UPPER-COLUMBIA RIVER STEELHEAD KELT RECONDITIONING PROJECT:

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Prepared by:
Matthew S. Abrahamse
Keely G. Murdoch

Yakama Nation
Fisheries Resource Management
P.O. Box 151
Toppenish, Washington 98948

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P.O. Box 3621
Portland, Oregon 97283-3621

Yakama Nation Fisheries
Toppenish, WA

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1 Introduction

Steelhead *Oncorhynchus mykiss* display a variety of life history strategies that may allow the preservation of population genetics in the face of potential environmental changes (Behnke 1992). Iteroparity, the ability to repeat spawn, is one such life history. Iteroparity in steelhead is unique among anadromous Pacific salmonids. It is thought that iteroparity may allow steelhead populations to retain genetic diversity and increase lifetime reproductive success (Seamons and Quinn 2010).

Upper Columbia River (UCR) steelhead are listed as "Endangered" under the ESA, and naturally-spawning populations currently exist at threshold levels. The incidence of iteroparity in the Columbia Basin appears to be negatively correlated with distance from the ocean and rates of iteroparity for UCR steelhead populations are extremely low. Low rates are likely due to high mortality imposed by such factors as extreme energetic demand, degraded habitat quality, and post-spawning migration through the Columbia River hydropower system.

The artificial reconditioning of post-spawn steelhead, known as kelts, holds special promise for UCR populations subject to high mortality rates that depress productivity and iteroparity. Artificial reconditioning is defined as culturing kelts for 6-10 months in a captive environment where they reinitiate feeding, grow, and redevelop mature gonads. It is believe that kelt reconditioning may help counter the selective forces against iteroparity imposed by the hydroelectric power systems and provide benefits in addressing the population demographic and genetic issues in steelhead recovery (Hatch et al. 2002, 2003, and 2011).

The Yakama Nation (YN) is currently implementing a kelt reconditioning project within the Upper Columbia consistent with FCRPS BiOp requirements and the Columbia Basin Anadromous Fish Accords. Early work for the project has focused primarily in the Methow River Basin. The goal of the Upper Columbia River Steelhead Kelt Reconditioning Project (UCKRP) is to increase the abundance of naturally-produced UCR steelhead on natural spawning grounds by as much as 10 percent through the use of kelt reconditioning. The program has three objectives:

(1) Implement a kelt reconditioning program in the UCR to increase natural origin steelhead abundance relative to current conditions,
(2) Evaluate kelt survival and program effectiveness, and
(3) Collaborate with ongoing M&E studies to document the reproductive success of kelts released from the reconditioning program.

This report will provide a summary of the steelhead kelt reconditioning efforts undertaken by this project in 2013. Topics address will include: kelt collection efforts, kelt reconditioning efforts, kelt release and tracking efforts, and future project direction.

2 Kelt Collection

Determining reliable sources of natural origin (NOR) steelhead kelts is critically important to the success of the UCKRP. Unlike kelt reconditioning projects in the Yakama River in Washington and Clearwater River in Idaho, the UCKRP does not have a collection or trapping location providing large numbers of kelts. Instead of pursing a large scale collection effort at a single location, the UCKRP chose to pursue smaller kelt collection opportunities at a variety of locations. The two methods chosen were live spawning of NOR steelhead broodstock and the application of temporary tributary traps.

2.1 Live Spawning

The spawning of anadromous salmonids in a hatchery setting has almost exclusively applied lethal spawning techniques, with the exception of a small number coastal steelhead programs. Lethal spawning practices insured that all available gametes could be harvested and fish carcasses could be sampled for pathogens. Prior to the spring of 2012 all Upper Columbia steelhead hatchery programs lethally spawned all broodstock. The UCKRP proposed that the application of live spawning techniques for NOR steelhead females would allow their inclusion into a reconditioning program and subsequently provide an opportunity to repeat spawn in the natural environment.

Before hatchery programs would agree to alter their methodologies, the efficacy of live spawning needed to be evaluated. The lack of published studies comparing live and lethal spawning methods raised concerns that live spawning could result in a reduction in the number of eggs collected. Since UCR steelhead are listed as “Endangered” and the number of NOR steelhead available for broodstock is limited, it could be difficult for hatcheries to take additional broodstock if egg take was reduced. The UCKRP proposed a study to address those concerns.

Under the 2011 contract, the UCKRP explored potential of live spawning steelhead broodstock females collected for hatchery conservation programs in the Methow River. The results the 2011 study demonstrated that live spawning did not negatively impact the number of eyed eggs collected. As a result, an agreement was reached with US Fish and Wildlife Service (USFWS) hatchery managers to begin live spawning the NOR female steelhead broodstock and allow for their inclusion into the UCKRP starting in the spring 2012 and continuing in 2013.

2.1.1 Methods

The spawning activities took place at Winthrop National Fish Hatchery (WNHF). Steelhead broodstock were collected through the onsite fish ladder and through hook-and-line methods in the Methow River. Air spawning was chosen as the method for live spawning based on literature review (Shrable et al 1999; Orr et al 1999) and personal communications with fish culture professionals identifying it as the most effective live spawning method.

Fish were anesthetized using Tricaine methanesulfonate (MS 222) prior to air spawning. Female steelhead were held by a person with one hand near the head and the other just anterior to the tail. A16-gauge hypodermic needle with a 1 inch tip, attached to a small air compressor via a rubber hose was then inserted ½ inch into the body cavity just posterior to the pelvic girdle by a second person. Then 5-7 psi of compressed air was injected into the body cavity to expel the eggs.

Once all the eggs were collected the fish was taken to a tank filled with water. The fish was held vertically in the water with the head at the bottom of the tank. Gentle hand pressure was applied to the

fish's abdomen just posterior of the operculum and drawn towards the tail to expel any air remaining in the body cavity.

Data was collected from all steelhead kelts following the expulsion of air. The data recorded included: length (fork and mid-orbital post-hypural) in millimeters, weight in grams, origin (natural or hatchery), sex, fish condition (good- lack of any wounds or descaling, fair- lack of any major wounds and/or descaling, poor- major wounds and/or descaling), and color (bright, medium, and dark). All fish were scanned for the presence of PIT tags. If a tag was present we recorded the tag number. If no tag was present, we inserted a tag into the fish's pelvic girdle.

Once data had been collected, the kelts were transferred to the MSKF for reconditioning.

2.1.2 Results

Due to difficulty in acquiring NOR broodstock, there were fewer steelhead available for live spawning in 2013 than in previous years. A total of eight female steelhead were live spawned in 2013, six NOR and 2 hatchery origin (HOR). The HOR females were spawned and brought into the reconditioning project because our experience suggested increasing the number of kelts in the tank increased the competition for food and encouraged the kelts to resume feeding. Reconditioning the HOR kelts also proved useful as it allowed us to cull them to evaluate fat levels, gamete maturation, and other metrics of reconditioning success.

Table 2.1 - Summary of data collected during live spawning at Winthrop National Fish Hatchery, 2013.

	Length							
Date	FL	POH	W	Origin	Sex	Condition	Color	PIT
4/16/2013	729	610	3372	W	F	GOOD	BRIGHT	384.3B2399F131
4/23/2013	687	500	2740	W	F	GOOD	BRIGHT	384.3B239A393F
4/23/2013	752	586	3450	W	F	GOOD	BRIGHT	384.3B239AA629
4/23/2013	810	620	4170	W	F	GOOD	MEDIUM	3D9.1C2D73DFAF
4/23/2013	721	570	2704	H	F	GOOD	BRIGHT	384.3B239A5077
4/23/2013	584	460	1674	W	F	GOOD	BRIGHT	384.3B239A8CBF
5/14/2013	573	480	1500	H	F	GOOD	BRIGHT	3D9.1C2D73438B
5/14/2013	715	580	2684	W	F	GOOD	BRIGHT	384.3B2399AA58

The first female was live spawned on April 16th. The last spawning date was May 14th. All fish were transferred to the MSKF in good conditioning. There were no mortalities during the live spawning process as was seen in previous years. A summary of the data collected at spawning can be found in Table 2.1.

2.1.3 Discussion

Live spawning NOR steelhead broodstock has been the most consistent source for kelts for the UCKRP to date. These kelts start the reconditioning process in excellent physical condition and have shown to do well in the program. The project will look to expand the contribution of live spawned broodstock to the

reconditioning project in 2014. The expansion of the USFWS steelhead program at WNFH could result in greater numbers of kelts for the UCKRP. Beginning in 2014 the USFWS will be raising only local Methow River steelhead and eliminating the rearing of steelhead from Wells Dam Fish Hatchery. This will increase the minimum number of spawning pairs from 12 to 24 and could potentially double the number of NOR females available for reconditioning. Further expansion of the steelhead program at WNFH could begin as early as 2015 which could again double the minimum number of spawning pairs required to meet minimum production goals and further increase the number of NOR females available for reconditioning.

In addition to the expansion of live spawning at WNFH, the UCKRP will begin live spawning activities at the Methow Fish Hatchery (MFH) in 2014. The steelhead program at MFH is operated by the Washington Department of Fish and Wildlife (WDFW) and yearly spawns 13 pair of NOR steelhead from the Twisp River. Live spawning these fish will not only increase the number of kelts for reconditioning, but will also increase the possibility of having reconditioned kelts return to the Twisp River. If reconditioned kelts return to the Twisp River they will become part of the ongoing steelhead genetic analysis being conducted by WDFW. This will allow assessment of the reproductive success of reconditioned kelts which is a research need identified in the Upper Columbia Salmon Recovery Plan and one of the project objectives.

2.2 Kelt Trapping

The collection of NOR kelts that have spawned in the natural environment is a priority for the UCKRP. It is unclear if genetics, fish condition, or some combination of the two drives a fish to iteroparity. Whatever cause, these fish attempting to out migrate have the necessary drive. The most successful reconditioning programs to date have been able to collect large numbers of kelts that appear as by-catch in juvenile bypass traps at diversion and hydropower dams. The UCKRP does not have ready access to such traps.

The UCKRP has chosen to attempt to collect kelts in the natural environment using multiple traps in small tributaries in the Methow Basin. The application of small temporary traps would allow the project to test its ability to collect and recondition NOR kelts with lower costs and permitting requirements than would a single, large scale method of collection. The project chose to implement temporary picket weirs based on their versatility, low impact, and relative low cost.

2.2.1 Methods

Trapping Sites

Trapping locations were selected based on four criteria: a low spring stream discharge, site morphology that includes pools or slow water, site access, and steelhead spawning activity. Streams that have a relatively low discharge at their peak do not move large amounts of debris which can cause of weir failures. Weir trap boxes must be placed in slow water or pools so kelts are not subject to the stress of having to continually maintaining themselves in the current. Reasonable access to the site by truck is important so kelts can be transported to the MSKF in a timely fashion. Only streams in which five or more redds had be observed within the last five years were considered for trapping so that resources were being spent in streams with a higher likelihood of encounter kelts.

Three sites were selected for trap operations in 2013: Little Bridge Creek, South Fork Gold Creek, and Hancock Springs. The weir on Little Bridge Creek was located 0.15 river miles from the confluence with the Twisp River, 48.381186 W, -120.286668 N. At this point, reduced gradient creates a wide pool area where water velocity is diminished. The site was accessed from a small two track road off of National Forest Development Road 4415. The weir on Hancock Springs was located 0.17 river miles from the confluence with the Methow River, 48.53734 N, -120.33625 W. The trap was placed in a deep pool downstream of the culvert on Wolf Creek Road. The site can be accessed from Wolf Creek Road. The weir on South Fork Gold Creek was located 0.59 river miles from the confluence of South Fork Creek and Gold Creek and 1.77 river miles from the confluence of Gold Creek and the Methow River, 48.1779 N, -120.1209 W. The trap was placed in a deep pool adjacent to private property.

Trap Construction

The traps consisted of weir panels, pickets, a downstream trap box, and an upstream passage chute. The weir panels were constructed of angle iron 4.5 feet tall and 6 feet long with 0.875 inch holes spaced 1.5 inches apart. Two adjustable legs were attached to each frame for support and to allow the angle of the panel to be modified to best suit their placement location and stream flow. Steel electrical conduit pickets, 5 ft tall and 0.75 inch diameter, were inserted into the holes in the cross pieces of the weir panels. The pickets were not attached to the panel frame to allow their removal during cleaning and times of high flow.

The trap box at Little Bridge Creek was constructed of an angle iron frame 3 ft wide by 4 ft long by 3 ft deep. The sides and floor of the trap consisted of 1 inch aluminum pipe installed horizontally at a spacing of 1.5 inches to allow small, non-target fish to swim through the trap box. The downstream end of the box was removable. The upstream end of the trap was configured into a downstream facing V with a gap of 4 inches to which a cod trigger was attached to prevent fish from swimming out. The top of the trap was hinged to allow fish to be removed (Figure 2.1). The upstream passage chute allows fish to move past the weir unimpeded. The frame of the chute was constructed of the same materials used on the trap box, 2 ft wide by 4 ft long by 2 ft deep. A downstream trap box was placed in a deep area directly downstream of an existing side channel. An upstream passing chute was placed in the thalweg (Figure 2.2).

Figure 2.1 - Little Bridge Creek weir trap layout, downstream view.

Figure 2.2 - Little Bridge Creek weir trap layout, upstream view.

The panel construction for the weirs in Hancock and South Fork Gold Creeks was the same as those installed in Little Bridge Creek. The trap boxes for Hancock and South Fork Gold creeks were designed to operate in the smaller streams. The trap box and passage chute were attach to form a single unit. The trap box was constructed of an angle iron frame 2 feet wide by 4 feet long by 3 feet deep. The sides of the trap consisted of 1 inch steel pipe installed horizontally at a spacing of 1.5 inches. The floor of the trap box consisted of Vexar mesh fastened to the frame with zip ties. The downstream end of the trap box

had 1 inch steel pipe installed horizontally at a spacing of 1.5 inches instead of mesh to allow small, non-target fish species to swim through the trap box. The downstream end was removable. The upstream end of the trap box was configured into a downstream facing V with a gap of 4 inches to which a cod trigger will be attached to prevent fish from swimming out. The upstream passage chute would allow fish to move upstream, past the weir, unimpeded. The frame of the chute will be constructed of angle iron frames 1 ft wide by 4 feet long by 2 feet deep, attached to the frame of the trap box. The sides and floor of the chute will consist of 1 inch steel pipe installed horizontally at a spacing of 1.5 inches.

Trap Operation

The traps were to be operated from the middle of April to the middle of June. The traps were checked a minimum of twice per day, seven days a week. If the traps could not be checked regularly, the downstream panel of the trap boxes would be removed so fish could move past the weirs without obstruction.

Data was collected from all steelhead kelts captured in the downstream trap boxes. The data recorded will included: fork length in millimeters, weight in grams, origin (natural or hatchery), sex, fish condition (good- lack of any wounds or descaling; fair- lack of any major wounds and/or descaling; poor- major wounds and/or descaling), and color (bright, medium, and dark). All fish were scanned for the presence of PIT tags. Tag numbers were recorded if present. If no tag was present a tag was inserted into the fish's pelvic girdle. Natural origin kelts were taken to the MSKF at Winthrop National Fish Hatchery for reconditioning. All hatchery origin kelts, pre-spawn steelhead, or other non-target fish were released downstream of the weir.

2.2.2 Results

Little Bridge Creek

The weir in Little Bridge Creek was installed on May 16th, a month later than intended. The delay in installation was the result of new requirements imposed by US Forest Service (USFS) for Categorical Exclusions of Special Use Permits. Categorical Exclusions now require a 45 day comment period. If a comment is received, there is an additional 15 day review period to address the comments. A comment was unexpectedly received regarding the weirs installation and, while the comment had to effect on how the weir could be installed, the USFS was required delay issuing the permit until the 15 review period had elapsed.

Despite the delay, one NOR female kelt was trapped and transported to the MSKF for reconditioning on May 31st. Two additional steelhead were trapped at Little Bridge Creek on May 23rd and were determined to be pre-spawn, wild male steelhead. These males were released downstream of the weir.

The weir was removed on June 12th.

South Fork Gold Creek

The weir in South Fork Gold Creek was installed on April 16th. Two wild male steelhead were caught at the trap, one on April 18th and one on April 23rd. Both were determined to be in pre-spawning condition and were released downstream of the weir. The trap was removed on May 8th due to increased stream discharge. It was hoped that the weir could be reinstalled when water level decreased but discharge remained too high throughout the rest of the trapping season.

Hancock Springs

The weir in Hancock Springs was installed on April 15th. Three wild male steelhead were caught at the trap, two on May 20th and one on May 21th. These were determined to be in pre-spawn condition and were released downstream of the weir. A hole was discovered on the downstream end of the trap box on May 9th. Although the hole was repaired upon discovery it is possible that kelts were able to escape the trap prior to the repairs.

2.2.3 Discussion

Although the operation of temporary picket weirs has yielded few kelts for recondition, the project feels that their application is still a viable means for collection. Unforeseen permitting challenges have delayed the installation of the Little Bridge Creek weir for two consecutive seasons. The experience the project has gained with the complex regulations associated with operating a trap on USFS land should limit permit related delays in the future. Maintaining the trap during rising stream discharge, as was seen in South Fork Gold Creek, will likely be an ongoing challenge and adaptive management must be applied whenever possible.

Beginning in 2014, the UCKRP will begin installing traps in late March wherever conditions allow. An analysis of PIT tag data from the Methow Basin suggested that a large portion of the kelts may out migrate earlier than April 15th, which has been the target installation date in previous seasons. The project also plans to add another temporary weir trap on Libby Creek, at tributary to the Methow River, beginning in 2014.

The UCKRP will begin implementing a new trapping method for kelts in 2014. An agreement has been reached with Chelan County Public Utility District (CPUD) to collect kelts at Rock Island Dam. Kelts will by collected by CPUD at the juvenile bypass trap as part of their normal sampling operations. CPUD typically encounters kelts while trapping juveniles and release them immediately. Instead of releasing the kelts CPUD has agreed to place the kelts in a holding tank and call YN personnel to alert them that a kelt is available to transport. YN personnel will transport NOR kelts from Rock Island Dam to the Methow Steelhead Kelt Facility.

It is hoped that these actions will improve the project's ability to collect naturally spawning kelts and their inclusion into the reconditioning project.

3 Kelt Reconditioning

The UCKRP utilizes long-term kelt reconditioning techniques in pursuit of its project objectives. Long-term reconditioning is the process where steelhead kelts are collected through live spawning or during their seaward migration, held and cultured in large tanks, and released in fall of the same year as maiden steelhead spawners are returning from the ocean. Long-term recondition has been determined to be the most effective reconditioning methods (Hatch et al. 2012).

The section describes the reconditioning efforts that the UCKRP conducted during 2013.

3.1 Methods

3.1.1 Methow Steelhead Kelt Facility

The MSKF was constructed on Winthrop National Fish Hatchery grounds in 2011. The facility was constructed by the Yakama Nation specifically for the UCKRP. The building is a pre-engineered, all-steel building, 70 ft. long and 27 ft. wide. The facility contains four circular, fiberglass tanks. The tanks are 12 ft. in diameter and 4 ft. in depth. Each tank has 340 ft^3 of rearing volume and has a maximum rearing capacity of 34 adult steelhead. The facility has a total adult capacity of 136 adults.

To prevent the spread of pathogens from the NOR steelhead held at the MSKF to the surrounding watershed, all effluent was sterilized. The MSKF has a UV sterilization system capable of treating a maximum of 200 gallons/minute. The system consists of a concrete settling basin to separate solids and three UV units. The three units allow for two units to be operated in concert and one available as a backup in case maintenance is required on one unit. Additional bio-security measures were taken to ensure that pathogens are not carried out of the MSKF by humans. Foot baths at facility exits were maintained to contain pathogens. Vehicle and foot traffic access was limited through the parking lot outside the fenced hatchery rearing area.

Modifications were made to the facility during 2013 including: adding tank liners, building jump screens around the tanks, completing a permanent formalin drip system, and installing an alarm system.

3.1.2 Treatment

Emamectin Benzoate

Kelts held for an extended period time in a captive environment are susceptible to severe infestation of parasitic copepods of the genus *Salmonicola*. These copepods attach to the gill lamellae and can inhibit oxygen uptake and gas exchange at the gill lamelle/water surface interface. All kelts coming into the reconditioning program received an injection of emamectin benzoate for the treatment of parasites. The emamectin was administered at a dosage of 200 micrograms per kilogram of body weight which was injected into the body cavity.

Formalin

Kelts are particularly susceptible to fungal infections due to the presence of dermal abrasions, lesions, or lacerations. Kelts have a weakened immune system and untreated fungal infections can be lethal. Fungal infections can be difficult to treat once established. To prevent the establishment of fungus the kelt tanks were drip treated with formalin at 167 ppm for one hour. Treatments were administered every other day for the duration of the reconditioning process. If fungus became established the concentration of formalin was increased to 200 ppm and tanks were treated every day until the infection resolved.

Salt

Kelts come into the reconditioning project in a weakened and stressed state due to the combination of the upstream migration, long periods without active feeding, and spawning activities. The project added approximately 2 lbs of salt to the tanks once per day for the first three months of the reconditioning process to ease the kelts' stress in the early stages of reconditioning. Salt is thought to reduce the stress of maintaining osmotic balance and potentially encourage feeding. Additional treatments were given after potentially stress inducing events such as tank cleaning and the removal of mortalities.

3.1.3 Feeding

The kelts were initially offered parboiled, flash frozen Antarctic krill. Kelts were fed one to two times per day until significant feeding activity is observed. Once kelts were observed actively feed they were fed two to three times per day to satiation for approximately six weeks. After six weeks the kelts were slowly transitioned to a modified Moore-Clark pellet feed designed to have a sink rate comparable to the krill. Initially a mixture of 75% krill and 25% pellets are fed for one to two weeks. The ratio was the shifted to include 50% krill and 50% pellets for another one to two weeks and then 25% krill and 75% pellets. Once fully transitioned to pellets the kelts were fed two to three times per day to satiation until one week prior to release.

3.1.4 Mortalities

Any kelt mortalities were immediately removed from the tank. Date collected from mortalities included fork length in millimeters, POH length in millimeters, weight in grams, origin (natural or hatchery), sex, fish condition (good- lack of any wounds or descaling; fair- lack of any major wounds and/or descaling; poor- major wounds and/or descaling), color (bright, medium, and dark), percent fungus coverage, presence of parasites, and maturation status. All fish were scanned for the presence of PIT tags and the data was included in the database.

3.1.5 Release and Tracking

Kelt surviving to the September, at which time maiden spawners are returning to the Methow River, were considered to be successfully reconditioned. Successfully reconditioned kelts were then evaluated during a pre-release workup to determine their maturation status. All surviving kelts were measured for fork length, POH length, weight, and lipid percentage to evaluate any growth during the reconditioning process. Blood samples were taken and evaluated by Columbia River Intertribal Fish Commission (CRITFC) researches for plasma levels of vitellogenin and estradiol, indicators of maturation status. Fish were then released into the river to coincide with the fall migration of maiden spawners. Movement of the kelts was monitored using PIT tag antenna arrays throughout the Methow and Columbia River basins.

3.2 Results

3.2.1 Methow Steelhead Kelt Facility

Modifications made to the MSKF during 2013 improved function and ensured greater fish safety. Black tank liners were installed in all four tanks prior to the arrival of kelts. In 2012, kelts appeared to react poorly to the light blue color of the tanks. They were reluctant to feed and swam erratically if someone approached the tank, often hitting the sides. It appeared that installing dark tank liners would gave the fish a better sense of concealment and reduce stress levels. The kelts began feeding much sooner than the previous year, moved more freely while feeding, and no longer swam into the sides of the tank when someone approached.

Jump screens were installed on the three tanks that were designated to receive fish. The screens were constructed of black mesh and extended vertically for 4 feet. The screens also appeared to increase the kelts level of comfort as the blocked the view of anyone approach the tanks. Netting was attached across the top of the jump screens after a mortality was found on the floor of the facility on May 1st. No holes or gaps were found in the sides of the screen and it was determined that this fish must have jumped over the screen. There were no additional mortalities after netting was fastened to the top of screens.

A permanent formalin drip system was installed to allow for accurate formalin distribution to all four tanks and to limit personnel exposure to potentially dangerous chemicals. The system pumped formalin from a chemical storage building outside of the facility and through a manifold that divide the flow into four tubes that each led to a tank. A heating system was added to the chemical storage building to allow safe storage of formalin in cold temperatures.

An alarm system was installed after the reconditioning season was completed in 2013. This system monitors the water levels in the MSKF to insure that tanks are not dewatered or overflow when staff is not present. The alarm was designed to call a designated phone number if water levels fall under or exceed optimal levels. This will help insure that equipment failure does not result in fish mortality.

3.2.2 Treatment

Emamectin Benzoate

The application of emamectin benzoate appeared to be extremely successful in the control of copepod infestation. In 2012 all successfully reconditioned fish had large numbers of copepods on their gills in September. This lead to poor fish condition at the time of release and likely impacted in river survival. No copepods were observed on any of the successfully reconditioned kelts in 2013.

Formalin

Fungal infections were far less common in 2013 that in the previous year. For the first time, kelts were effectively treated of fungal infections through the increase in formalin concentration and frequency of treatment. In the previous year, kelts that presented with fungus typically died from and treatments served only to prevent the spread to other fish. The project feels confident that greater understanding of how to properly treat fungal infections will increase kelt survival and increase the number of successfully reconditioned fish.

Salt

It is uncertain if the administration of salt had a significant impact on the survival and condition of the kelts due to the many changes made to how the project cultured these fish. There certainly did not appear to be any deleterious effects from the use of salt. The excellent condition of the kelts and ease and inexpensiveness of the treatment encourage the continued application during the early stages of reconditioning.

3.2.3 Feeding

Kelts began feeding earlier and ate more in 2013 than in 2012. Much of this can be attributed to the improvement made to the tanks, as was described earlier, but modifications made to the types of food presented were likely also a factor. Early in 2012 the project fed freeze dried krill instead of the blanched, flash frozen krill. Although the freeze dried krill was said to be a more nutritious form it not

have the natural appearance, odor, or sink rate that NOR kelts would likely prefer. Its tendency to float also made the transition to pellet feed more challenging.

The type of pellets used in 2013 had a much slower sink rate than those used in 2012. This appeared to be a significant change as it gave the kelts more time to access the food before it reached to tank bottom. The sink rate also mirrored the sink rate of the frozen krill, which made the transition to pellets much smoother. At one point, the kelts began selecting the pellets over the krill which was an important step in the reconditioning process. The pellets contain a much higher lipid content which is important for the regrowth of gametes.

3.2.4 Mortalities

There were a total of four mortalities at the MSKF during 2013. Two of the mortalities were HOR kelts and two mortalities were NOR kelts. One of the HOR mortalities jumped out of the tank prior to installing netting at the top of the tanks. The other three mortalities appeared to have died from a combination of lack of feeding and fungal infection. One HOR was successfully reconditioned but was not released. This kelt was sacrificed to allow examination of gamete development.

3.2.5 Release and Tracking

A total of six kelts were successfully reconditioned in 2013, five NOR and one HOR. Four of the six surviving kelts were considered re-mature. The re-mature kelts demonstrated an increase in weight and a fat meter reading of greater that 2% (Table 3.1). The reconditioned kelts demonstrated excellent physical condition prior to release (Figure 3.1).

Table 3.1 – Summary of data from successfully reconditioned kelts.

			Weight (g)					
PIT	Sex	Origin	Start	End	Change	Re-mature?	Fat %	Location
3D9.1C2D73438B	F	H	1500	2108	608	YES	5.2	---
384.3B239AA629	F	W	3450	5138	1688	YES	5.8	843.075
384.3B239A393F	F	W	2740	3490	750	YES	4.7	834.000
384.3B2399F131	F	W	3372	5328	1956	YES	11.2	834.000
3D9.1C2D73DFAF	F	W	4170	3424	*-746*	NO	1.0	843.001
384.3B2399AA58	F	W	2684	2677	*-7*	NO	1.7	843.075

The five successfully reconditioned NOR kelts were released at three separate locations. The decision to release at three separate locations was made primarily because the best location for the kelts overwinter and to avoid the sport fishery is unknown. The project felt that dividing the release could reduce the exposure of some of the kelts to the fishery and may contribute movement information which would help us determine future release locations. Kelts were released on November 18th. Two kelts were released mid-Methow River at river kilometer 75, one kelt was released near the mouth of the Methow River at river kilometer 1, and two kelts were released in the Columbia River above Wells Dam at river kilometer 834.

One instance of PIT tag detection has been observed at the time of this report's completion. A kelt released in the Columbia River was detected at the Lower Methow River PIT tag array on November 21st,

three days following its released. Further detections are expected when water temperature and river discharge increase and maturing steelhead move upstream for spawning in the spring of 2014.

Figure 3.1 – Before and after photographs of fish marked with PIT tag number 3B4.3B2399F131 showing marked improvement in physical condition.

3.3 Discussion

The combination of steps taken to improve reconditioning methods resulted in better survival and improved fish condition in 2013. The project will continue to pursue the same treatment and feeding protocols. A philosophy of adaptive management will continue to be applied to the reconditioning phase of this project and any potential means of improving the survival and condition of kelts will be explored whenever possible.

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