MID-COLUMBIA COHO REINTRODUCTION FEASIBILITY STUDY:

2013 ANNUAL REPORT
February 1, 2013 through January 31, 2014

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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 2012) 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 2013 through January 2014, 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 2013-2014. 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 (Ishida 2013; Appendix A).

2.0 BROODSTOCK COLLECTION AND SPAWNING

2.1 WENATCHEE RIVER BASIN

2.1.1 Broodstock Collection

Broodstock collections occurred at Dryden Dam, Leavenworth National Fish Hatchery (LNFH) adult ladder, Priest Rapids Dam and Tumwater Dam. Due to a low return, Priest Rapids Dam had to be used as a collection point in an attempt to meet production goals. 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 2012).

Coho returning to the Wenatchee River in 2013 were comprised primarily of brood year (BY) 2010 adults with limited contributions from BY2011 jacks. The Wenatchee program was comprised primarily of 4th generation, Mid-Columbia River (MCR) returns but also included approximately 25%, 3rd generation MCR returns originating from the Methow basin (Priest Rapids collections to ensure broodstock goals). These fish were marked with a top caudal clip for later identification during spawning and post-spawn data collection.

Dryden Dam fish traps were passively operated five days per week, 24-hours per day from September 1 through November 21. 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 15, 2013. 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.

In addition to the above documented collections, a v-trap weir in the upper bay of the LNFH ladder was installed the first week of October and operational October 21 through November 22. 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 2012). 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 18.1% and 40.9% of the total broodstock were collected at Tumwater Dam and Dryden Dam, respectively. Remaining brood fish originated from LNFH ladder/Priest Rapids 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, 2013.

Location	**Coho Handled (*broodstock*)**	**Steelhead**	**Sockeye**	**Chinook**	**Bull Trout**
Priest Rapids Dam	257 (257)	N/A	N/A	N/A	N/A
Dryden Dam	454 (394)	57	6	272	4
Tumwater Dam	204 (174)	N/A	N/A	N/A	N/A
LNFH ladder trap	169 (138)	0	0	0	0

2.1.2 Spawning

A total of 895 coho were collected for broodstock; 388 females and 507 males. The pre-spawn mortality rate at LNFH was 2.1% (19 fish; 6 females and 13 males).

A total of 876 coho (382 F and 494 M) were spawned between October 22 and November 25, 2013. Of the 382 females spawned, 378.5 were considered viable. Non-viable females were either over-ripe or green at time of spawning. Peak spawn occurred on October 29 with 118 viable females (Figure 1).

Spawn timing for the 2013 brood was different when compared to the program mean from 2000-2012 (Figure 2). The peak spawn week was 2 weeks earlier than usual, and an increase in females spawned happened in week 5, when it would normally be trending down. 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 (2007-2012), an estimated fecundity of 2,973 eggs per female and a pre-spawn mortality rate of 3.0% 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, protocols developed by YN and USFWS (fish health and Willard NFH personnel) for transportation and subsequent virology sampling were implemented and all coho eggs that had not been 100% tested as adults were transported to Willard NFH. Gametes from 100% adult sampled lots were able to be transported as eyed eggs to Cascade FH. 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 389 fish spawned were LNFH origin returns from 2012 (BY2010) and 2013 (BY2011) releases, while 309 were fish acclimated and released from upper Wenatchee River basin ponds during the same time period (Table 2). After scale analysis, the remaining 178 fish consisted of 119 hatchery origin fish with unknown release locations, 5 natural origins and 6 unknown origin (scale analyses were inconclusive). The remaining 48 fish were from out-of-basin releases (Methow River releases).

Table 2. Summary of coded-wire-tag and scale analysis from coho spawned at Leavenworth National Fish Hatchery in 2013.

Juvenile Release Location		BY2010 Adults	BY2011 Jacks	Percentage of Brood by Release Site
Leavenworth National Fish Hatchery	*Small Foster-Lucas Ponds*	217	2	25.0%
	Large Foster-Lucas Ponds	167	3	19.5%
Upper Wenatchee River Basin	*Coulter Pond*	18	2	2.3%
	Butcher Creek Pond	73	0	8.3%
	Beaver Creek Pond	92	1	10.7%
	Rohlfing's Pond	102	2	11.8%
	Nason Creek Wetlands	19	0	2.1%
Out-of-Basin	*Wells FH*	14	0	1.6%
	Winthrop NFH	22	1	2.6%
	Winthrop BC	1	0	0.1%
	Lower Twisp Ponds	10	0	1.1%
Unknown Hatchery Origin		118	1	13.6%
Unknown Origin		6	0	0.7%
Natural Origin		5	0	0.6%
Totals		**864**	**12**	**100.0%**

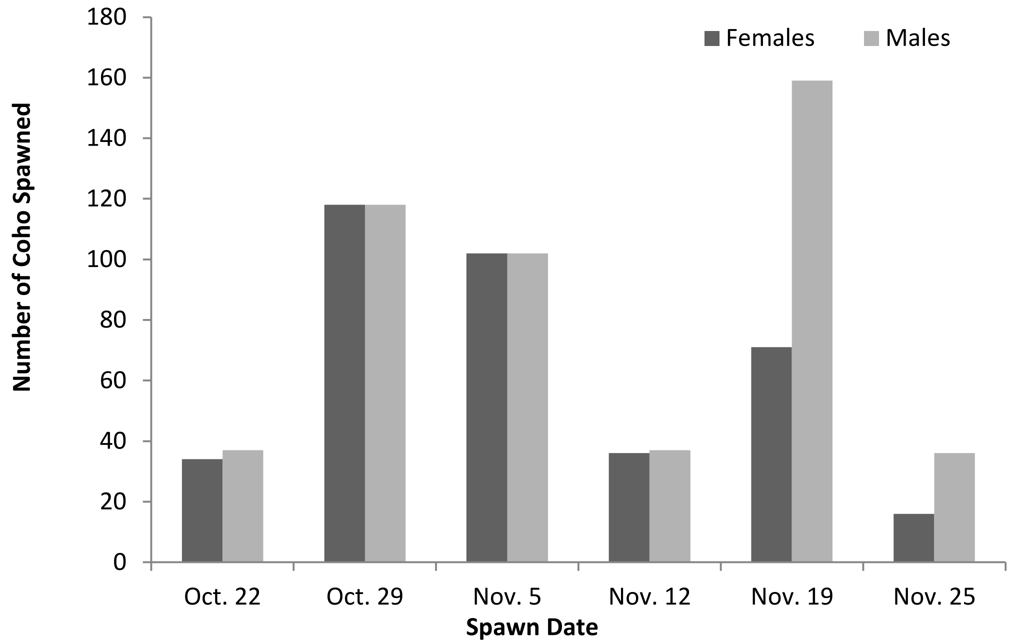


Figure 1. Number of coho spawned at Leavenworth National Fish Hatchery, 2013.

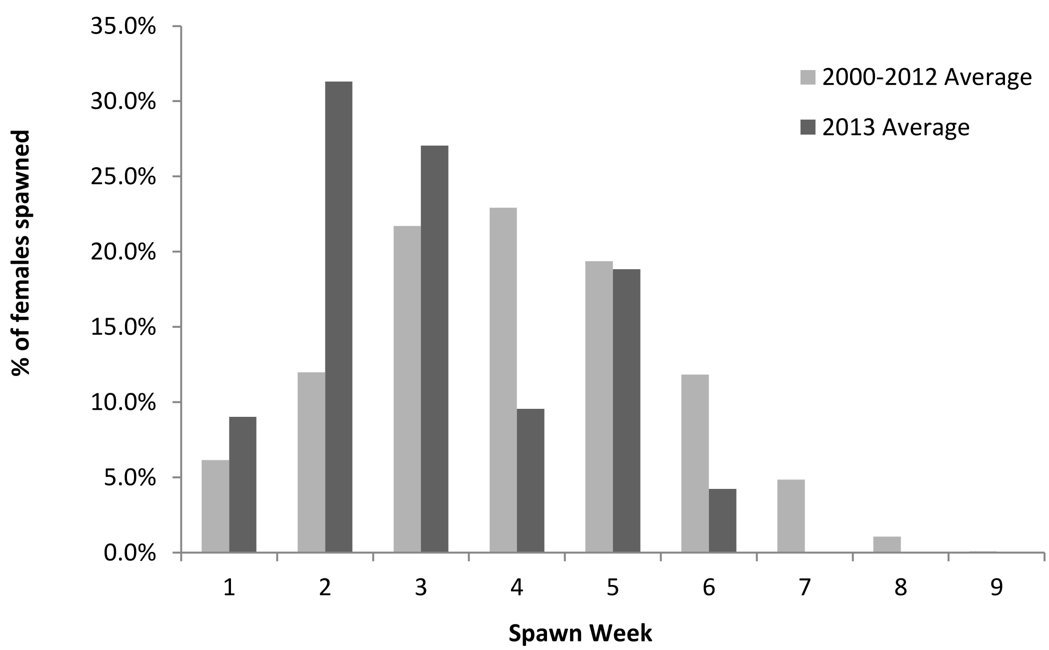


Figure 2. Temporal spawning distribution for brood years 2000-2012 and 2013.

2.1.3 Incubation

A total of 1,045,859 green eggs were collected from the 2013 coho broodstock, with an additional 350,000 eggs transported from Eagle Creek NFH to Willard NFH to supplement the shortfall. Of the total green eggs, 717,257 were incubated at LNFH while the remaining 355,615 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 717,257 and 355,617 respectively. Combined total average eye-up rate for the 2013 brood was 84.9%. The 2013 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, 2013.

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	22-Oct	3-Dec	33.5	91,817	15,003	76,814	2,741	2,293	83.7	Willard NFH
LNFH	29-Oct	12-Dec	118	360,930	59,089	301,841	3,060	2,559	83.6	Willard NFH
LNFH	5-Nov	20-Dec	102	264,511	25,941	238,570	2,326	2,073	90.2	Willard NFH
PIF	12-Nov	3-Jan	36	105,567	12,060	93,508	2,932	2,597	88.6	Willard NFH
Willard NFH	13-Nov	--	5	10,178	464	9,714	2,036	1,943	95.4	Willard NFH
PIF	19-Nov	19-Dec	70	207,478	27,303	180,176	2,964	2,574	86.8	Willard NFH
PIF	25-Nov	28-Dec	14	42,570	23,973	18,596	3,041	1,328	43.7	Willard NFH
			378.5	**1,045,859**	**163,206**	**882,653**	**2,800**	**2,363**	**84.9**	

2.2 METHOW RIVER BASIN 2013

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 7 and concluded when collection goals were met on November 25. Supplemental collections occurred concurrently at the Wells Dam west ladder facility with WDFW's steelhead and summer Chinook broodstock collections between September 30 and November 5. 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. Additionally, Wells FH volunteer ladder was operated between October 10 and November 5 once low return numbers were being observed at primary facilities. 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 277 (116 F and 161 M) adults were collected for Methow broodstock. A breakdown of individuals collected by facility is outlined in 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.

Table 4. Summary of Methow program coho broodstock collections, 2013.

Location	Coho Handled (*broodstock*)	Steelhead (*Wells FH broodstock*)	Summer Chinook (*Wells FH broodstock*)	Bull Trout
Winthrop NFH adult holding pond	(*21*)	0	0	0
Winthrop NFH collection weir	69 (*66*)	0	0	0
Methow FH collection weir	32 (*15*)	0	1	1
Wells Dam West Ladder	(*32*)	118[a] (*53*)	3,164[a] (*3*)	0
Wells Dam East Ladder	22 (*21*)	44 [a] (7)	828	0
Wells FH Vol. Channel	124 (*122*)	56	6,765	0

a - Total numbers of adult steelhead and summer Chinook encountered by YN personnel during broodstock collection efforts for 2013.

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 228 viable adult coho (113 F and 115 M) were successfully spawned during the six week period. Peak spawn occurred on November 4 with 46 viable females (Figure 3). The remaining 36 males were returned to the river and deemed program excess due to insufficient females numbers within program. Spawn timing was disproportionate when compared to the historical average with peak spawning occurring earlier than seen previously (Figure 4).

Pre-spawn mortality remained consistent from what was observed the previous year (2013: 4.3% vs. 2012: 4.2%). 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.

CWT analysis revealed that the majority of adults spawned originated from 2012 Winthrop NFH releases (42 F and 51 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.

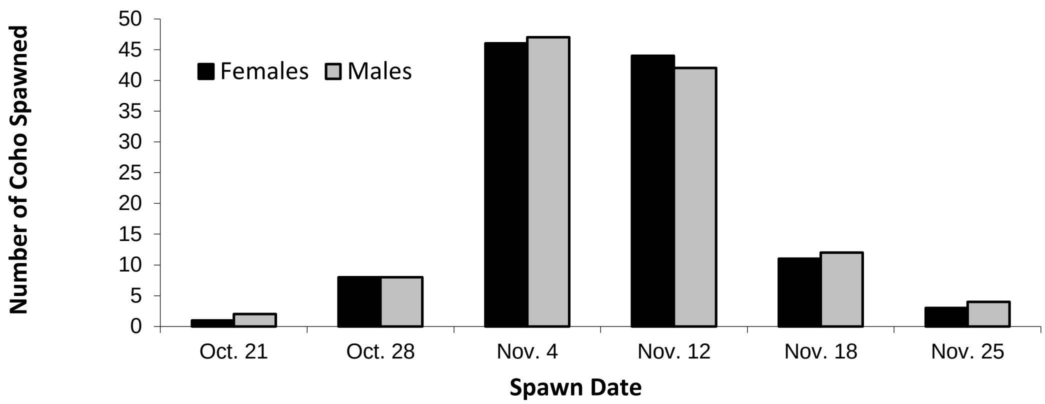


Figure 3. Number of coho spawned at Winthrop National Fish Hatchery, 2013.

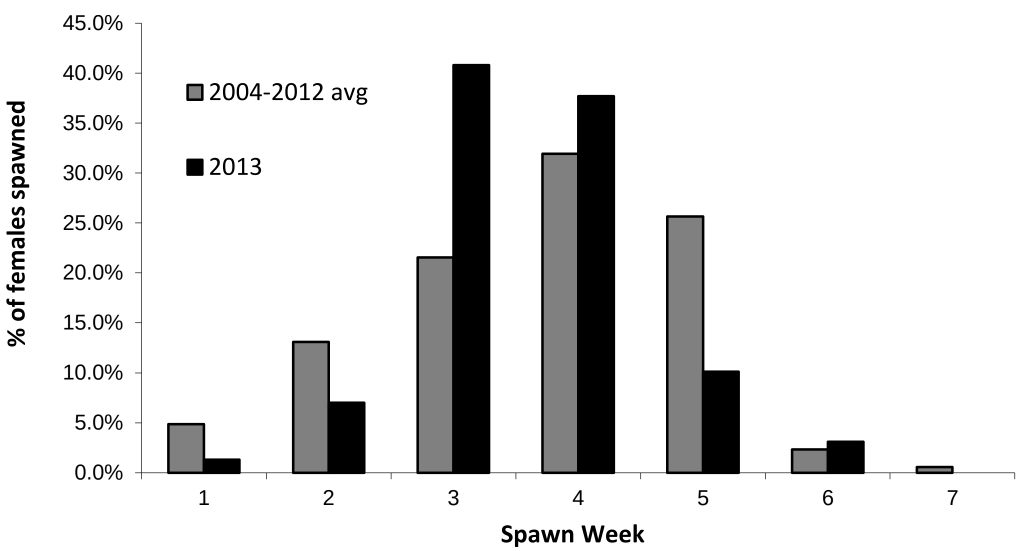


Figure 4. Temporal spawning distribution: brood years 2004-2012 and 2013 at Winthrop NFH.

Table 5. Broodstock composition and collection locations for fish spawned at Winthrop NFH, 2013.

Juvenile Release Location		BY2013 Adults
Winthrop NFH	*On-station*	93
Winthrop NFH	*Back Channel*	6
Twisp Ponds		14
Wells FH	*On-station*	79
Unknown Hatchery		43
Unknown Origin		1
Natural Production		5
Totals		**241**

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 335,403 green eggs were collected from the 2013 Methow broodstock between October 21 and November 25. Eyed eggs totaled 277,230, of which, all stayed on-station for full term rearing and release as smolts in 2015. Average eye-up for the 2013 brood was 82.7%; a decrease of 4.3% over the previous years' brood but similar to the previous years' (BY2007-BY2012) average. 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, 2013.

Incubation Location	Spawn Date	Number of 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	21-Oct	1	3,278	3,278	0	3,278	0	0	Winthrop NFH
Winthrop NFH	28-Oct	7.5[a]	23,775	10,256	13,519	3,170	1,803	56.9%	Winthrop NFH
Winthrop NFH	4-Nov	45	130,402	19,708	110,694	2,898	2,460	84.9%	Winthrop NFH
Winthrop NFH	12-Nov	44	133,823	18,211	115,612	3,041	2,628	86.4%	Winthrop NFH
Winthrop NFH	18-Nov	11	34,892	4,487	30,405	3,172	2,764	87.1%	Winthrop NFH
Winthrop NFH	25-Nov	3	9,233	2,233	7,000	3,078	2,333	75.8%	Winthrop NFH
Totals		**111.5**	**335,403**	**58,173**	**277,230**	**3,008**	**2,509**	**82.7%**	

[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.*

3.0 SPAWNING GROUND SURVEYS

In 2013, 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). Prompted by a lack of coho passage above Tumwater Dam, commencement of surveys in the upper basin was delayed until a sufficient number (n = 15) of coho passed at the fish ladder. Prior to this point, total retention of coho adults at Tumwater Dam for broodstock purposes prevented all passage into upper-basin tributaries. Once began, surveys above Tumwater Dam were performed both weekly and bi-weekly depending on historical spawning density.

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 determining number of retained eggs in conjunction with average fecundity of BY2010 hatchery coho females (2,979 eggs per female) to calculate a % egg voidance. Egg voidance was calculated as:

% Egg Voidance = ((2,979 - # eggs present in cavity)/2,979) x 100

Beginning in 2013, tissue samples were taken from all carcasses processed for future Parental Based Tracking (PBT), with the exception of pre-spawn females. Samples were taken either as a single fin clip measuring approximately 2cm x 2cm or a series of three opercule punches. Tissue-sampled carcasses also had their level of decomposition graded on a scale of 1-3 (1-excellent and 3-poor) in an attempt to identify the relationship between physical state and viability of DNA analysis.

To prevent re-sampling, the caudal fin was removed before discarding the carcass along the stream bank. The target sample rate for carcasses from each major tributary was 20% and incorporated the run-at-large, male-to-female sex ratio of 1.4:1.0. The sample rate was calculated as:

% Sample Rate = (# of Carcasses)/(# of redds x 2.4) x 100

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 2012). 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 2013.

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 2013, YN identified a total of 108 redds and collected 32 adult coho carcasses throughout the Wenatchee River subbasin for an overall sample rate of 12.3%. All redds located in 2013 were found in the lower Wenatchee River and tributaries at/or downstream of Leavenworth. Low overall adult return along with targeted broodstock collections at Tumwater Dam in accordance with the protocols of Broodstock

Development Phase II (YN FRM 2010) resulted in no documented spawning activity in the upper-Wenatchee basin.

Table 8. Summary of Wenatchee River coho redd counts, distribution and carcass recovery in 2013.

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	0	0	0	0	0	0	0	**0.0%**
Chiwawa	0	0	0	0	0	0	0	0	0	0	0	0	**0.0%**
Icicle	38	54	2	73	165	305	16	486	1	15	2	18	**8.0%**
Chumstick	0	0	NS	0	7	4	NS	11	0	0	0	0	**0.0%**
Mission	0	1	NS	1	0	0	0	0	0	0	0	0	**0.0%**
Nason	0	0	NS	0	0	0	NS	0	0	0	NS	0	**0.0%**
Peshastin	0	1	NS	1	0	1	NS	1	0	0	NS	0	**0.0%**
Roaring	0	0	0	0	0	0	0	0	0	0	0	0	**0.0%**
Wenatchee	2	29	2	33	50	78	0	128	1	13	0	14	**17.7%**
Total	40	85	4	**108**	222	388	16	**626**	2	28	2	**32**	**10.3%**

[a] – sample rate was based on Fish Per Redd (fpr) derived from calculated sex ratios form the run-at-large (1.4M: 1F)
NS-Surveys not performed during month due to hazardous river conditions (snow, anchor ice, etc.)

A total of 19 coded wire tags (CWT) were recovered from adult carcasses in the Wenatchee River basin in 2013 (Table 9). CWT analysis showed that 73.7% (*n* = 14) of carcasses recovered were of fish that had been released as juvenile from LNFH. Conversely, 26.3% (*n*= 5) of the CWTs recovered were from coho that were released from upper Wenatchee River acclimation ponds as juveniles. The proportion of naturally spawned fish was 5.0% (*n* = 1). Due to predation and decomposition, CWTs could not be recovered from 12 carcasses.

Table 9. Summary of carcass distribution and origin throughout the Wenatchee River and its tributaries, 2013.

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
Upper Wenatchee	LNFH SFL 22-24 (overwintered)	-	-	-	1	-	-	-	-	-	-	**1**
	LNFH LFL 1, 2	-	-	-	2	-	-	-	-	-	-	**2**
	LNFH SFL 23-25	-	-	-	2	-	-	-	-	-	-	**2**
	LNFH SFL 8,9,19-21	-	-	-	1	-	-	-	-	-	-	**1**
	LNFH SFL 8-12,16,18-20	-	-	-	4	4	-	-	-	-	-	**8**
Upper Wenatchee	Beaver Creek Acc. Pond	-	-	-	1	2	-	-	-	-	-	**3**
	Rolfing's Acc. Pond	-	-	-	1	-	-	-	-	-	-	**1**
	Nason Creek Wetlands	-	-	-	-	1	-	-	-	-	-	**1**
Natural Origin		**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**
Unknown Hatchery		**-**	**-**	**-**	**6**	**6**	**-**	**-**	**-**	**-**	**-**	**12**
Out-of-Basin Hatchery		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0**
TOTAL		**3**	**4**	**0**	**58**	**49**	**0**	**0**	**0**	**0**	**1**	**115**

Table 10. Origin, determined by scale analysis, of carcasses without CWTs recovered in the Wenatchee River Basin, 2013.

Carcass Recovery Location	Origin		
	Unknown Hatchery	Natural Origin	Unknown (unreadable scales)
Icicle Creek	4	0	2
Wenatchee River	5	1	1
Total = 13	**9**	**1**	**3**

3.1.1 Icicle Creek

A total of 14 surveys were conducted on the Icicle Creek main channel (I1) while the restored side channel was surveyed 15 times between October 2 and December 4. Bi-weekly surveys were conducted on the Icicle River into early November in lieu of upper-basin reaches. The Icicle River between the headgate and the hatchery intake was covered initially but discontinued after 5 surveys due to lack of coho activity. YN personnel recorded 48 redds in the main channel and 25 redds in the restored channel (Icicle Creek Total = 73). Redds recorded in Icicle Creek represented 67.6% of the total number found in the Wenatchee River basin (Table 8).

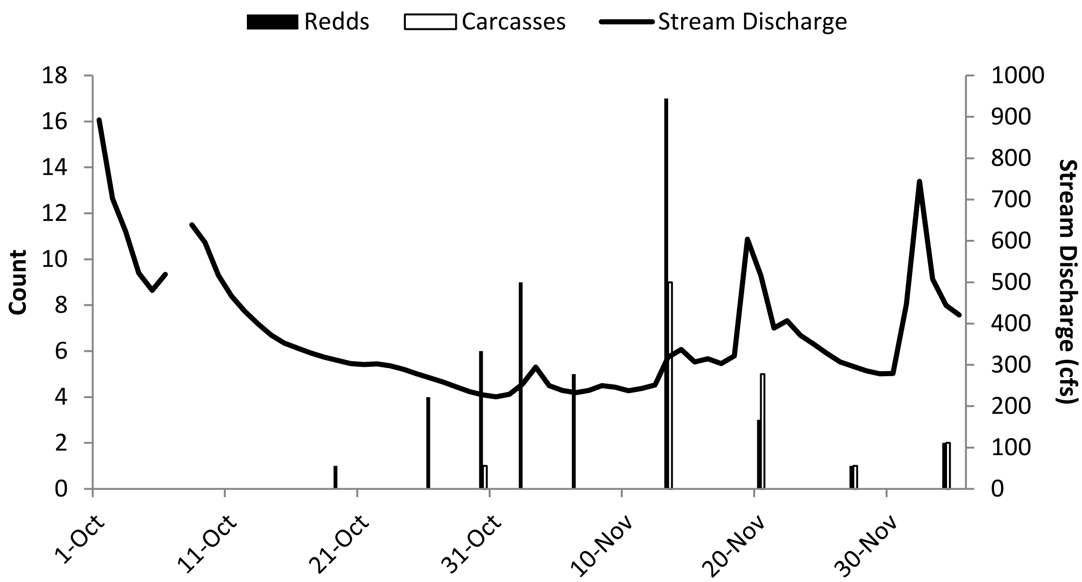


Figure 5. Weekly redd counts conducted in Icicle Creek from October 1 through December 5, 2013.

YN recovered 18 coho carcasses (7 male and 11 female) from Icicle Creek for a sample rate of 0.8%. Mean POH lengths for male and female carcasses were 41.8cm (*n* = 5; *SD* = 12.7*)* and 54.1cm (*n* = 7; *SD* = 3.7), respectively. Among female carcasses that were intact and appeared to have died from natural causes (not predation) mean egg voidance was 68.4% (*n* = 5; *SD* = 0.3).

3.1.2 Wenatchee River

A total of 33 redds were recorded on the mainstem Wenatchee River from Lake Wenatchee to the Columbia River confluence (reaches 1-7), between October 7 and December 11 (Table 8). Lower Wenatchee River (W1 – W4) and the Tumwater Canyon (W5) surveys were conducted on a weekly basis. Surveys on Wenatchee River reaches above Tumwater Canyon (W6 & W7) were forgone until a sufficient number of coho (*n* = 15) were passed above the Tumwater Dam fish ladder. Once sufficient passage above the dam was noted, surveys on the upper Wenatchee were conducted every 14 days. All redds counted in the Wenatchee River were counted in the Lower reaches (*n = 33*), with no observations above the Icicle Road Bridge in Leavenworth. Redds located on the mainstem accounted for 30.5% of the total number of coho redds in the entire Wenatchee

River basin. YN personnel recovered 14 carcasses from the mainstem Wenatchee River for a sample rate of 17.7%. Mean POH lengths for male and female carcasses were 45.3cm (n = 4; SD= 5.5) and 52.9cm (n = 9; SD = 3.3), respectively. Mean egg voidance was 70.0% (n = 7; SD = 0.5) among sampled females.

Adults returning to the upper Wenatchee must migrate through the Tumwater Canyon where fish can be passed or collected at Tumwater Dam.   In 2013, the total number of adult coho counted at this facility was 206. Of these, 32 were allowed to pass upstream (174 coho were collected as hatchery broodstock). Subsequent to the allowed passage of coho upstream of Tumwater Dam, efforts were made to document spawning activity in the upper-basin reaches. However, challenging river conditions (poor visibility, high water levels) and low spawner escapement ultimately limited the number of coho observations that could be made in these reaches.

3.1.3 Nason Creek
Weekly surveys of Nason Creek were conducted between October 31 and November 29. As with all upper-basin reaches, surveys were postponed until sufficient passage of coho above Tumwater Dam was documented. During the survey period no coho redds, carcasses, or live fish were observed in Nason Creek.

3.1.4 Mission/Brender Creeks
YN conducted seven surveys of Mission/Brender creeks between October 7 and November 26. During this time only a single redd was documented in the survey area. There also were no live coho or carcasses observed in the reach. Despite its short length, the Mission/Brender Creek survey usually yields a high density of redds. The low incidence of coho in Mission/Brender was undoubtedly due in part to the low overall return of Wenatchee River fish. However, surveyors noted that the amount spawning habitat present in previous years was severely decreased due to heavy sedimentation. Throughout the survey season, high turbidity caused by fine sediment was observed even in times of decreased discharge. The deposition of sediment in the survey reach may have been the result a major fire occurring in the land bordering the upper reaches of Mission Creek in 2012. An illegal alteration to the bank by a private landowner within the reach may have also contributed to the sedimentation.

3.1.5 Peshastin Creek
Nine surveys were conducted on Peshastin Creek between October 3 and November 30 (Table 8). Only a single coho redd and a single live fish were observed during this time. The single redd located in Peshastin Creek represents 0.9% of the total documented in the Wenatchee River Basin during the year. There were no carcasses found in Peshastin Creek in 2013.

3.1.6 Chumstick Creek
A short section of the lower Chumstick Creek was survey on a weekly basis between October 7 and November 26. Although this area has hosted spawning activity in the past,

no redds or carcasses were counted in 2013. Coho observed in the lower sections of the creek showed no spawning activity and most likely returned to the mainstem Wenatchee River.

3.1.7 Roaring Creek

Roaring Creek was surveyed weekly between October 3 and October 31. This survey effort was part of an effectiveness monitoring plan for a nearby habitat restoration project. Surveys were discontinued after five surveys yielded no signs of coho activity.

3.2 METHOW BASIN REDD COUNTS

In the Methow River basin, a total of 50 coho redds were identified and a total of 30 carcasses were collected for an overall sample rate of 23.1%. Majority of redds were located in the mainstem Methow River (*n* = 18) and associated outfalls of Winthrop NFH and Methow FH (*n* = 21). For a spawning ground summary for the Methow Basin, please see Table 11.

Table 11. Summary of Methow River coho redd counts, distribution and carcass recovery in 2013.

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 R.	1	17	0	18	2	3	0	5	1	13	1	15	32.1%
Winthrop NFH	3	14	2	19	10	15	6	31	0	8	1	9	18.2%
Methow FH	1	1	0	2	0	2	0	2	0	0	0	0	0.0%
Gold Creek	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
Twisp R.	4	7	0	11	1	0	0	1	0	6	0	6	21.0%
Total	9	39	2	**50**	13	20	9	**39**	1	27	2	**30**	**23.1%**
Out of Basin													
Chelan FH outfall (Beebe Springs).	0	0	0	0	0	0	3	3	0	0	0	0	0.0%
Total	0	0	0	**0**	0	0	0	**3**	0	0	0	**0**	**0.0%**

[a] – *Sample rate is based on a sex ratio of 1.6M: 1.0F observed as swim-ins to Winthrop NFH. Sample rate was calculated as Carcasses/Sex Ratio x Redd Count = Escapement.*

A total of 30 carcasses were recovered in the Methow River basin with 50.0 % (*n* = 15) being found in the mainstem Methow River. CWT analysis of 19 confirmed and recovered tags revealed that 11 and 6 of the recoveries originated from Winthrop NFH and Lower Twisp Ponds releases, respectively. The remaining two were released from 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, 2013.

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	-	5	-	-	6	-	11
	Winthrop NFH Back Channel	-	-	-	-	-	-	-
	Lower Twisp Ponds	-	2	-	3	1	-	6
Out of Basin	Wells Fish Hatchery	1	-	-	-	1	-	2
TOTAL		**9**	**7**	**-**	**3**	**8**	**-**	**19**

Table 13. Origin of carcasses without CWTs recovered in the Methow River Basin, 2013.

Carcass Recovery Location	Origin[a]		
	Unknown Hatchery	Unknown Origin (unreadable scales)	Natural Origin
Methow River	6	-	1
Twisp River	2	-	1
Spring Creek	1	-	-
Total = 8	**9**	**-**	**2**

[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 18 coho redds were identified on the mainstem; 5 and 13 redds identified in the lower and middle reaches, respectively. Fifteen carcasses were identified during surveys; 14 females and 1 male. Fork lengths and POH for females was 64.7cm (*SD* = 3.1) and 51.5cm (*SD* = 2.4) while the lone male recorded a fork length of 59.0cm and a POH of 47.0cm. All females with intact body cavities were examined for presence of eggs. Mean egg voidance for females recovered was 80.6% (*n* = 14). Two of these females possessed intact egg skeins and were determined to be pre-spawn mortalities. Carcass recovery rate for the mainstem Methow River was 32.1% (Table 11).

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 7 and ending December 19. The Winthrop NFH complex (on-station raceways and back-channel pond) continues to function as the primary release location in the Methow River basin, 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 19 redds were located within Spring Creek between mid-October through mid-December. Five males and four females were sampled with a mean FL of 59.8cm (*SD*=4.3) and 65.5cm *(SD*=4.8) and a mean POH of 49.5cm (*SD*=4.5) and 54.0cm (*SD*=7.6), respectively.

A total of 2 redds were identified within the Methow FH outfall between mid-October through late-December. Zero carcasses were identified in this location.

3.2.3 Twisp River

Twisp River surveys were conducted between October 6 and November 17. Surveys included six reaches extending from War Creek Bridge (RK 28.5) to the confluence with the Methow River (RK 0.0). Survey reaches TR 1-3 were prioritized and surveyed twice weekly between October 6 and November 17. The frequency of spawning surveys within these reaches was increased, previously 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. Survey reaches TR4 and TR5 were surveyed twice, during peak and post- peak spawn between November 1 and 17. One survey was conducted in TR 6 during peak spawn on November 1. A total of 11 redds were located, of which, 8 were located upstream from the Twisp Ponds acclimation site between RK 11.4 and RK 1.7. 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. One male was sampled with a FL of 54.0cm and POH of 43.0cm, and five females with mean FLs of 63.0cm (*SD* = 4.0) and mean POHs of 56.0cm (*SD* = 8.4), respectively. Mean egg voidance was 89.4% ($n = 5$) and the carcass sample rate was 21.0% for the Twisp River (Table 11).

3.2.4 Gold Creek

Gold Creek surveys were conducted twice; once before, and once after peak spawn between October 10 and December 12. 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. There were no redds identified, live fish observed or carcasses recovered within this tributary

3.2.5 Chelan FH Outfall (Beebe Springs)

Survey efforts outside of the Methow Basin were limited to the Chelan FH outfall in 2013 due to the need for increased staff time for broodstock collections and spawning surveys in the target basin. Surveys occurred twice after peak spawn between December 3 and 11, in an effort to account for fish returning from 2012 Wells FH smolt releases and potential dropouts associated with in-basin releases (would only be verified through CWT extraction from carcass recoveries). Surveys were conducted as one reach, from the Columbia River confluence upstream to the Chelan Falls FH diversion. Three live fish were identified with zero redds or carcasses observed.

4.0 SMOLT ACCLIMATION: WENATCHEE AND METHOW

4.1 ACCLIMATION SITES

In 2013, within the Wenatchee River basin, YN acclimated coho pre-smolts at LNFH, Beaver Creek and three 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 2013, acclimated coho pre-smolts were reared and released from three sites on Nason Creek; Coulter Creek, Rohlfing's Pond and 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. Three 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

2013, a barrier net was used to encircle the majority of the channel to contain the coho during the acclimation period. 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).

4.1.3.4 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 2013, 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.

4.1.7 Gold Creek Acclimation Pond

The acclimation site is comprised of a series of four, man-made ponds on private property adjacent to South Fork Gold Creek, located at RK 1.0 from the confluence with Gold Creek. The site is intended to provide an additional release location in-basin, prior to the initiation of the Natural Production Implementation Phase (NPIP) of the program in 2017. Pre-transfer, individual seine nets within each pond were moved, shore outward and installed to segregate incoming hatchery pre-smolts from potential interactions with naturally produced juveniles inhabiting the same pond complex while providing migratory access. Once the net was in-place, staff members conducted a snorkel survey and confirmed absence of fish within the contained area. Additional surveys were conducted throughout the acclimation period to ensure the acclimation net was secure, as well as determine if use, primarily outside of the contained area, occurs by different species during the acclimation time period. Three PIT tag detection systems were installed, in series, below the pond's outfall to monitor escapees as well as providing outmigration success and survival.

4.1.8 Wolf Creek Acclimation Pond

Coho acclimation at this location is intended to provide an additional release location, similar to Gold Creek Ponds, to increase the proportion of in-basin program releases. Seine net installation and snorkel surveys followed the same protocols as identified above "***Gold Creek Acclimation Pond (4.1.6)"***. Juveniles at this location were not PIT tagged due to the site's proximity to Winthrop NFH (< 2.0 RK) when looking at Methow River residence time as well as sufficient years' worth of historical site data to provide estimate in-pond survivals.

4.2 TRANSPORTATION AND VOLITIONAL RELEASE

4.2.1 Wenatchee River Basin

Mid-Columbia coho pre-smolts (BY2011) were transported to the Wenatchee River basin from rearing facilities at Willard NFH and Cascade FH between December 3, 2012 and April 1, 2013. Coho were acclimated between 5 and 20 weeks at five acclimation sites

All coho smolts acclimated at LNFH were force-released between April 24-26. One pond at LNFH was held until May 7 to test the ability to use secondary water supplies to keep coho on-station longer. 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, Coulter Creek Pond, Rohlfing's Pond, and Beaver Creek Pond from May 1 through 9. All acclimation facilities were deemed empty by June 161.

Coho released in 2013 were CWT'ed with a 98.4% (*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 98.0% (*n*=10,000) retention. This secondary mark provided the means to implement Broodstock Development Phase II (YN FRM 2012) 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 2013, 27,996 coho juveniles were marked with PIT tags prior to transfer to acclimation sites. 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). A minimum of two PIT tag detection systems were installed in series at each of the upper basin acclimation sites to ensure maximum detection efficiency.

A total of 899,245 hatchery produced coho smolts were released from the Wenatchee River basin in 2013. 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 (BY2011) were acclimated in-basin at Winthrop NFH on-station raceways, Winthrop NFH back-channel pond, Lower Twisp, Gold and Wolf Creek acclimation ponds. Out-of-basin acclimation occurred at Wells FH. Juvenile coho were transported by Oregon Department of Fish and Wildlife (ODFW) personnel to all four acclimation ponds between March 6 and April 1. Additionally, ODFW transported coho pre-smolts to Wells FH on March 7. 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 15 and May 6. A follow-up forced release was initiated on May 9 at Winthrop NFH to allow sufficient time for staff to conduct routine raceway maintenance prior to transferring BY2012 juveniles out of the nursery tanks. Emigrations from all acclimation ponds were visually determined complete by June 13. A forced release was initiated for juveniles rearing at Wells FH on May 2. CWT retentions from juveniles acclimating on-station at Winthrop NFH and within the Winthrop NFH back-channel were 99.4% and 96.5%, respectively. Juveniles acclimated at Lower Twisp, Gold and Wolf Creek ponds were 96.9%, 97.5%, and 96.3%, respectively. CWT retentions from juveniles released from Wells FH were 96.4%. 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 555,314 coho juveniles were released for the Methow program (Table 14). For detailed mark information, see Appendix C. Juvenile releases in 2012 marked the sixth 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 2012).

Table 14. Mid-Columbia coho smolt release summary, 2013.

Location	Release Date	Release Number	Size @ release (FPP)	No. PIT Tags
Beaver Pond	May 1	89,733	15.4	5,133
Coulter Creek	May 9	50,822	15.9	5,448
Rohlfing's Pond	May 1	121,362	15.4	5,764
Nason Creek Wetlands	March 28	128,082	20.4	0
Leavenworth NFH LFL's (large Foster-Lucas Ponds)	April 24	180,673	18.4	4,318
Leavenworth NFH SFL's (small Foster-Lucas Ponds)	April 25&26; May 7	328,573	17.5	4,705
Wenatchee Total		**899,245**		**25,368**
Winthrop NFH (on-station)	April 22	249,330	16.4	5,902
Winthrop NFH (back-channel pond)	April 19	40,576	16.5	5,704
Twisp Ponds Complex	May 6	65,677	15.0	5,646
Gold Creek Ponds	May 6	35,420	16.2	5,894
Wolf Creek	May 6	65,394	17.1	0
Wells FH	May 2	98,917	14.3	0
Methow Total		**555,314**		**23,146**
Wenatchee/Methow Totals		**1,454,559**		**48,514**

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 Beaver Pond included blue herons, mallards, mink, and North American river otters. All of the piscivorous predators observed at Beaver Pond were also observed at Coulter 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 mink 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.

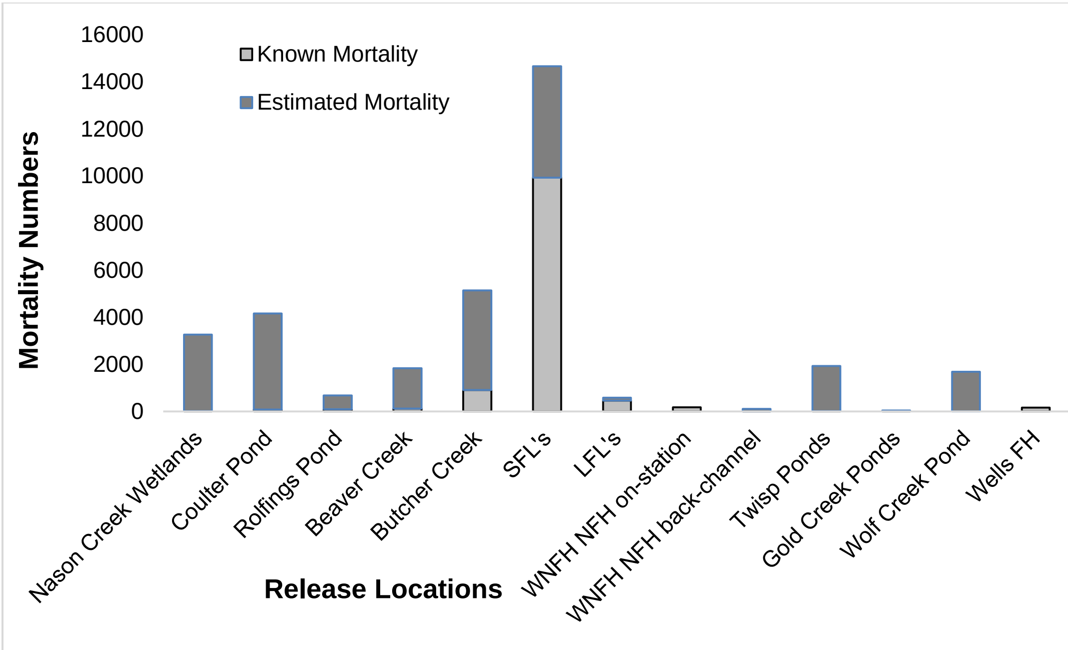


Figure 6. Known and estimated mortality at all acclimation sites in the Methow and Wenatchee river basins, 2013.

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 2013 acclimation, YN installed PIT tag antenna arrays at Rohlfing’s Pond, Coulter, Beaver Creek, 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.

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

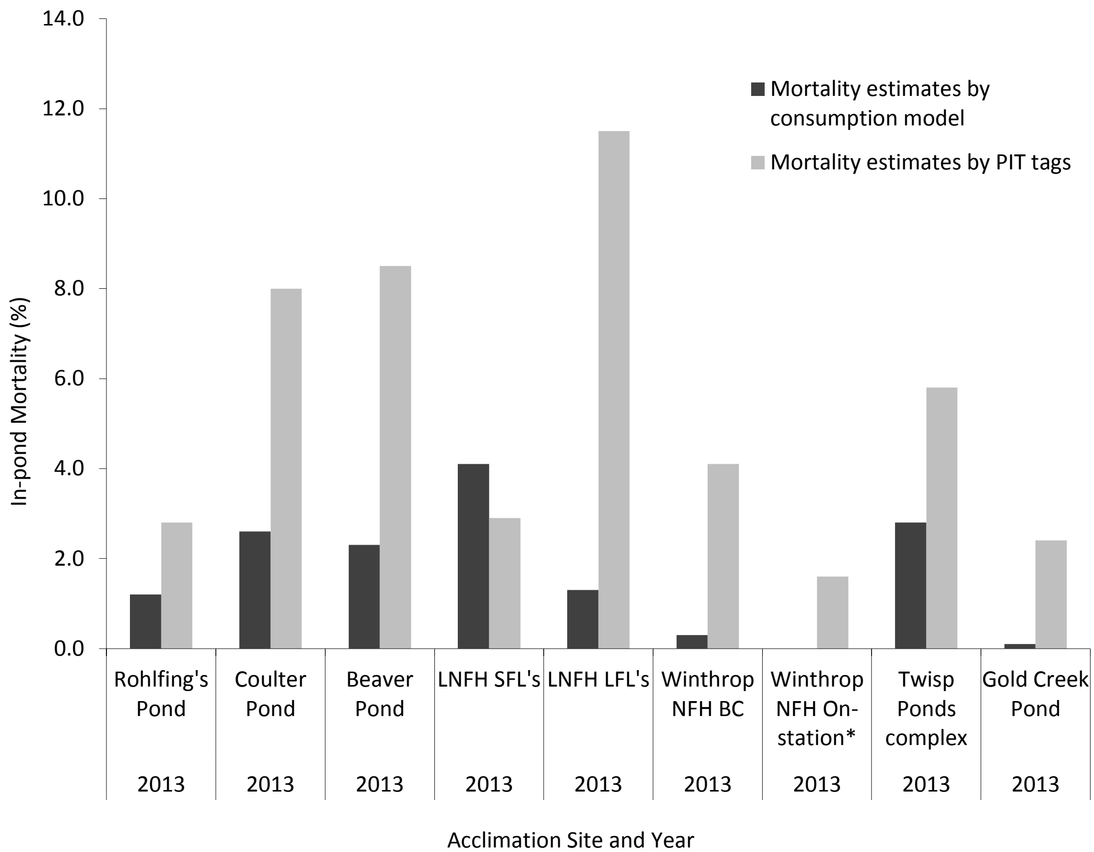
By querying the PTAGIS database for downstream PIT tag detections for fish released from a given acclimation pond we are able to estimate the efficiency of our antennas by determining the proportion of the fish detected downstream that were also detected exiting the pond. Estimates of detection efficiency 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, 2013.

	Rohlfing's Pond	Coulter Pond	Beaver Pond	LNFH SFLs	LNFH LFLs	Winthrop NFH back-channel	Winthrop NFH on-station	Lower Twisp Ponds	Gold Creek Ponds
Total PITs	5,912	5,919	5,610	4,846	4,880	5,976	5,995	5,968	5,976
Unique Outlet Detections	5,673	5,373	5,102	4,684	4,280	5,444	5,617	5,440	5,763
Unique Downstream Detections	1,460	877	2,937	902	900	2,389	2,652	2,381	2,735
Downstream and Outlet Detections	1,437	877	2,919	898	892	2,266	2,524	2,294	2,695
Detection Efficiency	98.4%	98.6%	99.4%	99.5%	99.1%	94.9%	95.2%	96.3%	98.5%
PITs released	5,764	5,448	5,133	4,705	4,318	5,740	5,902	5,646	5,849
In-Pond Survival	**97.2%**	**92.0%**	**91.5%**	**97.1%**	**88.5%**	**96.0%**	**98.4%**	**94.6%**	**97.9%**

A comparison of in-pond mortality estimates based upon PIT tags and predator consumption model expansions can be found in Figure 7 & 8. 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 2013, 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, 2013.

5.0 SURVIVAL RATES

5.1 Smolt Survival Rates – Release to McNary Dam

5.1.1 2013 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. Juvenile survivals for coho reared full-term at Cascade FH were not significantly higher than those released at the same acclimation site but reared at Willard NFH (e.g. - Rohlfing's Pond, LNFH LFLs). A summary of release-to-McNary survival rates for the 2013 releases can be found in Table 16.

Table 16. PIT tag release numbers and locations, 2013.

Basin	Release Tributary	Release Location	Rearing Facility	Brood Origin	*n*	McNary survival % (SD)
Methow	Spring Creek	WNFH Back-channel	Willard NFH	MCR	5,740	57.0 (8.4)
		WNFH On-station	Winthrop NFH	MCR	5,902	63.0 (8.9)
	Twisp River	Lower Twisp Ponds	Willard NFH	MCR	5,646	51.4 (6.4)
Wenatchee	Beaver Creek	Beaver Cr.	Willard NFH	MCR	5,133	48.6 (8.2)
	Nason Creek	Rohlfing's Pond	Cascade FH	MCR	2,861	55.4 (9.9)
			Willard NFH	MCR	2,903	42.1 (7.8)
		Coulter Creek Pond	Willard NFH	MCR	5,448	36.2 (3.9)
	Icicle Creek	SFL	Cascade FH	MCR	4,705	65.4 (8.2)
		LFL	Cascade FH	MCR	2,194	57.7 (8.7)
			Willard NFH	MCR	2,124	53.9 (9.3)

5.2 Smolt-to-Adult Survival Rates (SAR) for Brood Year 2010

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 2013, 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, 2013.

Method	Est. Run Size
1) Dryden Dam counts expanded for non-trapping days plus redds located below Dryden Dam[1]	895 (784 adults & 101 jacks)
2) Redd counts plus broodstock collected[1]	1,014 (938 adults & 76 jacks)
3)Tumwater Dam counts, redds below Tumwater Dam, and broodstock collected[1]	1,296 (1,219 adults & 77 jacks)
4) Mainstem Dam Counts[2]	2,079 (1,875 adults & 204 jacks)

[1]Each redd count was expanded by 2.8 fish per redd based on the sex ratio of coho observed at Dryden Dam, 1.8M: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, 2013.

Method	Est. Run Size
1) Redd counts plus broodstock collected [1]	371 (370 adults & 1 jacks)
2) Wells Dam Counts plus Wells Dam broodstock collected[2]	731 (724 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 2010 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	120	51,571	0.23%
	6 weeks	MCR	Willard NFH	6	24,024	0.03%
Coulter Cr. Pond	5 weeks	MCR	Willard NFH	22	66,361	0.03%
Nason Creek Wetlands	3 weeks	MCR	Willard NFH	13	46,911	0.03%
Rohlfing's Pond	7 weeks	MCR	Cascade FH	133	52,404	0.25%
	7 weeks	MCR	Willard NFH	13	23,687	0.05%
Butcher Cr. Pond	5 weeks	MCR	Cascade FH	94	99,565	0.09%
Leavenworth NFH: Large Foster Lucas Ponds	8 weeks	MCR	Cascade FH	262	183,177	0.14%
Leavenworth NFH: Small Foster Lucas Ponds	8 weeks	MCR	Cascade FH	311	231,905	0.13%
	8 weeks	MCR	Willard NFH	36	79,525	0.05%
TOTAL		**MCR**		**1,011**	**859,130**	**0.12%**
Naturally Produced Coho[c]		**MCR**	**N/A**	**10**	**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 1,066 fish (method 3) was used in the calculation of BY2010 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 2010 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	186	264,725	0.07%
WNFH Back	5 weeks	MCR	Willard	12	42,741	0.03%

Channel		(Methow)	NFH			
Twisp Ponds	6 weeks	MCR (Methow)	Willard NFH	87	66,405	0.13%
Wells FH	6 weeks	MCR (Methow)	Willard NFH	74	92,228	0.08%
Total				**359**	**466,099**	**0.08%**
Naturally Produced Coho			**N/A**	**12**	**1,618**	**0.76%**

[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 371 fish (method 1) was used in the calculation of BY2010 SARs for returns to the target watershed (Methow basin). All SARs should be considered provisional until the natural origin run component is determined.

A comparison of smolt-smolt survival and smolt-to-adult survival across years (1999 through 2013) can be found in Table 21.

Table 21. Hatchery comparison of smolt-to-smolt and smolt-to-adult survival rates, brood years 1997-2011.

Brood Year	Release Year	Methow R. Smolt Survival	Icicle Creek Smolt Survival	Upper Wen. 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%-	49.9%-	37.4%-	2011	0.13%-	0.32%-

		79.9%	77.0%	84.1%		0.41%	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	0.03%-0.13%	0.03%-0.23%
2011	2013	51.4%-63.0%	53.9%-65.4%	36.2%-55.4%	2014	0.17%-0.60%	0.21%-1.04%

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 2013; results are briefly summarized below.

- Between September 1 and November 22, YN collected 895 coho at Dryden Dam, Leavenworth NFH and Tumwater Dam on the Wenatchee River. At Winthrop NFH, Methow FH adult weir and Wells Dam, 277 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 876 coho at Leavenworth NFH and 519 at Winthrop NFH. An eye-up rate of 84.9% was calculated for the Wenatchee program and 82.7% 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 2013, YN found a total of 108 coho redds; 73 redds in Icicle Creek, 33 redds in the Wenatchee River, and a combined 2 redds in Mission and Peshastin creeks.

- During spawning ground surveys in the Methow Basin for 2013, YN found a total of 50 coho redds; 19 in Spring Creek (Winthrop NFH back-channel), 18 in Methow River, 11 in the Twisp River, and 2 located in WDFW Methow FH outfall.

- Acclimating pre-smolts on local waters is an essential component to the restoration program. Smolt release numbers for the Methow and Wenatchee rivers in 2013 were 555,314 and 889,245 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 95.7%. In the Wenatchee basin, overall, mean survival was 94.0% from transport to release. 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 BY2010 hatchery coho smolts released in the Wenatchee River basin was 0.12% (1,021 adults and jacks) for all release groups. Smolt-to-adult survival rate varied between release groups (range 0.03% - 0.25%). Using scale analysis for verification of fish origin, we estimated that 10 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 BY2010 hatchery coho was 0.08%. The SARs for each release group ranged from 0.03% to 0.13% (370 adults and 1 jack). These SARs calculations included releases from Wells FH that contributed 2.0% (*n*=4) of fish collected in the analysis. Using scale analysis for verification of fish origin, we estimated that 12 adults originated from natural production.

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, Robert Farley, Jason Hickman, Angela Wynne, Andrew Carr, Connor Parrish, Casey Heemsah, Leonard Blake, Ryan Peters, Ashton Bunce 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. 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: 2013 NASON CREEK SMOLT TRAP REPORT

Population Estimates for Juvenile Salmonids in Nason Creek, WA

2013 Annual Report

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ABSTRACT

In 2013, 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, 2013. We collected 6,567 spring Chinook salmon, 2,678 summer steelhead, 4 bull trout, and 89 coho; all of natural origin and varying age classes. Daily fish abundances for spring Chinook, steelhead, and coho were expanded by stream discharge-to-trap efficiency regression. All estimates were made with a 95% confidence interval (CI) with total emigration estimates for BY2011 spring Chinook juveniles and coho juveniles of 20,406 (± 3,890) and 2,281 (± 531), respectively. We estimated the total BY2010 summer steelhead emigration at the trap to be 13,483 (± 3,221). Egg-to-emigrant survival rates for BY2011 Chinook and BY2011 coho were 2.4% and 0.8%, respectively. The egg-to-emigrant survival rate for BY2010 summer steelhead was 0.9%. Productivity, as measured by emigrants-per-redd, for spring Chinook, summer steelhead, and coho was 120, 50 and 26, respectively.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

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 Elaine Bianchi, Matthew Clubb, Jamie Hallman, Arlene Heemsah, Barry Hodges, Tim Jeffris, Greg Robison, and Kevin Swager 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 Peter Graf (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 on a limited basis solely for hatchery coho predation studies. This project is a cost share between the YN's Mid-Columbia Coho Reintroduction and Grant County PUD's Hatchery Monitoring Plan. Trap operations were conducted in compliance with ESA consultation specifically to address abundance and productivity of spring Chinook, steelhead trout, and coho salmon in Nason Creek.

Within this document we will report:

1) Juvenile abundance and productivity of spring Chinook salmon (tkwínat) *Oncorhynchus tshawytscha*, steelhead trout (shúshaynsh) *Oncorhynchus mykiss* and coho salmon (súnx) *Oncorhynchus kisutch* in Nason Creek.

2) Emigration timing of spring Chinook salmon, steelhead trout and coho salmon emigrating from Nason Creek.

The data presented will be directly used to address Objective 2 in the Monitoring and Evaluation Plan for PUD Hatchery Programs (Hillman et al. 2013) on a 5-year analytic cycle:

Objective 2: Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks (Hillman et al. 2013).

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 2013, mean daily discharge for Nason Creek was 390 cfs with mean daily stream temperatures ranging from 0.0°C to 19.6°C (Figure 2 & 3). Spring snowmelt brought on several early discreet spikes in discharge levels. These brief high water events however did not persist for an extended period of time.   Flow levels remained near the 11-year mean cfs for the majority of the trapping season. Water temperature in Nason Creek also closely followed the 11-year daily mean with no major anomalies.

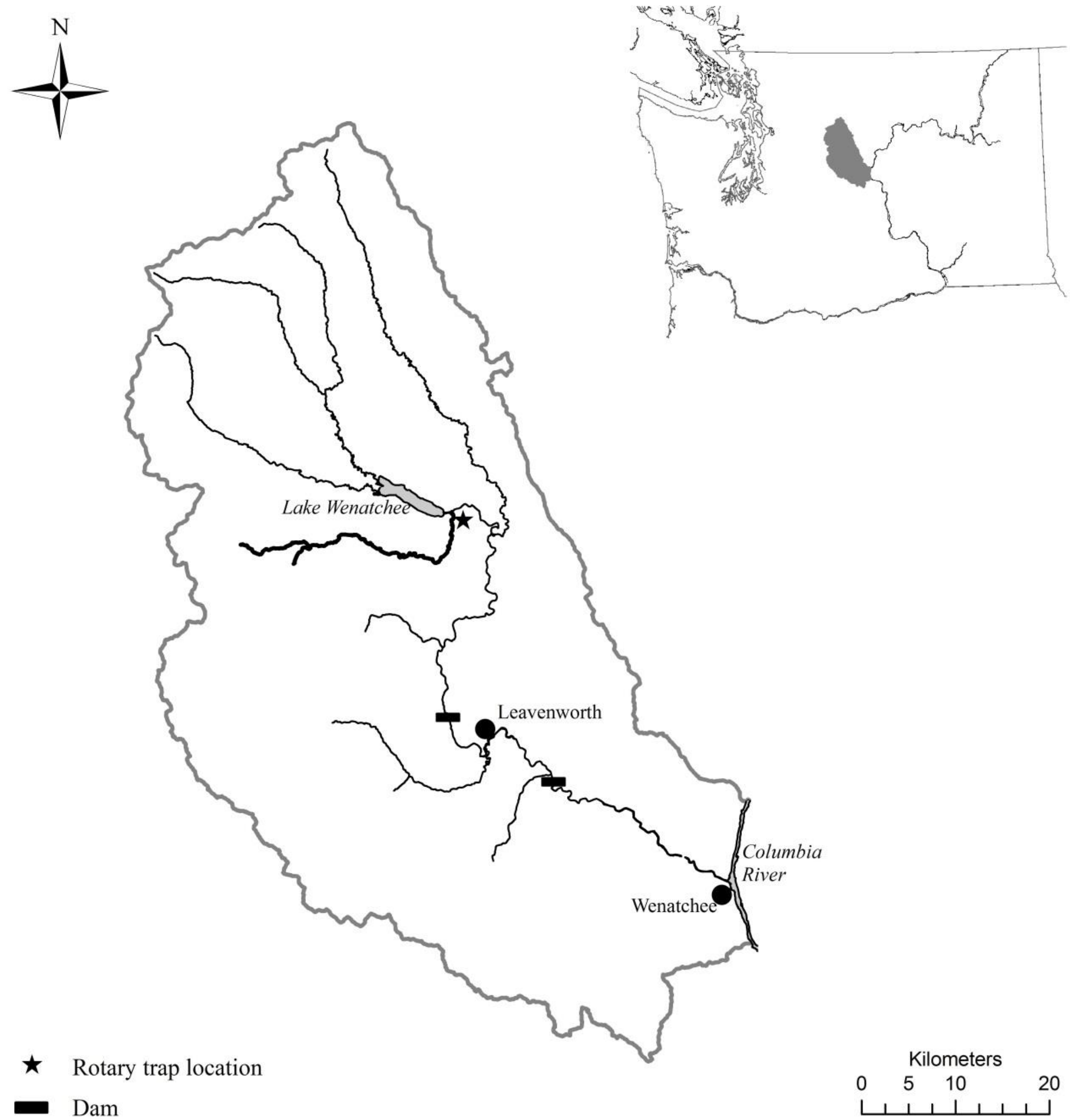


Figure 8. Map of Wenatchee River Subbasin with the Nason Creek rotary trap location.

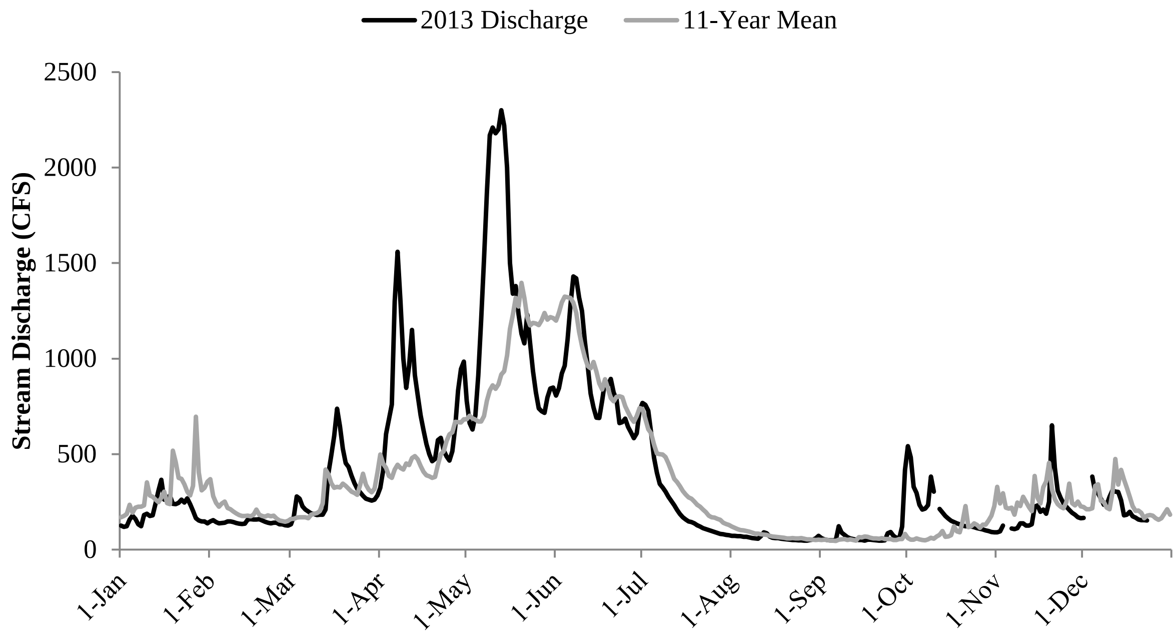


Figure 9. Mean daily stream discharge at the Nason Creek WDOE stream monitoring station in 2013.

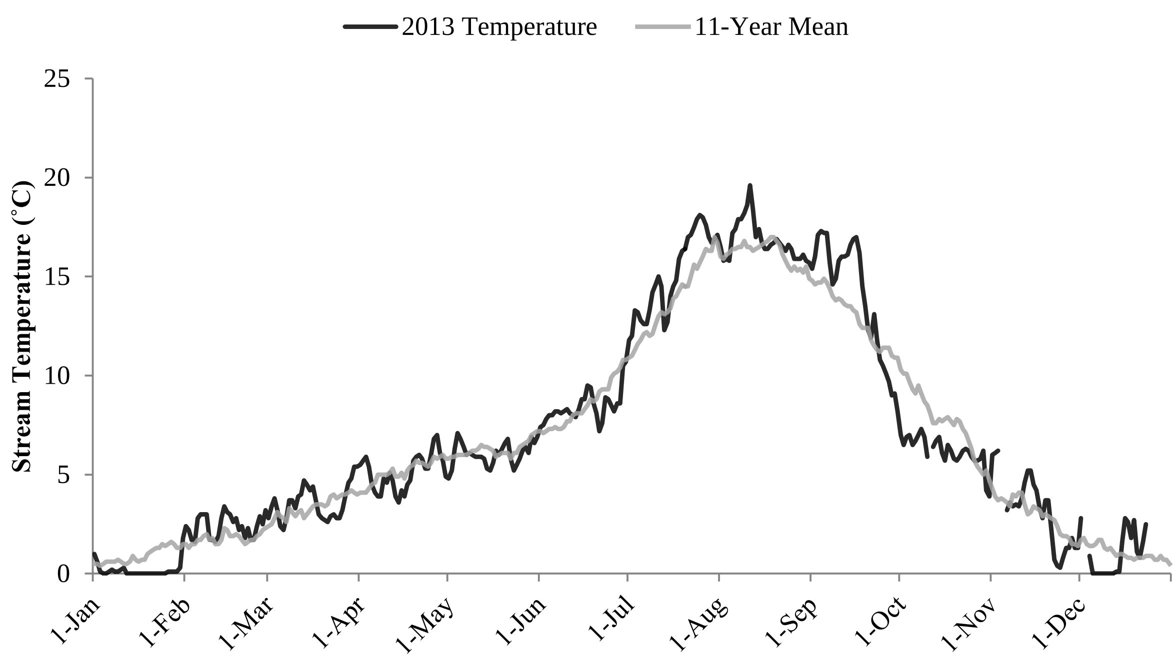


Figure 10. Mean daily water temperature at the Nason Creek DOE stream monitoring station in 2013.

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 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.

Previous years employed the use of alternative trap positions during periods of extreme low discharge levels (≤50cfs). However, in 2013 a revised trapping regime was implemented to simplify data analysis by eliminating obsolete trap posistions that generated very little data. By operating the trap in a single position thoughout the season, we minimized the number of models required to estimate emigration . The Nason Creek smolt trap was operated successfully in the "back" position for the entire season until base flows were reached.

The Nason Creek smolt trap was operated continually 24 hours per day, 7 days per week for the majority of the season. During spring snowmelt, operations occurred only during hours of darkness in order to minimize trap damage and capture mortality, while retaining the ability to sample during periods of peak fish movement. In response to previous incidence of vandalism towards the smolt trap, daytime operations were greatly abbreviated during periods of peak visitation at the surrounding campgrounds (July 1 to September 30). By pulling the cone during the majority of the day, we hope to dissuade acts of vandalism as well as decrease potential danger to the public. Past observations at the Nason smolt trap have indicated that the effect of suspended trapping during hours of daylight on capture rates is negligible, presumably due to limited daytime fish movement.

During periods when the trap was not operating (e.g. high discharge, high debris or mechanical malfunction), 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.

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. 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 (at the request of GCPUD) 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 12.5mm Digital Angel 134.2 kHz type TX 1411ST PIT tag was inserted into the body cavity. PIT tags and needles were stetrilized by soaking 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 at nautical twilight from an automated release box.

2.4 Mark-Recapture Trials

Groups of marked juveniles were released during a range of stream discharges in order to determine the trapping efficiency. PIT tags were primarily used to mark wild and hatchery-origin fish although two hatchery coho trials were performed using caudal clips. These releases followed the protocols described in Hillman (2004), in which the author suggests a minimum sample size of 100 fish for each mark-recapture trial. Although 100 fish/trial represented the ideal mark group, low abundance of fish often required mark-recapture trials be completed with smaller sample sizes. To achieve the largest marked group possible, we combined 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 or floating holding boxed anchored to the stream bank. A pre-season, minimum mark group size for each species/life stage was initially determined based on past regression models. In light of high abundance, minimum trial sizes could be raised to a more robust mark group with the intention of strengthening existing regression models.

Each mark-recapture trial was conducted over a three-day (72 hour) period to allow time for passage or capture. Completed trials were only considered invalid if an interruption to trapping occurred or proper pre-release procedures were not followed. Trials resulting in zero recaptures were included in the efficiency regression (if determined valid once vetted through release/recapture protocols) as allowed by the new method of observed trap efficiency calculation. The model used (Bailey) employs use of recaptures +1 in the calculation of efficiency as a mode of bias correction. As a result, even trials yeilding no recaptures can be included in regression modeling (See equation 3 in **2.5.1 Estimate of Abundance**).

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:

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

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:

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

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:

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

where $V\hat{a}r(b_0 + b_1 flow_i) = M\hat{S}E\left(1 + \frac{1}{n} + \frac{\left(flow_i - \overline{flow}\right)^2}{(n-1)s_{flow}^2}\right)$, and $\hat{V}ar(b_0)$ and $\hat{V}ar(b_1)$ 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:

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

where $\hat{\bar{e}}$ = 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:

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

where $\overline{m}$ 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 = $1.96 \times \sqrt{\sum \mathrm{var}\left[\hat{N}_i\right]}$

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, estimates of fall migrant parr were added to subsequent spring smolt estimates to generate a single brood year estimate. For steelhead, a single brood year may require up to three years for emigration from Nason Creek to occur. Pending scale analysis, steelhead captured in 2013 were aged via an age-length histogram built upon previously analyzed scale samples. For all three species, egg-to-emigrant estimates were calculated by dividing estimated emigrants by approximated egg deposition during a spawning brood (average fecundity used to determine egg deposition derived from WDFW Chiwawa broodstock 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 28, 2013 (started on March 1) and removed on December 2 (stopped on November 30). The trap was operated continuously 24 hours a day, 7 days per week including periods of extreme high flows (>2,000cfs) associated with spring snowmelt. Trap stoppages were relatively few despite the accumulation of downed tress within the channel caused by a major snow event during the previous winter. Suspended trapping from mid-August to mid-September was the result of a period of extreme low flows when cone rotation was not possible (Table 1).

Table 22. Summary of Nason Creek rotary trap operation.

Date of Trap Operations	Trap Status	Description	Days
March 1 to June 30	Operating	Continuous data collection.	121
	Interrupted	Interrupted by debris, ice and/or low flows.	1
	Pulled	Intentionally pulled to prevent harm to fish or protect the trap during high flows.	0
July 1 to November 30	Operating	Continuous data collection.	106
	Interrupted	Interrupted by debris and/or low flows.	5
	Pulled	Intentionally pulled due to low discharge levels or ice formation	42

3.2 Daily Captures and Biological Sampling

3.2.1 Spring Chinook Yearlings (BY2011)

Between March 1 and June 30, a total of 239 wild Chinook yearlings were captured at the trap (Figure 4). The majority of these fish were collected prior to spring snowmelt, with peak catch occuring on April 2. Following a significant increase in stream discharge, capture numbers dropped substantially with the last emigrating Chinook yearling captured on May 15. The trap was operated without interruption making daily catch estimates obsolete during this period. Mean FL and weight for Chinook yearlings was 90.6mm (*n* = 239; *SD* = 7.5) and 7.9g (*n* = 239; *SD* = 2.1; Table 2), respectively. Tissue sample were collected from 236 fish for an ongoing, parental-based DNA analysis by WDFW. There were no yearling Chinook mortalitites.

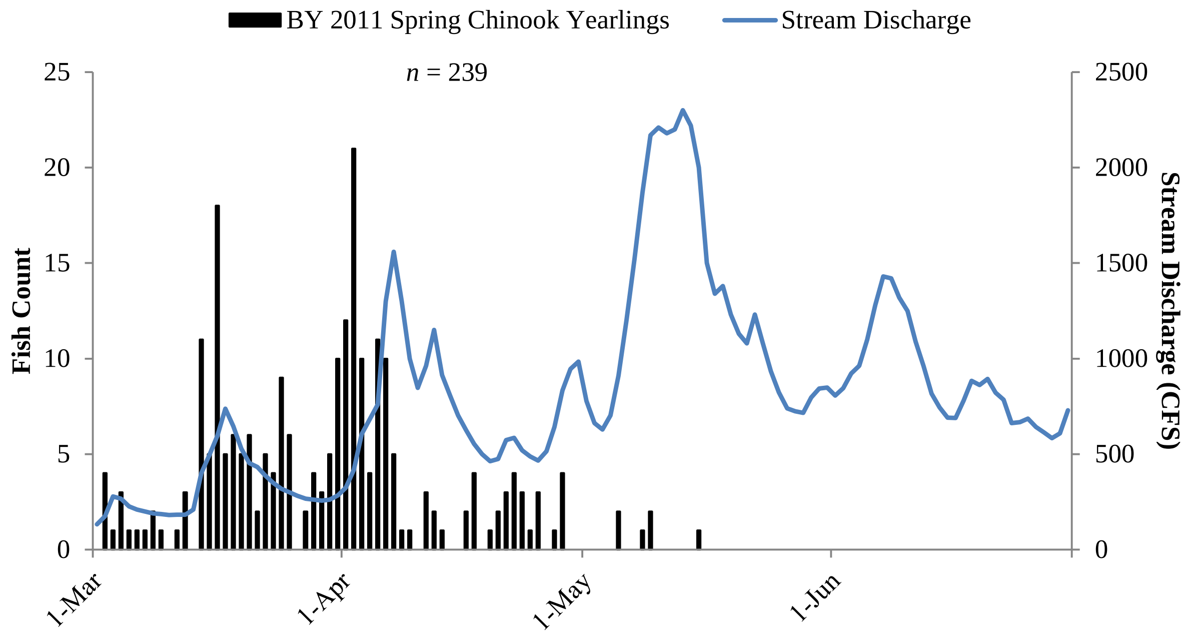


Figure 11. Daily catch of BY2011 spring Chinook yearlings with mean daily stream discharge at the Nason Creek rotary trap, March 1 to June 30, 2013.

Table 23. 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	
2011	Wild Chinook Yearling Smolt	90.6	239	7.5	7.9	239	2.1	1.1
2012	Wild Chinook Subyearling Fry	45.6	1,824	6.8	1.0	1,803	0.6	1.1
2012	Wild Chinook Subyearling Parr	70.0	4,422	11.4	3.8	4,409	1.7	1.1

3.2.2 Spring Chinook Subyearlings (BY2012)

A total of 4,461 wild spring Chinook subyearling parr were captured between July 1 and November 30, with an additional 1,867 subyearling fry captured prior to July 1 (Figure 5). A peak daily capture of 196 subyearling Chinook parr occurred in mid-July as snowmelt driven high water subsided. As discharge levels dropped, daily catch of Chinook parr decreased accordingly until trapping was suspended in mid-July due to low-flow conditions (Table 1). Resumed trapping in September successfully captured an additional two peaks in migration before operations were discontinued for the season. Mean FL and weight among fall subyearling parr was 70.0mm (*n* = 4,422; *SD* = 11.4) and 3.8g (*n* = 4,409; *SD* = 1.7), respectively. We estimate that an additional 555 Chinook subyearling parr would have been captured if the trap had been operated without interuption during this period: 282 Chinook during short discreet stoppages (≤3days in duration) and 273chinook during the prolonged suspension due to low flow. Estimated catch during extended non-trapping periods were likely an overestimate however, with average flow (54cfs) within the period being less that the three days before and after (83cfs). A total of 45 subyearling Chinook (12 fry and 33 parr) mortalities occurred in 2013. Causes of death included trapping mortality, tagging/handing mortality, and pre-existing fungal infection/poor condition.

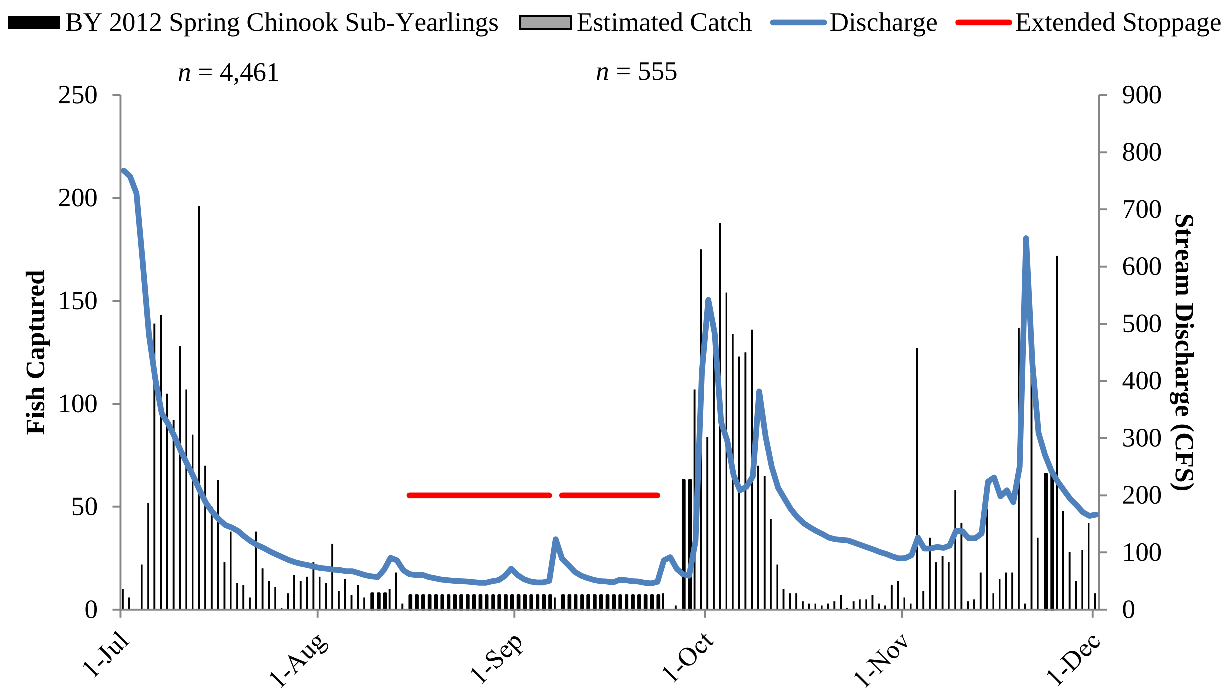


Figure 12. Daily catch of BY2011 spring Chinook subyearlings with mean daily stream discharge at the Nason Creek rotary trap, July 1 to November 30, 2013.

3.2.3 Summer Steelhead

A total of 2,678 wild summer steelhead juveniles were captured throughout the season from March 1 to November 30 with a peak catch of 170 fry on September 29 (Figure 6). We estimated that an additional three juveniles would have been captured if there had been no interruptions to trapping during the migratory period (Mar 1 to July 31). Histogram analysis of known steelhead ages sampled from 2005 to 2012 allowed us to estimate ages of fish captured in 2013 using FL. We estimate that of the total steelhead captured, 878 were young-of-the-year, 1,777 were age-1, and 21 were age-2. Two steelhead did not have FL measurements taken and could not be aged. Subyearling steelhead had a mean FL of 56mm (*n* = 878; *SD* = 11.3), and a mean weight of 2.1(*n* = 777; *SD* = 1.1). The majority of steelhead juveniles captured were age-1 parr emigrating past the trap in spring. Mean FL and weight of age-1 fish was 77mm (*n* = 1,777; *SD* = 14.7; Table 3) and 5.4g (*n* = 1772; *SD* = 4.2), respectively. Age-2 steelhead were caught throughout the year with a daily maximum catch of only two fish. Mean FL and weight of age-2 fish was 144mm (*n* = 21; *SD* = 15.7) and 31.6g (*n* = 21; *SD* = 10.2), respectively. Tissue samples were obtained from 1,952 fish, ranging in size from 60mm to 225mm. Scales were taken from a sub-sample (*n* = 947) to be used for future age analyses. There were seven steelhead mortalities (See **3.6 ESA Compliance**).

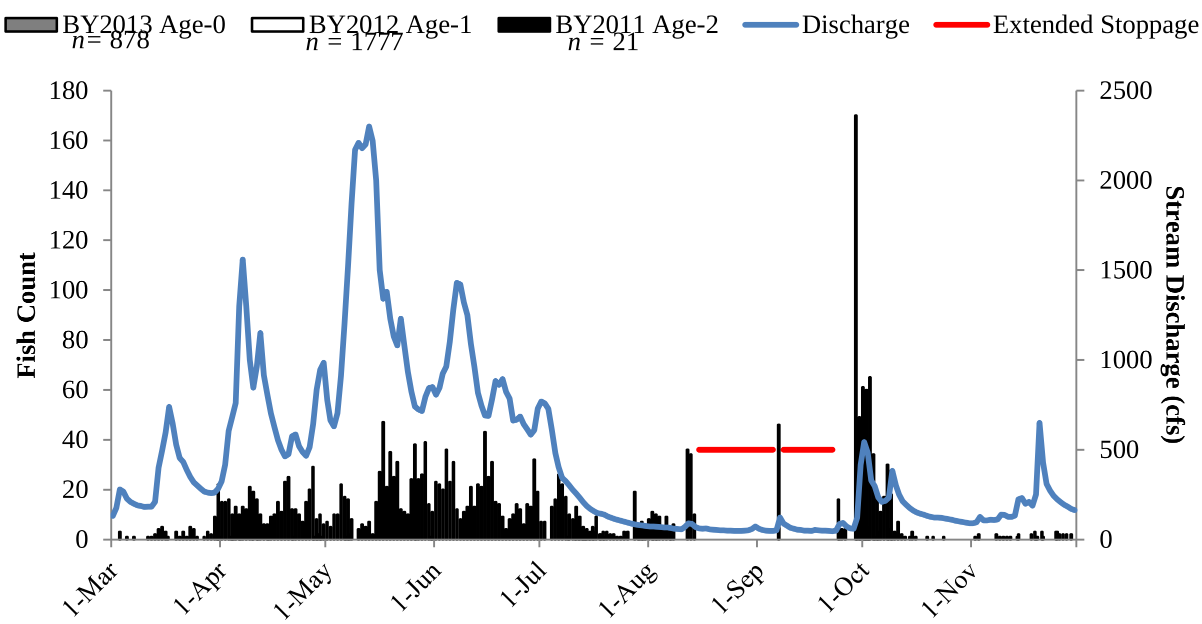


Figure 13. Daily catch of wild summer steelhead with mean daily stream discharge at the Nason Creek rotary trap, March 1 to November 30, 2013. Estimates of fish passage during trap interruptions are not depicted.

Table 24. 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	
2013	Wild Summer Steelhead (Age-0)	56.1	878	11.3	2.1	777	1.1	1.2
2012	Wild Summer Steelhead (Age-1)	77.5	1777	14.7	5.4	1772	4.2	1.2
2011	Wild Summer Steelhead (Age-2)	144.7	21	15.7	31.6	21	10.2	1.0
2010	Wild Summer Steelhead (Age-3)	—	—	—	—	—	—	—
2012	Hatch. Summer Steelhead Smolt	166.2	365	21.4	49.2	363	18.2	1.1

3.2.4 Hatchery Steelhead Smolts

Between March 26 and April 13, WDFW released five separate groups of hatchery summer steelhead totaling 72,745 fish into Nason creek above the trap. Subsequently, a total of 909 hatchery steelhead were captured at the smolt trap with a mean FL and weight of 166mm (*n* =365; *SD* = 21.4) and 49.2g (*n* = 363; *SD* = 18.2), respectively (Figure 7). While most recaptures occurred within the first four to five months after direct plant (*n*= 901), sporadic captures were observed throughout the year (*n* = 8). Hatchery origin was determined by the presence of coded wire tags (CWT). There were no hatchery steelhead mortalities.

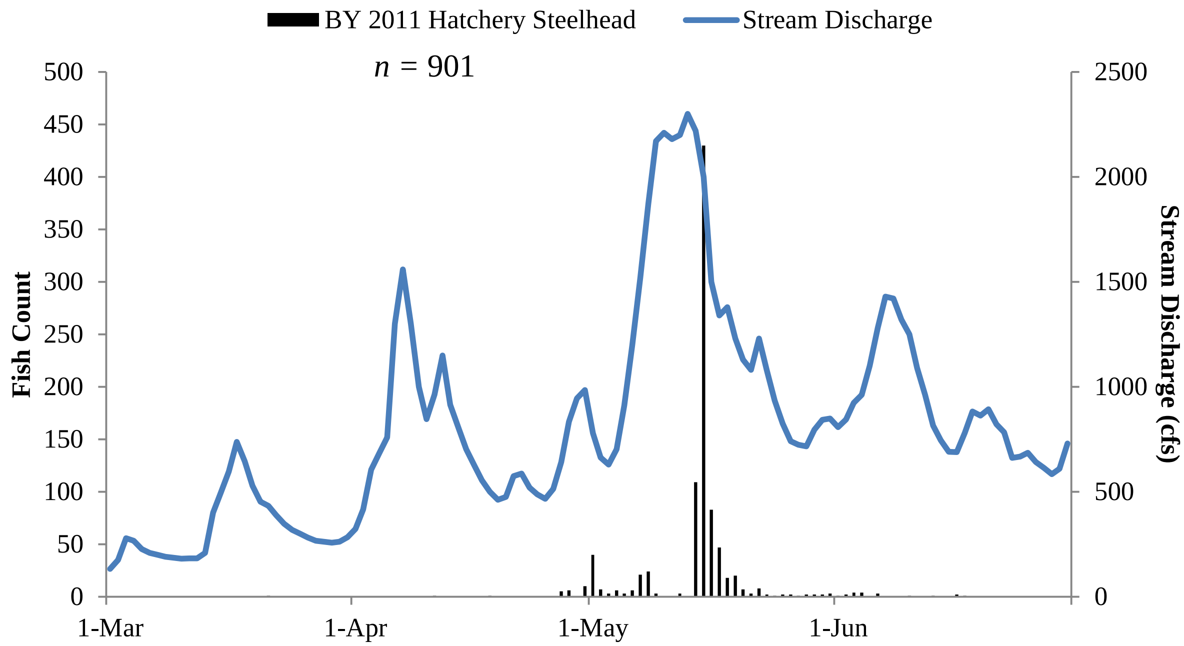


Figure 14. Daily catch of hatchery steelhead smolt with mean daily stream discharge at the Nason Creek rotary trap, March 1 to June 30, 2013.

3.2.5 Bull Trout

A total of four bull trout were captured with a mean fork length of 222mm (*n* = 4; *SD* = 47.3; Table 4). Tissue samples were taken from two fish at the request of GCPUD. There were no mortalities. In 2014, we will no longer PIT tag or collect genetic/scale samples from bull trout as per the request of GCPUD personnel. All bull trout captured in the future will be measured, weighed, and released without further handling.

Table 25. 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	222.25	4	47.3	119.9	3	78.1	1.1

3.2.6 Coho Yearlings (BY2011)

A total of 81 naturally produced coho yearlings were captured during spring emigration between March 1 and June 30 (Figure 8). Peak catch of six yearling smolts occurred on May 8 following an increase in flow associated with spring snowmelt. Mean FL and weight were 97mm (*n* = 81; *SD* = 10.1) and 10.0g (*n* = 81; *SD* = 3.1), respectively (Table 5). There were no coho yearling mortalities. Tissue and scale samples were collected from 76 fish to continue developing a baseline of freshwater growth patterns for naturally produced coho from Nason Creek.

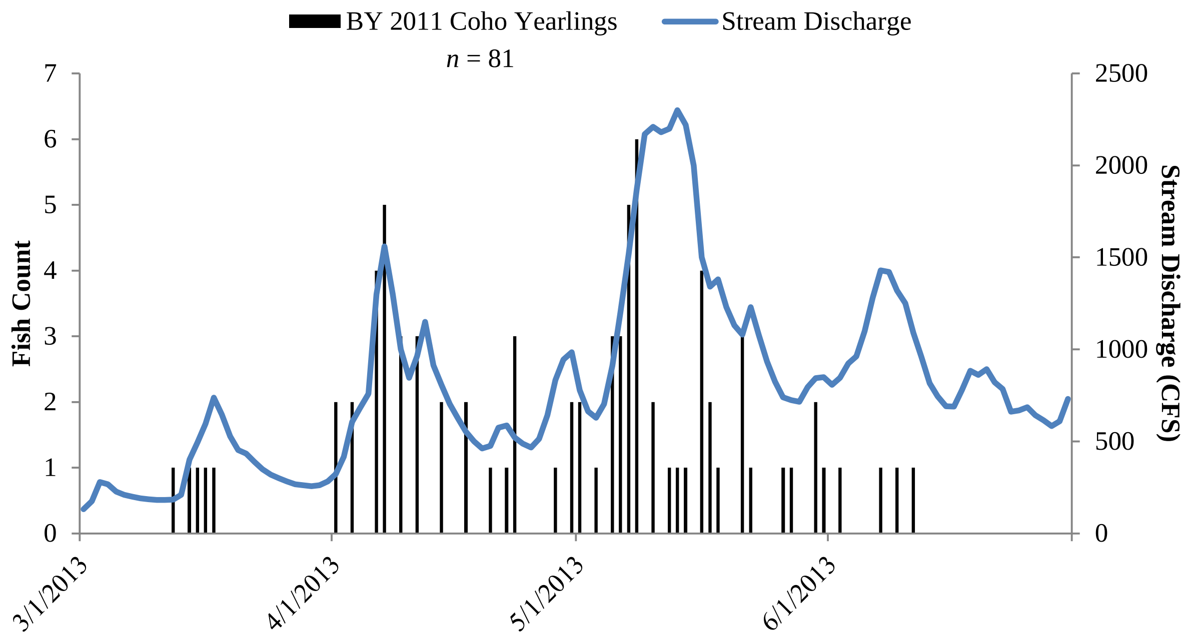


Figure 15. Daily catch of BY2011 naturally produced coho yearlings with mean daily stream discharge at the Nason Creek rotary trap, March 1 to June 30, 2013.

Table 26. Summary of length and weight sampling of juvenile coho salmon captured at the Nason Creek rotary trap in 2013.

Brood Year	Origin/Species/Stage	Fork Length (mm)			Weight (g)			K-Factor
		Mean	N	SD	Mean	N	SD	
2011	Naturally Produced Coho Yearling Smolt	97.0	81	10.1	10.0	81	3.1	1.1
2012	Naturally Produced Coho Subyearling Fry	47.3	3	9.6	1.0	3	0.7	0.9
2012	Naturally Produced Coho Subyearling Parr	87.8	4	3.8	6.6	4	1.0	1.0
2011	Hatchery Coho Yearling Smolt	130.1	982	8.5	23.2	977	4.9	1.1

3.2.7 Coho Subyearlings (BY2012)

A total of five naturally produced coho subyearling parr were captured during between July 1 and November 30 (Figure 9). Mean FL and weight were 87mm (*n* = 4; *SD* = 3.8) and 6.6g (*n* = 4; *SD* = 1.0), respectively. An additional three fry were captured a mean length of 47mm (*n*= 3; *SD* = 9.6) and mean weigth of 1.0g (*n* = 3; *SD* = 0.7). Tissue and scale samples were taken from four coho parr. Collected scale samples will continue to develop a freshwater aging baseline mentioned previously. There were no BY2012 coho mortalities during the 2013 trapping season.

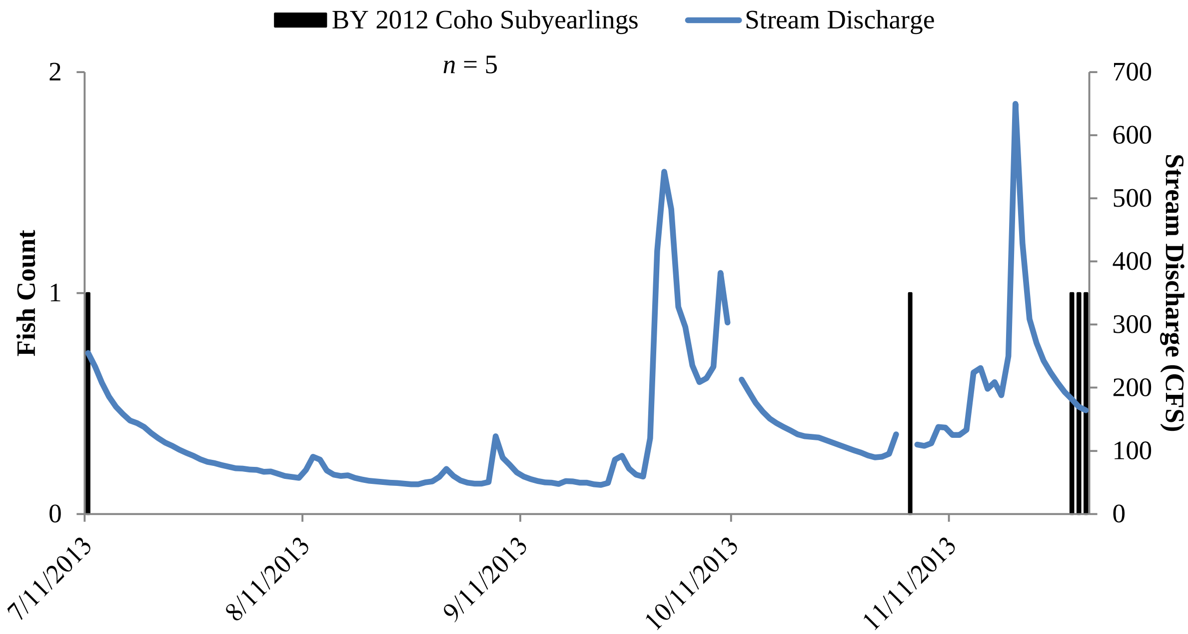


Figure 16. Daily catch of BY2012 naturally produced coho subyearlings with mean daily stream discharge at the Nason Creek rotary trap, July 1 to November 30, 2013.

3.2.8 Hatchery Coho Smolts (BY2011)

A total of 305,314 hatchery coho were released into Nason Creek above the trap in spring of 2013. The majority of hatchery coho released were acclimated in natural ponds adjacent to Nason Creek and reared to smolt stage prior to volitional release. Timing of release was established 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 2,387 hatchery coho were captured at the trap (Figure 10). Mean FL was 130mm (*n* = 982; *SD* = 8.5) and mean weight was 23.2g (*n* = 977; *SD* = 4.9; Table 2). Peak daily catch occurred on May 10 (*n* = 434) following volitional release into Nason Creek. An early spike in catch occurring in late March/early April was the result of a containment net breach at an upstream acclimation pond. Three coho mortalities incurred as a result of capture and/or handling stress. Hatchery coho emigration data at the Nason Creek trap assists MCCRP by providing size-at-emigration, emigration timing and duration of residence in Nason Creek.

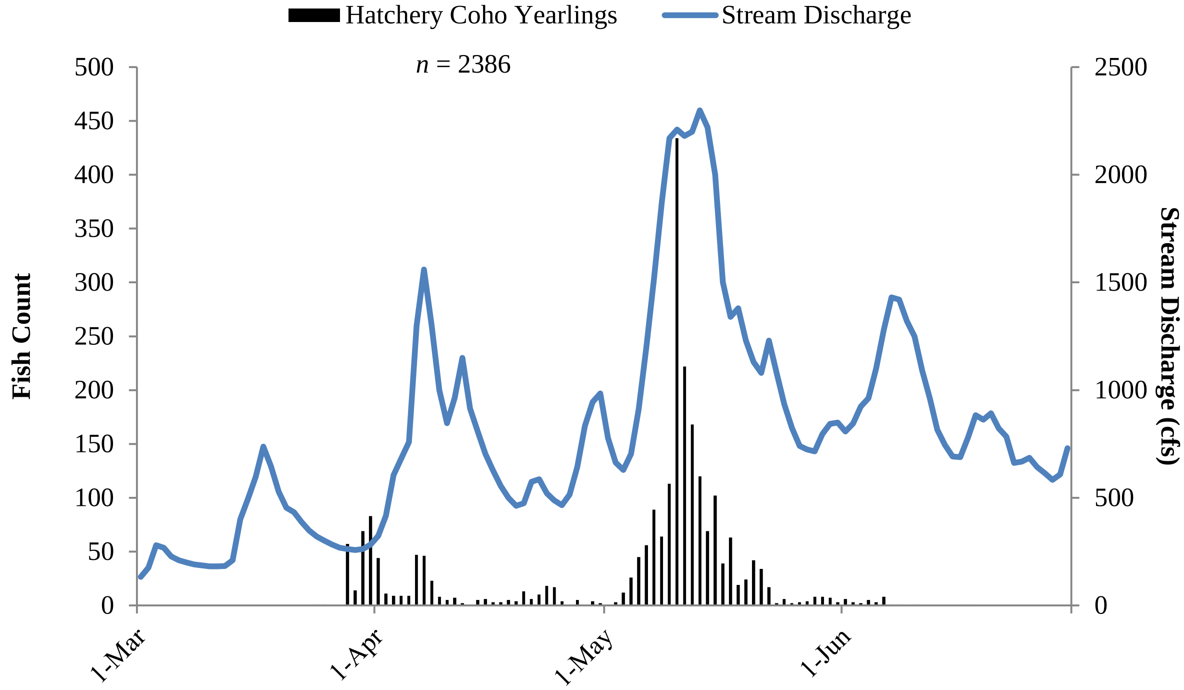


Figure 17. Daily catch of BY2011 hatchery coho smolt with mean daily stream discharge at the Nason Creek rotary trap, March 1 to June 30, 2013.

3.3 Trap Efficiency Calibration and Population Estimates

3.3.1 Spring Chinook Yearlings (BY2011)

Low abundance of yearling Chinook allowed us to only conduct three efficiency trials in 2013 (Minimum mark group size = 20 smolts; Table 6). Initial minimum mark group size was set at 20 fish in response to observed low abundance. In realizing that these trials would do little to strengthen the multi-year model, the minimum was eventually raised to 40 fish. The multi-year weighted flow-efficiency regression was statistically significant ($r^2 = 0.13$, $p = 0.05$; *See Appendix C*). We estimated a total of 2,414 (± 650; 95% CI) BY2011 Chinook yearlings emigrated in spring of 2013 (Table 7). Combined with a recalculated BY2011 subyearling estimate of 17,991 (± 3,837; 95% CI), we estimated that a total of 20,406 (± 3,891; 95% CI) BY2011 spring Chinook juveniles emigrated from Nason Creek during the period of trap operation.

Table 27. Trap efficiency trials conducted with BY2011 wild spring Chinook 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)
Wild Chinook Yearlings	1+	3/17/2013	Back	38	5	15.8%	645
Wild Chinook Yearlings	1+	4/2/2013	Back	22	1	9.1%	605
Wild Chinook Yearlings	1+	4/5/2013	Back	22	0	4.5%	1300

*See equation 3 in **2.5.1 Estimate of Abundance**

Table 28. 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 ± 95% CI		
2002	294	5,024	1,477,056	DNOT	4,634	4,634 ± 1,421	—	—
2003	83	6,191	513,853	8,829	6,401	15,230 ± 3,165	3.0%	183
2004	169	4,846	818,974	11,822	2,613	14,435 ± 2,779	1.8%	85
2005	193	4,365	842,445	11,841	8,589	20,402 ± 5,061	2.4%	106
2006	152	4,773	725,496	4,144	7,822	11,966 ± 1,813	1.6%	79
2007	101	4,656	470,256	15,556	5,631	21,187 ± 2,889	4.5%	210
2008	336	4,691	1,576,176	23,182	3,617	26,799 ± 6,760	1.7%	80
2009	167	4,691	783,397	27,720	1,697	29,417 ± 12,775	3.8%	176
2010	188	4,548	855,024	8,491	3,529	12,020 ± 1,968	1.4%	64
2011	170	4,969	844,730	17,991	2,414	20,405 ± 3,891	2.4%	120
2012	413	4,522	1,867,586	28,110	—	28,110 ± 4,611	—	—
Avg.[c]	173	4,859	825,595	14,397	4,701	19,096	2.5%	123

[a] Data provided by Hillman et al. 2013.
[b] Does not include subyearling fry prior to July 1.
[c] 9-year average of complete brood data, 2003-2011.

3.3.2 Spring Chinook Subyearlings (BY2012)

A total of 13 efficiency trials using spring Chinook subyearling parr were conducted between July 7 and November 27 (Minimum mark group size = 100 parr; Table 8). Efficiency data collected in 2013 was added to a multi-year data set, which allowed us to increase minimum mark group size while also expanding the range of flows tested. The resulting model had a minimum mark group size of 150 parr and demonstrated significance ($r^2 = 0.55$, $p = 0.001$; *See Appendix C*). We estimated that a total of 28,110 (± 4,611; 95% CI) BY2012 spring Chinook subyearling emigrated from Nason Creek in the fall of 2013 (Table 7).

Table 29. Trap efficiency trials conducted with BY2012 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	Marked	Recaptured	Trap Efficiency	Discharge (cfs)
Wild Chinook Subyearlings	0	7/15/2013	Back	118	8	7.6%	158
Wild Chinook Subyearlings	0	9/30/2013	Back	171	12	7.6%	542
Wild Chinook Subyearlings	0	10/2/2013	Back	213	43	20.7%	328
Wild Chinook Subyearlings	0	10/3/2013	Back	181	41	23.2%	296
Wild Chinook Subyearlings	0	10/4/2013	Back	147	25	17.7%	235
Wild Chinook Subyearlings	0	10/5/2013	Back	134	15	11.9%	209
Wild Chinook Subyearlings	0	10/7/2013	Back	242	31	13.2%	233
Wild Chinook Subyearlings	0	10/9/2013	Back	203	40	20.2%	303
Wild Chinook Subyearlings	0	10/11/2013	Back	104	16	16.3%	213
Wild Chinook Subyearlings	0	11/4/2013	Back	130	4	3.8%	107

Wild Chinook Subyearlings	0	11/8/2013	Back	106	4	4.7%	138
Wild Chinook Subyearlings	0	11/20/2013	Back	133	18	14.3%	429
Wild Chinook Subyearlings	0	11/27/2013	Back	241	55	23.2%	182

[a] Estimated value. Flow data not available.

3.3.3 Summer Steelhead

Summer steelhead efficiency trials were conducted on 20 separate occasions between March 1 and November 30 (Minimum mark group size = 30 parr/smolt; Table 9). Trials were completed frequently and over a relatively wide range of flows, allowing us to create an in-year regression using 2013 data alone ($r^2 = 0.14$, $p = 0.05$; *See Appendix C*). M-R data from 2013 was also used to strengthen our multi-year steelhead regression, which was subsequently used to recalculate previous emigrant estimates. We utilized a single steelhead model specific to the back position to estimate age 1+ smolt/parr abundance throughout the entire trapping period. Estimates of age-0 fry and parr were not made due to insufficient evidence that active migration is occurring at this young age. Previous attempts to build a model based on YOY steelhead parr in the fall have yielded weak flow-efficiency relationships; further suggesting that age-0 parr catch is the result of displacement rather than active migration. We estimated that 25,349 (± 6,335; 95% CI) BY2012 age-1 and 469 (± 224; 95% CI) BY2011 age-2 steelhead emigrated past the trap in 2013 (Table 10). There were no age-3 steelhead identified through age estimation (histogram). We estimate that total (age 1-3) BY2010 emigration to be 13,483 (± 3,221; 95% CI).

Table 30. 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	Date	Trap Position	Marked	Recaptured	Trap Efficiency	Discharge (cfs)
Wild Steelhead Parr/Smolt	4/2/2013	Back	39	1	5.1%	636
Wild Steelhead Parr/Smolt	4/5/2013	Back	31	0	3.2%	1350
Wild Steelhead Parr/Smolt	4/9/2013	Back	49	1	4.1%	888
Wild Steelhead Parr/Smolt	4/13/2013	Back	47	3	8.5%	851
Wild Steelhead Parr/Smolt	4/18/2013	Back	41	2	7.3%	496
Wild Steelhead Parr/Smolt	4/22/2013	Back	66	6	10.6%	559
Wild Steelhead Parr/Smolt	4/26/2013	Back	50	2	6.0%	688
Wild Steelhead Parr/Smolt	4/30/2013	Back	54	2	5.6%	832
Wild Steelhead Parr/Smolt	5/4/2013	Back	29	1	6.9%	972
Wild Steelhead Parr/Smolt	5/8/2013	Back	62	0	1.6%	2250
Wild Steelhead Parr/Smolt	5/19/2013	Back	122	15	13.1%	1180
Wild Steelhead Parr/Smolt	5/22/2013	Back	58	4	8.6%	1140
Wild Steelhead Parr/Smolt	5/26/2013	Back	79	3	5.1%	765
Wild Steelhead Parr/Smolt	5/30/2013	Back	92	7	8.7%	890
Wild Steelhead Parr/Smolt	6/3/2013	Back	71	6	9.9%	996
Wild Steelhead Parr/Smolt	6/7/2013	Back	94	4	5.3%	1470
Wild Steelhead Parr/Smolt	6/13/2013	Back	64	2	4.7%	783
Wild Steelhead Parr/Smolt	6/17/2013	Back	115	5	5.2%	916
Wild Steelhead Parr/Smolt	6/29/2013	Back	60	12	21.7%	759

Wild Steelhead Parr/Smolt	7/7/2013	Back	75	9	13.3%	342

[*]See equation 3 in **2.5.1 Estimate of Abundance**

Table 31. 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 ± 95%CI		
2001	27	5,951	160,677	DNOT	DNOT	722	—	—	—
2002	80	5,776	462,080	DNOT	1,960	0	—	—	—
2003	121	6,561	793,881	4,149	1,006	26	5,181 ± 1,072	0.7%	43
2004	127	5,118	649,986	4,871	865	19	5,755 ± 964	0.9%	45
2005	412	5,545	2,284,540	7,007	1,787	258	9,052 ± 1,957	0.4%	22
2006	77	5,688	437,976	15,423	1,920	43	17,386 ± 3,902	4.0%	226
2007	78	5,840	455,520	20,945	1,661	114	22,720 ± 5,129	5.0%	291
2008	88	5,693	500,984	6,853	1,101	0	7,954 ± 1,821	1.6%	90
2009	126	6,199	781,074	12,695	546	142	13,383 ± 3,120	1.7%	106
2010	270	5,458	1,473,660	10,876	2,607	0	13,483 ± 3,221	0.9%	50
2011	235	6,276	1,474,860	10,583	469	—	—	—	—
2012	212	5,309	1,125,508	25,349	—	—	—	—	—
Avg	162	5,763	922,203	10,352	1,437	75	11,864	1.9%	109

[a] Data provided by Hillman et al. 2013.
[b] 8-year average of complete brood estimates, 2003-2010.

3.3.4 Coho (BY2011)

The spring of 2013 saw continued good catches of coho yearlings; progeny of a large BY2011 adult return. Despite a relatively high abundance, daily catch of coho smolts were dispersed throughout the spring and did not provide for sufficient mark group sizes (limited by 72hr maximum holding time). A multi-year wild spring Chinook yearling model was used to expand daily catch of naturally produced coho smolts ($r^2 = 0.13$, $p = 0.05$; *See Appendix C*). In the spring of 2013, we estimated that 1,263 (± 412; 95% CI) emigrated past the trap (Table 12). This gave us a total BY2011 emigrant estimate of 2,281 (± 531; 95% CI).

In an attempt to test the assumption that release box distance was sufficient to allow equal mixing, three paired releases using hatchery coho were performed in the spring. In these trials, one group was released at the current release box location while the other group was simultaneously released approximately 3.5RKM upstream (oxbow). None of the paired trials showed markedly different recapture rates between the two sites.

Table 32. Trap efficiency trials conducted with BY2011 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	Date	Trap Position	Release Location	Marked	Recaptured	Trap Efficiency	Discharge (cfs)
Hatchery Coho Smolt	4/2/2013	Back	Oxbow	100	0	1.0%	605

Hatchery Coho Smolt	4/2/2013	Back	Release Box	103	1	1.9%	605
Hatchery Coho Smolt	5/10/2013	Back	Oxbow	98	0	1.0%	2,180
Hatchery Coho Smolt	5/10/2013	Back	Release Box	97	1	2.1%	2,180
Hatchery Coho Smolt	5/18/2013	Back	Oxbow	95	1	2.1%	1,230
Hatchery Coho Smolt	5/18/2013	Back	Release Box	97	1	2.1%	1,230

*See equation 3 in **2.5.1 Estimate of Abundance**

Table 33. 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 ± 95% CI		
2003	6	2,458	14,748	DNOT	932	—	—	—
2004	35	3,084	107,940	204	55	259 ± 153	0.2%	7
2005	41	2,866	117,506	27	895	922 ± 353	0.8%	22
2006	4	3,126	12,504	7	0	7 ± 10	0.1%	2
2007	10	2,406	24,060	14	134	148 ± 104	0.6%	15
2008	3	3,275	9,825	50	0	50 ± 57	0.5%	17
2009	14	2,691	37,674	471	235	706 ± 478	1.9%	50
2010	8	3,411	27,288	27	427	454 ± 60	1.7%	57
2011	89	3,114	277,146	1,018	1,263	2,281 ± 531	0.8%	26
2012	21	2,752	57,792	46	—	—	—	—
Avg.[b]	26	2,997	76,743	227	376	603	0.8%	24

[a] Does not include subyearling fry prior to July 1.
[b] 7-year average of complete brood data, 2004-2011.

3.3.5 Coho (BY2012)

A total of only eight coho subyearlings did not allow us to make any further attempts to build species/age specific a regression model. As in 2012, we used a wild spring Chinook subyearling model to expand 2013 subyearling data ($r^2 = 0.55$, $p = 0.001$; *See Appendix C*). Using this flow-efficiency relationship, we estimated that 46 (± 27 ; 95% CI) emigrated past the trap in the fall of 2013 (Table 12).

3.4 PIT Tagging

During the 2013 trapping season, we PIT tagged 3,527 wild spring Chinook, 1,998 steelhead, 81 naturally produced coho, and 3 bull trout (Table 13). All tagging files were submitted to the PTAGIS database. A total of 3 shed PIT tags were recovered in holding boxes where fish had been held for 24-72 hours after tagging.

Table 34. Number of PIT tagged coho, Chinook, steelhead and bull trout with shed rates at the Nason Creek rotary trap in 2013.

Species/Stage	Year-to-date Catch	Year-to-date PIT Tagged	No. of Shed Tags	Percent Shed Tags

Chinook Yearling Smolt	239	237	0	0.00%
Chinook Subyearling Parr (Mar 1 to June 30)	584	30	0	0.00%
Chinook Subyearling Parr (July 1 to Nov 30)	4,310	3,260	1	0.03%
Steelhead Parr	2,418	1,977	2	0.10%
Steelhead Smolt	22	21	0	0.00%
Bull Trout Parr	4	3	0	0.00%
Coho Yearling Smolt	81	77	0	0.00%
Coho Subyearling Parr	5	4	0	0.00%

* Counts do not include fish with FL<50mm (fry).

3.5 Incidental Species

Along with wild spring Chinook, wild steelhead/rainbow trout, and naturally produced coho, other resident fish species captured at the Nason Creek rotary trap and included in Table 14 are: cutthroat trout *Oncorhynchus clarki*, flathead minnow *Pimephales promelas*, longnose dace *Rhinichthys cataractae*, northern pikeminnow *Ptychocheilus oregonensis*, redside shiner *Richardsonius balteatus*, sculpin *Cottus sp.*, sucker *Catostomus sp.*, and mountain whitefish *Prosopium williamsoni*. A single precocial hatchery-origin spring Chinook was captured on September 26. Its origin and stage was determined by its comparative size and presence of a wire tag. Since this fish hand an intact adipose fin it is probable it originated from the White River captive broodstock program.

Table 35. Summary of length and weight sampling of incidental species captured at the Nason Creek rotary trap in 2013.

Species	Total Count	Length (mm)			Weight (g)		
		Mean	N	SD	Mean	N	SD
Cutthroat Trout	2	161.0	2	32.5	38.2	2	19.2
Fathead Minnow	2	48.0	2	0.0	1.2	2	0.0
Hatchery Spring Chinook	1	115.0	1	—	16.5	1	—
Longnose Dace	157	78.5	155	37.5	13.4	105	6.9
Northern Pikeminnow	5	171.2	5	72.1	83.1	5	82.4
Redside Shiner	36	39.6	36	16.1	1.7	22	2.9
Sculpin	78	65.9	77	37.2	12.3	52	18.8
Sucker	70	122.4	70	35.9	25.9	69	21.6
Whitefish Fry	40	38.4	40	5.8	0.6	21	0.3
Whitefish Parr	52	87.9	52	61.0	22.5	51	66.5

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 the maximum permitted (20%) for each species. Lethal take was well below the allowable level of 2% for spring Chinook (0.9%), summer steelhead

(0.3%), and bull trout (0.0%; Table 15). Stream temperatures neared or exceeded 18˚C on four occasions in August at which times fish were enumerated only, and quickly released.

Table 36. 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 (BY2011)	239	0	0.00%
Spring Chinook Subyearling (BY 2012)	4,461	45	1.01%
Total Spring Chinook	**4,700**	**45**	0.96%
Steelhead Age-0 (BY2013)	878	2	0.23%
Steelhead Age-1 (BY2012)	1777	5	0.28%
Steelhead Age-2 (BY2011)	21	0	0.00%
Total Summer Steelhead	**2678***	**7**	0.26%
Total Bull Trout	**4**	**0**	0.00%
Coho Yearling (BY2011)	82	0	0.00%
Coho Subyearling (BY2012)	7	0	0.00%
Total Coho	**89**	**0**	0.00%

*Total includes two fish not handled to to existing injury.

4.0 DISCUSSION

Fish collection in 2013 saw few unexpected interruptions to trapping due in part to careful monitoring during spring run-off and increased efforts to prevent vandalism to the trap during the summer months. The predominant peak in steelhead and spring Chinook migratory behavior coinciding with spring high-water was successfully trapped with only one interruption. The only significant gap in data collection came in the summer months when base flows did not allow the trap to be operated in its fixed position. Previously used low-discharge trapping methods such as the forward position or the smaller three-foot trap provided only sporadic operation at low flow and in the case of the miniature trap, produced data insufficient to support a model. Despite the potential to operate the trap for fewer days, limiting the trap to a single position provided the best opportunity to produce a reliable estimate. Base flows in 2013 extended from August 8 to September 22, in which daily mean discharge was only 56cfs. Although low discharge levels prevented operation of the trap for a total of 42 days, total suspension of operations in 2013 was near the 8-year average (41 days). Only slightly elevated total days of suspended trapping despite the prolonged summer stoppage was largely due to a lack of intentional stoppages outside of the low-flow period. This data collection gap did not affect steelhead estimates as most of the fish caught are YOY fry and assumed to be non-migratory. Historical daily mean Chinook catch (n = 1) at the forward trap position during flows ≤ 60cfs (approximate back position limit) suggests limited migratory behavior at this discharge range. Estimated daily catch during this period was likely an overestimate due to the estimates being based on the days prior to and following the decrease in flow. However, due to the low estimated number of fish caught and assumed high trap efficiency, we believe that this period of suspended trapping did not greatly affect our overall estimate.

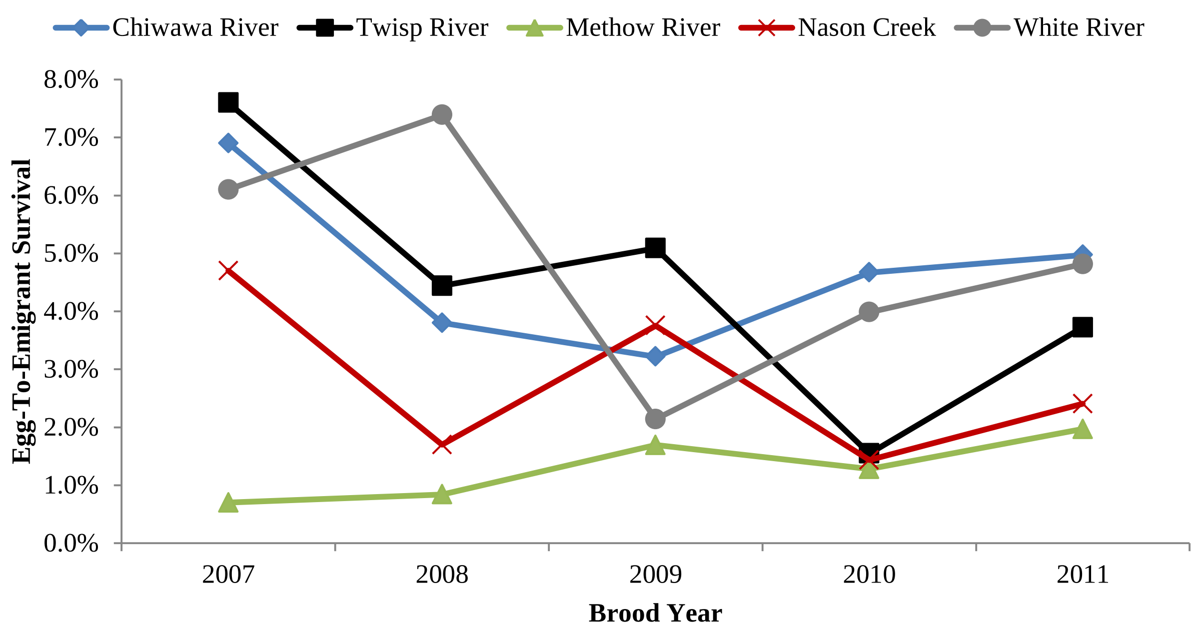
In 2013, we continued to refine our linear flow-efficiency regression models. This alternative to the previously used pooled method was prompted mainly by a revised regression-based methodology developed and distributed by WDFW in 2012. Both methods (pooled estimates and the regression based methodology) are limited by the range of flows in which efficiency can be effectively tested. These limitations can be significant when low abundance does not allow for consistent yearly mark-recapture trials across all flow levels. A main advantage of linear regression analysis is the ability to build flow-efficiency relationships over multiple years; an alternative if low abundance prohibits an in-season regression. Building a flow-efficiency model over multiple years can increase the range of flows tested while establishing larger mark group sizes. This is especially advantageous in tributaries like Nason Creek where a high variability in discharge and abundance can affect ability to perform efficiency trials on an annual basis. Conversely, pooled estimates require that all trials be conducted in a single trapping year in order to account for variations in annual discharge patterns.

Spring Chinook

BY2011 spring Chinook redd count, fecundity, and resulting estimated eggs deposited were comparable to the nine-year historical average values. Catch data expansion also yielded abundance estimates that fell close to the running brood year averages. Timing of migratory behavior in BY2011 Chinook displayed the typical trend in which the majority of juveniles emigrate from Nason Creek as subyearlings. We estimated that 88.1% of the total cohort emigrated past the trap as subyearlings in the fall of 2012, while 21.9% emigrated as smolts in the spring of 2013. Chinook estimates for the 2003 to 2011 brood-years indicate that an average of 75.4% of a brood typically emigrates out of Nason Creek as subyearlings. While parr emigration for 2011 brood year was high compared to the average, it is still well below the 94.2% emigration as parr for the 2009 brood. Driven by a strong adult return, an estimated 28,110 BY2012 subyearling Chinook passed by the trap in the summer/fall of 2013. This figure is nearly twice the nine-year average (14,397 parr) and represents the largest estimated subyearling migration in Nason Creek to date.

Comparison of spring Chinook egg-to-emigrant survival in five local tributaries shows that rates estimated in Nason Creek fall within ranges commonly seen at other smolt traps (Figure 11), but are typically lower than observed in the Chiwawa and White rivers. Interestingly, fluctuations of egg-to-emigrant survival are most similar between those of Nason Creek and the Twisp River. Over the past five brood years, these two tributaries have displayed the same trends in juvenile survival rates.

Figure 18. Comparison of wild spring Chinook abundance estimates (BY2007-2011) made at the White River, Nason Creek, Chiwawa River, Twisp River, and Methow River smolt traps.



Summer Steelhead

High juvenile steelhead abundance (BY2012 parr) allowed us to develop an in-year regression model for spring emigration. This marks the first instance in which such a model could be created for any species at Nason Creek. Although we believe our multi-year regressions to be sound, this in-year model could represent a higher level of accuracy in a year-specific estimator and is ultimately the goal year to year. The wide range of flows tested in 2013 also provided the opportunity to strengthen our multi-year regressions, which were subsequently used to recalculate previous estimates.

Steelhead collection in 2013 allowed us to conclude our estimate of BY2010 steelhead emigrants (age 1-3) with a total of 13,483 parr/smolt. Although overall BY2010 abundance was near the eight-year total emigrant average of 11,864 parr/smolt, egg-to-emigrant survival (0.9%) was only half of the running average (1.9%). This could result from density dependent mortality with higher competition for resources leading to lowered overall in-stream survival. The BY2011 age-2 estimate of only 469 parr/smolt steelhead is also well under the eight-year average (1,437 parr/smolt) despite an elevated annual redd count (n = 235). A large BY2012 age-1 estimate of 25,349 parr despite a redd count (n = 212) higher than the eight-year average (n = 162) suggests that density-dependent effects are not the only factors determining the success of juvenile steelhead.

Proportions of juvenile steelhead age classes caught in 2013 were typical of the Nason Creek population. In general, the overwhelming majority of a single brood is assumed to be moving past the trap during the spring as age-1 parr. The peak in migration coincides with spring snowmelt and the first initial freshets of the year. This major push of steelhead emigrants includes sparse numbers of age-2 and the odd age-3 steelhead of previous brood years. After discharge levels subside in the summer months, age-0 or YOY fry/parr are the predominant age class caught at the trap.

Coho

The total BY2011 coho emigrant estimate of 2,281 parr/smolt was the largest to date at over three times the seven-year average (n = 603). The abundance of this cohort was due in part to a record adult escapement to the upper basin (n = 685) as well as the direct-planting of adult coho from the lower Wenatchee basin into Nason Creek. Future parental analysis (via tissue sample collections of all direct-planted coho in 2011 and BY2011 juveniles captured at the Nason Creek trap) will hopefully demonstrate contributions of both naturally returning and relocated adults and their ability to successfully produce offspring. Although there was a high abundance of BY2011 coho, their egg-to-emigrant survival (0.8%) and emigrants per redd (n = 26) were similar to the running average.

BY2012 parr were the progeny of an adult escapement (21 redds) closer in size to the seven-year average (26 redds). Despite an average adult return in 2012, we estimated that only 46 parr passed the trap; well under the mean emigration of 227 subyearlings. Completion of the brood year estimate in 2014 will indicate whether this low preliminary estimate is the product of a late migration as yearlings, or simply an artifact of underrepresentation at the trap.

Cursory analysis of our data suggests that unlike spring Chinook, coho may have more variable migratory timing in which the overwhelming majority of the brood year may not move out as subyearlings. Seven-year averages of coho abundance suggest that more coho leave as yearlings versus subyearling parr. A strong inverse to this behavior is consistently seen in spring Chinook. However, with limited coho abundance at the trap, identifying specific patterns in population dynamics remains difficult. Currently, broodstock collection at Tumwater Dam significantly restricts the number of adult coho allowed to return to the upper Wenatchee basin. We anticipate that with a shift in emphasis to local adaption during the future Natural Production Phases (NPP; YNFRM 2010), we will see a substantial increase in juvenile coho productivity and abundance and subsequently be able to verify or dismiss any trends currently observed.

2014 Trap Operations at Nason Creek

In the summer of 2014 we intend to move the Nason Creek trap to a new site approximately 750m downstream of its current location in the Nason Creek Campground. The timing of the trap relocation will coincide with the initial collection of BY2013 spring Chinook parr and eliminate the need to combine estimates from the two locations to determine the final brood abundance. The new location is on the outside of a channel bend which creates a consistent thalweg across all ranges of discharge and is the primary advantage of the new site. At the current location, the thalweg migrates left-to-right depending on discharge levels, and can leave the trap fishing outside of its bounds for prolonged periods of time. Fixed trap positioning in the thalweg at the downstream location will likely result in higher trap efficiency, more fish trapped for use in efficiency trials, a more consistent flow-efficiency relationship, and faster cone rotation during low flow periods. Aside from the benefits to data collection, the relocation will also increase the safety of fish and people alike. Intentional stopping of the trap by campers had previously lead to unacceptable mortality events of both spring Chinook and summer steelhead. The presence of the smolt trap in the campground also presents a potential hazard to swimmers and waders. Although changes to trapping protocols in 2013 have minimized dangers to both humans and fish, removal of the trap completely from the campground remains the best way to prevent further incidents.

5.0 LITERATURE CITED

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APPENDIX A. Daily Stream Discharge and Stream Temperature

Date	Stream Discharge (CFS)	Water Temperature (˚C)
1/1/2013	125	1
1/2/2013	119	0.6
1/3/2013	123	0.1
1/4/2013	158	0
1/5/2013	178	0
1/6/2013	161	0.1
1/7/2013	132	0.2
1/8/2013	122	0.1
1/9/2013	181	0.1
1/10/2013	187	0.2
1/11/2013	176	0.3
1/12/2013	179	0
1/13/2013	241	0
1/14/2013	308	0
1/15/2013	365	0
1/16/2013	262	0
1/17/2013	274	0
1/18/2013	281	0
1/19/2013	239	0
1/20/2013	238	0
1/21/2013	244	0
1/22/2013	261	0
1/23/2013	247	0
1/24/2013	269	0
1/25/2013	238	0
1/26/2013	203	0.1
1/27/2013	164	0.1
1/28/2013	152	0.1
1/29/2013	148	0.1
1/30/2013	147	0.3
1/31/2013	138	1.8
2/1/2013	147	2.4
2/2/2013	154	2.2
2/3/2013	144	1.7
2/4/2013	138	1.6
2/5/2013	139	2.8
2/6/2013	140	3
2/7/2013	147	3
2/8/2013	148	3
2/9/2013	144	1.7
2/10/2013	139	1.7
2/11/2013	135	1.6
2/12/2013	134	1.9
2/13/2013	135	2.8
2/14/2013	158	3.4
2/15/2013	160	3.1
2/16/2013	157	3
2/17/2013	157	2.6
2/18/2013	159	2.8
2/19/2013	152	2.2
2/20/2013	146	2.4
2/21/2013	140	1.8
2/22/2013	137	2.3
2/23/2013	141	1.7
2/24/2013	140	1.7
2/25/2013	133	2.4
2/26/2013	133	2.9
2/27/2013	128	2.5
2/28/2013	126	3.2
3/1/2013	132	2.8
3/2/2013	175	3.4
3/3/2013	279	3.8
3/4/2013	267	3.2
3/5/2013	227	2.4
3/6/2013	209	2.2
3/7/2013	199	2.8
3/8/2013	190	3.7
3/9/2013	186	3.7
3/10/2013	181	3.3
3/11/2013	182	3.9
3/12/2013	183	4
3/13/2013	209	4.7
3/14/2013	400	4.5
3/15/2013	495	4.2
3/16/2013	596	4.4
3/17/2013	738	3.7
3/18/2013	645	3
3/19/2013	528	2.8
3/20/2013	453	2.7

3/21/2013	433	2.6	5/3/2013	629	6.3
3/22/2013	388	2.9	5/4/2013	703	7.1
3/23/2013	348	3	5/5/2013	911	6.8
3/24/2013	319	2.8	5/6/2013	1200	6.4
3/25/2013	300	2.8	5/7/2013	1520	6
3/26/2013	282	3.2	5/8/2013	1870	6.1
3/27/2013	267	3.9	5/9/2013	2170	6
3/28/2013	262	4.6	5/10/2013	2210	5.9
3/29/2013	257	4.8	5/11/2013	2180	5.9
3/30/2013	262	5.4	5/12/2013	2200	5.9
3/31/2013	283	5.4	5/13/2013	2300	5.8
4/1/2013	323	5.5	5/14/2013	2220	5.3
4/2/2013	416	5.7	5/15/2013	2000	5.2
4/3/2013	605	5.9	5/16/2013	1500	5.6
4/4/2013	682	5.4	5/17/2013	1340	6.2
4/5/2013	759	4.5	5/18/2013	1380	6
4/6/2013	1300	4.1	5/19/2013	1230	6.3
4/7/2013	1560	3.9	5/20/2013	1130	6.6
4/8/2013	1300	3.9	5/21/2013	1080	6.8
4/9/2013	1000	4.8	5/22/2013	1230	5.8
4/10/2013	846	4.6	5/23/2013	1080	5.2
4/11/2013	963	5.1	5/24/2013	934	5.5
4/12/2013	1150	4.7	5/25/2013	824	5.8
4/13/2013	914	3.9	5/26/2013	740	6.2
4/14/2013	807	3.6	5/27/2013	724	6.4
4/15/2013	703	4.2	5/28/2013	716	6.1
4/16/2013	626	3.9	5/29/2013	796	6.9
4/17/2013	554	4.5	5/30/2013	843	6.6
4/18/2013	500	4.7	5/31/2013	849	6.9
4/19/2013	462	5.7	6/1/2013	807	7.4
4/20/2013	475	5.9	6/2/2013	845	7.5
4/21/2013	574	6	6/3/2013	923	7.8
4/22/2013	586	5.8	6/4/2013	962	8
4/23/2013	520	5.3	6/5/2013	1100	8
4/24/2013	488	5.3	6/6/2013	1280	8.2
4/25/2013	466	6	6/7/2013	1430	8.2
4/26/2013	514	6.8	6/8/2013	1420	8.1
4/27/2013	642	7	6/9/2013	1320	8.2
4/28/2013	834	6.1	6/10/2013	1250	8.3
4/29/2013	945	5.7	6/11/2013	1090	8.1
4/30/2013	984	4.9	6/12/2013	961	8
5/1/2013	778	4.8	6/13/2013	816	7.9
5/2/2013	663	5.2	6/14/2013	745	8.3

6/15/2013	691	8.8	7/28/2013	82.7	17
6/16/2013	689	8.8	7/29/2013	80.3	16.7
6/17/2013	780	9.5	7/30/2013	77.6	16.9
6/18/2013	883	9.4	7/31/2013	74.8	17.1
6/19/2013	862	8.6	8/1/2013	72.6	16.5
6/20/2013	893	8.1	8/2/2013	71.9	15.8
6/21/2013	822	7.2	8/3/2013	70.1	15.9
6/22/2013	784	7.6	8/4/2013	69.6	15.8
6/23/2013	662	8.9	8/5/2013	67	17.2
6/24/2013	668	8.8	8/6/2013	67.3	17.4
6/25/2013	685	8.5	8/7/2013	63.7	17.9
6/26/2013	642	8.2	8/8/2013	60.3	17.9
6/27/2013	614	8.6	8/9/2013	58.5	18.2
6/28/2013	583	8.6	8/10/2013	56.9	18.6
6/29/2013	609	10.5	8/11/2013	69.8	19.6
6/30/2013	730	10.7	8/12/2013	90.6	18.4
7/1/2013	768	11.8	8/13/2013	86.1	17
7/2/2013	758	12	8/14/2013	68.9	17.4
7/3/2013	728	13.3	8/15/2013	62.4	16.7
7/4/2013	611	13.2	8/16/2013	60.3	16.4
7/5/2013	481	12.8	8/17/2013	61	16.4
7/6/2013	403	12.6	8/18/2013	56.9	16.6
7/7/2013	343	12.6	8/19/2013	54.8	16.7
7/8/2013	325	13.3	8/20/2013	52.8	16.9
7/9/2013	303	14.2	8/21/2013	51.8	16.7
7/10/2013	277	14.6	8/22/2013	50.5	16.5
7/11/2013	255	15	8/23/2013	49.7	16.3
7/12/2013	233	14.5	8/24/2013	49.1	16.6
7/13/2013	208	12.3	8/25/2013	48.2	16.4
7/14/2013	186	12.7	8/26/2013	47.1	15.9
7/15/2013	170	14	8/27/2013	47	15.9
7/16/2013	158	14.5	8/28/2013	50	15.9
7/17/2013	148	14.8	8/29/2013	51.5	16.1
7/18/2013	144	15.9	8/30/2013	58.8	15.8
7/19/2013	138	16.3	8/31/2013	71.5	15.7
7/20/2013	128	16.4	9/1/2013	60.4	15.4
7/21/2013	120	17	9/2/2013	53.3	16
7/22/2013	113	17.1	9/3/2013	49.5	17.1
7/23/2013	108	17.5	9/4/2013	47.9	17.3
7/24/2013	102	17.9	9/5/2013	47.8	17.2
7/25/2013	96.9	18.1	9/6/2013	50.3	17.2
7/26/2013	92	18	9/7/2013	123	15.7
7/27/2013	86.7	17.6	9/8/2013	89.2	14.6

9/9/2013	77.7	14.9	10/22/2013	122	6.2
9/10/2013	65.9	15.8	10/23/2013	121	6.3
9/11/2013	59.1	16	10/24/2013	117	6.2
9/12/2013	55.3	16	10/25/2013	113	5.9
9/13/2013	52.2	16.1	10/26/2013	109	5.7
9/14/2013	49.9	16.6	10/27/2013	105	5.7
9/15/2013	49.5	16.9	10/28/2013	101	5.8
9/16/2013	47.7	17	10/29/2013	97.4	6.2
9/17/2013	52.3	16.2	10/30/2013	92.9	4.2
9/18/2013	51.4	14.5	10/31/2013	89.8	3.9
9/19/2013	49.6	13.5	11/1/2013	90.4	6
9/20/2013	49.4	12.3	11/2/2013	95.1	6.1
9/21/2013	46.8	11.9	11/3/2013	126	6.2
9/22/2013	46.1	13.1	11/4/2013	No Data	No Data
9/23/2013	48.8	11.8	11/5/2013	No Data	No Data
9/24/2013	86.3	10.8	11/6/2013	110	3.2
9/25/2013	92	10.5	11/7/2013	108	3.6
9/26/2013	71.8	10.1	11/8/2013	112	3.4
9/27/2013	62.4	9.7	11/9/2013	138	3.5
9/28/2013	59.4	9	11/10/2013	137	3.4
9/29/2013	120	9.1	11/11/2013	125	3.8
9/30/2013	417	8.2	11/12/2013	125	4.6
10/1/2013	542	7	11/13/2013	133	5.2
10/2/2013	483	6.5	11/14/2013	224	5.2
10/3/2013	328	6.9	11/15/2013	231	4.5
10/4/2013	296	7	11/16/2013	198	4.2
10/5/2013	235	6.5	11/17/2013	209	3.3
10/6/2013	209	6.7	11/18/2013	188	2.8
10/7/2013	215	7	11/19/2013	250	3.7
10/8/2013	233	7.3	11/20/2013	650	3.7
10/9/2013	382	6.9	11/21/2013	429	2.3
10/10/2013	303	5.9	11/22/2013	309	0.7
10/11/2013	No Data	No Data	11/23/2013	271	0.4
10/12/2013	213	6.4	11/24/2013	243	0.3
10/13/2013	194	6.7	11/25/2013	224	0.8
10/14/2013	176	6.9	11/26/2013	208	1.3
10/15/2013	162	6.1	11/27/2013	193	1.3
10/16/2013	151	5.7	11/28/2013	182	1.8
10/17/2013	144	6.5	11/29/2013	170	1.3
10/18/2013	138	6.2	11/30/2013	164	1.3
10/19/2013	132	5.8	12/1/2013	166	2.8
10/20/2013	126	5.7	12/2/2013	No Data	No Data
10/21/2013	123	5.9	12/3/2013	No Data	No Data

12/4/2013	382	0.9	12/18/2013	174	1.8
12/5/2013	304	0	12/19/2013	168	2.7
12/6/2013	295	0	12/20/2013	157	1.1
12/7/2013	267	0	12/21/2013	154	0.8
12/8/2013	235	0	12/22/2013	154	1.6
12/9/2013	235	0	12/23/2013	152	2.5
12/10/2013	277	0	12/24/2013	No Data	No Data
12/11/2013	310	0	12/25/2013	No Data	No Data
12/12/2013	303	0	12/26/2013	No Data	No Data
12/13/2013	302	0.1	12/27/2013	No Data	No Data
12/14/2013	258	0.1	12/28/2013	No Data	No Data
12/15/2013	179	1.6	12/29/2013	No Data	No Data
12/16/2013	183	2.8	12/30/2013	No Data	No Data
12/17/2013	198	2.6	12/31/2013	No Data	No Data

APPENDIX B. Daily Trap Operation

Date	Trap Status	Comments
3/1/2013	Op.	Trap Set
3/2/2013	Op.	
3/3/2013	Op.	
3/4/2013	Op.	
3/5/2013	Op.	
3/6/2013	Op.	
3/7/2013	Op.	
3/8/2013	Op.	
3/9/2013	Op.	
3/10/2013	Op.	
3/11/2013	Op.	
3/12/2013	Op.	
3/13/2013	Op.	
3/14/2013	Op.	
3/15/2013	Op.	
3/16/2013	Op.	
3/17/2013	Op.	
3/18/2013	Op.	
3/19/2013	Op.	
3/20/2013	Op.	
3/21/2013	Op.	
3/22/2013	Op.	
3/23/2013	Op.	
3/24/2013	Op.	
3/25/2013	Op.	
3/26/2013	Op.	Stopped: Out of pos.
3/27/2013	Op.	
3/28/2013	Op.	
3/29/2013	Op.	
3/30/2013	Op.	
3/31/2013	Op.	
4/1/2013	Op.	
4/2/2013	Op.	
4/3/2013	Op.	
4/4/2013	Op.	
4/5/2013	Op.	
4/6/2013	Op.	
4/7/2013	Op.	
4/8/2013	Op.	
4/9/2013	Op.	
4/10/2013	Op.	
4/11/2013	Op.	
4/12/2013	Op.	
4/13/2013	Op.	
4/14/2013	Op.	
4/15/2013	Op.	
4/16/2013	Op.	
4/17/2013	Op.	
4/18/2013	Op.	
4/19/2013	Op.	
4/20/2013	Op.	
4/21/2013	Op.	
4/22/2013	Op.	
4/23/2013	Op.	
4/24/2013	Op.	
4/25/2013	Op.	
4/26/2013	Op.	
4/27/2013	Op.	
4/28/2013	Op.	
4/29/2013	Op.	
4/30/2013	Op.	
5/1/2013	Op.	
5/2/2013	Op.	
5/3/2013	Op.	
5/4/2013	Op.	
5/5/2013	Op.	
5/6/2013	Op.	
5/7/2013	Op.	
5/8/2013	Op.	
5/9/2013	Op.	
5/10/2013	Op.	
5/11/2013	Op.	
5/12/2013	Op.	
5/13/2013	Op.	
5/14/2013	Op.	
5/15/2013	Op.	
5/16/2013	Op.	
5/17/2013	Op.	

5/18/2013	Op.	6/30/2013	Op.	
5/19/2013	Op.	7/1/2013	Op.	
5/20/2013	Op.	7/2/2013	Op.	
5/21/2013	Op.	7/3/2013	Op.	
5/22/2013	Op.	7/4/2013	Op.	
5/23/2013	Op.	7/5/2013	Op.	
5/24/2013	Op.	7/6/2013	Op.	
5/25/2013	Op.	7/7/2013	Op.	
5/26/2013	Op.	7/8/2013	Op.	
5/27/2013	Op.	7/9/2013	Op.	
5/28/2013	Op.	7/10/2013	Op.	
5/29/2013	Op.	7/11/2013	Op.	
5/30/2013	Op.	7/12/2013	Op.	
5/31/2013	Op.	7/13/2013	Op.	
6/1/2013	Op.	7/14/2013	Op.	
6/2/2013	Op.	7/15/2013	Op.	
6/3/2013	Op.	7/16/2013	Op.	
6/4/2013	Op.	7/17/2013	Op.	
6/5/2013	Op.	7/18/2013	Op.	
6/6/2013	Op.	7/19/2013	Op.	
6/7/2013	Op.	7/20/2013	Op.	
6/8/2013	Op.	7/21/2013	Op.	
6/9/2013	Op.	7/22/2013	Op.	
6/10/2013	Op.	7/23/2013	Op.	
6/11/2013	Op.	7/24/2013	Op.	
6/12/2013	Op.	7/25/2013	Op.	
6/13/2013	Op.	7/26/2013	Op.	Stopped: Low Water
6/14/2013	Op.	7/27/2013	Op.	
6/15/2013	Op.	7/28/2013	Op.	
6/16/2013	Op.	7/29/2013	Op.	
6/17/2013	Op.	7/30/2013	Op.	
6/18/2013	Op.	7/31/2013	Op.	
6/19/2013	Op.	8/1/2013	Op.	
6/20/2013	Op.	8/2/2013	Op.	
6/21/2013	Op.	8/3/2013	Op.	
6/22/2013	Op.	8/4/2013	Op.	
6/23/2013	Op.	8/5/2013	Op.	
6/24/2013	Op.	8/6/2013	Op.	
6/25/2013	Op.	8/7/2013	Op.	
6/26/2013	Op.	8/8/2013	Op.	Pulled: Low Water
6/27/2013	Op.	8/9/2013	No Op.	Pulled: Low Water
6/28/2013	Op.	8/10/2013	No Op.	Pulled: Low Water
6/29/2013	Op.	8/11/2013	Op.	Trap Set

8/12/2013	Op.	
8/13/2013	Op.	
8/14/2013	Op.	
8/15/2013	No Op.	Pulled: Low Water
8/16/2013	No Op.	Pulled: Low Water
8/17/2013	No Op.	Pulled: Low Water
8/18/2013	No Op.	Pulled: Low Water
8/19/2013	No Op.	Pulled: Low Water
8/20/2013	No Op.	Pulled: Low Water
8/21/2013	No Op.	Pulled: Low Water
8/22/2013	No Op.	Pulled: Low Water
8/23/2013	No Op.	Pulled: Low Water
8/24/2013	No Op.	Pulled: Low Water
8/25/2013	No Op.	Pulled: Low Water
8/26/2013	No Op.	Pulled: Low Water
8/27/2013	No Op.	Pulled: Low Water
8/28/2013	No Op.	Pulled: Low Water
8/29/2013	No Op.	Pulled: Low Water
8/30/2013	No Op.	Pulled: Low Water
8/31/2013	No Op.	Pulled: Low Water
9/1/2013	No Op.	Pulled: Low Water
9/2/2013	No Op.	Pulled: Low Water
9/3/2013	No Op.	Pulled: Low Water
9/4/2013	No Op.	Pulled: Low Water
9/5/2013	No Op.	Pulled: Low Water
9/6/2013	Op.	Trap Set
9/7/2013	No Op.	Stopped: Debris, Pulled
9/8/2013	No Op.	Pulled: Low Water
9/9/2013	No Op.	Pulled: Low Water
9/10/2013	No Op.	Pulled: Low Water
9/11/2013	No Op.	Pulled: Low Water
9/12/2013	No Op.	Pulled: Low Water
9/13/2013	No Op.	Pulled: Low Water
9/14/2013	No Op.	Pulled: Low Water
9/15/2013	No Op.	Pulled: Low Water
9/16/2013	No Op.	Pulled: Low Water
9/17/2013	No Op.	Pulled: Low Water
9/18/2013	No Op.	Pulled: Low Water
9/19/2013	No Op.	Pulled: Low Water
9/20/2013	No Op.	Pulled: Low Water
9/21/2013	No Op.	Pulled: Low Water
9/22/2013	No Op.	Pulled: Low Water
9/23/2013	Op.	Trap Set

9/24/2013	Op.	
9/25/2013	Op.	
9/26/2013	No Op.	Stopped: Low CFS, Pulled
9/27/2013	No Op.	Pulled: Low Water
9/28/2013	Op.	Trap Set
9/29/2013	Op.	
9/30/2013	Op.	
10/1/2013	Op.	
10/2/2013	Op.	
10/3/2013	Op.	
10/4/2013	Op.	
10/5/2013	Op.	
10/6/2013	Op.	
10/7/2013	Op.	
10/8/2013	Op.	
10/9/2013	Op.	
10/10/2013	Op.	
10/11/2013	Op.	
10/12/2013	Op.	
10/13/2013	Op.	
10/14/2013	Op.	
10/15/2013	Op.	
10/16/2013	Op.	
10/17/2013	Op.	
10/18/2013	Op.	
10/19/2013	Op.	
10/20/2013	Op.	
10/21/2013	Op.	
10/22/2013	Op.	
10/23/2013	Op.	
10/24/2013	Op.	
10/25/2013	Op.	
10/26/2013	Op.	
10/27/2013	Op.	
10/28/2013	Op.	
10/29/2013	Op.	
10/30/2013	Op.	
10/31/2013	Op.	
11/1/2013	Op.	
11/2/2013	Op.	
11/3/2013	Op.	
11/4/2013	Op.	
11/5/2013	Op.	

11/6/2013	Op.		11/19/2013	Op.	
11/7/2013	Op.		11/20/2013	Op.	Stopped: Debris
11/8/2013	Op.		11/21/2013	Op.	
11/9/2013	Op.		11/22/2013	No Op.	Stopped: Ice, Pulled
11/10/2013	Op.		11/23/2013	No Op.	Pulled: Ice
11/11/2013	Op.		11/24/2013	Op.	Trap Started
11/12/2013	Op.		11/25/2013	Op.	
11/13/2013	Op.		11/26/2013	Op.	
11/14/2013	Op.		11/27/2013	Op.	
11/15/2013	Op.		11/28/2013	Op.	
11/16/2013	Op.		11/29/2013	Op.	
11/17/2013	Op.		11/30/2013	Op.	
11/18/2013	Op.		12/1/2013	Op.	Trap pulled for the season

APPENDIX C. Regression Models

Model: Chinook Yearlings (Spring '06-'13) Back Position, (r^2 = 0.13; p = 0.05)

Origin/Species/Stage	Age	Date	Trap Position	Mark	Recap	Trap Efficiency (R+1) / M	ASIN Transform	Discharge
Wild Chinook Smolt	1+	4/3/2006	Back	81	10	0.14	0.38	188
Wild Chinook Smolt	1+	4/6/2006	Back	42	9	0.24	0.51	264
Wild Chinook Smolt	1+	4/24/2006	Back	59	3	0.07	0.26	368
Wild Chinook Smolt	1+	3/17/2007	Back	64	7	0.13	0.36	936
Wild Chinook Smolt	1+	3/20/2007	Back	91	13	0.15	0.40	1230
Wild Chinook Smolt	1+	3/23/2007	Back	59	7	0.14	0.38	876
Wild Chinook Smolt	1+	3/31/2007	Back	40	2	0.08	0.28	869
Wild Chinook Smolt	1+	4/3/2007	Back	46	1	0.04	0.21	656
Wild Chinook Smolt	1+	4/10/2007	Back	53	4	0.09	0.31	966
Wild Chinook Smolt	1+	4/14/2008	Back	195	40	0.21	0.48	327
Wild Chinook Smolt	1+	4/17/2008	Back	72	13	0.19	0.46	274
Wild Chinook Smolt	1+	4/24/2008	Back	57	8	0.16	0.41	210
Wild Chinook Smolt	1+	4/28/2008	Back	127	19	0.16	0.41	271
Wild Chinook Smolt	1+	5/1/2008	Back	102	16	0.17	0.42	315
Wild Chinook Smolt	1+	4/21/2009	Back	53	0	0.02	0.14	732
Wild Chinook Smolt	1+	4/14/2010	Back	42	4	0.12	0.35	173
Wild Chinook Smolt	1+	4/18/2010	Back	67	2	0.05	0.21	330
Wild Chinook Smolt	1+	3/31/2012	Back	43	5	0.14	0.38	250
Wild Chinook Smolt	1+	4/13/2012	Back	53	4	0.09	0.31	358
Wild Chinook Smolt	1+	4/16/2012	Back	53	7	0.15	0.40	443
Wild Chinook Smolt	1+	4/19/2012	Back	48	7	0.17	0.42	434
Wild Chinook Smolt	1+	4/23/2012	Back	58	1	0.03	0.19	1380

Model: Chinook Subyearling (Fall '06-'13) Back Position, (r^2 = 0.55; p = 0.001)

Origin/Species/Stage	Age	Date	Trap Position	Mark	Recap	Trap Efficiency (R+1) / M	ASIN Transform	Discharge
Wild Chinook Parr	0	10/26/2006	Back	183	50	0.28	0.56	51
Wild Chinook Parr	0	10/30/2006	Back	168	52	0.32	0.60	63
Wild Chinook Parr	0	11/1/2010	Back	254	42	0.17	0.42	198
Wild Chinook Parr	0	11/4/2010	Back	287	49	0.17	0.43	215
Wild Chinook Parr	0	11/7/2010	Back	168	32	0.20	0.46	241
Wild Chinook Parr	0	11/13/2010	Back	185	35	0.19	0.46	131
Wild Chinook Parr	0	11/3/2012	Back	201	25	0.13	0.37	402
Wild Chinook Parr	0	11/7/2012	Back	233	27	0.12	0.35	394
Wild Chinook Parr	0	11/11/2012	Back	328	87	0.27	0.54	217
Wild Chinook Parr	0	11/15/2012	Back	195	34	0.18	0.44	213
Wild Chinook Parr	0	9/30/2013	Back	171	12	0.08	0.28	542

Wild Chinook Parr	0	10/2/2013	Back	213	43	0.21	0.47	328
Wild Chinook Parr	0	10/3/2013	Back	181	41	0.23	0.50	296
Wild Chinook Parr	0	10/7/2013	Back	242	31	0.13	0.37	233
Wild Chinook Parr	0	10/9/2013	Back	203	40	0.20	0.47	303
Wild Chinook Parr	0	11/27/2013	Back	241	55	0.23	0.50	182

Model: Chinook Subyearling (Fall ’06-’13) Forward Position, (r^2 = 0.16; p = 0.02)

Origin/Species/Stage	Age	Date	Trap Position	Mark	Recap	Trap Efficiency (R+1) / M	ASIN Transform	Discharge
Wild Chinook Parr	0	7/13/2006	Back	52	8	0.17	0.43	171
Wild Chinook Parr	0	7/17/2006	Back	138	15	0.12	0.35	129
Wild Chinook Parr	0	7/20/2006	Back	74	5	0.08	0.29	113
Wild Chinook Parr	0	7/28/2006	Back	54	5	0.11	0.34	91
Wild Chinook Parr	0	7/31/2006	Back	99	7	0.08	0.29	79
Wild Chinook Parr	0	9/18/2006	Back	55	10	0.20	0.46	46
Wild Chinook Parr	0	7/31/2008	Back	60	15	0.27	0.54	121
Wild Chinook Parr	0	8/12/2008	Back	103	2	0.03	0.17	85.6
Wild Chinook Parr	0	8/22/2008	Back	75	11	0.16	0.41	97
Wild Chinook Parr	0	8/28/2008	Back	72	7	0.11	0.34	81.9
Wild Chinook Parr	0	10/9/2008	Back	110	22	0.21	0.48	63.5
Wild Chinook Parr	0	10/27/2008	Back	51	12	0.26	0.53	56.1
Wild Chinook Parr	0	10/30/2008	Back	84	15	0.19	0.45	53
Wild Chinook Parr	0	11/6/2008	Back	78	8	0.12	0.35	77.7
Wild Chinook Parr	0	11/10/2008	Back	88	0	0.01	0.11	309
Wild Chinook Parr	0	7/14/2009	Back	86	2	0.04	0.19	193
Wild Chinook Parr	0	7/15/2009	Back	105	4	0.05	0.22	179
Wild Chinook Parr	0	7/17/2009	Back	122	8	0.07	0.28	157
Wild Chinook Parr	0	7/20/2009	Back	89	2	0.03	0.19	135
Wild Chinook Parr	0	8/17/2009	Back	73	1	0.03	0.17	58
Wild Chinook Parr	0	9/10/2009	Back	56	7	0.14	0.39	60
Wild Chinook Parr	0	8/8/2010	Back	58	1	0.03	0.19	85
Wild Chinook Parr	0	8/11/2010	Back	114	8	0.08	0.29	77
Wild Chinook Parr	0	9/11/2010	Back	68	9	0.15	0.39	75
Wild Chinook Parr	0	10/12/2010	Back	216	42	0.20	0.46	126
Wild Chinook Parr	0	10/15/2010	Back	192	37	0.20	0.46	95
Wild Chinook Parr	0	10/18/2010	Back	193	36	0.19	0.45	81
Wild Chinook Parr	0	10/22/2010	Back	92	18	0.21	0.47	69
Wild Chinook Parr	0	10/25/2010	Back	60	7	0.13	0.37	78
Wild Chinook Parr	0	10/29/2010	Back	127	0	0.01	0.09	95.1
Wild Chinook Parr	0	8/19/2011	Back	106	5	0.06	0.24	123

Model: Summer Steelhead Back Position (’06-’13), (r^2 = 0.26; p = 0.01)

Origin/Species/Stage	Age	Date	Trap Position	Mark	Recap	Trap Efficiency (R+1) / M	ASIN Transform	Discharge
Wild Steehead Parr/Smolt	1+	6/9/2007	Back	71	9	0.14	0.39	842
Wild Steehead Parr/Smolt	1+	6/12/2007	Back	65	8	0.14	0.38	704
Wild Steehead Parr/Smolt	1+	6/21/2007	Back	67	4	0.08	0.28	751

Wild Steehead Parr/Smolt	1+	4/14/2008	Back	149	46	0.32	0.60	327
Wild Steehead Parr/Smolt	1+	4/17/2008	Back	75	3	0.05	0.23	274
Wild Steehead Parr/Smolt	1+	4/28/2008	Back	74	11	0.16	0.41	271
Wild Steehead Parr/Smolt	1+	5/1/2008	Back	176	29	0.17	0.43	315
Wild Steehead Parr/Smolt	1+	6/9/2008	Back	142	20	0.15	0.40	938
Wild Steehead Parr/Smolt	1+	6/12/2008	Back	83	10	0.13	0.37	823
Wild Steehead Parr/Smolt	1+	6/16/2008	Back	81	8	0.11	0.34	1140
Wild Steehead Parr/Smolt	1+	4/20/2010	Back	121	11	0.10	0.32	675
Wild Steehead Parr/Smolt	1+	4/22/2010	Back	121	10	0.09	0.31	726
Wild Steehead Parr/Smolt	1+	6/20/2010	Back	128	11	0.09	0.31	926
Wild Steehead Parr/Smolt	1+	5/22/2011	Back	84	3	0.05	0.22	1540
Wild Steehead Parr/Smolt	1+	6/12/2012	Back	69	5	0.09	0.30	1170
Wild Steehead Parr/Smolt	1+	4/22/2013	Back	66	6	0.11	0.33	520
Wild Steehead Parr/Smolt	1+	5/19/2013	Back	122	15	0.13	0.37	1130
Wild Steehead Parr/Smolt	1+	5/26/2013	Back	79	3	0.05	0.23	724
Wild Steehead Parr/Smolt	1+	5/30/2013	Back	92	7	0.09	0.30	849
Wild Steehead Parr/Smolt	1+	6/3/2013	Back	71	6	0.10	0.32	962
Wild Steehead Parr/Smolt	1+	6/7/2013	Back	94	4	0.05	0.23	1420
Wild Steehead Parr/Smolt	1+	6/17/2013	Back	115	5	0.05	0.23	883
Wild Steehead Parr/Smolt	1+	7/7/2013	Back	75	9	0.13	0.37	325

Model: 2013 Summer Steelhead Back Position (In-yr.), (r^2 = 0.15; p = 0.05)

Origin/Species/Stage	Age	Date	Trap Position	Mark	Recap	Trap Efficiency (R+1) / M	ASIN Transform	Discharge
Wild Steehead Parr/Smolt	1+	4/2/2013	Back	39	1	0.05	0.23	605
Wild Steehead Parr/Smolt	1+	4/5/2013	Back	31	0	0.03	0.18	1300
Wild Steehead Parr/Smolt	1+	4/9/2013	Back	49	1	0.04	0.20	846
Wild Steehead Parr/Smolt	1+	4/13/2013	Back	47	3	0.09	0.30	807
Wild Steehead Parr/Smolt	1+	4/18/2013	Back	41	2	0.07	0.27	462
Wild Steehead Parr/Smolt	1+	4/22/2013	Back	66	6	0.11	0.33	520
Wild Steehead Parr/Smolt	1+	4/26/2013	Back	50	2	0.06	0.25	642
Wild Steehead Parr/Smolt	1+	4/30/2013	Back	54	2	0.06	0.24	832
Wild Steehead Parr/Smolt	1+	5/8/2013	Back	62	0	0.02	0.13	2170
Wild Steehead Parr/Smolt	1+	5/19/2013	Back	122	15	0.13	0.37	1130
Wild Steehead Parr/Smolt	1+	5/22/2013	Back	58	4	0.09	0.30	1140
Wild Steehead Parr/Smolt	1+	5/26/2013	Back	79	3	0.05	0.23	724
Wild Steehead Parr/Smolt	1+	5/30/2013	Back	92	7	0.09	0.30	890
Wild Steehead Parr/Smolt	1+	6/3/2013	Back	71	6	0.10	0.32	962
Wild Steehead Parr/Smolt	1+	6/7/2013	Back	94	4	0.05	0.23	1420
Wild Steehead Parr/Smolt	1+	6/13/2013	Back	64	2	0.05	0.22	745
Wild Steehead Parr/Smolt	1+	6/17/2013	Back	115	5	0.05	0.23	883
Wild Steehead Parr/Smolt	1+	6/29/2013	Back	60	12	0.22	0.48	730
Wild Steehead Parr/Smolt	1+	7/7/2013	Back	75	9	0.13	0.37	325

APPENDIX B: SPAWNING GROUND SURVEY RECORDS FOR THE WENATCHEE AND METHOW RIVERS, 2013

Stream	Reach & Description	Surveyors	Date	New Redds	Live Fish	Carcass Recover
Chumstick	Mouth to North Rd. Bridge	BI	10/7/2013	0	0	0
		BI	10/14/2013	0	0	0
		BI	10/21/2013	0	4	0
		BI	10/28/2013	0	3	0
		MWC,KS	11/13/2013	0	4	0
		MWC,KS	11/20/2013	0	0	0
		BI	11/26/2013	0	0	0
	Chumstick Total			**0**	**11**	**0**
Icicle	1- Mouth to Hatchery	JH,BI	10/2/2013	0	0	0
		JH,BI	10/9/2013	0	0	0
		JH,KS	10/12/2013	0	2	0
		BI,JH	10/16/2013	0	16	0
		JH,KS	10/19/2013	1	48	0
		BI,JH	10/23/2013	0	31	0
		JH,KS	10/26/2013	4	38	0
		JH,BI	10/30/2013	5	16	1
		JH,KS	11/2/2013	8	25	0
		TJ,BI	11/6/2013	4	20	0
		JH,BI	11/13/2013	17	51	9
		JH,BI	11/20/2013	3	25	5
		JH,TJ	11/27/2013	1	45	1
		BI,JH	12/4/2013	2	15	2
	2 - Hatchery to Headgate	BI	10/2/2013	0	0	0
		JH,KS	10/4/2013	0	0	0
		JH,BI	10/9/2013	0	0	0
		JH,KS	10/12/2013	0	0	0
		BI,JH	10/16/2013	0	1	0
		JH,KS	10/19/2013	0	0	0
		BI,JH	10/23/2013	3	2	0
		JH,KS	10/26/2013	1	5	0
		JH,BI	10/30/2013	3	7	0
		JH,KS	11/2/2013	2	29	0
		BI,TJ	11/6/2013	4	11	0
		JH,BI	11/13/2013	12	73	0
		JH,BI	11/20/2013	0	18	0
		JH	11/27/2013	0	9	0
		BI,JH	12/4/2013	0	1	0

	3 - Headgate to Intake	JH,KS	10/4/2013	0	0	0
		TJ	10/9/2013	0	0	0
		TJ	10/16/2013	0	0	0
		TJ	10/23/2013	0	0	0
		TJ	10/30/2013	0	0	0
	Icicle Total			**70**	**488**	**18**
Mission/Brender	Mouth to Residential/Mill Rd.	BI	10/7/2013	0	0	0
		BI	10/14/2013	0	0	0
		BI	10/21/2013	0	0	0
		BI	10/28/2013	0	0	0
		JH	11/15/2013	0	0	0
		JH	11/22/2013	0	0	0
		BI	11/26/2013	1	0	0
	Mission/Brender Total			**1**	**0**	**0**
Nason	1 - Mouth to Coles Corner	JH,KS	10/31/2013	0	0	0
		MWC	11/7/2013	0	0	0
		JH,KS	11/14/2013	0	0	0
		JH,KS	11/21/2013	0	0	0
		JH,KS	11/29/2013	0	0	0
	2 - Coles Corner to Butcher Pond	JH,KS	10/31/2013	0	0	0
		KS	11/7/2013	0	0	0
		BI	11/18/2013	0	0	0
	3 - Butcher Pond to Ray Rock	TJ	10/31/2013	0	0	0
		TJ	11/7/2013	0	0	0
		TJ	11/14/2013	0	0	0
		TJ	11/21/2013	0	0	0
	Nason Total			**0**	**0**	**0**
Peshastin	1 - Mouth to YN Office	JH,KS	10/3/2013	0	0	0
		KS,JH	10/11/2013	0	0	0
		JH,KS	10/18/2013	0	0	0
		JH,KS	10/24/2013	0	0	0
		KS,JH	11/1/2013	0	0	0
		MWC	11/8/2013	0	0	0
		KS	11/15/2013	0	0	0
		JH,KS	11/22/2013	0	0	0
		JH,KS	11/30/2013	0	0	0
	2 - YN Office to Mountain Home Rd.	JH,KS	10/5/2013	0	0	0
		KS,JH	10/11/2013	0	0	0
		JH,KS	10/18/2013	0	0	0
		JH,KS	10/25/2013	0	0	0
		JH,KS	11/1/2013	0	0	0
		KS	11/8/2013	0	0	0
		KS	11/15/2013	1	1	0
		JH,KS	11/21/2013	0	0	0
	Peshastin Total			**1**	**1**	**0**

Roaring Creek	Mouth to Confluence	KS	9/13/2013	0	0	0
		KS,JH	9/16/2013	0	0	0
		TJ	10/3/2013	0	0	0
		JH,KS	10/12/2013	0	0	0
		TJ	10/16/2013	0	0	0
		TJ	10/24/2013	0	0	0
		TJ	10/31/2013	0	0	0
	Roaring Total			**0**	**0**	**0**
Wenatchee	1 - Mouth to Cashmere	MWC,TJ	10/7/2013	0	0	0
		JH,KS	10/10/2013	0	0	0
		MWC,TJ	10/14/2013	0	2	0
		JH,KS	10/17/2013	0	0	0
		MWC,TJ	10/21/2013	0	2	0
		JH,KS	10/24/2013	0	1	0
		MWC, TJ	10/28/2013	0	2	0
		MWC,TJ	11/4/2013	2	7	0
		MWC,BI	11/11/2013	3	5	3
		MWC,TJ	11/18/2013	4	6	0
		MWC,BI	11/25/2013	3	1	0
	Wenatchee 1 Total			**12**	**26**	**3**
	2- Cashmere to Dryden Dam	MWC,BI	10/8/2013	0	0	0
		BI,MWC	10/15/2013	0	0	0
		BI,MWC	10/22/2013	0	0	1
		MWC,BI	10/29/2013	0	0	0
		MWC,BI	11/5/2013	0	2	0
		MWC,BI	11/19/2013	0	0	0
		MWC,TJ	11/26/2013	0	1	0
	Wenatchee 2 Total			**0**	**3**	**1**
	3 - Dryden Dam to Leavenworth Boat Launch	BI,MWC	10/6/2013	0	0	0
		MWC,BI	10/13/2013	0	1	0
		MWC,BI	10/20/2013	0	0	0
		BI,MWC	10/27/2013	0	1	0
		MWC,BI	11/3/2013	0	0	1
		MWC	11/10/2013	0	2	3
		MWC,BI	11/17/2013	0	1	0
		MWC,BI	11/24/2013	0	1	3
	Wenatchee 3 Total			**0**	**6**	**7**
	4 - Leavenworth Boat Launch to Icicle Rd. Bridge	JH,BI	10/2/2013	0	0	0
		BI,JH	10/9/2013	0	0	0
		JH,KS	10/12/2013	0	0	0
		BI,JH	10/16/2013	0	0	0
		JH,KS	10/19/2013	0	0	0
		JH,BI	10/23/2013	1	5	0
		JH,KS	10/26/2013	0	2	0
		JH,BI	10/30/2013	0	4	0
		JH,KS	11/2/2013	0	3	0

		TJ,BI	11/6/2013	1	1	0
		JH,BI	11/13/2013	1	2	1
		JH,BI	11/20/2013	0	3	0
		JH,TJ	11/27/2013	0	4	1
		BI,JH	12/4/2013	0	0	0
		JH	12/11/2013	0	0	0
		MWC,KS	10/2/2013	0	0	0
		MWC,KS	10/9/2013	0	0	0
		MWC,KS	10/16/2013	0	0	0
		MWC,KS	10/23/2013	0	4	0
		MWC,KS	10/30/2013	1	24	0
		MWC,KS	11/6/2013	5	21	1
		MWC,KS	11/13/2013	6	16	0
		MWC,KS	11/20/2013	0	0	0
		MWC,KS	11/27/2013	4	3	0
		MWC,KS	12/4/2013	2	0	0
		JH,MWC	12/11/2013	0	0	0
	Wenatchee 4 Total			**21**	**92**	**3**
	5 - Icicle Rd. Bridge to Chiwaukum Bridge	TJ	10/9/2013	0	0	0
		TJ	10/16/2013	0	0	0
		TJ	10/23/2013	0	0	0
		TJ	10/31/2013	0	0	0
		TJ	11/7/2013	0	0	0
		TJ	11/14/2013	0	0	0
		TJ	11/21/2013	0	0	0
	Wenatchee 5 Total			**0**	**0**	**0**
	6 - Chiwaukum Bridge to Plain	JH,KS	11/16/2013	0	0	0
	Wenatchee 6 Total			**0**	**0**	**0**
	7 - Plain to Lake Wenatchee	BI,KS	11/9/2013	0	0	0
		JH,KS	11/23/2013	0	0	0
	Wenatchee 7 Total			**0**	**0**	**0**
	Wenatchee Basin Total			**105**	**627**	**32**

Stream	Reach and Description	Surveyors	Date	New Redds	Live Fish	Dead F
Methow	1 - Mouth to Steel Bridge	JH,AC	10/18/2013	**0**	**0**	**0**
		JH,AB	11/4/2013	1	0	0
		AC,AB	11/15/2013	1	0	1
		JH,AC	11/20/2013	0	0	0
	Methow 1 Total			**2**	**0**	**1**
	2 - Steel Bridge to Lower Burma Bridge	JH,AC	11/18/2013	0	0	0
		BioAnalyst	10/25/2013	0	0	1
		JH,AB	11/4/2013	1	0	0
		AC,AB	11/15/2013	0	0	0
		JH,AC	11/20/2013	0	0	0
	Methow 2 Total			**1**	**0**	**1**
	3 - Lower Burma Bridge to Upper Burma Bridge	JH,TS	10/9/2013	0	0	0
		AT,TS,LB,KM	11/1/2013	0	0	0
		CP,TS	11/4/2013	0	0	0
		AC,CP	11/8/2013	0	0	0
		JH,AT	11/14/2013	0	0	0
		CP.CH,BM,AB	11/24/2013	0	0	0
	Methow 3 Total			**0**	**0**	**0**
	4 - Upper Burma Bridge to Lower Gold Creek Bridge	TS,BM	10/11/2013	0	0	0
		TS,BM	10/17/2013	0	0	0
		RA,MA	10/31/2013	1	0	0
		JH,TS,AT	11/6/2013	0	0	0
		AB,BM	11/9/2013	0	0	0
		JH,AT	11/14/2013	1	0	0
		JH,TS,LB,KM	11/19/2013	0	0	0
		CP,BM,CH,AB	11/24/2013	0	0	0
		LB,BM	12/3/2013	0	0	0
	Methow 4 Total			**2**	**0**	**0**
	5 - Lower Gold Creek Bridge to Carlton	TS,BM	10/17/2013	0	0	0
		JH,AB	10/21/2013	0	0	0
		JH,AT	10/31/2013	0	2	0
		RA,RP	11/5/2013	1	0	1
		RA,MA	11/14/2013	1	1	1

		JH,AC,TS,AT	11/19/2013	1	1	0
		BM,CP,AB	11/23/2013	1	0	0
		LB,BM	12/3/2013	0	0	0
	Methow 5 Total			**4**	**4**	**2**
	6 - Carlton to Holterman's Hole	AB,JH	10/21/2013	0	0	0
		JH,AT	10/30/2013	0	0	0
		JH,TS	11/5/2013	2	0	0
		BM,AC,AB,CP	11/10/2013	4	0	0
		LB,TS	11/14/2013	0	0	1
		AB,CP,TS,JH	11/18/2013	0	0	1
		CH,CP	11/22/2013	0	0	0
		CP,TS	12/2/2013	0	0	0
	Methow 6 Total			**6**	**0**	**2**
	7 - Holterman's Hole to MVID dam	JH,AT	10/30/2013	0	0	0
		JH,TS	11/7/2013	0	0	0
		JH,TS,AT	11/12/2013	0	0	0
		CP,BM	11/15/2013	1	0	1
		RA,LB	11/21/2013	2	0	1
		JH,TS,AT	11/25/2013	0	0	0
		AB,BM,LB	12/2/2013	0	0	0
	Methow 7 Total			**3**	**0**	**2**
	8 - MVID dam to Red barn	JH,AT	10/30/2013	0	0	0
		JH,TS	11/7/2013	0	0	0
		JH,TS,AT	11/12/2013	0	0	3
		CP,BM	11/15/2013	0	0	1
		RA.LB	11/21/2013	0	0	0
		JH,TS,AT	11/25/2013	0	0	0
		BM,LB	12/2/2013	0	0	1
	Methow 8 Total			**0**	**0**	**5**
	9 - Red barn to Wolf Creek	BioAnalysts	11/4/2013	0	0	1
		JH,TS	11/13/2013	0	0	0
		CP,AC	11/17/2013	0	0	0
		BM,AB	11/22/2013	0	0	1
		CP,TS	12/3/2013	0	0	0
	Methow 9 Total			**0**	**0**	**2**

	10 - Wolf Creek to Rip Rap	JH,TS	11/13/2013	0	0	0
		CP,AC	11/17/2013	0	1	0
		BM,AB	11/22/2013	0	0	0
		CP,TS	12/3/2013	0	0	0
	Methow 10 Total			**0**	**1**	**0**
	11 - Rip Rap to Weeman Bridge	JH,TS	11/13/2013	0	0	0
		CP,AC	11/17/2013	0	0	0
		BM,AB	11/22/2013	0	0	0
		CP,TS	12/3/2013	0	0	0
	Methow 11 Total			**0**	**0**	**0**
	Weeman Bridge to Suspension Bridge	TS,JH	11/21/2013	0	0	0
	Methow 12 Total			**0**	**0**	**0**
	Suspension Bridge to Mazama	TS,JH	11/21/2013	0	0	0
	Methow 13 Total			**0**	**0**	**0**
	Methow Total			**18**	**5**	**15**
Winthrop NFH Spring Creek	Mouth to Winthrop NFH Irrigation Diversion	JH,AC	10/7/2013	0	0	0
		JH,TS	10/9/2013	0	0	0
		KM,CP,BM	10/21/2013	0	4	0
		CP,KM,BM,AB, AC	10/28/2013	3	6	0
		BM,TS,AC,CP, AT,RP	11/4/2013	7	3	1
		AC,BM,LB	11/12/2013	3	1	2
		CP,BM	11/15/2013	3	4	1
		AC,BM,LB	11/18/2013	1	0	0
		LB,TS	11/20/2013	0	2	1
		CP,LB,AB,BM	11/25/2013	0	5	3
		LB,BM,AB	12/2/2013	1	2	0
		AB,CP	12/9/2013	0	0	0
		BM.CP.AB	12/19/2013	1	4	1
	Winthrop Total			**19**	**31**	**9**
WDFW Methow FH Outfall	Mouth to Hatchery Adult Weir	JH,AC	10/17/2013	0	0	0
		CP,KM,BM	10/21/2013	0	0	0
		CP,KM,BM,AC, AB	10/28/2013	1	0	0
		JH,AT	10/30/2013	0	0	0
		TS,CP	11/4/2013	0	0	0
		JH,TS	11/13/2013	0	2	0

		CP,BM	11/15/2013	0	0	0
		LB,BM,AC	11/18/2013	1	0	0
		CP,LB,AB,BM	11/25/2013	0	0	0
		CP,TS	12/213	0	0	0
		AB.CP	12/9/2013	0	0	0
		BM,CP,AB	12/19/2013	0	0	0
	WDFW Total			**2**	**2**	**0**
Twisp	1 - Mouth to Lower Poorman Bridge	JH,TS	10/25/2013	0	0	0
		RA	11/1/2013	0	0	0
		KM,RP	11/7/2013	2	0	0
		KM,AT	11/13/2013	0	0	1
		AB,BM	11/17/2013	1	0	2
	2 - Lower Poorman Bridge to Upper Poorman Bridge	KM,RP	10/6/2013	4	1	0
		JH,TS	10/25/2013	0	0	0
		RA	11/1/2013	0	0	0
		AB,CP	11/12/2013	2	0	2
		AB,AC	11/16/2013	1	0	1
	3 – Upper Poorman Bridge to Twisp River Weir	JH,TS	10/25/2013	0	0	0
		AB,CP	11/12/2013	1	0	0
		AB,AC	11/16/2013	0	0	0
	4 – Twisp River Weir to Buttermilk Creek Bridge	CP,AC	11/9/2013	0	0	0
		CP,BM	11/15/2013	0	0	0
	5 – Buttermilk Creek Bridge to War Creek Bridge	JH,TS	11/1/2013	0	0	0
		BM,AB	11/8/2013	0	0	0
		KM,AT,LB	11/13/2013	0	0	0
		AB,BM	11/17/2013	0	0	0
	Twisp Total			**11**	**1**	**6**
Gold		JH,TS	10/9/2013	0	0	0
		TS,CP	12/2/2013	0	0	0
	Methow Basin Total			**50**	**39**	**30**
Chelan FH outfall	Outfall of hatchery to confluence with the Columbia River	AC,CH	12/3/2013	0	3	0
		BM,LB,AC	12/11/2013	0	0	0
	Chelan FH Total			**0**	**3**	**0**
	Out of Basin Total			**0**	**3**	**0**

APPENDIX C: Wenatchee and Methow Basin Coho Release Numbers and Mark Groups, BY2011

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 9	June 12	**190299 +BT**	98.8%	55,242	50,822	50,212	5,448
									55,242	**50,822**	**50,212**	**5,448**
Wenatchee	Nason Cr	Nason Wetlands	Cascade FH	MCR-WEN	March 26	March 26	**190302 +BT**	99.3%	64,119	64,119	63,670	0
Wenatchee	Nason Cr	Nason Wetlands	Cascade FH	MCR-WEN	March 28	March 28	**190303 +BT**	99.2%	63,963	63,963	63,451	
									128,082	**128,082**	**127,121**	0
Wenatchee	Nason Cr	Rohlfing's Pond	Willard NFH	MCR-WEN	May 1	June 12	**190312 +BT**	98.6%	29,565	28,737	28,335	2,824
Wenatchee	Nason Cr	Rohlfing's Pond	Willard NFH	MCR-WEN	May 1	June 12	**190313 +BT**	98.5%	30,645	29,787	29,340	
Wenatchee	Nason Cr	Rohlfing's Pond	Cascade FH	MCR-WEN	May 1	June 12	**190304 +BT**	99.5%	64,648	62,838	62,524	2,940
									124,858	**121,362**	**120,199**	**5,764**
Wenatchee	Beaver Cr	Beaver Creek	Willard NFH	MCR-WEN	May 1	June 12	**190310 +BT**	98.3%	34,688	31,740	31,200	1,226
Wenatchee	Beaver Cr	Beaver Creek	Willard NFH	MCR-WEN	May 1	June 12	**190311 +BT**	98.6%	33,600	30,744	30,314	1,376
Wenatchee	Beaver Cr	Beaver Creek	Willard NFH	MCR-WEN	May 1	June 12	**190317 +BT**	97.1%	10,700	9,791	9,507	1,367
Wenatchee	Beaver Cr	Beaver Creek	Willard NFH	MCR-WEN	May 1	June 12	**190318 +BT**	99.5%	19,080	17,458	17,371	1,164
									98,068	**89,733**	**88,392**	**5,133**

Wenatchee	Icicle Cr	LNFH SFL 25	Willard NFH	MCR-WEN	May 7	May 7	**190309**	98.5%	29,754	29,670	29,225	
Wenatchee	Icicle Cr	LNFH SFL 22-24	Cascade FH	MCR-WEN	Apr 26	Apr 26	**190301**	98.4%	65,063	63,176	62,165	2,353
Wenatchee	Icicle Cr	LNFH SFL 10-12; 16-18	Cascade FH	MCR-WEN	Apr 26	Apr 26	**190297**	97.0%	130,267	126,489	122,695	2,352
Wenatchee	Icicle Cr	LNFH SFL 8-9, 19-21	Cascade FH	MCR-WEN	Apr 26	Apr 26	**190296**	97.7%	110,793	109,238	106,726	
									335,877	**328,573**	**320,811**	**4,705**

Wenatchee	Icicle Cr	LNFH LFL 1 & 2	Cascade FH	MCR-WEN	Apr 24	Apr 24	**190298**	98.3%	130,107	115,145	126,602	2,194
Wenatchee	Icicle Cr	LNFH LFL 1 & 2	Willard NFH	MCR-WEN	Apr 24	Apr 24	**190305**	96.8%	74,043	65,528	63,431	2,124
									204,150	**180,673**	**176,619**	**4,318**

Methow	Methow	Winthrop NFH C12-16	Winthrop NFH	MCR-MET	Apr 22	May 9	**190319**	99.4%	253,265	249,330	247,834	5,902
Methow	Methow	Twisp Ponds	Willard NFH	MCR-MET	May 6	June 22	**190308**	96.9%	69,744	65,677	63,641	5,646
Methow	Methow	Winthrop NFH BC	Willard NFH	MCR-MET	Apr 19	June 4	**190316**	96.5%	42,304	40,576	39,156	5,740
Methow	Methow	Gold Creek	Willard NFH	MCR-MET	May 6	June 13	**190315**	97.5%	36,301	35,420	34,535	5849
Methow	Methow	Biddle Pond	Willard NFH	MCR-MET	May 6	May 24	**190306**	96.3%	67,078	65,394	62,974	-
									468,692	**456,397**	**448,140**	**23,137**

Methow	Methow	Wells FH	Willard NFH	MCR-MET	April 19	June 4	**190307**	95.6%	65,445	65,336	62,461	-
Methow	Methow	Wells FH	Willard NFH	MCR-MET	April 19	June 4	**190314**	97.1%	33,636	33,581	32,607	-
									99,081	**98,917**	**95,068**	-

Total	**1,514,050**	**1,454,559**	**1,426,562**	**48,514**

	Total Coho Released	Total CWTs Released
Wenatchee Basin	899,245	883,354
Methow Basin (+ Wells FH)	555,314	543,208