MID-COLUMBIA COHO REINTRODUCTION FEASIBILITY STUDY:

2012 ANNUAL REPORT
February 1, 2012 through January 31, 2013

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1.0 INTRODUCTION

Wild stocks of coho salmon *Oncorhynchus kisutch* were once widely distributed within the Columbia River Basin (Fulton 1970; Chapman 1986). Since the early 1900s, native stocks of coho had been extirpated from several Columbia River tributaries (Wenatchee, Entiat and Methow rivers; Mullan 1983). Efforts to restore coho within these areas will rely heavily on hatchery coho releases. Feasibility of re-establishing coho within mid-Columbia tributaries initially depended upon resolution of two central issues; (1) adaptability of domesticated, lower Columbia coho stocks used in the re-introduction efforts measured through their associated survival rates and (2) ecological risk to other species of concern, such as ESA listed spring Chinook, steelhead and bull trout. Both of these key issues have been resolved in a positive sense (i.e. – insignificant interspecific interactions), therefore allowing the project to continue forward while attempting to achieve its ultimate goal of coho restoration through implementation of the Mid-Columbia Coho Reintroduction Plan (MCCRP).

If coho re-introduction efforts in mid-Columbia tributaries are to succeed, parent stocks must possess sufficient genetic variability to allow for phenotypic plasticity in response to ever changing, selective pressures to environmental conditions between lower Columbia River and mid-Columbia tributaries. Both the Mid-Columbia Coho Hatchery and Genetic Management Plan (HGMP 2002) and Master Plan for Coho Restoration (YN FRM 2009) describe strategies that will be implemented to facilitate the local adaptation process.

We are optimistic that the project will continue to observe positive trends in hatchery coho survival now that the transition has been made from exclusively using lower Columbia River hatchery coho to the sole use of in-basin, locally adapted broodstock. Therefore, it is important to measure hatchery fish performance, not only as an indicator of project performance, but to track potential short- and long-term program benefits from the outlined strategies.

If re-introduction efforts are to be successful long term, adult returns must be adequate to meet replacement levels without adversely affecting other fish populations. Additionally, minimizing hydro impacts, compensating for habitat loss and providing additional harvest opportunities will ultimately play a role in the coho re-introduction program.

This report documents coho restoration activities and results for the performance period of February 2012 through January 2013, to include acclimation, broodstock collection, spawning, egg incubation and transportation, spawning ground surveys and survival (both juvenile and adult). In addition, the Yakama Nation (YN) operated a 5-foot rotary smolt trap to estimate the number of naturally produced coho emigrating from Nason Creek in 2012-2013. This trap is operated with joint funding from Grant County Public Utility District (GCPUD, #430-2365) and BPA coho (#1996-040-00); therefore detailed population and productivity estimates are not included in the body of this report but included as a supplemental document (Collins and Ishida 2012; Appendix A).

2.0 BROODSTOCK COLLECTION AND SPAWNING

2.1 WENATCHEE RIVER BASIN

2.1.1 Broodstock Collection

Broodstock collections occurred at Dryden Dam, Tumwater Dam and Leavenworth National Fish Hatchery (LNFH) adult ladder. Although Dryden Dam has been the primary source of brood collection in the past, Tumwater Dam has become increasingly significant as program collections shift toward incorporating more upper basin returning adults, which have successfully ascended Tumwater Canyon to Tumwater Dam. The emphasis on collecting coho salmon at Tumwater Dam is described in the Mid-Columbia Coho Restoration Master Plan (Broodstock Development Phase II; YN FRM 2009).

Coho returning to the Wenatchee River in 2012 were comprised primarily of brood year (BY) 2009 adults with limited contributions from BY2010 jacks. The Wenatchee program was comprised entirely of 4^{th} generation, Mid-Columbia River (MCR) returns. Dryden Dam fish traps were passively operated five days per week, 24-hours per day from September 1 through November 23. On Saturdays and Sundays, both facilities were opened, allowing unimpeded upstream passage for target and non-target species. Coho trapping at Dryden Dam occurred concurrently with the Washington Department of Fish and Wildlife's (WDFW) summer steelhead and Chinook stock assessment. On occasion, WDFW also collected summer steelhead if broodstock quotes had fallen short at Tumwater Dam.

Coho broodstock was collected concurrently at Tumwater Dam up to five days per week, 8 hours per day, between September 1 and November 10, 2012. All coho encountered at Tumwater Dam were assessed for condition and if deemed suitable, incorporated into the broodstock. Unsuitable individuals consisted of any fish with signs of significant abrasions or wounds, fungus, and/or were overripe (factors that would decrease the likelihood of an individual to survive to spawning) were passed upstream. Overall, less than 5% of the collections fell into this category and fish passed on active trapping days was minimal. Coho collected at Tumwater Dam were externally marked with a green floy tag in the left dorsal sinus and given a left-side opercule punch for later identification during spawning and post-spawn data collection. The opercule punch served as a secondary mark in the event that the floy tag became dislodged during holding. A small proportion (n = 33) of coho collected at Tumwater Dam had been previously floy tagged at Dryden Dam as a part of an ongoing YN mark-recapture study.

In addition to Dryden and Tumwater collections, a v-trap weir in the upper bay of the LNFH ladder was installed the first week of October and operational October 26 through November 8. This site has been and will continue to be used as a back-up broodstock collection site, ensuring that overall goals are met while transitioning through Broodstock Development Phase II (YN FRM 2009). Coho collected at LNFH were externally marked with an orange floy tag in the right dorsal sinus and given a right-side opercule punch to allow for later identification during spawning and post-spawn data collection.

The differential marking schemes at multiple trap locations provided the necessary evaluation tools to parse out supplemental collections when evaluating smolt-to-adult survivals rates as well as determine migratory success for coho. Approximately 53.6% and 27.8% of the total broodstock were collected at Tumwater Dam and Dryden Dam, respectively. Remaining brood fish originated from LNFH ladder collections.

A summary of broodstock collection and fish handled at all trapping sites can be found in Table 1. All coho broodstock were transported to LNFH and held until spawning.

Table 1. Coho salmon and incidentals handled during trapping, 2012.

Location	Coho (*broodstock*)	Steelhead	Sockeye	Chinook	Bull Trout
Dryden Dam	1395* (252)	198	9	303	1
Tumwater Dam	685* (474*)*	N/A	N/A	N/A	N/A
LNFH ladder trap	245* (179)	0	0	0	0

**Actual number of coho handled during trapping at Dryden Dam, Tumwater Dam, and LNFH during broodstock collection efforts for 2012.*

2.1.2 Spawning

A total of 905 coho were collected for broodstock; 429 females and 476 males. The pre-spawn mortality rate at LNFH was 3.9% (35 fish; 7 females and 28 males).

A total of 870 coho (422 F and 448 M) were spawned between October 9 and November 13, 2012. Of the 422 females spawned, 409 were considered viable. Non-viable females were either over-ripe or green at time of spawning. Peak spawn occurred on November 6 with 112.5 viable females (Figure 1).

Spawn timing for the 2012 brood was similar when compared to the program mean from 2000-2011 (Figure 2). YN collection protocols used a variety of estimators to determine collection numbers for both programs. Two of the largest values that impacted production were fecundity and pre-spawn mortality. Based on a five year mean of the previous broodstocks (2006-2011), an estimated fecundity of 2,850 eggs per female and a pre-spawn mortality rate of 3.7% were established.

Joy Evered, United States Fish and Wildlife Service (USFWS), Fish Health Specialist determined that spawn 2 tested positive for the Viral Hemorrhagic Septicemia virus (VHSv) of the IVa genotype (80% probability the result came from one female). The virus is regulated by the United States Department of Agriculture (USDA) and has the potential to cause widespread mortality in infected stocks if an outbreak were to occur. The virus is predominately shed horizontally through feces and urine. VHSv IVa has been detected very sporadically over the past couple of decades and primarily identified in coho adults. Most all isolations of VHSv have been identified from fish species originating in marine waters or adult salmon that have just exited marine waters, supporting the hypothesis that infection occurs in the marine environment (Amos et al. 1998). Most probable source of the virus would be through the consumption of herring (common species that contracts the virus). Although the virus has been present in several cases, a clinical disease has not been documented in either wild or cultured salmonids (Amos et al. 1998). Vertical transmission of the virus has not been documented and widely-used disinfection practices (post fertilization at 75 ppm iodine for 30 minutes) further protects against the spread of VHSv. In documented observations, eggs naturally exposed to the virus remained positive for only 3.5 hours while experimentally infected eggs were virus positive until day 10 but no later (Bovo et al. 2005).

Upon detecting VHSv in the second spawn, YN, USFWS, Oregon Department of Fish and Wildlife (ODFW), Cascade FH and Willard NFH personnel decided that all coho eggs taken in the Wenatchee basin were to be transported to Willard NFH. The reason for keeping the eggs together at one facility was a) USFWS Fish Health determined that due to lack of 100% adult sampling for the coho program, all fish from the entire brood lot were to be treated as "suspect individuals" and b) ODFW policy prohibited out-of-basin VHSv positive tested individuals or progeny of, to enter Oregon. As a contingency plan, Methow staff took additional eggs in case all or a portion of the Wenatchee basin eggs were culled. After tissues cultures were analyzed in subsequent fry and parr, results were negative and the brood was cleared.

Coded-wire tag (CWT) analysis showed that 345 fish spawned were LNFH origin returns from 2011 (BY2009) and 2012 (BY2010) releases, while 451 were fish acclimated and released from upper Wenatchee River basin ponds during the same time period (Table 2). After scale analysis, the remaining 74 fish consisted of 46 hatchery origin fish with unknown release locations, 22 natural origins and 4 unknown origin (scale analyses were inconclusive). The remaining 2 fish were from out-of-basin releases (BY10 Wells FH).

Table 2. Summary of coded-wire-tag and scale analysis from coho spawned at Leavenworth National Fish Hatchery in 2012.

Juvenile Release Location		BY2009 Adults	BY2010 Jacks	Percentage of Brood by Release Site
Leavenworth National Fish Hatchery	*Small Foster-Lucas Ponds*	235	1	27.1%
	Large Foster-Lucas Ponds	109	0	12.5%
Upper Wenatchee River Basin	*Coulter Pond*	111	0	12.8%
	Butcher Creek Pond	80	0	9.2%
	Beaver Creek Pond	127	0	14.6%
	Rohlfing's Pond	118	0	13.6%
	Nason Creek Wetlands	15	0	1.7%
Out-of-Basin	*Wells FH*	2	0	0.2%
Unknown Hatchery Origin		45	1	5.3%
Unknown Origin		4	0	0.5%
Natural Origin		22	0	2.5%
Totals		**868**	**2**	**100.0%**

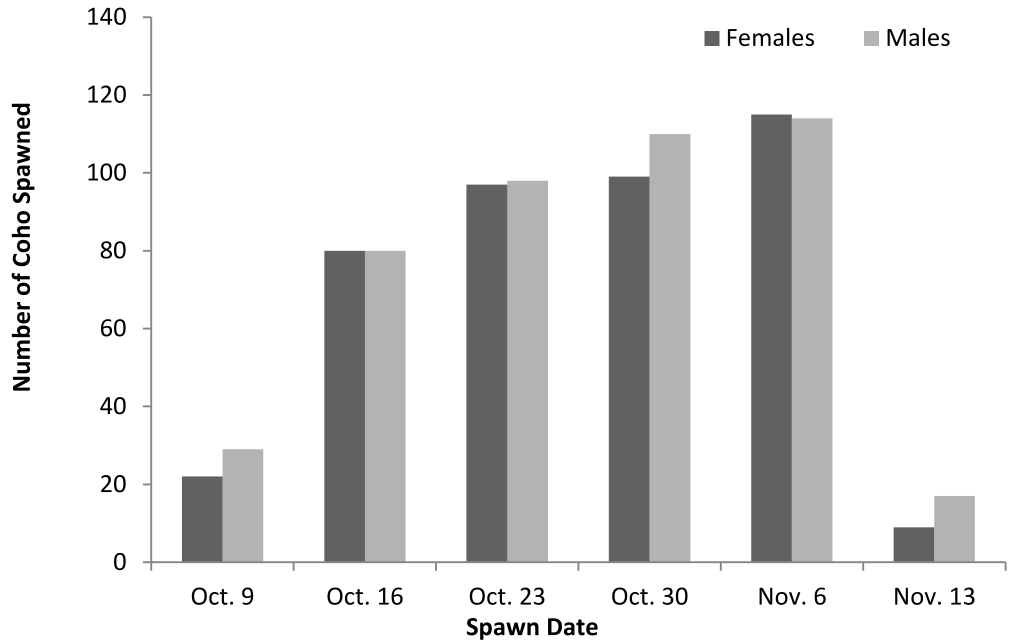


Figure 1. Number of coho spawned at Leavenworth National Fish Hatchery, 2012.

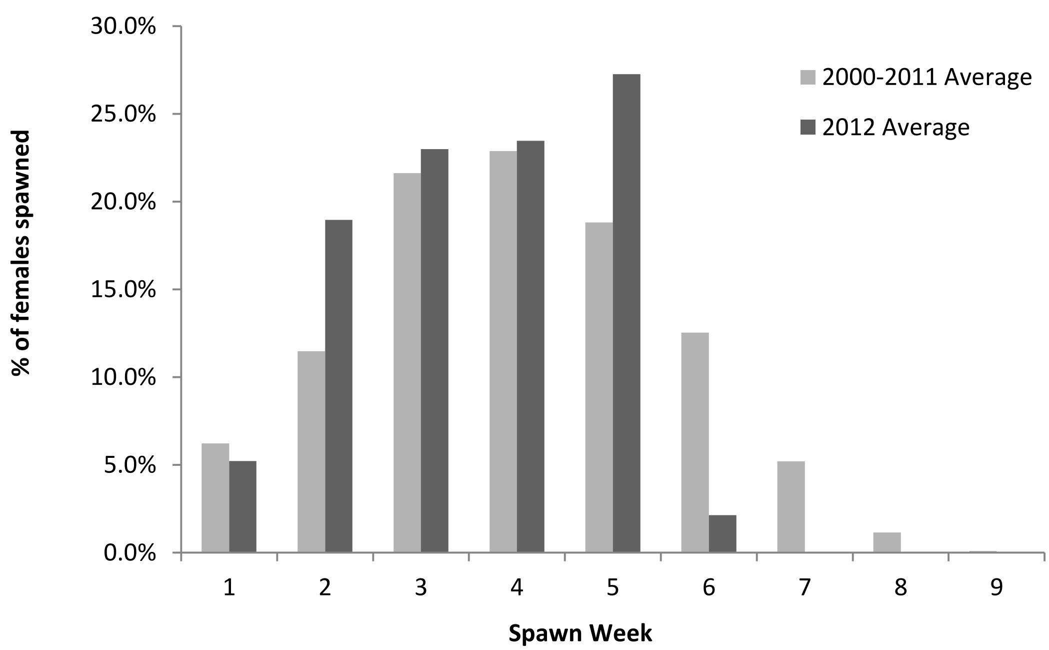


Figure 2. Temporal spawning distribution for brood years 2000-2011 and 2012.

2.1.3 Incubation

A total of 1,117,276 green eggs were collected from the 2012 coho broodstock, approximately 71,608 eggs short of YN's green egg goal. Of the 1,117,276 green eggs, 572,752 were incubated at LNFH while the remaining 544,524 were transported to YN operated Peshastin Incubation Facility (PIF). Vertical stacks were used to incubate coho eggs at LNFH while coho eggs at PIF were bulk incubated in deep troughs. This bulk incubation system has been efficient for coho since it allows for a relative large number of eggs to be successfully incubated in a cost-effective manner while using low volumes of water as compared to the more traditional vertical stack method (5 gpm vs 20 gpm). Chilled water, supplied at 4-5 gal/minute at 44° F, was supplied to coho eggs at both facilities. Water source at the two facilities was 100% groundwater and non-chlorinated city water with a groundwater backup at LNFH and PIF, respectively.

Protocols at both LNFH and PIF facilities had eggs from each female being fertilized with one primary and one back-up male. During fertilization, a 1.0% saline solution was used to increase sperm motility. Eggs were held for a minimum of 2-3 minutes allowing for maximum fertilization success. After fertilization, excess milt, ovarian fluid and other organics were decanted and eggs soaked in 75 parts per million (ppm) of PVP iodine for disinfection purposes. The treatment occurred for 30 minutes and was immediately followed by a freshwater rinse and eggs being placed into the incubation vessel.

Eyed-egg totals for LNFH and PIF were 510,062 and 509,397 respectively. Combined total average eye-up rate for the 2012 brood was 91.2%. The 2012 brood coho eyed-eggs from both incubation facilities were transported to Willard NFH between mid-November and early January for long-term rearing until they reach the pre-smolt stage. A summary of spawn dates, number of green eggs collected, eye-up rate at LNFH and PIF and transport to the rearing facility can be found in Table 3. Transportation from the incubation facilities to the rearing facilities occurred between 550 and 600 temperature units (°F).

Table 3. Spawn dates, number of eggs collected, and eye-up rate at LNFH and the PIF, 2012.

Incubation Location	Spawn Date	Trans. Date	Number of Viable Females	Total green eggs	Number dead eggs	Number eyed eggs	Avg. Eggs per female	Avg. Eyed eggs per female	Avg. % Eye-up	Receiving/ rearing hatchery
LNFH	9-Oct	3-Dec	22.0	60,007	8,044	51,963	2728	2362	86.6	Willard NFH
LNFH	16-Oct	12-Dec	77.5	205,322	26,804	178,518	2649	2303	86.9	Willard NFH
LNFH	23-Oct	20-Dec	92.0	255,295	23,790	231,505	2775	2516	90.7	Willard NFH
LNFH	30-Oct	3-Jan	20.0	52,128	4,052	48,076	2606	2404	92.2	Willard NFH
PIF	30-Oct	19-Dec	76.0	210,876	10,680	200,196	2775	2634	94.9	Willard NFH
PIF	6-Nov	28-Dec	110.5	309,807	22,025	287,782	2804	2604	92.9	Willard NFH
PIF	13-Nov	3-Jan	8.0	23,841	2,422	21,419	2980	2677	89.8	Willard NFH
			406	**1,117,276**	**97,817**	**1,019,425**	**2752**	**2511**	**91.2**	

2.2 METHOW RIVER BASIN 2012

2.2.1 Broodstock Collection

Coho broodstock were collected at Winthrop National Fish Hatchery (Winthrop NFH), Methow Fish Hatchery (Methow FH) and Wells Dam west ladder facility. Broodstock collections at Winthrop NFH primarily relied on volitional swim-ins to the hatchery holding pond. A secondary collection weir, located within the Winthrop NFH's back-channel (Spring Creek) and adjacent to the fish ladder, was also effective for broodstock collections. The Methow FH adult weir was used for a second consecutive year due to the high likelihood of fish attempting to enter the facility since both hatcheries share a common surface water source. Adults collected from both facilities were transported daily to the Winthrop NFH holding pond. Adults entered these traps volitionally and will be referred to as "swim-ins" throughout the remainder of the document. Swim-in collections at Winthrop NFH facility and Methow FH began on October 1 and concluded when collection goals were met on November 14. Supplemental collections occurred concurrently at the Wells Dam west ladder facility with WDFW's steelhead and summer Chinook broodstock collections between September 24 and November 3. The west ladder was actively operated by YN and/or Wells FH staff no more than three days per week throughout the duration of collection efforts and although permitted collections allowed for an extended trap period after October 10, broodstock goals were being met in-basin and no additional trap days were warranted. Fish returning to Methow basin collection locations were prioritized during broodstock collection/spawning since they demonstrated the necessary energetic capabilities and homing fidelity required to complete the migration to their point of release; a fundamental requirement to meet Broodstock Development Phase II goals established within the YN Master Plan.

A total of 687 (254 F and 433 M) volitional swim-ins were collected from in-basin collection points while 92 (73 F and 19 M) adults were intercepted at Wells Dam west ladder facility to fulfill broodstock requirements (Table 4). Of the fish handled at Wells Dam, all individuals were tagged in the dorsal sinus with sequentially numbered floy tags and given a left side opercule punch prior to transport to Winthrop NFH. Marks were used to differentiate fish collected at Columbia River collection points versus swim-ins to during spawning and post-spawn data collection. Sodium chloride, Poly Aqua® and MS-222 were used to decrease stress during transport from Wells Dam to Winthrop NFH. No mortalities occurred during transportation. Handling of non-target individuals, consisting of summer Chinook and summer steelhead, are documented in Table 4. Bull trout were not observed or handled at Winthrop NFH, Methow FH or Wells Dam west ladder. As increasing numbers of swim-ins were observed at Winthrop NFH, previously collected adults from Wells Dam were in-excess of program needs and returned to the Methow River to spawn naturally.

In summary, 779 fish were encountered as swim-ins to Winthrop NFH and Methow FH adult weir or trapped at the Wells Dam west ladder. Of these, 585 coho (287 F and 298 M) were used for broodstock, 151 (23 F and 128 M) were released back into the Methow River and Spring Creek to presumably spawn, 33 (8 F and 25 M) were attributed to pre-spawn mortality and 10 (9 F and 1 M) were non-viable (i.e. possessing gametes that were underdeveloped or in unsuitable condition for fertilization) at the time of spawning.

Table 4. Summary of Methow program coho broodstock collections, 2012.

Location	**Coho broodstock (*sampled*)**	**Steelhead (*Wells FH broodstock*)**	**Summer Chinook (*Wells FH broodstock*)**	**Bull Trout**
Winthrop NFH adult holding pond	516	N/A	N/A	0
Winthrop NFH collection weir	169	N/A	N/A	0
Methow Fish Hatchery	2	N/A	N/A	0
Wells Dam West/East Ladder	92 (*42*)	4(*56*)[a]	12(*51*)[a]	0

[a] - Total numbers of adult steelhead and summer Chinook diverted into the west ladder holding pond for Wells FH broodstock.

2.2.2 Spawning

Coho broodstock collected from all facilities were spawned at Winthrop NFH. Spawning activities occurred on a weekly basis beginning the third week of October and continued through mid-November. A total of 585 viable adult coho (287 F and 298 M) were successfully spawned during the five week period. Peak spawn occurred on November 5 with 138 viable females (Figure 3). Spawn timing was similar when compared to the historical average (Figure 4).

A total of 522 (236 F and 286 M) viable, spawned adults originated as swim-ins while the remaining 63 (51 F and 12 M) were fish intercepted from Wells Dam. Pre-spawn mortality increased from 1.6% in 2011 to 4.2% in 2012. Exact causes for the increase in pre-spawn mortality is unknown, however it is speculated that a proportion of the mortalities may have resulted from increased stress and/or physical impairment incurred from the automated crowding and elevator system, installed in summer 2012. YN and USFWS staff observed some individuals impinged between the crowder and floor during prior to the fourth spawn on November 5. Corrective modifications to the automated system and holding pond were completed in February, 2013. Handling procedures during spawning activities included utilization of CO^2 to reduce potential stress incurred while assessing for ripeness as well as segregating adults by maturation level to reduce frequency of handling. Formalin treatments were initiated three times per week as a preventative measure to inhibit pathogens from spreading within the holding pond.

One hundred and fifty-one coho adults (23 F and 128 M) were program excess, of which, twenty two males were released back into Spring Creek and one hundred twenty nine (23 F and 106 M) adults were released into the Methow River (RK 64.6) on November 14.

CWT analysis revealed that the majority of adults spawned originated from 2011 Winthrop NFH releases (272 F and 286 M). Adults that were not identifiable by the presence of a CWT, scale analysis was conducted and revealed all forty-two were of unknown hatchery origin. For a complete summary of broodstock composition and collection locations, please refer to Table 5.

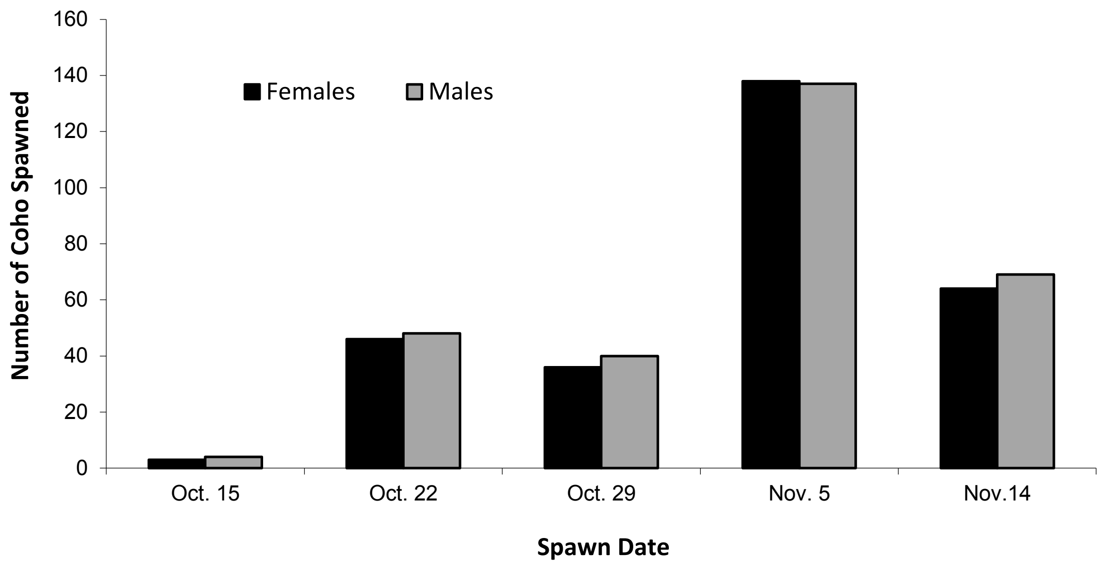


Figure 3 Number of coho spawned at Winthrop National Fish Hatchery, 2012.

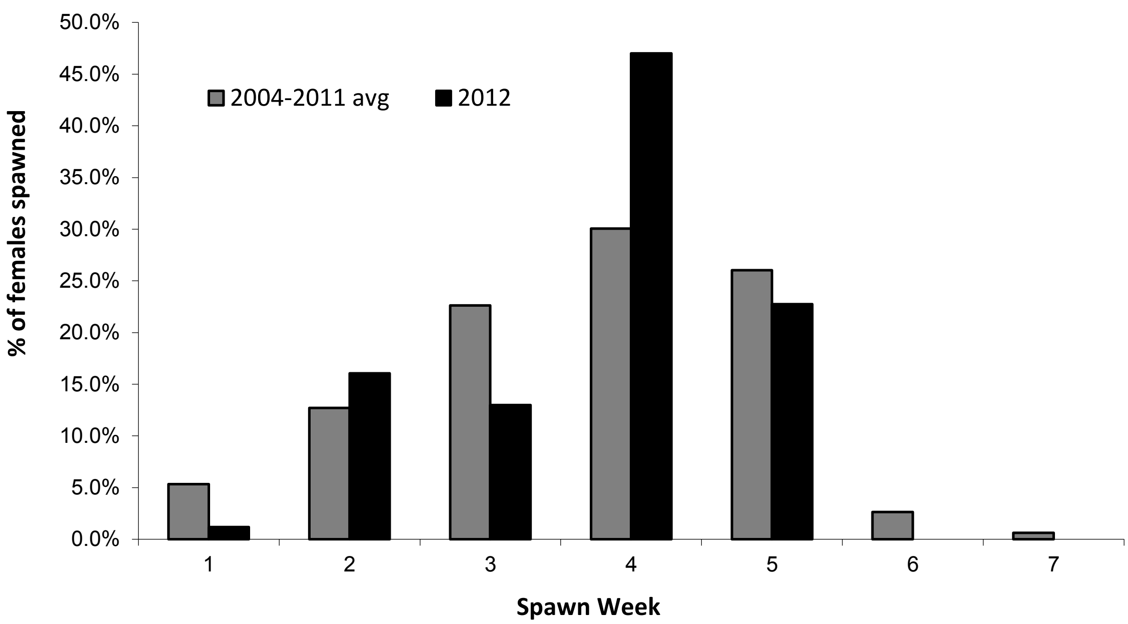


Figure 4. Temporal spawning distribution: brood years 2004-2011 and 2012 at Winthrop NFH.

Table 5. Broodstock composition and collection locations for fish spawned at Winthrop NFH, 2012.

Juvenile Release Location		BY2009 Adults	Total
Winthrop NFH	*On-station*	484	484
Winthrop NFH	*Back Channel*	74	74
Lower Twisp Ponds		17	17
Wells FH	*On-station*	11	11
Unknown Hatchery		42	42
Totals		**628**	**628**

2.2.3 Incubation

Spawning protocols involved eggs from each female being mated with one primary and one back-up male. Females were "bled out" by severing gill arches prior to extracting gametes. Bleeding out females reduced the amount of excess organic matter which could potentially cause an obstruction to the egg's micropyle, prohibiting successful fertilization. During fertilization, gametes were mixed within one gallon buckets and a 1.0% saline solution was used to increase sperm motility. Buckets were then placed into transport coolers and fertilized eggs were allowed to stand until cooler capacity was met (approximately 5 buckets per cooler), or a minimum of 10-15 minutes. Coolers were then transported from the spawning shed to the incubating room located inside the main building. Excess milt, ovarian fluid and other organics were decanted and fertilized eggs were laid into trays with 75ppm PVP iodine solution for disinfection purposes (*see 2.1.3 Incubation*) and placed into vertical stacks. The treatment occurred for 30 minutes and was immediately followed by a freshwater rinse with 100% groundwater at 39° F.

A total of 700,580 green eggs were collected from the 2012 Methow broodstock between October 15 and November 14. Eyed eggs totaled 609,574; 271,082 remained on-station at Winthrop NFH while 338,451 were transported to Cascade FH between December 20 and 26, 2012. Due to positive identification of VHSv at Leavenworth NFH and subsequent decision to transfer all Wenatchee program eyed-eggs to Willard NFH, Methow program eyed-eggs designated for transfer were shipped to Cascade FH for incubation and rearing to pre-smolt stage. Approximately 68,000 of these eyed-eggs were incorporated into the Wenatchee program due to broodstock collection short falls. Mean fecundity for the 2012 brood was 2,864 green eggs per female. Average eye-up for the 2012 brood was 87.0%; a decrease of 3.8% over the previous years' brood but similar to the previous five years' (BY2007-BY2011) average. Transportation of these eyed eggs occurred at approximately 600 temperature units (°F). A summary of spawn dates, number of eggs collected, fecundity and the eye-up rate at Winthrop NFH can be found in Table 6.

Table 6. Spawn dates, number of eggs collected, and eye-up rate at Winthrop NFH, 2012.

Incubation Location	Spawn Date	Trans. Date	Number of Viable Females	Total green eggs	Number dead eggs	Number eyed eggs	Avg. Eggs per Female	Avg. Eyed eggs per Female	Avg. Eye-up (%)	Receiving/ rearing hatchery
Winthrop NFH	15-Oct	N/A	3.0	9,282	1,205	8,077	2,857	2,455	87.0	Winthrop NFH
Winthrop NFH	22-Oct	N/A	45.5[a]	115,707	25,023	90,684	3,152	2,602	78.4	Winthrop NFH
Winthrop NFH	29-Oct	N/A	36.0	91,944	9,181	82,763	2,887	2,632	90.0	Winthrop NFH
Winthrop NFH/ Cascade FH	5-Nov	Dec 20 and 26	137.5[a]	326,975	42,216	284,759[b]	2,846	2,539	87.1	Winthrop NFH/ Cascade FH
Cascade FH	14-Nov	Dec 20	64.0	156,672	13,381	143,291	2,686	2,477	91.5	Cascade FH
Totals			**286.0**	**700,580**	**91,006**	**609,574**	**2,864**	**2,489**	**87.0**	

[a] - *Females observed to be only partially fecund during spawning activities were enumerated as 0.5 in an attempt to more accurately quantify the individual's contribution to the brood.*
[b] - *Approximately 195,160 eyed eggs were transported to Cascade FH between Dec 20 and 26 while the remaining 89,599 eyed eggs were incubated and reared to full term at Winthrop NFH.*

3.0 SPAWNING GROUND SURVEYS

In 2012, coho salmon spawning ground surveys were conducted on the mainstem Wenatchee River from Lake Wenatchee to the mouth at the city of Wenatchee. Portions of Beaver Creek, Chiwawa River, Chumstick Creek, Icicle Creek, Mission/Brender Creek, Nason Creek and Peshastin Creek were also surveyed. Efforts focused on tributaries where current juvenile releases occurred (e.g. Beaver, Nason & Icicle creeks) as well as areas in proximity to release sites (e.g., middle reaches of the Wenatchee River).

Methow basin surveys were prioritized based on historical spawner densities/distribution observed and typically occurred on a weekly basis (e.g. - Methow River, Twisp River and Spring Creek). Survey frequency ranged from weekly to multiple times per season dependent on redd abundance. Periodic surveys, typically at or near peak spawning, were conducted in tributaries where historical redd data demonstrated low counts (historical avg. <5 redds) or had not been surveyed in previous years. These reaches included Libby Creek, Wolf Creek and Gold Creek. Additional out-of-basin survey efforts were conducted above and below Wells Dam, to include Chelan FH outfall (Beebe Springs), Chelan River and Foster Creek. These surveys were prioritized secondarily to in-basin surveys to assess spawner escapement. Complete survey records for both basins can be found in Appendix B.

Surveys in both basins were conducted either by foot, raft or pontoon boat depending on size of stream and flow conditions. Foot surveys were conducted by two staff members. Raft surveys were performed by three people; one person rowing while a second person surveyed, and a third staff member via a pontoon boat which served as a satellite spotter. Individual redds were either recorded on a map or flagged in the field by tying surveyor's tape to nearby riparian vegetation. Each marker listed the date, redd location, redd number, agency and the surveyor's initials. Global positioning (GPS) was used to record the exact location of individual redds on all surveys. While surveys were being conducted, we recorded the number of new redds, live and dead fish, time required to complete the survey, and the stream temperature.

Coho carcasses were recovered during each survey with fork length (FL) and post-orbital-hypural lengths (POH) measured to the nearest centimeter. Measurements of POH were generally more reliable than those of FL since many recovered carcasses were found with substantially worn snouts and/or caudal fins. For the purpose of accurate comparisons, measurements of POH, rather than FL were described. Snouts were removed from all carcasses for subsequent CWT analysis. Sex of each carcass was recorded, if discernible at the time of sampling. In-tact females (i.e. - no tears within the abdomen wall) were checked for egg retention by counting number of eggs present in the body cavity. Egg voidance was calculated by subtracting known number of eggs remaining in an individual female from the average fecundity recorded during that seasons' coho broodstock from their respective basins and expressed as a percentage. To prevent re-sampling, the caudal fin was removed before discarding the carcass along the stream bank.

Spawning ground survey objectives were to:

1) Determine spatial and temporal distribution of naturally spawning coho salmon.

2) Collect biological data from the carcasses of naturally spawning coho to determine return composition (hatchery vs natural origin) and carcass recovery rate.

3) Estimate spawning escapement and subsequent seeding level (total egg deposition) of naturally spawning adults within the Methow and Wenatchee rivers and their tributaries.

Data generated from these efforts are used to monitor progress and development of the recently reintroduced coho population and inform hatchery production through annual abundance estimates, stray rates and adult age composition. These surveys are comprehensive and will remain so until established spawner distribution patterns have been documented as a result of Natural Production Phases (YN FRM 2010). At that point in time, index reaches (shorter and representative) could be used to estimate spawner escapement. Current survey reaches were determined by length and duration of time necessary to complete them in a single day and derived from established agency protocols in the Upper Columbia for a variety of other species surveys (spring Chinook, summer Chinook and steelhead; Table 7).

Table 7. Spawning ground survey reaches for the Wenatchee and Methow river subbasins in 2012.

Reach Designation	Reach Description	Reach Location (RK)
	Wenatchee River Basin	
	Icicle Creek	
I1	Mouth to Hatchery	0.0 - 4.5
I2	Hatchery to Head Gate	4.5 – 6.2
I3	Headgate to LNFH intake	6.2 – 8.0
	Nason Creek	
N1	Mouth to Coles Corner	0.0 - 7.0
N2	Coles Corner to Butcher Pond	7.0 - 14.3
N3	Butcher Pond to Rayrock	14.3 – 20.0
N4	Rayrock to Whitepine Creek	20.0 – 22.0
	Wenatchee River	
W1	Mouth to Cashmere Park	0.0 – 13.4
W2	Cashmere to Dryden Dam	13.4 – 28.0

W3	Dryden Dam to Boat Ramp	28.0 – 38.0
W4	Boat Ramp to Leavenworth Bridge	38.0 – 41.7
W5	Leavenworth Br. to Tumwater Bridge	41.7 – 56.2
W6	Tumwater Bridge to Plain Bridge	56.2 – 69.2
W7	Plain to Lake Wenatchee	69.2 – 86.0
	Beaver Creek (WEN)	
BV1	Mouth to Acclimation Pond	0.0-2.4
	Brender Creek	
BR1	Mouth to Mill Road	0.0 - 0.3
	Chiwaukum Creek	
CW1	Mouth to Hwy 2 Bridge	0.0 – 1.0
	Chiwawa River	
CH1	Mouth to Weir	0.0 – 1.0
	Chumstick Creek	
CM1	Mouth to North Road	0.0 – 0.5
	Mission Creek	
M1	Mouth to Residential Area	0.0 – 1.0
	Peshastin Creek	
P1	Mouth to YN Office	0.0 – 3.5
P2	YN Office to Mountain Home Road	3.5 – 8.0
P3	Mountain Home Rd. to Valley High Bridge	8.0 – 13.3
	Methow River Basin	
	Wolf Creek	
W1	Mouth to Biddle Acc. Ponds	0.0-1.6
	Hancock Springs Creek	
HS1	Mouth to Source	0.0 - 1.5
	Beaver Creek (MET)	
BC1	Mouth to Culvert	0.0-0.4
BC2	Culvert to Hwy 20 Br.	0.4-3.0
	Libby Creek	
L1	Mouth to Hwy 153 Br.	0.0-0.5
	Gold Creek	
G1	1.7 to RM 2.1	1.7-2.1
	Chewuch River	
C1	Mouth to Co. HWY 1613	0.0-4.0
C2	Co. Hwy 1613 to East County Junction	4.0-15.3
	Twisp River	
T1	Mouth to Lower Poorman Br.	0.0-3.0
T2	Lower Poorman Br. to Upper Poorman Br.	3.0-8.0
	Spring Creek	
SP1	Mouth to Winthrop NFH	0.0-0.4
	WDFW/ Methow FH Outfall	
MFH1	Mouth to hatchery adult weir	0.0-0.5
	Methow River	

M1	Mouth to Steel Br.	0.0-7.2
M2	Steel Br. to Lower Burma Br.	7.2-14.9
M3	Lower Burma Br. to Upper Burma Br.	14.9-23.8
M4	Upper Burma Br. to Lower Gold Creek Br.	23.8-33.7
M5	Lower Gold Creek Br. to Carlton	33.7-46.9
M6	Carlton to Holterman's Hole	46.9-64.6
M7	Holterman's Hole to MVID dam	64.6-74.6
M8	MVID dam to Red barn	74.6-83.7
M9	Red Barn to Wolf Creek	83.7-88.1
M10	Wolf Creek to Rip Rap	88.1-92.7
M11	Rip Rap to Weeman Br.	92.7-98.6
	Columbia River Basin	
BB1	Chelan FH (Beebe Springs)	0.0-0.7
CF1	Chelan Falls	0.0-0.8
FC1	Foster Creek	0.0-1.9

3.1 WENATCHEE BASIN REDD COUNTS

In 2012, YN identified a total of 574 redds and collected 154 adult coho carcasses throughout the Wenatchee River subbasin for an overall sample rate of 12.8%. The majority of redds (*n* = 551) were located in the lower Wenatchee River and tributaries at/or downstream of Leavenworth. Redds found upstream of Leavenworth totaled 23 with most of these occurring in Nason Creek (*n* = 21). Numbers of adult coho that migrated past Tumwater Dam remained low due to increased broodstock collection efforts. For a spawning ground summary for the Wenatchee basin, please see Table 8.

Table 8. Summary of Wenatchee River coho redd counts, distribution and carcass recovery in 2012.

Stream	Redd Count				Live Fish Count				Recovered Carcasses				Sample Rate[a]
	Oct	Nov	Dec	Tot.	Oct	Nov	Dec	Tot.	Oct	Nov	Dec	Tot.	FINAL
Beaver	0	0	0	0	0	1	0	1	0	0	0	0	**0.0%**
Icicle	126	95	2	223	629	355	18	1,002	29	46	1	76	**16.2%**
Chumstick	0	0	0	0	0	0	0	0	0	0	0	0	**0.0%**
Mission	6	6	0	12	27	10	0	37	1	3	0	4	**15.9%**
Nason	21	0	0	21	39	2	0	41	0	0	0	0	**0.0%**
Peshastin	15	1	0	16	20	3	0	23	5	1	0	6	**17.9%**
Wenatchee	45	257	0	302	450	198	1	649	28	39	1	68	**10.7%**
Total	213	359	2	**574**	1,165	569	19	**1,753**	63	89	2	**154**	**12.8%**

[a] – sample rate was based on Fish Per Redd (fpr) derived from calculated sex ratios form the run-at-large (1.1M: 1F)

A total of 154 carcasses were recovered in the Wenatchee River basin with 98.7% (*n* = 152) being found in the mid to lower drainage. Analysis of 115 recovered CWTs revealed that 80 fish originated from LNFH juvenile releases while the remaining 34 were released from several upper Wenatchee River acclimation ponds (Table 9). A single carcass, recovered on Icicle Creek, originating from Winthrop NFH releases. The remaining 39 unknown origin adults are summarized in Table 10. The proportion of naturally origin returns in the Wenatchee Basin was 5.2%.

Table 9. Summary of carcass distribution and origin throughout the Wenatchee River and its tributaries, 2012.

Juvenile Coho Release Location/Origin through CWT analysis		Adult Recovery Location										
		Lower Wenatchee					Upper Wenatchee					
		Mission	Peshastin	Chumstick	Icicle	Wenatchee 1-4	Chiwaukum	Chiwawa	Beaver	Nason	Wenatchee 5-7	TOTAL
Lower Wenatchee	LNFH SFL 17-24 (overwintered)	1	1	-	23	13	-	-	-	-	-	38
	LNFH LFL 1, 2	-	-	-	19	8	-	-	-	-	-	27
	LNFH SFL 10-12	-	2	-	7	6	-	-	-	-	-	15
Upper Wenatchee	Beaver Creek Acc. Pond	1	1	-	2	8	-	-	-	-	1	13
	Rolfing's Acc. Pond	-	-	-	3	4	-	-	-	-	-	7
	Butcher Creek Acc. Pond	-	-	-	2	4	-	-	-	-	-	6
	Coulter Creek Acc. Pond	1	-	-	1	4	-	-	-	-	-	6
	Nason Creek Wetlands	-	-	-	-	2	-	-	-	-	-	2
Methow River Basin	Winthrop National Fish Hatchery	-	-	-	1	-	-	-	-	-	-	1
TOTAL		**3**	**4**	**0**	**58**	**49**	**0**	**0**	**0**	**0**	**1**	**115**

Table 10. Origin of carcasses without CWTs recovered in the Wenatchee River Basin, 2012.

Carcass Recovery Location	Origin[a]		
	Unknown Hatchery	Natural Origin	Unknown (unreadable scales)
Icicle Creek	11	5	1
Mission Creek	1	-	-
Peshastin Creek	1	-	-
Wenatchee River	14	3	3
Total = 39	**27**	**8**	**4**

[a] – Origin was determined through scale analysis

3.1.1 Icicle Creek

YN conducted 10 weekly spawning ground surveys in the main channel (I1) and restored side channel (I2) of Icicle Creek between October 1 and December 12 (Figure 5). YN recorded 154 redds in the main channel and 69 redds in the restored channel (Icicle Creek total = 223). Redds recorded in Icicle Creek represented 39.1% of the total number of redds found in the Wenatchee River basin (Table 8).

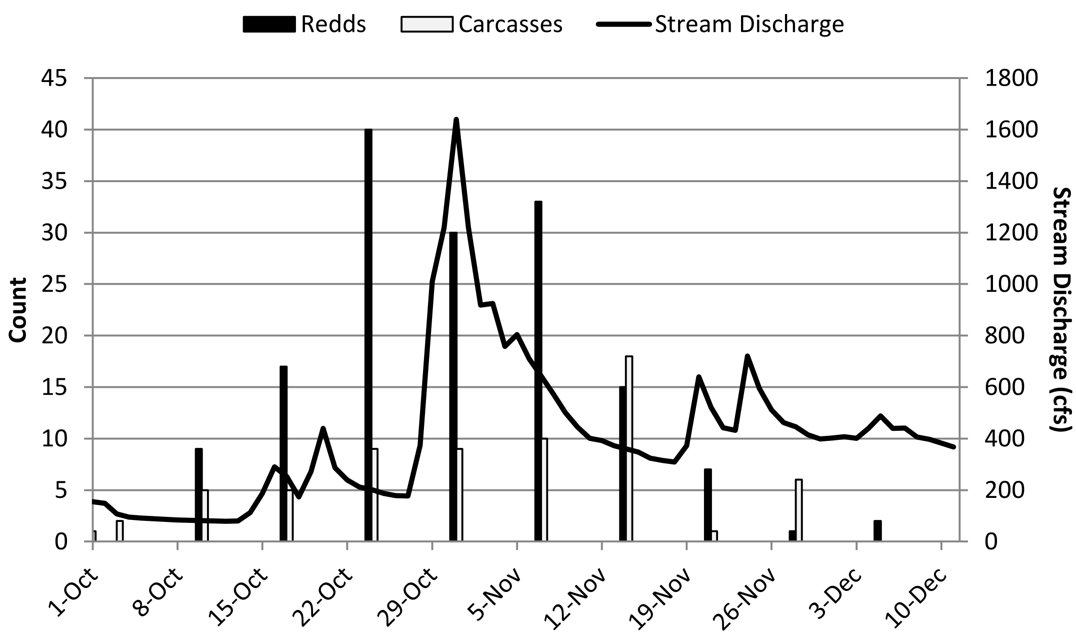


Figure 5. Weekly redd counts conducted in Icicle Creek from October 1 through December 10, 2012.

YN recovered 76 coho carcasses (54 females, 18 males and 4 unknown) from Icicle Creek for a sample rate of 16.2%. Mean POH lengths for male and female carcasses were 52.5cm (*n* = 46; *SD* = 3.6*)* and 49.1cm (*n* = 18; *SD* = 5.2), respectively. All females with intact body cavities were examined for the presence of eggs. Among female carcasses that were intact and appeared to have died from natural causes (not predation), mean egg voidance was 74.4% (*n* = 30; *SD* = 0.4).

3.1.2 Wenatchee River

A total of 302 redds were recorded on the mainstem Wenatchee River, from Lake Wenatchee to the Columbia River confluence (reaches 1-7), between October 2 and December 12 (Table 8). Weekly surveys were conducted on the lower Wenatchee River reaches from Leavenworth to the mouth (W1 – W4). Upper Wenatchee River reaches were surveyed every 14 days. Majority of redds were counted in the lower Wenatchee River (*n* = 301; 99.6%) with only one redd being located in the upper river. Redds located on the mainstem accounted for 52.6% of the total number of coho redds in the entire Wenatchee River basin. YN recovered 68 carcasses from the mainstem Wenatchee River for a sample rate of 10.7%. Mean POH lengths for male and female carcasses were 51.3cm (*n* = 42; *SD*= 4.4) and 47.9cm (*n* = 17; *SD* = 5.1), respectively. Mean egg voidance was 64.4% (*n* = 30; *SD* = 0.4).

Adults returning to the upper Wenatchee must migrate through the Tumwater Canyon where fish can be passed or collected at Tumwater Dam. In 2012, total number of adult coho counted at this facility was 1,153. Of these, 678 were allowed to pass upstream while 475 coho were collected as hatchery broodstock. Strong efforts were made to locate spawning coho in Wenatchee reaches 6 and 7. However, challenging river conditions (e.g. - poor visibility, high water levels) limited coho observations within these reaches. Also, sex ratios observed at Tumwater Dam have been heavily skewed towards males in recent years and was also in 2012, further decreasing available females above Tumwater Dam.

3.1.3 Nason Creek

Weekly surveys were conducted in Nason Creek between October 1 and November 23; a total of 21 redds were recorded (Table 8). Nason Creek redds represented 3.7% of the coho redds identified in the Wenatchee River basin. Carcass recovery was difficult or impossible (no carcasses were recovered) due to severely increased stream flows in late October. Flows levels did not immediately subside and visibility remained poor for the rest of the survey season. As with the majority of the upper Wenatchee subbasin, these counts probably underestimated numbers of redds in Nason Creek.

3.1.4 Mission/Brender Creeks

YN conducted nine surveys of Mission/Brender creeks between October 3 and December 5. A total of 12 redds were recorded which represented 2.1% of the total coho redds in the Wenatchee River basin (Table 8). YN recovered four carcasses for a sample rate of 15.9 %. Mean POH lengths for males and females were 48.7cm (*n* = 3; *SD* = 3.8) and

49.0 cm (*n* = 1), respectively. Egg voidance was calculated on a single female carcass and observed to be 64.2%.

3.1.5 Peshastin Creek

Eight surveys were conducted on Peshastin Creek between October 4 and November 29 (Table 8). Redds located in Peshastin Creek represented 2.8% of those recorded in the basin. A total of six carcasses (all females) were recovered for a sample rate of 17.9%. Mean POH lengths was 50.3cm (*n* = 6; *SD* = 3.7). Mean egg voidance was 81.0% among females sampled (*n* = 2).

3.1.6 Other Tributaries

Site surveys were also conducted in Beaver and Chumstick creeks. Beaver Creek was surveyed on November 2 and timed to coincide with the peak spawning. A single, live fish was identified but no redds or carcasses were observed. Chumstick Creek was surveyed on October 8 and the water was determined to be too low to allow for adult passage.

3.2 METHOW BASIN REDD COUNTS

In the Methow River basin, a total of 200 coho redds were identified and a total of 73 carcasses were collected for an overall sample rate of 13.5%. Majority of redds were located in the mainstem Methow River (*n* = 89) and associated outfalls of Winthrop NFH and Methow FH (*n* = 76). For a spawning ground summary for the Methow Basin, please see Table 11.

Spawning ground surveys were also conducted within select tributaries located in proximity both above and below Wells Dam. These were initiated in an effort to account for adults returning from 2011 Wells FH releases selecting spawning habitat in tributaries above and below their release point.

Table 11. Summary of Methow River coho redd counts, distribution and carcass recovery in 2012.

Stream	Redd Count				Live Fish Count				Recovered Carcasses				Sample Rate[a]
	Oct	**Nov**	**Dec**	**Tot.**	**Oct**	**Nov**	**Dec**	**Tot.**	**Oct**	**Nov**	**Dec**	**Tot.**	**FINAL**
Methow	36	50	3	89	182	48	1	231	6	28	15	49	**20.4%**
Winthrop NFH (Spring Creek)	31	21	2	54	24	11	1	36	1	13	2	16	**11.0%**
Twisp	11	18	4	33	11	7	0	18	1	7	0	8	**9.0%**
Methow FH Outfall	13	9	0	22	3	17	1	21	0	0	0	0	**0.0%**
Gold	2	0	0	2	1	0	0	1	0	0	0	0	**0.0%**
Chewuch	0	0	0	0	0	0	0	0	0	0	0	0	**0.0%**
Beaver	0	0	0	0	0	0	0	0	0	0	0	0	**0.0%**
Total	93	98	9	**200**	221	83	3	**307**	8	48	17	**73**	**13.5%**

[a] – *Sample rate is based on a sex ratio of 1.7M: 1.0F observed as swim-ins to Winthrop NFH. Sample rate was calculated as Carcasses/Sex Ratio x Redd Count = Escapement.*

A total of 73 carcasses were recovered in the Methow River basin with 67.1 % (*n* = 49) being found in the mainstem Methow River. CWT analysis of 68 confirmed and recovered tags revealed that 33 and 25 of the recoveries originated from Winthrop NFH and Lower Twisp Ponds releases, respectively. The remaining 10 were released from the Winthrop NFH back channel and Wells FH. Summaries of carcass distribution and origin of carcasses recovered without CWTs are provided in Tables 12 and 13.

Table 12. Summary of carcass distribution and origin throughout the Methow River and its tributaries, 2012.

Juvenile Coho Release Location/Origin through CWT analysis		Adult Recovery Location						
		Methow River					Out of Basin	
		Methow 1-4	Methow 5-8	Methow 9-11	Twisp River	Spring Creek	Beebe Springs	TOTAL
Methow River Basin	Winthrop NFH	1	20	1	-	10	1	33
	Winthrop NFH Back Channel	1	4	-	-	1	-	6
	Lower Twisp Ponds	4	10	-	8	2	1	25
Out of Basin	Wells Fish Hatchery	3	-	-	-	-	1	4
TOTAL		**9**	**34**	**1**	**8**	**13**	**3**	**68**

Table 13. Origin of carcasses without CWTs recovered in the Methow River Basin, 2012.

Carcass Recovery Location	Origin[a]	
	Unknown Hatchery	Unknown Origin (unreadable scales)
Methow River	3	2
Spring Creek	2	1
Total = 8	**5**	**3**

[a] – Origin was determined through scale analysis

3.2.1 Methow River

Methow River redd surveys were conducted every seven days between October 8 and December 19. Surveys included eleven reaches (M1-M11) on the Methow River extending from Weeman Bridge (RK 98.6) to confluence with the Columbia River (RK 0.0). A total of 89 coho redds were identified on the mainstem; 26 redds in lower reaches M1-M4 (RK 0.0-33.7), 56 redds in middle reaches M5-M8 (RK 33.7-83.7) and the remaining 7 redds in upper reaches M9-M11 (RK 83.7-98.6). A total of forty- nine carcasses were identified during surveys. Twenty- nine males and twenty females were sampled with a mean FLs of 58.6cm (*SD* = 7.4) and 61.6cm (*SD* = 3.5) and a POH of 43.6cm (*SD* = 5.4) and 47.1cm (*SD* = 3.7), respectively. All females with intact body cavities were examined for the presence of eggs. Mean egg voidance for females recovered was 78.1% (*n* = 20). Three of these females possessed intact egg skeins and were determined to be pre-spawn mortalities. Carcass recovery rate for the mainstem Methow River was 20.4% (Table 11).

The high proportion of redds identified within the middle reaches continues to demonstrate a shift in spawning distribution when compared to previous years; historically, the highest proportion of redds were observed within the lower four reaches of the mainstem (M1-M4; RK 0.0-33.9). This may be attributed to an increasing number of adults, returning from Winthrop NFH and Lower Twisp Ponds releases, demonstrating sufficient energetic levels to return to preferred habitat in proximity to their release point when compared to previous years.

3.2.2 Winthrop NFH (USFWS)/ Spring Creek and Methow FH (WDFW) Outfalls

Spring Creek and the Methow FH outfall were surveyed weekly beginning October 15 and ending December 21. The Winthrop NFH complex (on-station raceways and back-channel pond) was the primary release location of two within the Methow River basin in 2011, resulting in unnaturally high spawning densities surrounding the hatchery outfall. Similarly, high spawning densities were observed around the outfall to the Methow FH due to similar imprinting signatures resulting from a common point source for both hatchery facilities' surface water diversions.

A total of 54 redds were located within Spring Creek between mid-October through mid-December. These redds accounted for 27.0% of all coho redds identified within the Methow basin (Table 11). Three males and thirteen females were sampled with a mean FL of 65.3cm (*SD*=5.0) and 60.7cm *(SD*=5.0) and a mean POH of 46.7cm (*SD*=2.7) and 45.9cm (*SD*=4.3), respectively.

A total of 22 redds were identified within the Methow FH outfall between mid-October through late-December. These redds accounted for 11.0% of all coho redds identified within the Methow basin (Table 11). Zero carcasses were identified in this location.

3.2.3 Twisp River

Twisp River surveys were conducted between October 23 and December 9. Surveys included six reaches extending from War Creek Bridge (RK 28.9) to the confluence with the Methow River (RK 0.0). Survey reaches TR 1-3 were prioritized and surveyed twice weekly between October 23 and December 6. The frequency of spawning surveys within these reaches was increased in 2012 as a result of an observed increase in spawning densities proximal to Lower Twisp Ponds release location (RK 1.6) as well as overall expansion of surveys since acclimated releases began in 2009 from this tributary. A total of 33 redds were located, of which, 28 were located upstream from the Twisp Ponds acclimation site. Four redds were observed in survey reach TR 5 (RK 13.5-21.6) on December 1. These redds were located above the Little Bridge Creek confluence (RK 15.2) which constituted the furthest observed coho distribution in the Twisp River basin since comprehensive surveys were initiated in 2005. The number of redds identified in 2012 was the highest recorded since programs' inception. Redds observed upstream of the acclimation site may demonstrate an increased, energetic fitness allowing adults to migrate and locate suitable spawning habitat beyond their point of release. Two males and six females were sampled with mean FLs of 63.5cm (*SD* = 7.8) and 60.8cm (*SD* = 3.1) and mean POHs of 47.5cm (*SD* = 7.8) and 48.2cm (*SD* = 4.3), respectively. Mean egg voidance was 100.0% (*n* = 6) and the carcass sample rate was 9.0% for the Twisp River (Table 11).

3.2.4 Gold Creek

Gold Creek surveys were conducted four times between October 24 and December 1. Surveys were conducted as one reach on Gold Creek, extending from State Boundary markers (RK 2.1) to private estate land (RK 1.7). YN staff will continue to work with landowners to allow more frequent surveys within this reach. A total of two redds were located within Gold Creek (Table 11). There were no live fish observed or carcasses recovered within this reach.

3.2.5 Chewuch River

Chewuch River redd surveys were conducted three times between October 27 and November 16. Surveys included three reaches (CR1-CR3) on the Chewuch River extending from Methow State Wildlife Area (RK 21.9) to confluence with the Methow River (RK 0.0). There were no redds identified, live fish observed or carcasses recovered within this tributary.

3.2.6 Beaver Creek

Beaver Creek surveys were conducted twice during peak spawn between November 1 and November 15. Surveys included two reaches (BM1 and BM2) extending from State Route 20 Bridge (RK 3.0) to the confluence with the Methow River (RK 0.0). There were no redds identified, live fish observed or carcasses recovered within these reaches.

3.2.7 Hancock Springs Creek and Suspension Creek

Three surveys; pre, during and post-peak spawning were conducted on Hancock Springs Creek between October 21 and November 18. Surveys were conducted as one reach extending from the confluence with the Methow River to approximately 1.5 kilometers upstream to the water source; a natural spring. One survey was conducted on Suspension Creek after peak spawn on November 18. The survey was conducted as one reach (SCB1) extending from the confluence with the Methow River upstream approximately 250 meters. There were no live fish observed or carcasses recovered within these tributaries.

3.2.8 Chelan FH Outfall (Beebe Springs)

Survey efforts continued in 2012 in areas downstream and upstream of Wells Dam to account for fish returning from 2011 Wells FH smolt releases and potential dropouts associated with in-basin releases (would only be verified through CWT extraction from carcass recoveries). Surveys at the Chelan FH outfall (Columbia RK 808) were conducted once before and after peak spawn on October 31 and November 19; out –of-basin surveys were secondary to Methow River basin surveys. Beebe Springs Creek surveys were performed from the Columbia River confluence upstream to the Chelan Falls FH diversion. Two redds were observed. One male and two females were sampled. The male FL was 66.0cm and POH was 46.0cm. Mean female FLs was 62.5cm (SD = 3.5) and a mean POH of 46.0cm (SD = 0.0). CWT analysis revealed that the 1 male originated from the 2011 Twisp Pond release, 1 F originated from the 2011 Winthrop NFH on-station release and the remaining 1 female was released from Wells FH is 2011. Mean egg voidance was 82.5% (n = 1000).

3.2.9 Foster Creek

Foster Creek, located at the base Chief Joseph Dam (RK 870) on the left bank of the Columbia River, was surveyed on October 31 and November 19. There were no live fish observed or carcasses recovered within this reach. Surveys were conducted as one reach (FC1) on Foster Creek from the confluence with the Columbia River upstream to the first bridge.

4.0 SMOLT ACCLIMATION: WENATCHEE AND METHOW

4.1 ACCLIMATION SITES

In 2012, within the Wenatchee River basin, YN acclimated coho pre-smolts at LNFH, Beaver Creek and four sites on Nason Creek. For the Methow River broodstock development program, YN acclimated coho pre-smolts at Winthrop NFH, Winthrop NFH back-channel pond, the Twisp Ponds Complex (Twisp ponds) and Wells FH.

4.1.1 Leavenworth National Fish Hatchery (LNFH)

LNFH is located at river kilometer (RK) 4.5 on Icicle Creek. Coho smolts were acclimated in refurbished raceways, also known as small and large Foster-Lucas (SFL & LFL) ponds. Originally, these Foster-Lucas ponds were designed for rearing steelhead, sockeye, and spring Chinook. The intent for the oval-shape design was to create a low-maintenance raceway. These ponds were discontinued by USFWS staff due to insufficient turnover rates and maintenance difficulties in favor of more widely used 8x100 and 10x100-foot raceways. Both SFL's and LFL's were partially refurbished by Yakama Nation Fisheries and supplied with re-use water for coho acclimation. The water source for the LFL's originates from the hatchery's 10'x100' juvenile spring Chinook raceway effluent. Re-use water supplied to the SFL's was pumped from a sump below the adult holding ponds, which doubles as a rearing/acclimation pond for juvenile spring Chinook until release in late-April. Water to each Foster-Lucas pond was manually adjusted to achieve flow requirements needed for coho densities on-hand. In 2012, acclimation for both coho and spring Chinook continued until mid-April. Upon release from marked ponds, four passive integrated transponder (PIT) tag detection systems were installed to monitor the release and provide emigration timing, determine residence time, calculate in-pond survival and provide accurate release numbers for a smolt-to-smolt survival analysis (Section 4.4 and 5.0).

4.1.2 Beaver Creek

The Beaver Creek acclimation pond is located at RK 2.4 on Beaver Creek. The Beaver Creek drainage enters into the Wenatchee River near Plain, Washington at RK 74.4. The acclimation pond was constructed in the mid-1980s and located behind Mountain Springs Lodge. Originally, the property owner stocked the pond with Kamloops rainbow trout for aesthetic purposes. River otter predation on these year-round resident trout became too problematic and the stocking was discontinued in the early 1990s. After the stocking ceased, Beaver Creek pond had been void of salmonids until YN began using the site in 2002 to acclimate coho salmon prior to release. Pre-acclimation activities included installing containment structures at the pond's inlet and outlet. The expectation was that returning adults from the Beaver Creek release would either spawn in Beaver Creek or the upper Wenatchee River watershed. The resulting natural production would continue to build the ongoing broodstock development process. Two PIT tag detection systems were installed to monitor the release and provide emigration timing, determine residence time, calculate in-pond survival and provide accurate release numbers for a smolt-to-smolt survival analysis (Section 4.4 and 5.0).

4.1.3 Nason Creek

In 2012, acclimated coho pre-smolts were reared and released from four sites on Nason Creek; Butcher Creek, Coulter Creek, Rohlfing's Pond and the Nason Creek Wetlands. All acclimation sites in Nason Creek are natural or semi-natural earthen ponds. Natural and earthen ponds may have advantages over conventional, hatchery raceways by providing lower rearing densities, access to a variety of invertebrates for diet supplementation and other improved environmental conditions (e.g. natural temperature and flow regimes, increased water quality, volitional pond migration, etc.) that should produce a juvenile with adequate imprinting capabilities and persist during springtime rearing and subsequent downstream migration.

4.1.3.1 Rohlfing's Pond

Rohlfing's Pond acclimation site is located on an unnamed, seasonal creek which connects to the lower end of Mahar Creek before reaching Nason Creek at RK 20.3. This earthen pond was constructed and developed by the property owner. In 2003, to create a more suitable acclimation environment, YN enlarged the pond and planted native riparian vegetation. Again in 2010, the pond was enlarged and native riparian vegetation planted. This expansion was largely to facilitate a multi-species acclimation opportunity with ESA listed steelhead as a part of the YN's Expanded and Multispecies Acclimation project (BPA Project #-2009-001-00). In 2012, a well was installed to provide a reliable year round water source. Two barrier nets were installed at the outlet of the pond was installed to contain the fish until release. Additionally, a barrier net was installed to separate the pond and provided adequate rearing area for coho and steelhead. Goal was to acclimate the two species separately and used as a precautionary measure to reduce interspecies competition however, no adverse effects were observed after a high water event in late April caused mixing of the two species. Two PIT tag detection systems were installed to monitor the release and provide emigration timing, determine residence time, calculate in-pond survival and provide accurate release numbers for a smolt-to-smolt survival analysis (Section 4.4 and 5.0).

4.1.3.2 Coulter Pond

The Coulter Pond acclimation site is located at RK 1.6 on Coulter Creek. Fish released from Coulter Pond immigrate through the Nason Creek Wetlands at the easternmost point of the complex just prior to entering Nason Creek at RK 13.7. This natural beaver pond contains multiple braided channels which coalesce into one, large, widened waterway. In

2012, a barrier net was used to encircle the majority of the channel to contain the coho during the acclimation period. Upon release, a 12-inch pipe was installed from the pond to about twenty feet into the release channel in an effort to minimize beaver impacts on fish escapement. The hope was that the beaver would block the outflow over the pipe and not impede the outmigration. Despite the beaver's efforts to block the pipe, the vegetation was easily removed and did not significantly block passage for outgoing smolts. The release was closely monitored to ensure fish could pass through multiple beaver dams into Nason Creek. Two PIT tag detection systems were installed to monitor the release and provide emigration timing, determine residence time, calculate in-pond survival and provide accurate release numbers for a smolt-to-smolt survival analysis (Section 4.4 and 5.0).

4.1.3.3 Butcher Creek

The Butcher Creek acclimation site is located at RK 13.2 on Nason Creek. This site, which was once the original channel of Nason Creek, is now a beaver pond at the mouth of Butcher Creek. Coho smolts were volitionally released directly into Nason Creek from the pond. Prior to transportation, a net was placed upstream of the beaver's natural barrier to contain coho during acclimation. Floating and submerged structures were installed to provide protection from predators and reduce in-pond stress.
Two PIT tag detection systems were installed in 2012 to monitor the release and provide emigration timing, determine residence time, calculate in-pond survival and provide accurate release numbers for a smolt-to-smolt survival analysis.

4.1.3.4 Nason Creek Wetlands

The Nason Creek Wetlands is part of a wetland complex that includes the lower portion of Coulter Pond. The 26-acre wetland complex encompasses the downstream portions of Roaring and Coulter creeks and was purchased by YN in 2005 through Pacific Coast Salmon Recovery Funds (PCSRF) to preserve wetland habitat. These creeks converge to form a complex series of natural beaver ponds that eventually empty into Nason Creek at RK 13.7. In 2012, a section of the wetlands was partitioned off and a seine net was installed that provided unimpeded passage of endemic stocks.

4.1.4 Winthrop National Fish Hatchery (Winthrop NFH)

Coho smolts released into the Methow River from Winthrop NFH, located at RK 80.6, were acclimated from the fingerling stage to release within five, on-station raceways as well as the Winthrop NFH back-channel pond. The back-channel pond is located on Spring Creek (Winthrop NFH outfall) and functions as a semi-natural acclimation site. Beginning in 2010, coho juveniles are co-acclimated with spring Chinook juveniles within the back-channel pond as part of the Expanded and Multi-species Acclimation program. These fish were allowed to co-exist with coho to determine if it was feasible to acclimate multiple species within the same rearing environment without negative impacts to either stock. Prior to acclimation, a one piece, net canopy was installed over the back-channel acclimation pond and floating covers were installed to enhance the rearing environment by providing cover and shade. A juvenile fish- bypass system was also integrated so that wild juveniles migrating from upstream of the acclimation pond could travel unimpeded through the pond area to the Methow River. YN staff installed one, pass-through PIT tag detection downstream of the pond to monitor juvenile escapement until the United States Fish and Wildlife Service (USFWS) completed the installation of a Multi-plex PIT tag detection system in early April. This system included three "hybrid" antennas, constructed as a combination of pass-over and pass-through configurations; with the upstream ends secured to the substrate allowing the detections systems to adjust to stream fluctuations. This configuration was intended to increase the system's detection efficiency and is essential for managing large numbers of PIT tags deployed from the Winthrop NFH complex. This system functioned to monitor juvenile escapement until release as well as in-pond and release-to-McNary survivals.

4.1.5 Wells Fish Hatchery

In 2012, coho were acclimated at Wells Fish Hatchery (FH) located at RK 829.0 on the Columbia River. Wells FH is funded by Douglas County PUD and operated by WDFW. Under contract with YN, WDFW acclimated coho pre-smolts within one, on-station concrete holding pond that was previously used to rear summer Chinook. Coho acclimated and released at Wells FH in 2011 were intended to assist broodstock development phases until additional acclimation facilities were permitted within the Methow River basin. Adults returning from Wells FH releases will provide a backup brood source, should a broodstock shortfall occur at the targeted collection facilities.

4.1.6 Lower Twisp Ponds

Lower Twisp Ponds, located at RK 1.6 on the Twisp River, functions as a semi-natural acclimation facility that is owned and operated by the Methow Salmon Recovery Foundation (MSRF). The site was constructed in 2002 and comprised of a series of five ponds. The pond complex receives surface water from the Twisp River at an inlet, located at RK 2.5, just upstream of the first pond. A ground water pump system is also available for use if the water supply from the Twisp River is impeded (e.g. ice, woody debris) or insufficient for acclimation due to low river flows. Coho acclimation occurs in the furthest downstream pond. The pond is approximately 42.0 meters in length and includes a small outlet back to the Twisp River. Coho acclimation at this location is intended to help reach phased goals (YN FRM 2010) by increasing in-basin production. Prior to fish arrival, additional large woody debris (LWD) and shade covers were placed within the ponds to enhance rearing conditions and minimize predation. In addition, three automatic, sensory triggered sprinklers were installed to deter predation, primarily avian species common to this location. YN staff also installed three, pass-through PIT tag detection systems, in series, within the outlet of the pond to monitor juvenile escapement and assess in-pond and smolt-to-smolt survival. Acclimation at this location in 2011 marked the third consecutive year these ponds were used by the MCCRP.

4.2 TRANSPORTATION AND VOLITIONAL RELEASE

4.2.1 Wenatchee River Basin

Mid-Columbia coho pre-smolts (BY2010) were transported to the Wenatchee River basin from rearing facilities at Willard NFH and Cascade FH between December 1, 2011 and April 13, 2012. Coho were acclimated between 4 and 20 weeks at six acclimation sites

All coho smolts acclimated at LNFH were force-released between April 16-18. Coho acclimated at LNFH presented several fish health challenges. Several ponds were infected with *Trichodina sp.* and *Flavobacterium psychrophilum* (Bacteria Coldwater Disease; BCWD). Timely treatment of these infections, culling of diseased fish and maintaining clean rearing environments significantly reduced the potential mortality that would have occurred if gone unchecked.

Volitional releases began at the Nason Creek Wetlands, Butcher Creek Pond, Coulter Creek Pond, Rohlfing's Pond, and Beaver Creek Pond between April 30 and May 17. All acclimation facilities were deemed empty by August 1.

Coho released in 2012 were CWT'ed with an 83.4% (*n*=16,000) retention rate. In addition to CWTs, all upper Wenatchee basin released coho had a secondary, blank wire inserted into the adipose region with 96.6% (*n*=8,000) retention. This secondary mark provided the means to implement Broodstock Development Phase II (YN FRM 2009) by selectively passing returning adult coho destined for the upper basin at the Dryden Dam broodstock collection facility (lowermost brood collection point) for potential recapture at Tumwater Dam (uppermost brood collection point). By demonstrating that a sufficient proportion of adults (# of trappable adults to achieve 50% of broodstock needs) can navigate above Tumwater Dam, whether collected into broodstock or passed upstream, is critical in achieving specific management goals designed within YN's phased approach for reintroduction and would continue the broodstock development and adaptation towards the upper watershed.

In 2012, 34,443 coho juveniles were marked with PIT tags. These PIT tagged fish were used to measure survival from release point to McNary Dam and determine in-pond survival at select release sites (see Section 4.4). Two PIT tag detection systems were installed in series at each of the upper basin acclimation sites (Butcher Pond and Rohlfing's Pond) to ensure maximum detection efficiency.

A total of 992,109 hatchery produced coho smolts were released from the Wenatchee River basin in 2012. Release numbers, size-at-release, release locations and PIT tag numbers can be found in Table 14. For detailed mark and release information, see Appendix C.

4.2.2 Methow River Basin

For the Methow basin, Mid-Columbia River juveniles (BY2010) were acclimated in-basin at Winthrop NFH, Winthrop NFH back-channel and Lower Twisp Ponds. Out-of-basin acclimation occurred at Wells FH. Juvenile coho were transported from Willard NFH to the Winthrop NFH back-channel pond and Lower Twisp Ponds for acclimation on March 5 and April 5, respectively. Additionally, coho pre-smolts were transported by Oregon Department of Fish and Wildlife (ODFW) personnel to Wells FH on March 5. All juveniles acclimated and released were 100%, 2nd generation MCR progeny from the Methow program.

Volitional releases were initiated at all in-basin release sites and occurred between April 18 and May 8. A follow-up forced release was initiated on May 2 at Winthrop NFH to allow sufficient time for staff to conduct routine raceway maintenance prior to transferring BY2011 juveniles out of the nursery tanks. Emigrations from both acclimation ponds were visually determined complete by June 7. A forced release was initiated for juveniles rearing at Wells FH on May 1. CWT retentions from juveniles acclimating on-station at Winthrop NFH and within the Winthrop NFH back-channel were 98.8% and 76.8, and 78.3% from juveniles acclimated at the Lower Twisp ponds. CWT retentions from juveniles released from Wells FH were 77.4%. Data collected from PIT tagged juveniles will be used to evaluate metrics measuring release to McNary Dam survival, in-pond survival, and downstream migration timing (see section 4.4 and 5.0). Release summary information is provided in Table 14.

A combined total of 537,862 coho juveniles were released for the Methow program (Table 14). For detailed mark information, see Appendix C. Juvenile releases in 2012 marked the fifth consecutive year that 100% of the smolts were progeny of locally returning adults to the Methow basin. The development of a local broodstock is critical for achieving program goals within the Methow River basin (YN FRM 2010).

On October 1, approximately 25,615 surplus coho parr (BY2011) were out-planted from C-Bank raceways to Star Landing on the Columbia River (RK 836), located approximately five miles downstream of the confluence with the Methow River; after receiving NMFS approval in late September. These out-plants were necessary to alleviate potential overcrowding concerns, which could have transpired into health issues (e.g. - BCWD outbreaks) within the raceways. Star Landing was chosen as an out-of-basin release location, intended on prohibiting potential in-stream interactions between listed and endemic stocks while staying within production goals.

Table 14. Mid-Columbia coho smolt release summary, 2012.

Location	Release Date	Release Number	Size @ release (FPP)	No. PIT Tags
Beaver Pond	May 8	83,786	16.0	4,750
Coulter Creek	May 14	76,770	16.3	5,428
Rohlfing's Pond	May 15	90,331	16.4	5,380
Butcher Pond	May 17	110,383	20.1	4,787
Nason Creek Wetlands	April 30	54,421	20.7	0
Leavenworth NFH LFL's (large Foster-Lucas Ponds)	April 16	187,298	21.4	3,263
Leavenworth NFH SFL's (small Foster-Lucas Ponds)	April 17 & 18	342,843	22.7	2,832
Wenatchee Total		**945,833**		**26,440**
Winthrop NFH (on-station)	April 18	267,940	14.7	5,980
Winthrop NFH (back-channel pond)	April 23	55,652	17.0	5,849
Twisp Ponds Complex	May 8	84,808	16.4	5,894
Wells FH	May 1	121,582	13.8	0
Methow Total		**529,982**		**17,723**
Wenatchee/Methow Totals		**1,476,219**		**44,163**

4.4 PREDATION ASSESSMENT

As standard practice of good fish husbandry and fish health, moribund and deceased coho were recovered from all site locations daily until the end of release to determine known mortality during this rearing period. The number of observed mortalities is typically low (avg. < 2%), however we assume that the majority of loss occurs through predation and precludes enumeration. This unaccounted for loss can have a significant impact on acclimation rearing, not only directly but also indirectly through elevated and continual stress. Unusually high densities of hatchery fish can create an optimal situation for predation while consistent stress events can negatively affect coho survival (e.g.- delayed fight vs. flight stimuli response, disrupted Na-K and ATPase activity, reduced overall condition and delayed downstream migration). YN used both a predator consumption model and PIT tag detection (where applicable) to estimate in-pond predation.

4.4.1 Estimated Mortality-Predator Consumption Model versus PIT tag Detection

4.4.1.1 Predation Model

Primary predators observed during the acclimation period were the North American river otter (*Lutra canadensis*) and the common merganser (*Mergus merganser*). Adult river otters can consume as much as 20% of their body weight in the natural environment (Beckel 1982) and may be an underestimate considering the environment that acclimation sites provide. Average body weights for male and female river otters used in this model, derived from multiple sources of documentation, were 25 and 19 pounds, respectively. Common mergansers can consume upwards of one pound of fish per day and can congregate in large numbers (Stephenson 2004). In addition to these key predators, mink, belted kingfishers, great blue herons, and hooded mergansers have all been documented throughout the basin and observed in small numbers at some of the sites. Mallards and other "dabbler" types of ducks have recently also been identified as opportunistic, piscivorous predators if ideal conditions are present. Although these opportunistic bird species persist, literature determining their consumption is difficult to attain. Based on limited observations by USFWS and YN staff, an estimated consumption rate for dabblers has been estimated to be approximately one-third that of the common merganser. Since both species are similar in body weight, the dabbler-type ducks likelihood of success assumes that they are only 1/3 as likely to successfully prey on juvenile coho and that these fish have a higher probability of avoiding such predatory attempts. In the past couple of years, estimated predation numbers have decreased in part to the extended hazing efforts conducted by YN personnel during this period. Staff was stationed at these sites from dawn until dusk, seven days a week, focusing on the early morning and late evening periods. This tactic was particularly effective against sight-feeding avian predators such as mergansers and mallards. Once hazing pressure was applied, mammalian feeders, primarily North American river otter, shifted towards a nocturnal feeding schedule. This behavior limited the effectiveness of hazing efforts by YN staff. Although hazing efforts were very beneficial, predation still occurred at these locations. To try and determine the final numbers of juvenile coho released from natural acclimation ponds, daily documentation of predator abundance was used to estimate predation mortality using the following equation.

$$C_e = C_t * FPP * N_i * D_p$$

C_e= Estimated consumption for an individual predator

C_t= Consumption total per day (kg) for an individual predator

FPP= Fish per pound

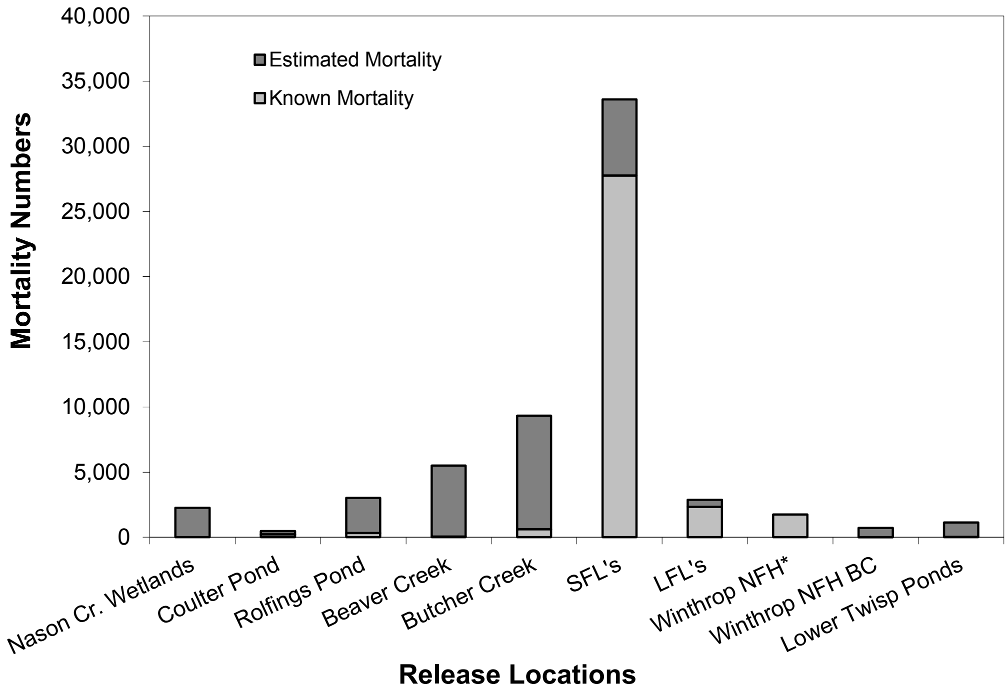
N_i= Number of same species predators observed during time interval i

D_p= Duration of same species predators observed

The estimated predator consumption varied between acclimation ponds (Figure 6). Pond shape, pond size, numbers of coho, geographic location, cumulative riparian area, and aquatic vegetation all affect the predator abundance and predation mortality.

Various predators were observed at all of the upper basin acclimation locations. Piscivorous avian and mammalian predators at Butcher Pond included hooded mergansers, belted kingfishers, blue herons, mallards, mink, and two North American river otters. All of the piscivorous predators observed at Butcher Pond were also observed at Beaver Creek Pond. Although the mallard piscivorous dietary intake is relatively unknown, these opportunistic individuals have been observed occasionally feeding on coho pre-smolts. Predator sightings at Rohlfing's pond included hooded mergansers, belted kingfishers, mallards, mink, and otter. Coulter Creek Pond had the fewest number of predator sightings, piscivorous predators sighted include blue herons, hooded mergansers, mallards and otter.

In the Methow basin, species of piscivorous avian and mammalian predators observed at acclimation locations included both common and hooded mergansers, belted kingfishers, blue herons, mallards, mink, and osprey. Predator sightings were highest at the Twisp ponds, primarily common mergansers, belted kingfishers, and blue herons. This location is a preferred nesting habitat for a variety of avian species. Although predators were observed at this facility and predation is assumed to occur, there were no documented sightings of predators in or proximal to the juvenile coho raceways during acclimation. The numerous juvenile raceways used at this facility facilitate multiple options for predators; further impeding the estimate for predation loss. Predation observed at the Winthrop NFH back-channel pond continues to be significantly less than in years prior and may be attributed to the protection provided by custom, predation netting installed in 2008. Common mergansers, belted kingfishers, and blue herons were the most commonly observed at this location.



**Estimated predation was not calculated due to the lack of observed predation on-station in 2012.*

Figure 6. Known and estimated mortality at all acclimation sites in the Methow and Wenatchee river basins, 2012.

4.4.1.2 PIT tag Detection

In addition to documenting predator abundance and estimating mortality, select locations had an in-pond survival estimate measured with the use of PIT tags. Each selected group that was tagged varied in the proportion of PIT tagged fish, but a minimum of 6,000 tags were designated for target acclimation ponds to provide for both estimates of in-pond survival and release-to-McNary Dam survival. If detection efficiencies at Rocky Reach Dam continue to be high, YN may consider decreasing numbers of tags assigned to individual ponds as downstream detections are more than sufficient to perform release-to-McNary survival estimates.

Prior to the 2012 acclimation, YN installed PIT tag antenna arrays at Rohlfing's Pond, Butcher Pond, Winthrop NFH back-channel pond (USFWS Multi-plex system) and Lower Twisp Ponds to detect any possible escapees immediately after transport. Additional units were added prior to initiating releases. Only sites with maintained outlet detection systems and employing a volitional release strategy (high tag collisions during forced releases) could be used for measuring in-pond survival and comparing methods for measuring in-pond survival (PIT tag vs. predation model).

In-pond survival was estimated by the following formula:

$$S_{ip} = \frac{(D_{outlet} / E_{detection})}{PIT_{total}}$$

Where S_{ip} = in-pond survival, D_{outlet} = unique detections at the pond outlet, $E_{detection}$ = estimated PIT detection efficiency at the outlet, and PIT_{total} = the total number of PIT tagged fish released into the pond.

We estimated the efficiency of the PIT tag arrays installed at the outlets with the following formula.

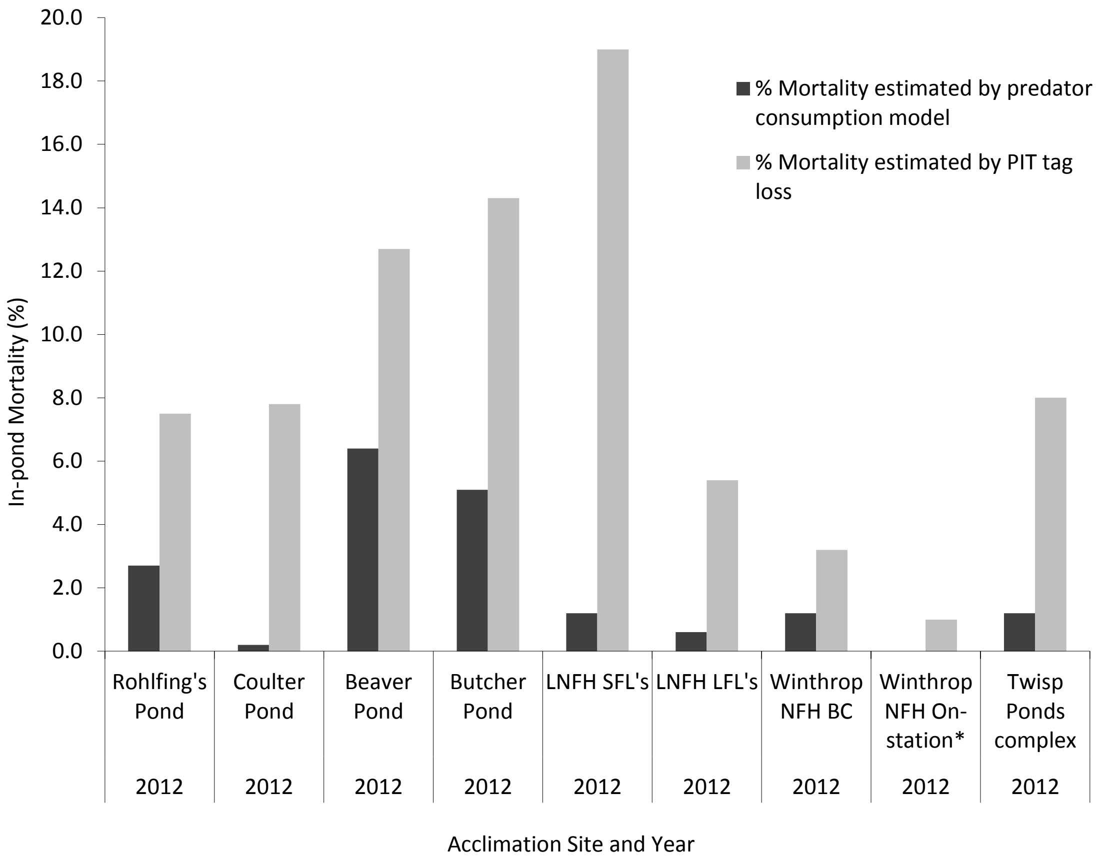
$$E_{detection} = \frac{\text{\# unique outlet detections that were also detected downstream}}{\text{Total number of downstream detections}}$$

By querying the PTAGIS database for downstream PIT tag detections for fish released from a given acclimation pond we are able to estimate the efficiency of our antennas by determining the proportion of the fish detected downstream that were also detected exiting the pond. Estimates of detection efficiency and in-pond survival for each site with PIT tag arrays can be found in Table 15.

Table 15. Estimates of in-pond survival and PIT tag detection efficiency, 2012.

	Rohlfing's Pond	Coulter Pond	Beaver Pond	Butcher Pond	LNFH SFLs	LNFH LFLs	Winthrop NFH back-channel	Winthrop NFH on-station	Lower Twisp Ponds
Total PITs	5,816	5,888	5,440	5,584	3,498	3,450	5,849	5,980	5,984
Unique Outlet Detections	4,147	4,844	4,711	2,902	2,619	2,826	1,880	1,885	4,594
Unique Downstream Detections	973	5,131	3,501	678	1,102	851	1,584	2,000	2,110
Downstream and Outlet Detections	750	4,579	3,472	411	1,019	737	526	631	1,774
Detection Efficiency	77.1%	89.2%	99.2%	60.6%	92.4%	86.6%	33.2%	31.6%	84.0%
PITs released	5,380	5,428	4,750	4,787	2,832	3,263	5,661	5,975	5,464
In-Pond Survival	**92.5%**	**92.2%**	**87.3%**	**85.7%**	**81.0%**	**94.6%**	**96.8%**	**99.9%**	**92.7%**

A comparison of in-pond mortality estimates based upon PIT tags and predator consumption model expansions can be found in Figure 7. Typically, the predator consumption model underestimates the in-pond mortality rate as compared with PIT tags. However, the PIT tag estimates could be an overestimate since it encompasses cumulative, unobserved loss at both the lower river facilities and acclimation site. Beginning in 2012, pre-transport PIT tag detection monitoring was implemented to better estimate the number of tags entering each site.



** Direct predation was not observed during the spring acclimation at Winthrop NFH and a predation consumption estimate was not done.*

Figure 7. Comparison of in-pond mortality estimation methods; PIT tag versus a predator consumption model, 2012.

5.0 SURVIVAL RATES

5.1 Smolt Survival Rates – Release to McNary Dam

5.1.1 2012 Methow and Wenatchee Smolt Survival

To obtain a McNary passage index of PIT-tagged fish released into the Wenatchee and Methow basins, the number of McNary Dam PIT tag detections were expanded by dividing by an estimate of the McNary detection-rate (efficiency). McNary detection rate is the proportion of total PIT-tagged fish passing the dam that are detected by the dam's PIT tag detectors. McNary passage is stratified into sequential days having similar detection rates. The McNary detection rate was calculated by summing the number of PIT-tagged fish detected at McNary and at a downstream dam and dividing by the total number detected at the downstream dam. An index of survival to McNary Dam is the estimated total passage divided by the number of fish detected either leaving the acclimation pond (release-to-McNary) or from original tagging files (tagging-to-McNary). Release numbers were used whenever possible and were only substituted with original tagging numbers if a) outlet detection efficiencies were poor or b) outlet detection capabilities were not present at the location. Data suggests that coho juveniles reared full-term at Cascade FH appear to have an increased release-to-McNary survival when compared to the other primary, full-term rearing facility (Willard NFH) at both upper and lower basin release locations. A summary of release-to-McNary survival rates for the 2012 releases can be found in Table 16.

Table 16. PIT tag release numbers and locations, 2012.

Basin	Release Tributary	Release Location	Rearing Facility	Brood Origin	*n*	McNary survival % (SD)
Methow	Spring Creek	WNFH Back-channel	Willard NFH	MCR	5,843	33.4 (3.6)[a]
		WNFH On-station	Winthrop NFH	MCR	5,980	45.0 (4.9)[a]
	Twisp River	Lower Twisp Ponds	Willard NFH	MCR	5,894	47.7 (4.8)
Wenatchee	Beaver Creek	Beaver Cr.	Cascade FH	MCR	2,233	32.9 (6.0)
			Willard NFH	MCR	2,517	25.6 (6.8)
	Nason Creek	Rohlfing's Pond	Cascade FH	MCR	2,753	43.1 (6.5)
			Willard NFH	MCR	2,627	41.8 (12.8)
		Butcher Creek Pond	Cascade FH	MCR	4,787	32.4 (4.6)
		Coulter Creek Pond	Willard NFH	MCR	5,428	54.3 (4.9)
	Icicle Creek	SFL	Willard NFH	MCR	2,832	27.5 (4.8)
		LFL	Cascade FH	MCR	3,263	42.4 (3.7)

[a]- Detection efficiencies were poor (< 35%) for releases into Spring Creek. This was due to excessive "tag collision" (i.e.-numerous PIT tags being located within the antenna read range) and therefore, tagging-to-McNary was used.

5.2 Smolt-to-Adult Survival Rates (SAR) for Brood Year 2009

For coho returning to the Wenatchee River, we calculated the number of coho returning to the basin using four methods:

1) Dryden Dam counts expanded by linear regression for non-trapping days, plus redd counts downstream from Dryden Dam
2) Broodstock collected at Dryden Dam plus all redd counts
3) Broodstock collected at Dryden Dam, Tumwater Dam counts, and redds counted downstream of Tumwater Dam
4) Mainstem dam counts (Rock Island Dam – Rocky Reach Dam).

Method one may underestimate the total number of coho returning to the basin if the trapping efficiency of Dryden Dam is low (due to fall freshets) or may overestimate the number of coho returning if fallback rates of fish not collected in the broodstock are high. Method two and three may also underestimate the number of coho to return to the Wenatchee River because it does not take pre-spawn mortalities or unidentified coho redds into account. Method four is likely an overestimate, as it assumes no fallbacks or drop-outs occurred between Rock Island and Rocky Reach dams. SARs calculated using methods one, two, and three for total escapement have been consistent in previous years.

In the Methow River, the number of coho returning to the basin was calculated using two methods:

1) Redd counts plus broodstock collected
2) Wells Dam counts plus broodstock collected at Wells Dam.

Estimated run size for the Wenatchee and Methow basins in 2012, using the aforementioned methods, can be found in Tables 17 and 18. Smolt-to-adult survival rates for the Wenatchee and Methow basins are summarized in Tables 19 and 20.

Table 17. Estimated coho run size to the Wenatchee River, 2012.

Method	Est. Run Size
1) Dryden Dam counts expanded for non-trapping days plus redds located below Dryden Dam[1]	2,332 (2,322 adults & 10 jacks)
2) Redd counts plus broodstock collected[1]	2,133 (2,130 adults & 3 jacks)
3)Tumwater Dam counts, redds below Tumwater Dam, and broodstock collected[1]	2,727 (2,717 adults & 10 jacks)
4) Mainstem Dam Counts[2]	5,837 (5,718 adults & 119 jacks)

[1]Each redd count was expanded by 2.1 fish per redd based on the sex ratio of coho observed at Dryden Dam, 1.1M:1F.

[2]Mainstem dam counts represent the difference in adult passage observed between Rock Island Dam and Rocky Reach Dam.

Table 18. Estimated coho run size to the Methow River, 2012.

Method	Est. Run Size
1) Redd counts plus broodstock collected [1]	1,168 (1,167 adults & 1 jacks)
2) Wells Dam Counts plus Wells Dam broodstock collected[2]	2,113 (2,106 adults & 7 jack)

[1] Each redd count was expanded by 2.7 fish per redd based on the sex ratio of coho observed at Winthrop National Fish Hatchery, 1.7M:1.F

[2] Coho collected for broodstock at Wells Dam were not incorporated into daily fish passage counts for 2012. Broodstock collected only reflects the proportion of fish taken at Wells Dam and not volunteer swim-ins at Winthrop NFH.

Estimation of SARs for hatchery fish were based on CWT recovery which allows for a comparison of survival between brood origins, rearing hatchery, and release sites (Table 20 and 21). In the Wenatchee basin, we used scale analysis to verify the origin of any coho without CWTs. SARs for naturally produced coho were based on an estimate of the number of natural origin adults returning to the basin and an estimate of smolt emigration from the basin for the same brood year. The smolt emigration estimate was provided by WDFW from data collected at smolt trap in the lower Wenatchee River.

SARs for natural origin fish in the Methow are pending completion of scale analysis for fish origin verification. All SARs reported for hatchery origin returns to the Methow River should be considered provisional until scale analysis and a complete estimate of run composition (numbers of hatchery origin and natural origin returns) can be completed.

Table 19. Wenatchee River brood year 2009 SARs by release site, brood origin, and rearing facility.

Release Site	Minimum Acclimation Duration[a]	Brood Origin	Rearing Facility	n (Adult and Jack Returns)	N (CWT Release Number)	SARs[b]
Beaver Cr. Pond	6 weeks	MCR	Cascade FH	275	58,963	0.47%
	6 weeks	MCR	Willard NFH	71	24,731	0.29%
Coulter Cr. Pond	5 weeks	MCR	Cascade FH	306	64,974	0.47%
Nason Creek Wetlands	3 weeks	MCR	Willard NFH	42	45,173	0.09%
Rohlfing's Pond	7 weeks	MCR	Cascade FH	286	64,334	0.44%
	7 weeks	MCR	Willard NFH	32	24,510	0.13%
Butcher Cr. Pond	5 weeks	MCR	Cascade FH	156	62,283	0.25%
	5 weeks	MCR	Willard NFH	76	48,994	0.15%
Leavenworth NFH: Large Foster Lucas Ponds	8 weeks	MCR	Cascade FH	358	134,690	0.27%
	8 weeks	MCR	Willard NFH	66	67,426	0.10%
Leavenworth NFH: Small Foster Lucas Ponds	8 weeks	MCR	Cascade FH	197	61,127	0.32%
	18 weeks	MCR	Cascade FH	621	144,804	0.43%
	8 weeks	MCR	Willard NFH	102	51,848	0.20%
TOTAL		**MCR**		**2,588**	**853,857**	**0.30%**
Naturally Produced Coho[c]		**MCR**	**N/A**	**139**	**N/A[d]**	**N/A[d]**

[a] Minimum acclimation duration is based on transport to release dates and does not account time required for all volitionally released fish to leave the acclimation pond.
[b] An estimated return to the basin of 2,727 fish (method 3) was used in the calculation of BY2009 SARs.
[c] Naturally produced coho were positively identified through scale analysis.
[d] SAR estimate not able to be calculated since there was not a juvenile population estimate generated (WDFW trap was inoperable in the lower Wenatchee River)

Table 20. Methow River brood year 2009 SARs by release site, brood origin, and rearing facility.

Release Site	Minimum Acclimation Duration[a]	Brood Origin	Rearing Facility	N Adult Return	N Released	SARs[b]
WNFH on-station	N/A reared on -station	MCR (Methow)	Winthrop NFH	611	234,148	0.26%
WNFH Back Channel	5 weeks	MCR (Methow)	Willard NFH	162	47,263	0.34%
Twisp Ponds	6 weeks	MCR (Methow)	Willard NFH	216	82,745	0.26%
Wells FH	6 weeks	MCR (Methow)	Willard NFH	180	48,205	0.37%
Total				**1,168**	**412,361**	**0.28%**
Naturally Produced Coho			**N/A**	**0[c]**	**2,330**	**N/A**

[a] Minimum acclimation duration is based on transport to release dates and does not account time required for all volitionally released fish to leave the acclimation pond.
[b] An estimated return to the basin of 1,168 fish (method 1) was used in the calculation of BY2009 SARs for returns to the target watershed (Methow basin). All SARs should be considered provisional until the natural origin run component is determined.
[c] SARs for naturally produced coho were determined to have no natural origin returns in 2012. Scales are being re-verified and any updates will be included in future reports.

A comparison of smolt-smolt survival and smolt-to-adult survival across years (1999 through 2012) can be found in Table 21.

Table 21. Hatchery comparison of smolt-to-smolt and smolt-to-adult survival rates, brood years 1997-2010.

Brood Year	Release Year	Methow R. Smolt Survival	Icicle Creek Smolt Survival	Nason Creek Smolt Survival	Return Year	Methow R. Smolt-Adult Survival	Wenatchee R. Smolt-Adult Survival
1997	1999	N/A	53.9%	N/A	2000	N/A	0.21% - 0.38%
1998	2000	33.3%	63.0%	N/A	2001	0.17% - 0.27%	0.17% - 0.86%
1999	2001	9.9%	21.6%	N/A	2002	0.03%	0.03%- 0.13%
2000	2002	N/A	87.4% - 78.5%	39.3%	2003	0.15%	0.32%- 0.51%
2001	2003	N/A	62.8%	37.2%	2004	0.16%	0.33% - 0.55%
2002	2004	26.1% - 29.5%	56.3% - 60.8%	30.5%- 36.2%	2005	0.19%	0.29%- 0.47%
2003	2005	N/A	34% - 44%	16%- 18%	2006	0.18%	0.15% - 0.37%

2004	2006	N/A	37% - 51%	16% - 47%	2007	0.13%- 0.47%	0.11% - 0.74%
2005	2007	N/A	39.4% - 86.7%	45.0% - 53.5%	2008	0.13%- 0.38%	0.03%- 0.33%
2006	2008	28.3%	40.5%- 63.4%	46.3%- 71.2%	2009	0.16%- 0.47%	0.12%- 0.60%
2007	2009	40.5%- 49.1%	43.8%- 50.5%	34.2%- 60.2%	2010	0.11%- 0.21%	0.02%- 0.44%
2008	2010	65.5%- 79.9%	49.9%- 77.0%	37.4%- 84.1%	2011	0.13%- 0.41%	0.32%- 1.15%
2009	2011	35.6%- 43.4%	28.6%- 53.6%	24.6%- 48.8%	2012	0.26%- 0.37%	0.09%- 0.47%
2010	2012	33.4%- 45.0%	27.5%- 42.4%	25.6%- 54.3%	2013	N/A	N/A

6.0 SUMMARY

The long-term vision for the mid-Columbia coho reintroduction project is to re-establish naturally reproducing coho salmon populations in mid-Columbia river basins at biologically sustainable levels which will provide opportunities for harvest for tribal and non-tribal fishers.

We are optimistic that the project will continue to observe positive trends in hatchery coho survival as developing local broodstock continues to adapt to conditions in mid-Columbia tributaries. Therefore it is important to measure hatchery fish performance not only to use as an indicator of project performance but to track potential short-and long-term program benefits. This document reports the coho restoration activities completed in 2012; results are briefly summarized below.

- Between September 1 and November 23, YN collected 905 coho at Dryden Dam, Leavenworth NFH and Tumwater Dam on the Wenatchee River. At Winthrop NFH, Methow FH adult weir and Wells Dam, 779 coho were collected for the Methow River program between September 24 and November 14. Excess coho for the Methow program were returned to the river to naturally spawn. Broodstock goals for both basins were to collect enough females to fulfill future acclimation release needs of 500,000 juveniles in the Methow River and 1,000,000 juveniles in the Wenatchee River.

- YN spawned 873 coho at Leavenworth NFH and 519 at Winthrop NFH. An eye-up rate of 92.1% was calculated for the Wenatchee program and 87.1% for the

Methow program. Increased eye-up rates and improved eyed-egg quality should lead to improved survival from the eyed stage to smolt release.

- During spawning ground surveys in the Wenatchee Basin for 2009, YN found a total of 1,601 coho redds; 818 redds in Icicle Creek, 482 redds in the Wenatchee River, 14 redds in Nason Creek and a combined 286 redds in Brender, Mission, and Peshastin creeks. The 2009 season marked the first coho redd identified in Beaver Creek.

- During spawning ground surveys in the Methow Basin for 2012, YN found a total of 202 coho redds, of which, 200 were identified in-basin. Of the total in-basin redds, 44.5% (*n*=89) were on the Methow River, 16.5% (*n*=33) in the Twisp River, 27.0% (*n*=54) in Spring Creek (Winthrop NFH back-channel), 11.0% (*n*=22) in the WDFW Methow FH outfall, and 1.0% (*n*=2) in Gold Creek. Out-of-basin surveys resulted in two redds found within the Chelan FH outfall (Beebe Springs).

- Acclimating pre-smolts on local waters is an essential component to the restoration program. Smolt release numbers for the Methow and Wenatchee rivers in 2012 were 529,982 and 946,237 fish, respectively (Appendix C). Coho within the Methow program were released from Winthrop NFH (on-station raceways and the outfall channel), remote acclimation sites (Lower Twisp Ponds), and Wells FH achieved a mean, estimated transport-to-release survival of 96.4%. In the Wenatchee basin, overall, mean survival was 94.3% from transport to release of 88.8%. Although survivals were lower than reported in past years, the ability of PIT tag detection at release has provided refined estimates that are more representative of actual release numbers.

- YN estimated that in-basin smolt to adult survival rates (SARs) for BY2009 hatchery coho smolts released in the Wenatchee River basin was 0.30% (2,727 adults and jacks) for all release groups. However, the smolt-to-adult survival rate varied between release groups (range 0.09% - 0.47%). Using scale analysis for verification of fish origin, we estimated that 139 adults originated from natural production. A SAR estimate was not possible since the broods' juvenile outmigration estimate was not available. WDFW was in the process of locating a new trapping location within the lower Wenatchee River and permitting delaying the start date of the rotary trap.

- In the Methow River, we estimate that the overall SARs for BY2009 hatchery coho was 0.28%. The SARs for each release group ranged from 0.26% to 0.37% (1,168 adults and jacks). These SARs calculations included releases from Wells FH that contributed to the majority of fish collected in the analysis. Initial scale analysis did not reveal any natural origin adults within the brood or on spawning ground surveys.

7.0 ACKNOWLEDGEMENTS

We are thankful to the many people involved in the coho reintroduction feasibility study. Bonneville Power Administration funded the study. Roy Beaty administered funding and contracting. Tom Scribner, project manager, provided program oversight and direction for the Mid-Columbia Coho Project. Clendon Allen, Dakota Arnoux, Neville Benson, Arlene Heemsah, Barry Hodges, Dan Mellenberger, Tammy Swan, Michelle Teo, Matt Clubb, Krista Ervin, Robert Farley, Jason Hickman, Dan Russell, Surya DiModica, Andrew Carr, James Pieratt, Casey Heemsah, Thomas Lewis and Brady Miller assisted with field data collection. Debbie Azure, Loverne George, Monica Clark and Louiza Umtuch provided much needed administrative support for this program. Doug Neeley (International Statistical Training and Technical Services) provided statistical consultation for survival estimates of PIT-tagged fish. Several employees at WDFW provided assistance throughout the year, including the Eastbank FH crew during broodstock collection; Todd Miller and Charlie Snow provided the population estimates of naturally produced coho emigrating from the Wenatchee and Methow rivers as well as adult coho carcass information.

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APPENDIX A: 2012 NASON CREEK SMOLT TRAP REPORT

Population Estimates for Juvenile Salmonids in Nason Creek, WA

2012 Annual Report

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ABSTRACT

In 2012, Yakama Nation Fisheries Resource Management (YN FRM) monitored emigration of naturally spawned juvenile coho salmon as well as Endangered Species Act (ESA) listed Upper Columbia River (UCR) spring Chinook salmon and summer steelhead in Nason Creek. This report summarizes juvenile abundance and freshwater survival estimates for each of these species. Fish were captured using a 1.5m rotary smolt trap between March 1 and November 30, 2012. We collected 2,606 spring Chinook salmon, 1,473 summer steelhead, 101 coho as well as 12 bull trout; all of natural origin and varying age classes. Daily fish abundances for coho, spring Chinook and steelhead were expanded by stream discharge-to-trap efficiency regression. All estimates were made with a 95% confidence interval (CI) with total emigration estimates for BY2010 coho juveniles and spring Chinook juveniles of 375 (± 202) and 10,992 (± 2,283), respectively. We estimated the total BY2009 summer steelhead emigration at the trap to be 9,003 (± 1,471). Egg-to-emigrant survival rates for BY2010 coho and BY2010 Chinook were 1.4% and 1.3%, respectively. The egg-to-emigrant survival rate for BY2009 summer steelhead was 1.2%. Productivity, as measured by emigrants-per-redd, for coho, spring Chinook and summer steelhead was 47, 58 and 71, respectively.

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ACKNOWLEDGEMENTS

This project is part of a basin wide monitoring program requiring close coordination between multiple agencies and contractors. We greatly appreciate the hard work of the YN FRM crew members including Dakota Arnoux, Elaine Bianchi, Matthew Clubb, Jamie Hallman, Arlene Heemsah, Barry Hodges, Tim Jeffris, Cory Kamphaus, Greg Robison and Michelle Teo who maintained and operated the trap during all hours including nights/weekends and through challenging weather conditions. We would like to also thank the Wenatchee River Ranger District (U.S. Forest Service) for providing use of the trapping site and accommodating the needs of this project as well as to Roy Beaty and Eric Lauver (Grant County PUD) for administering contracting and funding. Finally, thank you to Mike Hughes, Todd Miller, Andrew Murdoch, Ben Truscott, and J.B. Walters (Washington Department of Fish and Wildlife), and Tracy Hillman (Bio Analysts, Inc.) for shared data and smolt trap methodologies.

1.0 INTRODUCTION

Beginning in the fall of 2004, YN began operating a rotary smolt trap in Nason Creek for nine months per year. Prior to 2004, the smolt trap was operated exclusively for coho predation studies. This project is a cost share between the YN's Mid-Columbia Coho Reintroduction Project (MCCRP; BPA project #1996-040-00, Chelan County PUD #07-13174 and Grant County PUD #430-2540) and Grant County PUD's spring Chinook obligations. Trap operations were conducted in compliance with ESA consultation with the objectives to:

1) Estimate the juvenile abundance and productivity of spring Chinook salmon, steelhead trout and coho salmon in Nason Creek.

2) Describe the temporal variability of spring Chinook salmon, steelhead trout and coho salmon emigrating from Nason Creek.

The data generated from this project is used to calculate annual juvenile population estimates, egg-to-emigrant survival and emigrant-to-adult survival rates. Combined with other Monitoring and Evaluation (M&E) data, juvenile population estimates may be used to evaluate the effectiveness of supplementation programs in the Wenatchee River basin as well as provide data to develop a spawner-recruit relationship for Nason Creek. Such models are a useful way to evaluate density-dependent affects and estimate carrying capacity. Additionally, data recorded at the Nason Creek rotary trap is currently provided to multiple agencies, further contributing to the cooperative efforts of evaluating status and trends of locally adapted populations.

1.1 Watershed Description

The Nason Creek watershed drains 65,600 acres of alpine glaciated landscape where high precipitation and moderate rain on snow recurrence controls the hydrology and aquatic communities. Nason Creek originates near the Cascade crest at Stevens Pass and flows east for approximately 37 river kilometers (RK) until joining the Wenatchee River at RK 86.3 just below Lake Wenatchee. The smolt trap is located at RK 0.9; downstream from the majority of spring Chinook and steelhead spawning grounds (Figure 1). There are 26.4 RK along the mainstem accessible to anadromous fish in Nason Creek. Private land ownership comprises 52,300 acres (79.7%) of the watershed while 12,800 acres (19.5%) are federal and 480 acres (0.1%) are state owned (USFS et al. 1996).

The channel morphology of the lower 25 kilometers of Nason Creek has been impacted by development of highways, railroads, power lines, and residential development resulting in channel confinement and reduced side-channel habitat. The present condition is a low gradient (< 1.1%), low sinuosity (1:2 to 2:0 channel-to-valley length ratio) and depositional channel (USFS et al. 1996). Peak runoff typically occurs in May and June with occasional high water produced by rain on snow events in October and November.

In 2012, mean daily discharge for Nason Creek was 508 cfs with mean daily stream temperatures ranging from 0.0°C to 17.2°C (Figure 2 & 3). Snow melt during the spring caused high flows to occur early and remain higher than the 10-year average until mid-August. A heavy snowpack and spring snowmelt appeared to delay increases in stream temperatures from June through August.

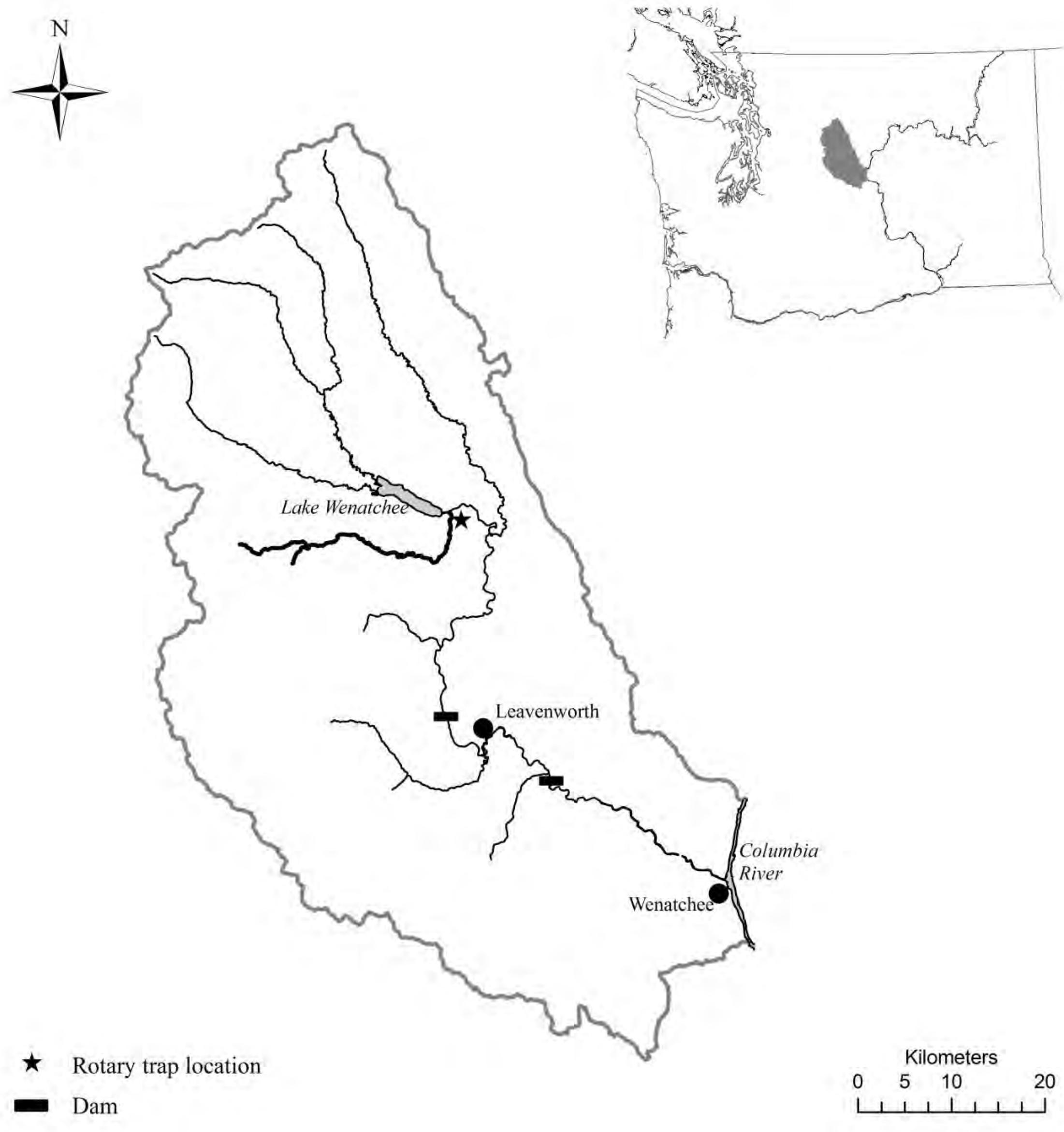

Figure 1. Map of Wenatchee River Subbasin with the Nason Creek rotary trap location.

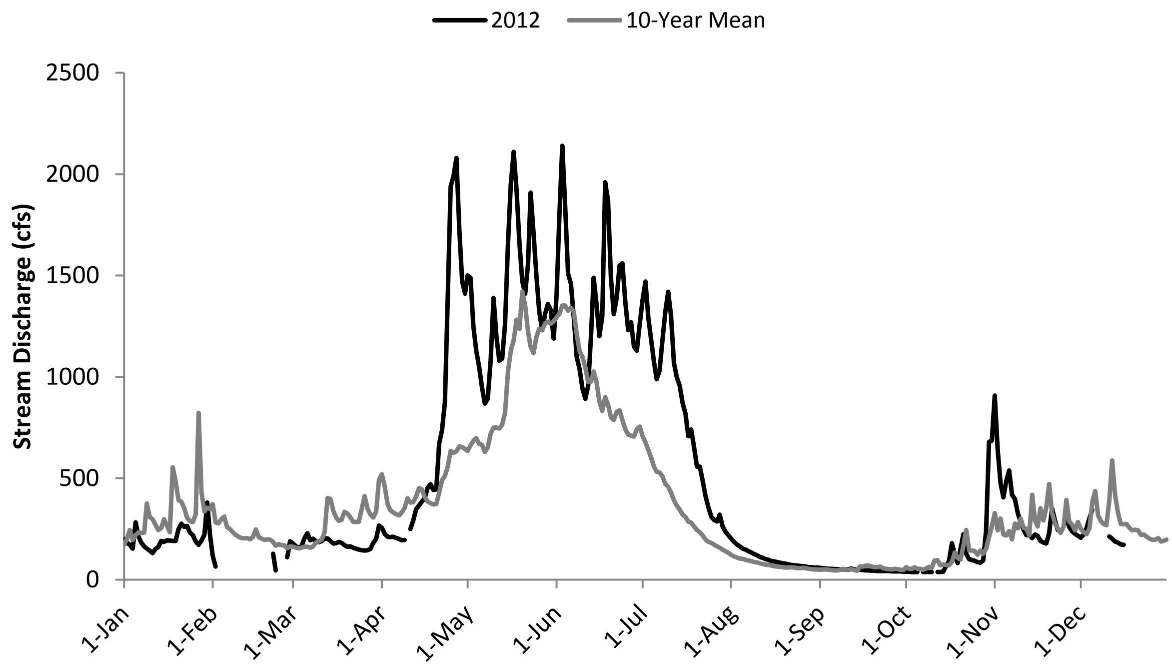

Figure 2. Mean daily stream discharge at the Nason Creek WDOE stream monitoring station in 2012.

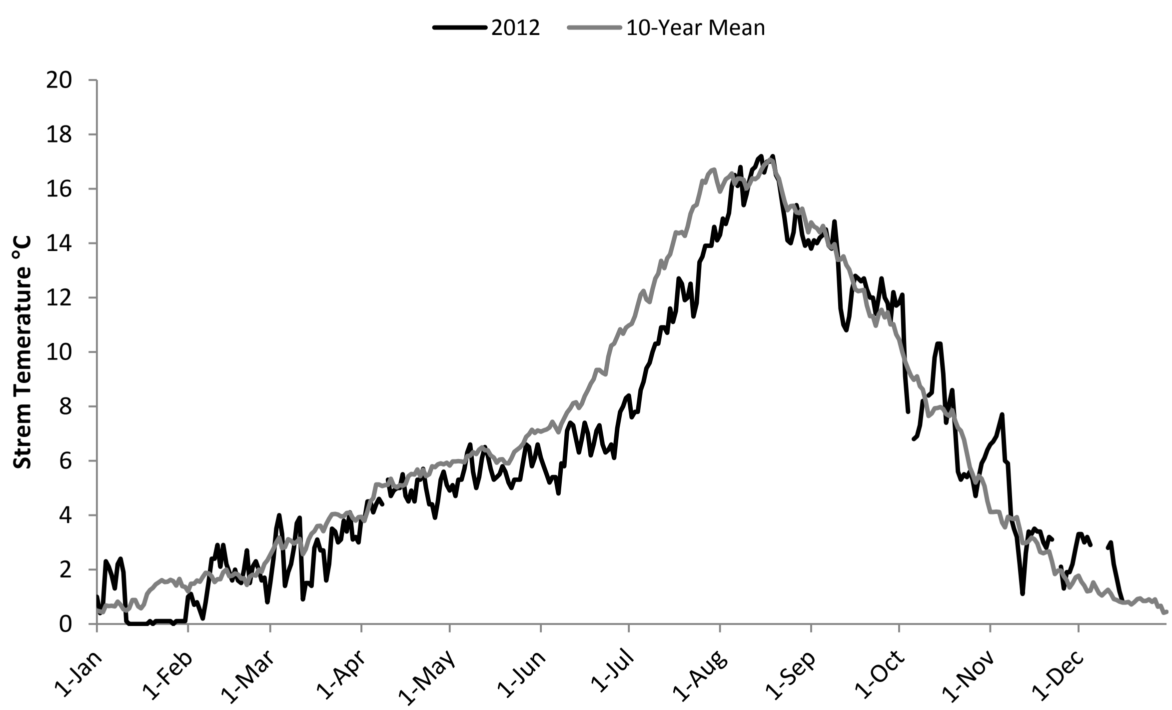

Figure 3. Mean daily water temperature at the Nason Creek DOE stream monitoring station in 2012.

2.0 METHODS

2.1 Trapping Equipment and Operation

A rotary smolt trap with a 1.5 m diameter cone was used to capture fish moving downstream at RK 0.9 on Nason Creek. Fish were removed from the primary collection box and retained in auxillary holding boxes until they were removed for efficiencies trials (up to 72 hours; Section 10 permit 1493). A rotating drum-screen constantly removed small debris from the live box to avoid fish injury. The trap was suspended with wire rope from a pulley connected to a river-spanning cable and was positioned laterally in the thalweg with winches. At flows above 100cfs, the trap was operated in the "back" position with lead-lines set at full extension. When flows dropped below 100cfs, the trap was operated in the "forward" position; lead-lines were shortened by five meters. At very low flows, cone rotations on the 1.5m trap were not sufficient to catch fish and the cone often made contact with the bed surface which allowed fish to escape. As flows approached base levels in late summer (≤50cfs), the 1.5m trap was pulled to the side of the river and replaced with a smaller 1.0m trap in an atttempt to continue sampling downstream migrants. Although the smaller trap was funtional at flows as low as 40 cfs, fish capture was limited to few fish. The 1.0m trap was used only to collected fish for sampling and no efficiency trials were conducted during its operation (26 days). Thus, estimates of emigration are not provided for this brief period of time.

2.2 Biological Sampling

Trap operating procedures and techniques followed a standardized basin-wide monitoring plan developed by the Upper Columbia Regional Technical Team (RTT) for the Upper Columbia Salmon Recovery Board (UCSRB; Hillman 2004), which was adapted from Murdoch and Petersen (2000).

All fish were enumerated by species and size class. Fish to be sampled were anesthetized in a solution of MS-222, weighed with an electronic scale and measured in a wetted trough-type measuring board. Anesthetized fish received oxygen through aquarium bubblers and were allowed to fully recover before being either released downstream of the trap or used in efficiency trials. Fork length (FL) and weight were recorded for all fish except when large numbers of fry or non-target species were collected; a sub-sample of 25 fish were measured and weighed while the remaining fish were tallied. Weight was measured to the nearest 0.1 gram and FL to the nearest millimeter. We used these data to calculate a Fulton-type condition factor (K-factor) using the formula:

$$K = (W/L^3) \times 100{,}000$$

Where K = Fulton-type condition metric, W = weight in grams, L = fork length in millimeters and 100,000 is a scaling constant.

Scale samples were collected from steelhead measuring ≥ 60 mm FL so that age and brood year could be assigned . Based on past scales analyses, steelhead under 60 mm were known to be young-of-the-year fry. Samples were collected according to the needs and protocols set by

Washington Department of Fish and Wildlife (WDFW), who conducted the analysis and provided YN with results. Tissue samples were collected from spring Chinook, steelhead and bull trout for DNA analysis. Samples from spring Chinook and steelhead were retained for reproductive success analyses conducted by WDFW and National Marine Fisheries Service (NMFS). Samples from bull trout were provided to GCPUD for bull trout monitoring and planning efforts. All target salmonids were classified as either natural or hatchery origin by physical appearance, presence/absence of coded wire tags (CWTs), or post-orbital elastomer tags. Developmental stages were visually classified as fry, parr, transitional, or smolt. Fry were defined as newly emerged fish with or without a visible yolk sac and a FL measuring < 50 mm. Age-0 coho and spring Chinook salmon captured before July 1 were considered 'fry' and were excluded from subyearling population estimates because of the uncertainity that these fish were actively migrating (UCRTT, 2001).

2.3 PIT Tagging

All natural origin Chinook, steelhead and coho measuring ≥ 60mm were PIT tagged; bull trout ≥ 70mm were PIT tagged as well but were not included in efficiency trials.

Once anesthetized, each fish was examined for external wounds or descaling, then scanned for the presence of a previously implanted PIT tag. If no tag was detected, a 12mm Digital Angel 134.2 kHz type TX 1411ST PIT tag was inserted into the body cavity. PIT tags and needles were soaked in ethyl alcohol for approximately 10 minutes prior to use. Each unique tag code was electronically recorded along with date of tag implantation, date of fish release, tagging personnel, FL, weight, and anesthetic bath temperature. Data were entered using P3 software and submitted to the PIT Tag Information System (PTAGIS). PIT tagging methods were consistent with methodologies described in the PIT Tag Marking Procedures Manual (CBFWA 1999) as well as in 2008 ISEMP protocols (Tussing 2008)

After marking and sampling, fish were held for a minimum of 24-hours in holding boxes at the trap to; a) ensure complete recovery, b) assess tagging mortality, and c) determine a PIT tag shed rate. Fish that were not used in mark-recapture trials were released downstream from the trap. Fish used in mark-recapture trials were then transported in 5-gallon buckets 1.0 RK upstream and released into the thalweg at nautical twilight from an automated mechanical release box.

2.4 Mark-Recapture Trials

Groups of marked juveniles (PIT tagged or caudal clipped) were released during a range of stream discharges in order to determine the trapping efficiency following protocols described in Hillman (2004). Hillman suggests a minimum sample size of 100 fish for each mark-recapture trial. Alhtough 100 fish/trial was the goal for each trial, low abundance of fish often required that mark-recapture trials were completed with smaller sample sizes or with hatchery surrogates. Each mark-recapture trial was conducted over a three-day (72 hour) period to allow time for passage or capture. Trials were considered invalid if no marked fish were recaptured or if there were significant interruptions to trap operation during the three-day period (i.e. debris/ice).

During periods when the trap was not operating (e.g. high discharge, high debris, mechanical problems), the number of target species captured was estimated. The estimated number of fish captured was calculated using the average number of fish captured three days prior and three days after the break in operation. This estimate of daily capture was incorporated into the overall emigration estimate.

To achieve the largest marked group possible we combined the catch over a maximum of 72 hours. Fish being held for mark-recapture trials were kept in auxiliary live boxes attached to the end of each pontoon. Marked groups were released and monitored regardless of sample size but only those groups consisting of ≥ 50 fish of a single size class and species were included in discharge-to-efficiency regression analyses.

2.5 Data Analysis

2.5.1 Estimate of Abundance

A recent WDFW review of smolt monitoring programs in the Wenatchee basin suggested that changes in the calculations for estimating abundance and its associated variance were necessary. Calculation of daily and seasonal smolt abundance changed only slightly. More significant changes were made to the variance estimator making the calculations more complex. The following describes the revised calculation of the point estimate, variance, and standard error of seasonal smolt abundances based on regression relationships.

Seasonal juvenile migration, N, was estimated as the sum of daily migrations, N_i, i.e., $N = \sum_i N_i$, and daily migration was calculated from catch and efficiency:

$$\hat{N}_i = \frac{C_i}{\hat{e}_i}, \qquad (1)$$

where C_i = number of fish caught in period *I*;

$\hat{e}_i$ = trap efficiency estimated from the flow-efficiency relationship, $\sin^2(b_0 + b_1 flow_i)$,

where b_0 is estimated intercept and b_1 is the estimated slope of the regression.

The regression parameters b_0 and b_1 are estimated using linear regression for the model:

$$\arcsin\left(\sqrt{e_k^{obs}}\right) = \beta_0 + \beta_1 flow_k + \varepsilon, \qquad (2)$$

where e_k^{obs} = observed trap efficiency of Eq. 2 for trapping period *k*;

β_0 = intercept of the regression model;

β_1 = slope parameter;

ε = error with mean 0 and variance σ^2.

In Equation 2, the observed trap efficiency, e_k^{obs}, is calculated as follows,

$$e_k^{obs} = \frac{r_k + 1}{m}. \quad \textbf{(3)}$$

The estimated variance of seasonal migration is calculated from daily estimates as:

$$Var\left(\sum_{i=1}^{n} \hat{N}_i\right) = \underbrace{\sum_i Var(N_i)}_{Part\,A} + \underbrace{\sum_i \sum_j Cov(N_i, N_j)}_{Part\,B},$$

or,

$$Var\left(\sum_{i=1}^{n} \hat{N}_i\right) = \underbrace{\sum_i Var\left(\frac{(C_i + 1)}{\hat{e}_i}\right)}_{Part\,A} + \underbrace{\sum_i \sum_j Cov\left(\frac{(C_i + 1)}{\hat{e}_i}, \frac{(C_j + 1)}{\hat{e}_j}\right)}_{Part\,B}. \quad \textbf{(4)}$$

Part A of equation 4 is the variance of daily estimates. Part B is the between-day covariance. Note that the between-day covariance exists only for days that use the same trap efficiency model. If, for example, day 1 is estimated with one trap efficiency model, and day 2 estimated from a different model, then there is no covariance between day 1 and day 2. The full expression for the estimated variance:

$$\hat{Var}\left(\sum_{i=1}^{n} \hat{N}_i\right) = \underbrace{\sum_i \hat{N}_i^2 \left(\frac{N_i \hat{e}_i (1 - \hat{e}_i)}{(C_i + 1)^2} + \frac{4(1 - \hat{e}_i)}{\hat{e}_i} \hat{Var}(b_0 + b_1 flow_i)\right)}_{PartA} +$$
$$\underbrace{\sum_i \sum_j 4\left(\hat{N}_i (1 - \hat{e}_i)\right)\left(\hat{N}_j (1 - \hat{e}_j)\right) \cdot \left[\hat{Var}(b_0) + flow_i flow_j \hat{Var}(b_1)\right]}_{PartB}$$

where $\hat{Var}(b_0 + b_1 flow_i) = M\hat{S}E\left(1 + \frac{1}{n} + \frac{(flow_i - \overline{flow})^2}{(n-1)s_{flow}^2}\right)$, and $\hat{Var}(b_0)$ and $\hat{Var}(b_1)$ are obtained from regression results. In Excel, the standard error (SE) of the coefficients is provided. The variance is calculated as the square of the standard error, SE^2.

In cases when there was no significant flow-efficiency relationship (i.e., low correlation), then a pooled, or average trap efficiency will suffice for the stratum. The estimator is calculated as follows:

$$\hat{\hat{e}} = \frac{\sum_{j=1}^{k} r_j}{\sum_{j=1}^{k} m_j}$$

where $\hat{\hat{e}}$ = the average or pooled trap efficiency for the stratum;
m_j = the number of smolts marked and released in efficiency trial j for the stratum;

r_j = the number of smolts recaptured out of m_j marked fish in efficiency trial j.

Abundance for a trapping period is estimated as:

$$\hat{N}_i^{pooled} = \frac{C_i}{\hat{\bar{e}}},$$

,and total stratum abundance is:

$$N^{pooled} = \sum_i \hat{N}_i^{pooled}.$$

The variance of seasonal abundance takes into account the variability in catch numbers that are a result of binomial sampling (Part A), the pooled variance of trap efficiency, $\hat{\bar{e}}$ (Part B), and the covariance in daily estimates that arises from using a common estimate of efficiency across all trapping days (Part C):

$$V\hat{a}r\left(\sum_{i=1}^{n} \hat{N}_i^{pooled}\right) = \underbrace{\left(\sum_i \frac{\hat{N}_i\left(1-\hat{\bar{e}}\right)}{\hat{\bar{e}}}\right)}_{PartA} + \underbrace{\frac{Var\left(\hat{\bar{e}}\right)}{\hat{\bar{e}}^2}\sum_i \hat{N}_i^2}_{PartB} + \underbrace{\frac{Var\left(\hat{\bar{e}}\right)}{\hat{\bar{e}}^2}\sum_i\sum_j \hat{N}_i\hat{N}_j}_{PartC}.$$

The Part B and Part C terms are combined in the calculation as a new Part B:

$$V\hat{a}r\left(\sum_{i=1}^{n} \hat{N}_i^{pooled}\right) = \underbrace{\left(\sum_i \frac{\hat{N}_i\left(1-\hat{\bar{e}}\right)}{\hat{\bar{e}}}\right)}_{PartA} + \underbrace{\frac{Var\left(\hat{\bar{e}}\right)}{\hat{\bar{e}}^2}\left[\sum_i \hat{N}_i^2 + \sum_i\sum_j \hat{N}_i\hat{N}_j\right]}_{PartB}.$$

The variance of $\hat{\bar{e}}$ is calculated as:

$$V\hat{a}r\left(\hat{\bar{e}}\right) = V\hat{a}r\left(\frac{\sum_{k=1}^{n} r_k}{\sum_{k=1}^{n} m_k}\right) = \frac{\sum_{k=1}^{n}\left(r_k - \hat{\bar{e}}_k m_k\right)^2}{\bar{m}^2 n(n-1)}$$

where $\bar{m}$ is the average release size across all efficiency trial, $\frac{\sum_{k=1}^{n} m_k}{n}$.

Confidence intervals were calculated using the following formulas:

95% confidence interval = $1.96 \times \sqrt{\sum \text{var}\left[\hat{N}_i\right]}$

The single M-R estimator of abundance carries a set of well documented assumptions (Everhart and Youngs 1981; Seber 1982),

1. The population is closed to mortality.
2. The probability of capturing a marked or unmarked fish is equal.

3. Marked fish were randomly dispersed in the population prior to recapture.
4. Marking does not affect probabilities of capture.
5. Marks were not lost between the time of release and recapture.
6. All marks are reported upon recapture.
7. The number of fish in the trap, C, is fully enumerated and known without error.

2.5.2 Production and Survival

Production estimates by age class were summed to produce a total emigration estimate. For spring Chinook and coho, the estimate of fall migrant parr was added to the smolt estimate from the subsequent spring to generate a total emigrant estimate for a single brood year. For steelhead, a single brood year may require three years to completely migrate. Scale analysis was used to determine the proportion of emigrants from multiple age classes within each brood year. The total number of emigrants produced from a single brood of spawning steelhead adults required at least three years of emigration estimates. For all three species, the egg-to-emigrant estimate was calculated by dividing total emigrant estimate by the estimated number of eggs deposited during spawning. The number of emigrants-per-redd for each brood year was calculated by dividing the total emigrant estimate by the number of redds counted during spawning ground surveys.

3.0 RESULTS

3.1 Dates of Operation

The Nason Creek trap was installed on February 29, 2012 (started on March 1) and removed for the season on December 1 (stopped on November 30). The 1.5m was successfully operated for a total of 194 days (Table 1). The trap was operated continuously 24 hours a day, 7 days per week except during periods of extreme high flows (>2,000cfs) or during direct releases of hatchery steelhead. A smaller 1.0m trap was operated during extremely low water in attempts to extend operations when the larger 1.5m trap's cone rotation ceased to effectively capture fish.

Table 1. Summary of Nason Creek rotary trap operation.

Date of Trap Operations	Trap Status	Description	Days
1.5 m Mar. 1 - Sept. 5 Oct. 16 - Nov. 30	Operating	Continuous data collection.	194
	Interrupted	Interrupted by debris, ice and/or low flows.	11
	Pulled	Intentionally pulled to prevent harm to fish or protect the trap during high flows.	32
1.0 m Sept 6. - Oct 15	Operating	Continuous data collection.	26
	Interrupted	Interrupted by debris and/or low flows.	1
	Pulled	Intentionally pulled to prevent harm to fish.	13

3.2 Daily Captures and Biological Sampling

3.2.1 Coho Yearlings (BY2010)

A total of 17 coho yearlings were captured during the spring emigraion between March 1 and June 30 (Figure 4). Mean FL and weight were 102.1mm (n = 17; SD = 9.1) and 11.9g (n = 17; SD = 3.0), respectively (Table 2). There were no coho yearling mortalities. Tissue and scale samples were collected from 16 fish to continue developing a baseline of freshwater growth patterns for naturally produced coho from Nason Creek.

3.2.2 Coho Subyearlings (BY2011)

A total of 84 coho subyearlings were captured during between July 1 and November 30 (Figure 5). A peak daily catch of 15 fish occurred on October 31 following a heavy rain event and a spike in the hydrograph. We estimated that an additional four fish would have been captured during trap interuptions. Mean FL and weight were 78.4mm (n = 84; SD = 9.3) and 5.0g (n = 84; SD = 2.1), respectively. No subyearling fry were identified prior to the summer months. Most coho subyearling were tissue and scale sampled (n = 83). Tissue samples were taken as part of a reproductive success study of translocated adults from Icicle Creek in 2011. Collected scale samples will continue to develop a freshwater aging baseline mentioned previously. There were two mortalities incurred by incidental debris buildup in the trap.

Table 2. Summary of length and weight sampling of juvenile coho salmon captured at the Nason Creek rotary trap.

Brood Year	Origin/Species/Stage	Fork Length (mm)			Weight (g)			K-Factor
		Mean	N	SD	Mean	N	SD	
2010	Wild Coho Yearling Smolt	102.1	17	9.1	11.9	17	3	1.1
2011	Wild Coho Subyearling Parr	78.4	84	9.3	5.0	84	2.1	1.0
2010	Hatchery Coho Yearling Smolt	126.2	1,684	7.6	21.5	1,684	5.5	1.1

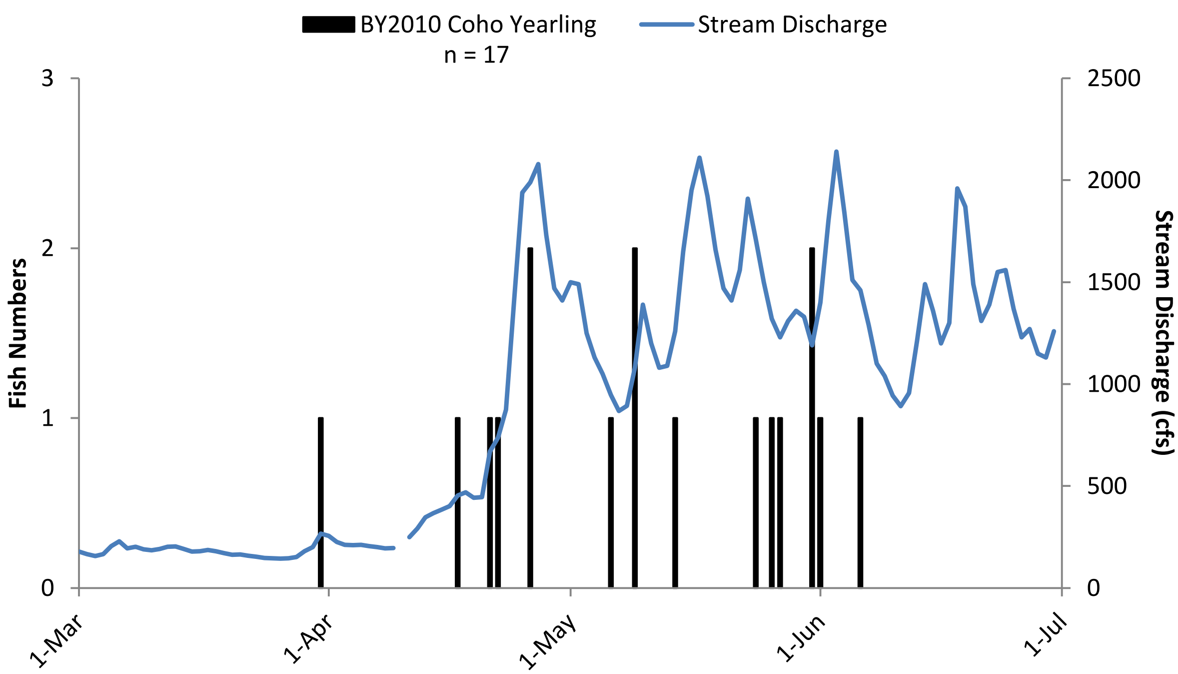

Figure 4. Daily catch of BY2010 wild coho yearlings with mean daily stream discharge at the Nason Creek rotary trap, March 1 to June 30, 2012.

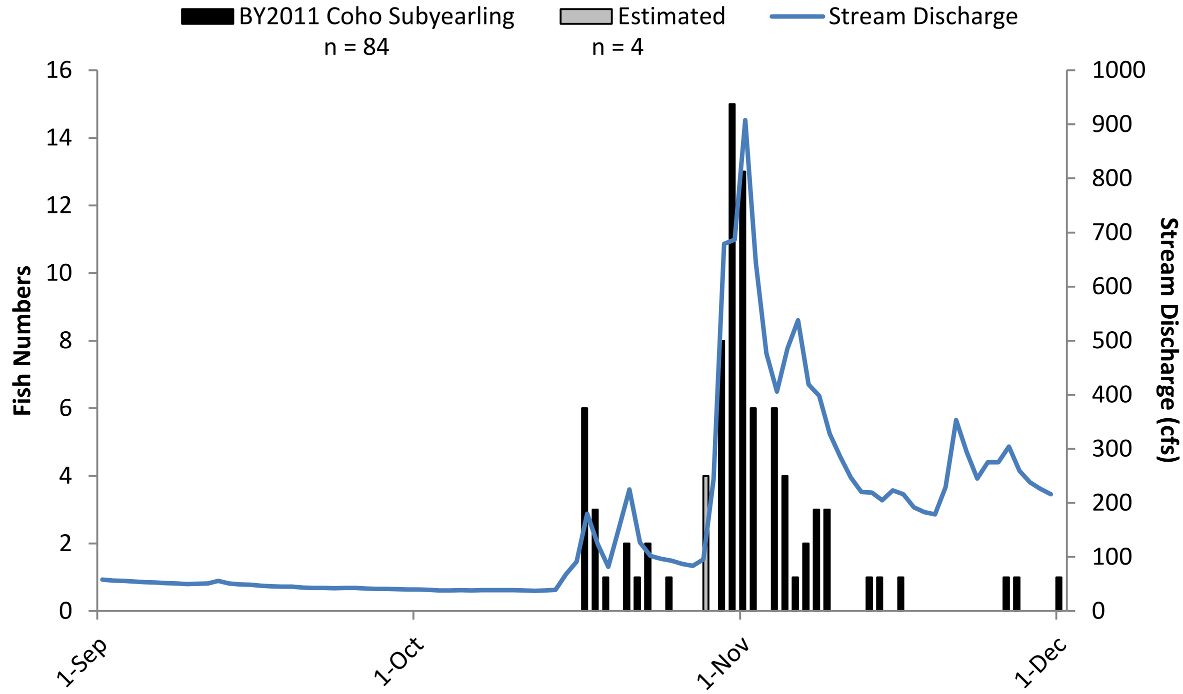

Figure 5. Daily catch of BY2011 wild coho subyearlings with mean daily stream discharge at the Nason Creek rotary trap, September 1 to November 30, 2012.

3.2.3 Hatchery Coho Smolt (BY2010)

A total of 351,474 hatchery coho were released into Nason Creek above the trap in spring of 2012. All hatchery coho were acclimated in natural ponds adjacent to the stream and reared to the smolt stage prior to volitional release, which was synchronized through a myriad of environmental/physiological cues demonstrating emigration readiness (e.g. - river discharge, extended daylight hours, silvery appearance, schooling behavior, etc.). Between March 1 and June 30, a total of 12,133 hatchery coho were captured at the trap (Figure 5). Mean FL was 126.2mm (*n* = 1,684; *SD* = 7.6) and mean weight was 21.5g (*n* = 1,684; *SD* = 5.5; Table 2). Peak daily catch occurred on May 18 (*n* = 2,313) following volitional release into Nason Creek. We estimated that an additional 1,108 fish would have been captured if the trap had been operated without interruption or delay. There were 13 mortalities incurred as a result of capture and/or handling stress. Hatchery coho emigration data at the Nason Creek trap assists YN's Coho Program by providing size-at-emigration, emigration timing and duration of residence in Nason Creek.

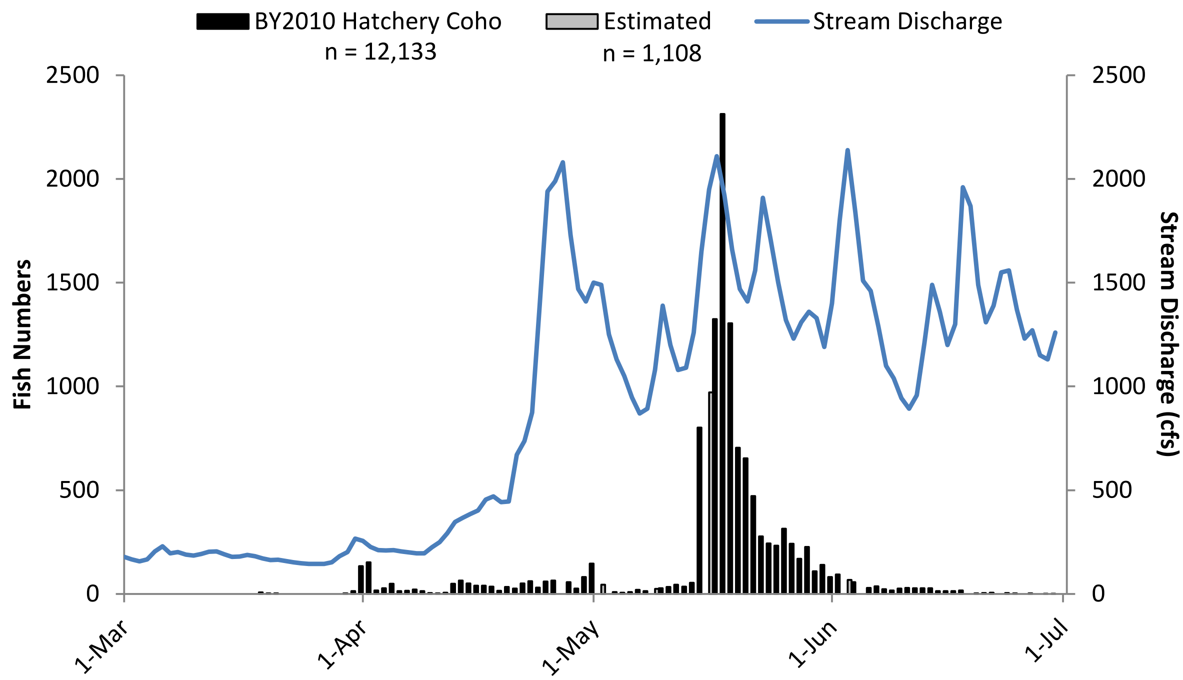

Figure 6. Daily catch of BY2010 hatchery coho smolt with mean daily stream discharge at the Nason Creek rotary trap, March 1 to June 30, 2012.

3.2.4 Spring Chinook Yearlings (BY2010)

Between March 1 and June 30, a total of 370 wild Chinook yearlings were captured at the trap (Figure 7). The majority of these fish were collected prior to spring snowmelt, with the peak catch occuring on April 21. Following a significant increase in stream discharge, capture numbers dropped substantially with the last emigrating Chinook yearling captured on June 14. An estimated two additonal fish would have been captured if the trap had not been interupted or delayed. Mean FL and weight for Chinook yearlings was 93.3mm (*n* = 368; *SD* = 7.0) and 9.2g (*n* = 368; *SD* = 2.2; Table 3), respectively. Tissue sample were collected from 362 fish for an ongoing, parental-based DNA analysis by WDFW. There was a single mortality incurred at the trap; likely associated with heavy debris loads following a high flow event.

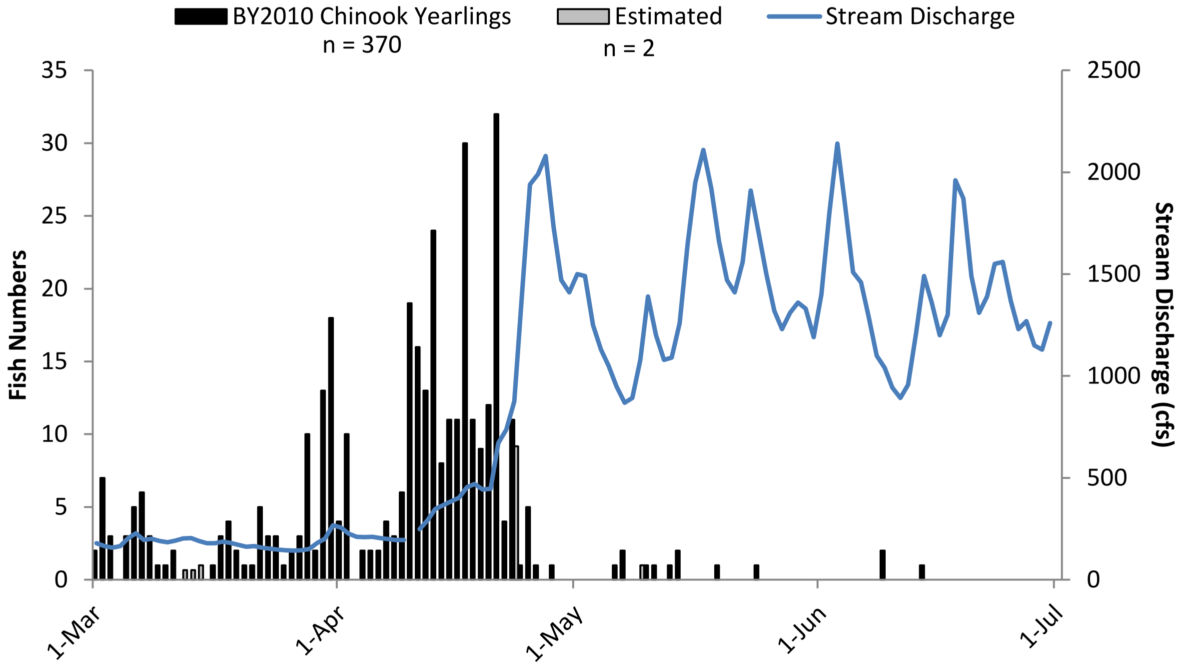

Figure 7. Daily catch of BY2010 spring Chinook yearlings with mean daily stream discharge at the Nason Creek rotary trap, March 1 to June 30, 2012.

Table 3. Summary of length and weight sampling of juvenile spring Chinook captured at the Nason Creek rotary trap.

Brood Year	Origin/Species/Stage	Fork Length (mm)			Weight (g)			K-Factor
		Mean	N	SD	Mean	N	SD	
2010	Wild Chinook Yearling Smolt	93.3	368	7.0	9.2	368	2.2	1.1
2011	Wild Chinook Subyearling Fry	42.7	48	9.1	0.9	48	0.6	1.2
2011	Wild Chinook Subyearling Parr	77.9	2,160	10.7	5.3	2,160	1.9	1.1

3.2.5 Spring Chinook Subyearlings (BY2011)

A total of 2,179 wild spring Chinook subyearlings parr (≥50mm) were captured between July 1 and November 30 with an additional 57 subyearling fry (≤49mm) captured prior to July 1 (Figure 8). Snowmelt subsided steadily in August as flows approached base levels by early September. During the summer, Chinook subyearling parr movement lasted from late July into mid- August with a peak in daily captures occuring on July 26 (*n* = 53). This brief period of emigration appeared to have ended several days before trap operations were suspended for one month (August 19 – September 18; *see 3.6 ESA Compliance*). Trap operations resumed on September 19. Extremely low flows during this period appeared to limit daily captures; stream discharge dropped to 37.6cfs. On October 13, a heavy fall freshet increased flows and subyearling movement picked up once again. Several more rain events appeared to trigger sharp increases in movemnt with a peak daily capture of 155 on October 31. Mean FL and weight among fall subyearling parr was 78.3mm (*n* = 2,133; *SD* = 10.7) and 5.3g (*n* = 2,133; *SD* = 1.9), respectively. We estimated than an additional 147 Chinook subyearlings parr would have been captured if the trap had been operated without interuption during this period. There were 14 subyearling mortalities, the majority of which were found dead upon daily inspection of the trap. Most mortalities were associated with woody debris that had been circulated through the trap with fish.

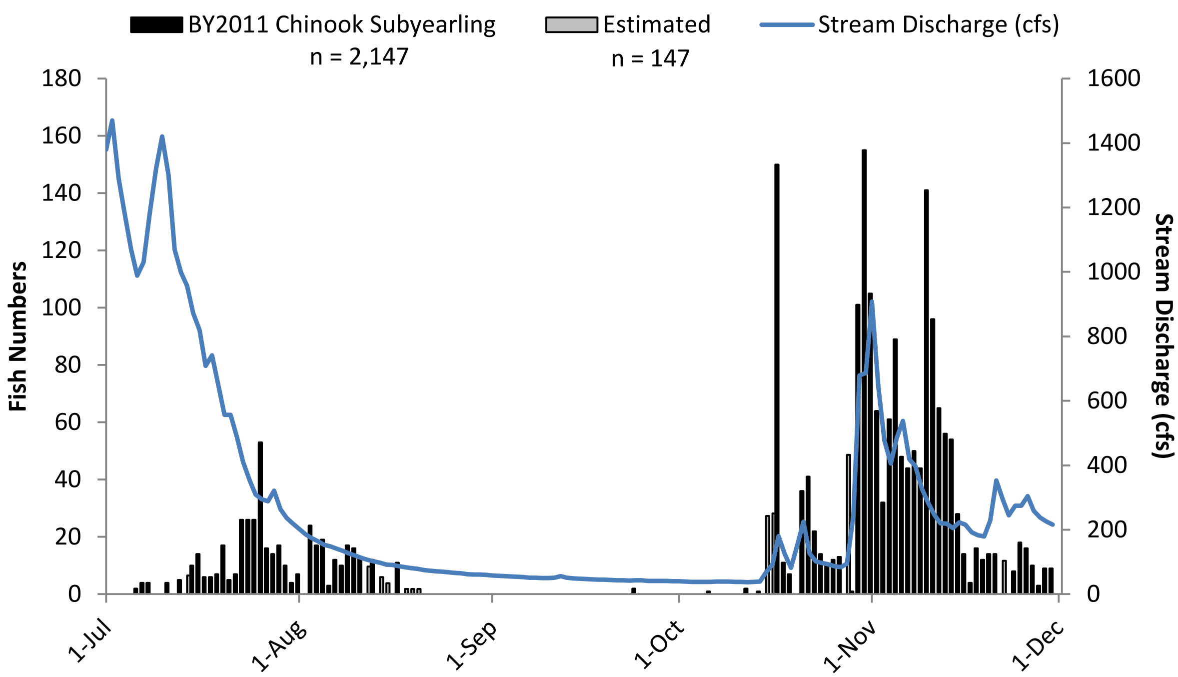

Figure 8. Daily catch of BY2011 spring Chinook subyearlings with mean daily stream discharge at the Nason Creek rotary trap, July 1 to November 30, 2012.

3.2.6 Summer Steelhead

A total of 1,473 wild summer steelhead juveniles were captured throughout the season from March 1 to November 30 with a peak catch of 72 fry on August 18 (Figure 9). We estimated that an additional 159 juveniles would have been captured if there had been no interruptions to trapping during the season. Catch numbers of young-of-the-year were low because the trap was not operated during the time fry movement is typically greatest (Aug-Sept). The majority of steelhead juveniles captured at the trap were age-1 parr emigrating past the trap in spring. The mean FL and weight of age-1 fish was 86.5mm (*n* = 812; *SD* = 18.1; Table 4) and 8.0g (*n* = 805; *SD* = 5.7), respectively. Most age-2 fish emigrated as smolt in the spring. Tissue samples were obtained from 1,055 fish that ranged in size from 60mm to 204mm. Scales were taken from a sub-sample (*n* = 826) of captured fish and used to estimate age among juvenile steelhead captured during the year. There were 69 fry and 16 parr mortalities (See 3.6 ESA Compliance).

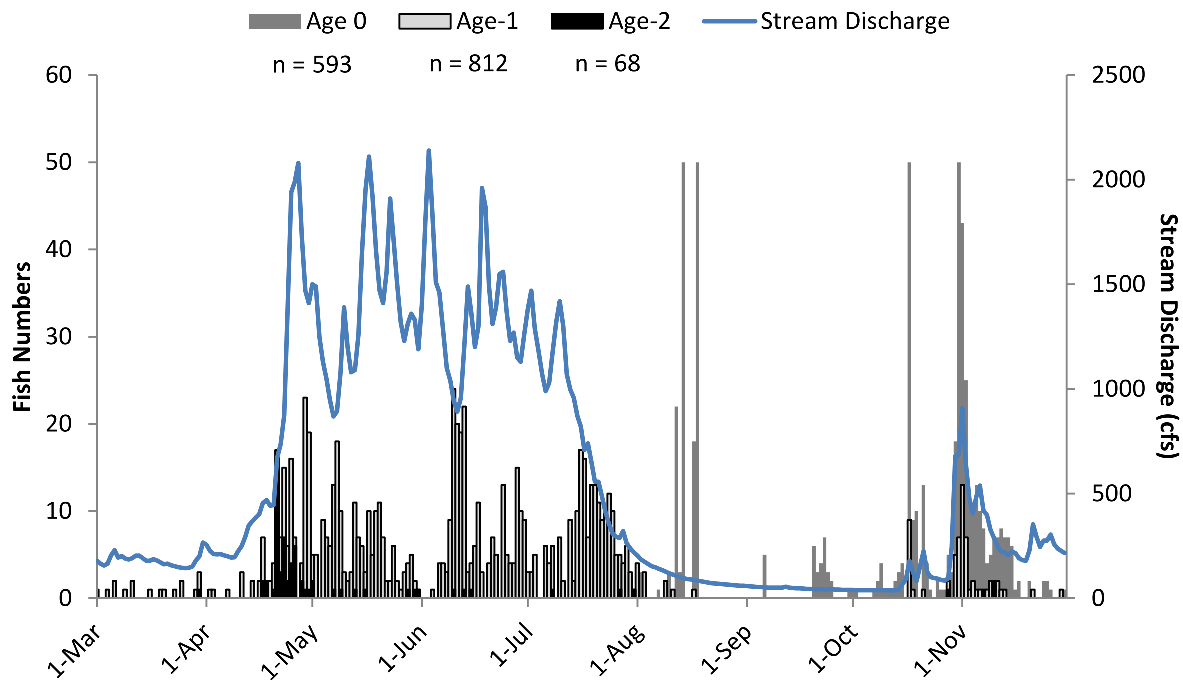

Figure 9. Daily catch of wild summer steelhead with mean daily stream discharge at the Nason Creek rotary trap, March 1 to November 30, 2012. Estimates of fish passage during trap interruptions are not depicted.

Table 4. Summary of length, weight and condition factor by age class of wild summer steelhead emigrants and hatchery steelhead captured at the Nason Creek rotary trap.

Brood Year	Origin/Species/Stage	Fork Length (mm)			Weight (g)			K-Factor
		Mean	N	SD	Mean	N	SD	
2012	Wild Summer Steelhead (Age-0)	63.4	405	9.6	2.7	405	1.3	1.1
2011	Wild Summer Steelhead (Age-1)	86.5	805	18.1	8.0	805	5.7	1.2
2010	Wild Summer Steelhead (Age-2)	151.5	68	78.0	36.1	68	12.7	1.0
2009	Wild Summer Steelhead (Age-3)	—	—	—	—	—	—	—
2011	Hatch. Summer Steelhead Smolt	154.8	318	20.9	37.7	318	14.0	1.0

3.2.7 Hatchery Steelhead Smolt

During May 2012, WDFW released multiple groups of hatchery steelhead smolts into Nason Creek above the trap (Figure 10). In total, 36,225 fish were directly planted in to the stream. In addition to these fish, 17,254 hatchery steelhead smolts were volitionally released from Rohlfing's Pond (RFP) on May 17; also upstream of the smolt trap. Subsequently, a total of 1,403 hatchery steelhead were captured at the trap with a mean FL of 154.8mm (n = 318; SD = 20.9). Hatchery fish were identified by PIT or elastomer markings (RFP = double pink; direct plant = single pink). There was a single mortality.

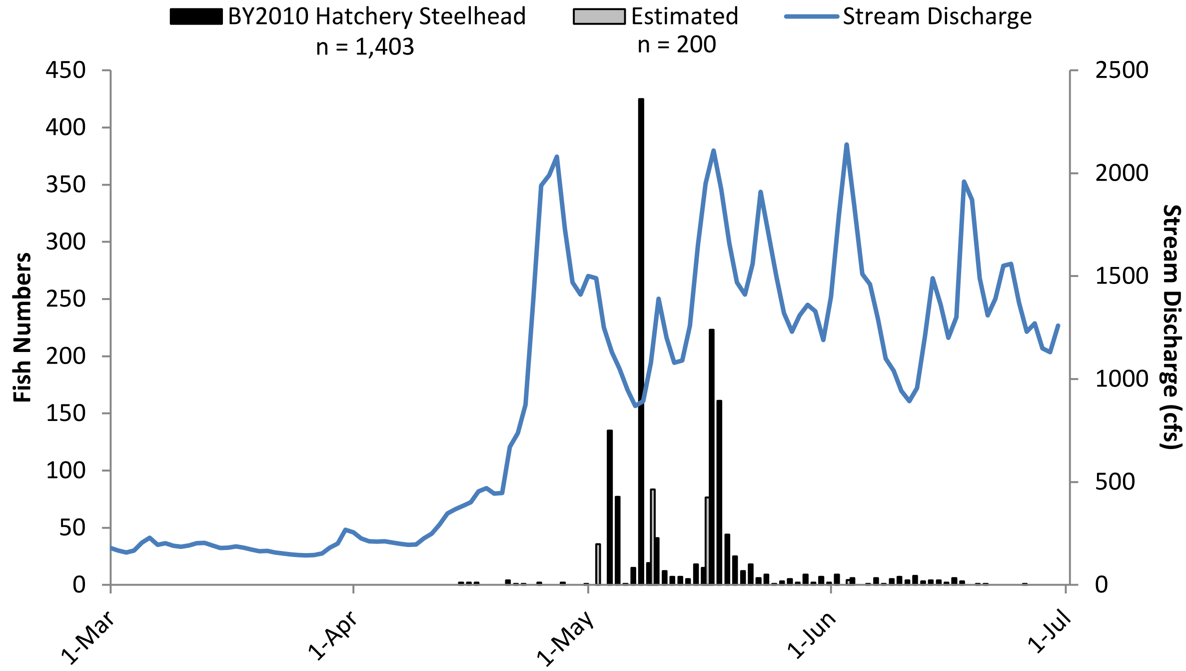

Figure 10. Daily catch of hatchery steelhead smolt with mean daily stream discharge at the Nason Creek rotary trap, March 1 to June 30, 2012.

3.2.8 Bull Trout

A total of 12 bull trout parr were captured with a mean fork length of 152.2mm (*n* = 12; *SD* = 32.2; Table 5). Tissue samples were taken from 10 fish and provided to GCPUD as part of their Monitoring and Evaluation Plan under their current BiOp. There were no mortalities.

Table 5. Summary of length, weight and condition factor for bull trout captured at the Nason Creek rotary trap.

Brood Year	Origin/Species/Stage	Fork Length (mm)			Weight (g)			K-Factor
		Mean	N	SD	Mean	N	SD	
Unknown	Wild Bull Trout Parr	152.2	12	32.2	38.5	12	27.4	1.1

3.3 Trap Efficiency Calibration and Population Estimates

3.3.1 Coho (BY2010)

Low catch numbers of naturally produced coho yearlings (n = 17) required the use of surrogate fish to perform trap efficiency trials. Initially, hatchery coho smolt were used because of their con-specific similarities and because they were readily available. Hatchery coho were collected in two ways; 1) fish that escaped from upstream acclimation ponds were collected at the smolt trap, PIT tagged and retained for up to 72 hours prior to release as an efficiency trial, and 2) hatchery smolts were collected immediately downstream of Rohlfing's Pond by dropping the retention barrier and allowing smolts to escape volitionally. We conducted 13 trials with a total of 1,269 hatchery smolt (Table 6). A linear regression using the hatchery coho dataset indicated that there was not a significant discharge-to-efficiency relationship. Therefore, we used a wild Chinook yearling, multi-year dataset with a minimum sample size of 50 fish/ trial to expand daily catch of wild coho (r^2= 0.28, $p < 0.04$; *See Appendix C*). Spring Chinook surrogates were used for population expansions considering their comparable sizes and similar migratory behavior when compared to coho yearlings. In spring of 2012, we estimated that 355 (± 182; 95% CI) BY2010 yearlings emigrated past the trap (Table 7). The subyearling estimate from the previous fall of 2011 was recalculated at 20 (± 16; 95% CI). The total estimate of BY2010 coho emigrants from Nason Creek was 375 (± 198 ; 95% CI).

Table 6. Trap efficiency trials conducted with BY2010 hatchery coho yearlings. Note: trap efficiency is reported as the percentage of recaptures + 1 divided by the number of marked fish in the trial.

Origin/Species/Stage	Age	Date	Trap Position	Marked	Recaptured	Trap Efficiency	Discharge (cfs)
Hatchery Coho Smolt	1+	4/3/2012	Back	99	11	12.1%	215
Hatchery Coho Smolt	1+	4/5/2012	Back	98	5	6.1%	203
Hatchery Coho Smolt	1+	4/7/2012	Back	99	8	9.1%	199
Hatchery Coho Smolt	1+	4/13/2012	Back	40	3	10.0%	383
Hatchery Coho Smolt	1+	4/15/2012	Back	156	17	11.5%	439
Hatchery Coho Smolt	1+	4/19/2012	Back	100	13	14.0%	509
Hatchery Coho Smolt	1+	4/24/2012	Back	141	5	4.3%	2,051
Hatchery Coho Smolt	1+	5/1/2012	Back	177	1	1.1%	1,351
Hatchery Coho Smolt	1+	5/7/2012	Back	55	4	9.1%	1,001
Hatchery Coho Smolt	1+	5/11/2012	Back	74	3	5.4%	1,101
Hatchery Coho Smolt	1+	5/23/2012	Back	104	6	6.7%	1,615
Hatchery Coho Smolt	1+	6/13/2012	Back	82	6	8.5%	1,444
Hatchery Coho Smolt	1+	6/16/2013	Back	44	6	15.9%	1856
Total				**1,269**	**88**		

Table 7. Estimated egg-to-emigrant survival and smolts-per-redd production for Nason Creek coho salmon.

Brood Year	No. of Redds	Fecundity	Est. Egg Deposition	No. of Emigrants			Egg-to-Emigrant	Emigrants per Redd
				Age-0[a]	Age-1	Total		
2003	6	2,458	14,748	DNOT	329	329	—	—
2004	35	3,084	107,940	85	45	130	0.1%	4

2005	41	2,866	117,506	6	984	990	0.8%	24
2006	4	3,126	12,504	6	0	6	0.0%	2
2007	10	2,406	24,060	12	76	88	0.4%	9
2008	3	3,275	9,825	15	0	15	0.2%	5
2009	14	2,691	37,674	124	162	286	0.8%	20
2010	8	3,411	27,288	20	355	375	1.4%	47
2011	89	3,114	277,146	910	—	—	—	—
Avg.[b]	16	2,980	48,114	38	232	270	05%	16

[a] Does not include subyearling fry prior to July 1.
[b] 7-year average of complete brood data, 2004-2010.

3.3.2 Coho (BY2011)

With a total of 84 naturally spawned coho subyearlings, a record high was captured for this species and life stage at the Nason Creek trap. Although we conducted two trap efficiency trials with a total of 46 fish (Table 8), this was not sufficient data to generate an accurate emigration estimate . Thus, subyearling estimates were made with wild Chinook, multi-year datasets. Since the trap was operated in two positions during the fall, we used two models to expand catch estimates. Both models indicated significant discharge-to-efficiency relationships (r^2 =0 .46, p = 0.007: r^2 = 0.31, p = 0.01; *See Appendix C*)). Using these regression models, we estimated that a total of 910 (± 239 ; 95% CI) BY2011 coho subyearlings emigrated from Nason Creek in fall of 2012 (Table 7).

Table 8. Trap efficiency trials conducted with BY2011 naturally produced coho subyearlings. Note: trap efficiency is reported as the percentage of recaptures + 1 divided by the number of marked fish in the trial.

Origin/Species/Stage	Age	Date	Trap Position	Marked	Recaptured	Trap Efficiency	Discharge (cfs)
Wild Coho Subyearling	0+	11/3/2012	Back	35	1	5.7%	446
Wild Coho Subyearling	0+	11/7/2012	Back	11	2	27.3%	364
Total				**46**	**3**		

3.3.3 Spring Chinook (BY2010)

We conducted five efficiency trials with 255 marked yearling Chinook in 2012 (Table 9). Regression analysis indicated that there was a likely a significant, within year relationship between stream discharge and trap efficiency (r^2 = 0.75, p = 0.06). However, we chose to use a multi-year dataset with increased number of mark groups, a minimum of 50 fish/trial, stronger significance, and good correlation to expand the daily catch numbers (r^2 = 0.28, p = 0.04; *See Appendix C*). Using this model, we estimated that a total of 3,333 (± 713; 95% CI) BY2010 Chinook yearlings emigrated in spring of 2012 (Table 10). Combined with a recalculated BY2010 subyearling estimate of 7,659 (± 1,570; 95% CI), we estimated that a total of 10,992 (± 2,293; 95% CI) BY2010 spring Chinook juveniles emigrated from Nason Creek.

Table 9. Trap efficiency trials conducted with BY2010 and BY2011 wild spring Chinook juveniles. Note: trap efficiency is reported as the percentage of recaptures + 1 divided by the number of marked fish in the trial.

Origin/Species/Stage	Age	Date	Trap Position	Marked	Recaptured	Trap Efficiency	Discharge (cfs)
Wild Chinook Yearling	1+	3/31/2012	Back	43	5	13.9%	238
Wild Chinook Yearling	1+	4/13/2012	Back	53	4	9.4%	383
Wild Chinook Yearling	1+	4/16/2012	Back	53	7	15.1%	476
Wild Chinook Yearling	1+	4/19/2012	Back	48	7	16.7%	509
Wild Chinook Yearling	1+	4/23/2012	Back	58	1	3.4%	1835
Total				**255**	**24**		

Table 10. Estimated egg-to-emigrant survival and smolts-per-redd production for Nason Creek spring Chinook salmon.

Brood Year	No. of Redds	Fecundity[a]	Est. Egg Deposition	No. of Emigrants			Egg-to-Emigrant	Emigrants per Redd
				Age-0[b]	Age-1	Total		
2002	294	5,024	1,477,056	DNOT	9,084	9,084	—	—
2003	83	6,191	513,853	7,899	2,096	9,995	1.9%	120
2004	169	4,846	818,974	12,569	3,267	15,836	1.9%	94
2005	193	4,365	842,445	7,280	7,732	15,012	1.8%	78
2006	152	4,773	725,496	3,247	6,680	9,927	1.4%	65
2007	101	4,656	470,256	10,783	2,032	12,815	2.7%	127
2008	336	4,691	1,576,176	15,056	2,986	18,052	1.1%	54
2009	167	4,691	783,397	10,975	1,617	12,592	1.6%	75
2010	188	4,548	855,024	7,659	3,333	10,992	1.3%	58
2011	170	4,969	844,730	17,026	—	—	—	—
Avg.[c]	174	4,845	823,203	9,435	3,718	13,153	1.7%	84

[a] Data provided by Hillman et al. 2012.
[b] Does not include subyearling fry prior to July 1.
[c] 8-year average of complete brood data, 2003-2010.

3.3.4 Spring Chinook (BY2011)

We conducted a total of 10 efficiency trials with subyearling Chinook from July 26 to November 11 (Table 11). During this period, trials were conducted with the trap set in one of two positions; back or forward. These two positions differed primarily by flow levels. At flows above 75cfs, the trap was operated in the back position. At flows below 75cfs, it was operated in the forward position. Results from 2012 trials conducted at either position were not indicate significant relationships between efficiency and flow. Therefore, multi-year datasets were developed for each trap position. Significant relationships were detectected in both back and forward regression models which were subsequently used to calculate subyearling emigrant numbers (back, r^2 =0 .46, p = 0.007; forward, r^2 = 0.31, p = 0.01; *See Appendix C*). We estimated that a total of 17,026 (± 2,693; 95% CI) BY2011 spring Chinook subyearling emigrated from Nason Creek in the fall of 2012.

Table 11. Trap efficiency trials conducted with wild spring Chinook subyearlings. Note: trap efficiency is reported as the percentage of recaptures + 1 divided by the number of marked fish in the trial.

Origin/Species/Stage	Age	Date	Trap Position / Season	Marked	Recaptured	Trap Efficiency	Discharge (cfs)
Wild Chinook Subyearling	0+	7/26/12	Back	37	2	8.1%	288
Wild Chinook Subyearling	0+	7/30/12	Back	29	4	17.2%	223
Wild Chinook Subyearling	0+	8/3/12	Back	31	2	9.7%	155
Wild Chinook Subyearling	0+	8/7/12	Back	36	1	5.6%	128
Wild Chinook Subyearling	0+	10/29/12	Back	54	7	14.8%	720
Wild Chinook Subyearling	0+	10/25/12	Back	83	18	22.9%	83
Wild Chinook Subyearling	0+	11/3/12	Back	201	25	12.9%	445
Wild Chinook Subyearling	0+	11/7/12	Back	233	27	12.0%	364
Wild Chinook Subyearling	0+	11/15/12	Back	195	34	17.9%	202
Wild Chinook Subyearling	0+	11/11/12	Back	328	87	26.8%	222
Total				**1,227**	**200**		

3.3.5 Summer Steelhead

Efficiency trials were conducted on 14 occasions between March 1 and November 30 with a total of 568 PIT tagged steelhead parr and/or smolt (Table 12). Initially, efficiency trials were stratified into groups according to trap position and flow conditions. Efficiency trials conducted in 2012 lacked sufficient data to establish adequate discharge-efficiency relationships. Therefore, the 2012 trials were combined with those from previous years to increase overall sample sizes and broaden the range of discharge levels that trials were conducted at. A single, multi-year dataset comprised of trials conducted during spring emigration was used to estimate steelhead emigration from March 1 through July 31 for all age classes from each brood year (r^2 = 0.37, p = 0.04; *See Appendix C*). However, we were not able to establish a similar model for fish captured during the late summer/fall (August 1 through November 30). This is likely due to the fact that summer/fall emigrants may not be actively migrating. To include the summer/fall dataset would be a violation of a primary assumption for efficiency driving population estimates at rotary traps; all fish must be actively migrating. Therefore our estimates do not include summer/fall emigrants and could be an underestimate of total emigration. Attempts to use pooled estimates resulted in variance levels above actual estimated numbers and were dismissed as inaccurate. With these datasets we generated estimates for BY2011 age-1, BY2010 age-2 and an overall estimate for BY2009 (ages1-3) juvenile steelhead (Table 13). A total of 10,237 (± 2,042; 95% CI) BY2011 age-1, and 708 (± 310; 95% CI) BY2010 age-2 steeelhead emigrated from Nason Creek in 2012. We estimated the total BY2009 steeelhead emigration to be 9,003 (± 2,884; 95% CI).

Table 12. Efficiency trials conducted with wild summer steelhead juveniles. Note: trap efficiency is reported as the percentage of recaptures + 1 divided by the number of marked fish in the trial.

Origin/Species/Stage	Age[a]	Date	Trap Position	Marked	Recaptured	Trap Efficiency	Discharge (cfs)
Wild Steelhead Parr/Smolt	1+	4/27/12	Back	35	3	11.4%	1,561
Wild Steelhead Parr/Smolt	1+	5/11/12	Back	28	5	21.4%	1,101
Wild Steelhead Parr/Smolt	1+	5/19/12	Back	29	2	10.3%	1,453
Wild Steelhead Parr/Smolt	1+	5/23/12	Back	22	1	9.1%	1,615
Wild Steelhead Parr/Smolt	1+	6/12/12	Back	69	5	8.7%	1,447
Wild Steelhead Parr/Smolt	1+	6/16/12	Back	37	3	10.8%	1,856
Wild Steelhead Parr/Smolt	1+	6/27/12	Back	26	1	7.7%	1,150
Total				**246**	**20**		
Wild Steelhead Parr/Smolt	1+	7/2/12	Back	24	4	20.8%	1,168
Wild Steelhead Parr/Smolt	1+	7/18/12	Back	49	6	14.3%	686
Wild Steelhead Parr/Smolt	1+	7/22/12	Back	44	4	11.4%	438
Wild Steelhead Parr/Smolt	1+	7/26/12	Back	63	4	7.9%	288
Total				**180**	**18**		
Wild Steelhead Parr/Smolt	0+	11/3/12	Back	84	3	4.8%	446
Wild Steelhead Parr/Smolt	0+	11/7/12	Back	36	1	5.6%	364
Wild Steelhead Parr/Smolt	0+	11/11/12	Back	22	3	18.2%	222
Total				**142**	**7**		

Table 13. Estimated egg-to-emigrant survival and emigrants-per-redd production for Nason Creek summer steelhead.

Brood Year	No. of Redds	Fecundity[a]	Est. Egg Deposition	No. of Emigrants				Egg-to-Emigrant	Emigrants per Redd
				1+	2+	3+	Total		
2001	27	5,951	160,677	DNOT	DNOT	230	—	—	—
2002	80	5,776	462,080	DNOT	2,151	30	—	—	—
2003	121	6,561	793,881	3,491	571	0	4,062	0.5	34
2004	127	5,118	649,986	4,045	646	0	4,691	0.7	37
2005	412	5,545	2,284,540	6,040	1,258	110	7,432	0.3	18
2006	77	5,688	437,976	11,645	1,217	0	12,862	2.9	167
2007	78	5,840	455,520	15,945	615	0	16,560	3.6	212
2008	88	5,693	500,984	3,596	812	21	4,429	0.8	50
2009	126	6,199	781,074	8,661	342	0	9,003	1.1	71
2010	270	5,458	1,473,660	9,508	708	—	—	—	—
2011	235	6,276	1,474,860	10,237	—	—	—	—	—
Avg.[b]	130	5,801	843,423	9,379	825	26	10,106	1.8%	104

[a] Data provided by Hillman et al. 2012.
[b] 7-year average of complete brood estimates.

3.4 PIT Tagging

During the 2012 trapping season, we PIT tagged 97 wild coho, 2,296 wild spring Chinook, 1,087 steelhead and 12 bull trout (Table 14). All tagging files were submitted to the PTAGIS database. A total of 11 shed PIT tags were recovered in holding boxes where fish had been held for 24-72 hours after tagging.

Table 14. Number of PIT tagged coho, Chinook, steelhead and bull trout with shed rates at the Nason Creek rotary trap.

Species/Stage	Year-to-date Catch	Year-to-date PIT Tagged	No. of Shed Tags	Percent Shed Tags
Coho Yearling	17	17	0	0.0%
Coho Subyearling	84	80	0	0.0%
Chinook Yearling	370	357	0	0.0%
Chinook Subyearling	2,147	1,939	6	0.3%
Steelhead Parr	1,191	1,016	5	0.5%
Steelhead Smolt	71	71	0	0.0%
Bull Trout Parr	12	12	0	0.0%

3.5 Incidental Species

Along with naturally produced coho, wild spring Chinook and wild steelhead/rainbow trout, other resident fish species captured at the Nason Creek rotary trap included in Table 15 are: cutthroat trout (*Oncorhynchus clarkii*), flathead minnow (*Pimephales promelas*), long-nose dace (*Rhinichthys sp.*), northern pikeminnow (*Ptychocheilus oregonensis*), redside shiner (*Richardsonius balteatus*), sculpin (*Cottus sp.*), sucker (*Catostomus sp.*), and mountain whitefish (*Prosopium williamsoni*). Hatchery Chinook were collected at the trap on May 8, immediately following a WDFW steelhead smolt release (direct-plant) upstream of the trap. Direct planted steelhead were overwintered at the Chiwawa Acclimation Facility and it is likely that a very small portion of on-station Chinook had accidentally co-mingled with steelhead and were released into Nason Creek during these transports..

Table 15. Summary of length and weight sampling of incidental species captured at the Nason Creek rotary trap.

Species	Total Count	Length (mm)			Weight (g)		
		Mean	N	SD	Mean	N	SD
Chinook (hatchery)	8	128.4	8	9.5	23.3	8	5.0
Cutthroat Trout	4	151.3	4	20.2	35.3	4	14.2
Fathead Minnow	7	64.3	7	2.4	3.3	7	0.7
Longnose Dace	52	103.0	52	16.0	15.4	52	5.7
Northern Pikeminnow	2	143.5	2	—	77.7	2	—
Redside Shiner	1	82.0	1	—	8.1	1	—
Sculpin	74	103.6	69	39.2	20.5	69	20.5

Sucker	42	123.3	41	46.6	32.7	41	61.5
Whitefish Parr	28	75.3	22	14.8	3.9	22	2.3
Whitefish Fry	2	280.5	2	—	247.2	2	—

3.6 ESA Compliance

The Nason Creek smolt trap was operated under consultation with NMFS and USFWS. Total numbers of UCR spring Chinook and UCR summer steelhead that were captured or handled (indirect take) at the trap were less than 20% of the maximum permitted for each species (Table 16). Direct or lethal take was below 2% for spring Chinook (0.6%) and bull trout (0.0%). For steelhead, there were a total of 69 steelhead fry mortalities that resulted from two occasions when small logs had become jammed into the cone. On both occasions, it was apparent that campers from the adjacent USFS campgrounds had thrown multiple logs towards the cone which eventually caused the trap to cease rotation. After the first incident (51 mortalities), the trap was pulled immediately and Craig Busack (NMFS) was notified that YN had exceeded its permitted take of 2%. Following consultation with NMFS, trap operations were resumed until a second incident of vandalism resulted in another 18 mortalities. Trap operations were then suspended from August 18 to September 20, until permission was granted by NOAA to resume trapping (See Appendix C; **NOAA Memo 09202012**). Stream temperatures remained below 18°C for the entire trapping season and did not affect ESA fish handling protocols.

Table 16. Summary of ESA species and coho salmon mortality at the Nason Creek rotary trap.

Species/Stage/Brood Year	Total Collected	Total Mortality	% Mortality
Spring Chinook Yearling (BY2010)	370	1	0.3%
Spring Chinook Fry (BY2011)	57	4	7.0.%
Spring Chinook Subyearling (BY 2011)	2,179	10	0.5%
Total Spring Chinook	**2,606**	**15**	**0.6%**
Steelhead Age-0 (BY2012)	593	69	11.6%
Steelhead Age-1 (BY2011)	812	16	1.9%
Steelhead Age-2 (BY2010)	68	0	0.0%
Steelhead Age-3 (BY2009)	0	0	0.0%
Total Summer Steelhead	**1,473**	**85**	**5.8%**
Coho Yearling (BY2010)	17	0	0.0%
Coho Subyearling (BY2011)	84	2	2.4%
Total Coho	**101**	**2**	**2.0%**
Bull Trout Parr	12	0	0.0%
Total Bull Trout	**12**	**0**	**0.0%**

4.0 DISCUSSION

Prior to 2012, most juvenile emigration estimates in Nason Creek were made using pooled data, rather than regression derived data, due to a consistent lack of correlation between stream discharge and trap efficiency. In most cases, this was due to low fish abundance and an insufficient number of mark-recapture trials for a given trap position, range of discharge levels, species, or life stage. A revised regression-based method, developed and distributed by WDFW, replaced the previous method (used by most regional smolt traps) with improvements to calculations of daily abundance and variance. Following a recent YN review of past discharge-efficiency data collected at the Nason Creek trap (2006 – 2012), several multi-year datasets with sufficient correlation were developed. Using combined annual datasets, we estimated juvenile emigration from Nason Creek in 2012 and recalculated previous estimates for coho, spring Chinook and summer steelhead (See 2.5 Data Analysis).

The primary strength of the discharge-efficiency regression model is that it is based on the principle that fish movment is strongly linked to changes in stream flow. Stream discharge is then used to estimate trap efficiency and subsequently calculate daily abundance. This method is preferred to " pooling" methods that combine results from a series of mark/recapture trials and provide a static efficiency rate over multiple flow levels. Unlike pooling methods, regression models also allow for the use of multi-year datasets to increase sample size and broaden the range of flows over which fish capture can be estimated. The main limitation to using the model can be acquiring data from trials conducted at very high or very low flows, when fish collection can be difficult and adequate sample sizes cannot be achieved. In most cases, the linear relationship established by a particular set of trials can be sufficient for predicting trap efficiency beyond the parameters of the dataset. However, for this study, each regression model was limited to the lowest and highest stream discharge levels in the dataset. In some cases this may have resulted in underestimation, but probably not to a significant degree.

Coho

Although the trend in naturally produced coho abundance appears to be gradually increasing over time, it remains difficult to discern significant patterns from this sparse population. The BY2010 coho emigration estimate of 375 was above the 7-year average of 270 for complete broodyear estimates. Egg-to-emigrant survival of 1.4% was more than twice that of the historical average of 0.5% while emigrant-per-redd production of 47 was also more than double the mean of previous seven years (n = 17; BY2004-BY2009). Encouraging for BY2010 is that egg-to-emigrant survival was comparable to both BY2010 spring Chinook (1.3%) and BY2009 steelhead (1.2%) demonstrating that fish are making it to the spawning grounds and successfully reproducing at a rate similar to the localized stocks in Nason Creek. As expected, BY2011 subyearling collection numbers were relatively high in 2012. This was due to high redd counts in 2011 (n = 89) that resulted from a combination of adult transfers from Icicle Creek and record escapement to the upper basin (n = 685). The estimate for the subyearling proportion of the brood is likely fairly accurate (n = 927), although the calcualtion was made using Chinook subyearling trap-efficiency data.

The practice of using one species (or population) to represent another for the purposes of establishing discharge-to-efficiency correlations was tested in the spring of 2012. We conducted two, paired efficiency trials using hatchery coho and wild Chinook yearlings to determine if there were differences in trap efficiency rates (Table 17). A Chi-square test of the two datasets indicated that results of the trials were not statistically different ($x^2 < 0.001$; $p = 0.99$). Given the similarities in life history and behavior among wild juvenile Chinook and coho, we used the results from these trials to justify using hatchery coho smolt or wild Chinook as surrogates for wild coho smolt. As previously mentioned, low numbers of naturally produced coho yearlings required this practice for population estimates to be made.

Table 17. Paired efficiency trials using hatchery coho smolts and wild spring Chinook smolts in spring, 2012.

Origin/Species/Stage	Age	Date	Trap Position	Marked	Recaptured	Trap Efficiency	Discharge (cfs)
Hatchery Coho Smolt	1+	4/13/2012	Back	40	3	10.0%	381
Wild Spring Chinook Smolt	1+	4/13/2012	Back	53	4	9.4%	381
Hatchery Coho Smolt	1+	4/19/2012	Back	100	13	14.0%	599
Wild Spring Chinook Smolt	1+	4/19/2012	Back	48	7	16.7%	599

Overall increases in abundance of naturally spawned coho continue at slow rate, but are somewhat restricted by YN's increased broodstock collection efforts at Tumwater Dam as part of the phased approach to coho reintroduction in the upper Columbia. With a shift in emphasis to local adaption during future Natural Production Phases (YNFRM 2010), we expect to see a more substantial increase in juvenile coho abundance and subsequent opportunity to accurately assess survival and productivity within this population.

Spring Chinook

Trap operations in 2012 provided good temporal coverage throughout the year, with some minor gaps in the trapping period during late summer. Despite this gap, extremely low flows likely reduced parr movement during this time, limiting the number of fish that were not accounted for. For BY2010 spring Chinook, there were no significant gaps in trapping during emigration. The total estimated abundance of BY2010 parr and smolt is likely a good representation of juvenile Chinook emigration from Nason Creek during summer/fall 2011 and spring 2010. The subyearling estimate of 7,659 was lower than the 8-year average of 9,379, while the yearling estimate of 3,333 was a bit closer to the 8-year average of 3,718. Subyearlings represented 69.7% of the total estimate; yearlings represented 30.3%. This is a somewhat consistent pattern for Nason Creek spring Chinook juveniles and will likely continue with BY2011 juveniles as well. Estimates of egg-to-emigrant survival and productivity (emigrants-per-redd) for BY2010 Chinook were 1.3% and 58, respectively. This was slightly less than the 8-year averages of 1.7% and 84 and appears to be a slight drop in an overall stable trend.

Summer Steelhead

Captures of juvenile steelhead were consistent throughout the year except for the late summer period when trap operations were suspended for a brief period. For BY2009 juveniles, 2012 was the last year of emigration since there were no age-3 fish captured for this brood. The estimate does not include age-0 fish, although they represent a large portion of total steelhead catch each year, because of the uncertainity that these individuals were actively emigrating. The total BY2009 estimate of 9,003 age-1 to age-3 juveniles was similar to the 7-year average of 10,106.

Egg-to-emigrant survival (1.2%) and emigrant per redd production (71) were lower than the 7-year averages of 1.8% and 104.

In terms of timing, downstream movement among the age classes appears to be somewhat consistent across the years with BY2009 juveniles adhering closely to this pattern. Each year, young-of-the-year fry (age-0) emerge in mid-to-late summer and movement is observed at the trap through the fall until the end of trapping on November 30. This segment of the brood represents a substantial percentage of each brood's total downstream numbers. Not long after the trap is re-installed on March 1of the next year, the most significant movement of the brood is of age-1 parr from April through July. Emigration of age-2 and age-3 steelhead also occurs in spring, but may be delayed by up to one year. Age-2 fish represent a small percentage of the total observed brood, with only an occasional age-3 fish. As with Chinook, there is likely some downstream movement occuring during the winter months. Resident or non-migratory rainbow trout/steelhead are also not represented in this estimate and would likely require an alternative method of investigation.

Annual estimates of steelhead emigration from Nason Creek are likely low and do not reflect the movement of fish during the summer and fall trapping periods. While no correlations of flow-to-efficiency were indicated either annually or through multi-year datasets, new methods for pooled estimates generated unacceptably high variances. Unlike spring migrants that are known to actively move downstream, summer/fall emigrants do not exhibit such defined movement patterns. It is unknown whether individulas passing the trap are actively migrating or relocating to different portions of the basin for overwintering and seaward emigration the subsequent spring. Since Upper Columbia steelhead are being managed at the basin level scale, population estimates from the lower Wenatchee rotary trap are essential and would encompass these tributary level fish that are relocating into the upper Wenatchee basin. This estimate methodolgy is consistent with other trap operators (e.g.- WDFW at the Chiwawa smolt trap). Therefore, because we are determining a tributary emigration estimate from Nason Creek, the summer/fall component was not included.

2013 Trap Operations at Nason Creek

Although these annual estimates are likely a good representation of juvenile emigration while the trap is operated, they do not include juvenile emigration that may occur during the winter months (December–February). Additionally, trapping during high spring flows may be adversly affected by low to undetectable trap efficiency. Currently, winter emigration is not well studied in Nason Creek, but limited fish movement during this period has been detected by instream PIT tag antenna arrays located downstream of the trap. For these arrays to be used more effectively, detection efficiencies across a range of stream dischare levels need to be established. Efforts to determine species specific movement and overall emigration patterns during non-trapping seasons are currently underway. In terms of trapping, it may also be possible to begin operations as early as February in any given year, but heavy snow and ice prevent trapping in January and February in most years.

In 2013, we plan to re-locate the Nason Creek smolt trap to a new site approximately 570m downstream. The current location was originally thought to be ideal due to stream channel configuration and easy access through the campground. Since then, data collected from the trap suggests that the stream channel may not be well suited for trapping juvenile fish (low flow =

trap avoidance; high flow = migrating thalweg). Additionally, repeated interference with the trap by summer visitors to the campgrounds has resulted in unacceptable mortality levels of ESA listed species. Following the most recent incidents (August 14 & 18, 2012), NMFS was quickly notified and trapping at Nason Creek was suspended for nearly a month. Although we do not believe the events that led to fish mortalies were malicious, the results were quite serious and potentially jeopardize the future operation of the Nason Creek smolt trap. The proposed USFS site solves both trap efficiency and security issues because: 1) it is a remote location with restricted access, and 2) the proposed location offers a strategic advantage to trapping fish. The combination of stream gradient, channel constriction and bed surface form a natural 'funnel' more suited to trapping juvenile fish. There are many factors to consider when operating a smolt trap for the purposes of generating juvenile population estimates. As we proceed with the relocation of the trap in 2013, we will employ the considerable knowledge gained from past operations at Nason Creek.

5.0 LITERATURE CITED

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APPENDIX A. Daily Stream Discharge and Stream Temperature

Date	Daily Discharge (cfs)	Daily Stream Temp. (°C)
3/1/2012	1.5	166.0
3/2/2012	2.4	157.0
3/3/2012	3.5	166.0
3/4/2012	4.0	205.0
3/5/2012	3.3	229.0
3/6/2012	1.4	195.0
3/7/2012	1.9	202.0
3/8/2012	2.2	190.0
3/9/2012	2.8	185.0
3/10/2012	3.7	192.0
3/11/2012	3.9	203.0
3/12/2012	0.9	204.0
3/13/2012	1.5	191.0
3/14/2012	1.5	179.0
3/15/2012	1.4	180.0
3/16/2012	2.8	187.0
3/17/2012	3.1	181.0
3/18/2012	2.7	171.0
3/19/2012	2.7	163.0
3/20/2012	1.6	165.0
3/21/2012	2.2	158.0
3/22/2012	3.5	153.0
3/23/2012	3.4	148.0
3/24/2012	3.0	145.0
3/25/2012	3.1	144.0
3/26/2012	3.8	145.0
3/27/2012	3.4	152.0
3/28/2012	4.1	181.0
3/29/2012	3.1	201.0
3/30/2012	3.2	267.0
3/31/2012	3.0	256.0
4/1/2012	3.9	226.0
4/2/2012	3.8	211.0
4/3/2012	4.5	210.0
4/4/2012	4.5	211.0
4/5/2012	4.1	205.0
4/6/2012	4.4	200.0
4/7/2012	4.6	195.0
4/8/2012	4.4	196.0
4/9/2012		
4/10/2012	5.3	249.0
4/11/2012	4.7	292.0
4/12/2012	4.9	347.0
4/13/2012	5.0	367.0
4/14/2012	5.0	385.0
4/15/2012	5.5	402.0
4/16/2012	4.7	454.0
4/17/2012	4.5	470.0
4/18/2012	4.9	443.0
4/19/2012	4.5	446.0
4/20/2012	5.3	671.0
4/21/2012	5.3	737.0
4/22/2012	5.7	875.0
4/23/2012	5.0	1400.0
4/24/2012	4.4	1940.0
4/25/2012	4.4	1990.0
4/26/2012	3.9	2080.0
4/27/2012	4.5	1730.0
4/28/2012	5.3	1470.0
4/29/2012	5.6	1410.0
4/30/2012	5.1	1500.0
5/1/2012	4.9	1490.0
5/2/2012	5.1	1250.0
5/3/2012	4.7	1130.0
5/4/2012	5.3	1050.0
5/5/2012	5.3	947.0
5/6/2012	5.7	869.0
5/7/2012	6.3	893.0
5/8/2012	6.6	1080.0
5/9/2012	5.6	1390.0
5/10/2012	5.0	1200.0
5/11/2012	5.4	1080.0
5/12/2012	6.1	1090.0
5/13/2012	6.5	1260.0
5/14/2012	6.2	1650.0
5/15/2012	5.7	1950.0
5/16/2012	5.3	2110.0
5/17/2012	5.4	1920.0
5/18/2012	5.5	1660.0
5/19/2012	5.8	1470.0
5/20/2012	5.6	1410.0
5/21/2012	5.2	1560.0

5/22/2012	5.0	1910.0	7/4/2012	7.8	1070.0
5/23/2012	5.3	1710.0	7/5/2012	8.6	989.0
5/24/2012	5.3	1500.0	7/6/2012	8.9	1030.0
5/25/2012	5.3	1320.0	7/7/2012	9.4	1180.0
5/26/2012	6.0	1230.0	7/8/2012	9.6	1320.0
5/27/2012	6.6	1310.0	7/9/2012	10.0	1420.0
5/28/2012	6.5	1360.0	7/10/2012	10.3	1300.0
5/29/2012	5.8	1330.0	7/11/2012	10.3	1070.0
5/30/2012	6.1	1190.0	7/12/2012	10.9	998.0
5/31/2012	6.6	1400.0	7/13/2012	10.9	957.0
6/1/2012	6.1	1800.0	7/14/2012	10.7	872.0
6/2/2012	5.8	2140.0	7/15/2012	11.6	820.0
6/3/2012	5.5	1840.0	7/16/2012	11.1	708.0
6/4/2012	5.2	1510.0	7/17/2012	11.5	741.0
6/5/2012	5.4	1460.0	7/18/2012	12.7	652.0
6/6/2012	5.4	1290.0	7/19/2012	12.5	557.0
6/7/2012	4.8	1100.0	7/20/2012	11.9	557.0
6/8/2012	5.9	1040.0	7/21/2012	12.0	487.0
6/9/2012	5.8	943.0	7/22/2012	12.5	411.0
6/10/2012	7.1	892.0	7/23/2012	11.3	355.0
6/11/2012	7.4	957.0	7/24/2012	11.8	309.0
6/12/2012	7.3	1210.0	7/25/2012	13.3	294.0
6/13/2012	6.8	1490.0	7/26/2012	13.5	288.0
6/14/2012	6.3	1360.0	7/27/2012	13.9	321.0
6/15/2012	6.8	1200.0	7/28/2012	13.9	264.0
6/16/2012	7.4	1300.0	7/29/2012	13.9	237.0
6/17/2012	7.0	1960.0	7/30/2012	14.6	219.0
6/18/2012	6.2	1870.0	7/31/2012	14.1	203.0
6/19/2012	6.6	1490.0	8/1/2012	14.3	186.0
6/20/2012	7.1	1310.0	8/2/2012	14.9	174.0
6/21/2012	7.3	1390.0	8/3/2012	14.7	164.0
6/22/2012	6.6	1550.0	8/4/2012	15.1	153.0
6/23/2012	6.3	1560.0	8/5/2012	16.1	148.0
6/24/2012	6.4	1370.0	8/6/2012	16.5	141.0
6/25/2012	6.6	1230.0	8/7/2012	16.1	135.0
6/26/2012	6.1	1270.0	8/8/2012	16.8	127.0
6/27/2012	7.2	1150.0	8/9/2012	15.4	120.0
6/28/2012	7.8	1130.0	8/10/2012	15.8	113.0
6/29/2012	8.0	1260.0	8/11/2012	16.3	107.0
6/30/2012	8.3	1380.0	8/12/2012	16.7	102.0
7/1/2012	8.4	1470.0	8/13/2012	16.8	97.3
7/2/2012	7.6	1290.0	8/14/2012	17.1	92.2
7/3/2012	7.8	1180.0	8/15/2012	17.2	90.4

8/16/2012	16.6	86.9	9/28/2012	11.1	40.7
8/17/2012	17.0	83.9	9/29/2012	12.2	40.1
8/18/2012	17.0	81.0	9/30/2012	11.7	39.8
8/19/2012	17.2	78.5	10/1/2012	11.8	39.2
8/20/2012	16.5	75.4	10/2/2012	12.1	38.3
8/21/2012	16.3	73.0	10/3/2012	9.1	38.2
8/22/2012	15.6	71.0	10/4/2012	7.8	38.6
8/23/2012	14.9	69.8	10/5/2012		
8/24/2012	14.1	67.9	10/6/2012	6.8	38.8
8/25/2012	14.0	66.4	10/7/2012	6.9	38.8
8/26/2012	14.4	64.7	10/8/2012	7.3	38.8
8/27/2012	15.4	62.4	10/9/2012	8.2	38.5
8/28/2012	15.0	61.4	10/10/2012		
8/29/2012	14.3	60.7	10/11/2012	8.4	37.6
8/30/2012	13.9	59.7	10/12/2012	8.5	38.0
8/31/2012	14.1	58.3	10/13/2012	9.8	39.3
9/1/2012	13.8	56.6	10/14/2012	10.3	68.3
9/2/2012	14.1	55.8	10/15/2012	10.3	91.6
9/3/2012	14.0	54.6	10/16/2012	9.2	180.0
9/4/2012	14.2	53.7	10/17/2012	7.4	124.0
9/5/2012	14.3	52.8	10/18/2012	8.1	82.1
9/6/2012	14.5	51.6	10/19/2012	8.6	153.0
9/7/2012	13.9	51.1	10/20/2012	7.2	225.0
9/8/2012	13.8	50.1	10/21/2012	5.6	127.0
9/9/2012	14.8	50.5	10/22/2012	5.3	102.0
9/10/2012	13.6	51.1	10/23/2012	5.5	96.5
9/11/2012	11.6	55.6	10/24/2012	5.4	93.0
9/12/2012	11.0	51.1	10/25/2012	5.6	87.1
9/13/2012	10.8	49.4	10/26/2012	5.3	83.8
9/14/2012	11.3	48.5	10/27/2012	4.7	95.2
9/15/2012	12.3	47.1	10/28/2012	5.4	244.0
9/16/2012	12.8	46.1	10/29/2012	5.9	679.0
9/17/2012	12.7	45.5	10/30/2012	6.1	687.0
9/18/2012	12.6	45.0	10/31/2012	6.4	908.0
9/19/2012	12.7	43.7	11/1/2012	6.6	645.0
9/20/2012	12.3	43.1	11/2/2012	6.7	477.0
9/21/2012	12.0	43.0	11/3/2012	6.9	406.0
9/22/2012	12.0	42.3	11/4/2012	7.3	486.0
9/23/2012	11.4	42.9	11/5/2012	7.7	538.0
9/24/2012	12.0	42.9	11/6/2012	6.0	419.0
9/25/2012	12.7	41.5	11/7/2012	5.9	398.0
9/26/2012	12.0	41.1	11/8/2012	3.9	328.0
9/27/2012	11.8	40.9	11/9/2012	3.5	285.0

11/10/2012	3.2	247.0
11/11/2012	2.2	220.0
11/12/2012	1.1	219.0
11/13/2012	2.6	205.0
11/14/2012	3.4	223.0
11/15/2012	3.3	216.0
11/16/2012	3.5	192.0
11/17/2012	3.4	183.0
11/18/2012	3.4	179.0
11/19/2012	3.0	229.0
11/20/2012	2.8	353.0
11/21/2012	3.2	294.0
11/22/2012	3.1	245.0
11/23/2012		
11/24/2012		
11/25/2012	2.1	304.0
11/26/2012	1.3	259.0
11/27/2012	1.9	238.0
11/28/2012	1.9	226.0
11/29/2012	2.2	216.0
11/30/2012	2.8	207.0

APPENDIX B. Daily Trap Operation

Date	Trap Status	Date	Trap Status
03/01/12	operating	04/10/12	operating
03/02/12	operating	04/11/12	operating
03/03/12	operating	04/12/12	operating
03/04/12	operating	04/13/12	operating
03/05/12	operating	04/14/12	operating
03/06/12	operating	04/15/12	operating
03/07/12	operating	04/16/12	operating
03/08/12	operating	04/17/12	operating
03/09/12	operating	04/18/12	operating
03/10/12	operating	04/19/12	operating
03/11/12	operating	04/20/12	operating
03/12/12	interrupted	04/21/12	operating
03/13/12	pulled	04/22/12	operating
03/14/12	pulled	04/23/12	interrupted
03/15/12	operating	04/24/12	operating
03/16/12	operating	04/25/12	operating
03/17/12	operating	04/26/12	operating
03/18/12	operating	04/27/12	operating
03/19/12	operating	04/28/12	operating
03/20/12	operating	04/29/12	operating
03/21/12	operating	04/30/12	operating
03/22/12	operating	05/01/12	operating
03/23/12	operating	05/02/12	pulled
03/24/12	operating	05/03/12	operating
03/25/12	operating	05/04/12	operating
03/26/12	operating	05/05/12	operating
03/27/12	operating	05/06/12	operating
03/28/12	operating	05/07/12	operating
03/29/12	operating	05/08/12	operating
03/30/12	operating	05/09/12	interrupted
03/31/12	operating	05/10/12	operating
04/01/12	operating	05/11/12	operating
04/02/12	operating	05/12/12	operating
04/03/12	operating	05/13/12	operating
04/04/12	operating	05/14/12	operating
04/05/12	operating	05/15/12	operating
04/06/12	operating	05/16/12	interrupted
04/07/12	operating	05/17/12	operating
04/08/12	operating	05/18/12	operating
04/09/12	operating	05/19/12	operating
		05/20/12	operating

05/21/12	operating	07/02/12	operating
05/22/12	operating	07/03/12	pulled
05/23/12	operating	07/04/12	pulled
05/24/12	operating	07/05/12	operating
05/25/12	operating	07/06/12	operating
05/26/12	operating	07/07/12	operating
05/27/12	operating	07/08/12	pulled
05/28/12	operating	07/09/12	operating
05/29/12	operating	07/10/12	operating
05/30/12	operating	07/11/12	pulled
05/31/12	operating	07/12/12	operating
06/01/12	operating	07/13/12	operating
06/02/12	operating	07/14/12	interrupted
06/03/12	inetrrupted	07/15/12	operating
06/04/12	pulled	07/16/12	operating
06/05/12	operating	07/17/12	operating
06/06/12	operating	07/18/12	operating
06/07/12	operating	07/19/12	operating
06/08/12	operating	07/20/12	operating
06/09/12	operating	07/21/12	operating
06/10/12	operating	07/22/12	operating
06/11/12	operating	07/23/12	operating
06/12/12	operating	07/24/12	operating
06/13/12	operating	07/25/12	operating
06/14/12	operating	07/26/12	operating
06/15/12	operating	07/27/12	operating
06/16/12	operating	07/28/12	operating
06/17/12	interrupted	07/29/12	operating
06/18/12	pulled	07/30/12	operating
06/19/12	operating	07/31/12	operating
06/20/12	operating	08/01/12	operating
06/21/12	operating	08/02/12	operating
06/22/12	operating	08/03/12	operating
06/23/12	operating	08/04/12	operating
06/24/12	operating	08/05/12	operating
06/25/12	operating	08/06/12	operating
06/26/12	operating	08/07/12	operating
06/27/12	operating	08/08/12	operating
06/28/12	interrupted	08/09/12	operating
06/29/12	operating	08/10/12	operating
06/30/12	operating	08/11/12	operating
07/01/12	operating	08/12/12	interrupted

08/13/12	operating	09/24/12	operating
08/14/12	interrupted	09/25/12	operating
08/15/12	pulled	09/26/12	operating
08/16/12	operating	09/27/12	operating
08/17/12	operating	09/28/12	operating
08/18/12	interrupted	09/29/12	operating
08/19/12	pulled	09/30/12	operating
08/20/12	pulled	10/01/12	operating
08/21/12	pulled	10/02/12	operating
08/22/12	pulled	10/03/12	operating
08/23/12	pulled	10/04/12	operating
08/24/12	pulled	10/05/12	operating
08/25/12	pulled	10/06/12	operating
08/26/12	pulled	10/07/12	operating
08/27/12	pulled	10/08/12	operating
08/28/12	pulled	10/09/12	operating
08/29/12	pulled	10/10/12	operating
08/30/12	pulled	10/11/12	operating
08/31/12	pulled	10/12/12	operating
09/01/12	pulled	10/13/12	operating
09/02/12	pulled	10/14/12	operating
09/03/12	pulled	10/15/12	interrupted
09/04/12	pulled	10/16/12	pulled
09/05/12	operating	10/17/12	operating
09/06/12	operating	10/18/12	operating
09/07/12	pulled	10/19/12	operating
09/08/12	pulled	10/20/12	operating
09/09/12	pulled	10/21/12	operating
09/10/12	pulled	10/22/12	operating
09/11/12	pulled	10/23/12	operating
09/12/12	pulled	10/24/12	operating
09/13/12	pulled	10/25/12	operating
09/14/12	pulled	10/26/12	operating
09/15/12	pulled	10/27/12	operating
09/16/12	pulled	10/28/12	pulled
09/17/12	pulled	10/29/12	operating
09/18/12	pulled	10/30/12	operating
09/19/12	operating	10/31/12	operating
09/20/12	operating	11/01/12	operating
09/21/12	operating	11/02/12	operating
09/22/12	operating	11/03/12	operating
09/23/12	operating	11/04/12	operating

11/05/12	operating	11/19/12	operating
11/06/12	operating	11/20/12	operating
11/07/12	operating	11/21/12	pulled
11/08/12	operating	11/22/12	pulled
11/09/12	operating	11/23/12	operating
11/10/12	operating	11/24/12	operating
11/11/12	operating	11/25/12	operating
11/12/12	operating	11/26/12	operating
11/13/12	operating	11/27/12	operating
11/14/12	operating	11/28/12	operating
11/15/12	operating	11/29/12	operating
11/16/12	operating	11/30/12	operating
11/17/12	operating	12/01/12	operating
11/18/12	operating		

APPENDIX C. Regression Models

Model: Chinook Yearlings (Spring ’06-’12) Back Position, (r^2 = 0.28; p = 0.040)

Origin/Species/Stage	Age	Date	Trap Position	Marked n > 50	Recaptured n > 0	Trap Efficiency (R+1) / M	ASIN Transform	Discharge cfs Updated 2013
Wild Chinook Smolt	1+	4/3/2006	Back	81	10	0.136	0.377	188
Wild Chinook Smolt	1+	4/24/2006	Back	59	3	0.068	0.263	368
Wild Chinook Smolt	1+	3/17/2006	Back	64	7	0.125	0.361	936
Wild Chinook Smolt	1+	3/20/2006	Back	91	13	0.154	0.403	1,230
Wild Chinook Smolt	1+	3/23/2007	Back	59	7	0.136	0.377	876
Wild Chinook Smolt	1+	4/10/2007	Back	53	4	0.094	0.312	966
Wild Chinook Smolt	1+	4/14/2008	Back	195	40	0.210	0.476	327
Wild Chinook Smolt	1+	4/17/2008	Back	72	13	0.194	0.457	274
Wild Chinook Smolt	1+	4/24/2008	Back	57	8	0.158	0.409	210
Wild Chinook Smolt	1+	4/28/2008	Back	127	19	0.157	0.408	271
Wild Chinook Smolt	1+	5/1/2008	Back	102	16	0.167	0.421	315
Wild Chinook Smolt	1+	4/18/2010	Back	67	2	0.045	0.213	613
Wild Chinook Smolt	1+	4/13/2012	Back	53	4	0.094	0.312	383
Wild Chinook Smolt	1+	4/16/2012	Back	53	7	0.151	0.399	476
Wild Chinook Smolt	1+	4/23/2012	Back	58	1	0.034	0.187	1,835
Total				**1,191**	**154**			

Model: Chinook Subyearling (Fall ’06-’12) Back Position, (r^2 = 0.46; p = 0.007)

Origin/Species/Stage	Age	Date	Trap Position	Marked n > 100	Recaptured n > 0	Trap Efficiency (R+1) / M	ASIN Transform	Discharge cfs Updated 2013
Wild Chk Subyearling	0+	10/26/2006	Back	183	50	0.279	0.556	51
Wild Chk Subyearling	0+	10/30/2006	Back	168	52	0.315	0.596	63
Wild Chk Subyearling	0+	11/19/2007	Back	115	26	0.235	0.506	188
Wild Chk Subyearling	0+	11/5/2009	Back	138	19	0.145	0.391	159
Wild Chk Subyearling	0+	11/8/2009	Back	120	13	0.117	0.349	250
Wild Chk Subyearling	0+	11/17/2009	Back	138	12	0.094	0.312	226
Wild Chk Subyearling	0+	11/4/2010	Back	254	42	0.169	0.424	215
Wild Chk Subyearling	0+	11/7/2010	Back	287	49	0.174	0.431	241
Wild Chk Subyearling	0+	11/10/2010	Back	168	32	0.196	0.459	159
Wild Chk Subyearling	0+	11/18/2010	Back	185	35	0.195	0.457	274
Wild Chk Subyearling	0+	11/3/2012	Back	201	25	0.129	0.368	406
Wild Chk Subyearling	0+	11/7/2012	Back	233	27	0.120	0.354	398
Wild Chk Subyearling	0+	11/11/2012	Back	328	87	0.268	0.544	220
Wild Chk Subyearling	0+	11/15/2012	Back	195	34	0.179	0.437	216
Total				**2,713**	**503**			

Model: Chinook Subyearling (Fall '06-'11) Forward Position, (r^2 = 0.31; p = 0.019)

Origin/Species/Stage	Age	Date	Trap Position	Marked n > 75	Recaptured n > 0	Trap Efficiency (R+1) / M	ASIN Transform	Discharge cfs Updated 2013
Wild Chk Subyearling	0+	7/17/2006	Forward	138	15	0.116	0.347	140
Wild Chk Subyearling	0+	7/31/2006	Forward	99	7	0.081	0.288	79
Wild Chk Subyearling	0+	8/12/2008	Forward	103	2	0.029	0.172	88
Wild Chk Subyearling	0+	8/22/2008	Forward	75	11	0.160	0.412	101
Wild Chk Subyearling	0+	10/9/2008	Forward	110	22	0.209	0.475	80
Wild Chk Subyearling	0+	10/30/2008	Forward	84	15	0.190	0.452	64
Wild Chk Subyearling	0+	11/6/2008	Forward	78	8	0.115	0.347	91
Wild Chk Subyearling	0+	7/14/2009	Forward	86	2	0.035	0.188	193
Wild Chk Subyearling	0+	7/15/2009	Forward	105	4	0.048	0.220	179
Wild Chk Subyearling	0+	7/17/2009	Forward	122	8	0.074	0.275	157
Wild Chk Subyearling	0+	7/20/2009	Forward	89	2	0.034	0.185	135
Wild Chk Subyearling	0+	8/11/2010	Forward	113	8	0.080	0.286	79
Wild Chk Subyearling	0+	10/12/2010	Forward	216	42	0.199	0.462	126
Wild Chk Subyearling	0+	10/15/2010	Forward	192	37	0.198	0.461	95
Wild Chk Subyearling	0+	10/18/2010	Forward	193	36	0.192	0.453	81
Wild Chk Subyearling	0+	10/22/2010	Forward	92	18	0.207	0.472	69
Wild Chk Subyearling	0+	8/19/2011	Forward	106	5	0.057	0.240	115
Total				**2,001**	**242**			

Model: Summer Steelhead (Spring '06-'11) Back Position, (r^2 = 0.37; p = 0.047)

Origin/Species/Stage	Age	Date	Trap Position	Marked n > 75	Recaptured n > 0	Trap Efficiency (R+1) / M	ASIN Transform	Discharge cfs Updated 2013
Steelhead Parr/Smolt	1+	4/27/2006	Back	155	12	0.084	0.294	450
Steelhead Parr/Smolt	1+	6/9/2007	Back	151	17	0.119	0.353	826
Steelhead Parr/Smolt	1+	4/15/2008	Back	149	46	0.315	0.596	327
Steelhead Parr/Smolt	1+	5/1/2008	Back	176	29	0.170	0.426	339
Steelhead Parr/Smolt	1+	6/9/2008	Back	142	20	0.148	0.395	947
Steelhead Parr/Smolt	1+	6/12/2008	Back	83	10	0.133	0.373	837
Steelhead Parr/Smolt	1+	6/16/2008	Back	81	8	0.11	0.340	1,080
Steelhead Parr/Smolt	1+	4/20/2010	Back	121	11	0.099	0.320	430
Steelhead Parr/Smolt	1+	4/22/2010	Back	121	10	0.091	0.306	919
Steelhead Parr/Smolt	1+	6/20/2010	Back	128	11	0.094	0.311	795
Steelhead Parr/Smolt	1+	5/22/2011	Back	84	3	0.048	0.220	1,550
Total				**1,391**	**177**			

APPENDIX D. NMFS Consultation Memo for Steelhead Fry Mortality

MATT COLLINS ● MID-COLUMBIA COHO RESTORATION PROJECT

7051 Hwy 97, Peshastin, WA 98847 ● 509.548.9413 x111 ● FAX: 509.548.2118

September 20, 2012

Mr. Craig Busack

Senior Fish Biologist

Hatcheries and Inland Fisheries Branch

Salmon Management Division

NMFS Northwest regional Office

1201 NE Lloyd Blvd., Suite 1100

Portland, OR 97202

RE: Steelhead Fry Mortalities at Nason Creek Smolt Trap

Dear Mr. Busack,

This letter summarizes the events that occurred on August 14 & 18, 2012 that resulted in the mortalities of steelhead fry at the Nason Creek smolt trap. This letter will be distributed accordingly to USFS personnel to inform them of the incident and illustrate the seriousness of interrupting trap operations and the potential harm caused to several federally protected species if this occurs.

On the morning of August 14, 2012 Yakama Nation (YN) personnel arrived.at the Nason Creek smolt trap located adjacent to USFS campgrounds to discover that a medium sized log had become jammed in the trap which prevented fish from properly exiting into the holding box. As a result, a total of 51 dead summer steelhead fry were removed from the cone. This single incident caused YN's year-to-date mortality to increase to 8.0%, which exceeds the maximum permitted "lethal take" of 2% in the Section 10 permit issued by the National Marine Fisheries Service (NMFS). Trap operations were suspended immediately and NMFS was notified. Following consultation with NMFS, YN was allowed to resume trapping. On August 18, YN personnel again discovered that woody debris had become jammed in the trap, resulting in the deaths of another 18 steelhead fry. Trap operations were again suspended and NMFS was notified. Following consultation and a sustained period of inactivity, trap operations were resumed on September 19.

Typically, debris is an issue at the trap during periods of high stream discharge or when there is a sudden increase in flows. During the month of August, flows were already low and steadily decreasing. In both cases, it was apparent that campers from nearby USFS campsites had either thrown debris into the river just upstream from the trap, or thrown debris directly into the trap. This caused the trap's cone to become jammed and subsequently resulted in the loss of 69 juvenile steelhead; a species listed as *threatened* under the Endangered Species Act (ESA) of 1973.

Upper Columbia River steelhead (*Oncorhynchus mykiss*) were originally listed as endangered in August 1997, and have since been re-classified as threatened. Reversing the trend of declining steelhead populations in the Columbia River and its tributaries is a goal shared by numerous fisheries management agencies of the Pacific Northwest. YN is just one of these agencies dedicated to the collaborative effort to gather scientific information used for the recovery of ESA listed salmon and steelhead.

The main purpose of the Nason Creek smolt trap is to collect data regarding endangered and threatened juvenile salmon and steelhead and generate population estimates that inform overall restoration decisions in the Wenatchee River and tributaries. It is an important tool that must remain in place and unobstructed if it is to be used effectively.

Since 2004, YN has operated the Nason Creek smolt trap at its current location without significant problems. Although we do not believe these most recent incidents to be malicious, the results were quite serious and jeopardize the future operation of the Nason Creek smolt trap. Precautions have been taken in the past to minimize the effects people could have by throwing debris into the path of the trap (i.e., automated alarms, debris guards and signs). Clearly, more effective measures must be taken to prevent further damage to fish.

Generally, the Nason Creek campgrounds experience increased annual visitation between Memorial Day and Labor Day, with peak visitation during mid-summer. For the remainder of the year, the campgrounds are seldom visited or are closed altogether. We propose that the following steps, practiced as a whole, will greatly reduce or eliminate the possibility of damage caused to ESA listed species:

Options	Action	Purpose	Timeline
Communicate & Educate	Enlist the help of camp hosts to communicate with visitors the purpose and requirements of the trap. Create educational flyers to be posted/distributed at campsites.	To educate the public and garner support for fisheries research.	Spring & Summer, 2013
Limit Trap Operation	Trap operations will be limited to nights only (8pm to 8am) so that the trap is not exposed to potential damage during the day.	To reduce the opportunity for fish damage by 50%.	Memorial Day through Labor Day, 2013
Mechanical Modification	Modify the current debris guard by adding weir-type pickets along front edge, extending 12" below surface.	To reduce the range of debris size/type that can affect the trap and/or result in fish mortality.	Immediately

Communications with USFS Personnel – Prior to each season, YN will notify the USFS District Biologist and Recreation Coordinator that trap is being installed. In the past, we have informally educated campground hosts about trapping; however, a more formal meeting can be suggested that includes the District Biologist and Recreation Coordinator. The purpose of this would be to discuss the importance of educating visitors to the campground about the trap and its requirements.

Trap Operations – Currently, YN operates the smolt trap continuously 24hrs/day, 7days/week from March 1 to November 30 each year. During spring snowmelt, operations are limited to nights only to reduce damage to fish and the trap caused by large woody debris. Similarly, YN will limit operations to nighttime only to reduce the potential for damage presented by high numbers of people. By reducing exposure by 50%, a significant risk should be mitigated for while still maximizing data collection since juvenile migratory behavior occurs primarily during the nighttime hours.

Mechanical Modification – By adding a 12 inch deep weir-type grate to the underside of the current debris guard, we may be able to significantly reduce the size and type of debris that enters the trap. The debris guard in its current state is designed primarily to address larger logs/trees and can allow small to medium-sized debris to pass underneath. The grate or "pickets" will be properly spaced as to not affect passage of fish into the trap's rotary cone and live box (nor will cause impingement of larger fish).

We appreciate the support and consultation NMFS has provided to our efforts on this matter. We look forward to the remainder of the data collection season and will maintain contact with you regarding the status of operations during this time.

Sincerely,

Matt Collins – Fisheries Biologist

Cc: Keely Murdoch – Yakama Nation Fisheries resource Management

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APPENDIX B: SPAWNING GROUND SURVEY RECORDS FOR THE WENATCHEE AND METHOW RIVERS, 2012

Stream	Reach	Date	New Redds	Live Fish	Dead Fish
Beaver	1	**11/2/2012**	**0**	**0**	**0**
Chumstick	1	**10/8/2012**	**0**	**0**	**0**
Icicle	1	10/3/12	0	28	2
		10/10/12	9	66	5
		10/17/12	17	100	5
		10/24/12	40	110	9
		11/4/12	30	137	9
		11/7/12	33	85	10
		11/14/12	15	45	18
		11/21/12	7	17	1
		11/28/12	1	3	6
		12/6/12	2	12	0
		Total	**154**	**603**	**65**
Icicle	2	10/1/12	1	20	0
		10/8/12	1	33	1
		10/15/12	26	104	4
		10/22/12	32	150	2
		10/29/12	0	18	1
		11/5/12	4	38	0
		11/12/12	3	4	2
		11/19/12	2	24	0
		11/26/12	0	2	0
		12/11/12	0	6	1
		Total	**69**	**399**	**11**
Mission/Brender	1	10/3/12	0	0	0
		10/10/12	1	0	0
		10/17/12	1	7	0
		10/24/12	2	12	1
		10/31/12	2	8	0
		11/7/12	5	9	1
		11/14/12	1	1	1
		11/28/12	0	0	1
		12/5/12	0	0	0
		Total	**12**	**37**	**4**
Nason	1	10/4/12	0	0	0
		10/11/12	3	3	0

		10/18/12	3	10	0
		10/25/12	4	9	0
		11/1/12	0	0	0
		11/10/12	0	1	0
		11/15/12	0	0	0
		11/23/12	0	0	0
		Total	**10**	**23**	**0**
Nason	2	10/4/12	0	0	0
		10/11/12	1	0	0
		10/18/12	3	4	0
		10/25/12	2	6	0
		11/1/12	0	0	0
		11/10/12	0	1	0
		Total	**6**	**11**	**0**
Nason	3	10/4/12	0	0	0
		10/11/12	0	0	0
		10/17/12	0	6	0
		10/25/12	4	0	0
		11/8/12	0	0	0
		11/13/12	0	0	0
		Total	**4**	**6**	**0**
Nason	4	10/1/12	0	0	0
		10/8/12	0	0	0
		10/15/12	0	0	0
		10/22/12	1	1	0
		10/29/12	0	0	0
		11/5/12	0	0	0
		Total	**1**	**1**	**0**
Peshastin	1	10/4/12	1	1	0
		10/11/12	0	0	0
		10/18/12	3	6	3
		10/25/12	4	5	0
		11/1/12	0	0	0
		11/10/12	0	2	0
		11/16/12	0	1	0
		11/29/12	0	0	0
		Total	**8**	**15**	**3**
Peshastin	2&3	10/5/12	0	0	0

		10/11/12	2	1	2
		10/19/12	1	3	0
		10/25/12	4	4	0
		10/26/12			
		11/2/12			
		11/15/12	1	0	1
		11/29/12	0	0	0
		Total	**16**	**23**	**6**
Wenatchee	1	10/2/12	0	3	1
		10/9/12	1	22	3
		10/16/12	0	2	1
		10/23/12	3	3	0
		10/30/12	0	0	0
		11/6/12	2	10	2
		11/13/12	4	5	1
		11/20/12	0	1	0
		11/27/12	0	1	1
		12/10/12	0	0	0
		Total	**10**	**47**	**9**
Wenatchee	2	10/6/12	0	13	1
		10/13/12	0	3	3
		10/20/12	0	4	1
		10/27/12	1	2	2
		11/3/12	0	0	0
		11/8/12	3	0	0
		11/18/12	0	0	1
		11/24/12	0	0	2
		11/29/12	0	0	3
		12/5/12	0	0	1
		12/11/12	0	0	0
		Total	**4**	**22**	**14**
Wenatchee	3	10/7/12	0	24	1
		10/14/12	1	14	2
		10/21/12	0	0	2
		10/28/12	0	2	6
		11/4/12	0	0	0
		11/11/12	0	0	7
		11/18/11	0	0	7

Appendix B:
Spawning Ground Survey Records for the Wenatchee and Methow Rivers

		11/25/12	0	0	0
		12/5/12	0	0	0
		Total	**1**	**41**	**28**
Wenatchee	4	10/3/12	0	87	0
		10/10/12	5	164	0
		10/17/12	7	41	3
		10/24/12	26	32	1
		11/3/12	121	135	4
		11/8/12	117	20	1
		11/14/12	8	21	4
		11/21/12	2	3	1
		11/28/12	0	0	1
		12/6/12	0	1	0
		Total	**286**	**504**	**15**
Wenatchee	5	**N/A**	**0**	**0**	**0**
Wenatchee	6	10/5/12	0	19	0
		10/19/12	1	4	0
		11/2/12	0	0	0
		11/9/12	0	1	1
		11/30/12	0	0	0
		Total	**1**	**24**	**1**
Wenatchee	7	10/12/12	0	2	0
		10/26/12	0	9	1
		11/16/12	0	0	0
		Total	**0**	**11**	**1**

Stream	Reach and Description	Surveyors	Date	New Redds	Live Fish	Dead Fish
Methow	1 - Mouth to Steel Bridge	JH AC	10/25/12	0	0	0
		JH AC	11/1/12	2	4	0
		JH AC	11/8/12	1	0	0
		JH AC	11/15/12	2	1	1
		JH AC	11/29/12	0	0	0
		AC JH	12/6/12	0	0	1
		JH AC	12/13/12	0	0	0
		JH AC	12/19/12	0	0	0
	Methow 1 Total			**5**	**5**	**2**
	2 - Steel Bridge to Lower Burma Bridge	JH AC	10/25/12	0	0	0
		JH AC	11/1/12	0	0	0
		JH AC	11/8/12	0	0	0
		JH BM	11/15/12	2	3	1
		JH AC	11/29/12	0	0	0
		JH AC	12/6/12	0	0	1
		JH AC	12/13/12	0	0	0
		JH AC	12/19/12	0	0	0
	Methow 2 Total			**2**	**3**	**2**
	3 - Lower Burma Bridge to Upper Burma Bridge	KM BM JAH BM	10/10/12	3	3	0
		JH AC	10/24/12	2	3	0
		JH AC	10/31/12	1	0	0
		JH AC	11/7/12	5	4	0
		JH AC	11/14/12	1	0	0
		JH AC	11/28/12	0	0	1
		JH BM	12/5/12	0	0	0
		JH AC	12/12/12	0	0	0
		JH AC	12/19/12	0	0	0
	Methow 3 Total			**12**	**10**	**1**
	4 - Upper Burma Bridge to Lower Gold Creek Bridge	JH JAH	10/8/12	0	20	0
		KM TS AC JH BM	10/18/12	0	15	0
		KM JAH BM	10/24/12	2	0	0
		RA TF JAH BM	10/31/12	1	2	0
		RA KM	11/2/12	0	0	1
		RA TF JAH BM	11/7/12	2	1	1
		TS TF CH JAH AC	11/14/12	0	0	0
		JH AC	11/28/12	2	1	3
		TF JH CH	12/5/12	0	0	0
		TF AC JH	12/12/122	0	0	0
	Methow 4 Total			**7**	**39**	**5**
	5 - Lower Gold Creek Bridge to Carlton	JH JAH	10/8/12	0	20	0
		KM TS JH	10/19/12	2	50	0

		AC BM				
		KM TS JH AC BM	10/24/12	3	0	0
		RA TF JAH BM	10/31/12	1	0	0
		JAH BM TF	11/7/12	2	2	0
		JAH BM TF	11/14/12	0	0	0
		JAH BM TF	11/28/12	0	0	3
		TF AC JH	12/5/12	2	0	0
		TF JH CH	12/12/12	0	1	0
	Methow 5 Total			**10**	**73**	**3**
	6 - Carlton to Holterman's Hole	JH JAH	10/9/12	0	20	0
		JH JAH BM CH	10/16/12	1	2	0
		JH JAH BM AC	10/23/12	1	2	0
		KM CH BM JAH	10/30/12	9	8	0
		JH AC BM	11/6/12	12	8	2
		KM BF AW JAH	11/13/12	4	7	0
		BF CH BM JH	11/27/12	0	0	0
		TF BM AC JH	12/4/12	0	0	5
		JH TF CH AC	12/11/12	0	0	2
	Methow 6 Total			**27**	**47**	**9**
	7 - Holterman's Hole to MVID dam	JH JAH GM TF	10/11/12	0	10	0
		TF BM JH JAH	10/15/12	0	11	1
		CH JH TS TF	10/22/12	0	0	1
		JH BM CH	10/25/12	2	0	2
		CH TS	10/29/12	0	0	0
		CH JH	11/5/12	7	10	0
		CH BF BM	11/8/12	2	1	1
		CH TS AC JH	11/12/12	0	0	1
		CH RA AW	11/15/12	2	0	0
		TS JH	11/19/12	0	0	0
		CH BM JAH JH	11/26/12	0	0	1
		JH AC BM TF	12/3/12	0	0	1
		BF BM	12/6/12	0	0	0
		TF JH AC TS	12/10/12	0	0	0
		JH AC	12/18/12	0	0	0
	Methow 7 Total			**13**	**32**	**8**
	8 - MVID dam to Red barn	JH JAH	10/11/12	0	10	0

		BM TF				
		TF BM JAH JH	10/15/12	0	0	1
		CH JH TS TF	10/22/12	2	1	0
		CH TS	10/29/12	0	4	1
		JH CH	11/5/12	3	0	0
		BF BM CH	11/8/12	0	0	1
		JH AC TS CH	11/12/12	0	0	4
		RA CH	11/15/12	0	6	4
		TS JH	11/19/12	0	0	2
		CH BM JAH JH	11/26/12	0	0	0
		JH AC TF BM	12/3/12	1	0	2
		BF BM	12/6/12	0	0	2
		TF JH AC TS	12/10/12	0	0	1
		JH AC	12/18/12	0	0	0
	Methow 8 Total			**6**	**21**	**18**
	9 - Red barn to Wolf Creek	CH TF	10/18/12	0	0	0
		CH TF	10/24/12	4	1	0
		CH TS	10/31/12	0	0	0
		JAH BM	11/12/12	0	0	0
		JAH BM	11/19/12	0	0	1
		BF CH	11/28/12	0	0	0
		CH TS	12/3/12	0	0	0
	Methow 9 Total			**4**	**1**	**1**
	10 - Wolf Creek to Rip Rap	CH TF	10/18/12	0	0	0
		CH TF	10/24/12	0	0	0
		CH TS	10/31/12	0	0	0
		JAH BM	11/12/12	0	0	0
		JAH BM	11/19/12	0	0	0
		BF CH	11/28/12	0	0	0
		CH TS	12/3/12	0	0	0
	Methow 10 Total			**0**	**0**	**0**
	11 - Rip Rap to Weeman Bridge	CH TF	10/18/12	0	0	0
		CH TF	10/24/12	0	0	0
		CH TS	10/31/12	2	0	0
		JAH BM	11/12/12	1	0	0
		JAH BM	11/19/12	0	0	0
		BF CH	11/28/12	0	0	0
		CH TS	12/3/12	0	0	0
	Methow 11 Total			**3**	**0**	**0**
Winthrop NFH Spring Creek	Mouth to Winthrop NFH Irrigation Diversion	KM BF BM	10/15/12	9	7	0
		KM BF BM	10/22/12	8	6	1
		TF TS	10/25/12	4	2	0
		BM BF	10/31/12	10	9	0
		JH BM	11/1/12	2	0	3

		BF	11/6/12	3	2	1
		TF TS	11/8/12	3	1	2
		KM BF AW	11/12/12	9	0	3
		TS JAH	11/20/12	0	5	3
		KM BF	11/26/12	4	3	1
		BF	12/5/12	1	1	2
		JAH BF	12/10/12	1	0	0
		JH TS	12/17/12	0	0	0
		KM BF	12/21/12	0	0	0
	Winthrop Total			**54**	**36**	**16**
WDFW Methow FH Outfall	Mouth to Hatchery Adult Weir	KM BF BM	10/15/12	0	0	0
		KM BF BM	10/22/12	1	0	0
		TF TS	10/25/12	1	0	0
		BM BF	10/31/12	11	3	0
		JH BM	11/1/12	2	1	0
		BF	11/6/12	3	7	0
		TF TS	11/8/12	1	2	0
		KM BF AW	11/12/12	1	0	0
		KM	11/17/12	1	1	0
		TS JAH	11/20/12	1	6	0
		KM BF	11/26/12	0	0	0
		BF	11/30/12	0	0	0
		BF	12/3/12	0	1	0
		JAH BF	12/10/12	0	0	0
		JH TS	12/17/12	0	0	0
		KM BF	12/21/12	0	0	0
	WDFW Total			**22**	**21**	**0**
Twisp	1 - Mouth to Lower Poorman Bridge	CH TS TF	10/23/12	1	0	0
		AC TF	10/26/12	1	0	0
		JH TS	10/30/12	2	6	1
		TF AC	11/2/12	0	0	1
		CH TS	11/6/12	0	0	0
		TF AC	11/9/12	1	0	1
		CH TS	11/13/12	0	0	0
		KM JAH	11/27/12	1	0	0
		JH TF	12/6/12	0	0	0
	2 - Lower Poorman Bridge to Upper Poorman Bridge	CH TS TF	10/23/12	2	0	0
		AC TF	10/26/12	4	3	0
		JH TS	10/30/12	0	2	0
		TF AC	11/2/12	0	0	3
		CH TS	11/6/12	0	0	0
		TF AC	11/9/12	0	0	0
		CH TS	11/13/12	1	0	0
		KM JAH	11/27/12	5	0	0
		JH TF	12/6/12	0	0	0
	3 – Upper Poorman Bridge to Twisp River Weir	CH TS TF	10/23/12	1	0	0
		JH TS	10/30/12	0	0	0

		TF AC	11/2/12	0	0	1
		CH TS	11/6/12	3	7	0
		TF AC	11/9/12	5	0	0
		CH TS	11/13/12	0	0	0
		KM JAH	11/27/12	2	0	1
		JH TF	12/6/12	0	0	0
	4 – Twisp River Weir to Newby Creek Bridge	AC TF	12/1/12	0	0	0
		TF JAH	12/9/12	0	0	0
	5 – Newby Creek Bridge to Buttermilk Creek Bridge	AC TF	12/1/12	4	0	0
		TF JAH	12/9/12	0	0	0
	6 – Buttermilk Creek Bridge to War Creek Bridge	TS TF	11/15/12	0	0	0
		TF JAH	12/9/12	0	0	0
	Twisp Total			**33**	**18**	**8**
Hancock	Mouth to Source	RA MA	10/21/12	0	0	0
		KM BF	11/8/12	0	0	0
		KM BF	11/18/12	0	0	0
	Hancock Total			**0**	**0**	**0**
Beaver	1 - Mouth to Hwy. 153 bridge	KM TF	11/1/12	0	0	0
		KM TF	11/15/12	0	0	0
	2 – Hwy. 153 bridge to Hwy. 20	KM TF	11/1/12	0	0	0
		KM TF	11/15/12	0	0	0
	Beaver Total			**0**	**0**	**0**
Gold	RK 1.7 to RK 2.1	AC JH	10/24/12	2	1	0
		TS TF	11/8/12	0	0	0
		KM BF	11/19/12	0	0	0
		AC TF	12/1/12	0	0	0
	Gold Total			**2**	**1**	**0**
Suspension	Mouth to 250 M upstream	TS TF	11/18/12	0	0	0
	Suspension Total			**0**	**0**	**0**
Chewuch	1 - Mouth to Fulton Dam	TF AC	10/27/12	0	0	0
		TF AC	11/3/12	0	0	0
		TF BM	11/16/12	0	0	0
	2 - Fulton Dam to Co. Hwy 1613	TF AC	10/27/12	0	0	0
		TF AC	11/3/12	0	0	0
		TF BM	11/16/12	0	0	0
	Co. Hwy 1613 to Methow State Wildlife Area	TF AC	10/27/12	0	0	0
		TF AC	11/3/12	0	0	0
		TF BM	11/16/12	0	0	0
	Chewuch Total			**0**	**0**	**0**
	Methow Basin Total			**200**	**307**	**73**
Chelan FH outfall	Outfall of hatchery to confluence with the Columbia River	BF TS	10/31/12	1	1	3
		KM BF	11/19/12	1	2	0
	Chelan FH Total			**2**	**3**	**3**
Foster	Mouth to first bridge	BF TS	10/31/12	0	0	0
		KM BF	11/19/12	0	0	0
	Foster Total			**0**	**0**	**0**

Appendix B:
Spawning Ground Survey Records for the Wenatchee and Methow Rivers

	Out of Basin Total			**2**	**3**	**3**

Appendix B:
Spawning Ground Survey Records for the Wenatchee and Methow Rivers

APPENDIX C: Wenatchee and Methow Basin Coho Release Numbers and Mark Groups, BY2010

Basin	River	Acclimation Site	Rearing Hatchery	Brood Source	Begin Release Date	End Release Date	CWT Code	Retention	Total Smolts Received	Total Smolts Released *	CWTs Released	PIT tags
Wenatchee	Nason Cr	Coulter Pond	Willard NFH	MCR-WEN	May 14	June 15	**190283 +BT**	87.8%	55,798	51,334	45,071	2,701
Wenatchee	Nason Cr	Coulter Pond	Willard NFH	MCR-WEN	May14	June 15	**190288 +BT**	83.7%	27,648	25,436	21,290	2,727
									83,446	**76,770**	**66,361**	5,428
Wenatchee	Nason Cr	Nason Wetlands	Willard NFH	MCR-WEN	April 30	May 1	**190184 +BT**	86.2%	56,680	54,421	46,911	0
									56,680	**54,421**	**46,911**	0
											-	
Wenatchee	Nason Cr	Rohlfing's Pond	Willard NFH	MCR-WEN	May 15	July 5	**190289 +BT**	73.3%	34,935	32,315	23,687	2,753
Wenatchee	Nason Cr	Rohlfing's Pond	Cascade FH	MCR-WEN	May 15	July 5	**190292 +BT**	89.7%	62,720	58,016	52,040	2,627
									97,655	**90,331**	**75,727**	**5,380**
Wenatchee	Nason Cr	Butcher Creek	Cascade FH	MCR-WEN	May 17	June 21	**190294 +BT**	90.2%	128,802	110,383	99,566	4,787
									128,802	**110,383**	**99,566**	**4,787**
Wenatchee	Beaver Cr	Beaver Creek	Willard NFH	MCR-WEN	May 8	Aug 1	**190287 +BT**	88.4%	31,131	27,177	24,025	2,517
Wenatchee	Beaver Cr	Beaver Creek	Cascade FH	MCR-WEN	May 8	Aug 1	**190293 +BT**	91.1%	64,844	56,609	51,571	2,233
									95,975	**83,786**	**75,595**	**4,750**

Wenatchee	Icicle Cr	LNFH SFL 23-25	Willard NFH	MCR-WEN	Apr 18	Apr 18	**190280**	80.7%	92,851	75,209	60,694	2,832
Wenatchee	Icicle Cr	LNFH SFL 22	Willard NFH	MCR-MET	Apr 18	Apr 18	**190286**	67.7%	29,212	27,815	18,831	0
Wenatchee	Icicle Cr	LNFH SFL 8-12,16, 18-20	Cascade FH	MCR-WEN	Apr 17	Apr 18	**190290**	96.7%	268,671	239,819	231,905	0
									390,734	**342,84.**	**322,139**	**2,832**
Wenatchee	Icicle Cr	LNFH LFL 1 & 2	Cascade FH	MCR-WEN	Apr 16	Apr 16	**190291**	97.8%	197,989	187,298	183,177	3,263
									197,989	**194,041**	**189,772**	**3,263**
Methow	Methow	Winthrop NFH C12-16	Winthrop NFH	MCR-MET	Apr 18	May 2	**190295**	98.8%	268,038	267,940	264,725	5,980
Methow	Methow	Twisp Ponds	Willard NFH	MCR-MET	May 8	June 7	**190279**	78.3%	92,970	84,808	66,405	5,894
Methow	Methow	Winthrop NFH BC	Willard NFH	MCR-MET	Apr 26	May 28	**190282**	76.8%	58,872	55,652	42,741	5,849
									418,677	**408,400**	**379,438**	**17,723**
Methow	Methow	Wells FH	Willard NFH	MCR-MET	May 1	May 1	**190281**	74.5%	93,390	93,142	69,391	0
Methow	Methow	Wells FH	Willard NFH	MER-MET	May 1	May 1	**190285**	80.3%	29,440	28,440	22,837	0
									122,830	**121,582**	**92,228**	
								Total	**1,592,788**	**1,475,815**	**1,330,433**	**44,163**

	Total Coho	**Total CWTs**
Wenatchee Basin	945,833	858,767
Methow Basin (+ Wells FH)	529,982	471,666

Appendix C:
Wenatchee and Methow Basin Coho Release Numbers and Mark Groups

APPENDIX D: USFWS 2012 MID-COLUMBIA COHO REPORT

Mid-Columbia Coho Production at U.S. Fish & Wildlife Service Facilities

Leavenworth National Fish Hatchery, Olympia Fish Health Center, Willard National Fish Hatchery, Winthrop National Fish Hatchery

Speros Doulos, Columbia Gorge National Fish Hatchery Complex Manager – Steve Wingert, Willard National Fish Hatchery Manager – Steve Croci, Leavenworth Fisheries Complex Deputy Manager – Chris Pasley, Winthrop National Fish Hatchery Manager – Dave Carie, Winthrop National Fish Hatchery Assistant Manager– Joy Evered, Olympia Fish Health Center Veterinary Medical Officer

February 1, 2012 – January 31, 2013

BPA Project No. 1996-040-00
Contract No. 55954

Statement of Work:
The activities in this contract are outlined in the Master Yakama Nation contract under Operation and Maintenance objectives and tasks and identified as Bonneville Power Administration (BPA) direct fund work.

This contract allows the U.S. Fish and Wildlife Service (Service) to rear coho salmon at Willard National Fish Hatchery (NFH), Leavenworth NFH, and Winthrop NFH including adult spawning, egg incubation, nursery rearing, and raceway rearing for transfer to Mid-Columbia River sites, main stem Columbia, Wenatchee, and Methow Rivers as part of the Yakama Nation coho reintroduction effort. Work also includes fish health laboratory and field services provided by the Olympia Fish Health Center (OFHC) for monitoring for adult and juvenile coho salmon health. The Statement of Work (SOW) included within this contract represents activities for the time frame of February 1, 2012 through January 31, 2013.

Background:
The long term vision of this restoration project is to restore coho salmon to the Wenatchee and Methow rivers in the Mid-Columbia River basin at or near carrying capacity, and provide harvest opportunities for tribal and non-tribal fisheries. The project works toward development of locally adapted, naturally spawning coho populations in the Wenatchee and Methow basins by increasing the fitness of reintroduced coho salmon by reducing domestication and emphasizing local adaptation. The program uses strict broodstock collection protocols, which ultimately will place a limit on the proportion of natural origin adults in the hatchery program and place a limit on the proportion of hatchery origin adults on the spawning ground. Hatchery smolt production work is covered under BPA contracts with other agencies.

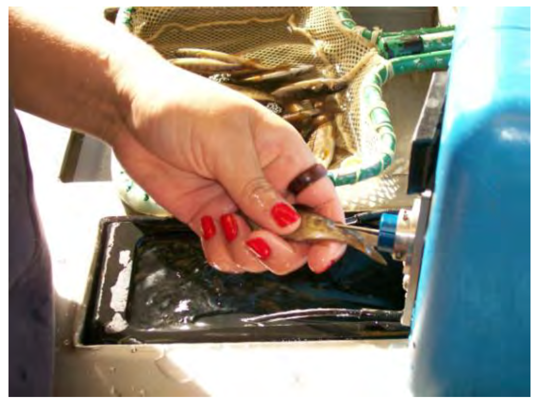
The Service, with funding from BPA, has assisted the Yakama Nation in an effort to re-establish and increase the number of coho salmon in the Upper Columbia River system using both locally adapted and lower river stocks of fish. The highest priority rearing program involves the use of gametes collected from fish returning to the Wenatchee and Methow River system in an attempt to develop a locally adapted stock of fish with a long term goal to re-establish coho salmon with enough numbers to be near carrying capacity and provide harvesting opportunities for tribal and non-tribal fisheries.

The Service is contracted to manage on the ground efforts and provide administrative support for this project. Work involves support of BPA's programmatic requirements including preparation of narrative and status reports that describe contract progress, achievement of milestones, preparation of SOW's, financial reports necessary to accomplish contract work and the preparation of an annual report that documents contract performance for all Service coho rearing activities. The Service provides equipment, and utilities to full-term rear and care for coho salmon eyed eggs until reaching a life stage necessary to achieve optimal survival following transfer to the Mid-Columbia Region at Willard NFH and Winthrop NFH while also providing facilities, labor, equipment and services for the spawning, incubation, shipping, rearing, acclimation, and releasing juveniles at Leavenworth NFH and Winthrop NFH. The OFHC monitors the health of coho salmon at Winthrop and Leavenworth NFH’s which includes exams, pathology sampling, laboratory processing of samples, discussions with fish culture staff, and consultation with other fish health professionals.

Willard NFH:
All deliverables described in the SOW for the Willard NFH were accomplished. Willard NFH production is initiated with the receipt of up to 672,000 eyed eggs resulting in up to 650,000 pre-

smolts for transfer to various acclimation and release sites within the Mid-Columbia River Basin including sites in the Methow, Wenatchee and main stem Columbia Rivers. Provide labor and fish food necessary to hold and rear up to 650,000 juvenile coho salmon from the previous brood year for transfer as pre-smolts following 18 months of rearing to acclimation facilities within the Mid-Columbia River Basin to assist reintroduction efforts.

During this report period a total of 482,855 coho salmon, derived from a native, locally adapted stock returning to and spawned on the Wenatchee River, WA, were reared at the Willard NFH and transferred to the Wenatchee or Methow River watersheds for release by biologists from the Yakama Nation. All of this year's transfers were brood year 2010 coho. Through a MOU, 60% of this project is supported by the Yakama Nation using BPA funds and the remaining 40% is provided by NOAA-Fisheries Mitchell Act funding. This is a cooperative effort by the Service and the Yakama Nation to assist with the reintroduction of coho salmon and development of locally adapted, naturally spawning populations of fish in the Wenatchee River watershed.



Brood Year 2010 Coho Salmon Production Summary
The following tables display brood year 2010 coho salmon production. Table 1 displays the inventory of brood year 2010 coho at the beginning of the report period.

Table 1. Willard NFH brood year 2010 coho salmon production as of February 1, 2012.

				Willard National Fish Hatchery				OUTDOOR RACEWAYS					
				COS-WEN-10-Wi-22									
Raceway Number	Previous Number	Monthly Mortalities	Current Number	Size (#/Lb.)	Weight	Length (Inches)	Density Index	Flow Index	Basin	Transfer Date	PIT Tags	Tagcodes	Destination
5*	31521	1	31,520	26.7	1182.7	4.84	0.16	0.56	WEN	3/7/2012		19-02-85	Wells FH
6	31422	0	31,422	26.7	1179.1	4.84	0.16	0.56	WEN	3/26/2012	3000	19-02-87 + BT	Beaver Pond
7	32004	2	32,002	32.2	993.5	4.55	0.14	0.50	MET	3/7/2012	2000	19-02-79	Twisp Ponds
8	31683	0	31,683	32.2	983.6	4.55	0.14	0.50	MET	3/7/2012	2000	19-02-79	Twisp Ponds
9*	31569	1	31,568	32.2	980.1	4.55	0.14	0.50	MET	3/7/2012	2000	19-02-79	Twisp Ponds
10	31876	2	31,874	32.2	989.6	4.55	0.14	0.50	MET	3/7/2012		19-02-81	Wells FH
11	31,604	0	31,604	27.4	1152.2	4.80	0.16	0.55	MET	3/7/2012		19-02-81	Wells FH
12*	31,624	1	31,623	27.4	1152.9	4.80	0.16	0.55	MET	3/7/2012		19-02-81	Wells FH
13	31,475	2	31,473	27.4	1147.4	4.80	0.16	0.55	MET	3/7/2012	3000	19-02-82	Winthrop NFH back-channel
14	21,535	8	21,527	27.4	784.8	4.80	0.11	0.38	MET	3/7/2012	3000	19-02-82	Winthrop NFH back-channel
15	28,081	15	28,066	27.2	1030.3	4.81	0.14	0.49	WEN	4/1/2012	2000	19-02-83 + BT	Coulter Pond
16	28,883	12	28,871	27.2	1059.9	4.81	0.14	0.51	WEN	4/1/2012	2000	19-02-83 + BT	Coulter Pond
17	30,030	25	30,005	27.2	1101.5	4.81	0.15	0.53	WEN	4/1/2012	2000	19-02-88 + BT	Coulter Pond
18*	29,852	12	29,840	27.2	1095.4	4.81	0.15	0.53	WEN	4/1/2012		19-02-84 + BT	Nason Creek Wetlands
19	28,618	16	28,602	27.2	1050.0	4.81	0.14	0.50	WEN	4/1/2012		19-02-84 + BT	Nason Creek Wetlands
20	31,522	21	31,501	27.2	1156.4	4.81	0.16	0.56	WEN	3/14/2012	3000	19-02-89 + BT	Rohlfing's Pond
TOTAL >>	483,299	118	483,181	28.4	17,039	4.75	0.15	0.52					

Brood Year 2011 Coho Salmon Production Summary

The following tables summarize brood year 2011 coho salmon production during this report period at Willard NFH. Table 2 displays the inventory of brood year 2011 coho after all lots had been ponded and table 3 displays the fish inventory at the end of the contract period.

Table 2. Willard NFH brood year 2011 coho salmon production, initial lot status.

				Willard National Fish Hatchery				INDOOR NURSERY TANKS		
				COS-WEN-11-Wi-30						**"Lot Update"**
Tank Number	Previous Number	Monthly Mortality	Current Number	Size (#/Lb.)	Weight	Length (Inches)	Density Index	Flow Index	Strain/ Cross	Notes
11*	21,641		21,641	1217.4	17.8	1.355	0.14	0.66	Random	Ponded 2/7/2012
12*	25,831		25,831	1313.6	19.7	1.321	0.16	0.74	lbm x upf	Ponded 2/14/2012
13	16,476		16,476	1228.0	13.4	1.351	0.11	0.50	ubm x lbf	Ponded 2/14/2012
15*	21,208		21,208	1215.4	17.4	1.356	0.14	0.64	Random	Ponded 2/22/2012
16	21,208		21,208	1215.4	17.4	1.356	0.14	0.64	Random	Ponded 2/22/2012
17	21,208		21,208	1215.4	17.4	1.356	0.14	0.64	Random	Ponded 2/22/2012
18	17,018		17,018	1261.9	13.5	1.339	0.11	0.50	lbm x lbf	Ponded 2/27/2012
19	25,045		25,045	1235.0	20.3	1.349	0.16	0.75	Winthrop	Ponded 2/27/2012
20	25,045		25,045	1235.0	20.3	1.349	0.16	0.75	Winthrop	Ponded 2/27/2012
21	25,045		25,045	1235.0	20.3	1.349	0.16	0.75	Winthrop	Ponded 2/27/2012
22	25,045		25,045	1235.0	20.3	1.349	0.16	0.75	Winthrop	Ponded 2/27/2012
23*	25,866		25,866	1236.0	20.9	1.348	0.17	0.78	Winthrop	Ponded 3/2/2012
24	25,866		25,866	1236.0	20.9	1.348	0.17	0.78	Winthrop	Ponded 3/2/2012
25	21,127		21,127	1245.0	17.0	1.345	0.14	0.63	Winthrop	Ponded 3/9/2012
26*	39,152		39,152	1144.7	34.2	1.383	0.27	1.24	Random	Ponded 3/20/2012
28	21,127		21,127	1245.0	17.0	1.345	0.14	0.63	Winthrop	Ponded 3/9/2012
29	25,866		25,866	1236.0	20.9	1.348	0.17	0.78	Winthrop	Ponded 3/2/2012
30	25,866		25,866	1236.0	20.9	1.348	0.17	0.78	Winthrop	Ponded 3/2/2012
31	25,045		25,045	1235.0	20.3	1.349	0.16	0.75	Winthrop	Ponded 2/27/2012
32	25,045		25,045	1235.0	20.3	1.349	0.16	0.75	Winthrop	Ponded 2/27/2012
33*	25,045		25,045	1235.0	20.3	1.349	0.16	0.75	Winthrop	Ponded 2/27/2012
34*	17,018		17,018	1261.9	13.5	1.339	0.11	0.50	lbm x lbf	Ponded 2/27/2012
35	21,208		21,208	1215.4	17.4	1.356	0.14	0.64	Random	Ponded 2/22/2012
36	21,208		21,208	1215.4	17.4	1.356	0.14	0.64	Random	Ponded 2/22/2012
37	21,208		21,208	1215.4	17.4	1.356	0.14	0.64	Random	Ponded 2/22/2012
38*	23,931		23,931	1226.8	19.5	1.352	0.16	0.72	ubf x ubm	Ponded 2/22/2012
40	16,476		16,476	1228.0	13.4	1.351	0.11	0.50	ubm x lbf	Ponded 2/14/2012
41*	21,641		21,641	1211.1	17.9	1.358	0.14	0.66	Random	Ponded 2/14/2012
42	21,641		21,641	1211.1	17.9	1.358	0.14	0.66	Random	Ponded 2/7/2012
TOTAL >>	669,106	-	669,106	1227.7	545	1.351	0.16	0.72		

Table 3. Willard NFH brood year 2011 coho salmon production as of January 30, 2013.

1/30/2013		Willard National Fish Hatchery				OUTDOOR RACEWAYS							
		COS-WEN-11-Wi-30											
Raceway Number	Current Number	Size (#/Lb.)	Weight	Length (Inches)	Density Index	Flow Index	Basin	Strain/Cross	Transfer Date	FPP Goal	PIT Tag	CW Tagcodes	Destination
1*	30,220	25.4	1192.1	4.93	0.16	0.57	WEN	Random	2/16/2013	25 fpp	2500	19-03-05	LFL 2
2*	42,770	31.7	1347.9	4.57	0.19	0.70	WEN	Random	2/16/2013	25 fpp		19-03-05	LFL 1
3*	30,308	29.5	1026.3	4.68	0.14	0.52	WEN	Random	2/16/2013	27 fpp		19-03-09	SFL 25
4*	30,571	29.1	1049.8	4.70	0.15	0.53	WEN	ubm x lbf	3/27/2013	22 fpp	1500	19-03-10+ body tag	Beaver Cr. Pond
5*	21,604	28.5	758.3	4.74	0.10	0.38	WEN	lbm x upf	3/27/2013		1500	19-03-17+ body tag	Beaver Cr. Pond
6*	26,290	27.7	950.5	4.78	0.13	0.47	WEN	ubf x ubm	3/27/2013		1500	19-03-18+ body tag	Beaver Cr. Pond
7*	31,332	29.2	1073.4	4.70	0.15	0.54	WEN	lbm x lbf	3/27/2013		1500	19-03-11+ body tag	Beaver Cr. Pond
8	27,476	28.7	956.4	4.72	0.13	0.48	WEN	Random	4/10/2013	20 fpp	3000	19-02-99+ body tag	Coulter
9	29,021	28.7	1010.1	4.72	0.14	0.51	WEN	Random	4/10/2013		3000	19-02-99+ body tag	Coulter
10	28,382	28.7	987.9	4.72	0.14	0.49	WEN	Random	3/22/2013	30 fpp		19-03-12 +body tag	Rohlfings
11*	31,405	28.7	1093.1	4.72	0.15	0.55	WEN	Random	3/26/2013	22 fpp	3000	19-03-13 + body tag	Rohlfing's Pond
12	33,801	27.4	1233.2	4.80	0.17	0.61	MET	Winthrop	3/7/2013	22 fpp		19-03-06	Biddle Pond
13	33,074	27.4	1206.6	4.80	0.16	0.59	MET	Winthrop	3/7/2013			19-03-06	Biddle Pond
14*	32,095	27.4	1170.9	4.80	0.16	0.58	MET	Winthrop	3/7/2013	25 fpp		19-03-07	Wells
15	35,172	27.4	1283.2	4.80	0.18	0.63	MET	Winthrop	3/7/2013			19-03-07	Wells
16	34,536	27.4	1260.0	4.80	0.17	0.62	MET	Winthrop	3/7/2013			19-03-14	Wells
17*	37,871	30.3	1251.1	4.64	0.18	0.64	MET	Winthrop	3/24/2013	22 fpp	3000	19-03-08	Twisp
18	34,885	30.3	1152.5	4.64	0.16	0.59	MET	Winthrop	3/24/2013		3000	19-03-08	Twisp
19	35,832	30.3	1183.7	4.64	0.17	0.60	MET	Winthrop	3/24/2013	22 fpp	6000	19-03-15	Gold Cr. Pond
20	40,952	27.4	1494.1	4.80	0.20	0.74	MET	Winthrop	3/7/2013	25 fpp	6000	19-03-16	Winthrop back channel
TOTAL >>	647,597	28.6	22,681	4.73	0.16	0.57					35500		

Brood Year 2012 Coho Salmon Production Summary
Table 5 summarizes brood year 2012 coho salmon egg and fry incubation during this report period at the Willard NFH.

Table 5. Willard NFH brood year 2012 coho salmon egg and fry incubation as of January 30, 2013.

Stock	Date Received	Date Spawned	Number of eggs received	T.U.'s Delivery
LNFH 10/09/12	12/3/12	10/9/12	51,794	607
LNFH 10/16/12	12/12/12	10/16/12	178,518	600
Peshastin 10-30-12	12/18/12	12/30/12	201,019	584
LNFH 10/23/12	12/20/12	10/23/12	231,505	583
Peshastin 11-06-12	12/28/12	11/6/12	287,782	613
Peshastin 11/13/12	1/3/13	11/3/12	21,419	596
LNFH 10/30/12	1/3/13	10/30/12	48,076	617
Total/avg.			1,020,113	600

	Date Received	Egg pick off	% pick off	total eggs after pick off
LNFH 10/09/12	12/3/12	14,768	28.51%	37,026
LNFH 10/16/12	12/12/12	14,983	8.39%	163,535
Peshastin 10-30-12	12/18/12	3,024	1.50%	197,995
LNFH 10/23/12	12/20/12	3,562	1.54%	227,943
Peshastin 11-06-12	12/28/12	1,972	0.69%	285,810
Peshastin 11/13/12	1/3/13	160	0.75%	21,259
LNFH 10/30/12	1/3/13	2,767	5.76%	45,309
Total/avg.		41,236	4.04%	978,877

Leavenworth Fisheries Complex:

Leavenworth NFH:

All deliverables described in the statement of work for Leavenworth NFH were accomplished. Leavenworth NFH ensured adequate water flow to coho rearing units; removed snow on a recurring basis in order to access coho rearing units; responded to water alarms and coordinated with YN prior to severe weather events; monitored effluent discharge to maintain compliance with the NPDES permit; provided electrical power to operate pumps and other equipment; provided guidance on or assisted with equipment repair and maintenance; and provide program administrative services in support of coho reintroduction program. To accommodate acclimation and rearing of juvenile coho salmon Leavenworth NFH provided adequate water and space and assisted the YN with planning and execution of fish release and other fish culture issues such as water temperature, dissolved oxygen and flow rates. In support of holding, spawning and incubating maintenance activities the Leavenworth NFH assisted YN staff with installation, operation, maintenance, and modifications of the ladder fish trap, holding pond, spawning area and egg incubation system. The hatchery purchased chemicals (formalin, iodine, and disinfectant) required for fish holding, spawning, rearing, and egg incubation. Employees also assisted with spawning and egg incubation activities.

To improve the capacity and function of the egg incubation system six stacks (16 incubation trays per) were purchased and installed. The hatchery also purchased and installed water flow and level sensors for Coho rearing and incubation units.

Coordination meetings, discussions, and consultations with Yakama Nation staff responsible for rearing and care of these fish were performed during this time period. Coordination and consultation with Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife, and US Fish and Wildlife Service Fish Health Specialists/Biologists was conducted during this time period regarding fish health concerns and transfer requirements for this program.

Winthrop NFH:

All deliverables described in the statement of work for Winthrop NFH were accomplished and included performing routine and preventative maintenance on facilities and equipment to accommodate the Coho salmon production program.

Brood Year 2010 Coho Salmon

This group originated entirely from adult Coho salmon collected at Winthrop NFH and Wells Dam. From a fish health perspective, this group reared very well. In March 2012, approximately 58,900 juveniles were transferred from Willard NFH and placed in the back channel for release in April. Total distribution of yearling Coho from Winthrop NFH to the Methow basin was 325,155 (266,294 from raceways and 58,861 from back channel).

Brood Year 2011 Coho Salmon

This group originated entirely from adult Coho salmon collected at Winthrop NFH and Wells Dam. Five hundred and sixty one adults were processed at Winthrop NFH this brood year, which included 233 females and 233 males spawned, 86 returned to the river, and 9 mortalities. A total of 662,830 green eggs were harvested, which resulted in 601,802 eyed-eggs at an eye-up rate of 90.8%. Approximately 326,339 eyed-eggs were transferred to Willard NFH leaving 275,463 eggs remaining on station as of December 2011.

The resulting progeny (253,365 at end of December 2012) have had minimal health issues and are on schedule to be released in April of 2013.

Brood Year 2012 Coho Salmon
This group originated entirely from adult Coho salmon collected at Winthrop NFH and Wells Dam. Seven hundred eighty seven adults were processed at Winthrop NFH this brood year, which included 293 females and 293 males spawned, 151 returned to the river, and 50 mortalities. Most of these mortalities were a result of a defect in the new fish elevator, an issue which will be addressed by the contractor in early 2013. A total of 703,058 eggs were harvested, which resulted in 612,052 eyed-eggs at an eye-up rate of 87.1%. Approximately 338,464 eyed-eggs were transferred to Cascade FH (ODFW) leaving 273,588 eggs remaining on station as of December 2012.

Olympia Fish Health Center:

Fish Health at Leavenworth NFH:
OFHC staff performed routine juvenile monitoring of brood years 2010 and 2011 during the period from February 2012 through January 2013. Monitoring included on site examinations and necropsies of juveniles captured from representative ponds of coho salmon to determine overall health and potential infections with bacteria or parasites. Diagnostic trips were also performed during this time period as requested by fish culture staff and as deemed necessary by OFHC staff. Preventive measures and treatment options were discussed with the coho fish culturists as needed.

In March 2012, a pre-release inspection was performed on the brood year 2010 coho salmon that had been transferred from Willard NFH and Cascade SFH for long term acclimation. It consisted of 60 fish sampled for kidney and spleen tissues and tested for viruses and culturable bacteria plus 30 fish sampled for individual kidneys and tested for *Renibacterium salmoninarum* using ELISA.

In October and November 2012, broodstock testing was performed on the fish spawned at Leavenworth and consisted of 151 female ovarian samples tested for viruses (32 pooled samples), 160 male kidney spleen samples tested for viruses and culturable bacteria (32 pooled samples), 99 female kidney samples tested individually for *Renibacterium salmoninarum* by ELISA, 60 head core samples tested for *Myxobolus cerebralis*, and 1 hindgut sample tested for *Ceratomyxa shasta*.

Viral Hemorrhagic Septicemia Virus (VHSV) type 4a was isolated out of one ovarian fluid sample. The identity and genotype of the virus was confirmed by the USGS Western Fisheries Research Center (WFRC) and found to be identical to the isolate found in 2010 at the Salmon River Tribal Hatchery on the Washington Coast. Two other isolations of VHSV 4a occurred in Washington this year at the Naselle and Dungeness State Fish Hatcheries. Both of those isolations were also in ovarian fluid samples from Coho salmon broodstock. Genotyping by the WFRC found the Dungeness isolate to be unique and the Naselle isolate to be identical to the Leavenworth isolate.

Due to this finding of VHSV in the broodstock and the identification of adult coho near the intake for Leavenworth NFH, additional testing was performed on the spring Chinook juveniles being reared on surface water. Three groups of 30 fish each were tested for viruses and bacteria in November and December of 2012. Although many of the moribund fish sampled had significant fungal lesions, no viruses or pathogenic bacteria were isolated from the kidney and spleen tissues.

Coordination meetings, discussions, and consultations with Yakama Nation staff responsible for rearing and care of these fish were performed during this time period. Coordination and consultation with Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife, Western Fisheries Research Center and US Fish and Wildlife Service Fish Culturists and Fish Health Specialists/Biologists was conducted during this time period regarding fish health concerns and transfer requirements for the coho program at Leavenworth and Winthrop NFHs. The VHSV isolation and control of soft shell issues in the eggs substantially increased the amount of time and resources expended by OFHC laboratory and field staff and FWS Regional Office personnel for the program this year.

Fish Health at Winthrop NFH:
In October and November 2012, broodstock testing was performed on the spawned fish and consisted of 155 female ovarian samples tested for viruses (31 pooled samples), 55 male kidney spleen samples tested for viruses and culturable bacteria (11 pooled samples), 87 female kidney samples tested individually for *Renibacterium salmoninarum* by ELISA, head core samples from 60 fish tested for *Myxobolus cerebralis*, and 5 hindgut samples tested for *Ceratomyxa shasta*. Kidney, heart, and gill tissue were collected from 15 fish as part of a two year virus monitoring project being conducted in cooperation with the Washington Department of Fish and Wildlife, the Northwest Indian Fisheries Commission, and the Alaska Department of Fish and Game.

The OFHC monitored brood year 2010 and 2011 coho salmon juveniles during this contract period from February 2012 through January 2013. Monitoring included on site examinations and necropsies of juveniles captured from representative ponds of coho salmon to determine overall health and potential infections with bacteria or parasites.

In March 2012 a pre-release Inspection was performed on the brood year 2010 coho salmon which consisted of 60 fish (12 pooled samples of kidney-spleen from Methow origin broodstock) sampled and tested for viruses and bacteria plus 30 fish sampled for individual kidneys and tested for *Renibacterium salmoninarum* using ELISA.