Narrative

Table 1. Proposal Metadata

Project Number	200845800
Proposer	Yakama Nation Fisheries Resource Management
Short Description	Upper Columbia Kelt Reconditioning Program
Province(s)	Columbia Cascade
Subbasin(s)	Wenatchee, Entiat, Methow, Okanogan, Mainstem
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Information transfer:

A. Abstract

Upper Columbia steelhead were listed as endangered in 1997 and currently exist at threshold population levels. Unlike other species of Pacific salmon, anadromous steelhead are iteroparous. Rates of iteroparity in the upper Columbia are depressed, likely due to factors as extreme energetic demands, harvest which may affect phenotypic qualities, and the development and operation of the hydropower system.

We propose to initiate a kelt reconditioning program within the upper Columbia region to enhance the abundance and life history diversity of naturally produced steelhead. Natural origin steelhead kelts would be colleted in two distinct ways: 1) a portion of natural origin return (NOR) hatchery broodstock (HCP hatchery compensation programs) would be live-spawned and then reconditioned and 2) NOR kelts would be collected at a variety of locations including mainstem juvenile bypass systems and tributary smolt traps and weirs.

The proposed kelt reconditioning program is uniquely suited to evaluate different reconditioning techniques and eventually, the reproductive success of reconditioned kelts. The proposed program includes a comprehensive monitoring and evaluation plan with defined objectives so that the program can be adaptively managed to ensure the greatest benefit to the population in terms of repeat spawner rates and phenotypic characteristics (e.g. spawn timing, spawn location etc) similar to first time spawners.

B. Problem statement: technical and/or scientific background

B.1 UCR Steelhead Background and History

Upper Columbia River tributaries were once productive wild summer steelhead systems, but the populations have declined significantly since the early 1900s. The intensive commercial fisheries in the late 1800s and industrial development of the Columbia River were largely responsible for the decline of the wild steelhead run (Mullan et al. 1992; Chapman et al. 1994b). Unlike chinook and sockeye salmon catches, steelhead harvest remained fairly constant from the early 1900s through 1940 at about 300,000 fish. Between 1938 and 1942, lower river commercial fisheries, including tribal fisheries within Zone 6, took about 70% of the run.

Curtailing the commercial fisheries resulted in a resurgence of wild steelhead productivity in the upper Columbia River region, where the run size tripled (5,000 fish to 15,000 fish) between 1941-1954 (Mullan et al. 1992). Sale of steelhead by non-Indians was prohibited beginning in 1975. Subsequent to the dramatic increase, escapement has fluctuated widely. When the wild productivity declined again with completion of the Columbia River hydropower system, hatchery steelhead had replaced natural production in the run counts, masking the gravity of the change in wild fish production. Wild fish were subjected to, and suffered as a result of, mixed stock fisheries in the lower Columbia River directed at their abundant hatchery cohort. And while the hatchery steelhead could sustain the relatively high harvest rates, their wild counterparts could not.

Hatchery fish made up an increasing fraction of the steelhead run after the 1960s, as wild runs became depleted (Chapman et al. 1994b). Mullan et al. (1992) spawner-recruit analysis calculated the maximum sustainable yield (MSY) run size and escapement for steelhead at Rock Island and Rocky Reach dams to be 16,000-19,000 and 4,000–7,000, respectively. When hatchery produced steelhead are combined with the naturally produced steelhead, no long-term declining trend is evident. However, naturally produced steelhead currently exist only at threshold levels.

B.2 ESA Listing Status

Upper Columbia River summer steelhead were listed as Endangered in August 1997 because the naturally spawning population was not replacing itself. Hatchery fish in the region, derived from local populations, were included in the listing because NMFS determined that they are necessary to achieve recovery.

B.3 Current Situation and Proposed Action

Artificial production programs using locally adapted summer steelhead were fully implemented by the late 1960s. External marking of all hatchery steelhead was implemented in 1987 allowing non-tribal fisheries to increase harvest rates on the component of the run that could sustain it, while providing more protection to the wild component. Current artificial production programs focus releases into the Wenatchee, Methow and Okanogan systems, although the Entiat River received a portion of the hatchery steelhead up through 1998.

Wild steelhead returning to the upper Columbia River region sustain themselves only at a threshold population size today. The high hatchery return rate, genetic homogeneity of hatchery and wild steelhead (Chapman et al. 1994b) and maintenance of near MSY levels in most years suggest a truly wild fish does not exist. Rather, hatchery production sustains these populations and has become a dominant component of the stocks that currently exist today.

Unlike other species of Pacific salmon *(Oncorhynchus spp.)* anadromous steelhead *(O. mykiss)* are iteroparous. Successful expression of iteroparity involves the downstream migration of post-spawned fish (kelts) to estuary or ocean environments. Each spring (March-June), hundreds if not thousands of kelt steelhead from ESA-listed steelhead populations in the mid/upper Columbia rivers are observed passing hydroelectric facilities in route to the ocean. There is little to no indication that these kelts successfully navigate the hydro system and return to spawn again. For this life history expression (iteroparity) to persist in future steelhead runs, successful methods must be developed to augment the current rate of iteroparity among Columbia River steelhead populations.

A developing approach to increase abundance and productivity of steelhead populations in the Columbia basin is to capitalize on their inherent iteroparity (ability to repeat spawn) by artificially reconditioning post-spawners (kelts). Estimated rates of repeat spawning for post-development Columbia River steelhead *Oncorhynchus mykiss* populations range from 1.5% to 17%. The highest recent estimates of repeat spawners from the Columbia River Basin were in the Kalama River (tributary of the unimpounded lower Columbia River) where they exceeded 17% (NMFS 1996). Farther upstream, 4.6% of the summer run in the Hood River (above only one mainstem dam) are repeat spawners (J. Newton, ODFW, pers. comm.). Iteroparity rates for Klickitat River steelhead were reported at 3.3% from 1979 to 1981 (Howell et al. 1984). Summer steelhead in the South Fork Walla Walla River have expressed 2% to 9% iteroparity rates (J. Gourmand, ODFW, pers. comm.), whereas repeat spawners composed only 1.6% of the Yakima River wild run (from data in Hockersmith et al. 1995) and 1.6% of the Columbia River run upstream from Priest Rapids Dam (A. Murdoch, WDFW, unpubl. Data; Table B-1).

It is thought that current iteroparity rates for natural origin steelhead in the Upper Columbia are depressed due to factors such as extreme energetic demands for these long-migratory fish, potential over harvest affecting phenotypic qualities, the development and operation of the hydropower system and/or other anthropogenic factors.

Table B-1. Repeat spawner rate for upper Columbia steelhead, measured at Priest Rapids Dam, 1989-2006. Data provided by WDFW.

Sample Year	**No. of Naturally Produced UC Steelhead Sampled**	**Number of Repeat Spawners in the Sample**	**Repeat Spawner Rate**
1986	63	1	1.59%
1987	141	2	1.42%
1988	99	1	1.01%
1989	97	0	0.00%
1990	77	0	0.00%
1991	161	3	1.86%
1992	64	0	0.00%
1993	47	0	0.00%
1994	54	5	9.26%
1995	97	1	1.03%
1996	73	1	1.37
1997	79	1	1.27%
1998	101	0	0.00%
1999	138	3	2.17%
2000	214	5	2.34%
2001	329	2	0.61%
2002	194	4	2.06%
2003	302	15	4.97%
2004	292	0	0.00%
2005	207	7	3.38%
2006	143	0	0.00%
Mean			**1.63%**
SD			**2.17%**

The rationale for initiating a kelt reconditioning program within the upper Columbia region is to enhance abundance and life history diversity of naturally produced spawners that will produce viable progeny for future generations. Kelt reconditioning could provide a viable technique to assist in the recovery of depressed steelhead populations and could help re-establish this naturally occurring life history trait. Reconditioning itself is the process of culturing post-spawned fish (kelts) in a captive environment by reinitiating feeding, rehabilitating muscle tissue, and redeveloping mature gonads. Reconditioning techniques were initially developed for Atlantic salmon *Salmo salar* and sea-trout *S. trutta* and are common in the commercial culture of rainbow trout and steelhead. Additional reviews of this subject in the Yakima River Basin (Hatch et al. 2002 and 2003) provide strong support of kelt reconditioning benefits to address population demographic and genetic diversity for steelhead recovery that could be applied to the upper Columbia region.

B.3.1 Comparison of Reconditioning Techniques

<u>Short-Term Reconditioning Treatment</u>

Successful expression of iteroparity in steelhead may be limited by post-spawning starvation and downstream passage through the mainstem corridor (Branstetter et al. 2007). The objective of a short term reconditioning program is to augment iteroparity rates by initiating the feeding response while still allowing kelts to naturally undergo gonadal development in the estuary and marine environments. Short-term reconditioning is defined as the period of time needed for kelts to initiate post-spawn feeding (approximately 3-12 weeks), followed by transportation of kelts around mainstem hydroelectric facility for release and rematuration in the Pacific Ocean (Branstetter et al. 2007). Because gonadal development occurs in the marine environment, the reproductive success of short-term reconditioned kelts is believed to be similar to that of kelts not artificially reconditioned.

Currently results of the short-term reconditioning program in the Yakima River show high survival to release when compared to kelts entering the long-term reconditioning program (Table 2), however repeat spawner returns from this group have been low.

<u>Long-Term Reconditioning Treatment</u>

Long term recondition is defined as holding and feeding post-spawn until river temperatures begin to fall, typically in mid-to late October. The fish are released in the river (based upon capture location) to over-winter and return to the spawning site on their own volition. While the proportion of re-maturing fish released into the environment has been higher than the proportion of short-term fish returning to repeat spawn (Table 2), the gamete viability and reproductive success of a long-term reconditioning treatment is unknown and questionable.

Table 1. Survival statistics by year for long- and short-term kelts reconditioned at Prosser Hatchery, 2001-2005 (Branstetter et al. 2007).

	2001	2002	2003	2004	2005	2006	2007	Total
Long-Term								
Held for Reconditioning	551	420	482	662	386	279	422	3202
Survived to Release	197	140	298	253	86 [a]	85	221	1280
Survival-to-Release	35.7%	33.3%	61.8%	38.3%	22.3%	30.5%	52.4%	39.9%
Mature at Release	108	76	254	216	75	79	202	1010
% mature at release	19.6%	18.1%	52.7%	32.6%	19.3%	28.3%	47.9%	31.5%
Repeat Spawner Success	n/a	n/a	n/a	n/a	n/a	n/a		n/a
Short-Term								
Held for Reconditioning		479	208	105	106	56	40	994
Released		334	187	83	96	50	38	788
Survival-to-Release		69.7%	89.9%	79.0%	90.6%	89.3%	95.0%	83.5%
Returned to Bonneville		43	8	5	0	0	0	42
% Detected Returning to Bonneville		9.3%	2.7%	3.4%	1.0%	0%	0%	5.9%

[a] Twenty of these fish were retained for gamete quality and reproductive success studies
[b] Iteropary rates are unknown.

Gamete viability tests at the Parkdale Fish Facility located near the Powerdale Dam on Hood River, indicated that gamete viability of reconditioned kelts may be lower (13%) than that of first time spawners (47%). However, only one female in the test group lived to be spawned a second time making it difficult to make any conclusions about the potential effect of artificial reconditioning on gamete and progeny quality viability (Branstetter et al. 2007).

Studies in the Yakima River, Omak and Shitike creeks are currently assessing the reproductive success of long-term reconditioning treatments. In 2005 researchers released 16 steelhead into Section Corner Creek to study reproductive success. The release was composed of five reconditioned female kelts, six female first time spawners and five male first time spawners (Branstetter et al. 2006). Parentage analysis of 159 juveniles indicated that production was from first-time spawning females only. It was believed that the reconditioned kelts were over-ripe and did not spawn (Branstetter et al. 2006). In genetic reproductive success studies, 2007 marked the first documented evidence that an artificially reconditioned steelhead kelt could successfully reproduce in the wild. Three juveniles that were of direct genetic lineage to a male steelhead kelt were detected in Omak Creek (Branstetter 2007). However successful reproduction for reconditioned female kelts remains undocumented. Specific questions regarding the success of artificially reconditioning kelt steelhead needs to be further explored to assess the net benefit of a long-term reconditioning program.

<u>Proposed Action</u>

We are proposing to initially implement both types of reconditioning techniques (short and long-term) until a definitive determination can be made on the benefit of a long-term reconditioning program versus a short term one. The project proponents believe that by initially pursuing both techniques will allow us to determine which method works best in the upper Columbia ESU without the risk of pursuing only one technique in the event that it is later determined not to be a viable method of increasing iteoparity. Further we present a comprehensive M&E plan (see Section 4.0), which makes extensive use of the current M&E infrastructure as a result of the ISEMP (Integrated Status and Effectiveness Monitoring Program) project (BPA project number 200701700) and the HCP Hatchery Compensation M&E Plans. Due to the intensive monitoring currently being implemented and continually being expanded in the upper Columbia, we believe that this proposed reconditioning program is uniquely suited to contribute to developing body of knowledge regarding kelt reconditioning.

For the proposed program, collection and reconditioning will be conducted at several sites in the mid/upper Columbia: Collection – Wells Hatchery, Rock Island, Rocky Reach and Priest Rapids dams, tributary smolt traps in the Wenatchee and Methow basins; Reconditioning – Entiat NFH. This is a collaborative project with the lead entity being the Yakama Nation Fisheries with participation by WDFW, USFWS, Columbia River Inter-Tribal Fish Commission; and the Mid-Columbia PUD's.

This proposal presents methodology for the crucial next step in empirically evaluating enhancement of iteroparity in steelhead: increased scope, greater geographic representation, and needed experimental replication and control relative to initial project research. This proposal provides an annually replicated and controlled experimental design to evaluate the ability of two reconditioning techniques to enhance steelhead iteroparity on a system-wide geographic scale. Based on data after three to five years of implementation, informed decisions will be made regarding which of the techniques would most favorably increase natural production in wild Columbia Basin steelhead populations.

C. Rationale and significance to regional programs

C.1 FCRPS BiOp Remand

The FCRPS BiOp Remand was a collaborative process among federal, state and tribal entities which listed a series of hatchery actions that could be implemented to reduce the recovery "gap" which is defined as a biological measure of a ESU's current status and the status the allows for delisting under ESA guidelines. This proposed Upper Columbia Kelt Reconditioning program was identified by all parties in this Remand process as a gap filling action that would contribute to steelhead recovery.

C.2 Columbia River Basin Accords

The Columbia River Basin Accords recognize that hatchery actions can provide important benefits to ESA-listed species and to the Tribes in support of their treaty fishing rights. The Three Treaty Tribes – Action Agency Agreement identifies Upper Columbia Steelhead Kelt Reconditioning as a new artificial production action. The proposed Upper Columbia Steelhead Kelt Reconditioning program will be carefully coordinated with other kelt reconditioning programs funded through the Accords (e.g. Snake River, Yakima River, Omak Creek) to facilitate the sharing of results and techniques.

C.3 Subbasin Plans

C.3.1 Wenatchee and Entiat Subbasin Plans

We believe this kelt reconditioning program will help achieve the goals of the Wenatchee and Entiat subbasin plans. Specifically, Goal 3 of the Wenatchee subbasin plan addresses the restoration of life history diversity for naturally produced populations.

From the Wenatchee and Entiat Subbasin Plans

> *Goal 3. Restore maintain, or enhance fish and wildlife populations to sustainable and harvestable levels, while protecting biological integrity and the genetic diversity of the species.*
>
> - *Maintain and/or restore performance (productivity, abundance, and life history diversity) of wild, indigenous population sin a manner that maintains or enhances genetic similarity to naturally producing populations. Artificial propagation is considered a relatively short term measure and is not intended to replace naturally reproducing population over the longer term*

The proposed kelt reconditioning program used fish culture techniques to rehabilitate steelhead kelts so that they may spawn in the natural environment, enhancing life history diversity. Because the reconditioned kelts will spawn in the natural environment we do not expect any genetic divergence of their progeny.

C.3.3 Methow Subbasin Plan

The Methow Subbasin Plan states that the goal for steelhead is "run size and spawning escapement levels that provide for the recovery of ESA-listed upper Columbia River steelhead in the Methow subbasin; management effectively mitigates of hydro-system losses and supports a harvestable surplus". The proposed kelt reconditioning program is one tool that may help achieve the goal for steelhead within the Methow subbasin plan by enhancing both abundance and life-history diversity. Further the proposed reconditioning plan may help achieve the overall vision for the subbasin.

From the Methow Subbasin Plan

> *Our vision for the Methow subbasin include viable, self-sustaining, harvestable, and diverse populations of fish and wildlife and their habitats, along with recognition of the need to support the economies, customs, cultures ,subsistence, and recreational opportunities within the subbasin.*

C.3.4 Okanogan Subbasin Plan

The Okanogan Subbasin Plan recommends using steelhead kelt reconditioning as one strategy to achieve steelhead recovery objectives (strategy 20-3; page 404).

C.4 Goals and objectives of the 2000 Fish and Wildlife Program

We believe that the proposed Upper Columbia Kelt Reconditioning Program is consistent with the objectives and principles of the 2000 Fish and Wildlife Program. The proposed UC kelt reconditioning program will help enhance life history diversity for steelhead in the upper Columbia which is congruent with the over arching objectives to sustain an abundant, productive, and diversity community of fish and wildlife, and to recovery fish affected by the development and operation of the hydro system that are listed under the Endangered Species Act.

The proposed kelt reconditioning program uses artificial production techniques to allow natural origin steelhead kelts the opportunity for iteroparity in a geographic location where rates of iteroparity are low. In addition to reconditioning kelts which have spawned in the natural environment, the proposed program will also incorporate natural origin steelhead that have been spawned in a hatchery environment. Reconditioning natural origin steelhead who have been included in a hatchery program will provide opportunity for these fish to spawn in the natural environment. The 2000 fish and wildlife program recommends that artificial production programs maintain a diversity of life history types. By allowing steelhead to the opportunity for iteroparity, the proposed UC kelt reconditioning program is helping to enhance life history diversity. The recommendations also state that artificial production must be implemented with an experimental adaptive management design that includes an aggressive program to evaluate the risks and benefits and address scientific uncertainties. The proposed UC kelt reconditioning program has an aggressive monitoring and evaluation program to ensure that critical uncertainties are addressed. The M&E plan also ensures that phenotypic behaviors such as spawn timing, run timing is consistent with first time spawners.

C.5 Upper Columbia River Salmon Recovery Plan

The Upper Columbia River Salmon Recovery Plan lists several objectives for hatchery programs within the upper Columbia region including examining the feasibility and effectiveness of kelt reconditioning in the Wenatchee, Entiat, Methow, and Okanogan Rivers. The Upper Columbia Regional Technical Team (UCRTT) has prioritized monitoring and research needs identified in the Recovery Plan and has ranked the need to assess the feasibility and effectiveness of kelt reconditioning as a Tier 1 (highest priority) research need. This proposal includes a robust M&E plan to evaluate the effectiveness of reconditioning techniques and strategies.

D. Relationships to other projects

Table D-1. Relationship to existing projects

Funding Source	Project #	Project Title	Relationship (brief)
BPA	200501700	Integrated Status and Effectiveness Monitoring Program	We expect that the monitoring and evaluation plan described for this proposal will coordinate closely with data being collected for ISEMP. Examples include remote PIT tag detection sites, steelhead spawning ground surveys, and the potential for capture kelts in ISEMP funded rotary smolt traps.
BPA	199604000	Mid-Columbia Coho Restoration	We expect that the proposed kelt reconditioning program may share some facilities or equipment (e.g. smolt traps for collection of kelts, and fish transport tanks) with the mid-Columbia coho restoration project.

Funding Source	Project #	Project Title	Relationship (brief)
Chelan and Douglas PUDs	N/A	Hatchery Compensation Program for Methow and Wenatchee Steelhead.	A portion of natural origin steelhead collected as broodstock for the Chelan and Douglas County hatchery compensation programs would be live spawned and then incorporated in to the proposed kelt reconditioning program. Reconditioning natural origin steelhead spawned in a hatchery facility would provide the opportunity to then spawn in the natural environment. Additionally trapping facilities and Rock Island and Rocky Reach dams are proposed for use to capture natural origin kelts.
USFWS	N/A	Entiat National Fish Hatchery	Entiat National Fish Hatchery (ENFH) has been proposed as a site for the kelt reconditioning facility. Preliminary meetings with USFWS staff have resulted in identification of a location for kelt reconditioning, water supply, and fish health requirements.

F. Proposal biological/physical objectives, work elements, methods, and metrics

F.1 Project Objectives

The project objectives of this proposed plan is to implement a steelhead kelt reconditioning program in the upper Columbia utilizing techniques that are similar to those already established in the Yakima and Okanogan Rivers and build upon those programs' results in order to supplement the steelhead spawning populations in the Entiat, Methow, Okanogan, and Wenatchee subbasins. Another objective is to determine the best reconditioning techniques for use in the Upper Columbia. We believe that steelhead kelt reconditioning may assist steelhead recovery for these individuals that express this unique, inherent iteroparous life history.

> Objective 1: Evaluate effects of short-term kelt reconditioning and subsequent transportation of kelts around the hydrosystem on enhancement of iteroparity.
> Objective 2: Evaluate effects of long-term kelt reconditioning and subsequent release for natural spawning on enhancement of iteroparity.
> Objective 3: Comprehensive project evaluation and management recommendations.

F.2 Kelt Collection

Work elements associate with steelhead kelt collection are outlined in Table F-1.

Table F-1. Work Elements associated with steelhead kelt collection

Work Element Title	Work Element Description
Trap/Collect/Transport Fish	Trap, collect and transport fish from collection facilities in the Wenatchee, Entiat, Methow,

	and Okanogan and Columbia rivers to a central kelt reconditioning facility.

Upper Columbia steelhead kelts would be collected in two distinct ways: 1) A portion of natural origin return broodstock would be live-spawned and subsequently reconditioned to allow the fish an opportunity to spawn in the wild, and 2) natural origin returns (NOR) kelts which have naturally spawned in the Wenatchee, Entiat, Methow and Okanogan basins would be collected at a variety of locations including mainstem juvenile bypass systems located on Rocky Reach and Rock Island dams, and both tributary smolt traps and weirs. So not to affect steelhead supplementation efforts ongoing by Washington Department of Fish and Wildlife (WDFW), gametes from live-spawned broodstock would continue to be incorporated into their respective programs.

Broodstock collection protocols for Methow and Wenatchee steelhead supplementation programs incorporate NOR’s as part of the overall broodstock propagation program. Presently, those fish are sacrificed at spawning for virology sampling. Modifications, based on current discussions with WDFW, to the current fish health disease control policy will allow for a sub-sampling of NORs at spawning is required for implementation of this proposal. Currently, broodstock for both the Methow and Wenatchee summer steelhead programs are held and spawned at Wells Fish Hatchery (FH). Historical disease profiles for Wells stock indicate that neither IPNV or IHNV have been discovered within the last 20 years and virology results have been negative for the past 10+ years (R. Rodgers, WDFW fish health, unpubl. data). Wenatchee disease profiles are not available at this time but are presumed to have low incidences for viral infections. NOR steelhead taken into the hatchery and live-spawned present a unique reconditioning opportunity. These fish, which would be collected as broodstock in the summer/fall and held through spawning in the early spring, may have a higher recondition success rate than their naturally spawning counterparts. By limiting certain natural processes such as migration to terminal spawning areas and creation and defense of redds, potential survival benefit exists with reduced energy expenditures. We speculate that live spawned NOR kelts entering the reconditioning program may have higher condition factors and less injuries than what would be typically seen in naturally reproducing adult steelhead. Potential numbers of NORs collected and incorporated into both the Methow and Wenatchee programs are listed in Table F-2. All collected steelhead kelts would be transported to a central facility for reconditioning. For this proposal, only a portion of the NORs will be live spawned and incorporated into the program. The remaining steelhead would be lethally spawned and subjected to virology sampling. The proportion of steelhead needed for fish health sampling is currently undetermined. We expect that live-spawned NORs from Wells FH would provide a large proportion of the steelhead for this reconditioning program.

Table F-2. Total number of natural origin returns for Wenatchee (WEN) and Methow (MEOK) summer steelhead supplementation programs, 1999-2007 (data provided by WDFW).

Broodyear	WEN F	WEN M	MEOK F	MEOK M	TOTAL
1999	31	21	18	9	79
2000	20	16	22	16	74
2001	21	30	10	15	76
2002	65	31	14	4	114
2003	34	15	18	8	75
2004	39	36	64	51	190

2005	52	35	39	24	150
2006	59	34	51	35	179
2007	42	34	26	18	120

Natural origin steelhead kelts would be collected where opportunities exist such as mainstem juvenile bypass systems, tributary smolt traps, and tributary weirs. In large escapement years, such as 2000 and 2002, several hundred kelts were encountered at the Rocky Reach and Rock Island dam bypass traps (T. Mosey CCPUD, pers. comm.) but origin was not identified. In 2003, an adult separator was installed at Rocky Reach Dam to bypass steelhead kelts while PUD personnel collected juvenile salmonids for upcoming survival studies. These facility modifications would potentially reduce the ability to capture kelts at levels documented in Table F-3. Collection duration and holding capacities would need to be coordinated between YN and Chelan County Public Utility District (CCPUD) during the planning and prior to the implementation phase of this proposal. This steep bypass was created to limit unnecessary handling of these sensitive downstream migrants but could be used for kelt collection as well. Any modifications would need to be coordinated and approved by CCPUD and associated costs would be the responsibility of YN (i.e.holding facilities, staffing, etc.). Rotary smolt traps within the subbasins may also provide a source of naturally spawned kelts for reconditioning, although expected contributions would be low. Trap operations conducive to our collection goals would include Monitor, Nason, Chiwawa, Entiat, Twisp, and the Methow. All kelts collected from these locations would fall within the upper Columbia ESU and could be incorporated into the reconditioning program.

Table F-3. Number of total steelhead kelts encountered at Rocky Reach and Rock Island bypass facilities, 2000-2007 (data provided by CCPUD).

Year	Rocky Reach	Rock Island	TOTAL
2000	177	21	198
2001	na	14	14
2002	124	77	201
2003	na	18	18
2004	na	35	35
2005	na	43	43
2006	na	67	67
2007	na	50	50

Estimated minimum and maximum numbers of kelts entering the proposed reconditioning program can be found in Table F-4.

Table F-4. Estimated minimum and maximum number of steelhead kelts expected to be available for reconditioning.

Kelt Collection Location	Est. Minimum	Est. Maximum
Wells Fish Hatchery (Wenatchee program and Methow/Okanogan program)	40	190
Rocky Reach Dam	0	100
Rock Island Dam	14	77

Misc.	0	15
Total	**54**	**382**

Steelhead kelts collected for the reconditioning program would be held at the various collection locations until transportation arrives to deliver these individuals to the reconditioning facility. Holding duration could range from a couple of hours to one day depending on logistics, equipment, densities and multi-agency cooperation that would need to be identified by all entities prior to collection. Collection and holding facilities are identified in 'Section H: Facilities and Equipment'.

F.3 Fish Health and Containment

Table F-4: work elements associated with fish health and containment.

Work Element Title	Work Element Description
Maintain Fish Health	USFWS will be subcontracted to provide fish health monitoring, pathology sampling, laboratory processing of samples and produce recommendations.

Implementation of this proposal would involve transportation of kelts from throughout the upper Columbia to a central reconditioning facility. For this reason, a high priority will be placed on bio-security through fish health practices and isolation of reconditioning tanks. The design of the reconditioning facility must be able to accommodate isolation and treatment of potential pathogens. Virology sampling will not be possible for kelts entering the reconditioning facility but pathogen sampling during spawning at Wells FH will provide a proportionate, annual disease profile for the stocks taken into the program. A disease management plan would be developed in coordination with USFWS to establish protocols to assess and manage risks associated with transfers of kelts on station, reconditioning, and release of fish. Initial bio-security measures could include tank isolation for long-term and short-term groups from each capture location, effluent water treatment, and regular fish health examinations. All mortalities will be sampled by USFWS fish health staff to determine cause of death.

F.4 Steelhead Kelt Processing

Table F-5: Work elements associated with steelhead kelt processing.

Work Element Title	Work Element Description
Collect/generate/validate field and lab data	Collect detailed fitness and condition data upon entering the reconditioning program.
Mark/Tag Animals	All kelts entering the reconditioning program will be marked with a PIT tag for unique identification.
PIT Tags	PIT tags would be purchased through BPA
Create/Manage/Maintain Database	Create and maintain a database of all kelts entering the program and reconditioning results.

Kelt processing begins at each collection site where fish are individually transferred to a temporary holding tank for anesthetisation and biological assessment. At the trapping location and prior to transportation, all steelhead kelts collected will go through an initial selection process to determine overall fitness and adequacy for reconditioning. Ultrasound will be utilized at non-broodstock locations to ensure that fish collected are post-spawning individuals. Fish deemed as poor condition (see assessment details below) or pre-spawner will not be taken into the program and returned to their collection point. Upon acceptance into the program, the kelts will be alternately assigned to the short-term, long-term, and control group (see Section G). Each fish will be reassessed at ENFH for the following:

1. presence or absence of physical abnormalities
2. coloration (bright, medium, or dark)
3. condition assessment for documentation (fair or good)
    a. fair- lack of any *major* wounds and/or descaling (<20%)
    b. good- lack of wounds and/or descaling
4. any visual implant markings that would indicate hatchery origin
5. Somatic lipid levels will be non-lethally measured with a ‘fish fat-meter’

If during the re-check of condition uncovers a fish that is deemed inadequate for reconditioning, it will be returned to its point of collection for immediate release.

Upon acceptance into the reconditioning program, each kelt will be PIT-tagged, lipid levels non-lethally measured, and condition documented. Each kelt will be isolated by collection location and by rearing group. PIT tags will allow for unique identification of each kelt throughout the reconditioning process and after release. The correlation between tag code and capture location will be critical when determining a specific release location of successfully reconditioned steelhead in relation to fish origin to eliminate any unnecessary energetic constraints (i.e.- long-term Wells broodstock adults would have to be released above Wells Dam). Non-lethal somatic lipid measurements will provide a baseline measurement for kelts within the program. Pre-kelt measurements, taken at selected locations where evaluations are currently ongoing, may provide “average” fat levels for fish prior to spawning and provide a benchmark for the LT program. This information would also be valuable to the ST program in that it would allow for relative fat gained. Determining energy expenditure between pre and post-spawning fish may provide a definable measure in determining when a fish is ready for reintroduction into the natural environment, or at least determine the build-up of these reserves from their depleted state.

Biological work-up will include: weight, fork length, POH length, scales, sex determination, and origin of transport. If not already tagged, a PIT tag will be inserted in the pelvic girdle,for identification purposes.

F.5 Steelhead Kelt Rearing

Table F-6. Work elements associated with steelhead kelt rearing

Work Element Title	Work Element Description
Build Artificial Production Facility	The proposed program makes use of existing facilities but additions, including circular tanks and effluent isolation will be necessary.
Rear Fish	Fish culture techniques will be used to recondition steelhead prior to re-release.
Collect/Generate/Validate Field and Lab Data	Periodic evaluation of reconditioning success including maturation, weight gain, blood

	indicators (ATPase and Thyroxine), and/or other determining factors will be assessed prior to an individual fish being deemed ready for release.
Create/Manage/Maintain Database	Create and maintain a database of all kelts entering the program and reconditioning results.

We propose to implement both short- and long-term reconditioning strategies. Results from other reconditioning programs that definitively demonstrate which conditioning strategy provides the largest number of viable repeat spawners is lacking. Although limited data indicates that reproductive success for long-term reconditioned kelts may be low, through collaboration with ongoing monitoring programs (HCP Hatchery M&E plans and ISEMP), we believe the Upper Columbia Region is uniquely suited to test differences between the two types of reconditioning programs (see section '4.0. Monitoring and Evaluation'). It is therefore premature to select only one of these conditioning strategies at this early planning stage.

Short-term reconditioned steelhead would be held on-station for approximately 3-11 weeks prior to transportation below Bonneville Dam. This reconditioning strategy assumes that no detrimental imprinting effects would occur to these steelhead after transportation to and from Entiat NFH. It is widely assumed that since these individuals have completed one, full life history cycle, which includes all critical imprinting periods, that adult transportation to the lower Columbia River would have no adverse effects to their subsequent return. This strategy allows for individuals to re-initiate feeding and improve fish condition while protecting these fish from downstream migration through multiple hydro projects. Release timing will be closely monitored so that when naturally emigrating kelts are passing Bonneville Dam, reconditioned individuals will be released in close proximity and may become incorporated into the downstream migration prior to entering the estuary and marine environment. Long-term rearing will consist of 6-10 months of conditioning, at which time, the majority of steelhead will be completely reconditioned and sexually mature. Release timing will be determined by each individual's sexual maturity level. Migration timing of naturally spawning steelhead will be monitored through mainstem and tributary counts. The hope is to incorporate reconditioned individuals into the natural, active migratory pattern so that reconditioned kelts have a high likelihood of successfully mating with other NORs or naturally spawning HORs.

Once kelts have been initially processed and admitted into their respective rearing units by strategy, the following activities and monitoring will occur:

1. All circular tanks will be treated using preventative measures for fungal outbreaks that may occur. Treatment will include 5 days a week formalin drip at 1:6,000 for 1 hour. Flow rates for each tank will range between 150-200 gallons-per-minute (gpm) of ground water; dependant on water availability. In addition to formalin treatments, steelhead will be administered with an initial treatment of Ivermectin, diluted with saline, due to the success in treating *Salmincola* (parasitic copepod) observed within the Yakima program. Typically, steelhead adults are susceptible to these parasitic copepods that reside on the gill lamellae. If left untreated, they will inhibit a fish's oxygen uptake resulting in mortality. Daily formalin treatments as well as any other additional treatments would be provided by YN staff.

2. An external/internal assessment will be conducted for all mortalities removed from the program to document any abnormal processes or reasons for the moribund fish. Mortality assessment would be conducted by YN or USFWS fish health staff. Carcass disposal would likely occur at the local landfill or alternate location at the recommendation of fish health specialists.
3. Feeding will occur daily. Based on results from the Yakima reconditioning program, krill works extremely well to re-initiate feeding. For long-term reconditioning, once feeding has been successfully re-initiated, manufactured pellets (top-coated with squid and krill) will be incorporated into the diet. Short-term individuals will be fed to the point of re-initiating feed and then prepared for transportation to the lower Columbia River. Other feed options are being used by the Colville Confederated Tribes (CCT) at the Cassimer Bar reconditioning facility. Feed sources include cod liver oil, anchovies, squid, and herring to mimic natural food sources that may be found in marine environments. When pelletized food is introduced, natural food source are still kept in rotation to provide trace minerals and polyunsaturated fatty acids which as been determined to be important in fish health and survival (Johnson et al. 1987). Feeding would be conducted by YN staff.
4. Periodic evaluation of reconditioning success will be conducted by YN staff by collecting biological assessment data; similar to the introduction sampling.
5. Maturation, weight gain, blood indicators (ATPase and Thyroxine), and/or other determining factors will be assessed prior to an individual fish being deemed ready for release. Maturation assessment will likely be verified through ultrasound. Blood indicators would be performed on long-term reared individuals as well as the state of maturation. Weight gain will aid in determining release timing for each release group. Migration timing will contribute to time of release, both immigration (long-term) and emigration (short-term). A pre-spawn length-weight relationship will be derived from Wenatchee River Basin HORs and NORs from the last two brood years to establish a baseline target for optimal condition factor for reconditioned steelhead. These data will be collected by WDFW at Tumwater Dam on all adults passing this facility which encompasses the majority of spawning (A. Murdoch, pers. comm.). Since the majority of steelhead redds are observed above Tumwater Dam, it is assumed that the majority of NORs are also represented above Tumwater Dam. Data representation of actual proportions of NORs and HORs is not available at this time but with the continuation of the steelhead reproductive success study, some of these uncertainties will be addressed in the future.

F.6 Steelhead Kelt Release

Table F-7. Work elements associated with Steelhead kelt release

Work Element Title	Work Element Description
Trap/Collect/Hold/Transport Fish	Kelt being released will be transported from the reconditioning facility to the designated release point (Table F-8)

Steelhead ready for release will be re-weighed to determine whether successful feeding occurred or not. These fish will be categorized as feeders and non-feeders. For short-term reared steelhead, release location will be below Bonneville Dam. Release locations for long-term reconditioned kelts will be determined by capture location through PIT tag identification. Multiple vehicles will be available for transportation to release sites. Radio-tags may be inserted into a portion of individuals to determine homing fidelity. Release sites for long-term reconditioned kelts are identified in Table F-8.

Table F-8. Proposed kelt collection and release sites.

Stock	**Kelt Collection Site**	**Release Site**
Methow NOR broodstock	Wells FH	Columbia River between Wells Dam and the confluence with the Methow River
Methow NOR spawners	Methow basin rotary smolt traps and weirs	Methow River or tributary of collection
Wenatchee River NOR broodstock	Wells FH	Wenatchee River between Dryden Dam and Peshastin Creek
Wenatchee River NOR spawners	Wenatchee River rotary smolt traps	Wenatchee River or tributary of collection, upstream of collection facility
NOR spawners	Rocky Reach juvenile bypass	Columbia River between Rocky Reach Dam and the Entiat River
NOR spawners	Rock Island juvenile bypass	Columbia River between Rock Island Dam and the Wenatchee River

Because of the multiple release locations within the long-term rearing/conditioning strategy, several vehicles will need to be retrofitted with transportation tanks. Currently, the mid-Columbia Field Station has two, 300-gallon tanks and a 960-gallon transportation truck to potentially assist with the original two 500-gallon tanks, if needed.

G. Monitoring and evaluation

Table G-1. Work elements associated with Monitoring and Evaluation

Work Element Title	**Work Element Description**
Collect/Generate/Validate Field and Lab Data	Data will be collected in order to determine recondition success in the hatchery, repeat spawn rate, spawn timing, and spawn distribution. The full description of metrics to be collected can be found following this table.
Create/Manage/Maintain Database	A comprehensive reconditioning database for storage of all reconditioning data collected.
Analyze/Interpret Data	
Produce Annual Progress Report	

Kelt reconditioning technology is relatively new. There are still many questions surrounding the reproductive success of reconditioned kelts from both short-and long-term reconditioning programs. Collaboration with intensive ongoing monitoring efforts in the Upper Columbia will provide a level of monitoring that is not currently available to other kelt reconditioning programs making the Upper Columbia uniquely suited to evaluate differing reconditioning techniques. Each objective described below will be measured for both the long- and short reconditioning programs. Annual reviews of the program will begin immediately. After 3-5 years of operation, an initial review will be made of results from both types and a decision will be made whether to continue with both short-and long-term reconditioning or to focus efforts on one type of reconditioning program.

Objective 1: Determine if the kelt recondition program is contributing to natural spawner abundance and/or diversity of UC summer steelhead.

The main objective of the kelt reconditioning program is to contribute to the recovery of UC summer steelhead through a boost to the natural spawner abundance and/or diversity by supporting the iteroparous life history of steelhead. The proportion of reconditioned kelts that successfully spawn in the natural environment relative to the repeat spawner rate of non-reconditioned kelts will be used to support this objective. The repeat spawner rate for non-reconditioned kelts will be measured through a randomly assigned PIT tagged control group. All kelts will be randomly assigned to a treatment/control group at the time of collection. Kelts in poor condition will not be considered for any group.

Monitoring Questions:
Q1: Is the repeat spawner rate for kelts entering the reconditioning program greater than the natural repeat spawner rate

Hypothesis:

Ho$_1$: Repeat spawner rate $_{\textbf{long-}\text{ term reconditioning program}}$ > Repeat spawner rate $_{\text{non-reconditioned kelts}}$
Ho$_1$: Repeat spawner rate $_{\textbf{short-term}\text{ reconditioning program}}$ > Repeat spawner rate $_{\text{non-reconditioned kelts}}$
Ho$_1$: Repeat spawner rate $_{\textbf{short-term}\text{ reconditioning program}}$ = Repeat spawner rate $_{\text{long-term reconditioning program}}$

Measured Variables:
- The number of short-term reconditioned kelts spawning in the natural environment
- The number of long-term reconditioned kelts spawning in the natural environment
- The number of kelts entering the short-term reconditioning program
- The number of kelts entering the long-term reconditioning program
- The number of non-reconditioned PIT tagged kelts sampled and released.
- The total number of non-reconditioned PIT tagged kelts returning to spawn

Derived Variables:
- Proportion of steelhead entering the long term reconditioning program which spawn in the natural environment
- Proportion of steelhead entering the short term reconditioning program which spawn in the natural environment
- The proportion of naturally spawning steelhead which return a second year to spawn without the aid of a reconditioning program

Statistical Analysis:
- Chi Square

- Two sample T-test to evaluate ratios over time
- Type I Error of 0.05
- Effect sizes will be reported annually

Objective 2. Determine if the run timing, spawn timing, and spawning distribution of reconditioned kelts is similar to the target population.

Inherent in the purpose of the program is that reconditioned kelts and naturally spawning steelhead are intended to spawn together in similar locations. Run timing, spawn timing, and spawning distribution may be affected through the hatchery environment. It is unknown if biological conditions at ENFH or Wells FH (for kelts entering the program as NORs taken into broodstock of other hatchery programs) will affect maturation rates or homing of reconditioned steelhead. If reconditioned kelts are not fully integrated into the naturally produced spawning population, the goals of the program may not be achieved. This metric will be measured for both long- and short-term reconditioning programs.

The Integrated Status and Effectiveness Monitoring Program (ISEMP) and HCP Hatchery M&E programs are currently installing remote PIT tag detection arrays at multiple locations throughout the Wenatchee, Entiat, Methow and Okanogan Rivers. Currently in the Wenatchee Basin PIT arrays are installed in Peshastin and Nason Creeks, Tumwater Dam, Tumwater Canyon, Chiwawa River and are planned for the lower Wenatchee, White and Little Wenatchee Rivers. Three PIT tag arrays are installed in the Entiat Basin, at the mouth of the Entiat River, RM 16.1, and at the mouth of the Mad River. In the Methow River arrays are currently installed or planned in Beaver Creek, Gold Creek, Libby Creek, Chewuch River, Methow River above the Chewuch, Twisp River, Methow River about the Twisp River and the Mouth of the Methow. Within the Okanogan, PIT tag antennae arrays can be found in Omak Creek, and may be installed in Antoine, 9 mile, and Salmon creeks. Collaboration with ISEMP, OBMEP (Okanogan Basin Monitoring and Evaluation Plan) and the HCP M&E programs will allow for detailed PIT tag data collection and spawning ground surveys to effectively measure run timing, spawn timing, spawning distribution and post-release homing fidelity.

PIT tag data, in some cases, may result in approximate redd locations. Specific redd location data may be collected either through radio-telemetry or through an external mark such as a floy or disc tag which would be visible on the spawning grounds. Any tags or marks with the exception of PIT tags may only be appropriate for kelts released from the long-term reconditioning program.

Monitoring Questions:

Q1: Is the migration timing of reconditioned kelts and first time spawning steelhead similar?

Hypotheses:
Ho$_1$: Migration Timing $_{\textbf{long}\text{- term reconditioning program}}$ = Migration timing $_{\text{first-time spawners}}$
Ho$_1$: Migration Timing $_{\textbf{short}\text{- term reconditioning program}}$ = Migration timing $_{\text{first-time spawners}}$
Measured Variables:

- Time of arrival at Bonneville Dam (short-term), Priest Rapids Dam (Short-term), Rock Island Dam (Short-term), Rocky Reach Dam (short and long-term), Wells Dam (short and long term) and within tributaries (e.g. Tumwater, Dryden, weirs; short-and long term).

Derived Variables
- Mean time of arrival for each treatment group; short-term reconditioned kelts, long-term reconditioned kelts, and first time spawners.

Statistical Analysis
- ANOVA by treatment and location

Monitoring Questions:
Q2: Is the timing of spawning similar for reconditioned kelts and first time spawners similar?

For detailed analysis, Q2 would require the use of an external mark or tag visible during spawning ground surveys (or radio-tag) this sort of mark may not be appropriate for kelts released from the short-term reconditioning program. For the short-term program we may be able to generally measure spawn timing through PIT tags in locations where instream PIT tag antenna arrays exist. For short term program kelts the assumption may need to be made that if migration timing is the same that spawn timing would be the same.

Hypotheses:
Ho_1: Spawn timing $_{\textbf{long-}\text{ term reconditioning program}}$ = Spawn timing $_{\text{first-time spawners}}$

Measured Variables:
- Time of redd completion for reconditioned kelts and first time naturally produced spawners within defined reaches.

Derived Variables
- Mean time of redd completion for each treatment group

Statistical Analysis
- ANOVA by treatment and location
- Type I Error of 0.05
- Effect sizes will be reported annually

Monitoring Questions:
Q3: is the spawning distribution of reconditioned kelts and first time spawners similar?

For detailed analysis, Q3 would require the use of an external mark or tag visible during spawning ground surveys (or radio-tag) this sort of mark may not be appropriate for kelts released from the short-term reconditioning program. For the short-term program we may be able to generally measure spawning distribution through PIT tags in locations where instream PIT tag antenna arrays exist.

Hypotheses:

Ho$_1$: Spawning distribution $_{\textbf{long-}\text{ term reconditioning program}}$ = Spawning distribution $_{\text{first-time spawners}}$

Ho$_1$: Spawning distribution $_{\textbf{short-}\text{ term reconditioning program}}$ = Spawning distribution $_{\text{first-time spawners/kelts}}$

Measured Variables:

- Spawning Location for reconditioned kelts and first-time spawners (GPS coordinate)

Derived Variables

- Spawning location for reconditioned kelts and first-time spawners (RKm)
- Calculate percent overlap in distribution across available spawning habitat.

Statistical Analysis

- ANOVA by treatment and location
- Type I Error of 0.05
- Effect sizes will be reported annually

Objective 3. Determine if reconditioned kelts were released at the target condition factor

For kelts entering the long-term reconditioning program, a pre-spawn length/weight relationship will be derived from Wenatchee River Basin HORs and NORs with data collected by WDFW from adults passing Dryden and Tumwater dams. From this data, a baseline target for optimal condition factor will be established for reconditioned steelhead. Non-lethally measured lipid levels may also be used to help develop a target condition for long-term reconditioned kelts. Currently there is no condition factor goal for kelts entering the short-term program. Short-term reconditioned fish will be considered released at target condition if they have successfully resumed feeding.

Monitoring Questions:

Q1: Is the condition factor of reconditioned kelts released equal to the program goal?

Q1 applies to both the short- and long-term reconditioning programs

Hypotheses:

Ho$_1$: Condition at Release $_{\textbf{long-}\text{ term reconditioning program}}$ = Program Goal

Ho$_1$: Condition at Release $_{\textbf{short-}\text{ term reconditioning program}}$ = Program Goal

Measured Variables:

- Length and weights of all reconditioned kelts prior to release

Derived Variables

- Condition factors
- Mean condition factor.

Statistical Analysis

- One-sample T-test to compare the condition of kelts released with the program goal
- Type I Error of 0.05
- Effect sizes will be reported annually

Objective 4. Determine the reproductive success of both short- and long-term reconditioned kelts.

The reproductive success of kelts from the short- and long- term program may help determine which type of program provides the greatest contribution to recovery. However, opportunities to measure the reproductive success will likely be very limited due to the large geographical scope of the program and by the number of successfully reconditioned kelts. The reproductive success of long-term reconditioned kelts is currently being evaluated in Omak Creek through a pedigree study, although sample sizes have been very low. We propose to coordinate with planned steelhead reproductive success evaluations in the Methow and Wenatchee Rivers which will be funded by the Mid C PUDs and the Bureau of Reclamation to measure the reproductive success of reconditioned steelhead kelts. In addition, any reconditioned steelhead spawning above Tumwater Dam in the Wenatchee River could be incorporated into the reproductive success study currently proposed by NMFS and WDFW.

Steelhead reproductive success evaluations are required under the Chelan County PUD and Douglas County PUD HCP hatchery sections. To meet these requirements, a pedigree study is currently being developed by NMFS and WDFW in the Wenatchee Basin. The HCP hatchery committees will approve any study plans prior to implementation. A similar study is expected for the Methow River. As reconditioned kelts are encountered in the study areas, they would be incorporated in to the pedigree analyses. These studies, still in the development phase but required under the Chelan and Douglas PUD HCP Hatchery compensation plans, present a rare opportunity to compare the relative reproductive success of short and long term reconditioned kelts alongside hatchery and natural first-time spawners.

H. Facilities and equipment

H.1 Temporary Kelt Holding and Transportation

Steelhead kelts collected for the reconditioning program would be held at the various collection locations until transportation arrives to deliver these individuals to the reconditioning facility. Holding duration could range from a couple of hours to one day depending on logistics, equipment, densities and multi-agency cooperation that would need to be identified by all entities prior to collection. Listed below are logistical scenarios for captured kelts at the collection facilities.

Wells FH

In coordination with WDFW and Douglas County Public Utility District (DCPUD), live-spawned steelhead would be placed into some type of temporary holding, after removal of gametes. Spawning of NOR steelhead typically begins in late December and runs through late-March/early-April. Ideally, especially on larger spawn days, YN staff would be present to load a portion of the live-spawned kelts into the necessary vehicles and transport them to a central reconditioning facility. Two 500-gallon transportation vehicles would be available that could support a maximum of 40 fish per tank (1 lb/gal of H_2O). These vehicles could be supplemented by the use of a 960-gallon transportation truck, if necessary. If transportation cannot occur immediately, temporary holding options would have to be identified, such as existing structure, holding tank, and/or net pens.

The first option for holding would be to utilize potential existing structure, such as the collection facility adjacent to the broodstock holding pond. This containment area is typically used for shunting adults from the west ladder trap of Wells Dam to the on-station area. These fish then await processing which typically occurs 1x per week. This area has been used to collect steelhead and coho broodstock for their respective upper Columbia production programs. If during the time frame of kelt collection, this holding area is not used, it would provide a convenient location for temporary holding of NOR spawned steelhead until drivers are available for transport. Temporary holding would be minimized as much as possible to reduce adverse conditions that may be present for these individuals, i.e. minimal temporary holding infrastructure plus bacterial and invertebrate infestations. YN staff would need to coordinate logistics of removing these kelts with DCPUD and WDFW hatchery staff.

The second option for temporary holding would occur with net pens installed at the lowest raceway prior to the effluent leaving the hatchery. There has been no mortality or disease from this method of holding which has been used for the past three years with adult coho collected from the Wells west ladder operations. Holding would be minimal and provide the least amount of stress possible.

The third option would require setting up a temporary holding tank in the general vicinity of the spawning area that would be equipped with re-circulating water. The water source is unidentified at this time but would likely come from the same location as the net pens, which is the lowest point in the hatchery effluent system, to minimize any cross-contamination.

Rocky Reach bypass facility

Steelhead kelts are typically encountered between mid-April to the end of May. A determination of the ability to perform kelt collection needs to be performed in consultation with Chelan PUD. If feasible, collection at Rocky Reach would be limited to CCPUD staff on-hand, if staff time is available, that operates the trap for ongoing survival studies and juvenile run enumeration unless co-permitting in obtainable and trap operations are allowed by YN staff. Currently, the Rocky Reach bypass trap is typically operated 2-3 hours per day, seven days a week. CCPUD and/or YN staff would be able to easily capture any actively migrating kelts from the sorter with a dip net. IF kelts can be collected, they would be placed into a temporary holding tank. The tank would consist of a circulating water system and could potentially hold 10+ adults at one time. This tank would need to be fabricated by YN. Pick up from this facility would need to be coordinated between YN and CCPUD and occur daily. Staffing needs would be identified through consultation with CCPUD staff.

Rock Island bypass facility

Kelts are encountered during the same timeframe as the Rocky Reach collection facility. The Rock Island juvenile bypass facility passively traps emigrating kelts. Typically when encountered, steelhead kelts are enumerated, sexed, and included in WDFW’s daily collection sample that is reported to the Fish Passage Center (FPC). These kelts would be transported to a temporary holding tank until YN transportation arrives. Holding tank specifications would be similar to that used at Rocky Reach. Pick up times, transportation, and delivery to the central facility need to occur daily and coordination between YN, WDFW, and CCPUD is required.

Tributary rotary smolt traps/weir traps

Kelt encounters are relatively rare at these locations but entrapped kelts would be incorporated into the program. Currently, many of the weir sites do not have the logistical capabilities to collect down-migrating kelts. Collection alternative may be possible but would require multi-agency coordination and involvement. If collection is plausible, portable in-stream holding boxes would be used for temporary kelt holding. Transportation to the reconditioning facility would need to occur as soon as possible and coordination between trapping agencies and YN will be required.

Additional collection facilities

Priest Rapids Dam may be a valuable contingency option if the aforementioned locations collectively do not provide adequate numbers of NOR's for the program. Logistics and collections numbers will be identified at a later date and designed as a secondary option. This facilities' distance from the proposed central reconditioning facility makes it a less desirable alternative.

H.2 Kelt Reconditioning Facility

Entiat National Fish Hatchery (ENFH) has been identified as a potential candidate for the reconditioning facility due to its centralized location among all the trapping facilities and with space availability with the absence of the spring Chinook program. Winthrop NFH is also being proposed as a alternative site for kelts originating from the upper Columbia region (i.e. Methow and Okanogan subbasins) if water demands for a full program cannot be met at Entiat NFH. Proposed plans for ENFH include raising/rearing coho salmon for a terminal fishery on the Entiat River while providing continued Wenatchee River coho spawning/ incubation operations/facilities, and incorporate the proposed steelhead recondition program. Current reconditioning facilities at ENFH are not available at this time but would include construction of similar infra-structure used in the Yakima River steelhead kelt program at Prosser, which includes circular rearing units and a work-up station. Circular tank dimensions would be 20' diameter by 4' in height. Numbers of circulars would be determined by study objectives with no fewer than four tanks initially. Initial source groups would be Wenatchee broodstock, Wells broodstock, Rock Island/Rocky Reach, and miscellaneous traps. Depending on holding at Wells FH of the Wenatchee and Wells stocks (shared water source), these two groups may be consolidated at ENFH. Each group would consist of a short-term and long-term rearing unit. Circular tanks will be used because of the results from the Yakima's program of trial-and-error of various rearing vessels. The YN found that circular tanks provide maximum duration of feed presence for kelts during the reconditioning process which is critical in the early stages when trying to re-initiate feeding. The capacity of these tanks is 200 adults per rearing container. One significant tank modification would include the installation of baffles in each circular tank. This modification would theoretically prevent problematic eye rubbing which may result in blindness as documented within the Yakima River program. These baffles are designed to break-up the continuous wall surface of the tanks that tend to cause the optic lens abrasions and to artificially simulate back-water eddies and feeding lanes that are typically observed in the natural environment.

Kelts would be reconditioned on a combination of surface and well water. While surface water may potentially introduce an unknown level of pathogens, we believe that a natural water temperature profile is needed to establish successful gonad development and may be one cause for overdevelopment of some long-term kelts within the Yakima program (Branstetter et al. 2007). During the summer months, a higher proportion of well water would be utilized to temper the summer surface water temperatures, or could be used exclusively depending on conditions. River water would likely be used the remainder of the year. Currently, an on-going study is being performed at ENFH with coho juveniles and rainbow trout to determine the pathogens that are present within the Entiat watershed as well as infectious time periods. Although coho are very different than steelhead in disease sensitivity and susceptibility levels, we anticipate that the study could provide insight of a pathogen profile for the Entiat River and provide direction for rearing steelhead kelts. Water up-welling and drainage could occur either in the center of the tanks or externally, as done for the sockeye program at NOAA's Manchester Facility (Joy Evered USFWS pers. comm.). Tank covers will be installed to provide shading and prevent kelts from jumping out.

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YN, CC (Yakama Nation and Chelan County). 2004. Entiat Subbasin Plan. Prepared for the Northwest Power and Conservation Council. May 2004.

YN, WDFW, BPA (Yakama Nation, Washington Department of Fish and Wildlife, Bonneville Power Administration). 1999. Hatchery and Genetics Management Plan: Mid-Columbia Coho Reintroduction Program. December 1999.

J. Key personnel

Mr. Tom Scribner will have the prime responsibility for ensuring that the project remains on schedule and within budget and will be directly accountable to the BPA. Ms. Keely Murdoch and/or Mr. Cory Kamphaus will be responsible and provide oversight for all program deliverables. Staff biologists will be responsible for successful execution of all field components of the proposal. These two individuals will ensure that data acquisition remains on schedule and of the highest possible quality. We will also contract with USFWS for fish health monitoring but incidental work performed by USFWS hatchery personnel at the ENFH.

J.1 Curriculum Vitae for Key Personnel

J.1.1 Tom Scribner – Yakama Nation Policy /Project Manager

Project Responsibility: Provides overall Tribal oversight and management of the BPA funded Coho Restoration contract. Directs, plans and manages activities and tasks in accordance with established policies, regulations, ordinances, and resolutions to achieve the YN Tribal goals of coho salmon restoration in the Mid-Columbia region.

Education

1975-77 University of Washington
Master of Science Degree, 1977
Major: Fisheries

1967-71 Middlebury College
Bachelor of Arts Degree
Major: Biology (Dean's List)

Experience

7/82 - present **Yakama Nation - Title: Mid-Columbia Policy Advisor**

Present: Oversee all salmon production in the Mid-Columbia for the Tribe including all fish propagation/outplantings done by the Yakama Nation or any other fisheries agency.

Tribal representative on the Rock Island, Rocky Reach and Wells Dam HCP Hatchery Committee. This interagency committee is responsible for implementing hatchery compensation measures and associated monitoring/evaluation plans to fulfill Chelan/Douglas PUDs No Net Impact obligations.

Tribal representative on the Priest Rapids Hatchery Committee. Similar to the HCP Hatchery Committee, this interagency committee is responsible for implementing hatchery compensation measures and associated monitoring/evaluation plans to fulfill Grant PUD's No Net Impact obligations.

Tribal representative on the Production Advisory Committee established to exchange information and to review and analyze present and future artificial and natural production programs pursuant to the *U.S. v. Oregon* Columbia River Fish Management Plan. Committee Chairman, 1993; re-elected for 1994.

92-94 Tribal representative on the Integrated Hatchery Operations Team. The team's purpose was to both develop and coordinate regional hatchery policies concerning fish health, genetics and ecological conditions and to provide hatchery performance standards. The team also developed a hatchery audit procedure and policy implementation plans.

85–90 Tribal representative on Northwest Power Planning Conservation Council's Artificial Production Review Team. This group comprised of resource managers and environmental organizations submits recommendations to the Council's review of hatchery operations and production.

Publications

M.S. Thesis, 1977. Relationship Between Growth and Population Density in Sockeye Salmon Fry, 111 pgs.
"Recommendation for Proposal and Evaluation of Salmonid Facilities", 84 pgs. (Publication for Congressional Act; Salmon and Steelhead Enhancement Act, 1980).
"Evaluation of Potential Species Interaction Effects in the Planning and Selection of Salmonid Projects", 72 pgs. (same publication conditions as above).
Scribner, T.B. 1993. "Spring Chinook Spawning Ground Surveys of the Methow River Basin." Report to Public Utility District No. 1 of Douglas County. Yakima Indian Nation, Fisheries Resource Management Program. Toppenish, WA.

J.1.2 Keely G. Murdoch, Fisheries Biologist

Project Responsibility: Provide oversight for M&E project deliverables

Education: **M.S. Biology, August 1996**
Central Washington University, Ellensburg, Washington
Coursework included Fisheries Management, advanced statistical analysis, research and study design.

B.S. Biology, June 1994
Western Washington University, Bellingham, Washington

Professional Experience:

Feb 2000- Present **Fisheries Biologist**
Yakama Nation, Fisheries Resource Management
Peshastin, Washington
Responsible for implementing the mid-Columbia coho reintroduction feasibility study monitoring and evaluation plan. Design and implement biological studies to assess ecological interactions between coho salmon, spring chinook, summer steelhead, and sockeye salmon. Studies include use of radio-telemetry to identify stray and drop-out rates of reintroduced coho salmon, redd surveys, hydro-acoustic surveys, direct predation evaluations, and micro-habitat use and competition evaluations. Techniques used include smolt-trap operation, underwater observation, electro-fishing, and tow-netting. Coordinate research activities with the USFWS, USFS, WDFW, CCPUD, DCPUD, GCPUD, private landowners and consultants. Contribute to the design, construction and implementation of coho acclimation sites in the Wenatchee River Basin. Designed and implemented adult coho trapping program. Responsible for spawning up to 1400 coho salmon and early egg incubation. Participate in technical work group meetings. Prepare annual reports and presentations. Supervise five biologists and up to nine fisheries technicians.

Mar 1997- Dec 1999 **Fisheries Biologist,** *Chelan County Public Utility District, Wenatchee WA*
Jan 1999 - Dec 1999 **Instructor - Statistical Analysis,** *Wenatchee Valley College, Wenatchee WA*
June 1996- Mar 1997 **Fisheries Biologist,** *U.S. Fish and Wildlife Service, Leavenworth WA.*
April 1995- Aug 1995 **Hydroacoustic Research Technician,** *Hydroacoustic Technology, Inc., Seattle, Washington*

Publications

Murdoch, K.G., C.M. Kamphaus, and S. A. Prevatte. 2005. Feasibility and Risks of coho reintroduction in mid-Columbia tributaries: 2003 Annual Monitoring and Evaluation Report. *Prepared for* Bonneville Power Administration, Portland OR.
Murdoch, K.G. and C.M. Kamphaus. 2004. Mid-Columbia coho reintroduction feasibility project: 2001 annual broodstock development report. *Prepared for:* Bonneville Power Administration, Portland OR. Project Number 1996-040-000.
Mosey, T. R., and K.G. Murdoch. 2000. Spring and summer chinook spawning ground surveys on the Wenatchee River Basin, 1999. Chelan County Public Utility District, Wenatchee Washington.
Titus, K. 1997. Stream Survey Report, Chumstick Creek, Washington. U.S. Fish and Wildlife Service, Mid-Columbia River Fisheries Resource Office, Leavenworth WA.

J.1.3 Corydon M. Kamphaus

Project Responsibility: Provide project oversight for operations and deliverables

Education: B.S. Zoology, December 1997
Washington State University, Pullman, Washington

Professional Experience:

Feb 2002- Present Fisheries Biologist
Yakama Nation, Fisheries Resource Management

Responsible for O&M activities for the mid-Columbia coho reintroduction feasibility program including**:**

1. Oversee acclimation for Wenatchee Basin coho releases
2. Determine in-pond survival at various acclimation sites by modeling predator consumption compared to PIT tag survival
3. Analyze multiple rearing strategies such as long versus short term juvenile rearing and semi-natural versus conventional acclimation
4. Design and implement adult collection protocols to maximize upstream collection facilities
5. Maintain broodstock integrity through run-at-large collection
6. Coordinate and facilitate broodstock collection with Chelan County PUD, USFWS, and WDFW.
7. Implement new propagation and incubation techniques to increase survival
8. Participate in technical work group meetings and prepare annual reports and presentations

Apr 1998- Feb 2002 Fisheries Technician
WDFW-Hatchery Evaluation

Responsible for monitoring and evaluating Chelan County PUD supplementation programs in the Wenatchee and Methow Rivers. Conduct hatchery evaluations on juvenile steelhead, spring chinook, summer chinook, and sockeye. Lead supervisor of the Methow/Okanogan summer chinook broodstock collection facilitated at Wells Dam. Conduct spawning ground surveys for Wenatchee River Basin sockeye, spring and summer chinook, and steelhead as well as the Okanogan summer chinook. Assist in the preparation of annual reports.

Publications

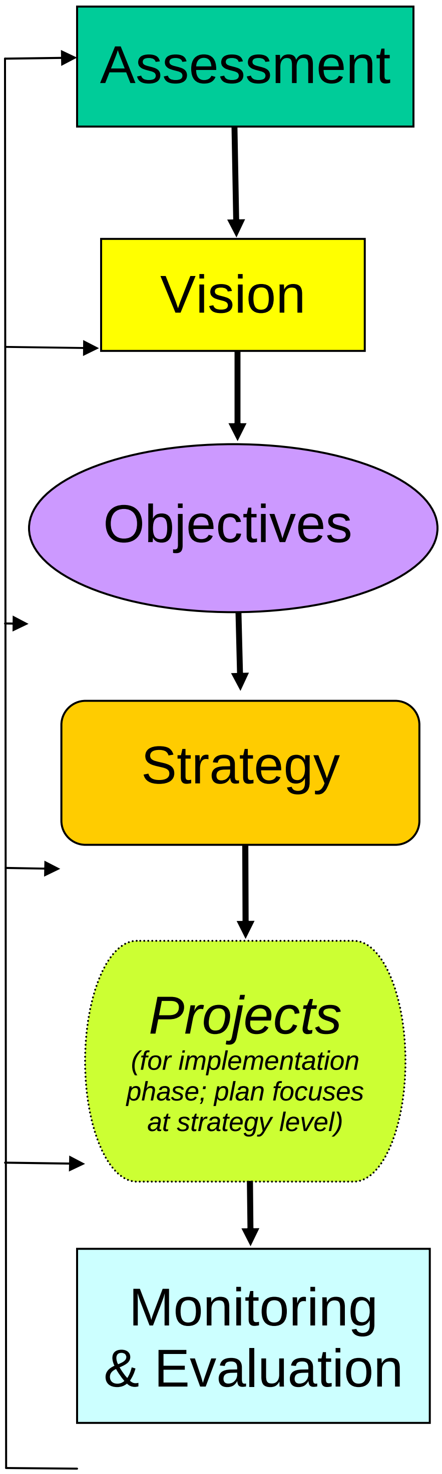
Murdoch, K.G., C.M. Kamphaus, and S. A. Prevatte. 2005. Feasibility and Risks of coho reintroduction in mid-Columbia tributaries: 2003 Annual Monitoring and Evaluation Report. *Prepared for* Bonneville Power Administration, Portland OR.

Kamphaus, C.K. and K.G. Murdoch. 2005. Mid-Columbia coho reintroduction feasibility project: 2003 annual broodstock development report. *Prepared for:* Bonneville Power Administration, Portland OR. Project Number 1996-040-000.

Murdoch, K.G., C.M. Kamphaus, and S. A. Prevatte. 2004. Feasibility and Risks of coho reintroduction in mid-Columbia tributaries: 2002 Annual Monitoring and Evaluation Report. *Prepared for* Bonneville Power Administration, Portland OR.

Kamphaus, C.K. and K.G. Murdoch. 2004. Mid-Columbia coho reintroduction feasibility project: 2002 annual broodstock development report. *Prepared for:* Bonneville Power Administration, Portland OR. Project Number 1996-040-000.

Attachment: ISRP Flowchart: Subbasin Plan Logic Path



Identifies Limiting Factors

Spawning habitat loss due to development in headwaters, passage problems at culverts, high water temperature in lower reaches, extinct coho run

Guides and Prioritizes Actions

Establish protected and rebuilt self-sustaining fish runs; maintain genetic integrity; reconnect habitats

Type 1, Population: Return 5,000 spring Chinook & 1,000 coho

Type 2, Habitat: Water temperature <70 in lower reaches

Build from Strength - *protect all actively spawning redds*
Restore Ecosystem - *recover riparian functions in lower reach*
Artificial Production - *restoration of coho run*

Habitat Acquisition in Headwaters 1985-045-01	Culvert Replacement and Fencing Exclosure 2001-000-01
Coho Reintroduction (RFP)	

Indicators: water temperature, sediment load, redd and juvenile counts
Performance Standards: lower reach water temperatures not to exceed 70

Note: the numbers given above are hypothetical and, for habitat projects, the ISRP and ISAB have recommended that performance standards may be more usefully articulated by coupling the potential range of parameter conditions (i.e., median, range, and variance) with a predicted rate of change from the current to the desired state. See the ISAB's report: A Review of Strategies to Recover Tributary Habitat (ISAB 2003-2) www.nwcouncil.org/library/isab/isab2003-2.htm.