CONSENSUS RESEARCH PROPOSAL

Evaluating the Responses of Snake and Columbia River Basin fall Chinook Salmon to Dam Passage Strategies and Experiences

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Preface

This proposal was developed collaboratively and represents the consensus of the principal investigators and collaborating parties. These are Idaho Department of Fish and Game, Nez Perce Tribe, National Marine Fisheries, Oregon Department of Fish and Wildlife, and U.S. Fish and Wildlife Service. The Columbia River Inter-tribal Fish Commission, Umatilla Tribe, U. S. Army Corps of Engineers, and the Washington Department of Fish and Wildlife provided comments that were incorporated into the proposal. This proposal is built upon and consistent with the Long-Term Framework for Evaluating the Responses of Snake and Columbia River Fall Chinook Salmon to Dam Passage Strategies and Experiences (AHG 2007; Appendix A). In some cases, alternative funding currently exists to support portions of this proposed work. These cases are identified throughout this document and in Appendix B. We are seeking U.S. Army Corps of Engineers funding for work identified as needing additional funding support.

Executive Summary

Purpose: Snake River juvenile fall Chinook Salmon utilize the mainstem Snake and Columbia rivers for both migration and rearing. As such, hydrosystem operations and transportation strategies affect the behavior and survival of this ESA listed species. Numerous policy and management decisions take into consideration impacts to Snake River fall Chinook salmon. Various study design requirements and management decisions that could be made yielded disagreement between entities, even when working towards the common goal of establishing acceptable hydro-system operations and fish passage strategies that support both recovery and maintain harvest of Snake River fall Chinook salmon. A long-term goal of the region is to determine a hydrosystem operation and fish passage strategy for Snake River Fall Chinook that will meet the recovery needs of this ESU, through a regionally developed approach.

Agreed To Study Design: To facilitate agreement on a long-term study design for evaluating the responses of Snake River Basin fall Chinook salmon to dam passage strategies and experiences, an AD HOC group has drafted three documents. The first is an executive summary (this document). The second is an agreed to "living" proposal. The third is an appendix that functions as a long-term framework that effectively memorializes original expectations that will hold parties to this study accountable over the 10 plus years it will take to realize study results.

Study Products: An important part of any research plan is the development of the key management questions. In general, the overall broad scale management questions expected to be answered by this evaluation are:

- Would bypassing or transporting individuals collected in the bypass systems result in a higher SAR for the Snake River fall Chinook population?
- What is the relative performance of in-river fish (i.e. spilled and passed via surface bypass) versus transported fish?
- What are the corresponding smolt to adult return rates under various conditions, various FCRPS entry points, and various routes of passage?
- How do various juvenile migration life history approaches contribute to population level status and trends?

Study Groups and Sample Size: The diversity of life history strategies exhibited by naturally-produced fall Chinook salmon and differences between hatchery and natural production requires this study to utilize multiple treatment groups with various samples sizes (Table 1). Two general analytical approaches are proposed. The first approach involves comparing two groups of fish that are released upstream of Lower Granite Reservoir, but whose treatment at collector dams differs in an effort to represent two different management strategies:

- transportation with summer spill/surface bypass (TWS); and
- screen bypass with summer spill/surface bypass (BWS).

The second general analytical approach compares groups of juvenile migrants based on their passage experience at the dams. The three possible passage experiences for these fish are:

- transportation from a collector dam (“T_0” group);
- passage undetected through spillways and turbines but not through juvenile collection and bypass systems at all four collector dams (“C_0” group); and
- collection and bypass back to the river at one or more juvenile fish bypass systems at collector dams (“C_1” group).

Table 1. Proposed sample sizes of PIT-tagged fish for the study.

Study Groups	Definition	Sample Size
Snake Basin surrogate subyearlings	Surrogate subyearlings would be reared to 70–75 mm and released from mid-May to early July to approximate the behavior and life history diversity of natural subyearlings.	328,000 or 417,000
Snake Basin production subyearlings	Production subyearlings are typically grown rapidly to a target fork length of approximately 85–90 mm fork length and then released in April–May.	250,000
Snake Basin production yearlings	Production yearlings are reared at Lyons Ferry Hatchery for approximately one year after emergence to a target release size of approximately 150–160-mm fork length.	57,000
Snake Basin natural subyearlings	Includes Snake and Clearwater production areas: 40 to 80 mm, captured and released late March to early August.	20,000 target
Hanford Reach natural subyearlings	Hanford Reach natural subyearlings: 55-78 mm, captured and released during late May to early June.	20,000 target
Deschutes River natural subyearlings	Deschutes River natural subyearlings: 50-68 mm, captured and released in mid-May.	20,000 target
Little White Salmon production subyearlings	Little White Salmon production subyearlings: 81-85 mm, released during third week of June.	25,000
Lyons Ferry Hatchery on-station yearlings[1]	Production yearlings are reared at Lyons Ferry Hatchery for approximately one year after emergence to a target release size of approximately 150–160-mm fork length.	30,000
Lyons Ferry hatchery on-station subyearlings[1]	Production subyearlings are typically grown rapidly to a target fork length of approximately 85–90 mm fork length, released in April–May.	45,000

[1]Seperate proposal - Evaluation of yearling and subyearling fall Chinook survival from Lyons Ferry Hatchery to be funded by the Lower Snake River Compensation Program

Study Duration: Fish production and marking should be implemented for five years (release groups). Since low numbers of returning adults may, in some years, preclude the production of study fish, these years may not occur consecutively. After five years of marking, further discussion/justification for continuation could be considered at that time. There may be good reason(s) to continue producing/marking fish for study or monitoring purposes, however that decision should be considered near the end of the 5 years of marking.

Study Tasks/Activities:

- Production and PIT tagging of surrogate subyearling in the Snake and Clearwater rivers.
- PIT tagging of Snake River general production subyearlings.
- PIT tagging of Snake River general production yearlings.
- PIT tagging of Lyons Ferry on-station releases (subyearlings and yearlings (sister proposal).
- PIT tagging of Snake and Clearwater River natural production.
- PIT tagging of Hanford Reach natural production.
- PIT tagging of Deschutes natural production.
- PIT tagging of Little White Salmon production subyearlings.
- Subsampling of juveniles at Snake River dams for growth.
- Subsampling of returning adults for scale collection and assessment of juvenile life history.
- Genetic analysis of juveniles for partitioning spring/summer or fall Chinook salmon.
- Data analysis methods workshops.
- Data interpretation and reporting workshops.
- Estuary trawling for PIT tag detection.

Remaining Uncertainties: While this proposed study will provide key information for improving understanding of fall Chinook from the Columbia and Snake Rivers, it is unlikely to provide resolution to all unresolved issues or answers to all possible management questions. Several high priority issues and critical uncertainties would be difficult to address via this study, including:

- What specific operations provide optimal in-river and transport conditions for fish?
- What is the relative survival of fish that migrate undetected during periods of summer spill to transported and bypassed fish?
- By route of passage at dams (e.g., spillway, turbine, and bypass),, what is the direct juvenile survival of smolts through the FCRPS under various conditions?

Collaboration Approach: The study will be conducted in three phases. A joint effort of tribal, state, and federal staff worked as an ad hoc group during Phase I to identify the components of the Columbia River Basin fall Chinook salmon populations to be studied and the sample sizes of PIT-tagged fish required for adequate statistical power (attached proposal). Phase II includes a series of workshops that will be open to federal, state, and tribal researchers to explore and identify analytical techniques. Phase III ensures federal, state and tribal co-managers opportunities for involvement during data analysis and reporting. The U.S. Army Corps of Engineers will sponsor the workshops by providing a meeting place and a facilitator.

Introduction

Like other Columbia Basin salmonids, understanding the responses of fall Chinook salmon (*Oncorhynchus tshawytscha*) over their life-cycle to environmental and management conditions within and outside the Federal Columbia River Power System (FCRPS; Figure 1) requires a consistent and comprehensive monitoring and evaluation program (Muir et al. 2001; Smith et al. 2002; Smith et al. 2003; Williams et al. 2005; Muir et al. 2006; Schaller et al. 2007). Passive integrated transponder (PIT) technology within the FCRPS (Prentice et al. 1990a; 1990b) and techniques for analyzing PIT-tag data (Skalski et al. 1998; Sandford and Smith 2002; Williams et al. 2005; Schaller et al. 2007) provide an opportunity for developing a comprehensive understanding of fall Chinook salmon demographic rates and how those rates vary over their life-cycle in response to environmental and management conditions.

Key demographic rates that can be obtained using PIT-tag analytical techniques include; juvenile migration and survival rates within the FCRPS, ocean survival rates (i.e., post-FCRPS), adult upstream migration and survival rates, and overall smolt-to-adult survival rates (SARs), although estimation of juvenile salmonid survival through the hydropower system is complicated by the tendency of some fall Chinook salmon to migrate during times of the year when juvenile fish bypass and PIT tag detections systems are not watered up (Connor et al 2005; Buchanan and Connor 2007). Methods are available for partitioning these rates based on migration experience (e.g., transportation, bypass or undetected in-river migration routes), rearing type (e.g., hatchery or wild), and points above and within the FCRPS (e.g., from release points and from detection sites).

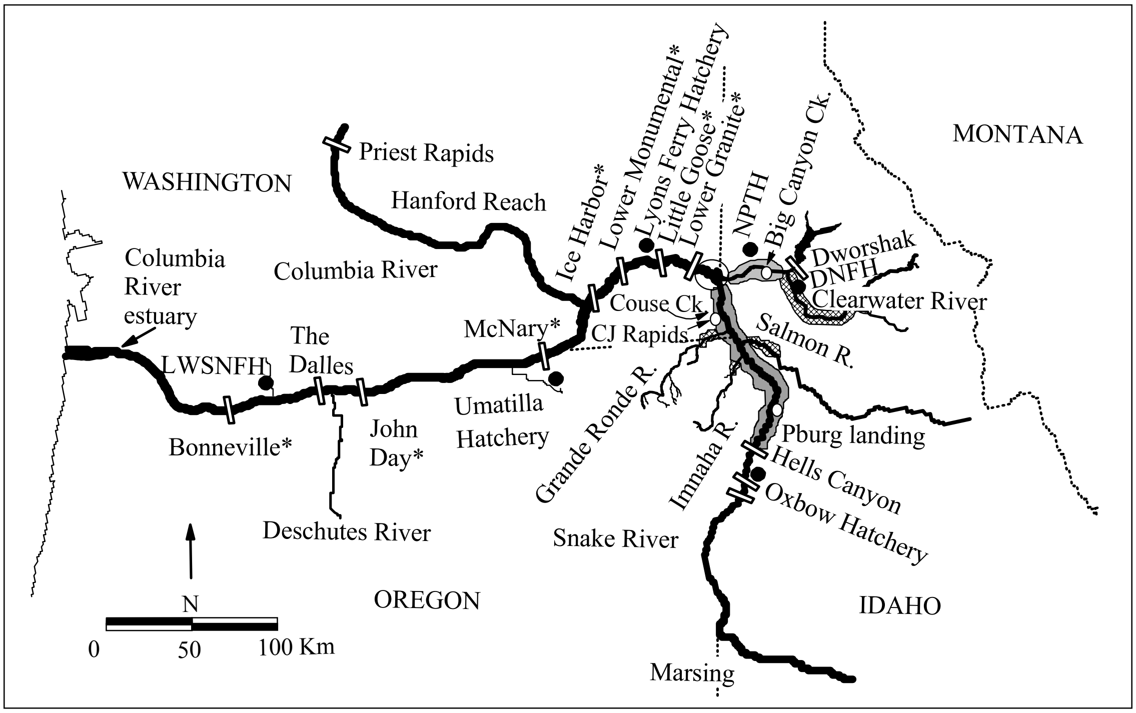

Figure 1.–The Federal Columbia River Power System (Dworshak Dam to Bonneville Dam) and the Snake and Columbia River basins including the contemporary primary (shaded areas) and secondary (cross-hatched areas) areas of fall Chinook salmon spawning in the Snake River Basin upstream of Lower Granite Reservoir (large white circle). Surrogate subyearlings reared at Dworshak National Fish Hatchery (DNFH; black circle) are directly released at Couse and Big Canyon creeks (arrows). Some of the hatchery fall Chinook salmon produced at Lyons Ferry Hatchery are transferred to Oxbow and Umatilla hatcheries (black circles) before release at the following locations. Production subyearlings and yearlings are acclimated and released at Pittsburg Landing, Captain John Rapids, and Big Canyon Creek (small white circles). Some production subyearlings are released directly into the Snake River without acclimation at Hells Canyon Dam and Couse Creek. Some production subyearlings are also released directly into the Grande Ronde River without acclimation. Lower Granite, Little Goose, Lower Monumental and McNary dams are collector dams, from which collected fish are transported for release downstream of Bonneville Dam. Dams equipped with PIT-tag detection systems are indicated by an asterisk. The Columbia River portion of this proposal focuses on fall Chinook salmon from the Hanford Reach, Deschutes River, and Little White Salmon National Fish Hatchery (LWSNFH).

For monitoring and evaluating Snake River Basin fall Chinook salmon, two analytical approaches are proposed. Each approach has its merits and limitations. The first approach was developed specifically for Snake River Basin fall Chinook salmon (Marsh and Connor 2004).

This approach involves comparing two groups of fish that are released upstream of Lower Granite Reservoir (Figure 1), but whose treatment at collector dams differs in an effort to represent two different management strategies; transportation with summer spill (TWS) and bypass with summer spill (BWS). Fish from the TWS group will be transported if they are detected at a collector project (Lower Granite, Little Goose, Lower Monumental and McNary dams; Figure 1) and fish from the BWS group will be bypassed if they are detected at a collector project. For both the TWS and BWS release groups, roughly half the fish in each group will not be detected at any of the four collector projects due to low collection efficiencies associated with summer spill and/or undetected passage during the winter or spring. Fish pass undetected because spillways and turbines are not equipped with PIT-tag detection systems and the juvenile fish bypass and PIT-tag detection systems are not watered up from late fall to early spring. This analytical approach is attractive because it requires few assumptions and the resulting SARs reflect two management strategies of interest. However, because both groups will have adults from undetected migrants returning, detecting a significant difference between the TWS and BWS groups will be more difficult.

The second analytical approach proposed for monitoring and evaluating Snake River Basin fall Chinook salmon was developed by Schaller et al. (2007) for spring/summer Chinook salmon and steelhead (*O. mykiss*). This approach also involves tagged fish released upstream of Lower Granite Reservoir, but compares groups of juvenile migrants based on their passage experience at the dams. The three possible passage experiences for these fish are: transportation from a collector dam ("T_0" group), passage undetected through spillways and turbines, but not through juvenile collection and bypass systems at all four collector dams ("C_0" group), and collection and bypass back to the river at one or more juvenile fish bypass systems at collector dams ("C_1" group). The analytical approach is attractive because it provides unbiased estimates of the number of first-year migrant smolts in the C_1, and T_0 study groups. The methods are also capable of estimating the number of first-year migrant smolts in the C_0 study group for populations of fall Chinook that exhibit low incidence of winter passage or overwintering behaviors above Lower Granite Dam. However, methods to estimate the number of smolts in the C_0 study group for populations of fall Chinook exhibit greater incidence of winter passage or overwintering are not presently applicable and are to be discussed and/or developed through upcoming technical workshops.

For both analytical approaches, a key demographic metric derived is the smolt-to-adult survival rate (SAR), measuring life-cycle survival from the smolt life stage to the adult life stage. Based on their group designation (for the first approach) or their migration experience at the four collector projects (for the second approach), returning adults are tabulated and divided by the corresponding number of smolts to determine the SAR. Comparing these SARs over time provides key information needed to improve understanding of the effects of environmental conditions and management strategies within and outside the FCRPS on life-cycle survival rates of salmonids (Williams et al. 2005; Muir et al. 2006; Schaller et al. 2007). However, it should be noted that estimates of SAR based on PIT tags may or may not be lower than SARs for the untagged population (Williams et al. 2005. Schaller et al. 2007).

Similar approaches can be used to monitor and evaluate the SARs of other Columbia River Basin fall Chinook populations. In addition to Snake River fall Chinook salmon, three other fall Chinook salmon stocks are proposed for monitoring and evaluation using PIT-tag analytical techniques including Hanford Reach wild, Deschutes River wild, and Little White Salmon National Fish Hatchery fall Chinook salmon (Figure 1). Each of these fall Chinook salmon populations experiences a different portion of the FCRPS and may respond differently to the environmental and management factors experienced within the FCRPS. Similarly, the responses of these populations may vary following their exit from the FCRPS. Comparing the SARs over time for other Columbia River Basin fall Chinook salmon groups may provide key information needed to improve understanding of the effects of environmental conditions and management strategies within and outside the FCRPS on life-cycle survival rates of Snake River Basin and Columbia River fall Chinook salmon.

In addition to SARs, PIT-tag data allow for the monitoring and evaluation of several other key demographic rates (Muir et al. 2001; Smith et al. 2002, 2003; Connor et al. 2003, 2004; Williams et al. 2005; Muir et al. 2006; Schaller et al. 2007). Within the FCRPS, these include fish travel time between release and all detection sites and survival rates between release and most detection sites, although estimation of juvenile survival is complicated by passage of reservoir-type fall Chinook salmon during late fall, winter, and spring. With a consistent tagging effort over time, functional relationships between these demographic rates and the environmental and management factors that are associated with the variability in those rates can be derived (Smith et al. 2002, 2003; Connor et al. 2004; Williams et al. 2005; Schaller et al. 2007). PIT-tag data also provide the unique opportunity to separate survival rates within the FCRPS from survival rates post-FCRPS. A key example of this type of analysis is evaluating the effects of arrival date at Bonneville Dam on ocean survival rates (Scheuerell and Zabel, *draft manuscript*). With tagged wild and hatchery groups released in the lower Columbia River, the amount of data available for this type of analysis is greatly expanded beyond the data available from tagging efforts in the Snake River Basin. Combining the data from the different release groups or rearing types may or may not be appropriate, but each tagging effort would substantially improve the understanding of the effects of Bonneville Dam arrival timing on ocean survival rates for each release group.

Ongoing efforts to evaluate the responses of Snake and Columbia River Basin fall Chinook salmon to passage strategies and experiences within the FCRPS have been hindered by several issues of disagreement (See Framework Document). One issue that has been partially resolved was the lack of spill at Lower Granite, Little Goose, and Lower Monumental Dams from June through August (hereafter, "summer spill"). In 2005, plaintiffs in the NWF vs. NMFS case regarding the remanded 2004 Biological Opinion requested summer spill to provide what they presumed would be better inriver migration conditions for migrating Snake River Basin fall Chinook salmon subyearlings. A preliminary injunction was granted and spill was provided from June 20th to August 31st, 2005. Summer spill was again provided in 2006 and 2007 with a slight reduction in volume. Volume and duration of summer spill in future years will vary in accordance with that prescribed in the new Biological Opinion and through policy level decisions and will not invalidate our consensus study design.

A second issue that has been partially resolved involves the seasonal dewatering of the PIT-tag detection systems stationed within the juvenile fish bypass systems at lower Snake River dams. Before 2006, the juvenile PIT-tag detection systems were dewatered at Lower Granite, Little Goose, and Lower Monumental dams prior to 2 November and they were not watered up until late March. The juvenile bypass systems of the Snake River dams are the only passage routes that can be monitored for the passage of PIT–tagged fish. Dewatering of the bypass system meant that passage that occurred during late fall and winter was not monitored. In 2006, the U.S. Army Corps of Engineers (COE) operated the juvenile fish bypass at Lower Granite Dam for an extended period compared to earlier years, continuing operation from 1 November to 16 December. Substantial numbers of PIT-tagged natural and hatchery fall Chinook salmon from the Clearwater River were detected between 1 November and 15 December. Modifications were made to the juvenile fish bypass system at Lower Granite Dam in 2006 that will facilitate late-fall and winter operation in the future. Furthermore, the COE is planning on structural modifications at Little Goose and Lower Monumental dams that will allow extended operation of the PIT-tag detection systems at these two dams by spring 2008.

The remainder of this proposal describes how federal, state, and tribal co-managers can help to facilitate evaluation of the response of Snake and Columbia River Basin fall Chinook salmon to management strategies (TWS and BWS), passage experience (T_0, C_0, C_1) at Snake River dams, and environmental conditions within and outside the FCRPS. The proposed study will not provide resolution to all unresolved issues or answers to all possible management questions (see Framework Document). If implemented, however, the study will help to inform federal, state, and tribal co-managers and facilitate long-needed analyses. The proposal is intended as a "living" document, to be modified with co-manager input and as new biological and technical information becomes available. It is structured in three phases.

Phase I offers resolution to the issue of identifying the components of the Snake and Columbia River Basin fall Chinook salmon population to be studied and the sample sizes of PIT-tagged fish required for adequate statistical power. Phase I also includes a series of supplemental evaluations. Phase II is intended to help resolve the issue of how best to analyze the data by establishing an agreed upon set of methods for data analysis. Phase II includes a series of workshops that will be open to federal, state, and tribal researchers to explore and identify analytical techniques. Phase III will help resolve the issue of collaboration by ensuring federal, state and tribal co-managers opportunities for involvement during data analysis and reporting. During Phase III, the principle investigators for each objective will preliminarily analyze the data based on input received during Phase II. Phase III will then proceed with a series of workshops open to federal, state, and tribal researchers to interactively analyze and interpret the data, as well as provide formal peer-review. This review will be used to refine the study results prior to preparation of a Final Report by the principal investigators for public release. The COE will sponsor the workshops by providing a meeting place, facilitator, and may support travel expenses for a select group of participants.

Phase I: A Plan for Tagging, Release, and Evaluations Needed for Phase II

Tagging Summary

We propose to tag fish representatively from major components of the Snake and Columbia Basin upriver bright fall Chinook salmon populations upstream of Bonneville Dam, with the exception of subyearlings released from the Nez Perce Tribal Hatchery (NPTH; Figure 1). We will tag natural subyearlings from the Snake River and Clearwater River drainages, Lyons Ferry Hatchery-origin subyearlings specially cultured and released as surrogates for natural subyearlings (hereafter, “surrogate subyearlings” or “surrogates”), Lyons Ferry Hatchery-origin subyearlings and yearlings (hereafter, “production subyearlings” and “production yearlings”), natural subyearlings from the Hanford Reach and Deschutes River, and hatchery subyearlings from Little White Salmon NFH (LWS) released from the locations described in Figure 1. The proposed sample sizes are shown in Table 1 with the methods used to derive them given under each objective.

Table 1. Proposed sample sizes of PIT-tagged fish for the study. The surrogate subyearling sample size will depend on fish availability.

Component	Sample Size
Snake Basin surrogate subyearlings	328,000 or 417,000
Snake Basin production subyearlings	250,000
Snake Basin production yearlings	57,000
Snake Basin natural subyearlings	20,000 target
Hanford Reach natural subyearlings	20,000 target
Deschutes River natural subyearlings	10,000 target
LWS[1] production subyearlings	25,000
LFH on-station yearlings[2]	30,000
LFH on-station subyearlings[2]	45,000

[1]Little White Salmon Hatchery
[2]Seperate proposal - Evaluation of yearling and subyearling fall Chinook survival from Lyons Ferry Hatchery to be funded by the Lower Snake River Compensation Program.

Objective 1.—Tagging and releasing Snake River Basin surrogate subyearlings (NMFS lead)

Sample Sizes for Surrogate Subyearlings

We are proposing to rear surrogate subyearlings to 70–75 mm and release them from mid-May to early July with the intent of approximating the average size and migration timing of PIT-tagged natural subyearlings including those that exhibit a reservoir-type juvenile life history. The variables we propose to analyze are given in Table 2.

Evaluation of the two management strategies will be based on the ratio of SARs for the TWS and BWS groups (hereafter "T/I ratio"). The SARs will be measured from the point of release as juveniles to return as adults to Lower Granite Dam. Assuming an SAR from release of 0.3% for the higher of the two groups, a two-sided test with significance level (α=0.1) and statistical power of 80% (β=0.2), an 18% difference in the SARs could be detected with a release of 328,000 fish. Under the same assumptions, a difference of 16% could be detected with a

Table 2. Variables that can be estimated by PIT tagging and releasing natural (target of 20,000) and surrogate subyearlings (*N* = 328,000 to 417,000) upstream of Lower Granite Reservoir. The Snake River Basin population of natural subyearlings includes natural fish from both the Snake River and Clearwater River drainages, whereas the Snake River Basin population of surrogate subyearlings includes releases made into the Snake and Clearwater rivers. An "X" indicates a high precision estimate. An "x" indicates lower precision estimate resulting from the division of the population into smaller subpopulations. An "A" indicates a high precision estimate that will require adjustments to the estimated number of smolts due to migration during winter or the following spring. An "a" indicates a lower precision estimate that will require adjustments to the estimated number of smolts due to migration during winter or the following spring. The adjustment method is presently unknown. Without adjustment estimates will be biased. A "0" indicates sample sizes of fish tagged with 12 mm tags are expected to be too small to make meaningful estimates. Application of the 8 mm tags might make it possible to calculate precise SARs (See Objective 6).

Variable evaluated	Snake River Basin population		Snake River subpopulation		Clearwater River subpopulation	
	Surrogates	Natural	Surrogates	Natural	Surrogates	Natural
SARs for passage strategies and passage-experience groups (can also be analyzed by dam)						
TWS[a]	X	0	x	0	x	0
BWS	X	0	x	0	x	0
Transported (T_0)	X	0	x	0	x	0
Undetected (C_0)	A	0	a	0	a	0
Bypassed (C_1)	X	0	x	0	x	0
Jun to Aug (T_0, C_1)	x	0	x	0	x	0
Sep to Dec (T_0, C_1)	x	0	0	0	x	0
Ratios of SARs						
T/I	X	0	x	0	x	0
T0/C0	A	0	a	0	a	0
T0/C1	X	0	x	0	x	0
C0/C1	A	0	a	0	a	0
Post-release attributes						
Passage timing	X	X	X	X	X	X
Travel time	X	X	X	X	X	X
Reservoir overwintering	X	X	X	X	X	X
Exposure to spill	X	X	X	X	X	X
Migrant size	X	X	X	X	X	X
Migration and survival[b]	X	X	X	X	X	X
Surivival	A	A	A	A	A	A

[a] Fish designated to the transport group will be bypassed back to the river if the decision is made to terminate transport operations (a.k.a., routing will be determined by monitor mode).
[b] Joint probability of active migration and survival.

release of 417,000 fish. Using the second proposed analytical approach and defining the T_0 and C_1 groups as the first-year migrants in those groups, assuming a SAR from Lower Granite Dam of 0.6% for the lower of the two groups, and a survival from release to Lower Granite Dam of 0.30, a 31% difference could be detected between the T_0 and C_1 groups with a release of 328,000 fish. Under the same assumptions, a 28% difference could be detected with a release of 417,000 fish.

For evaluation of the two management strategies groups, calculations were based on a two-sided test of the difference between two proportions (i.e., SARs). Sample sizes are based on the following formula:

$$n = (Z_{\alpha/2} + Z_{\beta})^2 (p_1 q_1 + p_2 q_2)/(p_2 - p_1)^2$$

where n is the size of each sample (i.e., the number of juvenile fish to release in each group), $Z_{\alpha/2}$ is the normal deviate corresponding to the significance level used in the test, Z_{β} is the normal deviate corresponding to the desired statistical power $(1-\beta)$ to detect the difference, p_1 is the proportion for group 1 ($q_1 = 1 - p_1$), and p_2 is the proportion for group 2 ($q_2 = 1 - p_2$).

Assuming that p_2 is the higher proportion and that it is equal to 0.0030 (0.3% SAR), an 18% difference would result in $p_1 = 0.00254$ (0.254% SAR). (If p_2=0.0030 were the SAR for the TWS, then T/I=1.18; if p_2=0.0030 were the SAR for the BWS, then T/I=0.85). Under these specifications, n = 163,097 ($2n$ = total juvenile release for two groups = 326,195). Figure 2 depicts alternative total release sizes and the associated detectable differences for the two-tailed test, given $\alpha = 0.10$, $\beta = 0.20$, and the higher of the two proportions is equal to 0.0030. Arrows denote the total release sizes of 250,000, 328,000 and 417,000, with the associated detectable differences plotted above the arrows.

We propose to represent natural fall Chinook salmon subyearlings by releasing surrogate subyearlings into both the Snake and Clearwater Rivers in proportion to redds counted in each respective drainage (Snake River drainage, 70% of all redds; Clearwater River drainage 30% of all redds; hereafter the "70:30 rule"). For example, 229,600 surrogate subyearlings will be tagged and released into the Snake River and 98,400 surrogate subyearlings will be tagged and released into the Clearwater River if 328,000 surrogate subyearlings are provided for the study.

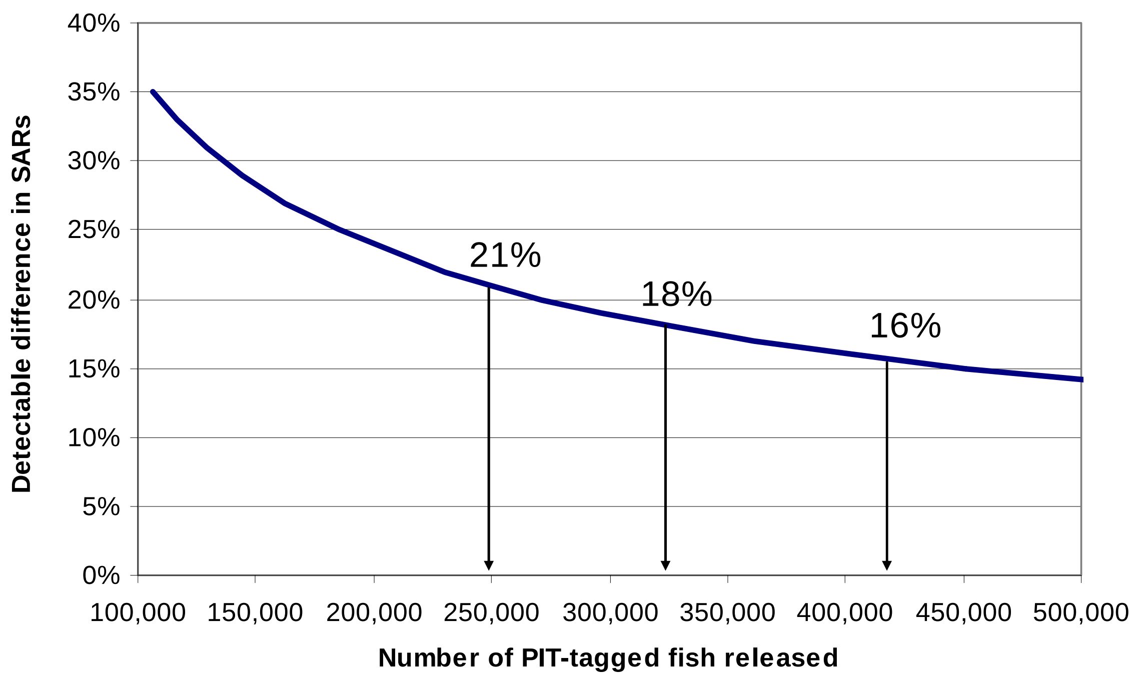

Figure 2.—The detectable difference in smolt-to-adult return rates (SARS) plotted against the number of PIT-tagged surrogate subyearlings released.

Task 1.1 Request fish through U.S. v. OR

The U.S. v. OR holds monthly meetings. During the October 2007 meeting, representatives of the principal researchers will formally request provision of 417,000 surrogate subyearlings. A sample size of 328,000 surrogate subyearlings is acceptable. Sample sizes less than 328,000 could also be used for the study, but will result in an increase in the detectable difference between SARs (Figure 2). Without revision of Table B.4 in the Snake River fall Chinook salmon production plan, surrogate production of 328,000 would be provided under priorities 12 and 14 and the remaining 89,000 would be made available only after all other approved production groups are met (assumes approval of study achieved). Modification of Table B.4 to increase the priority of surrogate subyearling releases would increase the likelihood of comparisons key to this proposal would be made with five consecutive release years.

Task 1.2 Surrogate subyearling transfer and rearing

During January–February, roughly 100,000 (for 328,000 sample size) eyed eggs or fry from Lyons Ferry Hatchery will be transferred to Umatilla Hatchery (Figure 1) for incubation in cold water to delay hatching. In April, after button-up, 60 randomly selected fry will be examined for *Renibacterium salmoninarum* antigen by ELISA. In addition, gill/kidney/spleen tissue will be examined for viruses associated with infectious pancreatic necrosis, infectious hematopoietic necrosis, and viral hemorrhagic septicemia. After disease testing is complete and state transportation permits are obtained, staff will transport the fry to Dworhsak National Fish Hatchery (Figure 1) where they will be reared to control growth to provide surrogate subyearlings for release into the Clearwater River.

In March, 60 randomly selected fish will be randomly tested from the roughly 230,000 subyearlings (for 328,000 sample size) set aside at Lyons Ferry Hatchery for surrogate subyearling releases into the Snake River. After disease testing is completed and state transportation permits are obtained, the fish will be transported to Dworshak National Fish Hatchery where growth will be controlled to provide surrogate fish of suitable size for release into the Snake River.

Task 1.3 Separation-by-Code designation, tagging, and release for surrogate subyearlings

Prior to release, we will randomly divide the tag codes into two equal sized groups to represent the TWS and BWS groups. We will coordinate with the Pacific States Marine Fisheries Commission to program the separation-by-code systems ("SbyC"; e.g., Marsh et al. 1999, Downing et al. 2001) at Lower Granite, Little Goose, Lower Monumental, and McNary Dams to route TWS designated codes to the raceways and BWS designated codes back to the river. In the case of the TWS group (and all other T groups in this proposal), SbyC will be run in monitor mode. Monitor mode insures representative SARs by routing TWS designated fish back to the river on the rare occasion when run-of-the-river fish entering the juvenile fish bypass system are not routed to the raceways. A total of 500–1,500 tag codes will also be pre-designated for SbyC diversion to net pens at Lower Granite Dam to provide sample fish for task 7.1 of objective 7. These fish will be excluded from further SAR analyses.

Tagging of the Snake River surrogate subyearlings will begin at Dworshak National Fish Hatchery in mid-May and will occur five days a week for three weeks. Tagging of the Clearwater River surrogate subyearlings will begin in mid-June and will occur five days a week for three weeks. These periods coincide with the historical period of peak beach seine catch of natural parr in the Snake and Clearwater rivers. The tagged fish will be transported, tempered, and released daily. Snake River and Clearwater surrogate subyearlings will be released at Couse Creek and Big Canyon Creeks, respectively (Figure 1).

Objective 2.—Tagging and releasing Snake River Basin production subyearlings (NPT lead).

Sample Sizes for Production Subyearlings

We are proposing to tag production subyearlings, which are typically grown to a target fork length of approximately 85–90 mm fork length and then released in April–May. Currently, 18,000 fish are PIT tagged under BPA funding, with the intent of characterizing the survival and life history diversity of production subyearlings. The production subyearling rearing strategy typically results in relatively high rates of seaward movement and survival, passage through the lower Snake River dams by late July, and very low incidence of migration during fall, winter, or the following spring (e.g., Rocklage 1999; Connor et al. 2004).

Valid SAR estimates from release to adult return at Lower Granite Dam can be calculated for the TWS and BWS groups of production subyearlings (Table 3). Using the first analytical approach and assuming an SAR from release of 0.3% for the higher of the two groups, an alpha of 0.1, and a beta of 0.2, a 21% difference in the SARs could be detected with a release of 250,000 fish. Using the second proposed analytical approach and defining the T_0 and C_1 groups as the first-year migrants in those groups, assuming an SAR from Lower Granite of 0.6% for the lower of the two groups, and a survival from release to Lower Granite of 0.41, a 31% difference could be detected between the T_0 and C_1 groups with a release of 250,000. Table 3 indicates the parameters that can be estimated if a full C_1 group of production subyearlings is tagged.

Table 3. Variables that can be estimated by PIT tagging and releasing production subyearlings (Age-0; *N* = 250,000 to 328,000) and production yearlings (Age-1; *N* = 56,000) upstream of Lower Granite Reservoir, provided that production subyearlings are larger than 85-mm fork length and released in May. The Snake River Basin population includes subyearlings and yearlings released into both Snake and Clearwater rivers. An "X" indicates a high precision estimate. An "x" indicates lower precision estimate resulting from the division of the population into smaller subpopulations. A "0" indicates sample sizes of PIT-tagged fish that are expected to be too small to make meaningful estimates.

	Snake River Basin population		Snake River subpopulation		Clearwater River subpopulation	
Variable	Age-1	Age-0	Age-1	Age-0	Age-1	Age-0
SARs for passage strategies and passage-experience groups (can also be analyzed by dam)						
TWS[a]	X	X	x	x	x	x
BWS	x	X	x	x	x	x
Transported (T_0)	X	X	x	x	x	x
Undetected (C_0)	X	X	x	x	x	x
Bypassed (C_1)	x	X	x	x	x	x
April and May (T_0,C_1)	x	x	x	x	x	x
June–July (T_0, C_1)	0	x	0	x	0	x
Ratios of SARs						
T/I	x	X	x	x	x	x
T_0/C_0	x	X	x	x	x	x
T_0/C_1	x	X	x	x	x	x
C_0/C_1	x	X	x	x	x	x
Post-release attributes						
Passage timing	X	X	X	X	X	X
Travel time	X	X	X	X	X	X
Reservoir overwintering	X	X	X	X	X	X
Exposure to spill	X	X	X	X	X	X
Migrant size	X	X	X	X	X	X
Survival	X	X	X	X	X	X

[a] Fish designated to the transport group will be bypassed back to the river if the decision is made to terminate transport operations (a.k.a., routing will be determined by monitor mode).

We propose to release tagged production subyearlings in proportion to the number of production subyearlings released at Pittsburg Landing, Captain John Rapids, and Big Canyon Creek acclimation facilities (Figure 1). For example, 41,666 (16.7% of the 250,000 tagging level) of the 500,000 Captain John Rapids subyearlings (U.S. v OR priority 7) (16.7% of the production total) will released at Captain John Rapids if full production of 3,200,000 subyearlings upstream of Lower Granite is achieved.

Task 2.1 Request fish through U.S. v. OR

Representatives of the principal investigators will request 250,000 production subyearlings for this proposed study at their October 2007 meeting.

Task 2.2 Separation-by-Code designation, tagging, and release for production subyearlings

For Snake Basin releases, the percentages of tagged fish placed in the T and I groups is 46% designated to the T group and 54% would be designated for I group. Based on recent detection efficiency estimates, these percentage designations are expected to result in even numbers of smolts in the C_1 and T_0 categories. Setting the SbyC system to monitor mode insures that the PIT-tagged fish follow the route of run-at-large fish; thus, very few of the detected PIT-tagged fish in the T group would be bypassed back to the river. A total of 500–1,500 tag codes will also be pre-designated for SbyC diversion to net pens at Lower Granite Dam to provide sample fish for task 2.1 of objective 2. These fish will be excluded from further SAR analyses.

The PIT-tagging will occur at primary rearing facilities (i.e., Lyons Ferry, Oxbow, Umatilla hatcheries) before transfer to acclimation facilities in May. In some years, fish may not reach a size sufficient to marking before transfer to acclimation facilities. If that occurs, tagging fish at the Pittsburg Landing and Big Canyon acclimation facilities will be considered; however, representative or full tagging may not be possible.

Objective 3.—Tagging and releasing Snake River Basin production yearlings (NPT lead)

Sample Sizes for Production Yearlings

Production yearlings are reared at Lyons Ferry Hatchery for approximately one year after emergence to a target release size of approximately 150–160-mm fork length. A total of about 450,000 production yearlings are transferred from Lyons Ferry Hatchery during March in equal lots of 150,000 to Pittsburg Landing, Captain John Rapids, and Big Canyon Creek acclimation facilities. The production yearlings are released in mid-to-late April. Production yearlings migrate seaward rapidly and survive passage in the lower Snake River hydrosystem at relatively high rates (Rocklage 1999). Production yearlings do not exhibit the reservoir-type life history.

In 2008, however, we only propose to collect pilot data and calculate a SAR under the TWS strategy (represents the unmarked subpopulation performance) to characterize the 450,000 production yearlings released from the three acclimation facilities. Funding for this pilot analysis limited the number of production yearlings tagged to 45,000 (15,000 from each acclimation facility). We estimated the expected precision of a SAR from a sample size of 45,000 by using the equation for the expected half-width of a 95% error bound (B^): 2(SQRT((p^q^/(n – 1))(N – n/N))) where; p^ was set at 0.6% (the mean release to Lower Granite Dam SAR observed for coded-wire tag groups of production yearlings in the late 1990s); q^ = 1-p = 99.4%; N = 450,000, and n was varied in increments of 1,000. We plotted the values of B^ against n to examine the effect of sample size on estimated precision. The expected 95% error bound for the release of 45,000 production yearlings was 0.07% (Figure 3).

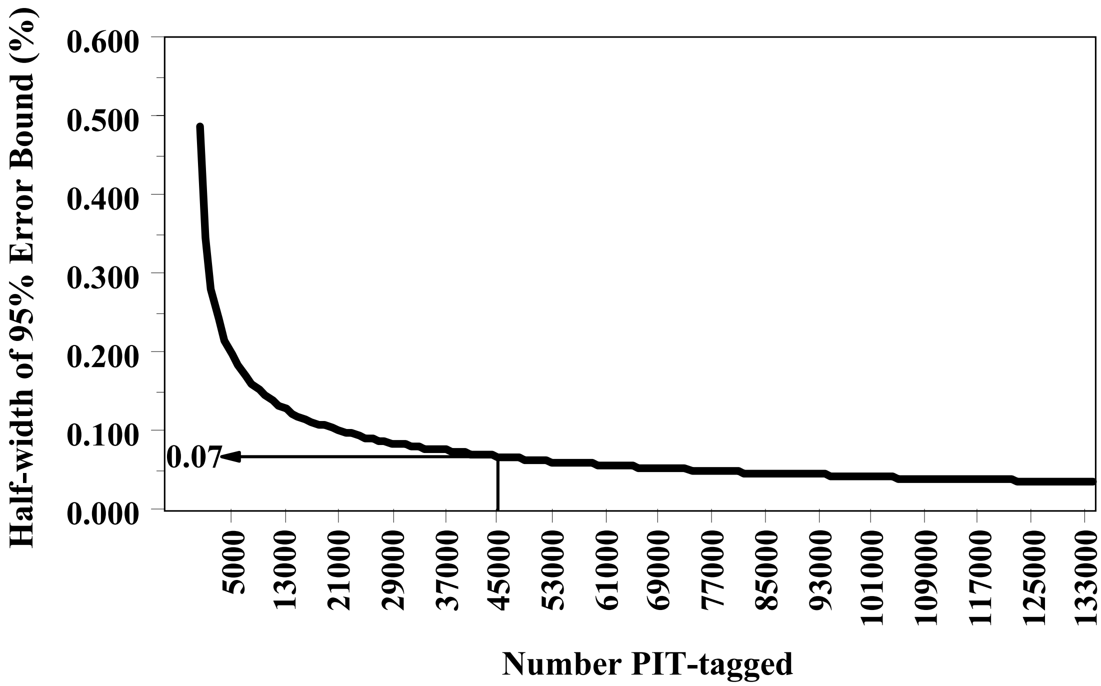

Figure 3. Expected half-width of a 95% error bound for a smolt-to-adult return rate of 0.6% plotted against sample size (*n*) of PIT-tagged production yearling fall Chinook salmon released from Pittsburg Landing, Captain John Rapids, and Big Canyon Creek acclimation facilities.

An additional 12,000 production yearlings will be released by NPT Fisheries as part of their long-term monitoring and evaluation program of post release juvenile survival and migration timing. These production yearlings will be designated for bypass bringing the total sample size of PIT-tagged yearlings up to 57,000. Thus, there is the potential for calculating a variety of SARs and comparing a variety of ratios (Table 3).

<u>Task 3.1 Request fish through U.S. v. OR</u>

The COE and representatives of the principal investigators will request 57,000 production yearlings for this proposed study at their October 2007 meeting.

Task 3.2 Separation-by-Code designation, tagging and release for production yearlings

All 45,000 of the production yearlings tagged as part of this study will be designated for monitor mode (i.e., transport, unless run-of-the river fish are being routed back to the river). The additional 12,000 fish tagged as part of long-term monitoring by NPT Fisheries will be designated for bypass. Tagging of the monitor mode fish will occur at Lyons Ferry Hatchery before transfer to the Pittsburg Landing, Captain John Rapids and Big Canyon Creek acclimation facilities in March.

Objective 4.—Tagging and releasing Snake River natural subyearlings (IFRO lead).

Sample sizes for Snake River natural subyearlings

Logistic and feasibility constraints limit the number of Snake River natural subyearlings that can be tagged, and thus target sample sizes reflect the expected number of fish that could be sampled and the resulting precision on the release to adult return SARs (Figure 4).

Task 4.1 Separation-by-Code designation, tagging and release for natural subyearlings

IFRO is presently funded by the Bonneville Power Administration to capture natural fall Chinook salmon subyearlings at sites in the free-flowing Snake River. Sampling will begin at the onset of fry emergence in late March and be conducted 3 d/week. A total of 15 permanent stations between rkm 227 and rkm 366 (rkm 0 = Snake River mouth) will be sampled every week of the study. During the release of Snake River surrogate subyearlings, supplemental sampling will increase the number of natural subyearlings that are PIT tagged. Sampling will be discontinued after the first week in July, when catch approaches or equals zero.

Origin (hatchery vs. natural) of fish with no mark (i.e., adipose fin not clipped) and no tag (i.e., no coded-wire or PIT tag) will be determined primarily from pupil diameter and body shape. Natural fish have smaller pupils and more robust body shapes than their hatchery counterparts (85–100% accurate; IFRO unpublished data). Each natural subyearling fall Chinook salmon captured will be anesthetized in a 3 ml MS-222 stock solution (100 g/L) per 19 L of water buffered with a sodium bicarbonate solution, measured (fork length in mm). Random tissue samples will be collected for future genetic analyses (e.g., to determine run). Natural subyearlings 60-mm fork length and longer will be implanted with a 12-mm PIT tag. A sample (approximately 10,000) of the natural subyearlings between 45 and 59-mm fork length will be implanted with 8-mm PIT-tags. Tagged fish will be released at the collection site after a 15-min recovery period.

Prior to release, we will randomly divide the tag codes into two equal sized groups to represent the TWS and BWS groups. We will coordinate with the Pacific States Marine Fisheries Commission to program the separation-by-code systems at Lower Granite, Little Goose, Lower Monumental, and McNary Dams to route TWS designated codes to the raceways and BWS designated codes back to the river. In the case of the TWS group (and all other T groups in this proposal), SbyC will be run in monitor mode. Monitor mode insures representative SARs by routing TWS designated fish back to the river on the rare occasion when run-of-the-river fish entering the juvenile fish bypass system are not routed to the raceways. A total of 500–1,500 tag codes will also be pre-designated for SbyC diversion to net pens at Lower Granite Dam to provide sample fish for task 7.1 of objective 7. These fish will be excluded from further SAR analyses.

Objective 5.—Tagging and releasing Clearwater River natural subyearlings (NPT lead).

Sample sizes for Clearwater River natural subyearlings

Logistic and feasibility constraints limit the number of Clearwater River natural subyearlings that can be tagged, and thus target sample sizes reflect the expected number of fish that could be sampled and the resulting precision on the release to adult return SARs (Figure 4).

Task 5.1 Separation-by-Code designation, tagging and release for natural subyearlings

NPT Fisheries is presently funded by Bonneville Power Administration to sample natural fall Chinook salmon subyearlings in the Clearwater River. Supplemental funding would be used to increase sampling effort throughout the season. NPT Fisheries will use beach seines, fyke nets, and rotary screw traps to capture natural fall Chinook salmon subyearlings in the lower Clearwater River. Seining will be conducted during May–August along the lower Clearwater River from rkm 7 to rkm 65 (rkm 0 = Clearwater River mouth). Permanent sites will be seined 5 days a week when flow allows. Supplemental sites will be seined when time and flow allow. Two sizes of beach seines fitted with 0.48 cm diameter mesh will be used (30.5 m x 1.8 m and 15.2 m x 1.2 m). Both will be fitted with weighted multi-stranded mud lines. The larger seine will be set from a jet boat. The smaller seine will be set by hand at less accessible and smaller beach seining sites. Four fyke nets and two 2.4 m diameter rotary screw smolt traps will be deployed and operated 5 days a week during beach seining. Beach seining and screw trapping will be discontinued the first week in August, when catch approaches or equals zero. Sampling will continue in August with a tow net and continue into October.

Origin will be determined as described for the Snake River. All salmonids captured by all methods will be placed in 18.9 L buckets and then placed in larger aerated 114 L plastic holding bins. Salmonids will be anesthetized in a 3 ml MS-222 stock solution (100 g/L) per 19 L of water buffered with a sodium bicarbonate solution. All natural fall Chinook will be measured to the nearest 1.0 mm fork length and weighed to the nearest 0.1 gm. A random subsample of natural fish (non-lethal upper caudal fin clip) will be collected for future genetic analyses. Natural subyearlings 60-mm fork length and longer will be implanted with a 12-mm PIT tag. A subsample (approximately 10,000) of natural subyearlings between 45 and 59-mm fork length will be implanted with 8-mm PIT-tags. Tagged fish will be released at the collection site after a 15-min recovery period.

Prior to release, we will randomly divide the tag codes into two equal sized groups to represent the TWS and BWS groups. We will coordinate with the Pacific States Marine Fisheries Commission to program the separation-by-code systems at Lower Granite, Little Goose, Lower Monumental, and McNary Dams to route TWS designated codes to the raceways and BWS designated codes back to the river. In the case of the TWS group (and all other T groups in this proposal), SbyC will be run in monitor mode. Monitor mode insures representative SARs by routing TWS designated fish back to the river on the rare occasion when run-of-the-river fish entering the juvenile fish bypass system are not routed to the raceways. A total of 500–1,500 tag codes will also be pre-designated for SbyC diversion to net pens at Lower Granite Dam to provide sample fish for task 7.1 of objective 7.

Objective 6.—Tagging and releasing Columbia River Basin subyearlings (CRFPO lead).

Sample sizes for other Columbia Basin subyearling groups

We are proposing to tag natural subyearlings from the Hanford Reach and the Deschutes River, and hatchery subyearlings from Little White Salmon NFH. Each of these groups is classified as upriver bright fall Chinook salmon. Logistic and feasibility constraints limit the number of subyearlings that can be tagged in each of these groups, and thus target sample sizes reflect the expected number of fish that could be sampled and the resulting precision on the release to adult return SARs.

Because of the limitation on the number of fish that can be tagged, most analyses for these groups will focus on demographic rates that can be monitored within the FCRPS. These include passage timing, travel time, the proportion overwintering, exposure to spill, migrant size, detection probabilities, and the probability of migrating and surviving. In addition to these metrics, the proposed sample sizes will be capable of providing estimates of the SAR from release to adult return (Figure 4). Assuming an SAR of 0.6% for Snake Basin releases (the average SAR for PIT-tagged natural subyearlings from the Snake River, brood years 1992–2001) a target release of 20,000 fish would result in an SAR with a coefficient of variation of 9%. Assuming a SAR of 0.7% for Hanford Reach natural releases (Jeffry Fryer, *personal communication*); a target release of 20,000 would result in a coefficient of variation of 8%. Assuming a SAR of 0.8% for Deschutes River natural releases, a target release of 10,000 would result in a coefficient of variation of 11%. Finally, assuming a SAR of 0.5% for Little White Salmon NFH (Tim Roth, *personal communication*), a release of 25,000 would result in a coefficient of variation of 9%.

In addition to the within-FCRPS metrics and SARs, these releases will increase the number of natural and hatchery upriver bright fall Chinook salmon detected at Bonneville Dam for evaluating the effects of Bonneville arrival timing on ocean survival rates (Scheuerell and Zabel, *draft manuscript*). A target release of 20,000 Snake Basin fall Chinook salmon would provide approximately 180 detections at Bonneville (based on a 0.9% average proportion of detections, 2003–2007). A target release of 20,000 Hanford.

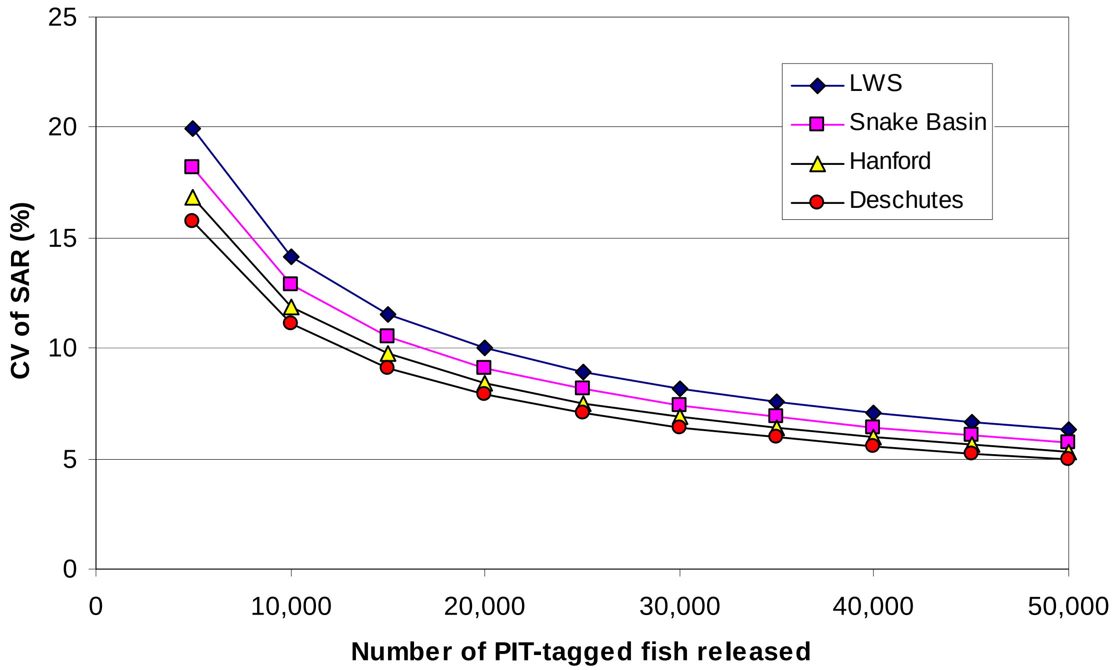

Figure 4. Coefficient of variation in SAR from release to adult return for natural (Snake Basin, Hanford, and Deschutes) and hatchery (Little White Salmon [LWS]) releases for various numbers of PIT-tagged fish released (assumed SARs are: LGR=0.6%, MCN=0.7%, Deschutes River=0.8%, and LWS NFH=0.5%).

Reach natural fall Chinook salmon would provide approximately 400 detections at Bonneville (based on a 2% average proportion of detections, 2003–2007). A target release of 10,000 Deschutes River natural fall Chinook salmon and 25,000 LWS NFH fall Chinook salmon would provide approximately 1,000 and 2,500 detections at Bonneville (based on a 10% average proportion of detections from JDA and TDA tailrace releases of hatchery fall Chinook salmon, 2006-2007). In total with these releases, approximately 1,600 natural fall Chinook salmon detections at Bonneville would be available for examining the effects of Bonneville arrival timing on ocean survival rates. Because fish from some of these rearing areas have known different ocean distributions, it remains to be determined whether all or some of the natural groups could be combined for these analyses, or whether ocean survival rates are different enough that combining groups may not be appropriate.

Task 6.1 Tagging and release of Columbia River Basin natural subyearlings

Dr. Jeffrey Fryer (CRITFC) has one year of funding from the State of Alaska to PIT-tag 20,000 natural Hanford Reach fall Chinook in 2008. The onset of the tagging activities is dependent on fish maturation rates. The PIT-tagging effort will begin when the percentage of fish greater than 48 mm in length has risen to 70–80% and the mean size has increased to about 53 mm. Tagging will end prior to the release of juvenile fall Chinook salmon from Priest Rapids Hatchery to ensure that hatchery fish are not tagged. Typically, tagging will begin on or near June 2 and will take place over four days.

Pre-smolt salmon will be collected by three crews of 3 to 4 persons working out of two 5.8 m to 6.4 m jet sleds. Fish will be collected primarily between the Hanford town site boat ramp and upstream of the White Bluffs town site boat ramp. Fish will be captured with stick seines 11.0 m to 18.3 m long and 1.8 m deep with a mesh size of 4.8 mm. The captured juvenile Chinook salmon will be temporarily placed into 19 liter plastic buckets and then transferred to the holding tanks equipped with oxygen aeration systems in each boat. When crews have a full load of fish they are transported to the tagging area and transferred into three 0.9 m x 0.9 m x 4.9m fiberglass tanks with a pump providing a continuous water flow. The tagging area will be located at the Hanford townsite boat ramp which has been used for this project since 1999.

Fish are graded by the tagging crew. The 60–80 mm and >80 mm groups will be placed in a holding tank for tagging with the 8 or 12.5mm tag, while the 48-59mm fish will be placed in a second additional holding tank for tagging with the 8 mm tag. PIT Tags will be inserted using standard techniques. Fish will be tagged in a trailer equipped with a recirculating anesthetic system and flow-through fish holding tanks. One person will tag the fish while another enters data and three to four others disinfect, load tag injectors, and support the operation. Subsequent to tagging, fish will be held for a minimum of 2 hours prior to release back into the river. We will hold groups up to 100 fish with the standard 12.5 mm tag. We will hold fish with the new 8.5 mm tag for longer periods to assure there is minimal to no impact of the tag on fish behavior or survival.

<u>Task 6.2 Tagging and release of Columbia River Basin hatchery subyearlings</u>

The Warm Springs Tribe has ongoing funding to sample natural fall Chinook salmon for coded-wire tagging. Up to 10,000 of these fish could be PIT-tagged each year from 2008–2012 with sufficient funding. Similar protocols to those used in the Hanford Reach and Snake River Basin would be used for handling, tagging, and releasing fish.

For Little White Salmon NFH releases, PIT-tagging will be conducted by CRFPO crews at the hatchery after fish are greater than 60 mm. CRFPO presently has funding to PIT-tag 15,000 fish per year, beginning in 2008. Additional funding would be required for supplementing these efforts with an additional 10,000 tags/year for three years (and 25,000 tags/year during 2011-2012). As transportation does not occur below McNary Dam, no tag designation will be required for LWS NFH releases.

Objective 7.— Comparisons among PIT-tag release groups and migration experiences

Task 7.1 Evaluation of surrogate performance (IFRO lead)

We will conduct comparisons and present results on the three PIT-tag groups of Snake Basin subyearlings four different ways. First, we will summarize tagging and release results. Second, we will pool the data collected from Snake and Clearwater River natural subyearlings to depict passage timing at Lower Granite, Little Goose, and Lower Monumental Dams to represent the natural population. We will do the same for the Snake and Clearwater River surrogate subyearlings and production subyearlings. We will not make statistical comparisons at the population level. We will weight the population-level analyses according to 70:30 rule in the instance of the surrogate releases when 70% of all natural fish tagged are not tagged in the Snake River and 30% of all the natural fish tagged are not tagged in the Clearwater River (or when the production subyearlings are not tagged in proportion to the actual numbers of untagged subyearlings released upstream of Lower Granite Reservoir). The third way we will analyze data and present results will be with statistical comparisons of the post-release attributes among the three PIT-tag groups (surrogate, production, natural) released into the Snake River. Fourth, we will make statistical comparisons among the three PIT-tag groups of subyearlings released into the Clearwater River. All statistical tests of differences among and between groups will use a significance level $\alpha = 0.05$. Tests will be done separately by dam except in the cases of travel time and the joint probability of active migration and survival. These two variables will be estimated and compared among the three PIT-tag groups of Snake River subyearlings at Lower Monumental Dam and the three PIT-tagged groups of Clearwater River subyearlings at Lower Granite Dam.

Analysis on passage timing at dams, level of exposure to spill, and travel time to Lower Monumental Dam will depend on estimated daily passage distributions at the dams. We will estimate the number of subyearlings from each of the three PIT-tag groups that passed a dam on a particular day as the counted number of PIT-tag detections for the group (or the expanded number in the instance of the Clearwater River fish during population-level analyses) divided by the estimated proportion of fish from the group that was detected as they passed that day. We will estimate the daily detection proportion at each dam using the methods of Sandford and Smith (2002). We will treat the estimated daily passage distributions as observations in statistical tests.

We will use a three-sample Kolmogorov-Smirnov test (hereafter "K-S" test) (Kiefer 1959) to test for differences among the 2008 cumulative passage distributions of the three PIT-tag groups. We will use two-sample K-S tests to evaluate pair-wise differences in the cumulative passage distributions between each pair of groups. We will report "Dmax" test statistics from the K-S tests in percentage points calculated as the maximum daily difference between the cumulative passage distributions of natural and surrogate subyearlings and natural and production subyearlings.

We will estimate the monthly percentage of each PIT-tag group of subyearlings that passed each dam by dividing estimated monthly passage by estimated total passage in 2008 and multiplying by 100. We will use a chi-square test to determine if there was a difference in monthly passage among the three PIT-tag groups of subyearlings. We will identify the peak month of passage for PIT-tagged natural subyearlings and use simple chi-square tests to compare daily passage during this month between natural and surrogate subyearlings and natural and production subyearlings.

For each of the three PIT-tag groups of subyearlings released in 2008, we will also calculate the percentage of the total detections (i.e., 2008 and 2009 combined) that were made in 2009 (i.e., fish that overwintered in a reservoir and completed migration in 2009). This percentage will provide an index of the relative proportion of reservoir-type juveniles in each group's migration histories, noting that PIT-tag detection systems will be dewatered at the dams during winter and passage that occurs during this period will be unmonitored. We will use a chi-square test to determine if there was a difference in the percentage of each group that passed in 2009 and then use simple chi-square tests to make pair-wise comparisons between all pairs of groups.

We will use the estimated 2008 passage distributions to estimate the percentage of each PIT-tag group of subyearlings that was exposed to summer spill. For statistical tests, we will transform these percentages to meet normality assumptions. We will use a two-way analysis of variance (factors: release group and dam) to test for differences in the level of exposure to spill. We will use Fisher's protected least significant difference (LSD) test to evaluate pair-wise differences in the level of exposure to spill between all pairs of groups.

For each PIT-tagged fish detected at Lower Monumental Dam (or Lower Granite Dam in the case of Clearwater River fish), we will calculate travel time as the number of days that elapsed between release and detection. Then, for each detection date, we will calculate the mean travel time of all fish that were detected that day from each of the three PIT-tagged groups of subyearlings. Finally, the average travel time for all fish from a group will be estimated as the weighted mean of estimates for each detection date, with the number of fish estimated to have passed Lower Monumental Dam on that date as the weight. We will use a one-way analysis of variance to test for differences in weighted mean travel time to Lower Monumental Dam among the three PIT-tag groups of subyearlings. We will use Fisher's protected LSD test to evaluate pair-wise differences in weighted mean travel time between two groups.

We will recapture subsamples of fish from each of the three PIT-tag groups of subyearlings at Lower Granite Dam, Bonneville Dam, and by hook-and-line sampling in Lower Granite Reservoir to characterize size during seaward migration as mean fork length (mm), mean weight (g), and mean condition factor K (weight divided by the cube of fork length multiplied by 100). Statistical analyses will depend on sample size.

Because of the reservoir-type juvenile life history, the detection data will not always conform to the classic single-release-recapture model described by Cormack (1964) and Skalski et al. (1998). Lowther and Skalski (1998) attempted to develop a model to deal with data of this nature. However, de-watering of the PIT-tag detection systems at the dams during late winter, and consequent unmonitored passage, will violate a critical assumption of both the single-release-recapture model and the model of Lowther and Skalski (1998).

One option for dealing with this situation is to use only detections during the year of release. This results in data more likely to fit assumptions of the single-release-recapture model, but requires re-interpretation of the model parameters. By ignoring detections of reservoir-type juveniles the year following release, there is no distinction in the resulting truncated data between cessation of active migration during the year of release and mortality. Consequently, the parameter that is usually interpreted as the probability of survival must instead be interpreted as the joint probability of actively migrating and surviving.

Natural fall Chinook salmon from the Snake River upstream of the Salmon River confluence rarely exhibit the reservoir-type juvenile life history (2% and less; Connor et al. 2002). Thus, we can assume that few of these fish pass dams unmonitored from late fall to winter when the PIT-tag detection systems are dewatered. Ignoring detections of reservoir-type juveniles the following year, after the PIT-tag detection systems are watered up, a typical single-release-model "survival" estimate to the tailrace of Lower Granite Dam for upper Snake River reach fish from the single release-recapture model might be 69%. In reality, this estimate is the product of the probability of migrating as a subyearling smolt and passing the Lower Granite Dam when the PIT-tag detection system is watered up (e.g., 98%) and the probability of surviving to the tailrace of Lower Granite Dam as a subyearling (e.g., 70%). That is, 69% = 98% x 70%. In this example, the estimate of the joint probability is only one percentage point lower than the actual survival probability. Therefore, the joint estimate is a relatively unbiased estimate of actual survival probability alone.

Natural fall Chinook salmon produced in the Clearwater River exhibit the reservoir-type juvenile life history more frequently (e.g., 6–85%; Connor et al. 2002) than natural fall Chinook salmon from the Snake River upstream of the Salmon River confluence. The prevalence of late fall passage, as well as empirical observations (Tiffan and Connor 2005; B. Arnsberg, NPT Fisheries, unpublished data), suggest that reservoir-type juveniles commonly pass dams unmonitored during the winter when the PIT-tag detection systems are dewatered. Ignoring detections of reservoir-type juveniles that occur in the spring following release, a typical single-release-model “survival” estimate to the tailrace of Lower Granite Dam for Clearwater fish might be 16%. Again, this quantity actually estimates the product of the probability of migrating as a subyearling smolt when the PIT-tag detection system at Lower Granite Dam is watered up (e.g., 40%) and the probability of surviving to the tailrace of Lower Granite Dam as a subyearling (e.g., 40%). That is, 16% = 40% x 40%. The joint probability estimate in this example is 24 percentage points lower than the actual survival probability.

In the first step of analysis of the data from this study, we will divide the natural subyearlings from each river into two intra-annual groups referred to as “cohorts” (Connor et al. 2003). For Snake and Clearwater River surrogate subyearlings, we will divide the data into intra-annual release groups based on week of tagging and release (n = 3 in the Snake River; n = 3 in the Clearwater River). The production subyearlings and yearlings will be kept in their original release groups by location. We will calculate SEs as described by Zar (1984) with the exception of the Clearwater River production subyearlings and yearlings in which case we will use the methods described by Cormack (1964) and Skalski et al. (1998).

To test for differences among the estimates of the joint probability of migration and survival for the PIT-tagged groups, we will square-root transform the joint probability estimates, and then used one-way analysis of variance, with group as the factor. We will use Fisher's protected LSD test to evaluate differences in the estimates between two groups.

The final step in the analyses will be to compile river-specific summaries. We will calculate a standardized index of attribute similarity between natural and surrogate subyearlings and between natural and production subyearlings. We will also tabulate the outcome of the hypothesis tests (i.e., yes, rejected Ho; no, failed to reject Ho) made during the analyses.

To calculate each index of attribute similarity, the higher value of the attribute will always be divided by the lower value of the attribute as shown in the following examples for travel time to Lower Monumental Dam. If travel time was 41 days for natural subyearlings and 45 days for surrogate subyearlings, the index for travel time of surrogate subyearlings would be

1.1 (45/41). If travel time was 41 days for natural subyearlings and 20 days for production subyearlings, the index for production subyearlings would be 2.0 (41/20). From this example, we would conclude there was a 1.1-fold difference between the mean travel times of natural and surrogate subyearlings and there was 2-fold difference between the mean travel times of natural and production subyearlings.

To calculate the indices for cumulative passage, we will use the cumulative percent passage values observed at Dmax. For peak monthly passage, we will use the percentages of the groups that passed during the peak month of passage observed for natural subyearlings. For passage in 2009, we will use the percentages of total detections (i.e., 2008 and 2009 combined) that occurred in 2009. For exposure to spill, we will calculate the indices from the estimated percentage that passed during the spill period in 2008. An example for travel time to Lower Monumental Dam was given previously. We will calculate the indices for size during seaward movement and the joint probability of active migration and survival to the tailrace of Lower Monumental Dam using means.

Task 7.2 Evaluation of migration of Snake River subyearlings through the FCRPS (IFRO lead)

In addition to the comparisons described under Task 7.1, IFRO will compile the existing journal articles on the effect of fork length, release date, release location, and environmental conditions following release on the variables compared among Snake River subyearlings. Additional analyses of the factors affecting some of these variables are presently funded by the Bonneville Power Administration (Project 199102900).

Task 7.3 Evaluation of migration of Columbia River subyearlings through the FCRPS (CRFPO lead)

Principle investigators will conduct preliminary comparisons and present results on the each of the PIT-tag groups of Columbia River subyearlings in three general steps. First, we will summarize tagging and release results. Second, we will summarize passage timing, fish travel time, proportion overwintering, spill exposure, detection probabilities, and migration and survival rates within the FCRPS. Third, we will make preliminary comparisons between the release groups documenting the similarities and differences in the demographic rates based on length, release date, release location, and environmental conditions following release.

Task 7.4 Scale pattern analyses for understanding life-history diversity (NOAA lead)

We PIT-tagged subyearling fall Chinook salmon from 2001–2006 as part of transportation evaluations as a baseline against which to compare SARs during years with and without summer spill (Marsh et al. 2003, 2004a, 2004b, 2005). Returning adults from these studies will be collected at Lower Granite Dam's adult fish trap using SbyC (Marsh et al. 2007). The numbers of adult fish collected will vary each year depending on the numbers of fish tagged as juveniles that form the various age-classes of returning adults, and the overall return rate for each age-class of outmigrants. Depending on SARs, the number of adults sampled could range from 100 to over 1,000. During fall 2006, we sampled approximately 140 adults.

Before the return of adult fall Chinook salmon in 2008, we will add the PIT-tag codes of all fish we PIT tagged as juveniles to the SbyC database. We will then collect each fish that is detected passing through the adult facility at Lower Granite Dam. Scales will be taken and associated with the PIT-tag code of the fish. Fork lengths will also be recorded. The scale envelope will be marked with a sequential sample number. The sample number and the PIT-tag code will then be recorded onto a log sheet. The scales will be analyzed to determine origin (natural or hatchery) and whether the first annulus was formed in seawater (seawater annulus) or in freshwater (freshwater annulus; see Connor et al. 2005). A seawater annulus indicates first-year wintering in seawater and age-0 ocean entry, whereas a freshwater annulus indicates first-year wintering in freshwater or the estuary and age-1 ocean entry (i.e., reservoir-type life-history). We will determine year of ocean entry from age at ocean entry. For example, if a juvenile was released in 1998 and entered seawater as a subyearling, then year of ocean entry was 1998. Scale pattern analysis prior to 2005 preceded the compilation of juvenile PIT-tag histories and was conducted without the knowledge of gender or fork length to ensure blind analysis of scale patterns.

The adults that will be sampled for scales passed Bonneville Dam that had the T_0, C_0, or C_1 passage experiences as juveniles. We will divide the T_0 group into summer (21 Jun–31 Aug) and fall (1 Sep–13 Dec) subgroups based on PIT-tag detection history. Membership in the C_0 and C_1 groups will also be determined based on PIT-tag detection history. The C_1 group will be divided into summer and fall groups as described for the T_0 group. The C_0 group cannot be divided because time of passage for these fish is unknown.

We will be able to conclusively identify first year wintering locale of some of the returning fall Chinook salmon recaptured at the trap based on the results of scale-pattern analysis and PIT-tag detection histories. The scale will have a saltwater annulus if the returning fall Chinook salmon had spent its first winter in saltwater. The scale will have a fresh-water annulus, and potentially a PIT-tag detection history indicating tagging in year t and detection at a dam in year t+1, when the returning fall Chinook salmon had spent its first winter as a juvenile in reservoir. A returning fall Chinook salmon that had spent its first winter as a juvenile in freshwater downstream of Bonneville Dam will also have scales with freshwater annuli, but conclusive identification of this first-year wintering history will require either a detection (1) when the fish was routed to a raceway and transported as a subyearling, or (2) when the fish passed Bonneville Dam via the juvenile fish bypass system as a subyearling. Using our present methods it is not possible to conclusively determine first-year wintering locale for a returning fall Chinook salmon that possess scales with freshwater annuli, but (1) is last detected upstream of Bonneville Dam as a subyearling (C_1 group) or (2) is never detected as a subyearling or as a yearling (C_0 group). We will continue to explore methods to confirm first-year wintering locale of these fish.

We will calculate time spent in seawater for each returning fall Chinook salmon by subtracting the year of ocean entry from the return year. For example, a subyearling that was released in 1998, entered seawater in 1998, and returned to freshwater in 1999 will be classed as a "I-salt" (Chinook salmon with this life history are males called jacks). A subyearling that was released in 1998, entered seawater as a yearling in 1999, and returned in 2000 will also be a "I-salt" (and also a jack). Fall Chinook salmon males that enter seawater as yearlings may also return to freshwater as "mini-jacks" ("0-salt") after residing at sea for only a few months (Zimmerman et al. 2003). These fish mature and return to spawn in the same year of seawater entry. We will consider only II-salt and older adults to be "full-term" adults.

Until adequate sample sizes are available, we will pool results for fall Chinook salmon from the Snake and Clearwater rivers to increase sample sizes for analysis of percentages by ocean age (I-, II-, III-, etc. salt).

In most instances, fork length (cm) will be measured on adult fish recaptured at the trap. To evaluate the effect of age at ocean entry on size at return, we will calculate mean fork length by ocean age. For this analysis, we will pool the data for hatchery fall Chinook salmon from the Snake and Clearwater Rivers across all return years to increase sample sizes. In some instances, gender will have been assigned to adult fish recaptured at the trap. We will calculate mean fork length by age at ocean entry and gender for comparison.

Task 7.5 Scale pattern analyses on Columbia River fish (CRFPO lead)

For comparative purposes, we propose to sample scales from returning adults from the Hanford Reach, Deschutes River and LWS NFH releases to determine age-at-ocean-entry.

Phase II: Exploring Methods for Analysis

The COE will host a workshop on potential analytical approaches to evaluate Snake and Columbia Basin fall Chinook passage, consistent with the study design agreed upon by the US v Oregon parties. Federal, state, or tribal researchers (or their representatives) interested in participating in the workshops and providing input to the development of the analytical methodologies will be given the opportunity to share their ideas, concerns, and candidate approaches. The workshops will provide an opportunity for participants to collaboratively develop and review a systematic analytical approach that fully considers uncertainties, evaluates evidence for and against each key assumption, and allows for adjustments in methods to account for critical uncertainties. Workshop results will advise and guide analysis, interpretation, and reporting of results using accepted scientific methods for analyzing data,. The COE will provide a professional facilitator responsible for summarizing the workshop products submitted by attendees, along with any additional supporting information developed during and after the meeting (within a reasonably short deadline) into a Phase II Workshop Report. The Workshop Report and results of any independent scientific review (e.g. ISRP or ISAB) will then be used by the principle investigators to prepare a Final Report of Methods for Analysis of Snake and Columbia Basin Fall Chinook Salmon Passage Strategies for use during Phase III. The principal investigators will work with workshop participants to ensure the analytical approach described in the Final Report of Methods for Analysis reflects, at best, a regional scientific agreement, and at least, the range of scientific opinion.

Phase III: Final Data Analyses and Reporting

During Phase III, principle investigators will analyze the data as described in the Phase II Final Report of Methods for Analysis of Snake and Columbia Basin Fall Chinook Salmon Passage Strategies. The principal investigators will share the data collected during the study with the managers in preparation for a series of workshops open to federal, state, and tribal researchers. The intent of the workshops is to provide an opportunity for the principal investigators to work interactively with other managers to analyze and interpret the data, as well as provide formal peer-review. Workshop participants can discuss and develop alternative analysis and interpretations of results during the workshops. The input received during the workshops will be included in a Final Draft Report that summarizes the analyses, study results and conclusions, prior to public release. The workshop facilitator will summarize the workshop products and supporting information provided into a Phase III Workshop Report. The Phase III

Workshop Report and the Final Draft Report summarizing study results may be sent out for independent scientific review (e.g. ISRP or ISAB). A Final Report of research results will then be prepared incorporating comments received during the public COE review process and the ISRP/ISAB review. Data will be made available for alternative analysis and publication.

The number of workshops required during Phase III will likely depend on the outcome of Phase II, but would likely be one or two workshops (or perhaps two the first year, and one per year thereafter).

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APPENDIX A

Long-term Framework for Evaluating the Responses of Snake and Columbia River Fall Chinook Salmon to Dam Passage Strategies and Experiences

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Introduction

Snake River juvenile fall Chinook Salmon utilize the mainstem Snake and Columbia rivers for both migration and rearing. As such, hydrosystem operations and transportation strategies affect the behavior and survival of this ESA listed species. Numerous policy and management decisions take into consideration impacts to Snake River fall Chinook salmon. Various study design requirements and management decisions that could be made yielded disagreement between entities, even when working towards the common goal of establishing acceptable hydro-system operations and fish passage strategies that support both recovery and maintain harvest of Snake River fall Chinook salmon. A long-term goal of the region is to determine a hydrosystem operation and fish passage strategy for Snake River Fall Chinook that will meet the recovery needs of this ESU, through a regionally developed approach.

To facilitate agreement on a long-term study design for evaluating the responses of Snake River Basin fall Chinook salmon to dam passage strategies and experiences, an AD HOC group has drafted three guiding documents. The first document is an executive summary. The second document is an agreed to proposal. The third document is an appendix (this document) that functions as a long-term framework to effectively memorialize original expectations and will hold parties accountable over the 10 plus years it will take to realize study results. The documents represent "will live with" approaches. These agreed to approaches may not be the best, or the ultimate desire of all individuals but each individual has a common understanding of what agreement was obtained and was acceptable to all.

Snake and Columbia River fall Chinook salmon have experienced many anthropogenic challenges to their existence. A program of maximized transportation around the Federal Columbia River Power System (FCRPS) was instituted beginning in the 1980's as the primary hydrosystem management strategy for the Snake River ESU. Despite this operation, abundance of this stock seriously diminished and in 1992 this stock was listed under the ESA. In 2005, the District Court of Oregon determined that spill operations should be implemented to better protect this ESU and this operation was codified in a court order for 2007. There is substantial regional disagreement as to the appropriate passage route that would result in achieving Viable Salmonid Population (VSP) and other management goals for the Snake River ESU: in-river migration through spill/surface bypass or collection and transportation. Regional parties are keenly interested in how to operate the hydropower system to meet the needs for the persistence, sustainability, and broad sense recovery of SRFC, therefore, in 2004, discussions were initiated to identify key management questions and to develop an evaluation plan. This document captures some of the details of those discussions, the plan that was developed, and a way forward for areas of disagreement.

Overall, the direction of this framework is two-fold. The first priority was to develop a study design that would meet the needs of the federal action agencies and cooperative parties to answer the needs of how to configure and operate the hydropower system relative to juvenile fall Chinook salmon survival. The issue of adult fall Chinook passage and survival under different operations also needs to be addressed (i.e. fallback and delay), but that is not addressed in this plan. The second purpose was to document points of agreement and disagreement identified and resolved during the development of the study design. If outstanding issues can be resolved or information gathered over the course of the evaluation indicates a need to change the study design, this plan may be modified towards that end. It is important to move ahead with a process and plan development that is acceptable to fishery managers and the Action Agencies.

Goal, Purpose and Need

A long term goal of the region is to determine a hydrosystem operation and fish passage strategy for Snake and Columbia River Fall Chinook that will meet the recovery and other management needs, through a regionally developed approach. Towards that goal, this plan was developed towards evaluating the performance of transportation of SRFC relative to inriver migration under the current court ordered spill operation.

The purpose of this framework is to:

1) Establish a collaborative approach;
2) Document key management questions regarding transportation and inriver migration of SRFC and Columbia River upriver bright fall Chinook salmon;
3) Document key management decisions with a focus on fish passage routes;
4) Document monitoring and evaluation objectives;
5) Describe general experimental design;
6) Points of agreement; and
7) Points of disagreement and decisions to move forward.

The regional managers have agreed that it is desirable to have agreement on the key management questions, study designs, data analysis and decision making at the outset of this evaluation, such that agreed to management decisions will be acceptable to participating parties and are as transparent and sound as possible. Thus, an overall plan for evaluating SRFC migration strategies is desired. This framework along with the consensus research proposal for evaluating the responses of Snake and Columbia River basin fall Chinook salmon to dam passage strategies and experiences is meant to satisfy that need.

Collaborating partners

Towards developing this evaluation plan (framework and proposal), federal, state and tribal agencies came together and worked in three primary groups including policy, planning and technical groups. The role of the technical group was to establish the biological issues and study design, the planning group was meant to develop the overall plan and to act as a liaison between the technical and policy group, and the policy group was meant to be the final decision making body. The primary participants are listed in the following table.

	BPA	CORPS	CRITFC	CTWS	IDFG	NOAA	NPT	ODFW	USFWS	WDFW
Policy	X	X	X	X	X	X	X[1]	X	X[2]	X
Planning	X	X	X		X	X	X	X	X	X
Technical	X	X	X		X	X	X	X	X	X

Other interested parties included technical staff from the Fish Passage Center, Pacific Northwest National Lab, Idaho Power Company, University of Washington and the US Geological Survey. In addition, to better coordinate the logistical aspects of the study, the *Snake River Fall Chinook Ad Hoc Group* was engaged at the technical level to facilitate coordination of the rearing and release groups from which the research fish were designated, and to facilitate technical discussion prior to submission to the *US v. Oregon* Policy Group. At the recommendation of the *US v. Oregon* parties (NPT and ODFW Feb 8th, 2006 letter to ACOE; Attachment 1), the fall Chinook research planning was brought into the FCRPS Biological Opinion Remand research, monitoring, and evaluation (RME) work group process. Finalization of this plan was not achieved during the collaboration portion of the Remand process, as such, this Ad Hoc Group has identified the USvOR and AFEP processes as the targeted forums for approval and implementation of this plan. However, this may not be acceptable to other basin fishery management parties that are not part of the ad-hoc group.

Historic Summer Operations (Pre-2005)

Prior to 2005, the Lower Snake River collector projects (LGR, LGO, LMN, McN) were operated without voluntary spill in an effort to maximize transportation during the summer in accordance with the 1995 and 2000 NOAA Biological Opinions. At that time, NOAA's concern was that high temperatures and low flow conditions would cause poor inriver survival for migrating SRFC; therefore fish collected at transportation dams should be transported to minimize mortality. However, recent analyses have indicated that transportation (under non-spill conditions) appears to neither greatly harm nor help these fish and that a combination of transportation and good inriver conditions for fish not collected and transported would be consistent with a "spread the risk" strategy until more is known. In the 2000 FCRPS BiOp and the Updated Proposed Action for the 2004 FCRPS BiOp, an evaluation of Snake River fall Chinook transportation and inriver migration was planned.

Recent and Future Summer Operations

In 2005, plaintiffs in the *NWF vs. NMFS* case regarding the remanded 2004 Biological Opinion, requested spill during the summer at the collector projects to provide what they believed to be better inriver migration conditions for these fish. Judge James Redden granted the Preliminary Injunction and spill was provided from June 20th to August 31st, 2005. In 2006, spill

[1] While some Nez Perce Policy personnel have been involved at various stages, whether the key policy personnel were involved in the design of the study may not have been well defined.
[2] While initially USFWS were within the policy group, moving to the remand group has made an unclear connection to the policy level where USFWS did not participate.

operations were laid out in the spill implementation plan which again included summer spill, however at volumes less than that provided in 2005. Variability in operations including spill levels, timing, and duration are anticipated and do not invalidate the study design; however realized operations are expected to maintain "good in-river conditions."

Management Questions, Decisions, and Research

Management Question and Policy Input

An important part of any research plan is the development of the key management questions. These questions help shape the overall research and planning efforts, allow the various interests to be addressed, and help to establish the operations that are needed for evaluation purposes. In general, the overall broad scale management question expected to be answered by this evaluation is:

- How should the FCRPS be operated to provide conditions for Fall Chinook during the migration and early rearing habitat phase within the FCRPS to achieve overall life cycle survival needed to support: recovery, other authorized purposes of the FCRPS, and sustainable harvest?

As subcomponents of this question, there were additional key questions that were raised at the Policy and Planning Groups including:

- What specific operations provide optimal in-river and transport conditions for fish?
- At what component of Snake River Fall Chinook should our management actions be directed to facilitate recovery?
- What is the relative performance of true in-river fish (i.e. spilled or passed via surface bypass) versus transported fish?
- What is the appropriate monitoring program to evaluate overall Snake River fall Chinook performance relative to the hydrosystem experience?
- Within and between years, what is the direct survival of smolts through the FCRPS under various conditions and routes of passage? What are the corresponding smolt to adult return rates under various conditions and various routes of passage?
- Do the marked fish used in the study represent the key component of Snake River Fall Chinook? If not, what changes are needed?

In an effort to answer these questions, the Policy group guidance was**:**

- Subject to logistical and financial constraints, mark enough wild fish (a good sample without mortalities), hatchery fish to size (surrogates); and hatchery fish to judge the effectiveness and survival over the long term.
- Design a transport study to have minimal (or no) impact on US v. Oregon release strategies and locations. If there is a change, be clear how and why so the US v. Oregon table can address this.
- When considering life cycle survival, figure in harvest rates from Canada and Alaska.

Management Decisions

Many management decisions could be informed by the evaluation outlined in this plan. These management decisions could include management of the hydropower system, management of harvest, or management of hatcheries. While the primary intent is to assess the management of the hydropower system, this evaluation could also yield additional information to these other H's to assist in the persistence, sustainability, and broad sense recovery of SRFC.

The management decisions which are the primary focus of this evaluation include whether:

- To transport or bypass SRFC back to the river at collector projects
- To spread the risk, maximize transport, maximize bypass or maximize spillway/surface bypass for migrants
- To use hatchery surrogate fish for research purposes to represent wild fish
  - Additional management decisions that <u>would likely be informed</u> because of this evaluation, but requiring additional analysis, include:
- When to transport SRFC from collector projects and when they should be bypassed back to the river
- To apply identifying marks to hatchery reared and natural origin fish.
  - Type of mark.
  - Number of fish marked.
  - Rearing location at time of marking.
  - Implement technical improvements for fish passage
- Tailor hydrosystem operations to address life history strategies
- How to monitor adult fish movement/passage.

Further management decisions that <u>may be informed</u> because of this evaluation, but requiring separate analysis could include:

- Need for additional flow augmentation and temperature modification
- Provide PIT tag information for harvest management
- To operate Lower Granite Dam trap to representative sample across fall Chinook run and remove identified "strays".
- How to prioritize energy generation and fish survival
- When to spill for fall Chinook
- How to operate hatchery mitigation programs
- How much spill to provide for fall Chinook at each dam

In addition to this evaluation, many additional studies are being performed for SRFC to determine direct passage survival at dams, habitat effects, behavior, and spawning success.

Monitoring and Evaluation Objectives

Members of the Policy workshop brought forward some basic tenets to follow regarding performing this type of evaluation. These tenets included that we should design a study to have minimal (or no) impact on *US v. Oregon* release strategies and locations, that we should look for opportunities to overlap efforts, and when considering life-cycle survival, we should figure in harvest rates from Canada and Alaska. In addition, discussions within the collaborative process identified the following as key technical information to make informed decisions.

- **Evaluate the SAR rates of SRFC by route (i.e. bypass, undetected and transport) across multiple years**

  The collaborating partners agree that by releasing fish upstream of the dams, collecting and transporting some, bypassing others, and allowing some to migrate inriver undetected, that a reasonable number of adults would return to compare SARs for assessing passage effectiveness by route for the years studied. This information should be obtainable from PIT-tagged fish.

- **Make direct estimates of survival & guidance efficiency for individual projects by route of passage, including in-season variations**

  Information on specific routes of passage (e.g., spillway, turbine, or bypass) will be gathered through radiotelemetry or acoustic tagging studies conducted as an additional component of the AFEP on an as needed basis.

- **Within and between years, determine the direct survival of juvenile SRFC migrating through the FCRPS under various conditions and routes of passage**

  The intent would be to examine the development of methods to assess fall Chinook survival based on what was learned from the tagging juvenile fish for multiple years, and the information on passage and run timing. Although the information gained from adult returns is believed to be of higher value.

- **Determine how well tagged fish used in the study represent their respective components of Snake River fall Chinook and assess what changes may be needed**

  Because there were three primary components of fish (hatchery, naturally produced and hatchery surrogate) tagged in 3 different river segments (lower Hells Canyon, upper Hells Canyon and the Clearwater River), with varying migrational behaviors and characteristics, the concern was that insufficient tagging of groups of fish would be occurring or that some fish tagged as representatives of others, would actually not be representative. In addition there is concern that surrogate fish may or may not represent the naturally produced fish that they were intended to.

In that large numbers of fish tagged as juveniles from each group would be tagged (2006 numbers of 183,000 production, 328,000 surrogates, and ~ 3,700 naturally produced fish) across various (close to representative) locations, it was thought that sufficient fish would be available from each group to assess if these fish are comparable, and representative of each other.

- **Estimate the proportion of fish migrating in river vs. transported**

  This should be informed in season and across years through the use of counts at dams, and evaluations being conducted concurrently. Radiotelemetry evaluations will provide estimates of fish guidance and passage through various routes. Monitoring at the fish facilities will allow for estimates of fish passing through bypass systems, and the proposed evaluation will provide substantial numbers of PIT tags passing through bypass systems to estimate the proportion of fish transported. Assessments of inriver abundance and survival towards developing these estimates are presently in the unresolved category.

- **Determine SARs for subyearling-type migrants vs. holdover yearling-type migrants**

  Recent information has indicated that fish that tend to over-winter in fresh water tend to return at higher rates than those that out migrated as subyearlings. Operating with and without spill may change the ratio of fish that holdover versus those that out migrate in the same year, potentially affecting the number of adult returns. This will be informed through this evaluation by monitoring for PIT tag codes at the adult fish facilities. If fish were detected as passing through detection systems as a juvenile, a comparison between life history of fish through the hydrosystem would be possible. In addition, scale readings on all PIT-tagged fish captured at the Lower Granite Adult Trap should provide an estimate of time of entry into salt water for all groups of fish. The proposed evaluation will provide substantial numbers of PIT tags to inform this question and appropriate sample numbers of adult fish would be worked through as to avoid any conflicts with run reconstruction efforts.

  Assessing survival in the mainstem river for those fish that hold over will be very challenging. Technology will be pursued for answering these questions; however, the Action Agencies believe that this is not presently possible.

- **Evaluate the comparative life cycle survival performance between Snake River and downriver fall Chinook salmon**

  Some of the collaborative participants would like to tag downriver populations of fall Chinook and use upstream/downstream comparisons to provide information on the latent effects of the FCRPS on fall Chinook. In their assessment of latent effects on spring/summer yearling Chinook, the ISAB recommended "the continuation of PIT tagging with a monitoring and evaluation program designed to reduce the current levels of uncertainty" and that "future monitoring and research is needed to further quantify biological factors that contribute to variability in estimated post-Bonneville mortality." The federal Action Agencies believe that there are too many differences between upstream and downstream stocks to provide reasonable comparisons. In addition, the ISAB reported, "the hydrosystem causes some fish to experience latent mortality, but strongly advises against continuing to try to measure absolute latent mortality. Latent mortality relative to a dam-less reference is not measurable. Instead, the focus should be on the total mortality of in-river migrants and transported fish, which is the critical issue for recovery of listed salmonids. Efforts would be better expended on estimation of processes, such as in-river versus transport mortality that can be measured directly." While the Action Agencies are in line with this opinion, this does not preclude the need to discuss these issues at a workshop in the future.

- **Determine the harvest rates of Snake River Fall Chinook**

  While harvest rates on fall Chinook may provide valuable information to the management of fall Chinook stocks, and this management question may be informed by this and other research. While data on harvest rates of Columbia and Snake Basin fall Chinook are currently being collected through coded-wire tagging (CWT) efforts, the assessment of transport to inriver migration does not rely on the assessment of harvest. This component lies outside the scope of this evaluation, but may be answerable through other RM&E efforts.

- **Spawner to spawner recruits ratio**

  This component lies outside the scope of this evaluation, however may be informed through the use of counts at dams, and research being conducted under the NPCC's program.

- **Hatchery effects**

  While hatchery effects on fall Chinook may provide valuable information to the management of fall Chinook stocks, and this may be informed by this research, this component presently lies outside the scope of this evaluation. Consideration of how to complement hatchery RME will be considered at a Workshop.

- **Dam operation effects on habitat**

  While effects of dam operations on habitat used for spawning, rearing and migration may be informed by this evaluation, this component lies outside the scope of this evaluation.

With a basic goal to develop a consistent and comprehensive monitoring and evaluation program to understanding the responses of fall Chinook salmon over their life-cycle to environmental and management conditions within and outside the Federal Columbia River Power System. The diverse nature of information described above goes beyond five primary objectives for evaluating the responses of Snake and Columbia River Basin fall Chinook salmon to dam passage strategies and experiences:

1. Estimate juvenile migration and survival rates within the FCRPS,
2. Estimate ocean survival rates (i.e., post-FCRPS),
3. Estimate adult upstream migration and survival rates,
4. Estimate overall smolt-to-adult survival rates (SARs) by management strategy and migration experience, and
5. Compare and contrast the above demographic rates, examining the effects of rearing type (hatchery, natural, surrogate), release and detection points above and within the FCRPS, release date, length at release, management strategy (TWS, BWS), migration experience (T_0, C_1), and environmental conditions following release (temperature, flow, water transit time, turbidity, spill).

General Experimental Design

What operations should be provided for the evaluation?

In general, there were two primary components at issue, one was the overall condition of whether to spill or not to spill, and the second was what volume to spill at the Snake River and McNary dams.

As far as overall operations, there were two general schools of thought on testing operations. One included a "max spill versus no spill (max transport) regime", while the other would be a test of a "spread the risk" operation. For the purposes of bringing forward one discussion topic in a short time period for discussion at the *US v. Oregon* forum, the spread the risk operation was brought forward. This was advised based on the 2005 court decision and discussions held in the remand forum. However, the understanding was that the no spill versus max spill operation would be revisited, but not necessarily within the primary scope of this evaluation. (This is in the unresolved issues section.) If one operation versus another is determined to be the better migrational strategy, the spill versus no spill may be a moot point. For example, if inriver migrating fish perform better than transported fish during a spill operation, a no-spill operation may not be warranted for testing in the future.

As far as specifics, the spill level for the 2005 operation was determined in the preliminary injunction as all flow other than one turbine operation at each project, with the exception of Little Goose Dam, which was changed to a 30% daytime operation in order to not affect adult migration, and McNary dam, which was to spill all flows over 50kcfs. For the 2006 operation, planned spill levels were 18kcfs at LGR, 30% LGO, 17kcfs at LMN, ICH 45kcfs day, cap night (30% testing purposes), McNary 40%/60% spill operation 24 hrs. These or similar operations are likely to continue through the course of the evaluation.

Marking Numbers and Design for 2005 and 2006

An initial tagging effort began in 2005 whereby 176,000 hatchery surrogate fish were released.

For 2006, a study was outlined using targets of 250,000 and 330,000 PIT-tagged hatchery production and hatchery surrogate fish (see attachments 1 & 2). Additionally, 10-20,000 naturally produced fish would be targeted for PIT tagging from the Snake and Clearwater rivers for comparing to the large numbers of hatchery PIT-tagged fish. This marking level was agreed to for the 2006 study based on the number of fish available through the *US v. OR* process. Actual fish numbers released in 2006 were roughly 185,000 production fish, 328,000 surrogate fish, and about 4,000 naturally produced fish.

In 2006, the hatchery surrogate fish were released in groups of which 50% were destined for transport if collected and 50% destined for bypass. The hatchery production fish were released in groups of which 65% were destined for transport and 35% destined for bypass. There were concerns by some of the partners that bypassed fish survive at lower rates; therefore this route was not preferable for the production group. The 35% of fish destined for bypass in this group was meant to allow for the potential of producing inriver survival estimates; although not all parties (primarily the Action Agencies) agreed that this was feasible. At the time, the Corps believed that in addition to their stewardship responsibilities for production fish, that tagging these fish provided a reasonable comparison between hatchery, surrogate and wild fish, and a certain level of transport analysis could still be performed.

Numbers of Fish and Statistical Precision

While the numbers of fish released in 2006 may provide enough information to assess the various migration strategies, they may not be acceptable to all parties in the region with regard to statistical precision.

Timeline

The exact number of years that will be required for the primary transportation evaluation depends on: 1) the number of fish that are marked, 2) the desired detectable difference between transported and in-river-migrating fish, 3) the number of years required for people/agencies to develop a level of confidence and comfort with the results, 4) the lag-times spent waiting for adult returns and 5) the decision criteria. With the marking levels proposed for this study in 2006, sample size calculations expected that differences of 25-50% between the transported and in-river-migrating groups could be detected with one year of marking. Although summer operations do not typically vary widely, the effects of transportation are likely to vary with differences in between year environmental conditions and thus this evaluation will require more than one year of tagging. Because of lag-times spent waiting for adult returns, the full returns from fish released in 2005 and 2006 will not be realized until 2009 and 2010 respectively. In the interim, jacks and mini-jacks will return in 2007 and the first egg bearing females will return in 2008. These initial returns will provide important information on whether the marking levels were appropriate for the initial sample size calculations, and should allow for modifications to the numbers of fish as necessary.

At a meeting on January 19, 2006 and at subsequent meetings, the number of years of tagging and targeted operations (spill) was discussed, ranging from a minimum of three years up to 10 years. In general, the technical group supported a target of 5 years of study for marking and operations which would be representative of one brood (one full cycle of smolt to spawners). This would require marking fish in 2006 and from 2008 through 2011. The full return for the

2011 releases would return by 2015, indicating that final assessment duration of nine years would be required for five years of operations. What operations and evaluations would occur in the interim (i.e. between the last year of tagging and the last year of adult returns) is in the unresolved issues section. This target duration would encompass five years of marking (with the possibility that the release numbers in the last two years could be altered based on the first adult returns in the fall of 2008), and five years of natural variation in the in-river environmental conditions. If the regional parties had the desire to evaluate additional operational scenarios or if extremely low flow years occurred at some time during the study period, additional years of marking and alternative operations would likely be required. Marking levels would need to be informed by the targeted operations.

It must be understood that this number of years (5) was not determined analytically or derived statistically because there is presently not sufficient information available to make that assessment. It is likely that several years of tagging will be required to develop a strong understanding of how operations and environmental conditions affect these fall Chinook metrics.

Although a general target of 5 years was supported, the regional parties believe that annual check in points would be prudent. An assessment of the returns of fish tagged from 2005-2006, and 2008, all years in which large numbers of PIT-tagged fish would be released and for which some level of adult returns with spill occurring will be in hand, may yield early clues as to whether one migration strategy was favorable over another. If differences in some migratory routes were drastically different than others, a reassessment of that operation and the evaluation (including duration) would be made. The potential is that a lesser number of years may be needed to assess these operations.

For the purposes of this, and potential subsequent operations planned for evaluation, the maximum number of years for planning to tag Snake River Fall Chinook is ten (with 2006 being year 1). This is not to say that tagging or specific operations would necessarily be required in all ten years or that fish would be requested in every year, however, based on check ins, decisional criteria, and certainty with the data, ten years provides sufficient flexibility for adaptive management purposes, while providing a solid end date for fish requests for members within the Policy Workgroup.

Points of Agreement

Overall, the level of agreement was quite high within the group regarding the mechanics of the evaluation. In general, it was agreed that:

- Hatchery-surrogate, naturally produced, and production fish would be used, with hatchery surrogates used in an attempt to mimic naturally produced fish. However, comparisons would be required to determine how well the hatchery surrogate fish mimicked the naturally produced fish.

- For the release groups, it would be best to have fish in pre-determined treatment groups for Bypass-if-collected and Transport-if-collected with sort by code occurring at each dam.

- When tagging the production fish, groups should come from a proportional tagging effort across the release sites.

- Hatchery surrogate fish would be released into the Clearwater and Snake rivers in roughly a 30%/70% ratio to mimic the proportions of redds in each river, meant to emulate the naturally produced fish proportions, size and timing.

- Performing adult fish scale reading would yield valuable information for the evaluation including an assessment of yearling and subyearling life history and over wintering behavior.

- It was agreed that jacks and mini jacks would be reported on, with the various analyses brought forward including all of the different groups of treatment fish. While the reporting of jacks was thought to be important, it was not agreed as to the management framework, as to whether or not jacks would be included in the management decision.

Points of Disagreement and Decisions to Move Forward

While the collaborating groups were in agreement on most of the issues regarding the research, there were still some unresolved issues. These issues ranged from minor technical differences to major policy issues. The following italicized text is the August 24th memo to USvOR small work group from the Snake Basin Fall Chinook Salmon Ad Hoc Group and subsequent small work group decisions. The USvOR small work group with representatives from Confederated Tribes of Umatilla Indian Reservation, Confederated Tribes of the Warm Springs Indian Reservation, Idaho Department of Fish and Game, National Oceanic and Atmospheric Administration – Fisheries, Nez Perce Tribe, Oregon Department of Fish and Wildlife, U.S. Fish and Wildlife Service, and Washington Department of Fish and Wildlife met on September 25th, 2007. The achieved consensus decisions on all eight points of disagreement.

To facilitate agreement[3] *on a long-term study design for evaluating the relative performance of Snake River Basin fall Chinook salmon (SRFC) using different passage routes at dams, an AD HOC group has been drafting a "living" document made up of three parts. The first part is an executive summary. The second part is a an agreed to proposal. The third part is an Appendix that functions as a long-term framework that effectively memorializes original expectations that will hold parties accountable over the 10 years it will take to realize study results. This memorandum describes areas of disagreement which need resolution in order to complete an agreed upon long-term Snake River fall Chinook salmon passage route study design. The issues identified here represent aspects identified by at least one entity as either essential to include or exclude in order to fund the study or for them to participate. If left unresolved, these issues*

[3] USvOR parties and COE.

would likely jeopardize conduct of all or part of the study either through lack of fish production/marking approval by USvOR and/or withdrawal of study funding by COE.

The memorandum was prepared for a small work group of USvOR, formed to help reach agreement on near-term and long-term topics in need of resolution. Results of discussions by the small work group will be included in the Appendix. As of August 22nd, 2007, there remain three general topics of disagreement[4]; (1) groups of fish to be marked, (2) collaborative approach for study conduct, and (3) management process for applying results. Each one of these topics has 2 or 3 associated decisions; resulting in eight total decisions needing to be made. Three of the points of disagreement may be resolved, but are included here in order to confirm the identified approaches. The decisions requiring resolution by September 14th, 2007 are:

Topic 1: Groups of fish to marked.

- *Should the study include a downstream (below Ice Harbor Dam) mark group that would serve as a reference against which smolt-to-adult returns (SAR's) of SRFC could be compared to assess latent and delayed mortality? (resolution pending)*
- *Should the production of surrogate SRFC for the study be assigned a higher priority than it is presently given in the USvOR fall Chinook salmon production priority agreement?*
- *Should general production be marked to enable inclusion of a bypass SAR group in the study?*

Topic 2: Collaborative approach for study conduct.

- *Should a weight of evidence approach, using a series of interactive workshops whose intent is to ensure the experimental design, data collection and analysis, and interpretation and reporting of study results reflect, at best, a regional scientific agreement, and at least, the range of scientific opinion that best informs policy choices be used)? (resolution pending)*
- *Should the US Army Corps of Engineers fund the participation of additional scientists in the collaborative process to conduct and/or participate in the SRFC evaluation, data analysis, and reporting? (resolution pending)*
- *Should the ISAB, ISRP, or some other independent scientific group perform a scientific review of the study design, workshops, and or results?*

Topic 3: Management process for applying results

- *Should fish marking as prescribed in this study be discontinued after 5 years of marking before adult returns/results are complete?*
- *Should hydro-system operation adaptive management related to Snake River fall Chinook salmon follow a pre-established decision tree, applying a standardized suite of primary metrics and precision targets?*

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[4] In November of 2006, six points of disagreement were communicated to US v OR, two of which (#2 and #5) have been resolved. The points of disagreement described in this memo are similar with remaining issues identified in 2006. 1) Should survival of other fall Chinook stocks be compared to survival of Snake River fall Chinook stocks as part of this study? 2) How many years should fish be tagged? 3) What would the interim FCRPS operations be during the period after the last year of tagging and before final results are available? 4) Should a bypass group be included in the analysis as a management alternative? 5) How much certainty do we need in the study results? 6) Who should be involved in and responsible for collecting, analyzing and reporting on evaluation results?

The reminder of this memorandum is structured to provide a description of:

1) Topic of disagreement;
A) decision required, including background; and
i) statements of opposing and supporting positions.

Topic 1: <u>Groups of fish to be marked</u>.

Decision 1.A) Should the study include downstream (below Ice Harbor Dam) mark groups that would serve as a references against which smolt-to-adult returns (SAR's) of SRFC could be compared to assess latent and delayed mortality? (resolution pending)

Background 1.A) Many regional salmon managers believe that an assessment of fall Chinook in the Columbia Basin in its entirety is important. This approach, to address latent mortality and differential delayed mortality between transport and in-river groups ("D"), follows that used in PATH and CSS studies of Snake River Basin spring/summer Chinook salmon. The ISAB reported, "the hydrosystem causes some fish to experience latent mortality, but strongly advises against continuing to try to measure absolute latent mortality. Latent mortality relative to a dam-less reference is not measurable. Presently it is not clear how decisions would be made regarding the operations for fall Chinook. For example if SARs are the primary metric for the evaluation, what difference between SARs is acceptable to salmon managers to choose one migration strategy over another? Instead, the focus should be on the total mortality of in-river migrants and transported fish, which is the critical issue for recovery of listed salmonids. Efforts would be better expended on estimation of processes, such as in-river versus transport mortality that can be measured directly." However, the ISAB clarified their position on this issue and recommended that data from downstream marked groups was indeed valuable and should be obtained (Implementation Team meeting June 7, 2007). A key element of the debate is whether fall Chinook stocks originating downstream from Ice Harbor Dam share the same ocean experiences to serve as legitimate "controls" for evaluating how passing the four Snake River dams or being transported from Snake River collector projects affects survival of Snake River fall Chinook.

Ad Hoc group members have recently discussed the following potential resolution. Inclusion of a downstream mark group will continue to be negotiated following description of downstream treatment groups, analysis of their suitability, and summary of ongoing tagging. Pending the identification of a suitable group, a stand-alone proposal will be prepared and considered for funding within AFEP and/or NPCC forums, or directly from BPA.

Support 1.A.i) Comparing the performance of upstream stocks versus those that have not migrated through the Lower Snake River hydro projects enables the consideration of whether and to what degree differential mortality related to migration through the Lower Snake River exists. To estimate the magnitude of latent mortality and "D" comparisons of SARs between Snake River Basin fish experiencing exposure to transport, bypass, and in-river passage to downriver stocks with no exposure is needed. (ODFW, CRITFC, USFWS-CRO)

Opposition 1.A.ii) With respect to tagging downstream stocks of fall Chinook we continue to have concerns with the underlying purpose and objectives. In discussions with salmon managers over the past several months, we have identified the need for an overall study proposal including underlying basis and rationale, and study design. Such information is important for us to determine if the research is properly within the Corps area of responsibility and what application it might have to Corps programs and projects. Among others, specific questions about this study of "downstream" fall Chinook include:

- *What tagging of lower river stocks is presently being done, whether coded wire or PIT tags that might be useful in looking at downstream stock performance?*
- *Why are the proposed stocks considered to be appropriate downstream controls considering the differences in their characteristics and life histories?*
- *Have the basic scientific principles been outlined and addressed in a proposal for using downstream stocks as a comparison to Snake River fall Chinook? These would include: the hypothesis, rationale for tagging, justification for numbers of fish, analysis to be performed and comparisons to be made, etc…. This is especially important in that the Corps would need to regionally vet this through its AFEP process in addition to determining our role as noted above.*

In considering the operation of the Corps projects on the Snake River, how would tagging downstream stocks inform the operational decisions at the collector projects? Lacking resolution of these issues we can not fund marking downstream stocks. (COE)

Opposition 1.A.iii) The federal Action Agencies have expressed concerns with tagging downstream stocks as comparisons to upstream stocks. To determine whether these comparisons are valid, they've called for more discussion about what is presently being tagged, what stocks might be appropriate for tagging, the hypothesis and rationale for tagging those fish, and the applicability to Snake River dams and McNary Dam operations. Their support would be conditioned on demonstration that the stocks are comparable in all aspects except their experience through the hydro-power system. (NOAA, USFWS-IFRO, COE, NPT)

Small-work Group Consensus Decision 1.A: Include implementation of downriver marking groups in the long-term framework for the study with a recommendation to have the COE fund or at least support funding in other forums. Justification should also include a description of how inclusion of downstream groups is consistent with and will contribute toward to the implementation of basic diagnostic regional monitoring and evaluation for the ESUs. Include rationale and design for downriver marking in a single proposal package with the Snake River basin (upriver) component. Provide responses to questions raised about the merits and appropriateness of including downstream mark groups as part of the study proposal.

Decision 1.B) Should the production of surrogate SRFC for the study be assigned a higher priority than it is presently given in the USvOR fall Chinook salmon production priority agreement?

Background 1.B) Revision of the existing production priority table is not required to enable study implementation. The current agreement includes surrogate production of 328,000 *as priorities 12 and 14. Rearing of surrogate production does not limit rearing capacity for general production fish. Rearing surrogate production does require eggs from the same brood as general production. Duration of surrogate production is not currently limited in the agreement. Surrogate production does not reduce or supplant general production if sufficient broodstock is available (i.e. under unlimited broodstock conditions surrogate production is above and beyond USvOR general production agreement). Lower production priority increases the chance/ frequency of years when surrogate groups would not be implemented due to shortages in broodstock.*

Opposition 1.B.i) The tribes believe that surrogate production profiles may result in fish with reduced survival rates, and possible other negative changes in productivity from modifications in sex ratios and age class structure relative to general production profiles. As such, programming of eggs to surrogate production, when broodstock is limited, could result in reduced adult returns. (NPT, CTUIR, CRITFC)

Support 1.B.ii) Given broodstock is most likely limited in some/most years, failing to assign a high priority to surrogate production may result in years without treatment fish. Although surrogate releases do not have to occur in consecutive years, the proposed duration of the study is based on achieving 5 years of surrogate releases, however, skipping years would delay the point when final data is obtained and available to inform adaptive management decisions. Annual uncertainty in whether the study will proceed increases uncertainty in annual management processes, effort, and staffing. (COE, NOAA, USFWS-IFRO)

Small-work Group Consensus Decision 1.B: Support reconsideration of priorities after agreement on a final study design is reached among US v Oregon parties, with final production priorities informed by COE funding decisions.

Decision 1.C) Should general production be marked to enable inclusion of a bypass SAR group in the study?

Background 1.C) Some general production (yearling and subyearling) fish need to be bypassed (i.e. collected at the projects and returned back to the river) to monitor in-river survival rates. However the number of fish that must be tagged is substantially higher if the objective is to evaluate the SARof bypassed fish as a treatment group. Some members of the collaborative process would prefer that a bypass group only be included in the study as a means to get an estimate of in-river survival (C0). Others believe that each migratory management option should be evaluated as a potential management tool for the future. The debate centers around the costs, risks, and priority of marking the additional fish necessary to evaluate the SAR of bypassed fish, given disagreements on its appropriateness as a long-term management alternative. Performance of bypassed fish relative to transported fish will occur with surrogate fish. One purpose of including a production bypass group is to better enable a comparison among surrogate, natural, and production fish using different passage routes. An additional consideration for having a bypass group is to allow for maintaining a 50:50, split between in-river and transport migration, with an early bypass and late transport approach. However, policy level discussions are ongoing about what is meant by a spread the risk strategy and 50:50. The COE position is that the 50% inriver component can be comprised of either bypass or *spilled/surface bypass fish. The fishery managers' position is that the 50% in-river component needs to pass the dams via spill/surface bypass.*

Support 1.C.i) COE desires to answer the question of what to do with juvenile migrating fish once collected. It's conceivable that fish that are collected and bypassed will have higher SARs than transported fish. Without evaluating the bypass route, we wouldn't know what to do with collected fish (transport or put back in the river). As some fish will always be collected, even with passage improvements (RSWs, TSWs, etc.), this management option needs evaluation. When making management decisions based on the results of this study, it will be important to know if surrogates and general production fish responded similarly to transportation. Would an operation benefit one group at the detriment of the other? Therefore, the COE feels if general production fish are included in the study; it needs to be with the same study design as the surrogates (i.e. bypass and transport treatments).

Bypass is a viable management option. It is not clear that bypassed production subyearling Chinook would have lower return rates. Hatchery yearling Chinook bypassed (PIT return to river) at Lower Granite in 6 of 11 years had higher SAR than their undetected cohort (NWFSC, 16 Aug 2007).

Data available for "bypassed" fish represents sort-by-code return to river system that in some cases were in poor locations and with low flows, not operation bypass. Also, bypassed fish tend to be smaller and perhaps more diseased then the general population and may have lower SAR regardless of their route of passage. Nevertheless, the COE is changing the bypass outfalls to avoid the secondary dewatering, separators, etc and adding PIT detectors to these "full flow" outfalls. This has been completed at all project expect Little Goose (2008) and Lower Granite (2012). Therefore, future bypass operations may perform better, do to reduced stress and increased discharge, than the PIT return river and facility bypass. (COE, NOAA)

Opposition 1.C.ii) Yearling juvenile spring Chinook and steelhead that have been bypassed at dams consistently show lower SARs than fish passing in other routes, including transportation. Because the emphasis is on comparing transportation to in-river passage with good conditions (i.e. spill/surface bypass) and due to the fact that fish available for marking likely will be limited, a comparison of bypass fish to fish passing other routes is likely logistically infeasible and not defensible. Given the existing data on low SARs for bypass fish and the limited amount of fish available for marking, it is not a prudent method for managing fall Chinook. (CRITFC, NPT)

Small-work Group Consensus Decision 1.C: Include marking of an additional 65,000 (250,000 fish total) general production subyearlings for evaluation of a bypass study group under the following conditions: inclusion of the bypass treatment should not limit the ability to mark 185,000 production fish needed to evaluate the transport and in-river comparisons; as many fish are marked as possible before transfer to acclimation sites, and, for all study groups, marking should be done without adding undue risk to fish health, especially if tagging done post transfer to acclimation sites. Tagging constraints assessed annually based on site specific rearing conditions.

Topic 2: <u>Collaborative approach for study conduct</u>

Decision 2.A) Should a weight of evidence approach, using a series of interactive workshops whose intent is to ensure the experimental design, data collection and analysis, and interpretation and reporting of study results reflect, at best, a regional scientific consensus, and at least, the range of scientific opinion that best informs policy choices be used)? (resolution pending)

Background 2.A) In response to a one-page request for proposals by the COE, two proposals on the efficacy of transportation and spill were submitted to the COE in 2005. A series of SRWG meetings were held to discuss the proposals. Existing data on topics such as life history diversity and SARs were presented by a small number of experts. Audience participation was limited to comments and questions. A proposal prepared by NOAA and IFRO was selected by the COE, based on these meetings and a review of the proposals by three independent contractors funded by the COE, BPA, and BOR. However, based upon their own evaluations of the proposal, several of the fisheries managers opposed the study and emphasized that a weight-of-evidence workshop was first necessary to move forward on a consensus proposal. The proposal that was selected by the COE specified that workshops would be held to share data, preliminary results, and provide the opportunity for peer-review.

The ad hoc group feels that agreement on this issue simply requires clarification. It is clear that shared confidence in the results of the evaluation will require some level of ownership by all the parties. Collaboration, defined as joint contribution to intellectual projects or process, is probably the most important factor affecting ownership. The ad hoc group discussed the following.

The COE will commit in writing to sponsor a series of facilitated interactive workshops, as special SRWG meetings, open to federal, state, and tribal researchers. The first series will explore and identify valid analytical techniques to be used in the evaluation. A report written by the facilitator and reviewed by all participants will describe the data analyses and techniques to be used when the adult returns from the first year of releases are complete (2009–2010). Then, the COE will sponsor a second series of facilitated interactive workshops. The workshop attendees will be provided the raw data and draft analyses from the principle investigators. The attendees will have the opportunity to analyze and interpret the data independently, and then provide oral and written feedback on their results. The results will be revised accordingly and draft report written. The draft report will not be distributed until it is reviewed by federal, state, and tribal co-managers. This will produce results that at best reflect a regional scientific understanding; and at least, the range of scientific opinion.

Support 2.A.i) Some co-managers supported the proposal selection process and the concept of a workshop.

Opposition 2.A.ii) The process of proposal selection and the plans for future data analyses did not meet the expectations of some co-managers who felt that: (a) the floor should have been open for presentation of data by others in addition to the experts, (b) the interaction during the meeting was not truly collaborative, (c) the independent review provided by the *contractors was biased, and (d) the COE was not fully committed to sponsoring the workshop. They proposed that the study design and analyses should follow the "weight of evidence approach."*

Small-work Group Consensus Decision 2.A: A collaborative effort should continue, using interactive workshops.

The COE will host a workshop on potential analytical approaches to evaluate Snake River fall Chinook passage, consistent with the study design agreed upon by the US v Oregon parties. Federal, state, or tribal researchers (or their representatives) interested in participating in the workshops and providing input to the development of the analytical methodologies will be given the opportunity to share their ideas, concerns, and candidate approaches. During the workshop, participants will have the opportunity to discuss and debate the alternative approaches presented. The COE will provide a professional facilitator responsible for summarizing the workshop products submitted by attendees, along with any additional supporting information developed during and after the meeting (within a reasonably short deadline) into a Phase II Workshop Report. The Workshop Report and results of any independent scientific review (e.g. ISRP or ISAB) will then be used by the principle investigators to prepare a Final Report of Methods for Analysis of Snake River Basin Fall Chinook Salmon Passage Strategies for use during Phase III. The principal investigators will work with workshop participants to ensure the Final Report reflects, at best, a regional scientific agreement, and at least, the range of scientific opinion.

During Phase III, principle investigators will analyze the data as described in the Phase II Final Report of Methods for Analysis of Snake River Basin Fall Chinook Salmon Passage Strategies. The principal investigators will share the data collected during the study with the managers in preparation for a series of workshops open to federal, state, and tribal researchers. The intent of the workshops is to provide an opportunity for the principal investigators to work interactively with other managers to analyze and interpret the data, as well as provide formal peer-review. Workshop participants can discuss and develop alternative analysis and interpretations of results during the workshops. The input received during the workshops will be included in a Final Draft Report that summarizes the analyses, study results and conclusions, prior to public release. The workshop facilitator will summarize the workshop products and supporting information provided into a Phase III Workshop Report. The Phase III Workshop Report and the Final Draft Report summarizing study results may be sent out for independent scientific review (e.g. ISRP or ISAB). A Final Report of research results will then be prepared incorporating comments received during the public COE review process and the ISRP/ISAB review. Data will be made available for alternative analysis and publication.

Decision 2.B) Should the US Army Corps of Engineers fund the participation of additional scientists in the collaborative process to conduct and/or participate in the SRFC evaluation, data analysis, and reporting? (resolution pending)

Background 2.B) Collaborative processes are most successful when all parties are represented and contribute to project direction and product development. This creates a sense of ownership and helps assure the project is consistent with and supportive of each entities *goals/mandates. Even when authority and/or desire to participate in a collaborative process exist, participation can be constrained by staff availably. Funding some level of staff participation by all parties demonstrates a real commitment to collaboration and holds participants accountable for contributions. To date, the various ad hoc and individual efforts to develop study designs, data anaylses, and write/review reports has been done without COE funding beyond the Principle Investigators (NOAA, USFWS-IFRO, NPT). Some co-managers had the expectation that the COE would fund their staff to be involved with this effort. Others supported the approach regardless of funding status. Further, some parties feel the researchers conducting the study can adequately implement, analyze, and report the results, with guidance from collaborators provided through the workshop process described above and the peer-review process.*

Ad Hoc group members have recently discussed the following potential resolution. The COE will fund a series of workshops to discuss and incorporate concerns, suggestions, and contributions from all interested parties (see Decision 2.A background for scope of workshop details). Funding will be provided to cover; meeting independent facilitation including reports, room costs, and participants travel/per diem/lodging.

Support 2.B.i) Funding of non-principle investigator staff to enable/ensure participation in design, implementation, analysis, and report writing will significantly contribute to the quality of the end products (tribes, Oregon, Idaho)

Opposition 2.B.ii) The COE encourages and welcomes broad agency participation in development of objectives, and review of proposals and reports through the Anadromous Fish Evaluation Program. However, we do not provide funding for this participation. COE lacks authority to fund general process participation and has some contacting constraints with certain types of entities. (COE)

Small-work Group Consensus Decision 2.B: The COE will fund a series of workshops to discuss and incorporate concerns, suggestions, and contributions from managers and related collaborators. Funding could be provided to cover; meeting independent facilitation including reports, room costs, and participants travel/per diem/lodging (number of participants may be limited).

Decision 2.C) Should the ISAB, ISRP, or some other independent scientific group perform a scientific review of the study design, workshops, and or results?

Background 2.C) Review of the study proposal, participation in workshops, and review of results by an independent scientific group has been suggested as a way to resolve points of disagreement by some parties. Not all parties agree that review of this plan or the research efforts should be conducted by the ISAB or ISRP without a clear and useful purpose. However, other agencies believe that a review by an independent scientific source is a prudent way to proceed, given that this issue is surrounded in controversy. The Northwest Power and Conservation Council has had this study as an agenda topic at their monthly meetings for the past 4-5 months. They have expressed their intent to have an ISRP review conducted.

This is a decision that the USvOR parties may not have authority to make/influence. However, unless the study is funded through the Council process or is expressively included in the Council Fish and Wildlife Program, the Council has no jurisdiction in this issue.

Opposition 2.C.i) The Ad Hoc Group participants are the regional experts on Snake River fall Chinook salmon and hydro-system operation. The ISAB, ISRP, or other group of independent scientist would need to be "educated" by the ad hoc group members in order to perform a review. Independence does not mean unbiased (we all have biases). As such, adding one more technical opinion to an issue that already has different technical opinions does not move us forward. Their participation essentially becomes one of arbitrator (not the intended purpose for independent review). The AFEP process for selecting projects and reviewing draft reports is open to all entities. However, the AFEP process is a COE process and the COE has the authority to override fishery managers' project selection priorities in the AFEP process- this has often been a serious point of contention and a significant reason why the AFEP process will not be acceptable to many of the fisheries managers for this issue.

Opposition 2.C.ii) The content of the pending agreed to study design will be technically sound. However, aspects of the study will represent inclusion and/or exclusion of aspects resulting from the collaborative effort at the technical, management, and policy levels. Alteration of the agreed to study design based on a post hoc review becomes problematic.

Support 2.C.iii) The NPCC process requires an independent review for scientific adequacy. This is the type of issue for which the ISRP and ISAB were created. They have conducted several reviews on related topics in recent years, and their input is likely to improve this study. (NPCC, NOAA)

Small-work Group Consensus Decision 2.C: The workshop reports from Phase II and III could be sent for independent scientific review (eg ISRP or ISAB) for their review.

Topic 3: <u>Management process for applying results</u>

Decision 3.A) Should fish marking as prescribed in this study be discontinued after 5 years of marking before adult returns/results are complete?

Background 3.A) After the initial years of study are performed and the agreed-to number of years of marking and operations have been achieved, final results from the research will not be obtained until 4 years after the evaluation. Ie. We have done the study but don't have the results yet, what should we do while we wait for results? Other questions include "should changes to major operations be made after the evaluation based on preliminary results?" And "should additional requiring research surrogate production and marking for evaluation of alternative operations or new questions arise, should they proceed?" An additional debate centers around whether interim FCRPS operations should remain unchanged from those that occurred during the evaluation, should be changed based on preliminary results from the evaluation, or should be changed to either maximize the proportion of juvenile fish transported or left in-river.

Support 3.A.i) Continued production of surrogate fish and marking of general production to address alternative operational strategies or address new management questions might be desired prior to obtaining final results from this study. (NOAA)

Opposition 3.A.ii) General production of surrogate fish and marking of general production is costly, unwarranted, or not worth the risk prior to final results being obtained. Dam operations should remain the same as conducted during the study until all of the adults return back to the Lower Snake River (COE, tribes)

Small-work Group Consensus Decision 3.A: Fish production and marking as prescribed in the long-term framework and study design should be implemented for five years (release groups). Since low numbers of returning adults may, in some years, preclude the production of study fish, these years may not occur consecutively. After five years of marking, further discussion/justification for continuation could be considered at that time. There may good reason(s) to continue producing/marking fish for study or monitoring purposes, however that decision should be considered near the end of the 5 years of marking.

Decision 3.B) Should hydrosystem operation adaptive management related to Snake River fall Chinook salmon follow a pre-established decision tree, applying a standardized suite of primary metrics and precision targets?

Background 3.B) Hydrosystem operations in terms of flow and juvenile fish passage route, have been and continue to be very contentious. Presently, it is not clear how, what, or when hydro-system operation adaptive management decisions would be made regarding fall Chinook salmon based on the results of this and other studies. Attempts to control and constrain data collection, analysis, and recommendations has become an unfortunate reality due to ineffective communications, mistrust, and limited resources (money and fish). As such, a need exists to formally establish how decisions are to be made, who will be involved, how conflicts would be resolved, and what type of feed back loops would be used to communicate between groups and agencies.

This issue is primarily a management process problem, only indirectly related to the scope of research study designs. For example if SARs are the primary metric for the evaluation, what difference between SARs is acceptable to salmon managers to choose one migration strategy over another? What level of statistical precision is required to justify a change in transport operations for SRFC from current status quo? This helps communicate what level of risk each entity is willing to assume.

It does have overlap with study design content by guiding the magnitude of samples sizes and replication required, however approaches for these technical aspects have been decided upon. Development of future study design would benefit from a pre-established decision tree.

Support 3.B.i) Developing and implementing a pre-established decision tree/matrix is desired. This approach would help identify/collect the specific data types needed for management decisions, and avoid collection of data not appropriate or insufficient for guiding decisions. (CBFWA/FPC, CRITFC, NPT).

Opposition 3.B.ii) Identification of all the detailed considerations used in management decisions years in advance is not feasible. Many aspects are intangible, and similar data may result in different management recommendations depending on agency goals. As such, adaptive management should not be hard wired, but should attempt to follow a transparent, but flexible process. (NPT, CRITFC, COE)

Small-work Group Consensus Decision 3.B: No. However, efforts should continue to better understand and communicate management decisions to be made and the level of precision needed to inform those decisions.

Conclusion

This plan is intended to be a living document that will be updated as necessary in accordance with regional technical input and ongoing discussions associated with the development and implementation of the FCRPS BiOp. It must be understood that as discussions occur in the remand process, as FCRPS BiOp activities occur, and other regional efforts continue forward, that this plan will be modified accordingly. However, the intent is to follow this plan as closely as possible, in a regional commitment to provide both sufficient fish and sufficient years of study to develop an acceptable management strategy for this species. Therefore, the baseline duration, marking levels and design are expected to change very little.

Attachment 1

Copy for Betty, Ed & Jay

Oregon

Theodore R. Kulongoski, Governor

MAR 23 2006

Nez Perce

March 9, 2006

Brigadier General Gregg F. Martin,
Commander and Division Engineer
U. S. Army Corps of Engineers,
Northwestern Division
P.O. Box 2870
Portland, OR 97208-2870

Dear Brigadier General Martin:

On February 8, 2006, *the United States v Oregon* parties discussed the request by the U.S. Army Corps of Engineers (ACOE) to PIT-tag hatchery-produced Snake River fall Chinook as part of an evaluation of passage alternatives through the Federal Columbia River Power System. The 2005-2007 Interim Management Agreement (Section III.E.1 (b)) directs the *U.S. vs. Oregon* parties to review and approve research designs involving hatchery-origin Snake River fall Chinook "in order to protect the integrity of the parties' production commitments." Artificial production of Snake River fall Chinook salmon occurs at facilities in the Clearwater and Snake rivers as part of the Lower Snake River Compensation Program at Lyons Ferry Hatchery, the Fall Chinook Acclimation Program, the Idaho Power Program, and the Nez Perce Tribal Hatchery.

On behalf of the *U.S. v Oregon* parties, we are writing to inform you about agreements the parties made regarding conditions and recommendations for the use in 2006 of Snake River fall Chinook hatchery sub-yearlings in an evaluation of how hydropower system operations, including transportation, affect the survival of hatchery fish. There are two "groups" of hatchery fish involved in the ACOE study proposal: 1) surrogate sub-yearlings reared to represent the size of wild fish, and 2) general production sub-yearlings.

Surrogate Sub-yearlings

The ACOE study proposal called for the PIT-tagging and release of up to 328,000 surrogate-sized fish (30% in the Clearwater and 70% in the Snake). Surrogate fish would be released between late-May to early-July and, based on emigration observations in 2005, are expected to experience summer spill conditions. In 2006, the surrogate fish would include a designated "transportation group" and a designated "bypass group".

The *U.S. vs. Oregon* parties support PIT-tagging up to 328,000 surrogate-sized fish in 2006, as described in the ACOE study proposal. Any future commitments will be based upon agreement by the *U.S. v Oregon* parties on a long-term evaluation plan.

General Production Sub-yearlings

The ACOE study proposal called for the PIT-tagging and release of up to 328,000 general-production fish. Because of the lack of an agreed-to long-term study design, the *U.S. v Oregon* parties, instead, agree to PIT-tag and release up to 185,000 "general production" group fish in 2006, as described in the attached Table 1. This number includes 19,500 fish already ear-marked for PIT-tagging under existing marking programs, and up to an additional 165,500 fish PIT-tagged for the evaluation. The *U.S. v Oregon* parties agree to this marking in 2006 under the following assumptions (which do not necessarily reflect a technical consensus among the parties, but interim agreement on the terms necessary to implement marking this year):

1. The commitments described in this letter are in effect for 2006 only. Any future commitments would be conditioned upon agreement by the *U.S. v Oregon* parties on a long-term evaluation plan.
2. The long-term evaluation will be included as part of a "regional" research, monitoring and evaluation plan developed in the remand process for the Biological Opinion on the Federal Columbia River Power System.
3. In 2006, the U.S. Army Corps of Engineers and/or Bonneville Power Administration will work cooperatively with appropriate *U.S. v Oregon* parties to fund the PIT-tagging of fall Chinook from the Little White Salmon Hatchery and, if feasible, from the Deschutes River and Hanford Reach of the Columbia River. *U.S. v Oregon* scientists will provide numbers to be PIT-tagged from each location.
4. The evaluation in 2006 will not include a "bypass treatment" group for Snake River "general production" hatchery fish, except as necessary to estimate reservoir-reach in-river survival of juvenile salmon. Except as mandated by existing agreements, fall Chinook collected at Snake River projects will be transported and not returned to the river.
5. The PIT-tagging of the "general production" hatchery group will be representative of the group at-large, and will be consistent with the programs described in Table B5 of the *U.S. v Oregon* "2005-2007 Interim Management Agreement for Upriver Chinook, Sockeye, Steelhead, Coho, and White Sturgeon". Production fish will be PIT-tagged as described in the attached Table 1.
6. The study sample procedures and statistical designs for adult scale sampling will be coordinated with the existing run reconstruction analysis.

Brigadier General Gregg F. Martin
March 9, 2006
Page Three

The parties of *U.S. v Oregon* recognize that planned hydropower operations and potentially good water conditions in 2006 may provide a unique opportunity for learning. It is in this spirit that the Parties support efforts this year to PIT-tag representative numbers of naturally- and hatchery-produced fall Chinook in the Snake River basin and lower Columbia River to evaluate their survival.

Sincerely,

Edward C Bowles

Ed Bowles
Fish Division Administrator
Oregon Department of Fish and Wildlife

Rebecca Miles
Chairman, Tribal Executive Committee
Nez Perce Tribe

cc: US v Oregon Parties
Steve Wright, Bonneville Power Administration

Attachment

APPENDIX B

Appendix B. Funding status for proposed tasks and associated activities by study year. Funding sources include ongoing Bonneville Power Administration (BPA) projects, Pacific Salmon Commission (PSC), and U.S. Fish and Wildlife Service (FWS). An X indicates funding is needed for a listed activity.

Tasks and activities	2008	2009	2010	2011	2012
Objective 1.—Tagging and releasing Snake River Basin surrogate subyearlings (NMFS lead)					
Task 1.1 Request fish through U.S. v. OR	X	X	X	X	X
Task 1.2 Surrogate subyearling transfer and rearing					
Snake Basin surrogate subyearlings					
Hatchery transfers	X	X	X	X	X
Rearing	X	X	X	X	X
Disease testing	X	X	X	X	X
Task 1.3 Separation-by-Code designation, tagging, and release for surrogate subyearlings					
Snake Basin surrogate subyearlings					
PIT tags and tagging	X	X	X	X	X
Transport & release	X	X	X	X	X
Objective 2.—Tagging and releasing Snake River Basin production subyearlings (NPT lead)					
Task 2.1 Request fish through U.S. v. OR	X	X	X	X	X
Task 2.2 Separation-by-Code designation, tagging, and release for production subyearlings					
Snake Basin production subyearlings					
PIT tags and tagging	BPA	BPA	X	X	X
Supplemental PIT tags and tagging	X	X	X	X	X
Transport, acclimation & release	FWS	FWS	FWS	FWS	FWS
Objective 3.—Tagging and releasing Snake River Basin production yearlings (NPT lead)					
Task 3.1 Request fish through U.S. v. OR	X	X	X	X	X
Task 3.2 Separation-by-Code designation, tagging and release for production yearlings					
Snake Basin production yearlings					
PIT tags and tagging	BPA	BPA	X	X	X
Supplemental PIT tags and tagging	X	X	X	X	X
transport, acclimation & release	FWS	FWS	FWS	FWS	FWS

Objective 4.—Tagging and releasing Snake River natural subyearlings (IFRO lead).					
Task 4.1 Separation-by-Code designation, tagging & release for natural/wild subyearlings					
Snake River natural subyearlings					
Capture	BPA	BPA	X	X	X
supplemental sampling and PIT tags and tagging	X	X	X	X	X
genetic sampling / DNA analysis of natural fish	X	X	X	X	X
Objective 5.—Tagging and releasing Clearwater River natural subyearlings (NPT lead).					
Task 5.1 Separation-by-Code designation, tagging & release for natural/wild subyearlings					
Clearwater River natural subyearlings					
capture	BPA	BPA	X	X	X
supplemental sampling and PIT tags and tagging	X	X	X	X	X
genetic sampling / DNA analysis of natural fish	BPA	BPA	X	X	X
Objective 6.—Tagging and releasing Columbia River Basin subyearlings (CRFPO lead).					
Task 6.1 Tagging and release of subyearlings					
Hanford Reach natural subyearlings					
capture & CWT	PSC	PSC	PSC	PSC	PSC
supplemental sampling and PIT tagging	PSC	X	X	X	X
Deschutes River natural subyearlings					
capture & CWT	PSC	PSC	PSC	PSC	PSC
supplemental sampling and PIT tags and tagging	X	X	X	X	X
genetic sampling / DNA analysis of natural fish	X	X	if needed	if needed	if needed
Task 6.2 Tagging and release of subyearlings					
Little White Salmon production subyearlings					
PIT tags and tagging	FWS	FWS	X	X	X
Objective 7.—Conduct supplemental evaluations					
Task 7.1 Evaluation of surrogate performance (IFRO lead)	X	X	X	X	X
Task 7.2 Evaluation of migration of Snake River subyearlings through the FCRPS (IFRO lead)	BPA	BPA	X	X	X
Task 7.3 Evaluation of migration of Columbia River subyearlings through the FCRPS (CRFPO lead)	X	X	X	X	X
Task 7.4 Scale pattern analyses for understanding life-history diversity (NMFS lead)	X	X	X	X	X
Task 7.5 Scale pattern analyses on Columbia River fish (CRFPO lead)	X	X	X	X	X

Additional tasks for improving study reliability					
Evaluate the use of 8.5 mm PIT-tags to represent smaller fish					
Hanford Reach	PSC	X	X	X	X
Deschutes River	X	X	X	X	X
Phase II: Exploring Methods for Analysis					
Travel support for participants	X	X	X	X	X
Facilitator	X	X	X	X	X
Workshop results	X	X	X	X	X
Phase III: Final Data Analyses and Reporting					
Travel support for participants	X	X	X	X	X
Facilitator	X	X	X	X	X
Workshop results	X	X	X	X	X