cedric Cooney (StreamNet), Evan Brown (StreamNet), Neil Ward (CBFWA), David Marmorek (ESSA)

Table I2. Agency leads for CSMEP's Pilot Projects in Idaho, Oregon and Washington.

Sam Sharr/Claire McGrath (IDFG)
Marnie Tyler (WDWF)
Tom Rien (ODFW)

Table I3. StreamNet leads assisting CSMEP with subbasin inventories (cost-sharing arrangement)

Cedric Cooney (Oregon)
Bart Butterfield/Evan Brown (Idaho)
Richard OConnor (Washington)

CBFWA Resumes

Neil Ward

CBFWA Fish and Wildlife Project Coordinator

Mr. Ward will be responsible for overall management of the CSMEP contract on behalf of CBFWA. He will undertake monitoring of work completion, review of invoices and financial management and coordination with BPA's COTR.

Past Experience:

1999 – 2003
Resident Fish Technical Analyst, Columbia Basin Fish and Wildlife Authority, Portland, Oregon
Responsible for providing technical and policy assistance to the Resident Fish Committee in support to its planning and implementation activities including the: development of detailed work plans, tracking implementation of specific program activities, evaluation, and annual reporting at the request of the caucus chair, preparation of issue and information papers, presentations to the NWPPC and others, facilitation of scientific reviews of resident fish projects by the resident fish managers and other interested parties, technical analysis for policy recommendations and related issue papers to address resident fish issues.

1996 – 1999
Research Coordinator, Texas Parks and Wildlife Department, Athens, Texas
Developed and supervised a fish genetics, health, and water quality laboratory, and planned, organized, directed, and performed associated research. Prepared research proposals, technical reports, manuscripts, and presentations addressing fisheries management, conservation genetics, fish health, and hatchery issues. Other activities includes: developed policies and procedures and explored technology applications, coordinated with regulatory authorities to execute appropriate lab procedures, served on the department's research committee, manuscript review committee, and genetics committee. Planned, organized, promoted, and implemented a public outreach program and established productive relationships with the media. Promoted the program via radio, television, newspaper, and magazine interviews, trade shows, educational seminars, and public meetings.

1993 – 1996
Genetics Research Assistant, Oregon Cooperative Fishery Research Unit, Department of Fisheries and Wildlife Sciences, Oregon State University, Corvallis, Oregon
Conducted genetic and morphological research of wild and hatchery salmonid populations and analyzed and interpreted data, prepared and edited scientific manuscripts, and communicated findings to diverse audiences.

Education:

1992 M.S. in Wildlife and Fisheries Sciences (Fisheries Management), South Dakota State University, Brookings, South Dakota
1990 B.S. in Wildlife and Fisheries Sciences (Fisheries Management), Texas A&M University, College Station, Texas

NOAA Fisheries Resumes

Christopher E. Jordan, Ph.D.

Mathematical Biology and Systems Monitoring, Program Manager
NOAA Fisheries, Corvallis OR

Education:

University of Washington Ph.D.	1994	Zoology
University of Chicago B.A.	1985	Biology

Positions Held:

Program Manager	NOAA/NMFS/NWFSC, Seattle,	2002 - present
Operations Research Analyst	NOAA/NMFS/NWFSC, Seattle	1999 - 2002
Research Assistant Professor	Washington State Univ., Pullman	1999 - present
Assistant Professor	University of Colorado, Boulder	1995 - 1999
Research Associate	University of Chicago, Chicago	1994 - 1995
Research/Teaching Assistant	University of Washington, Seattle	1987 - 1994

Mathematical and Biological Publications:

Steinberg, E.K. and C.E. Jordan. 1997. Using genetics to learn about the ecology of threatened species: the allure and the illusion of measuring genetic structure in natural populations. In: Conservation Biology. eds, P. Fiedler and P. Kareiva. Chapman Hall, New York.

McClure, M. M., Sanderson, B. L., Holmes, E. E. & Jordan, C. E., (2003). A large-scale, multi-species risk assessment: Anadromous salmon in the Columbia River Basin. Ecol. Apps. 13(4):964-989.

Roni, P., M.C. Liermann, C.E. Jordan, and A.E. Steel. Steps for designing a monitoring and evaluation program for aquatic restoration. Chapter 2 in P. Roni (ed) *Monitoring stream and watershed restoration. 2005 American Fisheries Society. Bethesda Maryland.* pp. 13-34.

Jordan, C. and 15 co-authors 2002. Mainstem/Systemwide Province Stock Status Program Summary. Guidelines for Conducting Population and Environmental Status Monitoring. February 22, 2002. Prepared for the Northwest Power Planning Council.
http://www.cbfwa.org/files/province/systemwide/subsum/020515StockStatus.pdf

Jordan C., J. Geiselman, M. Newsome, J. Athearn. (eds.). 2003. Draft Research, Monitoring & Evaluation Plan for the NOAA-Fisheries 2000 Federal Columbia River Power System Biological Opinion. 252 pp.

USFWS Resumes

Paul Wilson

Mr. Wilson has a B.A. in Environmental Science (Physics minor), University of Virginia. *Graduate work*: (1989-1992) Completed course work for M.S. at School of Fisheries, University of Washington. He has worked on Columbia River salmonid issues since 1993, as a modeler and biometrician, first at the Columbia Basin Fish and Wildlife Authority, and since 2000, at the U.S. Fish and Wildlife Service. Mr. Wilson has 15 years experience in modeling salmon population dynamics, including population genetics, and more than ten years experience in modeling management strategies for salmon recovery, including developing and updating juvenile passage and life-cycle models. Mr. Wilson has served on numerous collaborative groups in the past, and in addition to CSMEP, presently serves on the Comparative (salmon) Survival Study Oversight Committee and Bull Trout Recovery Monitoring and Evaluation Workgroup. Mr. Wilson has performed analyses used in biological opinions, 5-year reviews, and other ESA processes, and wrote and edited sections of the Bull Trout Recovery Plan dealing with monitoring and evaluation.

For CSMEP, Mr. Wilson will help complete the Snake River Pilot M&E design, primarily by helping to complete DQO steps 6-7 for hydrosystem decisions and publish/present results for feedback. He will also review tools developed for assessing M&E designs to detect recovery status. In addition, he assist with strengths & weaknesses assessments for bull trout for the Snake River Pilot. He expects to spend approximately 15-20% of his time on CSMEP tasks in FY07.

Sample publication

Wilson, P.H. 2003. Using population projections matrices to evaluate recovery strategies for Snake River spring and summer chinook salmon. *Conservation Biology* 17(3): 782-794

IDFG Resumes

Sam Sharr

Sam Sharr is currently a staff biologist for the IDFG in the Fisheries Bureau at the Boise headquarters office. Sam has a B.S. degree in Biology from the University of Washington and completed additional studies at the University of Wisconsin Limnology Laboratory. He has expertise in stock salmon and herring stock assessment, salmon escapement estimation techniques, stock identification techniques, and ocean harvest management. Sam spent 16 years with the Alaska Department of Fish and Game conducting population monitoring and life history studies on salmon and herring populations and damage assessment research on salmon populations impacted by the *Exxon Valdez* oil spill. He has also worked as a salmon research biologist for the Hoopa Valley Tribal Fisheries Department in California and as the Ocean Salmon Fisheries Manager for the Oregon Department of Fish and Wildlife. In the latter role, he had a lead role development of integrated escapement indicator and harvest rate indicator stock monitoring programs Oregon coastal fall chinook populations. Most recently, from 2002 through 2005, Sam was the principal fishery biologist for the IDFG anadromous natural production research group in Nampa. In that role he supervised the Chinook Salmon Natural Production Monitoring Project, the Idaho Supplementation Studies, and the Idaho Steelhead Monitoring and Evaluation Study.

Education:

- B.S., Biology, University of Washington (1972)

Employment:

- Staff Biologist, Idaho Department of Fish and Game, Boise, ID
- Principal Research Biologist, Idaho Department of Fish and Game, Nampa ID.
- Ocean Salmon Fisheries Manager, Oregon Department of Fish and Wildlife.
- Fisheries Research Biologist, Hoopa Valley Tribal Fisheries Department , Hoopa CA.
- Principal Investigator, salmon damage assessment, AK Department of Fish & Game.
- Prince William Sound Area Research Biologist, Alaska Department of Fish and Game.
- Statewide Stock Biology Research Biologist, Alaska Department of Fish and Game.

Selected publications:

Geiger, H., J. Brady, W. Donaldson, and S. Sharr. 1992. The importance of stock identification for management of the Prince William Sound pink salmon fishery. Alaska Department of Fish and Game Regional Information Report 5J92-12, Juneau.

Geiger, H.J., B.G. Bue, S. Sharr, A.C. Wertheimer, and T.M. Willette. 1996. A life history approach to estimating damage to Prince William Sound pink salmon caused by the *Exxon Valdez* oil spill. Pages 487-498 in Rice, S.D., R.B. Spies, D.A. Wolfe, and B.A. Wright, eds. Proceedings of the *Exxon Valdez* Oil Spill Symposium. American Fisheries Society, Symposium 18, Bethesda, Maryland.

Hilborn, R., B.G. Bue, and S. Sharr. 1999. Estimating spawning escapements from periodic counts: a comparison of methods. Canadian Journal of Fisheries and Aquatic Sciences 56:888-896.

Sharr, S., J.E. Seeb, B.G. Bue, S.D. Moffitt, and A.K. Craig. 1994. Injury to salmon eggs and preemergent fry in Prince William Sound, *Exxon Valdez* oil spill state/federal natural resource damage assessment final report. Restoration study number 60C. Alaska Department of Fish and Game, Anchorage.

Claire C. McGrath

Claire McGrath is a fisheries staff biologist at the Idaho Department of Fish and Game (IDFG), where she is a department technical representative on the Collaborative Systemwide Monitoring and Evaluation Project (CSMEP). Prior to her post at IDFG, Dr. McGrath had eight years experience conducting stream habitat, fish distribution, water quality, and aquatic foodweb studies in the Pacific Northwest and Rocky Mountain regions. Her research interests include population viability, invasive species, aquatic foodwebs, and fisheries management. Dr. McGrath received her B.A. degree in biology from Oberlin College, her M.S. degree in environmental science from Western Washington University, and her Ph.D. degree in ecology and evolutionary biology from the University of Colorado. Dr. McGrath began working with CSMEP in FY 2005.

Most of her technical work for CSMEP has been on monitoring designs for the Status and Trends subgroup, including development of a simulation model to investigate the propagation of uncertainty in monitoring data to error in policy decisions. During 2007-2009 she will continue to work principally in the Status and Trends Subgroup, and will assist with work products being developed by the Hatchery and Integration subgroups and on the assessment of strengths and weaknesses of regional monitoring programs.

Charles E. Petrosky

Ph.D. Fishery Resources, University of Idaho. 1984
M.S. Fisheries, University of Minnesota. 1973
B.S. Fisheries, University of Minnesota. 1970

2005-present Fisheries Program Coordinator, Idaho Department of Fish and Game (IDFG)
1987-2005 Fisheries Staff Biologist, (IDFG)
Coordinate and implement state-wide management programs with respect to ESA compliance (2005-present). Assess salmon and steelhead status, analyze management actions, and provide technical support to management, legal and policy staff. Member of Interior Columbia Technical Recovery Team, charged with recommending ESA delisting criteria for salmon and steelhead, evaluating limiting factors, and reviewing technical recovery plan products (2001-present). Participate in Collaborative System-wide Monitoring and Evaluation Project, status and trends and hydro subgroups (2004-present), and in Comparative Survival Study Oversight Committee (1996-present). Participant in PATH (Plan for Analyzing and Testing Hypotheses), evaluating causes of decline and recovery options for Snake River salmon (1995-2000).

1985-1987 Senior Fisheries Research Biologist, IDFG
Monitor status and trends of Clearwater and Salmon River salmon and steelhead populations, and evaluate effectiveness of off-site habitat mitigation.

Selected Publications and reports:

Berggren, T. and 7 co-authors. 2005. Comparative survival study (CSS) of PIT-tagged spring/summer chinook and PIT-tagged summer steelhead. 2005 annual report, mark/recapture activities and bootstrap analysis. BPA Contract 19960200. Prepared by Fish Passage Center and Comparative Survival Study Oversight Committee. December 2005. 155 pp.

Budy, P., G.P. Thiede, N. Bouwes, C.E. Petrosky, and H. Schaller. 2002. Evidence linking delayed mortality of Snake River salmon to their earlier hydrosystem experience. North American Journal of Fisheries Management 22:35-51.

Hassemer, P.F., S.W. Kiefer, and C.E. Petrosky. 1997. Idaho's salmon: can we count every last one? Symposium on Pacific Salmon and their Ecosystems: Status and Future Options. January, 1994. University of Washington, Seattle, WA.

Petrosky, C.E., H.A. Schaller, and P. Budy. 2001. Productivity and survival rate trends in the freshwater spawning and rearing stage of Snake River chinook salmon *(Oncorhynchus tschawystcha*). Canadian Journal of Fisheries and Aquatic Sciences 58:1196-1207.

Schaller, H.A., C.E. Petrosky and O.P. Langness. 1999. Contrasting patterns of productivity and survival rates for stream-type chinook salmon *(Oncorhynchus tschawystcha*) of the Snake and Columbia Rivers. Canadian Journal of Fisheries and Aquatic Sciences 56:1031-1045.

Proposed 2006 role in CSMEP (part-time; IDFG contributed): Participate in CSMEP hydro and status and trends subgroups, meetings, workshops and project planning.

Timothy Copeland

Tim Copeland is the Project Leader for the Idaho Natural Production Monitoring and Evaluation Project. He has the primary responsibility for data analysis, report writing and oversees the daily operations of the project. He participates on the CSMEP Habitat group and the Salmon Basin Pilot Monitoring Project Technical Oversight Committee. Tim has spent most of his career conducting fish population assessments for management purposes. Beyond the publications listed below, he has written over 50 technical management reports and outlined a fisheries management program for Fort A.P. Hill in Virginia. His graduate research has emphasized the population-level implications of fish physiology. FTE = 1

Education:

Ph.D., Fisheries & Wildlife Science, Virginia Polytechnic Institute & State University (2004).
M.S., Wildlife & Fisheries Science, The Pennsylvania State University (1996).
B.S., Wildlife Science, The Pennsylvania State University (1987).
B.S., Environmental Resource Management, The Pennsylvania State University (1987).

Employment:

2004-present, Senior Fisheries Research Biologist, Idaho Dept of Fish & Game, Nampa ID.
2003-2004, Fishery Ecologist, Conservation Management Institute, Blacksburg VA.
1997-2003, Graduate Research Assistant, Dept of Fisheries & Wildlife Sciences, Virginia Tech, Blacksburg VA.
1989-1997, Fisheries Technician, Pennsylvania Fish & Boat Commission, Sweet Valley PA.

Certification:

Certified Fisheries Professional, American Fisheries Society (2003)

Selected Publications:

Copeland, T., J. Johnson, and P.R. Bunn. 2004. Idaho natural production monitoring and evaluation, annual report. Idaho Department of Fish and Game Report 04-47. Prepared for Bonneville Power Administration, Project 1991-073-00. Portland, Oregon.

Copeland, T., and V.R. Emrick. 2004. Pond fisheries sampling protocols for Army National Guard Maneuver Training Center Fort Pickett. Report CMI-MLD-2004-25. Prepared for Fort Pickett Natural Resources Department. Conservation Management Institute, Blacksburg, Virginia.

Copeland, T., and R.F. Carline. 2004. Relationship of lipid content to size and condition in walleye fingerlings from natural and aquacultural environments. North American Journal of Aquaculture 66:237-242.

Copeland, T., J.J. Ney and B.R. Murphy. 1999. Alternative methods to predict fish proximate composition. Proceedings of the Annual Conference of Southeastern Fish and Wildlife Agencies Volume 53:110-118.

Copeland, T., and R.F. Carline. 1998. Overwinter survival and lipid content of walleye fingerlings. North American Journal of Fisheries Management 18:383-390.

Evan Brown

208-287-2721
ebrown@idfg.state.id.gov
PO Box 25, 600 S. Walnut St. Boise, ID 83707

Experience

2005-2003, Data Coordinator, IDFG/StreamNet Project:
Compile, distribute, facilitate collection of fisheries data.

2002-2001, Data Manager, PSMFC/IDFG StreamNet Project:
Collect, manage, distribute, and aid in analyses of fisheries data.

2000-1996, Senior Fisheries Technician, IDFGSupplementation Studies:
Collect, manage, and aid in the analyses of fisheries data.

Education:

1992, B.S. Biology
2000, ArcView GIS certification, Executrain
2003 MS Access Database Development, certification, Executrain

WDFW Resumes

Peter K. J. Hahn, Ph.D.

Fisheries Biometrician
Fish Program, Science Division, Quantitative Assessment Unit
Washington Dept. Fish & Wildlife
Olympia, WA

Proposed 07-09 CSMEP role: Washington liaison for the Hatchery and Status and Trends CSMEP Subgroups. Provides input on salmon and steelhead population and fisheries sampling protocols, sampling designs, and practical applications and constraints of monitoring and evaluation. Facilitate analysis of existing data to help test sampling design options.

Professional qualifications: Worked from 1978 to present with the Washington State Department of Game/Wildlife/Fish & Wildlife as: statistical and experimental design consultant to resident and anadromous fish biologists and managers; “research scientist” involved with improving the estimation of Chinook salmon spawning populations; fish research manager; fisheries data and computing system analyst and manager; human dimensions researcher; analyst and manager of steelhead trout in western Washington as co-lead of the "Boldt Case Area" (US vs. Washington) steelhead management, monitoring and research team; and expert witness in court advisory hearings for steelhead management. Most recently, focused on consultations and strength & weakness analyses for salmon population data and monitoring protocols. Functioned as a team member on the CSMEP committee from 2003 to present.

Kristen E. Ryding, Ph.D.

Fisheries Biometrician
Washington Department of Fish and Wildlife
Olympia, WA

Proposed 07-09 CSMEP role: Washington liaison for the Hydro and Harvest CSMEP Subgroups.

Education

Ph.D., Quantitative Ecology and Resource Management, 2002, University of Washington
M.S., Quantitative Ecology and Resource Management, 1998, University of Washington
B.S., with distinction, Mechanical Engineering, 1992, Worcester Polytechnic Institute

Experience

2/2004 - Present	Fisheries Biometrician Washington Department of Fish and Wildlife, Olympia, WA
8/2002 - 10/2003	Research Consultant – Biometrician Columbia Basin Research, School of Aquatic and Fisheries Science, University of Washington, Seattle, WA
09/2000 08/2002	Research Assistant – Statistician School of Aquatic and Fisheries Science, University of Washington, Seattle, WA
09/1998 09/2000	Statistician U.S. Environmental Protection Agency, Region 10; Seattle, WA 98101
06/1999 01/2000	Research Assistant – Statistician; School of Fisheries, University of Washington, Seattle, WA
09/1994 09/1998	Research Assistant – Statistician; Columbia Basin Research, School of Fisheries, University of Washington, Seattle, WA

Publications:

Thesis:
Ryding, K. E. 2002. Estimation of demographic parameters used in assessing wildlife population trends. Ph. D. Thesis. University of Washington, Seattle WA. 479 pp.

Ryding, K. E. 1998. Analyzing adult returns to assess ocean effects and salmon survival relationships. M. S. Thesis. University of Washington, Seattle WA. 212 pp.

Books:
Skalski, J. R., K. E. Ryding, J. J. Millspaugh. 2005 *Wildlife Demographics: Analysis of Field Survey Data*. Academic Press/Elsevier. 636 pp.

Papers:
Dillingham, P. W., J. R. Skalski, and K. E. Ryding 2005. Fine-scale geographic interactions between Steller sea lion (*Eumetopias jubatus*) trends and local fisheries. Canadian Journal of Fisheries and Aquatic Sciences 63:107-119

Ryding, K. E., J. R. Skalski 1999 Multivariate regression relationships between ocean conditions and early marine survival of coho salmon (*Oncorhynchus kistuch*). Canadian Journal of Fisheries and Aquatic Sciences 56: 2374-2384

Submitted Papers:
Ryding, K.E., Millspaugh, J.J., Skalski, J.R. Using time series to estimate rates of population change from abundance data. Journal of Wildlife Management.

Major, W. W. III, J. M. Grassley, K. E. Ryding, C. E. Grue, T. N. Pearsons, A. Stephenson. In review Distribution and Abundance of Piscivorous Birds along the Yakima River, Washington State: Implications for Fisheries Management. Submitted to North American Journal of Fisheries Management.

Major, W. W. III, J. M. Grassley, K. E. Ryding, C. E. Grue, T. N. Pearson, A. Stephenson. *In review* Piscivorous Bird Abundance, Fish Take and Flow Conditions at Artificial Structures within the Yakima River in Washington State. Submitted to Colonial Waterbirds

Technical Reports:
Major III, Walter W., J. M. Grassley, K. E. Ryding, C. E. Grue, T. N. Pearsons and A. Stephenson. 2003. The abundance, distribution and maximum consumption of piscivorous birds along the Yakima River, Washington State: Implications to natural resource managers. Draft Report submitted to Washington Department of Fish and Wildlfie.

Ryding, K. E. 2001. Review:2000 Skagit River Wild 0+ Chinook Production Evaluation. Washington Department of Fish and Wildlife, Olympia WA

Ryding, K., and J. R. Skalski. 1999. A multinomial model for estimating ocean survival from salmonid coded wire-tag data. Volume XII in the Design and Analysis of Salmonid Tagging Studies in the Columbia Basin. Bonneville Power Administration, Portland, OR.

Townsend, R. L., P. Westhagen, D. Yasuda, J. R. Skalski, and K. Ryding. 1996. Evaluation of the 1995 predictions of the run-timing of wild migrant yearling chinook in the Snake River Basin using Program RealTime. Bonneville Power Administration, Portland, OR. 64 pp.

Richard J. O'Connor

Biological Data Systems Manager
Washington Department of Fish and Wildlife
Olympia, Washington

Proposed 07-09 CSMEP role: Will assist as needed on data inventory work related to the proposed Washington pilot project. Any time that Dick spends on this effort would be billed to StreamNet funding.

Professional qualifications: Richard J. (Dick) O'Connor leads the Biological Data Systems (BDS) Unit of WDFW's Fish Science Division. His staff are responsible for data systems dealing with coded-wire tag (CWT) sampling, recovery, decoding, and expansion; sport catch record card harvest estimation; hatchery fish rearing, release, returns, and spawning; statewide GIS datasets including streams/lakes, fish distribution and use, and salmonid stock status; and datasets designed for regional exchange through the StreamNet Project and mandates of the Pacific Salmon Treaty. Dick has over 28 years experience developing fish data exchange formats and common systems for West Coast states and British Columbia through the PSMFC Committee on Anadromous Fish Marking and Tagging, the Pacific Salmon Commission (PSC) Data Sharing Committee's Work Group on Data Standards, and the Northwest Power and Conservation Council's StreamNet Project. Dick is the Washington StreamNet Project Steering Committee representative, a U.S. Section member of the PSC Data Sharing Committee, a member of Washington State's Salmon and Watershed Information Management Technical Advisory Committee, and an advisor to WDFW's Corporate Data Oversight Committee.

Annette Hoffmann, Ph.D.

Biometrician
Washington Department of Fish and Wildlife
Olympia WA

Role

Supervise the technical work in the subgroups through Drs. Kris Ryding and Pete Hahn by providing guidance on appropriate use of data and analyses, and ensuring consistency between technical work and Department goals and policies.

Education

- Ph.D., Biostatistics, 1993, University of Washington
- M.S., Biostatistics, 1990, University of Washington
- M.S., Statistics, 1988, University of California, Davis
- B.S., Zoology, 1985, University of California, Davis

Biographical Information

Dr. Hoffmann is the lead biometrician for the Washington Department of Fish and Wildlife. Her expertise is in the application of theoretical statistics to fisheries data, and includes experimental and sampling designs for harvest estimation, monitoring salmon recovery, analysis of varied data for complex stock assessments and development of new and innovative methods for assessing impacts of mark-selective fisheries. She has worked as a biometrician for WDFW since 1995.

Richard Stone

Wildlife Policy Lead
Intergovernmental Resource Management Division
Washington Department of Fish and Wildlife
Olympia WA

Proposed 07-09 CSMEP role:

WDFW policy representative to the CSMEP process. Any participation will be charged to other funding sources.

Education

M.S., Fisheries, 1976, University of Washington
B.S., Zoology, 1973, University of California, Davis

Professional Qualifications:

Mr. Stone is the statewide policy lead assigned to the WDFW Wildlife Program and the WDFW policy representative to the Columbia Basin Fish and Wildlife Authority. He has over 25 years experience managing salmon, steelhead, and other fisheries resources along the Washington coast, including extensive involvement in monitoring and evaluation, and four years acting as the statewide policy lead dealing primarily with wildlife related issues for WDFW.

ODFW Resumes

Thomas A. Rien

Title: Program Leader -- Columbia River Investigations

Recent employment:

- January 2004 – Present, Program Leader, Columbia River Investigations, Oregon Department of Fish and Wildlife
- April 1996 – December 2003, Project Leader, White Sturgeon Research, Oregon Department of Fish and Wildlife

Duties on the Collaborative Systemwide Monitoring and Evaluation Project:

- FTE/hours: 1 month annually as Project Manager.
- Participate on CSMEP harvest monitoring subgroup.

Education:

Oregon State University, Corvallis, OR, B.S. Wildlife Science, 1981

Expertise

Expert at age and growth evaluations of several fish species including white sturgeon; developing and implementing sampling designs to describe population parameters; interpreting and applying findings in population models; as well as project and personnel management.

Publications and Reports

Rien, T. A. and J. A. North. 2002. White sturgeon transplants within the Columbia River. In: W. van Winkle, P. Anders, D. Dixon, and D. Secor, editors. Biology, Management and Protection of North American Sturgeons. American Fisheries Society Press. American Fisheries Society Symposium, 28:233-236.

Rien, T. A., and R. C. Beamesderfer. 1994. Accuracy and precision of white sturgeon age estimates from pectoral fin rays. Transactions of the American Fisheries Society 123:255-265.

Rien, T.A., R.C.P. Beamesderfer, and C.A. Foster. 1994. Retention, recognition, and effects on survival of several tags and marks on white sturgeon. California Fish and Game 80:161-170.

Beamesderfer, R. C. P., T. A. Rien, and A. A. Nigro. 1995. Dynamics and potential production of white sturgeon populations in three Columbia River reservoirs. Transactions of the American Fisheries Society 124:857-872.

Burner, L. C., and T. A. Rien. 2002. Incidence of white sturgeon deformities in two reaches of the Columbia River. California Fish and Game 88(2):57-67.

Eric S. Tinus

Title: Project Biologist – Columbia River Investigations

Recent employment:

1994 – Present, Natural Resource Specialist 1/2, Oregon Department of Fish and Wildlife. Principal duties have included: 1) Recovery Planning for federally ESA listed salmon and steelhead in the Columbia River Basin. 2) Conducting stock assessment data reconnaissance, acquisition, summaries, and analyses for salmon, steelhead, sturgeon, Pacific lamprey, small stream fish assemblages, and warm water fishes. 3) Project biologist on Collaborative Systemwide Monitoring and Evaluation Project (CSMEP), Plan to Analyze and Test Hypotheses (PATH), StreamNet, Northern Pikeminnow Management Program, White Sturgeon studies, Owyhee Reservoir Bass study, and urban stream studies. 4) Participant in Pacific Lamprey Technical Work Group.

Duties on the Collaborative Systemwide Monitoring and Evaluation Project:

- FTE/hours: 8 month annually as Project Biologist.
- Participate on CSMEP harvest monitoring, and status & trends subgroups.
- Work with ODFW staff and CSMEP project to develop a pilot M&E plan for Grande Ronde and Imnaha basin steelhead.
- Develop run reconstruction template for steelhead based on recently completed products for Deschutes River and Fifteen-mile Creek Steelhead. Apply template to Grande Ronde and Imnaha basin steelhead.

Education:

Reed College, Portland, OR, B.A., German Literature (1985)
Portland State University (Portland, OR), Coursework towards B.S., Biology, (1990-91)

Expertise:

Retrospective analyses of Columbia Basin salmon and steelhead population performance and viability. Technical writing and editing; direct experience with methods and gears associated with habitat and fish surveys in streams, rivers, lakes, and reservoirs; implementation of field studies.

Publications and Reports

Tinus, E. and E. Olsen, Oregon Department of Fish and Wildlife, S. T. Allen, Pacific States Marine Fisheries Commission. 1993. FY 1993 Services and features report [of the Coordinated Information Services project]. Annual report prepared for U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife, Project Number 1988- 108, Contract Number DE-FC79-1989BP94402, 19 electronic pages (BPA Report DOE/BP-94402-9). Portland, Oregon.

Tinus, E.S., J.A. Koloszar and D.L. Ward. 2003b. Abundance and distribution of fish in City of Portland streams, Final Report. Prepared for City of Portland Bureau of Environmental Services Endangered Species Act Program. Oregon Department of Fish and Wildlife, Clackamas, Oregon.

Tinus, E.S. and R.C. Beamesderfer. 1994. An update on the distribution, fisheries, and biology of walleye in the Lower Columbia River. Information Report 94-3. Oregon Department of Fish and Wildlife, Columbia River Coordination Program. Clackamas, Oregon.

Bouwes, N., H. Schaller, P. Budy, C. Petrosky, R. Kiefer, P. Wilson, O. Langness, E. Weber, and E. Tinus. 1999. An analysis of differential delayed mortality experienced by stream-type chinook salmon of the Snake River. ODFW Technical Report. October 4, 1999.

Timothy J. Dalton

Title: Fisheries Programs Analyst – Columbia River Investigations
Recent employment:

- December 2005 – Present, Columbia River Fisheries Programs Analyst, Columbia River Investigations, Oregon Department of Fish and Wildlife.
- January, 1998 - December, 2005 – Assistant Project Leader, Life-Cycle Monitoring Project, Western Oregon Research and Monitoring, Oregon Department of Fish and Wildlife.

Duties on the Collaborative Systemwide Monitoring and Evaluation Project:

- FTE/hours: 3 months annually as Fisheries Programs Analyst.
- Participate on CSMEP integration design, and status & trends subgroups.
- Work with ODFW staff and CSMEP project to integrate pilot studies and subgroup products into Systemwide monitoring and evaluation design templates.
- Coordinate ODFW staff and CSMEP project to develop a pilot M&E plan for Grande Ronde and Imnaha basin steelhead.

Education:

University of Washington, Seattle, WA, PhD candidate, Fisheries, 9/94 – 6/95
University of Washington, Seattle, WA, MS Fisheries, 1989
Virginia Tech, Blacksburg, VA, BS Biology, 1982

Expertise:

Salmonid population monitoring and research; impacts of hatchery programs on natural production; study design, data management and analyses.

Publications and Reports

Solazzi, M.F., S.L. Johnson, B. Miller, T. Dalton, K.A. Leader. 2003. Salmonid Life-Cycle Monitoring Project 2002 Monitoring Program Report. Number OPSW-ODFW 2003-2, Oregon Department of Fish and Wildlife, Portland, Oregon..

Dalton, T.J. 1999. Juvenile salmonid outmigration in the Little North Fork Wilson and Little South Fork Kilchis Rivers-1999. Oregon Department of Fish and Wildlife Annual Report, Corvallis, OR, 11pp.

Swanton, CO., T.J. Dalton and B.Barrett 1992. Effects of pink salmon (Oncorhynchus gorbuscha) escapement to the Kodiak and Chignik management areas caused by the Exxon Valdez Oil Spill. Alaska State/Federal Natural Resource Damage Assessment: Fish/Shellfish Studies 7b and 8b.

Dalton, T.J. 1991. Variation in prevalence of Nanophyetus salmincola, a parasite tag indicating U.S. Northwest origin in steelhead trout (Oncorhynchus mykiss) caught in the central North Pacific Ocean, 1986-87. Can. J. Fish. And Aquat. Sci. 48:1104-1108.

Cedric X. Cooney

Oregon StreamNet Project Leader
Natural Resources Information Management Program Leader

Education

California State University, Long Beach, Bachelor of Science in Marine Biology, 1985

Current Employer and Responsibilities

Oregon Department of Fish and Wildlife

- Supervise permanent and seasonal staff that assemble, organize, manage and share natural resource tabular and GIS data sets
- Identify, prioritize, and plan data management activities
- Develop and administer projects and grants to provide data management services
- Coordinate data management efforts

Previous Employment:

Assistant Project Leader, Coastal Salmon Spawner Inventory Project
Oregon Department of Fish and Wildlife, Corvallis, OR, 1990 - 1997

California Department of Fish and Game, Long Beach, CA
Marine Biologist Range B, Long Beach, CA, 1987 - 1990

Expertise:

1) Management, coordination, and administration of multi-task, multi-staff projects and operations, 2) Management, development and delivery of multi-disciplinary and multi-platform natural resource databases, particularly aquatic natural resources, 3) Techniques and methodologies associated with large-scale inventories and assessments of anadromous salmonids, 4) Marine artificial reef development and evaluation techniques, and 5) Techniques and methodologies associated with at-sea inventories and assessments of marine pelagic species.

Publications/Activities:

Member: Oregon Department of Fish and Wildlife Data Management Workgroup & the ODFW GIS Coordination Group

Cooney, C. X., J. K. Lloyd, J. K. Bowers, and M. J. Hogansen. 2003. 1:24K Fish Habitat Distribution Development Project Completion Report. Oregon Department of Fish and Wildlife, Salem.

Co-author: ODFW (Oregon Department of Fish and Wildlife). 2001. 1:24K Fish Habitat Distribution Development Project Procedures Manual, February 2002 updated draft. Oregon Department of Fish and Wildlife, Portland.

Brodeur, S. M., J. K. Bowers, and C. X. Cooney. 1999. Salmonid Distribution Update, Standardization and Validation Project (unpublished draft). Oregon Department of Fish and Wildlife Project Completion Report F-173-R-01. Draft. 13 pp. Portland.

Author of the *Oregon coastal salmon spawning surveys* summary reports from 1990 through 1995, which documents and summarizes Oregon coastal salmonid inventory results and analysis. Co-author of this same annual report in 1997.

Co-author of *Improvement of methods used to estimate the spawning escapement of Oregon Coastal Natural coho salmon* research progress report from 1990 through 1994. This progress report documented an experimental Stratified Random Sampling approach to survey site selection in order to more accurately inventory Oregon coastal natural coho spawning populations.

Nez Perce Resumes

Jay Hesse

Research Director
Nez Perce Tribe- Department of Fisheries Resources Management

Education:

M.S. in Fisheries, Michigan State University, 1994
B.S. in Fisheries and Wildlife, Michigan State University, 1992

Duties:

Technical direction and oversight of fisheries research projects conducted within the research division. Prepare papers/reports and develop science-based fisheries management recommendations for the Nez Perce Tribe. Provide coordination with and guidance to region on research, monitoring and evaluation issues and activities. Assist with development and implementation of large-scale monitoring and evaluation plans and proposals. Provide tribal fisheries research representation at federal and state meetings.

Professional Experience:

- Director of Biological Services. Nez Perce Tribe Department of Fisheries Resources Management. 2004 - present.
- Fisheries Research Coordinator. Nez Perce Tribe Department of Fisheries Resources Management. 1998 – 2003.
- Project Leader, Idaho Salmon Supplementation Study. Nez Perce Tribe Department of Fisheries Resources Management. 1994 - 1997.

Relevant Publications:

Everett, S.R., M.A. Tuell, and J.A. Hesse. 2003. Evaluation of potential means of rebuilding sturgeon populations in the Snake River between Lower Granite and Hells Canyon dams - 1997-2002 Summary. 2002 Annual Report. Report to BPA. Contract Number 00004046, Project 199700900. Portland, OR.

Hesse, J.A. and S.P. Cramer. 2000. Monitoring and evaluation plan for the Nez Perce Tribal Hatchery: Phase 1 Action Plan. Prepared for Bonneville Power Administration, Project 8335000. Nez Perce Tribe, Lapwai, Idaho.

Hesse, J.H., J.R. Harbeck and R.W. Carmichael. 2004. Monitoring and evaluation plan for northeast Oregon hatchery Imnaha and Grande Ronde subbasin spring Chinook salmon. Prepared for BPA, DOE/BP-3267. Bonneville Power Administration, Portland, Oregon.

Rocklage, S. and J.A. Hesse. 2004. Snake River Basin Fall Chinook Salmon Production Program Marking Justification. May 3, 2004 Draft white paper for US vs. OR Technical Advisory Committee Review. Nez Perce Tribe. Lapwai, Idaho.

Vogel, J.l., J.A. Hesse, and J.R. Harbeck. 2004. Johnson Creek Summer Chinook Salmon Monitoring and Evaluation Plan. Northwest Power and Conservation Council Step 2/3 document. Prepared for BPA, DOE/BP-16450. Bonneville Power Administration, Portland, Oregon.

Christopher A. Beasley

Fisheries Scientist – Quantitative Consultants, Inc.

Education and Training

North Carolina Institute of Statistical Genetics
M.S. Zoology, North Carolina State University
B.S. Systematics and Ecology, University of Kansas

Contact

Office Phone: (360) 297-4813 Mobile: (360) 620-2883 Email: chris@qcinc.org

My focus is the conservation and restoration of aquatic resources. I use applied conservation genetics, statistical modeling, and risk analysis to evaluate population status, weigh the risks and benefits of alternative management actions, and formulate adaptive experimental designs to evaluate the effectiveness of implemented management actions. I have substantial field sampling experience, thus I understand the logistical realities that limit the effectiveness of alternative sampling designs, and the impact of those limitations on the quality and biological interpretation of resulting data. Finally, I have contributed to a number of projects seeking to address questions at larger spatial and temporal scales through the accumulation and coalescence of existing disparate projects operating at smaller scales.

Selected Projects

National Oceanic and Atmospheric Administration Effectiveness and Status Monitoring Pilot Projects Design of an effectiveness monitoring project aimed at evaluating the effects of multiple habitat restoration actions in the Lemhi River subbasin (upper Salmon River, Idaho) on the productivity, survival, abundance, and distribution of anadromous and resident salmonids. Design of a habitat and stock status and trend monitoring program for steelhead and Chinook salmon in the South Fork Salmon River watershed (Salmon River subbasin, Idaho).

Collaborative System-wide Monitoring and Evaluation Project, WA, ID, OR; Columbia Basin Fish and Wildlife Foundation Served as the lead of the Hatchery subgroup, and participant in the Status and Trends and Habitat subgroups. Assisted in the accumulation of metadata for the South Fork Salmon River, Middle Fork Salmon River, Upper Salmon River and Selway River (Snake River subbasin) and evaluated the strengths and weaknesses of existing RM&E in those locations.

CRITFC Resumes

Phillip B. Roger

Manager, Fishery Science Department
Columbia River Inter-Tribal Fish Commission
(503) 731-1301

PAST ACCOMPLISHMENTS

Designed and created the "Bristol Bay Databas containingall available information on freshwater production of sockeye salmon in the Kvichak River system, Alaska.

Designed and implemented a in-season data acquisition and analysis system for fishery management.

Expert witness in the U.S. v. Washington and U.S. v Oregon treaty fishing rights cases.

Member, North Pacific Fishery Management Council Salmon Plan Development Team.

Technical advisor to the U.S. delegation, Pacific Salmon Treaty negotiations.

Member, Pacific Salmon Commission Chinook Technical Committee

Member of a four-man international team which developed the first coast-wide ocean harvest model for chinook salmon.

Developed the initial version of the System Planning Model used to analyze alternate management options for chinook salmon in the Columbia River basin.

Member, Northwest Power Planning Council Monitoring and Evaluation Group. team responsible for evaluating the effectiveness of the Northwest Power Planning Council's Fish and Wildlife Program.

Member, Northwest Power Planning Council Genetics Workshop Steering Committee.

Leader of a team designing and implementing an electronic fishery library for the Columbia Basin.

Member, Yakima/Klickitat Production Project Experimental Design Work Group. Responsible for the experimental design and evaluation of a research hatchery with a projected annual production of approximately 11 million salmon smolts.

Ex-officio member, Independent Scientific Advisory Board. A jointly managed technical advisory body to NWPCC, NOAA Fisheries, and Columbia Basin tribes.

Chair, Technical Outreach and Assistance Team (TOAST), an interagency technical support team for subbasin planning in Oregon.

EDUCATION

B.S. Fisheries, University of Washington, Seattle Washington
M.S. Fisheries, 1971, University of Washington, Seattle Washington

Earl C. Weber

Occupation: Fisheries Scientist

Employment Experience:

1987 to present:

I am currently a Fisheries Scientist with the Columbia River Inter-Tribal Fish Commission. During my tenure I have been involved with inter-agency analytical assessments of management actions aimed at restoring salmonid stocks within the Columbia basin. My responsibilities have focused on the development and use of analytical methodologies for simulating the population dynamics of Pacific salmon. My work has involved all aspects of the life cycle of different salmonids but I have particular expertise in the effects of hydropower projects on the survival of salmon.

1977 to 1987

During this period I was a Fisheries Scientist with the National Marine Fisheries Service in La Jolla, California. There I studied the population dynamics of tunas and billfishes worldwide. My principal duties consisted if stock assessments of commercial stocks using established fisheries procedures and the development and operation of simulation models. Other duties included biological research on tunas and billfishes.

Educational Background:

M.S. 1977, Fishery Biology, The Ohio State University.

My educational focus was on advance coursework in analytical techniques and aquatic sciences. My Thesis work involved a cooperative study of the effects of stream channelization on fish populations and recreational fishing. Research was conducted through the Ohio Cooperative Fisheries Research Unit.

B.S. 1975, Fishery Management, The Ohio State University

My education focus was on fisheries biology and other aquatic sciences, and statistics. During this period I was a Research Assistant with the Ohio Cooperative Fisheries Research Unit where I was involved with a project that investigated the effects of reservoir impoundment on fish populations.

Publications

I have been the author or coauthor of numerous papers related to fisheries management and biology.

Jeffrey K. Fryer, Ph.D.

Columbia River Inter-Tribal Fish Commission
729 NE Oregon Street
Portland, Oregon 97232
(503) 731-1266
fryj@critfc.org

Education

1995 University of Washington Ph.D. (Fisheries). Dissertation title: Columbia Basin sockeye salmon-causes of their past decline, factors contributing to their present low abundance, and the future outlook.

1985 University of New Brunswick at Fredericton, New Brunswick, Canada. M.Sc. (Computer Science) University of New Brunswick at Fredericton. B.Sc.(Computer Science) with the equivalent of an honors in Statistics and a minor in Economics

Appointments

October 1989 to present: Fisheries scientist and project leader at the Columbia River Inter-Tribal Fish Commission. Duties have included the supervision of sockeye and chinook salmon stock identification projects. The stock identification project has required designing and implementing stock identification experiments, field sampling, reading scales for age, measuring scale circuli, creating computer programs, spreadsheets, and databases to manage and analyze data, making presentations at technical and professional meetings, and publishing technical reports and journal articles.

June 1987 to September 1989: Graduate research assistant at University of Washington.

September 1985 to June 1987: Teaching assistant at the University of Washington.

Selected Publications

Fryer, J.K. 1998. Frequency of pinniped-caused scars and wounds on adult spring-summer chinook and sockeye salmon returning to the Columbia River. North American Journal of Fisheries Management. 18: 46-51.

Fryer, J.K.. 2005. Identification of Columbia Basin sockeye salmon stocks in 2004. Columbia River Inter-Tribal Fish Commission Technical Report 05-2. Portland.

Hatch, D.R., J.K. Fryer, M. Schwartzberg, D.R. Pederson, and A. Wand. 1998. A computerized editing system for video monitoring of fish passage. North American Jounal of Fisheries Management. 18: 694-199.

Miranda, D; J. Whiteaker, and J.K. Fryer. 2005. Age and length composition of Columbia Basin chinook, sockeye, and coho salmon at Bonneville Dam in 2004. Columbia River Inter-Tribal Fish Commission Technical Report. Portland.

Schwartzberg, M. and J.K. Fryer. 1993. Identification of hatchery and naturally spawning Columbia Basin spring chinook salmon using scale pattern analyses. North American Journal of Fish Management. 13: 263-261.

Saang-Yoon Hyun

Columbia River Inter-Tribal Fish Commission (CRITFC)
Quantitative Fisheries Scientist
Phone number: (503) 731-1265 (office); (503) 626-2852 (home)
Email address: syhyun@alumni.washington.edu

Dr. Hyun is particularly skilled at evaluating the statistical properties of experimental and sampling methods. He is currently examining methods to improve preseason run estimators and estimate extinction risks posed by environmental and habitat conditions. This experience will serve the CSMEP project well in designing monitoring schemes to address CSMEP objectives 5.3a, 5.3c, and 5.3e. We will work with other team members to identify the best allocation of his time among these objectives.

Education

- Post-doc research (Fall 2002 - Winter 2003) In-season forecasts of sockeye salmon returns to the Bristol Bay districts of Alaska. Ph.D. dissertation, University of Washington, Seattle, Wash.
- Ph.D. (Fall quarter 1997 - Spring quarter 2002) in Quantitative Ecology and Resource Management (QERM) at the University of Washington (Seattle, WA). Advisors: Profs. Ray Hilborn, and James J. Anderson.
- M.S. (Fall quarter 1993 - Fall quarter 1996) in Fisheries at the University of Washington (Seattle, WA). Advisor: Prof. James J. Anderson.

Research fields of interest

Quantitative fisheries management, population dynamics, stock assessment, and biostatitics

Work experience

Jan 30, 2003 - present: Quantitative Fisheries Scientist at CRITFC.
Fall 2002 - Jan 29, 2003: Research associate (Post-doc) at the UW.

Refereed Publications

Hyun, S., and K.W. Myers. *In revision*. Year-to-year variability in productivity of the Columbia River Hanford Reach fall chinook salmon (*Oncorhynchus tshawytscha*). Fisheries Oceanography.

Hyun, S., R. Hilborn, J.J. Anderson, and B. Ernst. 2005. A statistical model for in-season forecasts of sockeye salmon (*Oncorhynchus nerka*) returns to the Bristol Bay districts of Alaska. Can. J. Fish. Aquat. Sci. 62: 1665-1680.

Hyun, S. 2002. Inseason forecast of sockeye salmon return timing to Bristol Bay, Alaska. J. Korean Soc. Fish. Res. 5: 41-51.

Norris, J.G., **S. Hyun**, and J.J. Anderson. 2000. Ocean distribution of Columbia River Upriver Bright Fall Chinook salmon stock. N. Pac. Anadr. Fish Comm. Bull. 2: 221-232.

Yakama Resumes

David E. Fast

Fisheries Resource Management
P.O. Box 151
Toppenish, Washington 98948
Work: 509-966-5291

Education

University of Washington, Seattle, Washington, Doctor of Philosophy in Fisheries Science, 1987.
University of Puerto Rico, Mayaguez, Puerto Rico, Master of Science in Marine Sciences, 1974.
St. John's University, Collegeville, Minnesota, Bachelor of Science in Zoology, 1969.

Research Experience

1988-Present: Research Manager. Fisheries Resource Management Program, Yakima Indian Nation.
Responsible for the design, development, and implementation of a major supplementation and research facility to test the concept of using artificial production to rebuild natural spawning populations of spring chinook salmon in the Yakima Basin. Write detailed project plans, develop short and long-term project goals and objectives, and supervise professional and technical staff.

1985-1988: Project Leader. Spring Chinook Enhancement Study.
Responsible for research project designed to determine the best methods of enhancing the spring chinook salmon population in the Yakima Basin. Evaluate survival through various life stages and total production of naturally producing salmon. Determine methods of supplementation with hatchery reared fish while minimizing adverse genetic impacts.

Fast, D.E. 1987. The Behavior of salmonid alevins in response to light, velocity and dissolved oxygen during incubation.

Pages 84-92 in Salmonid Migration and Distribution Symposium (E.L. Brannon, ed.), School of Fisheries, University of Washington, and Directorate for Nature Management, Norway, Trondheim, Norway.

Fast, D.E., J.D. Hubble, T.B. Scribner, M.V. Johnston, W.R. Sharp. 1989. Yakima/Klickitat Natural Production and Enhancement Program. 1989 Annual Report to Bonneville Power Administration. Project 88-120. 107 pp.

Fast, D.E. 1989. Supplementation Strategies For The Yakima/Klickitat Production Facility. Pages 143-147 in Northwest Fish Culture Conference Proceedings (R.Z. Smith, ed.).

Fast, D.E., J.D. Hubble, M.S.Kohn, and B.D.Watson. 1991. Yakima River Spring Chinook Enhancement Study. Project Completion Report to Bonneville Power Administration. Project 82-16. Volume 1 - 345 pp. and Volume 2 (Appendices) 133 pp.

William J. Bosch

Fisheries Resource Management
P.O. Box 151
Toppenish, Washington 98948
Work: 509-965-6270

Education History

International Honors Program, "Global Ecology: Integrating Nature and Society", 1990-91
Nine month program of travel abroad studying ecological issues offered through Bard College and the International Honors Program in Boston, MA
University of Washington, M.S. Computer Science, 1982
Gonzaga University, B.S. Mathematics, 1980

Employment History

Yakama Nation, 1991-Present, Fisheries Data Manager, Technical Analyst, and Policy Advisor
Hewlett-Packard, 1982-90, Systems Engineer/Performance Specialist
Gonzaga University, 1980-81, Systems Analyst/Programmer

Publications and Major Accomplishments

Bosch, W. J., T. H. Newsome, J. L. Dunnigan, J. D. Hubble, D. Neeley, D. T. Lind, D. E. Fast, L. L. Lamebull, and J. W. Blodgett. Evaluating the Feasibility of Reestablishing a Coho Salmon Population in the Yakima River, Washington. Submitted to American Fisheries Society, North American Journal of Fisheries Management, November 29, 2005. In final stages of peer review with expected publication early in 2006.

Dunnigan, J. L., W. J. Bosch, and J. D. Hubble. 2002. Preliminary results of an effort to re-introduce coho salmon in the Yakima River, Washington. In “Hatchery Reform: the Science and the Practice”, Proceedings of the International Congress on the Biology of Fish, July, 2002, Don MacKinlay, editor, 555 West Hastings St., Vancouver BC V6B 5G3 Canada.

U.S. versus Oregon Technical Advisory Committee, various articles including:

An analysis of three technical issues relating to the management of Snake River fall chinook, August, 1997

Columbia River Fish Management Plan, All Species Review 1996, August 1997

Performance News Notes, Hewlett-Packard technical journal, various articles, 1986 - 1990.

Chair, *U.S. versus Oregon* Technical Advisory Committee, 1996 – 1999

Colville Resumes

Keith Wolf

Principal Scientist, KWA Ecological Sciences, Inc.
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Education

- Whatcom Community College, Bellingham, WA. 1988-1989
- Western Washington University, Bellingham WA., Fisheries Science. 1989-1990
- Pacific Lutheran University, Tacoma, WA. *BS, Marine Biology*, 1990-1991
- Columbia Pacific University, San Rafael, California *36 Masters Degree credits;* Marine Biology/Animal Behavior, Columbia. 1997-1998
- Kennedy-Western University, Agoura Hills CA., *Ph.D-Candidate*, Environmental Engineering 2005-present

Professional Experience

KWA Ecological Sciences, Inc. 2002 to present
Duvall, Washington
Principal Scientist
Mr. Wolf is the owner and Principal of KWA, a private consulting firm specializing in salmon and steelhead population and habitat monitoring, salmon and steelhead recovery planning, ecosystem assessment, fish and wildlife management and statistical design. Clients include state, federal and local governments, tribes and private industry. KWA is also currently involved with independent research and compilation of existing information and professional knowledge regarding physical habitat conditions as it relates to ecosystem function and salmonid populations. KWA's professional staff has multidisciplinary backgrounds in fish ecology and biology, project management, facilitation and planning. Our services include ecosystem assessment, modeling, statistical analysis, environmental policy and regulatory compliance and both large and small scale monitoring and evaluation programs. We have a wide range of project experience in areas of hydrology, physical and biological indictors, performance standards and regulatory response planning.

Umatilla Resumes

Jesse David Merton Schwartz, PhD

Education
PhD Biology. Boston University, 2002
MS Environmental Biology. Antioch University, 1998
BA Environmental Biology. State University of New York at New Paltz, 1996

Technical Experience

2004-Present	Senior Biologist, Confederated Tribes of the Umatilla Indian Reservation
2002-2004	Field ecologist and postdoctoral faculty, Boston University, Boston, MA.
2001-2002	Ichthyoplankton taxonomist, Marine Research Inc., Falmouth, MA.
1999	Field Biologist, Lake Victoria Environmental Management Program, Lake Victoria, East Africa and Boston, MA.
1998-2002	Assistant to the Taxonomist, Harvard Museum of Comp. Zoology, Ichthyology Dep. Cambridge, MA.
1998	Field Biologist & Field Coordinator, The USFWS. Concord, NH.
1997-1998	Field Biologist, The Loon Preservation Committee. Moultonborough, NH.
1996-1997	Aquatic Toxicologist, EnviroSystems Inc. Hampton Falls, NH.

Selected Reviewed and Technical Publications

Schwartz, J.D.M., Kissner, P., Lambert, M., Mahoney, B., and Contor, C. 2005. Walla Walla Basin Natural Production Monitoring and Evaluation Project Progress Report, 2003. Confederated Tribes of the Umatilla Indian Reservation, report submitted to Bonneville Power Administration, Project No. 2000-039-00.

Mahoney, B., Contor, B., Bailey, T., Schwartz, J.D.M. (in prep) Capture, tag retention, and disposition, of adult bull trout and steelhead in the Walla Walla Subbasin.

Kaufman, L.S. Moran, B. and Schwartz, J.D.M. (2005) Culture induced abnormalities in Tautog, Tautoga onitis. North American Journal of Aquaculture.

Schwartz, J.D.M, Ogutu-Ohwayo, R., and Kaufman, L.S. (in press) Effects of Nile perch, Lates niloticus, on fish species composition & functional diversity in Uganda's Lake Kyoga Satellite System. African Journal of Ecology

Kaufman L.S. and Schwartz, J.D.M. (2002) A dynamic modeling approach for Nile perch, Lates niloticus, in Lake Victoria; Implications for conservation and management. Pp257-313 In: M. Ruth and J. Lindholm (Eds.) Dynamic Modeling for Marine Conservation, Springer-Verlag, NY. 480 p

DFO Resumes

Dr. Kim Hyatt

Dr. Hyatt is a research scientist who heads the Salmon in Regional Ecosystems Program within the Science Branch of Fisheries and Oceans Canada's Pacific region. His research and publications have addressed a broad range of topics dealing with salmon stock assessment issues (e.g. stock status reviews) and studies of factors controlling salmon production variations in freshwater and marine ecosystems. Kim is a member of the Salmon Subcommittee of Canada's Pacific Science Advisory Review Committee (PSARC), the Pacific Salmon Commission's Northern Transboundary Technical Committee and serves as the Fisheries Sector advisor to the Canadian Climate Impact and Adaptation Research Network (C-CIARN). He also serves on the American Fisheries Society's (AFS) Natural Resource Policy Committee. Dr. Hyatt has taught at Okanagan University College and currently holds Adjunct Professor appointments at the University of New Brunswick and in the Institute for Resources, Environment and Sustainability (IRES) at the University of British Columbia.

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Current Research:

- Assessments of the status of anadromous salmon stocks in the Pacific region (e.g. Slaney et al 1996).
- Investigations of mechanisms that control annual production variations of salmon populations in freshwater and marine ecosystems around the Pacific Rim (e.g. Hyatt et al 2005).
- Development of science-based models and decision support systems to improve the conservation and management of salmon populations within an ecosystem context (e.g. Alexander et al. 2005).
- Study of linkages among climate variation and change (CVC) events, life history responses of vulnerable salmon populations and identification of adaptation options for fisheries management. Dr Hyatt has developed: (i.) new predictive models of linkages between the Pacific Interdecadal Oscillation (PDO), aquatic temperature variations, and freshwater migration delays exhibited by Okanagan sockeye salmon (Hyatt et al. 2003) and (ii.) annual forecasts of Barkley Sound salmon returns which are influenced greatly by climate induced biological production variations.
- The current Okanagan Fish and Water Management Tools (FWMT) project (Alexander et al. 2005) involves development of coupled biophysical models and associated decision software to improve complex fisheries management and water resource management decisions in rivers under average to extreme climate events (e.g. floods and droughts).

Selected References:

Hyatt, K. D., K. L. Mathias, D. J. McQueen, B. Mercer, P. Milligan and D. P. Rankin. 2005. Evaluation of hatchery versus wild sockeye salmon fry growth and survival in two British Columbia lakes. North American Journal of Fisheries Management 25: 745-762.

Hyatt, K. D., M. M. Stockwell and D. P. Rankin. 2003. Impact and adaptation responses of Okanagan River sockeye salmon (*Oncorhynchus nerka*) to climate variation and change effects during freshwater migration: Stock restoration and fisheries management implications. Canadian Water Resources Journal 28: 1-26.

Hyatt, K. D. and D. P. Rankin. 1999. A habitat based evaluation of Okanagan sockeye salmon escapement objectives. Canadian Science Advisory Secretariat Research Document 1999/191. Available at: www.dfo-mpo.gc.ca/csas/

Alexander, C. A. D., B. Symonds and **K. D. Hyatt**. 2005. The Okanagan Fish/Water Management Tool (v1.0.001): Guidelines for Apprentice Water Managers. Prepared for the Canadian Okanagan Basin Technical Working Group (COBTWG), Kamloops, BC. 114 pp.

Independent Experts

David R. Marmorek

Post-Secondary Education

M.Sc. Zoology, University of British Columbia, 1983. Thesis topic: Effects of lake acidification on zooplankton community structure and phytoplankton-zooplankton interactions: an experimental approach. 397 pp.

B.E.S. (Honors), Man-Environment Studies and Mathematics, First class honors, University of Waterloo, 1975. Focus on application of simulation models to environmental problems.

Professional Experience

1981 – now	Systems Ecologist (1981), Director (1983) and President (2002), ESSA Technologies
1991 - now	**Adjunct Professor,** School of Resource and Environment Management, Simon Fraser University.
1975 - 1978	**Applied Ecologist/Urban Planner,** Proctor and Redfern Ltd.

Relevant Experience and Publications

- 2002-2005: led the development of modeling, monitoring and evaluation programs in the Columbia Basin (innovative project 2003-04; CSMEP 2003-2006; Okanagan Basin 2002-now) and the Trinity River Basin (2004-2005)
- 1998-2000: developed experimental designs for adaptive management experiments to understand how flow affects whitefish in the Canadian Columbia River, and fall chinook in Clear Creek, California
- 1995-2000: coordinated an interagency group of fisheries scientists and peer reviewers in decision analyses of endangered Columbia River salmon (PATH: Plan for Analyzing and Testing Hypotheses)
- 1982-1995: developed experimental designs and models for a series of major projects in Canada and the United States concerned with watershed restoration and monitoring related to acidic deposition
- 1993-1995: guided research, monitoring and modelling activities to restore salmonid populations in Kennedy Lake, BC, working with natives, fish agencies, logging companies, and community groups
- 1991-1993: developed experimental designs for the Fraser River Basin Assessment Program, and the EPA's Environmental Monitoring and Assessment Program

Peters, C.N. and Marmorek, D.R. 2001. Application of decision analysis to evaluate recovery actions for threatened Snake River spring and summer chinook salmon (*Oncorhynchus tshawytscha*). Can. J. Fish. Aquat. Sci. 58(12):2431-2446. http://www.nrc.ca/cgi-bin/cisti/journals/rp/rp2_tocs_e?cjfas_cjfas12-01_58

Peters, C.N., Marmorek, D.R., and Deriso, R.B. 2001. Application of decision analysis to evaluate recovery actions for threatened Snake River fall chinook salmon (*Oncorhynchus tshawytscha*). Can. J. Fish. Aquat. Sci. 58(12):2447-2458.http://www.nrc.ca/cgi-bin/cisti/journals/rp/rp2_tocs_e?cjfas_cjfas12-01_58

Marmorek, David R. and Calvin Peters. 2001. Finding a PATH towards scientific collaboration: insights from the Columbia River Basin. Conservation Ecology 5(2): 8. [online] URL: <http://www.consecol.org/vol5/iss2/art8>

Marmorek, D.R., G. Lacroix, J. Korman, I. Parnell, and W.D. Watt. 1998. Modelling the effects of acidification on Atlantic salmon: a simple model of stream chemistry. Can. J. Fish. Aquat. Sci. 55(9): 2117-2126.

Korman, J., D.R. Marmorek, G. Lacroix, P.G. Amiro, J.A. Ritter, W.D. Watt, R.E. Cutting, D.C.E. Robinson. 1994. Development and evaluation of a biological model to assess regional scale effects of acidification on Atlantic salmon. Can. J. Fish. Aquat. Sci. 51:662-680.

Marmorek, D.R. and J. Korman. 1993. The use of zooplankton in a biomonitoring program to detect lake acidification and recovery. Water, Air, and Soil Pollution 69: 223-241.

Qualifications Summary

David Marmorek will continue to act as lead Technical Facilitator for this project. As the President of ESSA Technologies Ltd., David has over twenty-five years of experience in environmental consulting, including technical facilitation, simulation models, ecological risk assessments and environmental monitoring plans for a wide variety of resource management problems, spanning local watershed to continental spatial scales. Recent relevant projects include a project on Clear Creek (Redding, California) to rigorously assess the benefits and costs of adaptive management experiments to generate variations in flow, as part of a watershed restoration project, and a similar project on the Canadian Columbia River (downstream of the Keenleyside Dam). He played a key role in the development of experimental designs for the Fraser Basin Assessment Program, the EPA's Environmental Monitoring and Assessment Program, and the National Acid Precipitation Assessment Program. From 1995 to 2000, he led an inter-agency team of 25 modelers, managers and policy makers, assessing risks to endangered chinook salmon stocks in the U.S. Columbia River and alternative rebuilding strategies, known as the PATH process (Plan for Analyzing and Testing Hypotheses). Mr. Marmorek has an Honours Degree in Environmental Studies and Mathematics from the University of Waterloo, and an M.Sc. in Zoology from the University of British Columbia. He is the author of over 25 peer-reviewed publications, and over 100 technical reports. He serves as an Adjunct Professor at Simon Fraser University. In 1985, Mr. Marmorek was awarded the prestigious Bronze Medal by the U.S. Environmental Protection Agency.

Marc S. Porter

Mr. Porter is a Systems Ecologist at ESSA Technologies Inc. with extensive experience in fisheries and wildlife inventory and research. Additionally, he is proficient with GIS and is highly skilled at integrating biological information with spatial datasets. He will assist in facilitation of CSMEP subgroups and provide analytical support.

Post-Secondary Education

- **MSc. Zoology. University of Guelph**, 1990–1993
- **BSc., Wildlife Biology.** University of Guelph, 1982–1986

Professional Experience

2003 - present	**Systems Ecologist**, ESSA Technologies Ltd., Vancouver, BC.
2001 - 2003	**Habitat Inventory Biologist/GIS Analyst,** DFO Pacific Region, Habitat Enhancement Branch, Vancouver, BC
1997 – 2001	**Research Biologist**, BC Fisheries Research Branch, Ministry of Environment, Lands and Parks, Vancouver, BC

Selected Publications and Reports

Marmorek D.R., I. Parnell and M. Porter, eds. 2005. Conceptual models and hypotheses for the Trinity River Restoration Program. Draft report prepared for the Trinity River Restoration Program, CA.

Parnell, I.J., D.R. Marmorek and M. Porter. 2004. Collaborative Systemwide Monitoring and Evaluation Project, Definition and Evaluation of Design Templates. Prepared for Columbia Basin Fish and Wildlife Authority, Portland, OR. Prepared by ESSA Technologies Ltd., BC, Canada.

Marmorek, D.R., M. Porter, I.J. Parnell and C. Peters, eds. 2004. Comparative Survival Study Workshop, February 11–13, 2004. Report compiled and edited by ESSA Technologies Ltd., Vancouver, B.C. for Fish Passage Center, Portland, OR and the US Fish and Wildlife Service, Vancouver, WA. 137 pp.

Marmorek, D.R. and M. Porter. 2004. Bull Trout Recovery Monitoring and Evaluation Technical Working Group (RMEG) Workshop 1 (March 10-11, 2004) - USFWS Regional Office, Portland, OR - Workshop Report. DRAFT report prepared by ESSA Technologies Ltd., Vancouver, BC for the US Fish and Wildlife Service, Vancouver, WA. 52 pp.

Marmorek, D.R., I.J. Parnell, M. Porter, C. Pinkham, C.A.D. Alexander, C.N. Peters, J. Hubble, C.M. Paulsen and T.R. Fisher. 2004. A Multiple Watershed Approach to Assessing the Effects of Habitat Restoration Actions on Anadromous and Resident Fish Populations. Prepared by ESSA Technologies Ltd., Vancouver, B.C. for Bonneville Power Administration, Portland, OR. 420 pp.

Porter, M. 2004. Delineation of fish species ranges based on the BC Watershed Atlas. Prepared by ESSA Technologies Ltd., Vancouver, B.C. for BC Ministry of Sustainable Resource Management.

Porter, M. 2003. Introduction to Geographic Information Systems (GIS): An Instructional Manual for DFO Personnel. Internal DFO training manual. 87 p.

Haas, G. and M.Porter. 2001. Bull trout – identifying strategies for conserving a species at risk. Fisheries Project Report No. 88. BC Fisheries.

Porter, M., G. Haas and E. Parkinson. 2000. Sensitivity of British Columbia's freshwater fish to timber harvest: using species traits as predictors of species risk. Fisheries Management Report No. 114.

Rosenfeld, J. M. Porter. E.A. Parkinson. 2000. Habitat factors affecting the abundance and distribution of juvenile cutthroat trout and coho salmon. Canadian Journal of Fisheries and Aquatic Sciences 57: 766-774.

Porter, M., J. Rosenfeld, and E.A. Parkinson. 2000. Predictive models of fish distribution in the Blackwater drainage, British Columbia. North American Journal of Fisheries Management 20: 349-359.

Darcy C. Pickard

Ms. Pickard is a Systems Ecologist at ESSA Technologies Inc. with extensive experience in statistical analyses, both theoretical and applied. She will assist in facilitation of CSMEP subgroups and provide analytical support.

Post-Secondary Education

- Master of Science (Statistics), Simon Fraser University, 2004–current
- Bachelor of Science (Major in Statistics, Minor in Ecology), Simon Fraser University, 2002

Professional Skills

- Area of interest: Application of statistical methods to environmental problems.
- Technical skills: Statistical analysis (classical and Bayesian statistics, parametric and nonparametric), design and analysis of experiments, sampling design and analysis, survival analysis, time series analysis, multivariate analysis, statistical process control, computer modelling (deterministic and stochastic simulations) and fish stock assessment methods.
- Research and communication: Comprehensive literature reviews and summaries, technical writing, and presentations of scientific information to technical and non-technical audiences.

Software Skills

- Statistical analysis using JMP, SAS, Splus, Minitab and R
- Simulation modeling using Splus, R and Minitab.
- Design and development of relational databases using Access

Professional Experience

2005-current **Project work**, ESSA Technologies Ltd., Vancouver, B.C.
- Assisting ESSA's Fisheries and Aquatic Sciences Team with statistical analysis, simulation modelling and literature review for various projects.

2005 **Statistical Consultant**, Statistical Consulting Service, Simon Fraser University, B.C.
- Participated in client meetings, analyzing data sets and producing summary reports under the supervision of the director of the consulting service.

Selected Project Descriptions:

Review of Hudson River Monitoring Data and estimating trends in abundance for six species – *2005*: Assessed the statistical methods cited to analyze the data. Collaborated with ESSA personnel to write SAS code to extract the data and estimate the abundance and trends for the six fish species. Developed list of questions / recommendations / exploratory analyses that address the sampling design and data and wrote a report to discuss their possible consequences for inferences about trend.

Collaborative, System-wide, Monitoring and Evaluation Project (CSMEP), review of bias and variance inherent in different methods of estimating fish abundance-*2004*: Completed a detailed literature review of methods used to estimate fish abundance. Primarily focussed on papers that specifically compared two or more methods. Collated this information into a simple table to be used as a reference by the CSMEP workgroups.

Collaborative, System-wide, Monitoring and Evaluation Project (CSMEP), simulation modelling to determine the most effective sampling design strategy-*CSMEP Status and trends sub-group*, *2005*: Developing a simulation model in R, that allows for the assessment of different monitoring designs. The designs are assessed by their ability to correctly determine the status of Snake River Spring/Summer Chinook Salmon at the sub-basin level. The model incorporates decision criteria developed by NOAA's National Marine Fisheries Service Technical Recovery Team (TRT) and allows for different sampling protocols within each of the populations in the sub-basin.

Lyman L. McDonald, Ph.D

Western EcoSystems Technology, Inc.
President & Senior Biometrician
PRINCIPAL

Dr. McDonald will serve as a Senior Biometrician to the project with responsibility for recommendations on sampling issues and statistical analyses. It is expected that Dr. McDonald will particularly focus on issues relating to evaluating the effectiveness of habitat restoration actions and the development of integrated tag monitoring designs.

Education

Ph.D.	Colorado State University	1970	*Statistics*
M.S.	Oklahoma State University	1964	*Mathematics*
B.S.	Oklahoma State University	1963	*Mathematics*

Selected previous and current positions

1991-Present, *Adjunct Faculty*, Department of Statistics, University of Wyoming.
2002-Present *Faculty Affiliate*, Department of Statistics, Colorado State University.
1973-1991, *Associate Professor and Professor of Statistics and Zoology*, Departments of Statistics and Zoology, University of Wyoming. Statistics Department Chairman 1981-1985.

Qualifications and experience summary

Professional Summary: Nationally known biometrician/statistician with 35 years of experience in the application of statistical methods to design, conduct, and analyze field and laboratory studies. Experience conceiving practical, common sense solutions to environmental sampling-monitoring problems that are consistent with feasible field and laboratory methods and giving rise to defensible statistical inferences.
Research: Author of more than 75 papers in scientific literature and joint author of the book entitled Resource Selection by Animals: Statistical Design and Analysis for Field Studies.

Honors

1998 Fellow of the American Statistical Association for the development and application of statistical methods in fish and wildlife biology and ecology.
1999 Twentieth Century Distinguished Service Award, Ninth Lukacs Symposium for Outstanding contribution to the development and direction of cross-disciplinary combination of practicality and scholarship for statistics, ecology, environment, and society in the form of Environmental Statistics.

Selected experience

Program Advisory Panel (PAP). Dr. McDonald was Chair of the Program Advisory Panel for the Middle Rio Grande Endangered Species Act Collaborative Program. The Panel review the scientific information available in the fall of 2004 concerning the population of Rio Grande Silvery Minnow in the Middle Rio Grande.

Independent Scientific Advisory Board. Dr. McDonald was a member of the Independent Scientific Advisory Board for the Northwest Power and Conservation Council, Portland, Oregon, and NOAA Fisheries, Seattle, Washington from 1996 to 2005. The Board is responsible to review the scientific information supporting management actions for recovery of anadromous species in the Columbia River Basin.

Independent Scientific Review Panel. Dr. McDonald was a member of the Independent Scientific Review Panel for the Northwest Power and Conservation Council, Portland, Oregon from 1997 to 2005. Duties of the Panel included review and recommendation on funding for proposals to the Council's Fish and Wildlife Program in the Columbia River Basin.

Charles M. Paulsen

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Lake Oswego, Oregon 97035
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cpaulsen@spiritone.com

Mr. Paulsen is a modeler in the field of fisheries population dynamics and statistical analysis. He has over 15 years' experience in Columbia Basin fisheries modeling. He has participated in ESA salmon modeling processes with representatives of many government agencies. He has performed many statistical analyses and modeling exercises, including fisheries life-cycle and passage models and advanced statistical analysis techniques. Mr. Paulsen received a Master of Environmental Management from Duke University in 1979 and a B.A. in Political Science from the University of Kentucky in 1974.
For the proposed CSMEP work, he will be applying statistical methods to PIT tag and spawner-recruit data.

Relevant Publications:

Paulsen, C.M. and Fisher, T.R. 2005. Do actions affect juvenile survival? An information-theoretic approach applied to endangered Snake River Chinook salmon (*Oncorhynchus tshawytscha*). TAFS 134:68-85

Paulsen, C.M. and Fisher, T.R. 2003. Detecting juvenile survival effects of habitat actions: power analysis applied to endangered Snake River spring/summer chinook (*Oncorhynchus tshawytscha*). Can. J. Fish. Aquat. Sci. 60: 1122-1132

Paulsen, C. M. and R. A. Hinrichsen, 2002. Experimental management for Snake River spring/summer chinook (*Oncorhynchus tshawytscha*): trade-offs between conservation and learning for a threatened species. Can. J. Fish. Aquat. Sci. 59: 717-725

Paulsen, C. M. and T. Fisher, 2001. "Statistical Testing and Validation of the Relationship Between Snake River Spring/Summer Chinook Salmon Parr-to-smolt Survival and Indices of Rearing Habitat Quality" TAFS. 130: 347-358.

Botsford, L. and C. Paulsen, 2000. "Covariability in Abundance among Index Stocks of Columbia River Spring/Summer Chinook Salmon," Can. J. Fish. Aquat. Sci, v. 57 616-627

Nicolaas Wilhelmus Bouwes Jr.

Eco Logical Research, Inc.

Nick Bouwes would provide technical support for evaluations and data analyses, and provide guidance on the development of monitoring programs. Nick has a strong foundation in biometric and data analyses, modeling, experimental and monitoring design, fisheries research and aquatic ecology and has detailed knowledge of the salmon, steelhead, and bulltrout issues in the Columbia River Basin. Nick is the owner of Eco Logical Research, Inc. He is also an adjunct professor at the Department of Fisheries and Wildlife, Utah State University, Logan UT. Projects he currently consults on include: CSMEP participant; Integrated Status and Effectiveness Monitoring John Day Pilot Project coordinator; and technical review and validation of models used in the FERC relicensing process of the Klamath River hydrosystem. Nick was previously employed first as a fish population analyst and then as a biometrician/modeler for ODFW on regional issues related to the salmon and steelhead management in Columbia River Basin. His project involvement included PATH, which was multi-agency evaluation of the impacts of alternative management actions on survival and recovery of listed salmon and steelhead stocks in the Columbia River Basin. He also worked on the NMFS TRT to determine recovery goals and assessing risk to endangered salmonids of Lower Columbia/Willamette. Mr. Bouwes received a BS in zoology from the University of WI, Madison, and a MS and PhD in aquatic ecology from Utah State University, Logan UT.

Relevant publications

Kershner, J.L, B.B. Roper, N. Bouwes, R. Henderson, and E. Archer. 2004. An analysis of stream habitat conditions in reference and managed watersheds on some federal lands within the Columbia basin. *North American Journal of Fisheries Management* 24:1363-1375.

Roper, B.B., J.L. Kershner, E. Archer, R. Henderson, and N. Bouwes. 2002. An evaluation of physical stream habitat attributes used to monitor streams. *Journal of the American Water Resources Association* 38(6):1637-1646.

Budy, P., G. P. Thiede, N. Bouwes, C. Petrosky, H. Schaller. 2002. Evidence linking delayed mortality of Snake River salmon to their earlier hydrosystem experience. *North American Journal of Fish Management.* 22:35-51

Robert Al-Chokhachy

Eco Logical Research, Inc.

Robert Al-Chokhachy would provide technical support for evaluations and data analyses, and provide guidance on the development of monitoring programs. Robert is experienced in data analyses, modeling, mark-recapture techniques, monitoring design, and has a detailed understanding of bulltrout issues in the Columbia River Basin. Robert recently joined Eco Logical Research, Inc. to provide expertise in the development and analyses of monitoring programs. He has also started a post-doc with USFWS and USGS/USU Cooperative to evaluate the interactions between bull trout and anadromous salmonids. Robert recently finished his Ph.D. in aquatic ecology at Utah State University. His dissertation research included the demography and ecology of bull trout in northeastern Oregon. He used mark/recapture techniques using the latest PIT-tag technology to examine survival at different life stages and life-history forms, and examined how habitat modeling can be used in the evaluation of recovery efforts for bull trout. Robert earned a B.A. in Economics at Bates College in 1992. and a B.S. in Biology at University of Utah in 2003.

Relevant Publications

Al-Chokhachy, R., Budy, P. and H. Schaller. 2005. A comparison of redd counts and mark/resight methods for estimating abundance and monitoring bull trout population trends. North American Journal of Fisheries Management, 25:1505-1512.

Al-Chokhachy, R., and P. Budy. In review. An assessment of the transferability of bull trout microhabitat relationships across three streams in eastern Oregon. North American Journal of Fisheries Management. Submitted April, 2005.

Al-Chokhachy, R., P. Budy, and M. Conner. In review. Detecting changes in bull trout population abundance: understanding the accuracy, precision, and costs of our efforts. Conservation Biology. Submitted October 2005.

Appendix 1: Summary of CSMEP Questions[6]

(used to guide both assessments of the strengths and weaknesses of existing data and the development of robust monitoring designs)

Tier 1. Broadscale Fish Distribution and Ecosystem Status

- What is the distribution of adult salmonid fishes across broad regions?
- What is the ecosystem status for Columbia River Basin (CRB) fish populations?

Tier 2. Fish Population and Habitat Status and Trends

- What is the size, annualized growth rate, freshwater productivity, age-structure of CRB fish populations?
- How frequently do resident fish spawn, and what life history types make up different populations?
- What is the fraction of potential natural spawners that are of hatchery origin?
- What are the physical habitat condition, biological condition and chemical water quality of CRB fish spawning and rearing habitat?
- Have listed CRB populations recovered sufficiently for delisting and removal of ESA restrictions?

Tier 3. Action Effectiveness of Specific Recovery Actions (habitat, hydro, hatchery, or harvest management)

HABITAT[7]

- Have specific habitat projects affected habitat conditions and local fish population survival, abundance or condition?
- Did groups of habitat projects within a subpopulation or sub watershed on aggregate affect fish survival, abundance or condition in a larger demographic unit?
- Are particular classes of habitat projects effective?
- What are the mechanistic connections between habitat actions and fish population responses?
- Have habitat projects achieved the expected improvements in conditions?

HARVEST

- What are the inseason estimates of run size and escapement for each management group and how do they compare to preseason estimates?
- What is the target and nontarget harvest and when is it projected to reach allowable levels?

HATCHERIES

- To what extent can hatcheries be used to assist in meeting harvest management goals while keeping impacts to natural populations within acceptable limits?
- To what extent can hatcheries be used to enhance viability of natural populations while keeping impacts to non-target populations within acceptable limits?
- To what extent can hatcheries be used to conserve the genetic legacy of imperiled fish populations?

HYDROSYSTEM

- Are smolt-to-adult survival rates (SARs) sufficiently high to meet NWPCC and recovery goals?
- Has hydrosystem complied with performance standards set out in 2000 FCRPS BiOp?
- What are the patterns in fish survival rates both within the mainstem and subsequent to it, for different species and groups of fish (e.g. transported vs. in-river, hatchery vs. wild, upstream vs. lower river)?

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[6] The questions grew from Jordan et al. (2002), and span 3 tiers: Tier 1 - broad-scale assessment of fish distributions at a sampling frequency of about 3 to 5 years, and a general assessment of ecosystem status at a sampling frequency of about 5 to 10 years. Tier 2 - statistically based sampling to determine the annual trends in the status of fish populations and their habitat. Tier 3 - research and monitoring to assess, in the form of explicitly posed experiments, the effectiveness of specific recovery actions.

[7] The effects of classes of habitat actions on fish habitat can be evaluated with reach-scale assessments of habitat performance measures. At the scale of a demographic unit however (e.g. a fish population), there are generally several classes of actions being implemented concurrently. Thus in many cases it may not be feasible to isolate the effects of particular classes of habitat actions on fish survival or abundance at the population scale. Even assessing the effects of groups of habitat actions on populations will require a greatly increased degree of regional coordination within and among subbasins in the timing and location of restoration project implementation (Marmorek et al. 2004a)

- What's the effect of different within-season transportation management and flow/spill management actions on various measures of fish survival rates?
- To what extent would Removable Spillway Weirs improve fish survival rates, at both the project scale and over the overall life cycle?

For each of the Tier 2 questions listed above, CSMEP biologists addressed the following five issues in their strengths and weaknesses assessments:

1. What are the spatial scales of interest for this question?
2. Has anyone attempted to answer this question before in this sub-basin, or for a larger spatial unit that contains this sub-basin? If Yes, who did this, and how? What methods were used? Provide reference citation. Was accuracy or precision of answer estimated?
3. If answer to #2 was no (or attempt failed), could question be answered with available data? (yes, no, maybe, don't know). Any ideas on how / method? At what level of accuracy AND precision, ideally with quantitative estimates, or if not available qualitative estimates (L, M, H).
4. On what spatial scale could answers be provided with existing information (e.g. tribs, individual pop, pop group, ESU) and over what temporal scale (e.g. last 20 years, last 5 years)?
5. Summarize the overall strengths and weaknesses of existing data for answering this question. What critical improvements are required to overcome weaknesses

Appendix 2 – Map of IMW Watersheds

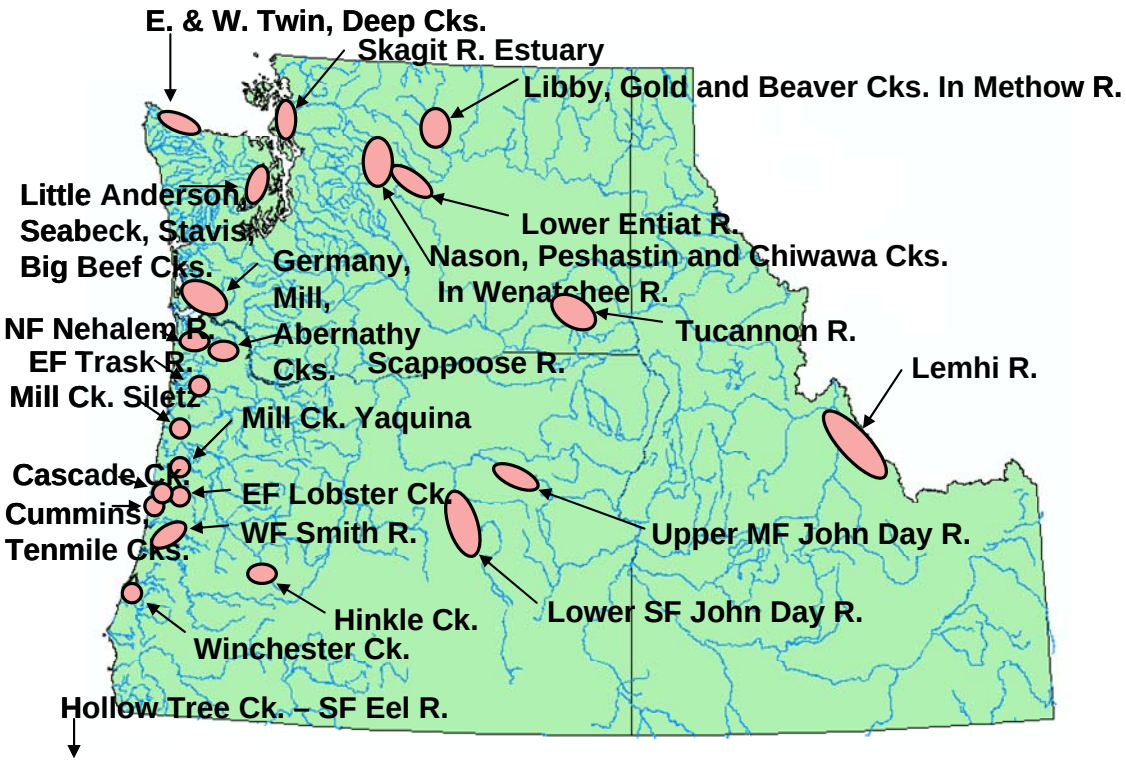

Figure A-1. Regional Network of Intensively Monitored Watersheds. Source (Jordan 2005)