MID-COLUMBIA COHO REINTRODUCTION FEASIBILITY STUDY:

2011 ANNUAL REPORT
October 1, 2010 through January 31, 2012

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1.0 INTRODUCTION

Wild stocks of coho salmon *Oncorhynchus kisutch* were once widely distributed within the Columbia River Basin (Fulton 1970; Chapman 1986). Since the early 1900s, the native stock of coho had been extirpated from the tributaries of the middle reach of the Columbia River (the Wenatchee, Entiat, and Methow rivers; Mullan 1983). Efforts to restore coho within the mid and upper Columbia Basin rely heavily upon hatchery coho releases. The feasibility of re-establishing coho within tributaries of the mid-Columbia 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. To date, both of these key issues have been resolved with positive results, allowing the project to continue forward in achieving its ultimate goal of coho restoration through the 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 between environmental conditions of the lower Columbia River and mid-Columbia tributaries. Both the Mid-Columbia Coho Hatchery and Genetic Management Plan (HGMP 2009) and Master Plan for Coho Restoration (YN FRM 2010) describe strategies that will be implemented to facilitate the local adaptation process.

We are optimistic that the project will observe positive trends in hatchery coho survival as the transition is made from reliance on a lower Columbia River hatchery coho towards exclusive use of in-basin, locally adapted broodstock. Therefore, it is important to measure hatchery fish performance, not only as an indicator of project success, but to track potential short- and long-term benefits.

If the re-introduction effort is to be successful long term, adult returns must be sufficient to meet replacement levels without adversely affecting other endemic populations. Also by 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 an expanded performance period of approximately 17 months from fall 2010 through 2011 to include broodstock collection, spawning, egg incubation and transportation, spawning ground surveys, acclimation and survival. Yakama Nation (YN) staff also operated a 5-foot rotary smolt trap to estimate the number of naturally produced coho emigrating from Nason Creek in 2010-2011. This trap is operated with joint funding from Grant County Public Utility District (GCPUD, #430-2365) and BPA (#1996-040-00); therefore detailed smolt trapping results are not included in the body of this report but included as supplemental documents (Murdoch and Collins, 2010 and 2011) provided in Appendices A and B.

2.0 BROODSTOCK COLLECTION AND SPAWNING

2.1 WENATCHEE RIVER BASIN

2.1.1 Broodstock Collection

Broodstock collections occurred at Dryden Dam, Tumwater Dam and Leavenworth National Fish Hatchery's (LNFH) adult ladder. Although Dryden Dam was the primary source of brood collection, Tumwater Dam has become increasingly important as program collections shift toward incorporating more returning adults that have successfully ascended Tumwater Canyon. Emphasizing collection at Tumwater Dam is intended to select for coho that are able to ascend Tumwater Canyon to reach key habitat in the upper watershed. For a more detailed description, please refer to the Mid-Columbia Coho Restoration Master Plan (Broodstock Development Phase II; YN FRM 2010). For the first time since the inception of the program, over 50% of the broodstock was collected from Tumwater Dam in 2011. All coho encountered at the various trapping locations were assessed for condition and if deemed suitable, incorporated into the broodstock. Unsuitable individuals were passed upstream, which consisted of any fish with signs of significant abrasions or wounds, fungus, and/or overripe females expressing eggs at the time of sampling (all factors that would decrease the likelihood of an individual surviving to spawning).

2.1.1.1 Dryden Dam

In 2010, coho returning to the Wenatchee River included brood year (BY) 2007 adults and BY 2008 jacks; both hatchery and natural origin returns. In 2011, the run consisted of mainly BY2008 adults with minimal contribution from BY2009 jacks (0.93% of the 2011 escapement). Both return years were represented 4^{th} generation Mid-Columbia River (MCR) returns. The Dryden Dam fish traps were passively operated five days per week, 24-hours a day in both 2010 and 2011. In 2010, the facility ran both ladders from September 1 through November 15. However in 2011 only the left bank facility was operational. An actuator that operates the main trap entrance gate at the Dryden Right bank facility was in need of replacement and Chelan County Public Utility District (CCPUD) advised YN that the gate could fail at any time, which would compromise fish health of trapped adult salmon, impede passage, and potentially create an unsafe work environment for staff. The decision was made to not operate right bank. Because of the unusually large return (n = 22,529) we were able to collect sufficient broodstock at alternate trap locations. In both years, Coho trapping at Dryden Dam occurred concurrently with a summer Chinook and steelhead stock assessment evaluation performed jointly by YN and Washington Department of Fish and Wildlife (WDFW).

2.1.1.2 Tumwater Dam

Coho broodstock were collected at Tumwater Dam up to five days per week, 8 hours a day. Operational periods for both years were similar (September 1- November 12, 2010; September 14 - November 9, 2011). All trapping occurred concurrently with WDFW's steelhead reproductive success study. 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 analysis. Opercule punches served as a secondary mark in the event that a floy tag was dislodged during holding. A small number (n = 44 in 2010 and n = 75 in 2011) of coho collected at Tumwater Dam had been previously floy and PIT tagged at Dryden Dam as a part of an ongoing mark-recapture study.

2.1.1.3 Leavenworth National Fish Hatchery

In addition to Dryden and Tumwater collections, a v-trap weir in the upper bay of the LNFH ladder was installed the first week of October and operated on an as needed basis. This site has been and will continue to be used as a back-up brood collection site; ensuring overall collection goals are met while implementing Broodstock Development Phase II (YN FRM 2010). 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 analysis.

The differential marking schemes at multiple trap locations provided the necessary evaluation tools to parse out returns by collection site when calculating smolt-to-adult return rates and determining migratory success. Approximately 29.0% and 4.7% of the total broodstocks were collected at the LNFH ladder trap in 2010 and 2011, respectively. Tumwater Dam provided 35.0% and 54.5% of the broodstocks within the previously mentioned years outlined above.

A summary of broodstock collection and fish handled at all trapping sites can be found in Tables 1 and 2. All coho broodstock were transported to LNFH and held until spawning.

Table 1. Coho salmon and incidentals handled during trapping, 2010.

Location	Coho[a] (*broodstock*)	Steelhead	Sockeye	Chinook	Bull Trout
Dryden Dam	1,057 (363)	221	3	623	0
Tumwater Dam	530 (353)	0	0	0	0
LNFH	342 (292)	0	0	0	0

[a]-Actual number of coho adults handled during trapping at Dryden Dam, Tumwater Dam and LNFH during broodstock collection efforts for 2010.

Table 2. Coho salmon and incidentals handled during trapping, 2011.

Location	Coho[a] (*broodstock*)	Steelhead	Sockeye	Chinook	Bull Trout
Dryden Dam	1,762 (424)	146	2	255	1
Tumwater Dam	704 (567)	0	0	0	0
LNFH	49	0	0	0	0

[a] -Actual number of coho handled during trapping at Dryden Dam, Tumwater Dam and LNFH during broodstock collection efforts for 2011.

2.1.2 Spawning

A total of 940 coho adults (453 F and 487 M) were spawned at LNFH between October 12 and November 22, 2010. Of the 453 total female coho spawned, 441 (97.4%) were considered viable. Non-viable females were either over-ripe or green at the time of spawning. Peak spawn occurred October 27 with 99 viable females (Figure 1). Of the 1,008 coho collected for broodstock needs in 2010, 48.0% were females (n = 484) and 52.0% were males (n = 524); which included both three-year old and two-year old fish. The pre-spawn mortality rate at LNFH was 1.4% in 2010; a decrease of 3.7% compared to the previous year.

Spawn timing for the 2010 brood was similar when compared to the program mean from 2003-2009. Since 2003, no more than seven spawns were necessary to meet green egg goals. 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. In 2010 we observed an increase in the fecundity along with a decrease in egg mortality which resulted in a surplus of eggs. Because of this surplus, 106,410 and 100,386 eggs from spawns 6 and 7 were culled (Table 5).

Post-spawning coded-wire tag (CWT) analysis of the 2010 broodstock showed that 470 fish were returns to LNFH from 2009 (BY2007) and 2010 (BY2008) releases, while 372 adults were acclimated and released from upper Wenatchee River basin ponds during the same time period (Table 3). Analysis also identified three fish released in the Methow basin; two from Wells Fish Hatchery and one from Winthrop NFH. Scale analysis was used to verify origin (hatchery or wild) of 95 fish that did not possess a CWT. Of the 95 non-CWT fish; 63 were hatchery, 25 natural and 7 unknown origin fish (inconclusive scale analysis) were observed.

In 2011, 828 coho adults (406 F and 422 M) were spawned between October 11 and November 15, 2011. Of the 406 female coho spawned, 392.5 (96.7%) were considered viable. Peak spawn occurred on October 25 with 112.5 viable females (Figure 2). In 2011, 1,040 coho were collected for broodstock (430 F: 610 M). The 2011 pre-spawn mortality was 3.2%. Of the 27 (8 females and 19 males) pre-spawn mortalities, 19 were collected from Tumwater Dam. A total of 61 males were excess to needs and returned to Icicle Creek to spawn naturally. The 2011 spawning was compressed over 6 weeks (Figures 2 and 3).

In 2011, YN implemented the following changes to spawning protocols: 1) specific parental crosses to determine if fish collected from Tumwater Dam produce progeny which are able to more successfully ascend Tumwater Canyon, and 2) in-season fecundity sampling to prevent an egg surplus.

Information from the parental cross study may be used to develop a contingency plan for meeting BDPII goals (50% of the broodstock collected from Tumwater Dam for three consecutive years). The four crosses were upper basin (UB) male (M) by lower basin (LB) female (F), LBF x UBM, UBF x UBM and LBF x LBM. Each cross consisted of 13 pairs, accounting for a mean survivals from green-to-eyed egg stage (x = 86%) and eyed egg to pre-smolt transport (x = 92%). The eggs from each cross were shipped to Willard NFH because of their ability to rear smaller lots (approx. 32,000) per raceway. Resulting crosses will be acclimated within one pond in the upper Wenatchee basin.

YN calculated fecundities at spawning were to assist in ensuring meeting green egg goals and allowing for in-season management. All loose eggs from every fifth female were sampled to determine fecundity. A total of 98, or 24% of the females were sampled. YN calculated fecundity to be 3,104 eggs per female and was consistent with egg weighted method used prior to eyed egg transports (n = 3,141). A length-at-fecundity relationship will be generated to allow for future fecundity predictions based on fish size. YN personnel continue to follow strict egg disinfection protocols during the water hardening process to reduce the risk of vertical transmission from positive parents to progeny.

Post-spawn coded-wire tag analysis indicated that 265 fish were LNFH origin returns from 2011 (BY2008) releases, and 472 were fish acclimated and released from upper Wenatchee River basin ponds (Table 4). Nintey-four adults did not have CWTs, of these scale analysis indicated 67 were hatchery origin, 15 were natural origin and 12 were inconclusive.

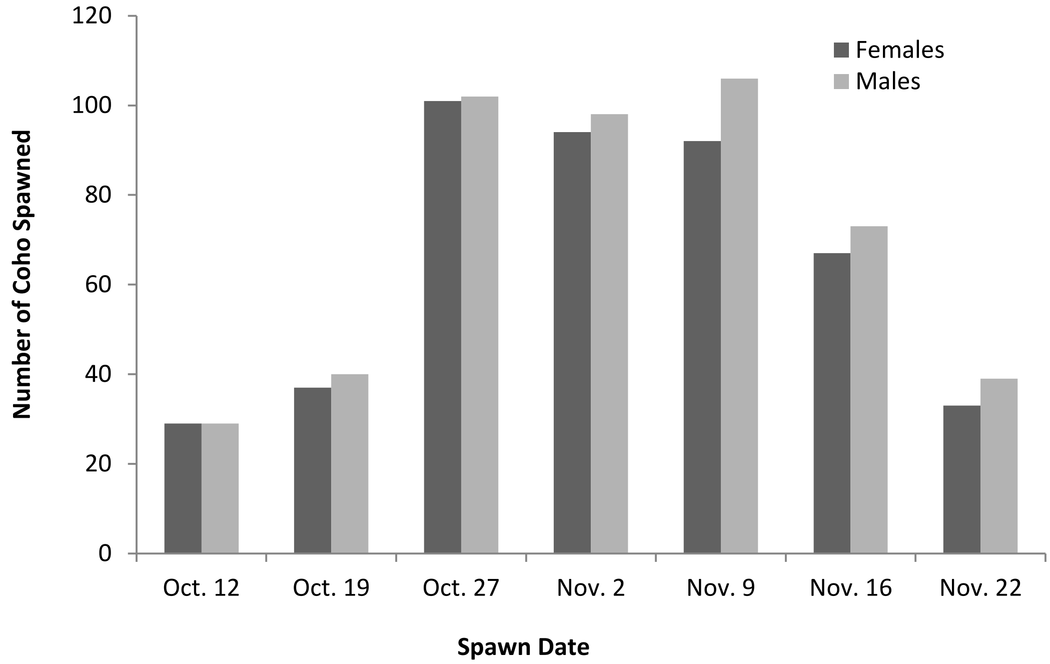

Figure 1. Number of coho spawned at Leavenworth National Fish Hatchery, 2010.

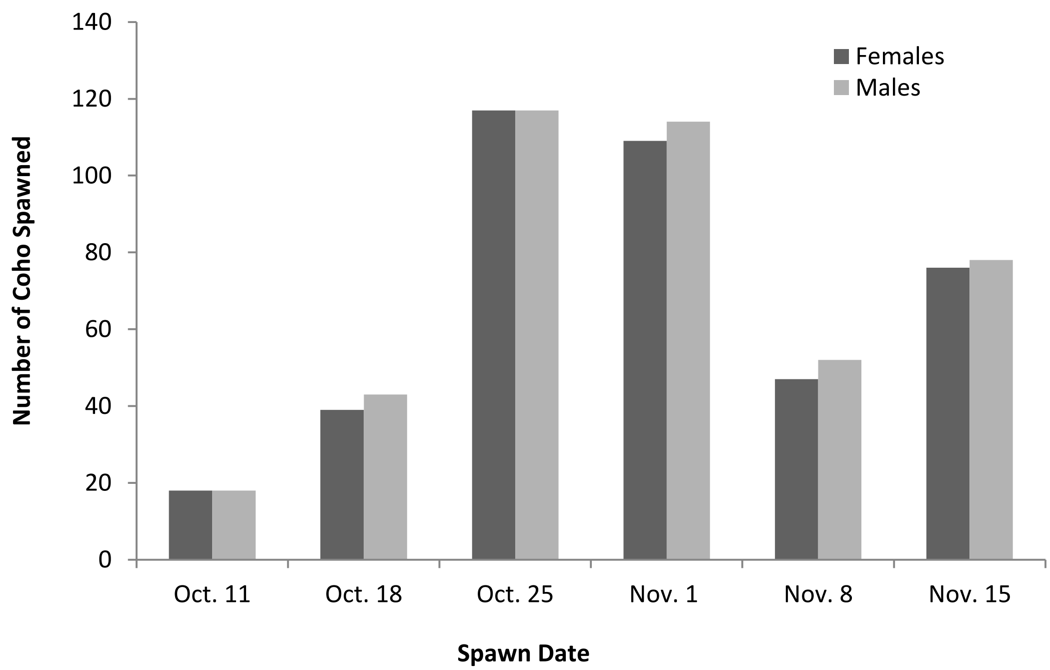

Figure 2. Number of coho spawned at Leavenworth National Fish Hatchery, 2011.

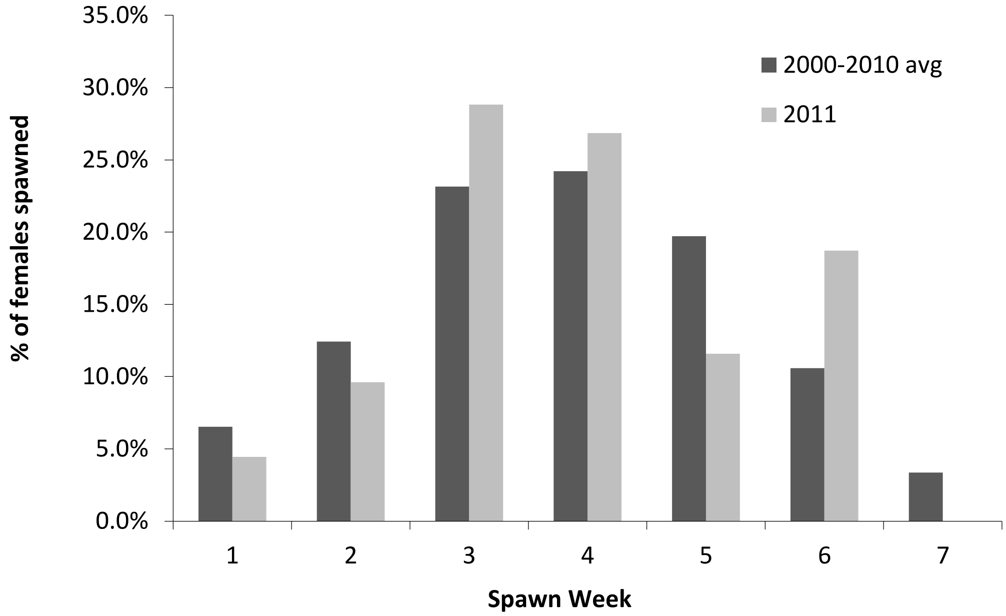

Figure 3. Temporal spawning distribution for brood years 2003-2010 and 2011.

Table 3. Summary of coded-wire tag and scale analysis from coho spawned at Leavenworth National Fish Hatchery in 2010.

Juvenile Release Location		BY2007 Adults	BY2008 Jacks	Percentage of Brood by Release Site
Leavenworth National Fish Hatchery	*Small Foster-Lucas Ponds*	130	3	14.1%
	Large Foster-Lucas Ponds	316	21	35.9%
Upper Wenatchee River Basin	*Coulter Pond*	94	0	10.0%
	Butcher Creek Pond	91	1	9.8%
	Beaver Creek Pond	82	0	8.7%
	Rohlfing's Pond	72	2	3.2%
	Nason Creek Wetlands	30	0	1.0%
Methow River	*Winthrop NFH*	1	0	0.1%

Basin	*Wells Dam*	2	0	0.2%
Unknown Origin	*Unknown*	69	1	7.4%
Wild		**25**	**0**	**2.7%**
Totals		**912**	**28**	**100.0%**

Table 4. Summary of coded-wire tag and scale analysis from coho spawned at Leavenworth National Fish Hatchery in 2011.

Juvenile Release Location		**BY2008 Adults**	**BY2009 Jacks**	**Percentage of Brood by Release Site**
Leavenworth National Fish Hatchery	*Small Foster-Lucas Ponds*	163	0	19.6%
	Large Foster-Lucas Ponds	102	0	12.3%
Upper Wenatchee River Basin	*Coulter Pond*	99	0	11.9%
	Butcher Creek Pond	136	0	16.4%
	Beaver Creek Pond	118	0	14.2%
	Rohlfing's Pond	97	0	11.7%
	Nason Creek Wetlands	22	0	2.6%
Unknown Origin	*Unknown*	79	0	9.5%
Wild		**15**	**0**	**1.8%**
Totals		**831**	**0**	**100.0%**

2.1.3 Incubation

A total of 1,504,517 green eggs were collected from the 2010 coho broodstock; of which 785,063 (52.1%) were incubated at LNFH while the remaining 719,454 (47.9%) were transported to YN's Peshastin Incubation Facility (PIF). Eyed-egg totals for LNFH and PIF in 2010 were 726,475 and 654,261, respectively. Average eye-up rate for the brood was 91.8% (Table 5). In 2011, 1,232,870 green eggs were fertilzed and incubated. Of these, 708,215 (57.4%) were incubated at LNFH while the remaining 524,655 (42.6%) incubated at PIF. The BY2011 eyed egg totals were 606,808 and 468,647, respectively. Eye-up rates in 2011 were 87.2% (Table 6). The lower eye-up rate was attributed to soft shell disease at the LNFH. The most likely causes of soft shell disease are bacteria, water chemistry and dietary deficiencies during the egg development stage (pers. comm. Thomas Sawtell, Argent Chemical Laboratories). Alevin that prematurely hatch during the shock, pick, ship or traying down process at receiving hatcheries will eventually die because they are not developed enough to survive outside of the egg shell. Eyed-eggs from both incubation facilities were transported to Cascade FH and Willard NFH between mid-November and early January for rearing until pre-smolts acclimation. Transportation from the incubation facilities to the rearing facilities occurred between 550 and 600 temperature units (°F). A summary of spawning and incubation activities can be found in Tables 5 and 6.

Mating protocols were the same at both LNFH and PIF. Eggs from each female were 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 to allow for fertilization, Excess milt, ovarian fluid, and other organics were then decanted. Next, the eggs were water hardened and disinfected with a 75 part-per-million (ppm) concentration of iodine 30 minutes. Eggs were rinsed with freshwater prior to placement into the incubators.

Table 5. Spawn dates, number of eggs collected, and eye-up rate at LNFH and PIF, 2010.

Incubation Location	Spawn Date	Number of Viable Females	Number eyed eggs	Number dead eggs	Total green eggs	Avg. Eggs per Female	Avg. Eyed eggs per female	Avg. % Eye-up	Receiving/ rearing hatchery
LNFH (L1)	12-Oct	29	82,286	6,338	88,624	3,056	2,837	92.8	WNFH
LNFH (L2)	19-Oct	36	117,596	10,896	128,492	3,569	3,267	91.5	WNFH
LNFH (L3)	26-Oct	99	305,029	25,972	331,001	3,343	3,081	92.1	WNFH/CFH
LNFH (L4)	2-Nov	66	221,564	15,382	236,946	3,590	3,357	93.5	CFH
PIF (P4)	2-Nov	23	64,437	10,995	78,432	3,410	2,932	85.9	CFH
PIF (P5)	9-Nov	91	271,880	34,774	306,654	3,444	2,988	88.7	CFH
PIF[a] (P6)	16-Nov	65	214,524	13,652	228,176	3,456	3,300	94.0	CFH
PIF[a] (P7)	22-Nov	32	100,420	5,772	106,192	3,319	3,138	94.6	N/A
		441	**1,377,736**	**123,781**	**1,504,517**	**3,398**	**3,113**	**91.6**	

a -A total of 106,410 from spawn P6 and all eggs from spawn P7 were overages and culled

Table 6. Spawn dates, number of eggs collected and eye-up rate at LNFH and PIF, 2011.

Incubation Location	Spawn Date	Number of Viable Females	Number eyed eggs	Number dead eggs	Total green eggs	Avg. Eggs per Female	Avg. Eyed eggs per female	Avg. % Eye-up	Receiving/ rearing hatchery
LNFH (L1)	11-Oct	18	46,577	9,182	55,759	3,098	2,588	83.5	WNFH
LNFH (L2)	18-Oct	37	95,470	24,664	120,134	3,337	2,580	79.5	WNFH
LNFH (L3)	25-Oct	112.5	304,382	47,661	352,043	3,129	2,706	86.5	WNFH
LNFH/ (L4)	1-Nov	57.5	160,379	19,900	180,279	3,135	2, 789	88.9	WNFH /CFH
PIF (P4)	1-Nov	49	141,404	14,375	155,779	3,179	2,886	90.8	CFH
PIF (P5)	8-Nov	45.5	123,201	16,983	140,184	3,081	2,708	87.9	CFH
PIF (P6)	15-Nov	73	204,042	24,650	228,692	3,133	2,795	89.2	WNFH/CFH
		392.5	**1,075,455**	**157,415**	**1,232,870**	**3,141**	**2,740**	**87.2**	

2.2 METHOW RIVER BASIN

2.2.1 Broodstock Collection

In 2010 broodstock were collected at Winthrop National Fish Hatchery (Winthrop NFH) and Wells Dam west ladder facility. Winthrop NFH's volunteer ladder was opened on September 27 and remained open until collection goals were met on November 15. Adults collected from both locations were transported to an on-station raceway at Winthrop NFH for holding until spawning. Fish returning to Winthrop NFH were collected volitionally as they entered the hatchery holding pond and/or within a temporary weir located in Spring Creek and will be referred to as "swim-ins" throughout the remainder of the document. At Wells Dam, broodstock collection occurred concurrently with WDFW's steelhead and summer Chinook collection at the Wells Dam west ladder trap. The west ladder trap was actively operated by YN and Wells FH staff no more than three days per week between September 22 and October 10. After October 10, coho broodstock collection continued up to 7 days a week. Trapping efforts at the Wells Dam were concluded when insufficient numbers of adult migrants over the dam and an increase of Winthrop NFH volitional swim-ins. Fish returning to Winthrop NFH were prioritized during broodstock collection and spawning since they demonstrated the necessary energetic ability and homing fidelity required to complete the migration up the Methow River to their point of release; a fundamental requirement to meet Broodstock Development Phase II goals established within the Coho Restoration Master Plan.

In 2010, 721 coho were collected for broodstock (467 swim-ins and 254 from Wells Dam). Of these, 72.0% (n = 519) were used as broodstock, 1.5% (n = 11; 10 F and 1 M) were non-viable adults (i.e. possessing gametes that were underdeveloped or in unsuitable condition for fertilization), and 1.4% (n = 10) were pre-spawn mortalities. The remaining 181 adults (*n* = 25.1%) were released back into the Methow River. No bull trout were observed or handled during trapping at either facility.

In 2011, YN staff added the Methow FH adult weir as a broodstock collection location. While coho were not released from this facility, Methow FH shares a common water source with Winthrop NFH. In-basin broodstock collection occurred from October 6 through November 13. A total of 435 coho were collected as swim-ins (377 at WNFH and 58 at Methow FH). Because most fish returned to the hatchery trap facilities, trapping at Wells Dam was reduced (*n* = 130; 74 F and 56 M).\

All coho collected at Wells Dam were tagged in the dorsal sinus with sequentially numbered floy tags and given a left side opercule punch prior to transport to Winthrop NFH. The mark allowed us to identify which fish were collect at Wells Dam during spawning. To decrease handling stress during transport from Wells Dam to WNFH, sodium chloride, Poly Aqua® and MS-222 were we added to the transport tank. No mortalities occurred during transportation. Handling of coho and non-target species (summer Chinook, summer steelhead and bull trout) are documented in Table 7. One bull trout was safely removed from the Methow FH adult weir on October 25, 2011 and reported to BPA and USFWS immediately.

Table 7. Methow Basin coho salmon trapped and incidentals diverted back to the river, 2010 and 2011.

Location	**2010 Coho Broodstock**	**2011 Coho Broodstock**	**2010 Steelhead *(Wells FH broodstock)***	**2011 Steelhead *(Wells FH broodstock)***	**2010 Chinook *(Wells FH broodstock)***	**2011 Chinook *(Wells FH broodstock)***	**2011 Bull Trout**
Winthrop NFH	467	377	0	0	0	0	0
Wells Dam West ladder Trap	254[a]	130[a]	116 (*64*)[b]	0(9)[b]	136 (*15*)[b]	5	0
Methow FH	n/a	58	n/a	0	n/a	0	1

[a] All adult coho intercepted at Wells Dam were transported to Winthrop NFH for broodstock. There were no adults passed at this facility during annual collections.
[b] Total numbers of adult steelhead and summer Chinook diverted into the west ladder holding pond for Wells FH broodstock.

2.2.2 Spawning

Coho were spawned at Winthrop NFH on a weekly basis between the third week of October and mid-November. In 2010, 256 F and 263 M were successfully spawned. Peak spawn occurred on November 8, 2010 with 115 females (Figure 4). Spawn timing was abbreviated when compared to the historical average (Figure 6).

In 2010, modifications in handling procedures during spawning activities as well as overall improved fish condition resulted in a low prespawn mortality of 1.4%. Modified handling procedures included the use of MS-222 to reduce handling stress while checking fish for ripeness and reducing the number of times a fish is handled by segregating broodstock in the holding pond based on state of maturation. All broodstock were treated with formalin three times per week to prevent the spread of pathogens within the holding pond.

One hundred and eighty one coho adults (83 F and 98 M) were collected in excess of program needs. All excess broodstock were wither released into Spring Creek (Winthrop NFH outfall; 54) or the Methow River (RK 28.8; 127) on November 15.

Coded-wire tag analysis in 2010 indicated that 87.8% (n = 474; 246 F and 228 M) of the fish collected for broodstock were acclimated and released in 2009 (BY2007) from Winthrop NFH; either on-station or the back channel pond. A total of 5.4% (n = 29; 13 M and 16 F) were released from the Twisp Ponds. Seveteen adults (3.1%) did not have a CWT, 2.4% (n = 13; 9 M and 4 F) were lost during the extraction process, 0.9% (n = 5) were jacks (BY 2008), and 0.4% (n = 2; 2 M) were acclimated and released from 2009 Wells FH. Scale analysis from unmarked broodstock indicated that two wild coho were trapped and spawned (the remaining unmarked broodstock were hatchery origin). Both natural origin coho were collected at Wells Dam. It is likely that we will need to increase the number of coho trapped at Wells Dam during future reintroduction phases to increase the proportion of naturaly origin fish in the broodstock. For a complete summary of broodstock composition and collection locations, please refer to Table 8.

In 2011, 466 viable adults (232 F and 234 M) were spawned during a five week period. Peak spawn occurred on October 31, 2011 (Figure 5). Similar to 2010, spawn timing was abbreviated when compared to the historical average (Figure 7). When spawning had concluded, eighty-six excess broodstock were released back to the river. Pre-spawn mortality was 1.6%.

Based on CWT analysis, 82.1% (n = 392) coho collected for broodstock were acclimated and released from the BY2008 Winthrop NFH, 3.3% (n = 16) were fish acclimated and released from the Twisp Ponds (BY2008), 1.0% (n = 5) were fish acclimated and released from Wells FH in 2010 (BY2008) and 0.8% (n = 4) did not possess a CWT. The remaining 12.9% (n = 62; 35 M and 27 F) were lost prior to tag extraction. Base on scale analysis all unmarked broodstock (n = 4) were of hatchery origin. For a complete summary of broodstock composition and collection locations, please refer to Table 9.

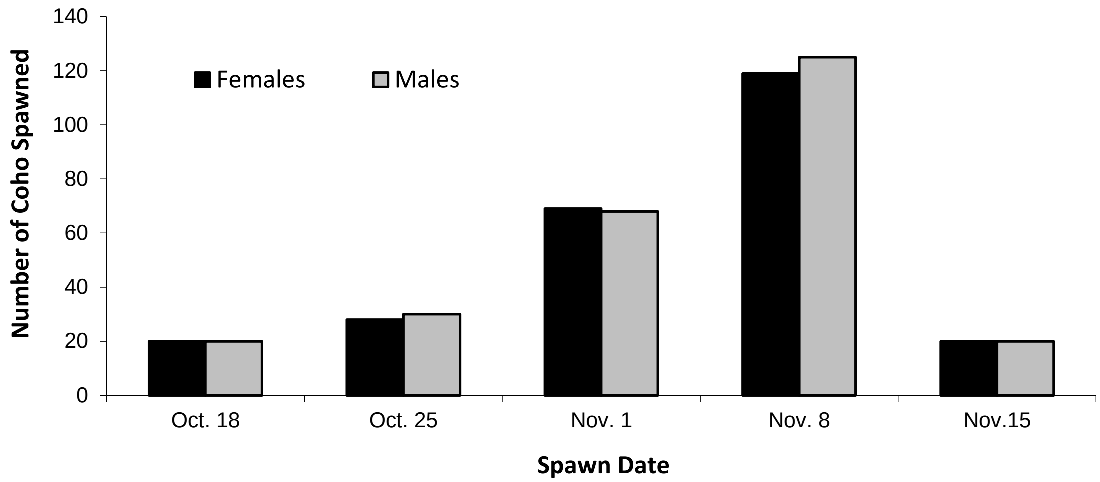

Figure 4. Number of coho spawned at Winthrop National Fish Hatchery, 2010.

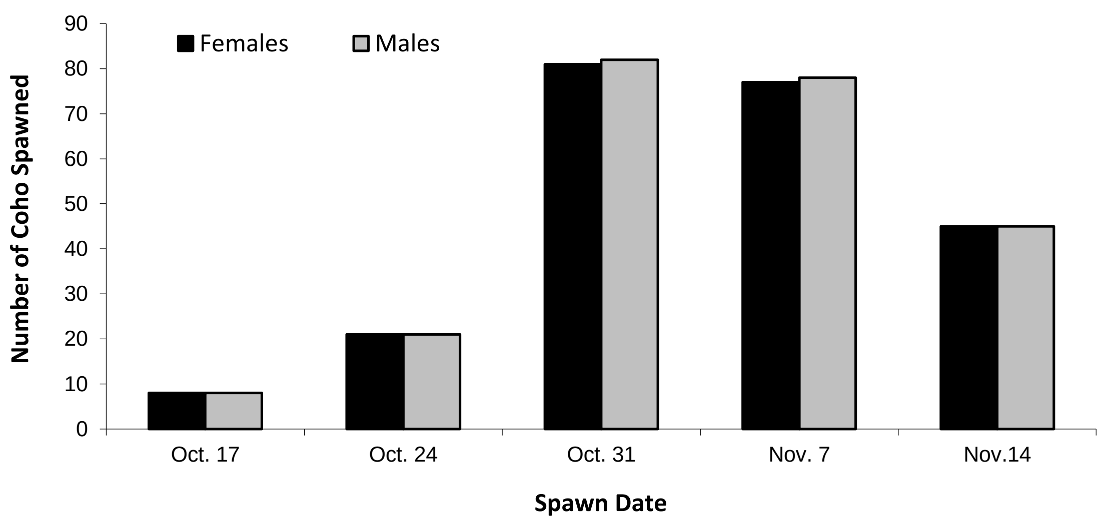

Figure 5. Number of coho spawned at Winthrop National Fish Hatchery, 2011.

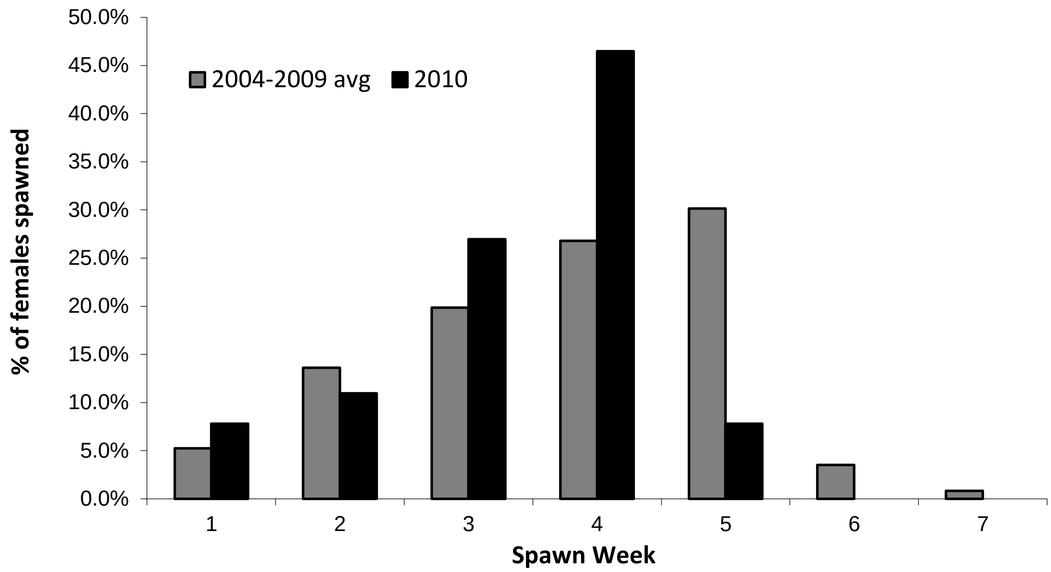

Figure 6. Temporal spawning distribution: brood years 2004-2009 and 2010 at Winthrop NFH.

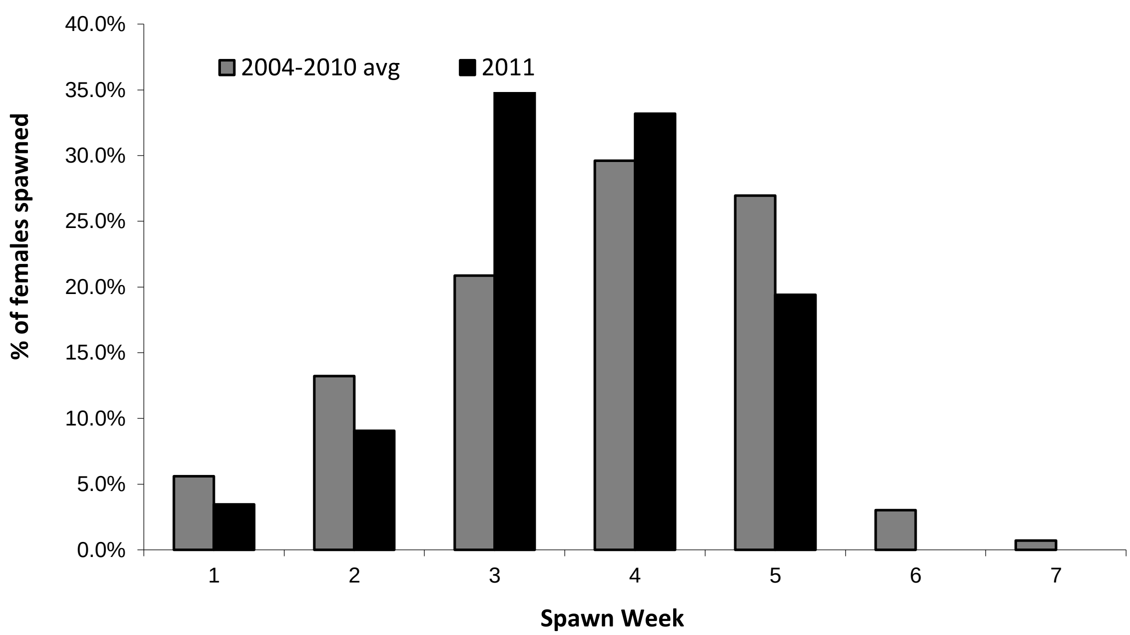

Figure 7. Temporal spawning distribution: brood years 2004-2010 and 2011 at Winthrop NFH.

Table 8. Broodstock composition and collection locations for fish spawned at Winthrop NFH, 2010.

Juvenile Release Location		BY2007 Adults	BY 2008 Jacks	Total
Winthrop NFH	*On-station and Back-channel*	474	5	479
Twisp Ponds		29	0	29
Wells Fish Hatchery	*On-station*	2	0	2
Unknown Hatchery		28	0	28
Natural Production		2	0	2
Totals		**535**	**5**	**540**

Table 9. Broodstock composition and collection locations for fish spawned at Winthrop NFH, 2011.

Juvenile Release Location		BY2008 Adults	Total
Winthrop NFH	*On-station and Back-channel*	392	392
Twisp Ponds		16	16
Wells Fish Hatchery	*On-station*	5	5
Unknown Hatchery		66	66
Natural Production		0	0
Totals		**479**	**479**

2.2.3 Incubation

Standarized protocols required eggs from each female were mated with one primary male and one back-up male. A 1.0% saline solution was used to increase sperm motility and eggs were allowed to stand for a minimum of 2-3 minutes to enhance the likelihood of successful fertilization. Once fertilized, excess milt, ovarian fluid and other organics were strained from the eggs and then soaked in a 75 ppm concentration of iodine for 30 minutes. After the disinfectant treatment had been completed, a freshwater rinse was administered prior to placement into vertical stack incubators. All eggs were incubated on groundwater at 41° F.

A total of 786,198 green eggs were collected in 2010, reslting in 652,921eyed-eggs. A portion (*n* = 253,506) of the eyed-eggs were transported to Willard NFH for rearing; the remainder were retained for rearing at Winthrop NFH. Mean fecundity for BY2010 was 3,126 eggs per female. Average eye-up for the 2010 brood was 83.0 %.

Approximately 25,000 eyed eggs were culled on January 26 and 108,145 excess, unfed fry were out planted to Spring Creek on April 14 to avoid exceeding rearing capacity at Winthrop NFH. Excess egg production was the result of a higher than expected fecundity coupled with lower than expected pre-spawn mortality.

In 2011, a total of 662,830 green eggs were collected resulting in 601,802 eyed-eggs, of which, 275,463 eyed eggs remained at Winthrop NFH while 326,339 eyed-eggs were transported to Willard NFH for rearing. Mean fecundity in 2011 was 2,869 green eggs per female. Average eye-up for the 2011 brood was 90.8% (the highest observed since the program began). A summary of spawn dates, number of eggs collected, fecundity and the eye-up rate at Winthrop NFH can be found in Table 10 & 11.

Table 10. Spawn dates, number of eggs collected and eye-up rate at Winthrop NFH, 2010.

Incubation Location	Spawn Date	Number of Females	Number eyed eggs	Number dead eggs	Total green eggs	Avg. Eggs per Female	Avg. Eyed eggs per Female	Avg. % Eye-up	Receiving/ rearing hatchery
Willard NFH	18-Oct	20	60,988	4,692	65,680	3,284	3,049	92.9	Willard NFH
Willard NFH	25-Oct	27	78,653	11,014	89,667	3,321	2,913	87.8	Willard NFH
Willard and Winthrop NFH	01-Nov	67.5	155,018[a]	48,008	203,026	3,008	2,297	76.4	Willard and Winthrop NFH
Winthrop NFH	08-Nov	117	301,270[b]	64,155	365,425	3,123	2,575	82.4	Winthrop NFH
Winthrop NFH	15-Nov	20	56,992	5,408	62,400	3,120	2,850	91.3	Winthrop NFH
Totals		**251.5**	**652,921**	**133,277**	**786,198**	**3,126**	**2,596**	**83.0**	

a- Approximately 113,865 eyed eggs were transported to Willard NFH on Dec 9 while the remaining 41,153 eyed eggs were incubated and reared to full term at Winthrop NFH.
b- Approximately 25,000 were culled on January 26 to avoid exceeding rearing capacity at Winthrop NFH.

Table 11. Spawn dates, numbers of eggs collected, and eye-up rate at Winthrop NFH, 2011.

Incubation Location	Spawn Date	Trans. Date	Number of Females	Number eyed eggs	Number dead eggs	Total green eggs	Avg. Eggs per Female	Avg. Eyed eggs per Female	Avg. % Eye-up	Receiving/ rearing hatchery
Willard NFH	17-Oct	19-Dec	8	20,133	2,431	22,564	2,821	2,517	89.2	Willard NFH
Willard NFH	24-Oct	19-Dec	20.5[a]	58,219	6,077	64,296	3,136	2,840	91.0	Willard NFH
Willard NFH	31-Nov	19-Dec	81	204,996	25,459	230,455	2,845	2,531	89.1	Willard NFH
Winthrop NFH	07-Nov	N/A	76.5	196,645	18,129	214,774	2,808	2,571	92.1	Winthrop NFH
Winthrop/ Willard NFHs	14-Nov	23-Dec	45	121,809[b]	8,932	130,741	2,905	2,707	93.2	Winthrop/ Willard NFHs
Totals			**231**	**601,802**	**61,028**	**662,830**	**2,869**	**2,605**	**90.8**	

a- Females observed to be only partially fecund during spawning activities were enumerated as 0.5 in an attempt to project an accurate average fecundity.
b- Approximately 42,991 eyed-eggs were transferred to Willard NFH and 78,818 remained on-station at Winthrop NFH

3.0 SPAWNING GROUND SURVEYS

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 Chiwawa River as well as Brender, Chumstick, Icicle, Mission, Nason, and Peshastin creeks were also surveyed. Efforts were focused on tributaries where current juvenile releases occur (e.g. Beaver, Nason & Icicle creeks) as well as areas in proximity to release sites (e.g. middle reaches of the Wenatchee River). Methow River surveys surveys concentrated on the mainstem Methow River and lower portions of tributaries, such as Chewuch and Twisp rivers, Beaver, Gold, and Spring creeks identified as primary coho spawning areas. The objectives of these surveys were to:

1) Determine spatial and temporal distribution of natural spawning.

2) Collect biological data from the carcasses of naturally spawning coho.

3) Estimate escapement of naturally spawning adults within the Wenatchee and Methow River basins.

Data generated from spawning ground surveys are used to monitor the progress and development of the recently reintroduced coho population and provide annual abundance estimates, stray rates, and adult age composition. These surveys are extensive and will remain so until predictable spawning distribution patterns have become established during the Natural Production Phases of the project (YN FRM 2010).

In areas of the Wenatchee basin, with relatively high spawning densities (e.g. - Icicle Creek, reach W4), redd identification tended to be difficult because of superimposition. Weekly surveys in these reaches are necessary to identify individual redds. Weekly surveys were also conducted on Beaver, Chiwawa, Mission, Peshastin, Nason, and Icicle creeks as well as the remaining reaches of the mainstem Wenatchee River.

In the Methow, tributary surveys varied and were prioritized by spawning densities observed in previous years; ensuring staff time was used efficiently. In tributaries where spawning densities were relatively abundant (>20 redds; e.g.-Winthrop NFH Methow FH outfalls), surveys were conducted every seven days to clearly identify individual redds before superimposition occurred. Tributaries that yielded a moderate level of natural production in past years (redds: >5 up to < 20; e.g. - Beaver Creek) were also surveyed every seven days. Periodic surveys, typically at or near peak spawning, were conducted in tributaries where historical redd data demonstrated low counts of redds (<5 redds) or had not been surveyed in previous years. These reaches included Gold, Libby and Wolf creeks. Hancock Springs was intermittently surveyed from the source to the confluence with the Methow River before, during, and after peak spawn. 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 of lower priority to in-basin surveys and documents out-of-basin distribution. Complete survey records can be found in Appendix C.

Spawning ground surveys were conducted either by foot or raft, depending on stream size and terrain. Foot surveys were conducted by a single person. Raft surveys were performed with two people; one person navigating while the other surveyed. Individual redds were either recorded on a map or flagged in the field. Each marker listed the date, redd location, and redd number, agency and the surveyor's initials. Global positioning system (GPS) receivers were used to record the physical location of individual redds on all surveys. For each survey, we recorded redd counts, live fish and carcass numbers, time required to complete the survey and stream temperatures.

Biodata was recorded from each carcass recovered during a survey. Fork length (FL) and post-orbital-hypural lengths (POH) were measured to the nearest centimeter. Measurements of POH were 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 in this summary, measurements of POH rather than FL were described. Snouts were removed from all carcasses for CWT analysis. The sex of each carcass was recorded and females were checked for egg retention by count of egg numbers present in the body cavity. Egg voidance was calculated by subtracting the number of eggs remaining in an individual female from that years' coho broodstock average fecundity. To prevent re-sampling, the caudal fin was removed before discarding the carcass back into the stream.

Table 12. Spawning ground survey reaches for the Wenatchee and Methow river basins.

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 – 35.4
	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	
CH1	Mouth to Hwy 2 Bridge	0.0 – 1.0
	Chiwawa River	
CR1	Mouth to Weir	0.0 – 1.0
	Chumstick Creek	
CU1	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	
WF1	Mouth to Biddle Acc. Ponds	0.0-1.6
	Hancock Springs Creek	
HC1	Mouth to Source	0.0 - 1.5
	Beaver Creek (MET)	
BM1	Mouth to Culvert	0.0-0.4
BM2	Culvert to Hwy 20 Br.	0.4-3.0
	Libby Creek	
LC1	Mouth to Hwy 153 Br.	0.0-0.5
LC2	Hwy 153 Br. to Roadside rip-rap	0.5-2.1
	Gold Creek	
GC1	Mouth to RM 1.5	0.0-2.4
GC2	Roadside rip-rap to South Fork G.C. Br.	1.5-2.3
	Chewuch River	
CR1	Mouth to Fulton Dam	0.0-1.6
CR2	Splash Dam to Co. Hwy 1613	1.6-4.0
	Twisp River	
T1	Mouth to Lower Poorman Br.	0.0-3.0
T2	Lower Poorman Br. to Upper Poorman Br.	3.0-8.0
T3	Upper Poorman Br. to Twisp River weir	8.0-11.2
	Spring Creek	
SPC1	Mouth to Winthrop NFH	0.0-0.4
	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
	Methow River Basin	
BB1	Chelan FH (Beebee 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 2010, YN staff identified a total of 219 redds in the Wenatchee River basin. The majority of redds (*n* = 204) were identified between the town of Leavenworth and the mouth of the Wenatchee River. Of the remaining redds (*n* = 15) found upstream of Leavenworth, 53.3% (*n* = 8) were located in Nason Creek. Increased broodstock collections at Tumwater Dam likely contributed to the low number of redds upstream of the facility. YN staff collected 75 post-spawn carcasses for an overall sample rate of 14.9% in the Wenatchee River basin (Table 13).

During the 2011, a total of 2,719 redds were identified and 1,287 adult coho carcasses collected throughout the Wenatchee River subbasin for an overall sample rate of 21.5% (Table 14). Redd counts and carcass recoveries were dramatically higher than past years due to the record number of coho adults returning to upper Columbia tributaries. The majority of redds (*n* = 2,515; 92.5%), were located between the town of Leavenworth and the mouth of the Wenatchee River. We counted 104 redds upstream of Leavenworth; approximately 3.8% of the total number of redd. Of these, 89 redds were located in Nason Creek. To date, this was the highest number of coho redds recorded in Nason Creek. Adult coho that spawn upstream of Tumwater Dam will continue to be limited while the program remains in BDPII. Duirng 2011 to test the success of adult out-planting as a reintroduction tool, we relocated 124 individuals (62 M and 62 F) from Icicle Creek to various locations in Nason Creek.

Table 13. Summary of Wenatchee River coho redd counts, distribution, and carcass recovery in 2010.

River	Number of Redds	Proportion of Redds in Basin	Recovered Carcasses	Sample Rate[a]
Beaver Creek	0	0.0%	0	—
Brender/Mission Creeks	20	9.1%	5	10.8%
Chiwaukum Creek	0	0.0%	0	—
Chumstick Creek	0	0.0%	0	—
Icicle Creek	100	45.7%	51	22.2%
Nason Creek	8	3.7%	0	0.0%
Peshastin Creek	15	6.8%	8	22.9%
Wenatchee River	76	34.7%	11	6.3%
Total	**219**	**100%**	**75**	**14.9%**

a- sample rate based on the 2010 brood collection sex ratio of 1.0F to 1.3M, or 2.3 fish per redd (FPR)

Table 14. Summary of Wenatchee River coho redd counts, distribution, and carcass recovery in 2011.

River	Number of Redds	Proportion of Redds in Basin	Recovered Carcasses	Sample Rate[a]
Beaver Creek	0	0%	0	—
Brender/Mission Creeks	83	3.1%	18	10.3%
Chiwaukum Creek	0	0%	0	—
Chumstick Creek	13	0.5%	3	11.1%
Icicle Creek	1,664	61.2%	694	19.9%
Nason Creek	89	3.3%	7	3.7%
Peshastin Creek	57	2.1%	7	5.8%
Wenatchee River	813	29.9%	558	32.7%
Total	**2,719**	**100%**	**1,287**	**22.5%**

a- sample rate based on the 2011 brood collection sex ratio of 1.0F to 1.1M, or 2.1 FPR

A total of 52 coded wire tags were recovered from adult carcasses in the Wenatchee River during 2010 (Table 15). Analysis indicated that 32.7% (*n* = 17) were fish released in upper Wenatchee River tributaries as juveniles while 69.2% (*n* = 36) were released from Icicle Creek. Twenty-two recovered carcasses lacked CWTs, scale analysis determined that thirteen were hatchery origin, six were natural origin and the remaining three had an undetermined origin (i.e. – unidentifiable scale pattern analysis through regeneration or poor extraction location). A summary of analysis for non-tagged individuals is provided in Table 17.

In 2011, a record 1,073 coded wire tags (CWT) were recovered from adult carcasses (Table 16). Analysis revealed that 23.4% (*n* = 251) were recovered from fish that had been released into upper Wenatchee River tributaries as juveniles, while 76.1% (*n* = 817) were fish released from LNFH. Very few (0.5% (*n* = 5) CWTs were recovered from out of basin releases (Wells Dam and Winthrop NFH). The origin of an additional 214 carcasses without CWTs (natural origin, unknown hatchery, or lost tags) was determined by scale analysis (Table 18). Among these, 89.7% (*n* = 192) were hatchery fish, 7.9% (*n* = 17) were naturally produced and 1.9% (*n* = 4) were of unknown origin (poor scale quality).

Table 15. Summary of coded-wire-tag analysis from adult coho carcasses recovered throughout the Wenatchee River Basin in 2010.

Juvenile Rearing/Release	# of CWT's	Spawning Location/CWT Recovery		
		Lower Basin		Upper Basin
Beaver Creek Acc. Pond	4	Icicle	2	
		Peshastin	1	
		Wenatchee	1	

Butcher Creek Acc. Pond	4	Icicle	2		
		Mission	1		
		Wenatchee	1		
Coulter Creek Acc. Pond	5	Icicle	3		
		Peshastin	1		
		Wenatchee	1		
Rolfing's Acc. Pond	4	Icicle	1	Wenatchee	1
		Peshastin	1		
		Wenatchee	1		
LNFH LFL 1-2	20	Icicle	18		
		Peshastin	1		
		Wenatchee	1		
LNFH SFL 9-12	5	Icicle	5		
LNFH SFL 18-25	10	Icicle	9		
		Wenatchee	1		
Unknown Hatchery	13	Icicle	10		
		Mission	1		
		Peshastin	1		
		Wenatchee	1		
Natural Origin (no tag)	6	Mission	3		
		Peshastin	2		
		Wenatchee	1		
Unknown	3	Peshastin	1		
		Wenatchee	2		
Grand Total			**74**		**1**

Table 16. Summary of coded-wire-tag analysis from adult coho carcasses recovered throughout the Wenatchee River Basin in 2011.

Juvenile Rearing/Release	# of CWT's Recovered	Spawning Location/CWT Recovery			
		Lower Basin		Upper Basin	
Beaver Creek Acc. Pond	79	Icicle	20		
		Mission	2		
		Peshastin	1		
		Wenatchee	56		
Butcher Creek Acc. Pond	70	Chumstick	1		
		Icicle	19		

		Wenatchee	50		
Coulter Creek Acc. Pond	45	Icicle	8	Nason	2
		Mission	1		
		Wenatchee	34		
Rolfing's Acc. Pond	57	Chumstick	1		
		Icicle	14		
		Wenatchee	42		
LNFH LFL 1-2	339	Icicle	237		
		Mission	1		
		Peshastin	1		
		Wenatchee	100		
LNFH SFL 8-9	15	Icicle	8		
		Wenatchee	7		
LNFH SFL 10-12	99	Icicle	66		
		Wenatchee	33		
LNFH SFL 16-17	43	Icicle	27		
		Mission	1		
		Wenatchee	15		
LNFH SFL 18-25	321	Icicle	208		
		Mission	4		
		Peshastin	1		
		Wenatchee	108		
Other Hatchery (Wells/Winthrop)	5	Icicle	6		
		Wenatchee	2		
Unknown Hatchery	192	Chumstick	1	Nason	4
		Icicle	78		
		Mission	8		
		Peshastin	3		
		Wenatchee	98		
Natural Origin	17	Icicle	7	Nason	1
		Mission	1		
		Wenatchee	8		
Unknown	5	Icicle	1		
		Peshastin	1		
		Wenatchee	3		
CWT Total	**1,073**		**1,066**		**2**
No CWT Total	**214**		**214**		**5**

Grand Total	1,287	1,280	7

Table 17. Scale analysis results of carcasses without CWTs in the Wenatchee River Basin, 2010.

Carcass Recovery Location	Origin		
	Unknown Hatchery	Naturally Spawned	Unknown
Icicle Creek	10	—	—
Mission Creek	1	3	—
Peshastin Creek	1	2	1
Wenatchee River	1	1	2
Total = 22	**13 (59.1%)**	**6 (27.3%)**	**3 (13.6%)**

*- Origin was determined by scale analysis for individuals not processing a CWT.

Table 18. Origin of non-CWT'ed fish recovered in the Wenatchee River Basin, 2011.

Carcass Recovery Location	Origin*		
	Unknown Hatchery	Natural Origin	Unknown
Chumstick Creek	1	0	0
Icicle Creek	79	7	1
Mission Creek	8	1	0
Nason Creek	4	1	0
Peshastin Creek	3	0	1
Wenatchee River	98	8	3
Total = 214	**192 (89.7%)**	**17 (7.9%)**	**4 (1.9%)**

*- Origin was determined by scale analysis for individuals not processing a CWT.

3.1.1 Icicle Creek

During 2010 and 2011, YN staff conducted weekly spawning ground surveys in the main channel (hatchery to mouth) and restored side channel (headgate to hatchery) of Icicle Creek; surveys ranging from early October through mid-December (Figures 8 & 9). In 2010, 63 redds in the main channel of Icicle Creek and 37 redds in the restored channel (Icicle Creek total = 100) were recorded. In 2011, a total of 1,131 redds in the main channel and 533 redds in the restored channel (Icicle Creek total = 1,664) were observed. Redds recorded in Icicle Creek represented 61.2% and 45.7% of the total number of redds found in the Wenatchee River basin within their respective years (Table 13 & 14).

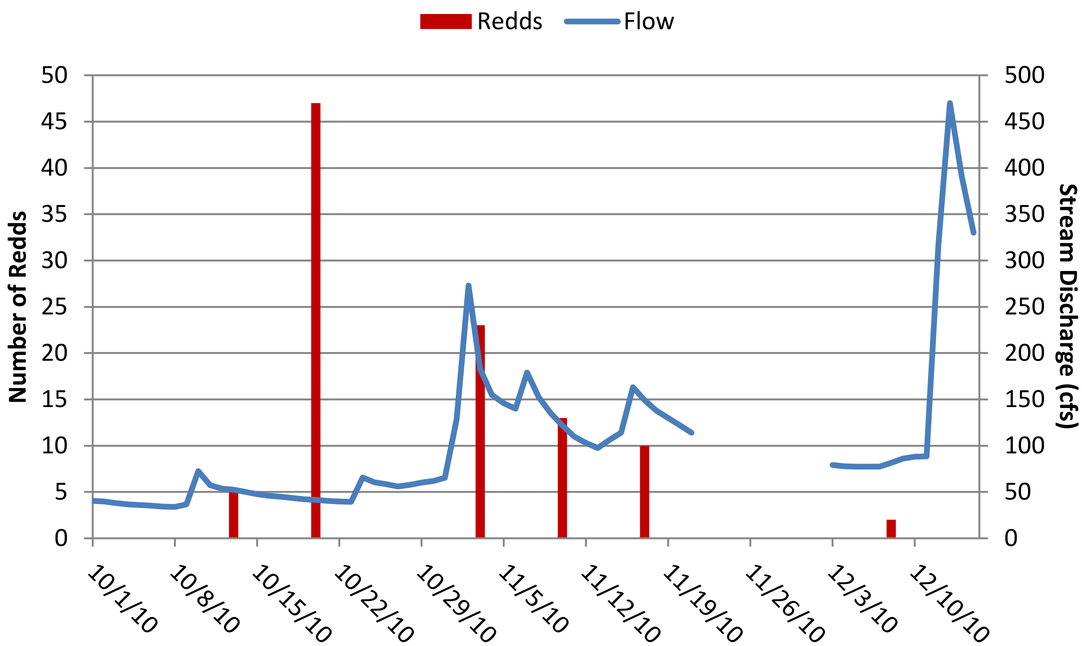

Figure 8. Weekly redd counts conducted in Icicle Creek from October 6 through December 8, 2010. Stream discharge data from nearby Peshastin Creek was used as a proxy for Icicle Creek data because the latter was not available. Stream discharge data provided by WSDOE (https://fortress.wa.gov/ecy/wrx/wrx/flows/station.asp?sta=45F070).

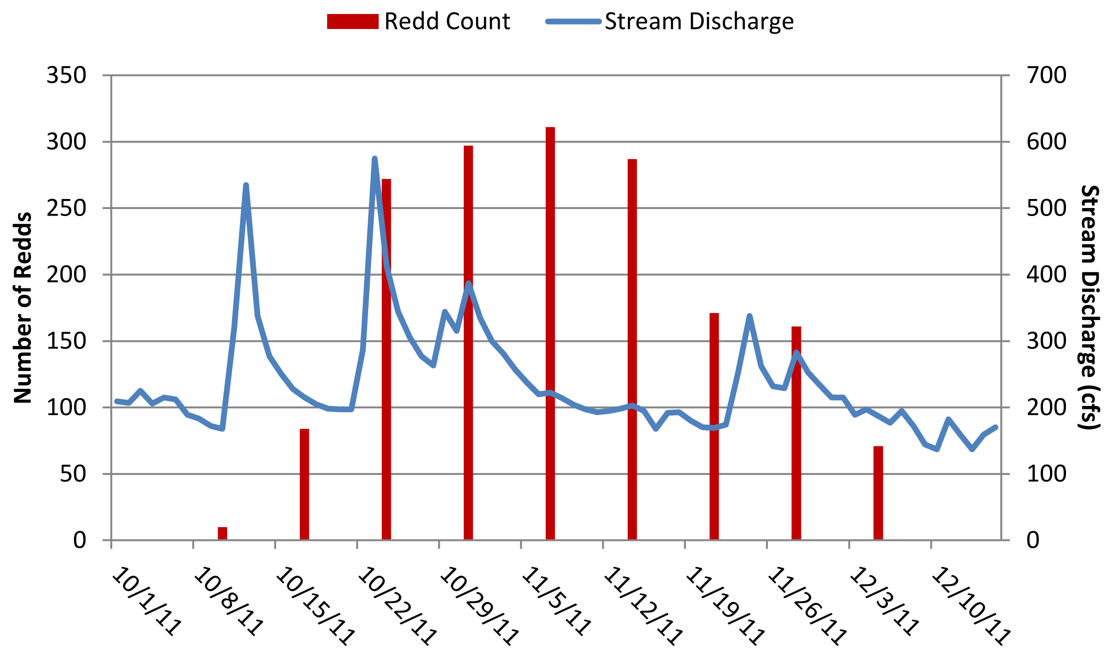

Figure 9. Weekly redd counts in Icicle Creek from October 1 through December 15, 2011.

YN staff recovered 51 coho carcasses from Icicle Creek for a sample rate of 22.2% during 2010 surveys. A brief period of precipitation resulted in increased flows (increased from 50 cfs to 275 cfs) during the month of November, making redd identification and carcass collection difficult. As flows subsided later in the month, additional redds were recorded and carcasses collected.

The mean POH lengths for male and female carcasses were 46.9cm (*n* = 9; *SD* = 14.7) and 56.3cm (*n* = 27; *SD* = 3.2), respectively. Fork lengths were not presented for carcass recoveries due to the variability created during the spawning process (i.e. - worn caudal fins). All females with intact body cavities were examined for the presence of eggs. Mean egg voidance was 79.9% (*n* = 37).

During the 2011 spawning ground season, YN staff recovered 694 coho carcasses (203 male, 488 female, 3 unknown) from Icicle Creek for a sample rate of 19.9%. Mean POH lengths for male and female carcasses were 53.3cm (*n* = 192; *SD* = 5.3) and 54.7cm (*n* = 464; *SD* = 3.5), respectively. All females with intact body cavities were examined for the presence of eggs; mean egg voidance was 89.8% (*n* = 353).

3.1.2 Nason Creek

In 2010, seven spawning ground surveys were conducted in Nason Creek between October 4 and November 22; a total of eight redds were recorded (Table 13). Nason

Creek redds represented 3.7% of the coho redds identified in the Wenatchee River basin. No carcasses were recovered.

An increase in survey frequency (*n* =10) in 2011 on Nason Creek between October 6 and December 6, 2011 resulted in a total of 89 redds (Table 14). Nason Creek redds represented 3.3% of the total Wenatchee River basin redd count. Seven carcasses were recovered for a sample rate of 3.6%. Observed predation and deep pools may have contributed to the low sample rate. Mean POH for male and female carcasses were 76.0cm (*n* = 1) and 71.0cm (*n* = 3), respectively. Egg voidance among females could not be recorded due to the poor condition of the carcasses (i.e. - exposed body cavity at time of examination).

Nason Creek is regarded as a high priority tributary for coho reintroduction. Over ¾ of the hatchery coho acclimated above Tumwater Dam are located within the Nason Creek drainage. As such, Nason Creek is the most likely return destination for adults ascending Tumwater Canyon. Total numbers of adult coho counted at Tumwater Dam was 1,421 (Columbia River, DART); almost 3x the 10-year average (*n* = 542 adult coho). In 2011, 567 coho (421 males; 146 females) were collected for broodstock while 854 were allowed to pass upstream. The high number of adult fish upstream of Tumwater probably contributed to the increased number of redds found in Nason Creek, although a large proportion (>80%) of these fish were males.

As part of an ongoing evaluation to determine if relocating adult returns is a viable means of re-introducing coho salmon (when no suitable acclimation site can be found), YN staff transplanted an additional 124 Icicle Creek adult returns to Nason Creek throughout the spawning season. Several visual observations during stream surveys confirmed these fish (marked with high visibility, external spaghetti tags) were co-mingled with non-transplanted migrants on the spawning grounds, presumably mating. Individual spawner success will be evaluated through a parentage analysis to determine relative reproductive success of these outplanted individuals. Tissue samples will be collected from the 2011 Nason Creek progeny; originating from transplanted and naturally migrating spawning aggregates. Several collection methods will be employed to achieve the desired number of samples needed (i.e. - in-stream snerding, smolt trap collections, etc.) to provide a base for parental assignments.

3.1.3 Wenatchee River

In 2010, 76 redds were identified during weekly surveys of the mainstem Wenatchee River. The surveys extended from Lake Wenatchee to the Columbia River confluence (reaches W1-W7) and occured between October 8 and November 15. Mainstem Wenatchee River coho redds accounted for 34.7% of the total, observed redds in the basin. YN recovered 11 carcasses along the mainstem Wenatchee River for a sample rate of 6.3%. Mean POH lengths for male and female carcasses were 50.7cm (*n* = 7; *SD* = 5.8) and 54.0cm (*n* = 6; *SD= 4.8*), respectively. Egg voidance was 73.2% (*n* = 6) among females. Four carcasses did not possess CWTs or were too decomposed to recover (Table 15).

The 2011, we observed a dramatic increase in spawner abundance with a total of 813 redds recorded during weekly surveys between October 7 and December 15 (Table 14). Redds located on the mainstem Wenatchee River accounted for 29.9% of the total coho redds observed in the Wenatchee River basin. YN recovered 558 carcasses along the mainstem Wenatchee River for a sample rate of 32.7%. The mean POH lengths for male and female carcasses were 52.8cm (n = 173; SD= 4.8) and 54.9cm (n = 353; SD = 3.1), respectively. Egg voidance was 71.2% (n = 247) among sampled females.

3.1.4 Chumstick Creek

In 2011, six surveys were conducted in Chumstick Creek. Thirteen redds were recorded; this accounted for 0.5% of redds found in the Wenatchee River basin. Three female carcasses were recovered with an average POH of 59.3cm. Sample rate for Chumstick Creek was 10.3%. Prior to 2011, reliable surveys were not conducted because of a migratory blockage (i.e.-North Road culvert) that was present.

3.1.5 Mission/Brender Creeks

In 2010, YN staff conducted ten surveys of Mission/Brender creeks between October 2 and December 6 and recorded 20 redds. Redds located represented 9.1% of the total coho redds recorded in the Wenatchee River basin (Table 13). YN recovered five carcasses for a sample rate of 10.8 %. Mean POH lengths for males and females were 52.0cm (n = 2) and 55.0 cm (n = 2), respectively. Egg voidance was estimated at 48.8% (n = 2). A total of four carcasses did not possess CWTs or were too decomposed to recover (Table 15).

In 2011, we increased the number of surveys in Mission and Brender creeks to 12 between between October 1 and December 12 finding 83 redds. Redds located in Mission and Brender creeks represented 3.1% of the total coho redds observed in-basin (Table 14). YN recovered 18 carcasses for a sample rate of 10.3%. Mean POH lengths for both males and females were 48.0cm (n = 4; SD = 2.9) and 54.5cm ($n = 11$; SD = 2.8), respectively. Egg voidance was 74.3% among sampled females (n = 7).

3.1.6 Peshastin Creek

YN conducted eight surveys on Peshastin Creek and identified15 coho redds between October 3 and November 21, 2010. Eight carcasses were sampled for a recovery rate of 25.4%. Redds located in Peshastin Creek represented 6.8% of all coho redds recorded in the Wenatchee River basin. Mean POH lengths for males and females were 50.0cm (n = 2) and 54.2cm (n = 5; SD = 5.6), respectively. Egg voidance was 77.3% among females sampled (n = 16). A total of three carcasses did not possess CWTs or were too decomposed to recover (Table 15).

Six additional surveys were conducted in 2011 (*n* = 14) on Peshastin Creek and 57 coho redds recorded between October 7 and November 18 (Table 14). Seven carcasses were recovered for a sample rate of 5.8%. Redds located in Peshastin Creek represented 2.1% of all coho redds recorded in-basin. The mean POH lengths for males and females were 48.0cm (*n* = 1) and 54.3cm (*n* = 4; *SD* = 6.0), respectively. Egg voidance was 100% among females sampled (*n* = 4).

3.1.7 Other Tributaries

We also conducted spawning grounds surveys in Beaver Creek from early October through the end of November in 2010 and 2011 with no redds or carcasses being located. Chiwaukum Creek was surveyed in 2010 with no observations but could not be surveyed in 2011 due to road and bridge construction. Chiwawa River was surveyed from the Wenatchee River confluence to the fish weir; no redds were recorded in both years.

3.2 METHOW BASIN REDD COUNTS

In 2010, 119 coho redds were identified in the Methow Basin. Approximately ½ the redds observed (*n* = 66; 55.5%) were located within the mainstem while the remainder (*n* = 53; 44.5%) were identified in select tributaries/outfalls such as the Twisp River, Gold Creek, and both Winthrop NFH/Methow FH outfalls. A preponderance of mainstem redds (*n* = 47; 71.2%) were found within the lower reaches; below RK 33.9. A total of 47 carcasses were collected for an overall basin sample rate of 18.8% (Table 19).

In 2011, a total of 312 coho redds were identified; more than double the previous years' total. Redd distribution was comparable with majority of redds observed (*n* = 183; 58.7%) within the mainstem while remaining redds (*n* = 129; 41.4%) were identified in tributaries/hatchery outfalls. A total of 369 carcasses were collected for an overall, in-basin sample rate of 51.4% (Table 20). This recovery rate could be misleading if not all redds were identified in areas where group spawning (and superimposition) likely occurred; group spawning was observed within hatchery outfalls and reaches proximal to these locations, effectively reducing discernible redd identification. Survey frequencies within these reaches were increased, conducted multiple times between December 1 and 9, to account for the high numbers of carcasses observed post peak spawn. Additionally, stable river flows prevailed after peak spawn, contributed to an increased sampling efficiency.

Spawning ground surveys were also conducted outside the target watershed in the Chelan River and Chelan FH outfall. We implemented these out-of-basin surveys were to identify the extent of spawner distribution. Out-of-basin redds were not included in Methow Basin spawning escapement estimates. In 2010, seven redds were identified and fifteen carcasses recovered while 2011 resulted in twenty redds and seven carcasses were observed and sampled.

Table 19. Summary of coho redd counts, distribution in the Methow River Basin, and carcass recovery, 2010.

River	Number of Redds	Proportion of Redds in Basin	Recovered Carcasses	Sample Rate %[a]
Methow River	66	55.5%	26	18.8%
Winthrop NFH Spring Creek	29	24.4%	16	26.3%
WDFW Outfall	22	18.5%	3	6.5%
Twisp River	0	0.0%	0	0.0%
Beaver Creek	0	0.0%	0	0.0%
Chewuch River	0	0.0%	0	0.0%
Gold Creek	2	1.7%	2	47.6%
Libby Creek	0	0.0%	0	0.0%
Total	**119**	**100.0%**	**47**	**18.8%**

a- Sample rate is based on a sex ratio of 1.0F: 1.1M observed as swim-ins to Winthrop NFH. Sample rate was calculated as Carcasses/Sex Ratio x Redd Count = Escapement.

Table 20. Summary of coho redd counts, distribution in the Methow River Basin and carcass recovery, 2011.

River	Number of Redds	Proportion of Redds in Basin	Recovered Carcasses	Sample Rate %[a]
Methow River	183	58.7%	264	62.7%
Winthrop NFH Spring Creek	77	24.7%	100	56.6%
WDFW Outfall	39	12.5%	4	4.5%
Twisp River	11	3.5%	1	4.0%
Beaver Creek	0	0.0%	0	0.0%
Chewuch River	0	0.0%	0	0.0%
Gold Creek	2	0.6%	0	0.0%
Libby Creek	0	0.0%	0	0.0%
Total	**312**	**100.0%**	**369**	**51.4%**

a-Sample rate based on a sex ratio of 1F: 1.3M observed as swim-ins to Winthrop NFH. Sample rate was calculated as Carcasses/Sex Ratio x Redd Count = Escapement.

Table 21. Summary of coded-wire-tag analysis from coho carcasses recovered throughout the Methow River Basin and out-of-basin tributaries, 2010.

Juvenile Release Location	# of CWTs	Adult Recovery Location*	# of CWTs
Winthrop NFH Complex Female	31	Spring Creek	11
		WDFW outfall	1
		Methow River	10
		Gold Creek	1
		Out of basin	8
Winthrop NFH Complex Male	14	Spring Creek	4
		WDFW outfall	1
		Methow River	7
		Out of basin	2
Wells FH Female	2	Methow River	1
		Out of basin	1
Wells FH Male	2	Methow	1
		Out of basin	1
Twisp Ponds Female	5	Methow River	1
		Gold Creek	1
		WDFW outfall	1
		Spring Creek	1
		Out of basin	1
Twisp Ponds Male	2	Out of basin	2
Unknown Female	2	Methow River	2
Unknown Male	4	Methow River	4
Out of Basin Total			**15**
Grand Total			**62**

Table 22. Summary of coded wire-tag analysis from coho carcasses recovered throughout the Methow River Basin and out-of-basin tributaries, 2011.

Juvenile Release Location	# of CWTs	Adult Recovery Location*	# of CWTs
Winthrop NFH Female	167	Spring Creek	48
		WDFW outfall	4
		Methow River	114
		Out of basin	1
Winthrop NFH Male	111	Spring Creek	38
		Methow River	72
		Out of basin	1

Winthrop NFH back-channel Female	19	Spring Creek	4
		Methow River	15
Winthrop NFH back-channel Male	9	Spring Creek	5
		Methow River	4
Wells FH Female	5	Out of basin	5
Wells FH Male	1	Methow River	1
Twisp Ponds Female	22	Methow River	21
		Twisp River	1
Twisp Ponds Male	9	Methow River	9
Lost or No CWT Female	20	Methow River	20
Lost or No CWT Male	13	Methow River	13
Out of Basin Total			**7**
Grand Total			**376**

3.2.1 Methow River

Methow River redd surveys in 2010 began the first week of October and were suspended in mid-December due to inclement weather conditions (e.g. sub-zero temperatures and non-navigable survey reaches due to ice accumulation). Surveys included eleven reaches (M1-M11) on the Methow River, extending from Weeman Bridge (RK 98.6) to the Columbia River confluence (RK 0.0).

Of the 66 mainstem coho redds identified in 2010, 47 were located in reaches M1-M4, while the remaining 19 were distributed between the middle and upper reaches of M5-M11. Twenty six carcasses were identified during surveys; ten males and sixteen females were sampled with mean POHs of 51.0cm (*SD* = 4.7) and 52.5cm (*SD* = 4.6), respectively. Mean egg voidance for recovered females was 56.3% (*n* = 16). Six of these females possessed intact egg skeins and were determined pre-spawn mortalities. Carcass recovery rate for the mainstem Methow River was 18.8% (Table 19).

We identified 183 coho redds on the mainstem in 2011, of which, 126 were located in reaches M4-M8 while the remaining 57 were distributed in the lower and upper reaches M1-M3 and M9-M11. Ninety-eight males and one hundred sixty-six females were sampled, with a mean FL of 65.9cm (*SD* = 6.5) and 65.4cm (*SD* = 4.6) and mean POH of 48.0cm (*SD*=4.8) and 49.5cm (*SD*=4.0), respectively. Mean egg voidance for females recovered was 72.0% (*n* = 166). Thirty-two females possessed intact egg skeins and were determined to be pre-spawn mortalities. Carcass recovery rate for mainstem Methow River was 62.7% (Table 20).

For a summary of coded-wire-tag origins from coho carcasses recovered throughout the Methow River basin in 2010 and 2011, please refer to Table 21 & 22.

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

Spring Creek and Methow FH outfall were surveyed weekly beginning the second week of October and ending in December. The Winthrop NFH complex (on-station raceways and back- channel pond) was the primary release location within the Methow River basin in 2009 and 2010, 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 water source for both hatchery facilities' rearing practices.

A total of 29 redds were located within Spring Creek in 2010 between mid-October through mid-December (Table 19). Four males and twelve females were sampled with a mean POH of 48.0cm (*SD* = 4.1) and 52.3cm (*SD* = 3.6), respectively. In 2011, 77 redds were located within Spring Creek during similar time periods; mid-October through mid-December (Table 20). A higher occurrence of recoveries occurred in 2011 with forty-four males and fifty-six females sampled with mean POHs of 47.5cm (*SD* = 3.6) and 48.8cm (*SD* = 3.5). The 2011 analysis was comparable to the previous year in that 95.0% (43 M and 52 F) of recoveries originated from on-station and back-channel releases while 5.0% (1 M and 4 F) did not possess a CWT (Table 22). For a summary of origins from coho carcasses recovered throughout the Methow River basin in 2010 and 2011, please refer to Table 21 & 22.

In the Methow outfall, twenty-two redds were identified between October 11 and December 13, 2010 (Table 19). One male and two females were sampled with mean POHs of 48.0cm and 50.0cm (*SD* = 4.2), respectively. Coded wire tag analysis indicated that 66.7% (1 M and 1 F) originated from the 2009 Winthrop NFH on-station and back-channel releases and 33.3% (1 F) originated from the 2009 Twisp Pond acclimation site release. In 2011, thirty-nine redds were identified between October 17 and November 29 (Table 20). Four females were sampled with a mean FL of 61.8cm (*SD* = 3.0) and a POH of 46.8cm (*SD* = 3.4). Mean egg voidance was 75.0%. For a summary of origins from coho carcasses recovered throughout the Methow River basin in 2010 and 2011, please refer to Table 21 & 22.

3.2.3 Chewuch River

Chewuch River surveys were conducted as two reaches (RK 15.3 to the confluence of the Methow River) between mid-October and mid-November. Reaches were surveyed four times; twice before peak spawn and twice after. There were no redds, live fish or carcasses observed for both years.

3.2.4 Twisp River

In 2010, surveys on the Twisp River were conducted as two reaches (RK 8.0 to the confluence of the Methow River) between October 21 and November 15. Reaches were surveyed four times, twice before peak spawn and twice after. There were no redds identified, live fish observed or carcasses recovered within this tributary.

Survey reaches were expanded in 2011 to encompass five reaches (RK 31.9 to the confluence of the Methow River) between October 20 and November 15. Eleven redds were found on the Twisp River, with the majority (n = 9) located in the first reach (RK 3.0-0.0) while remaining redds (n = 2) were located in reach T2. Twisp River redds accounted for 3.5% of all coho redds identified in-basin and highest number observed in this tributary since comprehensive surveys were initiated. The observed natural production increase was likely attributed to increased hatchery juveniles released from the Lower Twisp Ponds (LTP) in 2010 (n = 90,285) as well as the record adult return in 2011. One female was sampled, with a POH of 47.0cm. Coded wire tag analysis revealed that she originated from the 2010 Twisp Ponds release. Egg voidance was 95.0% and carcass sample rate was 4.0%.

3.2.5 Libby Creek

Libby creek surveys were conducted as one reach (RK 0.5 to the confluence of Methow River) prior to peak spawn between mid-October and beginning of November. Surveying efforts were limited due to restricted access on most of the creek. 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 in both 2010 and 2011.

3.2.6 Beaver Creek

During both return years, Beaver Creek surveys were conducted as two reaches (RK 3.0 to the confluence of the Methow River) between mid-October and the end of November. There were no redds identified, live fish observed or carcasses recovered within this reach.

3.2.7 Gold Creek

Gold Creek surveys were conducted as one reach from RK 1.7 to RK 2.1. Two redds were identified in both 2010 and 2011. Surveys were completed between mid-October and the end of November. Redds accounted for 1.7% and 0.6% of all redds found in the Methow basin within their respective return years (Table 19 & 20).

In 2010, two females were sampled with a mean POH of 47.5cm (SD = 0.7). Coded wire tag analysis indicated that one originated from the 2009 Winthrop NFH on-station release while the other individual's origin was the Lower Twisp Pond acclimation site release. Egg voidance was 100.0% and carcass sample rate was 6.6% for this tributary. No carcasses were recovered in 2011.

3.2.8 Other Tributaries

Surveys were also conducted sporadically on Hancock Springs and Wolf creek; no coho redds, carcasses or live fish were observed.

3.2.9 Chelan FH Outfall and Chelan Falls

In 2010 and 2011, YN continued survey efforts in areas downstream and upstream of Wells Dam to account for fish returning from 2009 Wells FH smolt releases as well as document dropouts or stray rates. Surveys were conducted before and after peak spawn, between early and mid-November, to allow crews to focus on priority areas in the Methow River basin. Areas surveyed included Chelan FH outfall (Columbia RK 808; Beebe Springs), Chelan Falls (Columbia RK 806) and Foster Creek (Columbia RK 870).

Redds identified within Chelan FH outfall accounted for 100.0% (*n* = 7) and 95.0% (*n* = 19) of the total redds found outside the Methow River basin in 2010 and 2011 (Table 19 & 20). Fourteen (5 M and 9 F) fish were sampled in 2010 while 6 (1 M and 5 F) were identified in 2011. In both years all carcasses recovered in the Chelan Falls area were released in the Methow Basin or from Wells FH; details can be found in Table 21.

3.2.10 Foster Creek

Foster Creek, located at the base Chief Joseph Dam (RK 870) on the left bank of the Columbia River, was surveyed once after peak spawn, mid-November. In 2011, one redd was identified without a recovery or fish being observed.

SUMMARY

• During 2010 spawning ground surveys in Icicle Creek, YN observed 100 coho redds and recovered 51 carcasses. The mean egg voidance was 79.9% (*n* = 37). In 2011, a total of 1,664 redds and 694 carcasses were documented. Mean egg voidance was 89.8% (*n* = 353).

• Nason Creek surveys in 2010 and 2011 produced a total of 8 and 89 redds, respectively. While no carcasses were recovered in 2010, a total of seven individuals were sampled in 2011. Nason Creek represented 3.7% and 3.3% of the total redd counts within the Wenatchee River basin for 2010 and 2011.

• We located 111 and 966 redds, in the mid to lower portions of the Wenatchee River and tributaries basin during 2010 and 2011 returns. A total of 24 and 586 carcasses were recovered in Mission/Brender Creeks, Peshastin, and the mainstem of the lower Wenatchee River in 2010 and 2011.

• In 2010, a total of 126 redds were identified and 62 carcasses were recovered in both the Methow River basin and out-of-basin tributaries. Of these totals, 119 redds and 47 carcasses were located within the Methow River basin.

• Spawning distribution data in the Methow River basin demonstrated that of the 119 redds observed in the mainstem Methow River, 71.2% (*n* = 47) were located within the lower reaches (RK 0.0 - 33.9) while 28.8% (*n* = 19) were located in the middle and upper reaches (RK 33.9 – 98.6). Redds identified within tributaries accounted for 44.5% (*n* = 53) of all redds observed in the Methow basin.

• A total of 332 redds were identified and 376 carcasses recovered in both the Methow River basin and out-of-basin tributaries in 2011. Of these totals, 312 redds and 369 carcasses were located within the Methow River basin.

• Of the 183 coho redds identified on the mainstem, 68.9% (*n* = 126) were located in reaches M4-M8 (RK 23.8-83.7) while the remaining 31.1% (*n* = 57) were distributed in the lower and upper reaches M1-M3 (RK 0.0-23.8) and M9-M11 (RK 83.7-98.6). Redds identified within tributaries accounted for 41.3% (*n* = 129) of all redds observed in the Methow basin.

4.0 2011 SMOLT ACCLIMATION: WENATCHEE AND METHOW

4.1 ACCLIMATION SITES

In the Wenatchee River basin, YN staff acclimated coho pre-smolts at the LNFH, Beaver Creek and four sites on Nason Creek (Butcher Creek Pond, Rohlfing's Pond, Coulter Pond and Nason Wetlands).

In the Methow River basin, we acclimated coho pre-smolts at Winthrop NFH, Winthrop NFH back-channel pond, the Twisp Ponds Complex (Lower Twisp Ponds) and Wells FH.

4.1.1 Leavenworth National Fish Hatchery

LNFH is located at RK 4.5 on Icicle Creek. Coho smolts were acclimated in refurbished Foster –Lucas raceways. 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 but ponds were discontinued by USFWS due to insufficient turnover rates and maintenance difficulties. Both the small Foster Lucas (SFL) and large Foster Lucas (LFL) raceways were partially refurbished by YN (pipeline replacement and additional bio-security) and supplied with re-use water for coho acclimation. Reused, surface water from existing spring Chinook production is supplied to the SFLs and LFLs during coho acclimation. Water to each Foster-Lucas pond is manually adjusted to achieve flow requirements needed for coho densities on-hand.

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 pond was stocked with Kamloops rainbow trout for aesthetic purposes but heavy river otter predation on these year-round residences became too problematic and stocking was discontinued in the early 1990s. After pond stocking ceased, the site had been void of salmonids until YN began using the site for coho acclimation in 2002. Pre-acclimation activities included installing containment structures at the pond's inlet and outlet.

4.1.3 Nason Creek

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

4.1.3.1 Rohlfing's Pond

Rohlfing's Pond is located on an unnamed, seasonal creek which connects at the lower end of Mahar Creek before reaching Nason Creek at RK 23.4. 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. In 2010, the pond was deepened and revegetated to increase acclimation conditions as well as facilitate additional acclimation opportunity for ESA listed steelhead as a part of the YN's Expanded Acclimation project (BPA Project #-2009-001-00). Pond flow and volume was calculated to estimate the densities needed for each species. A barrier net at the outlet of the pond was installed to contain the fish until release. Three passive integrated transponder (PIT) tag detection systems were installed in 2011 to monitor the release and provide emigration timing, determine residence time, calculate in-pond survival and provide accurate release numbers for a release-to-McNary survival analysis (Section 4.4 and 5.0).

4.1.3.2 Coulter Creek Pond

Coulter Creek 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. A barrier net was used to encircle the majority of the channel during the acclimation period. Upon release, a 12-inch pipe was installed from the pond to about twenty feet into the release channel in an effort to minimize the beaver's impact on fish escapement. The hope was that the beaver would block the outflow over the pipe and not impede the outmigration. Despite the beaver's efforts to block the pipe, the vegetation was easily removed and did not significantly block passage for outgoing smolts. The release was closely monitored to ensure fish could pass through multiple beaver dams into Nason Creek.

4.1.3.3 Butcher Creek

The Butcher Creek acclimation site is located at RK 13.2 on Nason Creek. This site was once the original channel of Nason Creek but was disconnected when Nason Creek was 'straightned' during Highway 2 construction. The site currently exists as a beaver pond that drains directly into Nason Creek. Coho smolts were volitionally released directly into Nason Creek. Prior to transportation, a net was placed upstream of the beaver's natural barrier to contain coho during acclimation. Floating and submerged structures were installed to provide protection from predators and reduce in-pond stress. Two PIT tag detection systems were installed in 2011 to evaluate the same metrics mentioned above in 4.1.3.1 "*Rohlfing's Pond*".

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 both 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. YN personnel partitioned off a small portion of the wetland with a seine net while providing unimpeded upstream and downstream movement of endemic stocks (Table 13). The fish released into the complex were allowed to volitionally immigrate into Nason Creek.

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 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. Coho juveniles were co-acclimated with spring Chinook juveniles in the back-channel pond as part of the Expanded Acclimation Project. Prior to acclimation, a one piece net canopy and floating covers were installed to enhance the rearing environment by providing cover and protection from avian predation. 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; upstream ends secured to the substrate allowing the detections systems to adjust to stream fluctuations. This configuration was intended to increase system's detection efficiency and reduce signal collistion.

4.1.5 Wells Fish Hatchery

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 were intended to assist broodstock development phases until additional acclimation facilities were permitted within the Methow River basin. Adults returning from Wells FH releases can provide a backup brood source, should a broodstock shortfall occur at the other targeted collection facilities.

4.1.6 Twisp Ponds Complex (Lower Twisp Ponds)

Lower Twisp Ponds, located at RK 1.6 on the Twisp River, is a semi-natural acclimation pond that is owned and operated by the Methow Salmon Recovery Foundation (MSRF). The site was constructed in 2002 and comprised of five ponds in series. 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 salmon are acclimated in the furthest downstream pond. The pond is approximately 42.0 meters in length and includes a small outlet back to the Twisp River. Prior to fish arrival, additional large woody debris (LWD) and shade covers were placed within the ponds to enhance rearing conditions and minimize predation. Three automatic, sensory triggered sprinklers were installed to deter avian predation. YN staff also installed three, pass-through PIT tag detection systems within the outlet of the pond to monitor juvenile escapement and assess in-pond and smolt-to-smolt survival.

4.2 TRANSPORTATION AND VOLITIONAL RELEASE

4.2.1 Wenatchee River Basin

Mid-Columbia coho pre-smolts (BY2009) were transported to the Wenatchee basin from rearing facilities at Cascade FH and Willard NFH between December 9, 2010 and April 8, 2011. A total of 935,709 coho pre-smolts were received from Willard NFH and Cascade FH. Coho were acclimated between five and twenty-five weeks at six different acclimation sites within the Wenatchee River basin (Table 23).

All coho released in 2011 were CWT'ed with a mean, retention rate of 97.8% (*n* = 13,000). In addition to CWT's, fish acclimated in the upper Basin were marked with a blank wire tag insterted into the adipose tissue. Mean retention rates for blank wire tagged coho was 97.9%. The blank wire allows for selective broodstock collection and management (YN FRM 2010).

In 2011, a total of 25,309 coho juveniles (2.7% of fish released) were implanted with PIT tags. YN personnel monitored the emigration of PIT tagged coho released from LNFH, Butcher Creek Pond, Rohlfings Pond and Beaver Creek Pond (Table 23). These PIT tagged fish were used to measure survival from release-to-McNary Dam and determine in-pond survival at select release sites (*see Section 4.4*).

In an effort to refine release criteria based on visual stage of development, YN personnel also recorded hypoxanthine and guanine levels, which are purines that affect the silvering of out-migrating smolts, during the acclimation period. On two different occasions prior to release; one early on in the acclimation process and one pre-release, twenty fish from select sites (Butcher, Rohlfing's and Beaver acclimation ponds) were euthanized during growth sampling. Specimens were frozen whole and transported to Biotech Research and

Consulting for future analysis. If a significant correlation is observed between visual categorizing a fishes' "smolt readiness" with elevated purine levels, this could provide additional support for determining start time of release based on visual cues, which has been viewed as subjective to date.

An estimated 63,703 coho mortalities (n = 6.8%) occurred in the Wenatchee basin. Specific known versus estimated mortality can be found in Figure 10. Of all Wenatchee basin acclimation sites, LNFH, Beaver Creek and Butcher Creek incurred the highest losses due to predation. The common predator observed at all three locations was North American river otter, which consume the most fish relative to their body weight. A licensed trapper was hired to remove otters at LNFH but was unsuccessful. USFWS hatchery personnel also set traps and succeeded in relocating two otters.

A total of 872,006 coho smolts were released from the Wenatchee River basin. All coho smolts acclimated at LNFH were force-released between April 16 and April 18, 2011. Volitional releases began at the Nason Creek Wetlands, Butcher Creek Pond, Coulter Creek Pond, Rohlfing's Pond and Beaver Creek Pond between April 26 and May 14. All acclimation sites were deemed empty by July 14. Final release numbers, size-at-release and release locations can be found in Table 23. For detailed mark and release information. Please see Appendix E.

4.2.2 Methow River Basin

In the Methow basin, Mid Columbia River (MCR) juveniles (BY2009) were acclimated at Winthrop NFH, Winthrop NFH back-channel pond, and Lower Twisp Ponds. Juvenile coho were transported from Willard NFH to the Winthrop NFH back-channel pond and Lower Twisp Ponds for acclimation on March 9 and March 28, respectively.

Coho pre-smolts were transported by ODFW personnel to Wells FH on March 28 at 26.7 fpp and acclimated for approximately six weeks until released on May 11 at 16.1 fpp (Table 23). Juveniles acclimated at Wells FH were 2^{nd} generation MCR progeny from the Methow program. Coded-wire tag retentions were 99.6% for the Wells release.

Coho were forced release from Winthrop NFH on April 19. We volitionally released coho smolts from the back channel pond starting on April 15, although any fish remaining were forced from the pond on April 26 due to an impending maintenance project on Foghorn irrigation ditch; the back-channel pond's primary water source. A volitional release was initiated for the Lower Twisp Ponds on May 5 and was visually determined complete by June 15. All releases were CWT'ed with mean retention rate of 97.6%.

In 2011, 2.8% (n = 5,958), 14.2% (n = 6,973) and 8.2% (n = 6,988) of juveniles released from the Winthrop NFH on-station raceways, back-channel, and Lower Twisp Ponds were PIT tagged, respectively. Data collected will be used to evaluate metrics measuring in-pond survival, release-to-McNary Dam survival and downstream migration timing (*see Section 4.4 and 5.0*).

A combined total of 428,053 coho juveniles were released for the Methow program (Table 23). For detailed mark information, see Appendix E. Juvenile releases in 2011 marked the fourth consecutive year that 100% of the smolts were progeny of locally returning adults to the Methow basin. The development of a local broodstock is critical for achieving program goals within the Methow River basin (YN FRM 2010)

Table 23. Mid-Columbia coho smolt release summary, 2011.

Location	Release Date	Release Number	Size @ release (FPP)	No. PIT Tags
Beaver Pond	May 13	84,882	15.0	5,888
Coulter Creek	May 14	66,165	15.9	0
Rolfing's Pond	May 14	90,043	16.6	5,997
Butcher Pond	May 2	113,927	22.9	5,994
Nason Creek Wetlands	April 26	45,570	24.2	0
Leavenworth NFH LFL's	April 16	203,890	22.2	5,981
Leavenworth NFH SFL's	April 17	266,529	21.4	5,178
Wenatchee Total		**872,006**		**29,038**
Winthrop NFH (on-station)	April 19	246,212	14.4	6,994
Winthrop NFH (back-channel pond)	April 15	47,886	17.4	6,973
Twisp Ponds Complex	May 5	83,471	14.9	6,988
Wells FH	May 10	48,399	13.8	0
Methow Total		**425,968**		**20,955**
Wenatchee/Methow Totals		**1,297,974**		**49,993**

4.4 PREDATION ASSESSMENT

As standard practice of good fish health and husbandry, moribund and deceased coho were removed from all acclimation sites daily and are used to to determine known mortality during this rearing period. The number of observed mortalities is typically low in natural or semi-nattural ponds (avg. < 2%). It is certain that additional loss occurs through predation. The unaccounted loss can have a significant impact on acclimation rearing through reduced release numbers, and indirectly through elevated and continual stress which may negatively affect survival. Unusually high densities of hatchery fish can create an optimal environment for predation. To estimate losses due to predation, we developed a predator consumption model and also use PIT tag detections (where applicable) to estimate in-pond survival.

In 2011, YN staff attempted to quantify coho loss due to predation while rearing at lower river hatcheries. For all coho destined for each respective basin, we set up to four PIT tag detection systems in series on the outflow hose that was connected to a gas powered Heathro fish pump and attempted to detect PIT tags as the fish were being pumped from the hatchery ponds into each fish truck. The objective was to determine hatchery loss by subtracting estimated number of PIT tags (detected tags x detection efficiencies) from the overall number of tagged fish. Loss would have been through both observed and unobserved mortality and provided a mortality estimate during late rearing at LCR facilities without incurring that loss into in-pond survival at various Methow and Wenatchee acclimation sites. Variables such as pump speed, transfer hose length, tag collisions (i.e. - two tags detected at the same time cancelling out one another) and "noise" (electrical fields, metal and pump vibrations) attributed to lower than expected efficiencies. Ranges of between 40-90% of the tags were detected using this methodology, which provided too low of efficiencies (large confidence intervals) to accurately estimate loss. YN will look into improving methodology by using Biomark's Tag Counter 2 software in 2012 as well as conduct detection work prior to transfers, allowing for a slower detection rate.

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, 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 (e.g. – shallow and unprotected waters). Although these opportunistic bird species persist, literature to document their consumption rates are difficult to attain. Based on limited observations by USFWS and YN staff, estimated consumption rate for dabblers was 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, yearling coho and that these fish have a higher probability of avoidance. In the past couple of years, estimated predation numbers have decreased in part to the extended hazing efforts conducted by YN personnel during this time 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 routine. This behavior limited the effectiveness of hazing efforts by YN staff. Although hazing efforts were very beneficial, predation still occurred at these locations. To determine estimated 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 10). Pond shape, pond size, numbers of coho, geographic location, cumulative riparian area, and aquatic vegetation all affect the predator abundance and predation mortality. A common trend observed was that on-station hatchery production was not exposed to the same level of predation as remote acclimation sites; hence the lower estimated losses. Literature suggests that limited predation can condition individuals, based on visual and sensorial cues, to better prepare for natural, migratory conditions (Brown & Smith 1998). Although remote sites may be more exposed to predation, we believe that these ancillary benefits through exposure and greatly benefit these juveniles as they migrate through the Columbia River corridor in the coming months.

In the Wenatchee basin, various predators were observed at all upper basin acclimation locations (see Table 24). Beaver Creek pond had the highest incidence of predation, which included hooded mergansers, herons, belted kingfishers, mallards and North

American river otters. Butcher Creek pond had the second highest number of predator sightings; all species observed at Beaver Pond except herons. Rohlfing's and Nason Creek Wetlands had various species present as well. Coulter Creek pond and LNFH had the lowest numbers of predator sightings.

Table 24. Types and species of piscivorous predators observed at Wenatchee Basin acclimation sites.

	Acclimation Site					
Species	**Coulter Pond**	**Beaver Pond**	**NC Wetlands**	**Butcher Pond**	**Rohlfing's Pond**	**LNFH**
North American River Otter	-	x	x	x	X	x
Great Blue Heron	x	x	x	-	-	x
Common Merganser	x	x	x	x	-	-
Hooded Merganser	-	x	x	x	-	-
Mallard	x	x	x	x	X	x
Osprey	x	-	x	-	-	x
Belted Kingfisher	-	x	-	x	x	-

In the Methow basin, many of the same avian and mammalian predators persisted as observed in the Wenatchee basin. Predator sightings were highest at the Lower Twisp Ponds, primarily due to the location being a preferred nesting habitat for a variety of avian species. 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 species at this location. Direct predation on coho juveniles rearing on-station at Winthrop NFH was not observed during acclimation in 2011. 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 (Table 25).

Table 25. Types and species of piscivorous predators observed at Methow Basin acclimation sites.

	Acclimation Site		
Species	**Lower Twisp Ponds**	**Winthrop NFH on-station[a]**	**Winthrop NFH BC**
Great Blue Heron	x	-	x
Common Merganser	x	-	x
Hooded Merganser	-	-	-
Mallard	-	-	-
Osprey	-	-	-
Belted Kingfisher	x	-	x

a- Not observed directly predating on coho juveniles on hatchery grounds.

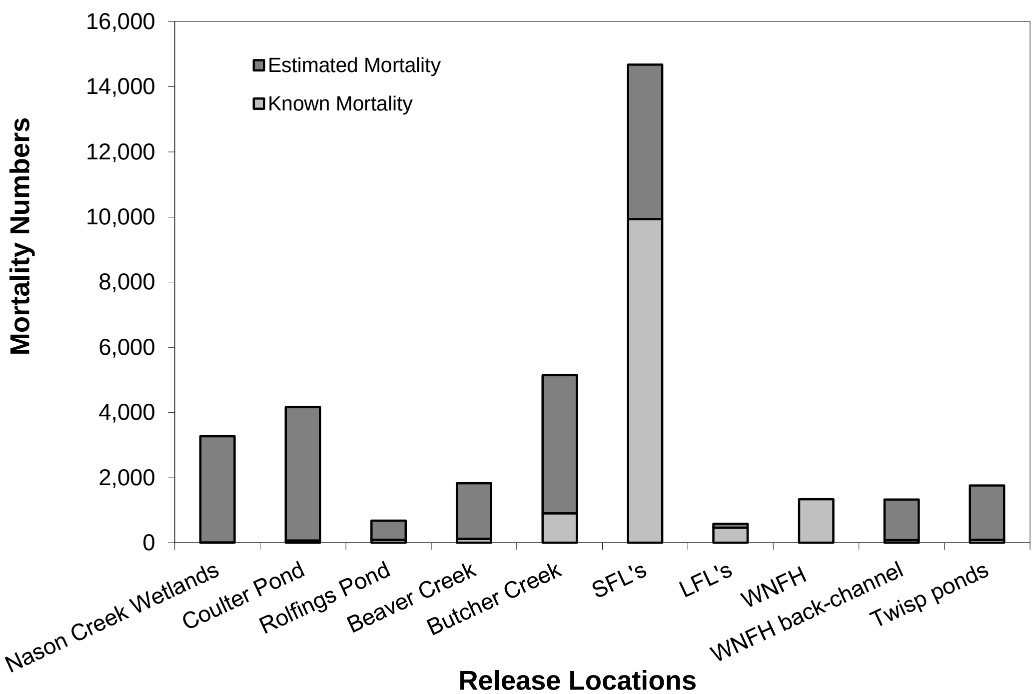

Figure 10. Known and estimated mortality (predation model) at all acclimation sites in the Methow and Wenatchee basins, 2011.

4.4.1.2 PIT tag Detection

In addition to documenting predator abundance and estimating mortality, at select acclimation sties we estimated in-pond survival with the use of PIT tags using a minimum of 6,000 tags. The PIT tag data was also used to estimate release to McNary Dam survival.

In 2011, prior to acclimation, YN personnel installed temporary PIT tag antenna arrays at Rohlfing's Pond, Butcher Pond, Beaver Pond, WNFH Spring Creek back channel and the Lower Twisp Ponds complex. Only sites with outlet detection capabilities could be used for measuring in-pond survivals.

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 outlet efficiency by determining the proportion of the fish detected downstream (pooling multiple detection sites) that were also detected exiting the pond. Estimates of PIT tag detection efficiency and in-pond survival for each site can be found in Table 26.

Table 26. Estimates of PIT tag detection efficiencies and in-pond survival, 2011.

	Butcher Creek Pond	**Beaver Pond**	**Rohlfing's Pond**	**WNFH Spring Creek Channel**	**WNFH on-station**	**Lower Twisp Ponds**
Total PIT tags	5,994	5,888	5,997	6,973	6,994	6,988
Unique detections at outlet	4,305	5,173	4,672	2,908	1,394	751

Proportion of tags detected at outlet	71.8%	87.9%	77.9%	41.7%	19.9%	10.7%
Total unique downstream detections	670	761	1,099	2,505	3,216	3282
Downstream detections also detected at pond outlet	598	746	937	1,140	646	354
Est. Detection Efficiency	**89.3%**	**98.0%**	**85.3%**	**45.5%**	**20.1%**	**10.8%**
Est. Total Tags exiting the pond	***4,823***	***5,277***	***5,480***	***6,390***	***6,940***	***6,963***
Est. In-Pond Survival	**80.5%**	**89.6%**	**91.4%**	**91.6%**	**99.2%**	**99.6%**

A comparison of in-pond mortality estimates based upon PIT tags and the predator consumption model can be found in Figures 11 & 12. Typically, the predator consumption model underestimated the in-pond mortality rate when compared to PIT tags (except for Beaver Creek Pond). However, the PIT tag methodology can overestimate loss since this method encompasses cumulative, unobserved loss at both raering facilities (Cascade FH and Willard NFH) as well as at the acclimation site.

YN personnel are actively working to decrease predation in all upper basin acclimation ponds by installing artificial habitat to provide refugia as soon as sites are ice free, implementing a predator hazing shifts, installing motion detection cameras to confirm the number of each predator species and acquiring the services of a licensed trapper.

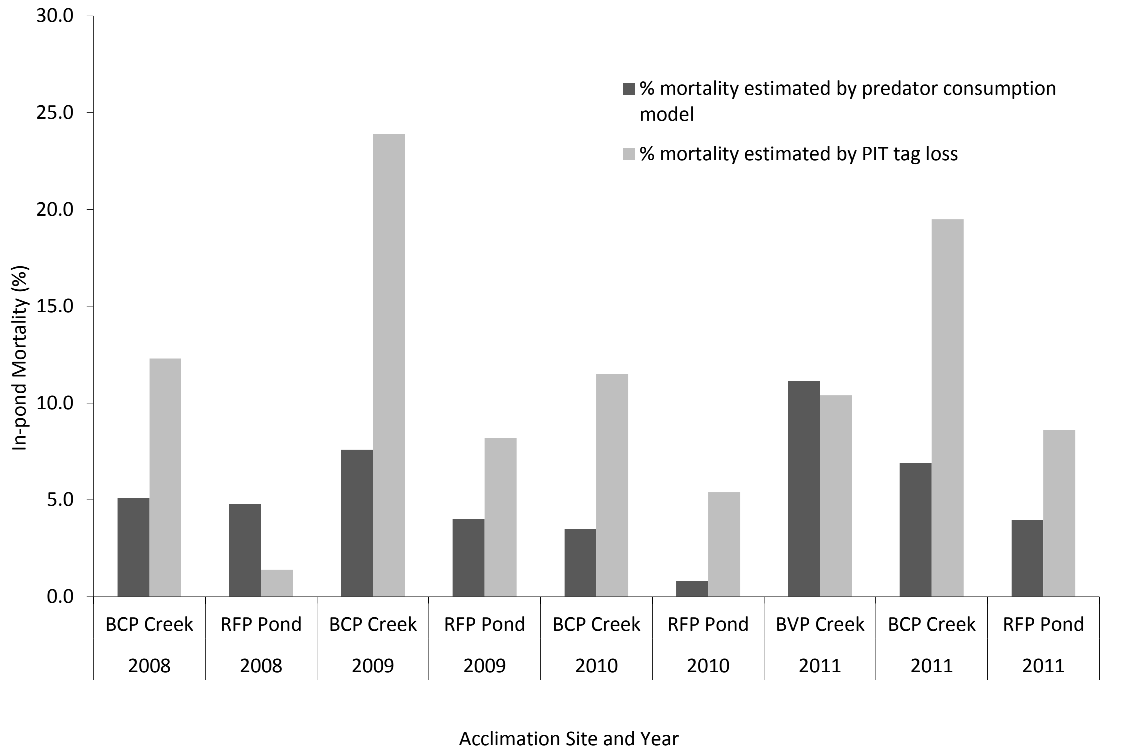

Figure 11. Comparison of in-pond mortality estimation methods: PIT tag versus a predator consumption model within the Wenatchee basin (2008-2011).

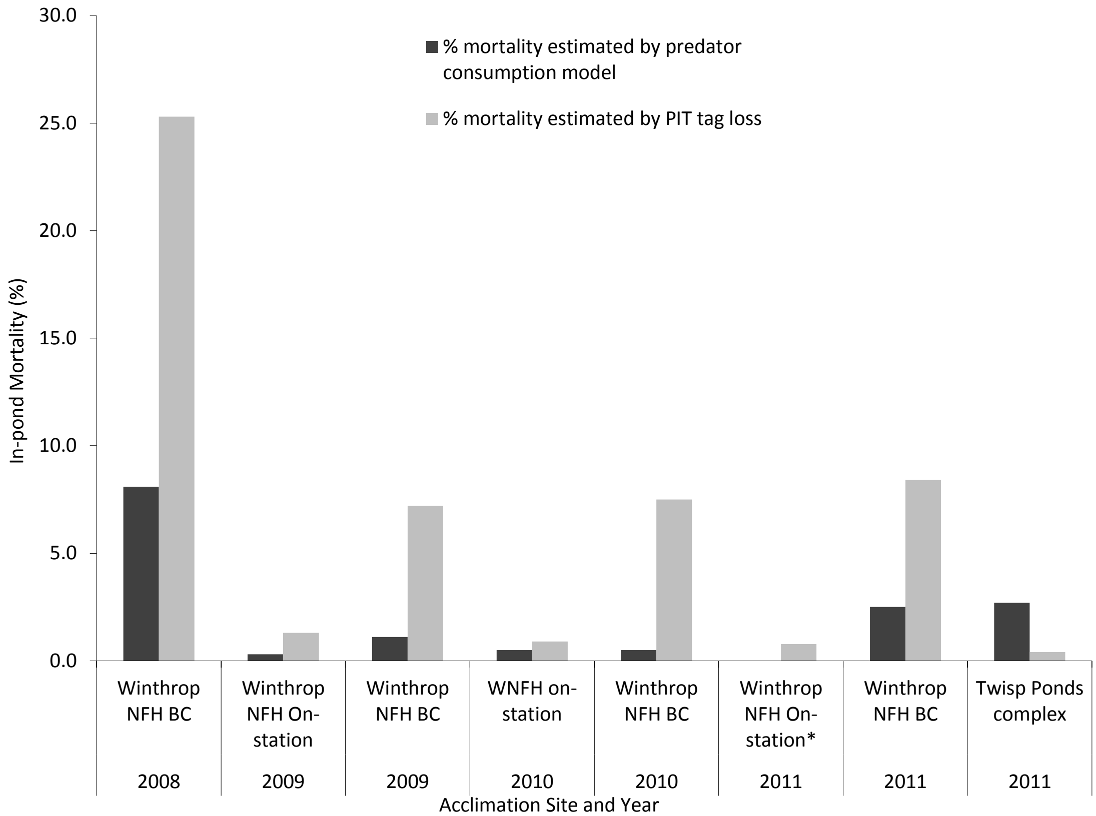

Figure 12. Comparison of in-pond mortality estimation methods: PIT tag versus a predator consumption model within the Methow basin (2008-2011).

5.0 SURVIVAL RATES

5.1 Smolt Survival Rates – Release to McNary Dam

5.1.1 2011 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). The 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 (stratum passage estimates added over all the strata) divided by either the number of tagged fish or the number of fish detected leaving the acclimation pond (number released). A summary of release-to-McNary survival rates for the 2010 and 2011 releases have been finalized and are presented below (Tables 27 and 28). Data suggests that coho juveniles reared full-term at Cascade FH appear to have an increased release-to-McNary survival when compared to the other primary, full-term rearing facility (Willard NFH) at both upper and lower basin release locations. Outliers to this appear to have a high standard deviation (SD) due either a) small tagging sample size or b) low number of detections occurring at the lowest most facility (John Day Dam or Bonneville Dam) used to calculate survivals.

Table 27. PIT tag release numbers and locations, 2010.

Basin	Release Tributary	Release Location	Rearing Facility	Brood Origin	*n*	% Survival to McNary (SD)
Methow	Winthrop NFH	Back-channel	Willard NFH	MCR	5,449	65.5 (12.4)
	Winthrop NFH	On-station	Winthrop NFH	MCR	5,501	73.2 (12.4)
Wenatchee	Nason Creek	Rohlfing's Pond	Cascade FH	MCR	2,775	53.9 (8.9)
			Willard NFH	MCR	2,623	84.1 (24.7)
		Butcher Creek Pond	Cascade FH	MCR	2,595	79.8 (16.9)
			Willard NFH	MCR	2,588	37.4 (6.5)
	Icicle Creek	SFL	Cascade FH	MCR	2,401	49.9 (16.2)
		SFL	Willard NFH	MCR	2,911	53.6 (16.5)
	Icicle Creek	LFL	Entiat FH*	MCR	5,483	77.0 (12.4)

**-reared full term at Entiat NFH with final acclimation occurring at Leavenworth NFH (mid-Feb. through mid-April)*

Table 28. PIT tag release numbers and locations, 2011.

Basin	Release Tributary	Release Location	Rearing Facility	Brood Origin	*n*	% Survival to McNary (SD)
Methow	Twisp River	Lower Twisp Ponds	Willard NFH	MCR	6,988	43.4 (4.2)
	Winthrop NFH	Back channel	Willard NFH	MCR	6,968	41.6 (5.9)
	Winthrop NFH	On-station	Winthrop NFH	MCR	6,994	35.6 (3.9)
Wenatchee	Nason Creek	Rohlfing's Pond	Cascade FH	MCR	2,511	48.5 (7.4)
			Willard NFH	MCR	2,339	32.5 (5.5)
		Butcher Creek Pond	Cascade FH	MCR	2,072	39.6 (8.0)
			Willard NFH	MCR	2,353	24.6 (5.9)
		Beaver Creek Pond	Cascade FH	MCR	2,597	48.8 (6.7)
			Willard NFH	MCR	2,576	30.8 (5.7)
	Icicle Creek	SFL	Cascade FH	MCR	2,003	34.8 (5.5)
		SFL	Willard NFH	MCR	2,762	53.6 (12.4)
		LFL	Cascade FH	MCR	2,543	41.8 (6.3)
		LFL	Willard NFH	MCR	2,286	28.6 (6.7)

5.2 Smolt-to-Adult Survival Rates (SAR) for Brood Years 2007 and 2008

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. In 2011, this method was not possible due to Dryden Dam having only on operable fish ladder and reducing the effectiveness of expanding daily catch. 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 basin in 2010 and 2011, using the aforementioned methods, can be found in Tables 29 & 30. For 2011, Method 1 estimate was not possible due to Dryden Dam being only partially operated, which provide an underestimate for passage at this facility. Methow run escapements for the same brood years can be found in Tables 31 & 32.

Table 29. Estimated coho run size to the Wenatchee River, 2010.

Method	Est. Run Size
1) Dryden Dam counts expanded for non-trapping days plus redds located below Dryden Dam[1]	1,483 (1,464 adults & 20 jacks)
2) Redd counts plus broodstock collected[1]	1,388 (1,342 adults & 46 jacks)
3)Tumwater Dam counts, redds below Tumwater Dam, and broodstock collected[1]	1,247 (1,201 adults & 45 jacks)
4) Mainstem Dam Counts[2]	4,439 (4,252 adults & 187 jacks)

[1]*Each redd count was expanded by 2.3 fish per redd based on the sex ratio of coho observed at Dryden Dam, 1.3M:1F.*
[2]*Mainstem dam counts represent the difference in adult passage observed between Rock Island Dam and Rocky Reach Dam.*

Table 30. Estimated coho run size to the Wenatchee River, 2011.

Method	Est. Run Size
1) Dryden Dam counts expanded for non-trapping days plus redds located below Dryden Dam[1]	n/a
2) Redd counts plus broodstock collected[1]	6,850 (6,747 adults & 103 jacks)
3)Tumwater Dam counts, redds below Tumwater Dam, and broodstock collected[1]	7,530 (7,351 adults & 180 jacks)
4) Mainstem Dam Counts[2]	23,833 (23,081 adults & 752 jacks)

[1]Each redd count was expanded by 2.1 fish per redd based on the sex ratio of coho observed at Dryden Dam, 1.1M:1F.
[2]Mainstem dam counts represent the difference in adult passage observed between Rock Island Dam and Rocky Reach Dam.

Table 31. Estimated coho runs size to the Methow River, 2010.

Method	Est. Run Size
1) Redd counts plus broodstock collected [1]	783 (783 adults & 0 jacks)
2) Wells Dam Counts plus Wells Dam broodstock collected[2]	1,216 (1,216 adults & 0 jacks)

Each redd count was expanded by 2.1 fish per redd based on the sex ratio of coho observed at Winthrop National Fish Hatchery, 1.1M:1.F.
[2] Coho collected for broodstock at Wells Dam were not incorporated into daily fish passage counts. Broodstock collected only reflects the proportion of fish taken at Wells Dam and not volunteer swim-ins at Winthrop NFH.

Table 32. Estimated coho run size to the Methow River, 2011.

Method	Est. Run Size
1) Redd counts plus broodstock collected [1]	1,290 (1,283 adults & 7 jacks)
2) Wells Dam Counts plus Wells Dam broodstock collected[2]	5,807 (5,796 adults & 11 jacks)

Each redd count was expanded by 2.3 fish per redd based on the sex ratio of coho observed at Winthrop National Fish Hatchery, 1.1M:1.F.
[2] Coho collected for broodstock at Wells Dam were not incorporated into daily fish passage counts. 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 (Tables 33 & 34). 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.

All SARs reported for both hatchery and natural origin returns to the Methow River were confirmed through both CWT and scale analysis (Tables 35 & 36). A comparison of smolt-smolt survival and smolt-to-adult survival across release years (1999 through 2011) can be found in Table 37.

Table 33. Wenatchee River brood year 2007 SAR 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	7 weeks	MCR	Cascade FH	87	63,245	0.14%
	7 weeks	MCR	Willard NFH	5	16,706	0.03%
Coulter Cr. Pond	12 weeks (6 int. rear @ LNFH)	MCR	Cascade FH	112	74,465	0.34%
Nason Creek Wetlands	Truck plant	MCR	Cascade FH	34	37,894	0.09%
Rohlfing's Pond	7 weeks	MCR	Cascade FH	80	76,895	0.10%
	7 weeks	MCR	Willard NFH	5	23,530	0.02%
Butcher Cr. Pond	7 weeks	MCR	Cascade FH	100	115,706	0.09%
	7 weeks	MCR	Willard NFH	7	20,233	0.03%
Leavenworth NFH: Large Foster Lucas Ponds	8 weeks	MCR	Entiat NFH	693	217,963	0.32%
Leavenworth NFH: Small Foster Lucas Ponds	8 weeks	MCR	Willard NFH	424	335,167	0.13%
TOTAL		MCR		1,547	981,804	0.16%
Naturally Produced Coho[c]		MCR	N/A	73	20,335	0.36%

[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 1,722 fish (method 3) was used in the calculation of BY2007 SARs.
[c] Naturally produced coho were positively identified through scale analysis.

Table 34. Wenatchee River brood year 2008 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	7 weeks	MCR	Cascade FH	867	113,508	0.76%
Coulter Cr. Pond	5 weeks	MCR	Cascade FH	623	54,183	1.15%
	5 weeks	MCR	Willard NFH	93	8,962	1.04%
Nason Creek Wetlands	3 weeks	MCR	Willard NFH	171	52,732	0.32%
Rohlfing's Pond	7 weeks	MCR	Cascade FH	575	57,766	1.00%
	7 weeks	MCR	Willard NFH	140	26,089	0.54%
Butcher Cr. Pond	7 weeks	MCR	Cascade FH	863	110,983	0.78%
	7 weeks	MCR	Willard NFH	148	28,380	0.52%
Leavenworth NFH: Large Foster Lucas Ponds	8 weeks	MCR	Entiat NFH	1,608	207,092	0.78%
Leavenworth NFH: Small Foster Lucas Ponds	24 weeks	MCR	Willard NFH	553	86,254	0.64%
	6 weeks	MCR	Willard NFH	238	55,726	0.43%
	9 weeks	MCR	Cascade FH	1411	207,386	0.68%
TOTAL		MCR		7,290	1,009,061	0.72%
Naturally Produced Coho[c]		MCR	N/A	164	20,741	0.79%

[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 7,355 fish (method 3) was used in the calculation of BY2008 SARs.
[c] Naturally produced coho were positively identified through scale analysis.

Table 35. Methow River brood year 2007 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
WNFH on-station	N/A reared on-station	MCR (Methow)	Winthrop NFH	710	373,481	0.19%
Wells FH	8 weeks	MCR (Methow)	Willard NFH	57	50,160	0.11%
Total				767	423,641	0.18%
Naturally Produced Coho[b]			N/A	11	1,144	1.00%

[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]-Naturally produced coho were positively identified through scale analysis.

Table 36. Methow River brood year 2008 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	1,059	257,179	0.41%
WNFH Back Channel	7 weeks	MCR (Methow)	Willard NFH	107	56,279	0.19%
Lower Twisp Ponds	5 weeks	MCR (Methow)	Willard NFH	114	85,663	0.13%
Wells FH	7 weeks	MCR (Methow)	Willard NFH	4	120,201	0.003%
Total				1,284	519,322	0.25%
Naturally Produced Coho[c]			N/A	15	2,330	0.65%

[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 1,288 fish (method 1) was used in the calculation of BY2008 SARs.
[c]-Naturally produced coho were positively identified through scale analysis.

Table 37. Hatchery comparison of smolt-to-smolt and smolt-to-adult survival rates for brood years 1997-2009.

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

			44%	18%			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%- 0.19%	0.02%- 0.32%
2008	2010	65.5%- 73.2%	49.9%- 77.0%	53.9%- 79.8%	2011	0.003%- 0.41%	0.32%- 1.15%
2009	2011	35.6%- 43.4%	28.6%- 53.6%	24.6%- 48.8%	2012	n/a	n/a

6.0 SUMMARY

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

We are optimistic that the project will continue to observe positive trends in hatchery coho survival as developing local broodstock continues to adapt to conditions in mid-Columbia tributaries. Therefore it is important to measure hatchery fish performance not only to use as an indicator of project performance but to track potential short-and long-term program benefits. This document reports the coho restoration activities completed in 2010-2011; results are briefly summarized below.

- Between September 14 and November 18, YN collected 1,008 coho at Dryden Dam, Leavenworth NFH, and Tumwater Dam on the Wenatchee River in 2010. At Winthrop NFH and Wells Dam, 721 coho were collected for the Methow River program between September 27 and November 15. Excess coho for the Methow program were returned to the river to naturally spawn.

- Between September 1 and November 10 2011, YN collected 1,040 coho at Dryden Dam left bank facility, the hatchery pool below the spillway at Leavenworth NFH, and Tumwater Dam. In 2011, an additional trapping location was brought online (Methow FH outfall) and combined with Winthrop NFH swim-ins and Wells captures, a total of 525 adult coho were collected for brood. Broodstock objectives for both basins were based on collecting 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 940 coho in 2010 and 828 in 2011 at Leavenworth National Fish Hatchery as part of the Wenatchee program. An average eye-up rate of 91.8% and 87.2% was calculated in 2010 and 2011, respectively.

- The Methow spawned 519 and 466 viable adults at Winthrop NFH during the 2010 and 2011 brood years. Eye-up rates for 2010 and 2011 were 83.0% and 90.8%, respectively. With the 2011 eye-up being the highest since the inception of the Methow program, increasing eye-up rates and improved eyed-egg quality should lead to improved survival from the eyed stage to smolt release which effectively reduces adult collections for brood purposes.

- During spawning ground surveys in the Wenatchee Basin for 2010 and 2011, YN found a total of 219 and 2,719 coho redds (highest in the programs' history). The majority of redds were located on Icicle Creek with the second leading counts occurring on the Wenatchee River. The 2011 season marked the highest redd total on Nason Creek (n = 89); likely due to supplemented adult plants conducted to determine spawner contribution of trans located adults taken from a lower Wenatchee basin stream (e.g.- Icicle Creek).

- During spawning ground surveys in the Methow Basin for 2010 and 2011, YN found a total of 119 and 312 in-basin coho redds. Majority of redds identified in both years were in the Methow River with secondary contributions occurring in both the Winthrop and Methow hatcheries' outfalls.

- Acclimating pre-smolts on local waters is an essential component to the restoration program. Smolt release numbers for the Methow and Wenatchee rivers in 2011 were 425,968 and 872,006 fish, respectively. Coho within the Methow program were released from Winthrop NFH (on-station raceways and the outfall channel) and Wells FH and achieved an estimated 98.2% transport-to-release survival for the on-station releases. In the Wenatchee basin, overall survival was 93.2% from transport to release, a decrease from 2010 due to BCWD (Appendix E).

- YN estimated that in-basin smolt to adult survival rates (SARs) for BY2007 hatchery coho smolts released in the Wenatchee River basin was 0.16% (4,439 adults and jacks) for all release groups. However, the smolt-to-adult survival rates varied between release groups (range: 0.03% - 0.34%). Using scale analysis for verification of fish origin, we estimated the SAR for naturally produced coho to be 0.36%.

- YN estimated that in-basin smolt to adult survival rates (SARs) for BY2008 hatchery coho smolts released in the Wenatchee River basin was 0.72% (23,833 adults and jacks) for all release groups. Smolt-to-adult survival rates varied between release groups (range: 0.43% - 1.15%). Using scale analysis for verification of fish origin, we estimated the SAR for naturally produced coho to be 0.79%.

- In the Methow River, we estimated that the overall SARs for BY2007 hatchery coho were 0.18%. The SARs for each release group ranged from 0.11% to 0.19% (1,216 adults and jacks). These SARs calculations included releases from Wells FH that contributed to a small degree. Using scale analysis for verification of fish origin, we estimated the SAR for naturally produced coho to be 1.00%.

- In the Methow River, we estimated that the overall SARs for BY2008 hatchery coho were 0.25%. The SARs for each release group ranged from 0.13% to 0.41% (5,807 adults and jacks). Using scale analysis for verification of fish origin, we estimated the SAR for naturally produced coho to be 0.65%.

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. Dakota Arnoux, Neville Benson, Barry Hodges, Bryan Ishida, Tim Jeffris, Dan Mellenberger, Amelia Morrison, Michelle Teo, Robert Farley, Jason Hickman, Dan Russell, Surya DiModica, Andrew Carr, James Pieratt, Casey Heemsah, Thomas Lewis and Brady Miller assisted with field data collection. Debbie Azure, Loverne George, Monica Clark and Louiza Umtuch provided much needed administrative support for this program. 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: 2010 NASON CREEK SMOLT TRAP REPORT

Population Estimates for Juvenile Salmonids in Nason Creek, WA

2010 Annual Report

March 2011

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Contract No. 43058 and No. 38968

ABSTRACT

In 2004, Yakama Nation Fisheries Resource Management began monitoring emigration of naturally spawning coho salmon as well as Endangered Species Act (ESA) listed Upper Columbia River (UCR) spring Chinook salmon and UCR steelhead in Nason Creek. This report summarizes abundance and freshwater survival estimates for each of these species. Data was collected using a 1.5 m rotary smolt trap between March 2 and November 30, 2010. We collected 27 coho parr, 371 Chinook smolts, 188 Chinook parr, 56 steelhead smolts, and 2,617 steelhead parr. Daily counts of fish caught at the trap were expanded by pooled trap efficiencies derived from mark and recapture trials. We estimated that 213 (± 9; 95% CI) BY2009 coho parr, 7,812 (± 672; 95% CI) BY2008 Chinook smolts, 35,280 (± 4,018; 95% CI) BY2009 Chinook parr; and 40,694 (± 3,079; 95% CI) steelhead parr/smolt passed the Nason Creek trap. Using spawning ground data collected in 2008, we estimated egg-to-emigrant survival for BY2008 wild coho and BY2008 wild spring Chinook to be 0.2% and 3.1%, respectively. Relative productivity estimates for steelhead will be provided pending age class/scale analyses.

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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 Yakama Nation FRM crew members including Matthew Clubb, Arlene Heemsah, Barry Hodges, Bryan Ishida, Greg Robison, Lily Sampson-Ohms, Kirk Olson, and Ben Truscott who maintained and operated the trap during all hours including nights/weekends through challenging weather conditions. We would like to thank the Wenatchee River Ranger District (U.S. Forest Service) for providing use of the trapping site and accommodating the needs of this study. Thanks to Pamela Nelle (Terraqua), Chris Jordan (National Oceanic and Atmospheric Administration), Roy Beatty (Bonneville Power Administration) and Chris Carlson (Grant County PUD) for administering contracting and funding. Thanks to Todd Miller and staff (Washington Department of Fish and Wildlife) for shared data and smolt trap methodologies. Additional thanks to Tom Desgroseillier and staff (U.S. Fish and Wildlife Service) for additional shared data and methodologies.

INTRODUCTION

Beginning in the fall of 2004, the Integrated Status & Effectiveness Monitoring Program (ISEMP, BPA project #2003-017-000) began sharing the cost of operating a rotary smolt trap in Nason Creek with the mid-Columbia Coho Reintroduction Project (MCCRP; BPA project #1996-040-00). This cost share extended previous trap operations from three months per year to nine months per year. In 2007, Grant County Public Utility District (GCPUD) also began funding this ongoing study. Trap operation was conducted in compliance with ESA consultation. The objectives of these projects are to:

1) Estimate the juvenile abundance and productivity of spring Chinook salmon, steelhead trout (BPA #2003-017-00, and GCPUD), and coho salmon (BPA #1996-040-00) in Nason Creek.

2) Describe the temporal variability of spring Chinook salmon, steelhead trout (BPA #2003-017-00, GCPUD), and coho salmon (BPA #1996-040-00) emigrating from Nason Creek.

The data generated from this project will be used to calculate annual population estimates, egg-to-emigrant survival, and emigrant-to-adult survival rates. Combined with other Monitoring and Evaluation (M&E) data, population estimates may be used to evaluate the effects of supplementation programs in the Wenatchee River basin as well as provide data to develop a spawner-recruit relationship for Nason Creek. Such models are a useful way to evaluate density-dependent affects and estimate carrying capacity. Tissue samples were collected from spring Chinook salmon, summer steelhead, and bull trout captured in the trap to supply DNA for ongoing studies in the basin. Passive integrated transponder (PIT) tags are implanted into juvenile naturally produced spring Chinook and summer steelhead salmon under the ISEMP program to determine if smolt traps in collaboration with other monitoring activities can provide the necessary data to resolve uncertainties regarding life history, growth, and survival in the Wenatchee basin (Murdoch et al. 2005). Beginning in 2008, PIT tags were also implanted into bull trout to support GCPUD's bull trout planning and monitoring.

The work described in this report is one component of three monitoring programs (ISEMP, GCPUD, and YN's MCCRP), and while it stands alone as an important contribution to the management of anadromous salmonids and their habitat, it also plays a key role within each of these monitoring programs. Each component of work within ISEMP is reported individually, as done here, and in annual and monthly summary reports that present all of the overall project components within a programmatic context and shows how the data and tools developed can be applied to the development of regionally consistent, efficient and effective Research, Monitoring and Evaluation (R,M&E).

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 0.8; 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).

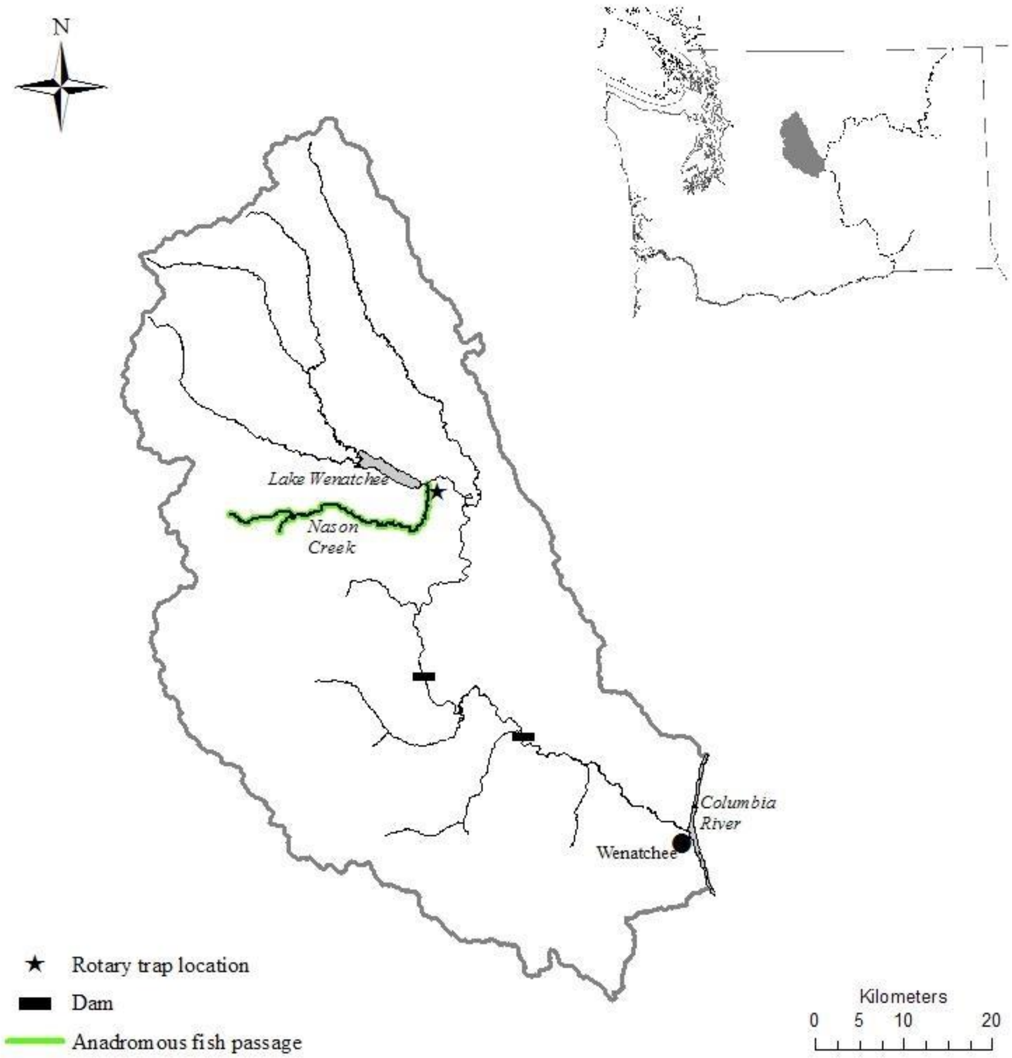

Figure 13. Map of Wenatchee River subbasin with Nason Creek rotary trap location.

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. The 8-year mean daily stream discharge is 336 cfs with stream temperatures ranging from 0.0°C to 17.7°C (Figures 2 & 3; See **Appendix A**).

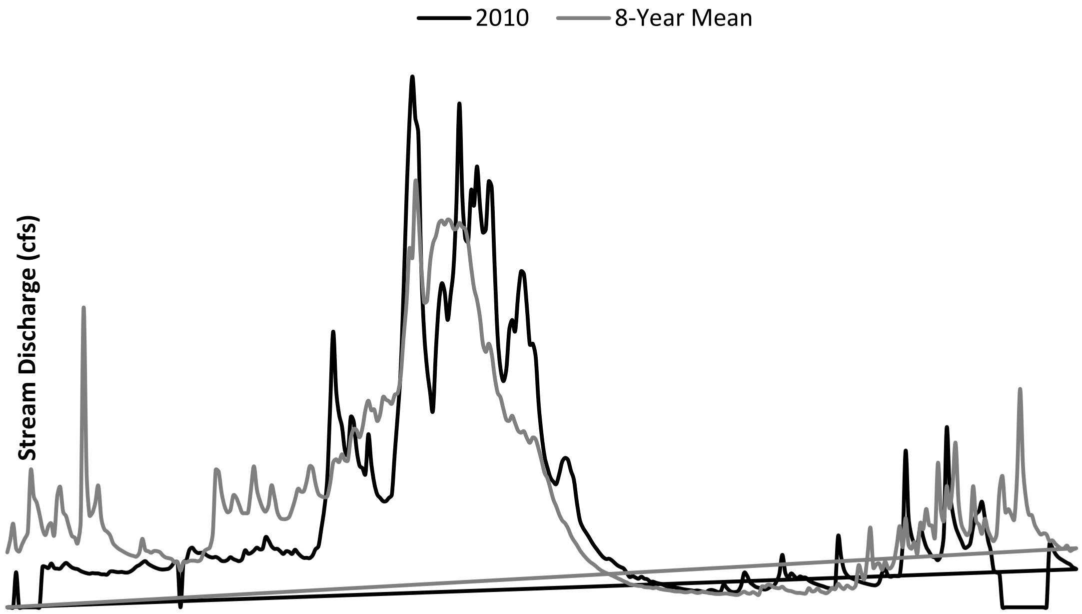

Figure 14. Mean daily stream discharge at the Nason Creek WDOE stream monitoring station in 2010.

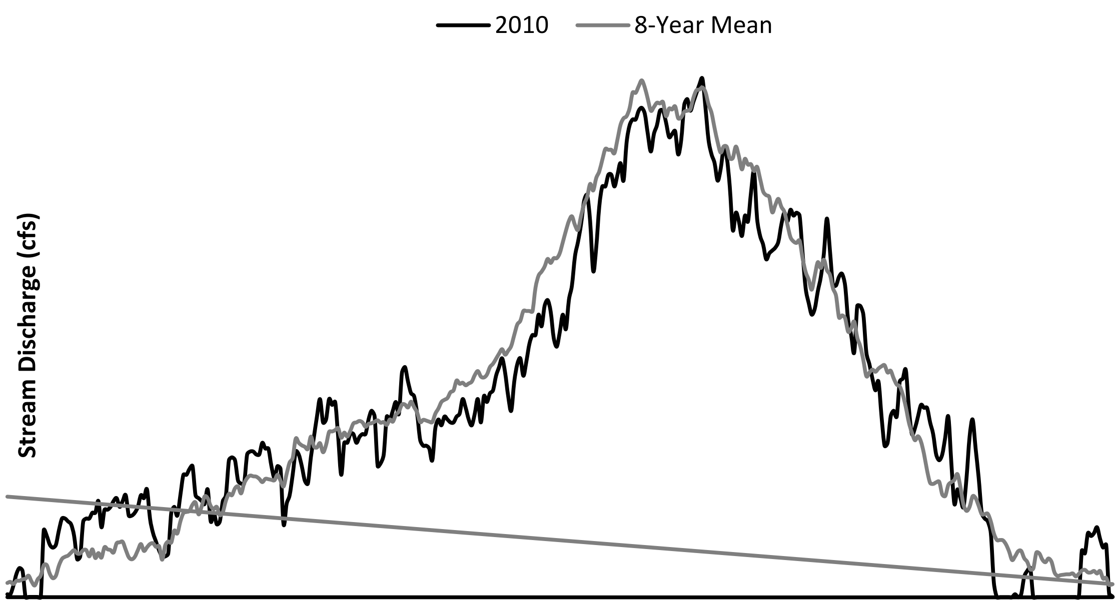

Figure 15. Mean daily water temperature at the Nason Creek DOE stream monitoring station in 2010.

Other salmonids commonly observed at the Nason Creek rotary trap include cutthroat trout (*O. clarki lewisi*, bull trout (*Salvelinus confluentus*), and mountain whitefish (*Prosopium williamsoni*; See **Table 11**). Hatchery activities in Nason Creek are comprised of the BPA funded MCCRP, the Chelan County PUD funded hatchery steelhead direct plants and previously the Grant County PUD funded spring Chinook captive brood program (2004 and 2005).

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 0.8 on Nason Creek. Fish were retained in a holding box until they were removed. A rotating drum-screen constantly removed small debris from the live box. The trap was suspended with wire rope from a pulley connected to a river-spanning cable and was positioned laterally in the thalweg with a 'come-along' type puller. Two trap positions were used during 2010; a 'back' position during periods of medium to high stream discharges (> 100 cfs) in the spring and fall. The 'forward' position was used during periods of low stream discharge (< 100 cfs) in the summer. Trap operation was suspended during extremely high/low stream discharges, hatchery releases, or if floating debris prevented cone rotation. Stream discharge lower than 40 cfs required that the cone be raised incrementally to avoid touching the streambed. Trap operations were generally suspended when stream discharge approached ~2000 cfs to avoid the influx of potentially hazardous debris (See **Appendix B**).

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 a portable 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 from the trap or used in trap efficiency trials. 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 was measured and weighed while the remaining fish were tallied only. Fork length was recorded to the nearest millimeter and weight to the nearest 0.1 gram. 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 fork length (FL) so that age and brood year could be assigned to each fish. Samples were collected according to the needs and protocols set by WDFW, who conducted the analysis and provided YN with results. Genetic samples were collected from spring Chinook, steelhead and bull trout. DNA samples from spring Chinook and steelhead were retained for reproductive success analyses conducted by WDFW and NMFS. Samples from bull trout were provided to GCPUD for bull trout monitoring and planning efforts.

All target salmonids were classified by their origin as natural or hatchery production by physical appearance and the 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 excluded from population estimates. All steelhead fry measuring < 50 mm were excluded from population estimates. Age-0 coho and spring Chinook salmon captured after 1 July were considered subyearling emigrants and were included in population estimates (UCRTT, 2001).

2.3 Mark-Recapture Trials

Groups of marked salmonids were used for trap efficiency trials. Marked groups of fish were released over the greatest range of discharges possible in order to increase the efficacy of the efficiency-discharge regression model used to estimate the daily trap efficiency (See **2.4 Data Analysis**). Mark-recaptured trials followed the protocol described in Hillman (2004). The protocol suggests a minimum sample size of 100 fish for each mark-recapture trial. Due to the limited number of fish caught in the trap, mark-recapture trials were often completed with smaller sample sizes. Results from efficiency trials were then pooled into groups according to the position the trap was operated. For example, if the trap was operated in the 'forward' position for one month, only efficiency trials conducted during that time period were pooled together.
Each mark recapture trial was conducted over a three-day period to allow for passage or capture of entire release groups. Trials were considered invalid if there were interruptions to trap operation during the three-day period (i.e., debris /log jam).

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

We typically combined the catch over a maximum of three days to provide the largest mark group possible within ESA section 10 permit limitations (#1493). Fish being held for mark-recapture trials were kept in auxiliary live boxes attached to the end of each pontoon. Marked groups were released regardless of sample size but only those groups consisting of ≥ 25 fish of a single size class and species were included in linear regression analyses (See **3.3 Trap Efficiency Calibration and Population Estimates**).

2.3.1 Marking and PIT tagging

Fish used in efficiency trials were PIT tagged and marked with a caudal fin clip. All spring Chinook, steelhead and coho measuring ≥ 60 mm were PIT tagged; bull trout ≥ 70 mm were PIT tagged as well but were not included in efficiency trials.

Once anesthetized, each fish was examined for external wounds or descaling, then scanned for the presence of a previously implanted PIT tag. If no tag was detected, a 12 mm Digital Angel 134.2 kHz type TX 1411ST PIT tag was inserted into the body cavity using a 12-gauge hypodermic needle. Hypodermic needles were soaked in ethyl alcohol for approximately 10 minutes prior to use. Each unique tag code was electronically recorded along with date of tag implantation, date of fish release, tagging personnel, fork length, weight and anesthetic bath temperature. Data were entered into a P_3 database 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 with 2010 ISEMP protocols.

After marking and/or PIT tagging, 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) determining a PIT tag shed rate. Fish were then transported in 5-gallon buckets 1.4 km upstream to a release site and released at or near dark. The release site was located on the right bank and accessible by vehicle. During the 2004 season, comparisons between marked groups released from the right bank, stream center, and both banks resulted in no difference in recovery rate (Prevatte and Murdoch 2004); we are confident that the stream hydraulics between the release site and the smolt trap facilitate adequate fish dispersal when released exclusively from the right bank.

2.4 Data Analysis

2.4.1 Trap Efficiency

Trap efficiency was calculated with the following formula:

Trap efficiency = $E_i = R_i / M_i$

Where E_i is the trap efficiency during time period i; M_i is the number of marked fish released during time period i; and R_i is the number of marked fish recaptured during time period i.

2.4.2 Emigration Estimate and Expansion of Daily Catch

The daily emigration estimate was calculated by expanding the catch at the trap by trap efficiency using the following formula:

Estimated daily migration $\hat{N}_i = C_i / \hat{e}_i$ =

Where N_i is the estimated number of fish passing the trap during time period i; C_i is the number of unmarked fish captured during time period i; and e_i is the estimated trap efficiency for time period i.

A linear regression was used to correlate trap efficiency from individual efficiency trials (dependent variable) with discharge (cfs; independent variable). If the results of the regression were significant ($p < 0.05$; $r^2 > 0.50$), the regression equation was used to estimate daily trap efficiency.

The variance for the total daily number of fish traveling downstream past the trap was calculated from the following formulas:

Variance of daily migration estimate =

$$\text{var}\left[\hat{N}_i\right] = \hat{N}_i^2 \frac{\text{MSE}\left(1 + \frac{1}{n} + \frac{\left(X_i - \overline{X}\right)^2}{(n-1)s_X^2}\right)}{\hat{e}_i^2}$$

Where X_i is the discharge for time period i, and n is the sample size.

If a relationship between discharge and trap efficiency was not present (i.e., p >0.05; r^2 □ 0.5), pooled trap efficiency was used to estimate daily emigration:

Pooled trap efficiency = $E_p = \sum R / \sum M$

The variance for daily emigration estimates using the pooled trap efficiency was calculated using the formula:

Variance for daily emigration estimate = $\text{var}\left[\hat{N}_i\right] = \hat{N}_i^2 \frac{E_p(1 - E_p)/\sum M}{E_p^2}$

The total emigration estimate and confidence interval were calculated using the following formulas:

Total emigration estimate = $\sum \hat{N}_i$

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

The following assumptions regarding efficiency trials must be made for the population estimate to be valid (Everhart and Youngs 1953):

1. Marked fish were randomly dispersed in the population prior to recapture.
2. All marked fish passed the trap or were recaptured during time period *i*.
3. The probability of capturing a marked or unmarked fish is equal.
4. All marked fish recaptured were identified.
5. Marks were not lost between the time of release and recapture.

3.0 RESULTS

3.1 Dates of Operation

The Nason Creek trap was installed on March 2 and operations began the same day. Barring interruptions from floating debris, the trap was operated continuously 24 hours a day 7 days per week, except during periods of extreme high/low flows (≥ 2000 cfs; ≤ 40 cfs) or large direct-plant hatchery steelhead releases upstream of the trap (Table 1). The trap was operated in the 'back' position during higher flows (≥ 100 cfs; March 2 to July 23; November 3 to November 23) and in the 'upper' position at lower flows (< 100 cfs; July 24 to November 2). Due to ice formation, trap operations ended on November 23 and the trap was subsequently removed from the creek on December 1 (See **Appendix B**).

Table 38. Summary of Nason Creek rotary trap operation, 2010.

Trap Status	Description	Days
Operating	Continuous Data Collection	229
Interrupted	Interrupted by debris or ice	11
Not Operating	Intentionally pulled to avoid high flows, debris, ice, hatchery releases or to perform maintenance/repairs.	34

3.2 Daily Captures and Biological Sampling

3.2.1 Coho Yearlings (BY2008)

No coho yearlings were captured during the spring emigration period from March 2 to June 23, 2010.

3.2.2 Coho Subyearlings (BY2009)

Coho fry were captured at the trap in mid-July (*n* = 2) but were not included in emigration estimates for this brood. There were no fry mortalities. A total of 28 coho subyearlings were captured at the Nason Creek trap between July 1 and November 23. We estimate that an additional two subyearlings would have been captured if the trap had operated without interruption during the entire subyearling emigration period. The mean FL and weight for subyearling coho was 83.6mm (*n* = 27; *SD* = 8.6; Table 2) and 6.7g (*n* = 27: *SD* = 2.4), respectively. There were no subyearling mortalities.

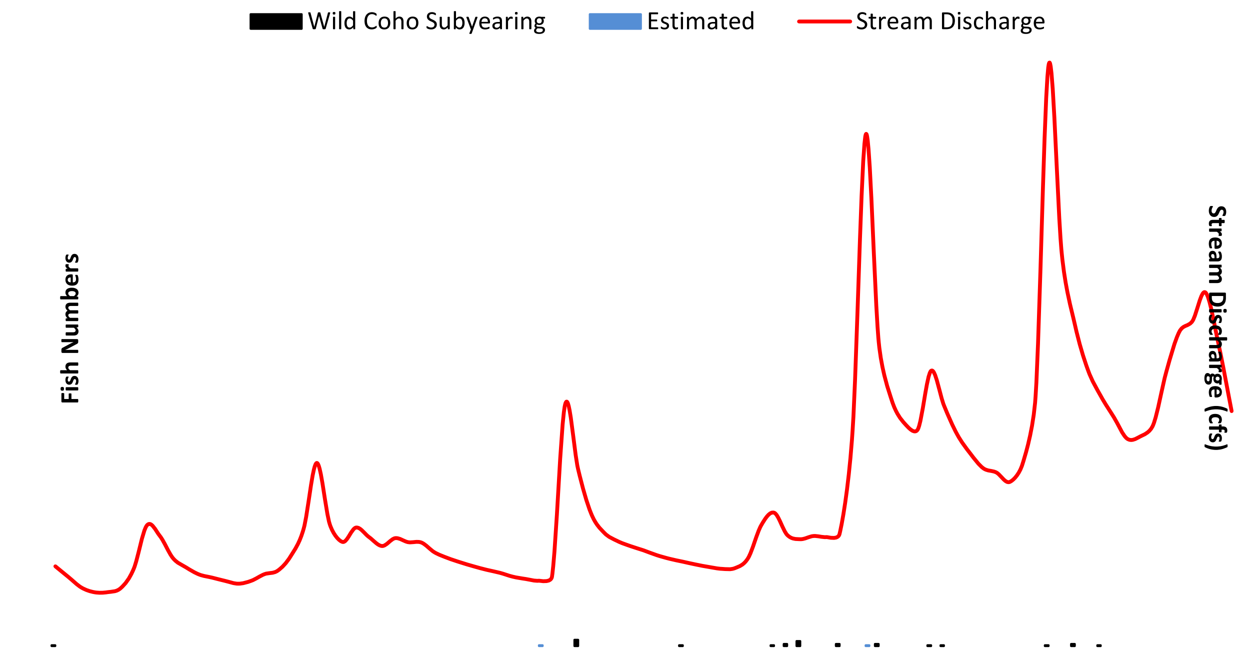

Figure 16. Daily catch of wild coho subyearlings with mean daily stream discharge at the Nason Creek rotary trap, July 1 to November 23, 2010.

Table 39. Summary of length and weight sampling of juvenile coho salmon captured at the Nason Creek rotary trap in 2010.

Brood Year	Origin/Stage	Fork Length (mm)			Weight (g)			K-Factor
		Mean	N	Mean	Mean	N	SD	
2008	Wild Smolt	—	—	—	—	—	—	—
2009	Wild Parr	83.6	27	8.6	6.7	27	2.4	1.1

3.2.3 Spring Chinook Yearlings (BY 2008)

A total of 371 yearling spring Chinook were collected between March 2 and June 30 with the peak catch occurring on April 18 (*n* = 29; Figure 4). We estimate that an additional two yearlings would have been captured if the trap had operated without interruption during the entire yearling emigration period. The mean FL and weight for yearling spring Chinook was 96.9mm (*n* = 366; *SD* = 7.3; Table 3) and 10.2g (*n* = 366; *SD* = 2.3), respectively. There were no yearling spring Chinook mortalities (See **3.6 ESA Compliance**).

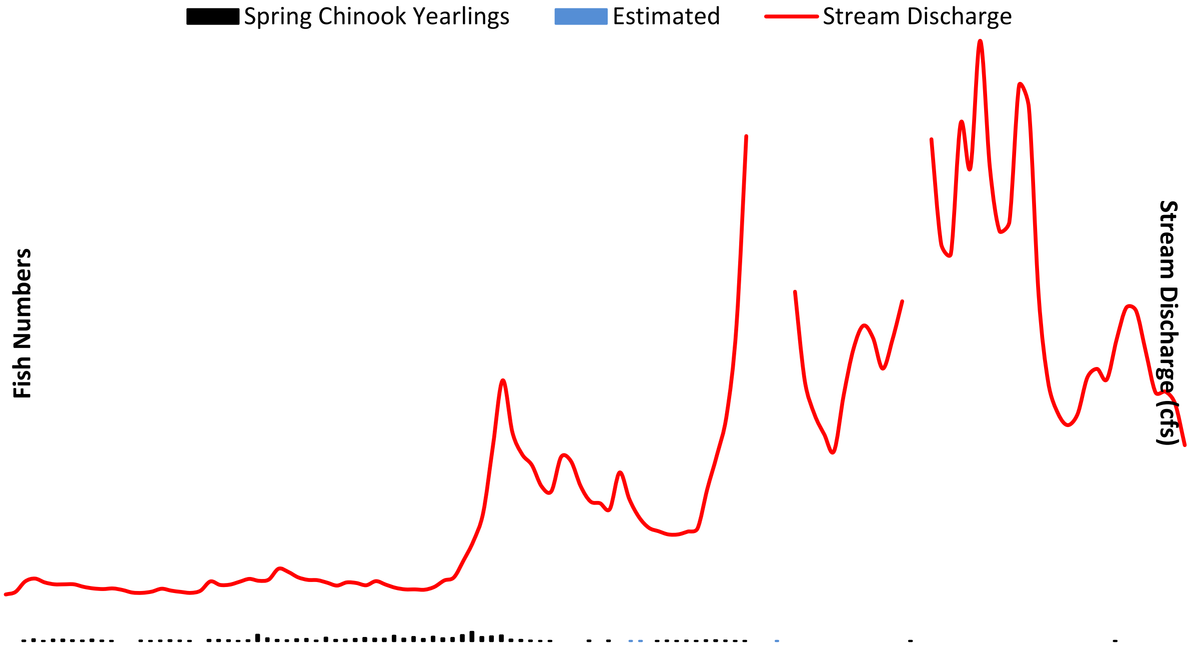

Figure 17. Daily catch of spring Chinook yearlings with mean daily stream discharge at the Nason Creek rotary trap, March 2 to June 30, 2010.

Table 40. Summary of length and weight sampling of juvenile spring Chinook captured at the Nason Creek rotary trap in 2010.

Brood Year	Origin/Stage	Fork Length (mm)			Weight (g)			K-Factor
		Mean	N	SD	Mean	N	SD	
2008	Wild Smolt	96.9	366	7.3	10.2	366	2.3	1.1
2009	Wild Parr	80.7	3021	10.7	6.2	3021	2.3	1.2

3.2.4 Spring Chinook Subyearling (BY2009)

A total of 126 spring Chinook fry were collected between March 2 and June 30 with the peak catch occurring on April 21 (*n* = 12). There were no fry mortalities. Fry captured prior to July 1 were not included in population estimates for BY2009 subyearling emigrants (See **2.2 Biological Sampling**). A total of 3,046 subyearling spring Chinook were collected between June 30 and November 23 with the peak catch occurring on November 3 (*n* = 242; Figure 6). We estimate that an additional 170 subyearlings would have been captured if the trap had been operated without interruption during this period. The mean FL and weight for subyearling Chinook (captured after July1) was 80.7mm (*n* = 3,021; *SD* = 10.7; Table 3) and 6.2g (*n* = 3,021; *SD* = 2.3), respectively. There were eight spring Chinook subyearling mortalities during the trapping season (See **3.6 ESA Compliance**).

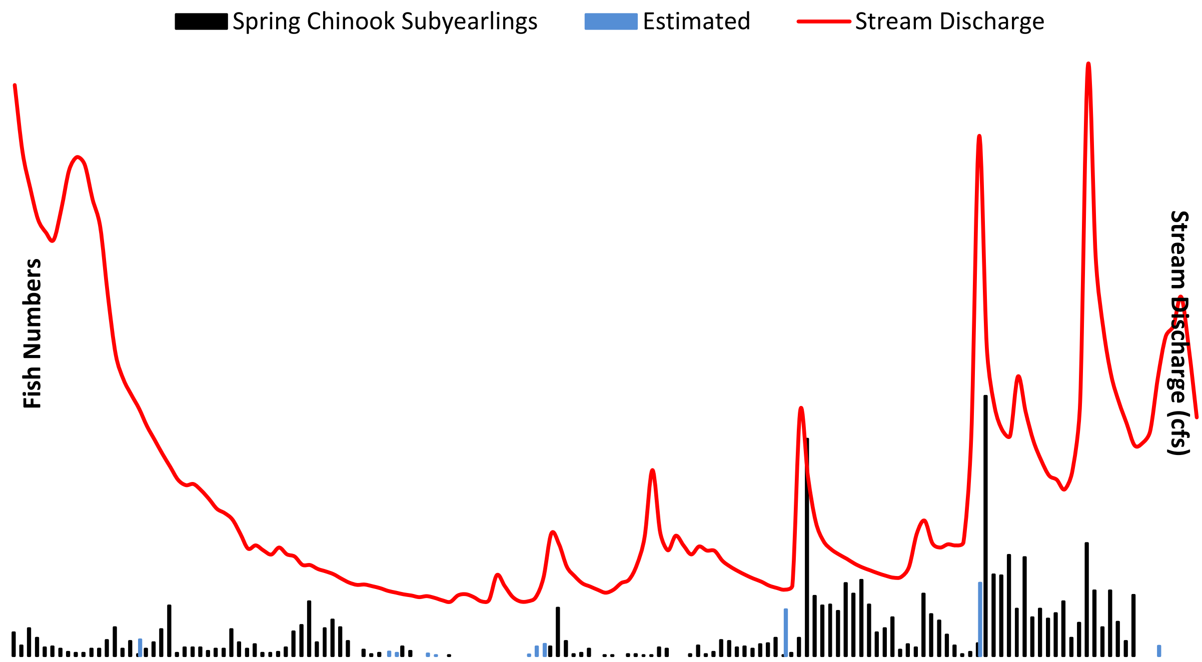

Figure 18. Daily catch of spring Chinook subyearlings with mean daily stream discharge at the Nason Creek rotary trap, July 1 to November 23, 2010.

3.2.6 Summer Steelhead Smolts

We collected 57 steelhead smolts and transitional smolts between March 2 and June 30 with a peak catch occurring on April 20 (*n* = 20; Figure 7). We estimated that an additional one smolt would have been captured if the trap had been operated without interruptions during this period. The mean fork length and weight for smolt steelhead was 148.8mm (*n* = 56; *SD* = 26.5; Table 4) and 37.2g (*n* = 56; *SD* = 16.3), respectively. There were no smolt mortalities. Age classes will be provided once scale analyses have been completed.

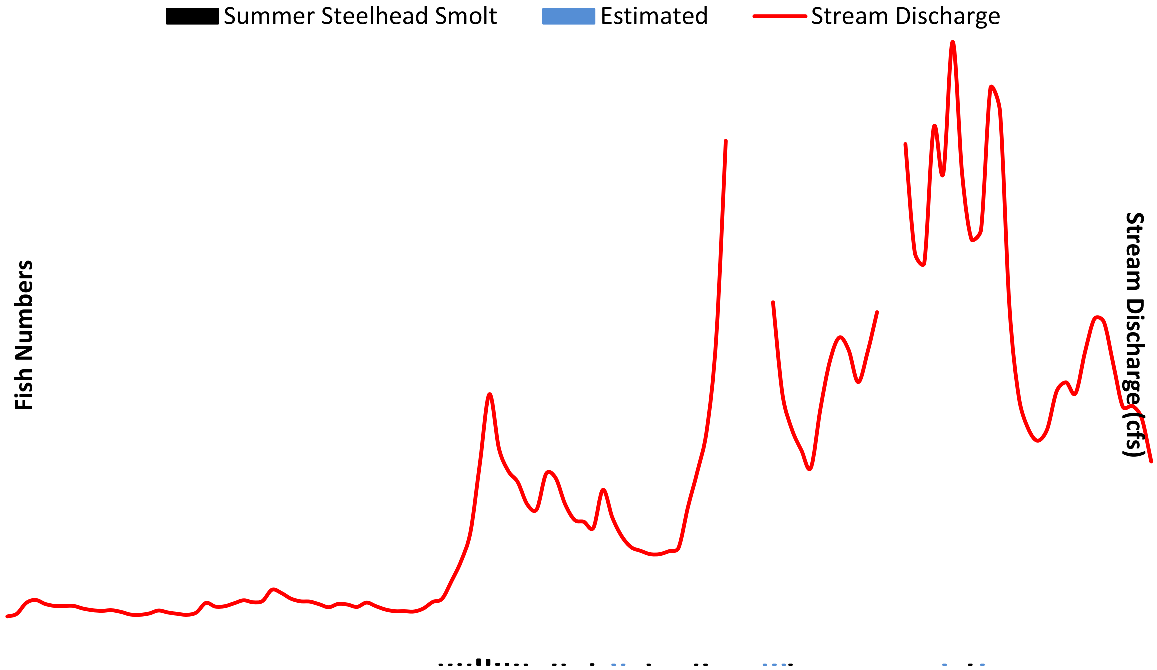

Figure 19. Daily catch of summer steelhead smolt with mean daily stream discharge at the Nason Creek rotary trap, March 2 to June 30, 2010.

Table 41. Summary of length and weight sampling of multiple age class juvenile summer steelhead at the Nason Creek rotary trap in 2009.

Brood Year[a]	Origin/Stage	Fork Length (mm)			Weight (g)			K-Factor
		Mean	N	SD	Mean	N	SD	
N/A	Wild Smolt	148.8	56	26.5	37.2	56	16.3	1.1
2009	Wild Fry	46.2	117	3.4	1.1	117	0.3	1.1
N/A	Wild Parr	79.1	1907	23.2	6.9	1907	8.1	1.4

[a] **Age-class data is pending scale analysis.**

3.2.7 Summer Steelhead Fry

A total of 842 summer steelhead fry between July 1 and November 30 with a peak catch occurring on September 8 (*n* = 281; Figure 8). We estimated that an additional 52 fry would have been captured if there had been no interruptions to trapping during this period. The mean FL and weight for fry steelhead was 46.2mm (*n* = 117; *SD* = 3.4; Table 4) and 1.1g (*n* = 117; *SD* = 0.3), respectively. There were three fry mortalities (See **3.6 ESA Compliance**).

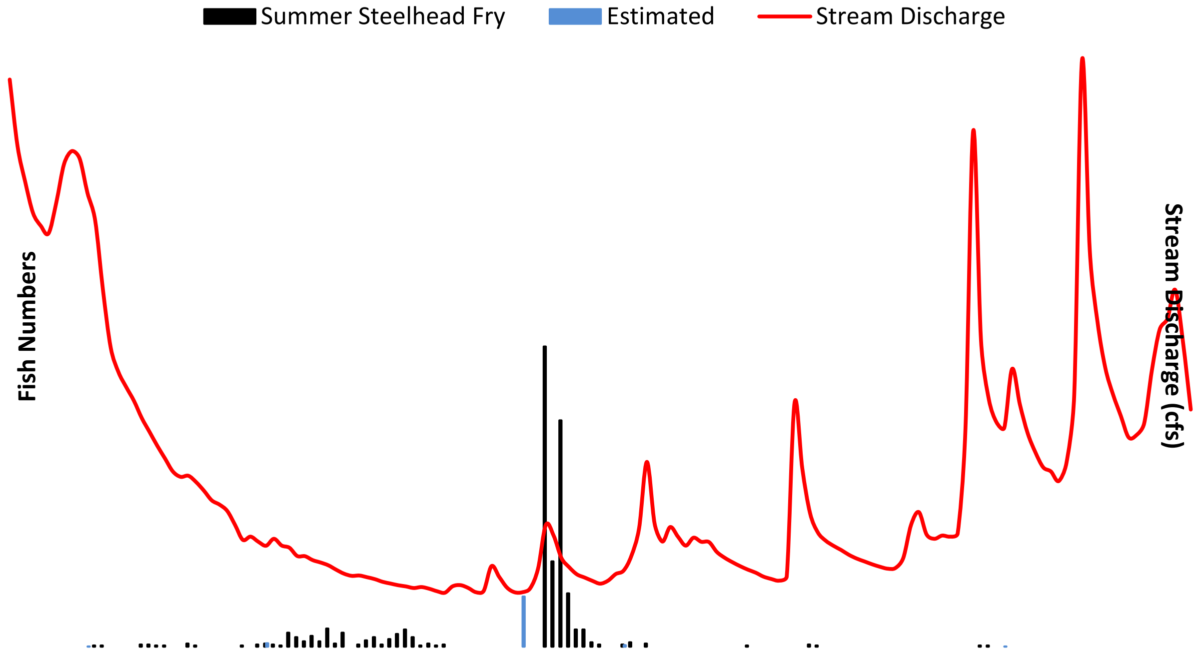

Figure 20. Daily catch of summer steelhead fry with mean daily stream discharge at the Nason Creek rotary trap, July 1 to November 23, 2010.

3.2.8 Steelhead/Rainbow Trout Parr

A total of 2,617 summer steelhead parr from multiple age classes were collected between March 2 and November 23 with a peak catch occurring on September 9 (*n* = 793; Figure 9). We estimated that an additional 243 parr would have been captured if there had been no interruptions to trapping during this period. The mean FL and weight for parr steelhead was 79.1mm (*n* = 1,907; *SD* = 23.2; Table 4) and 6.9g (*n* = 1,907; *SD* = 8.1), respectively. There were 10 summer steelhead parr mortalities (See **3.6 ESA Compliance**). Age classes will be provided once scale analyses have been completed.

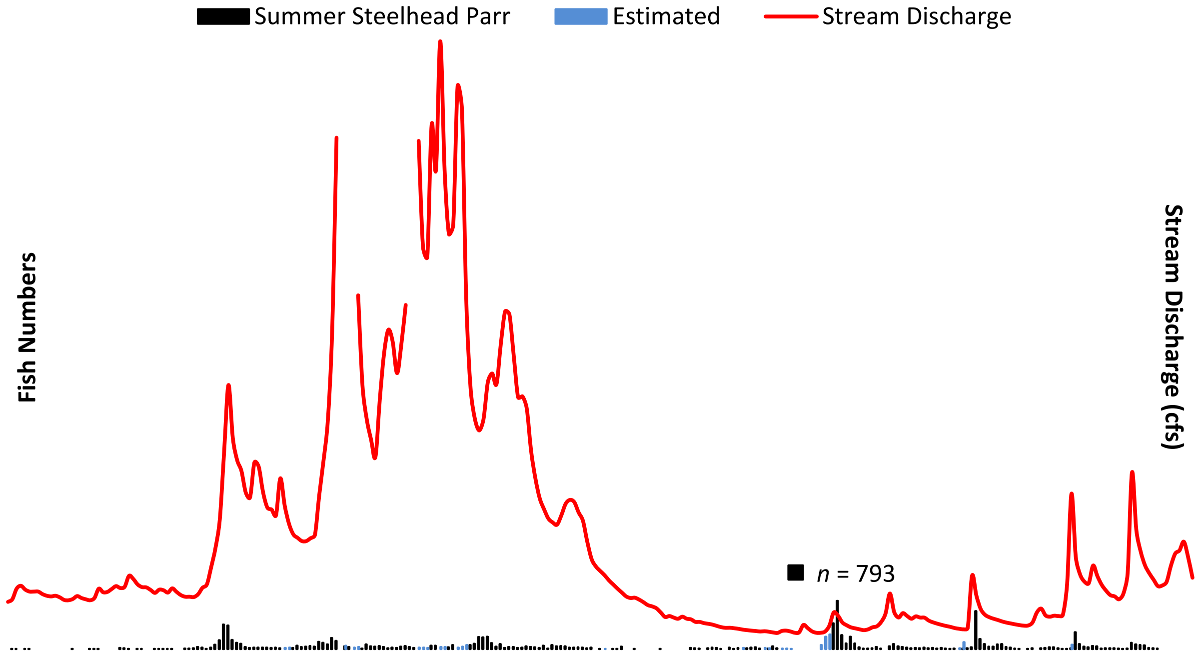

Figure 21. Daily catch of summer steelhead parr with mean daily stream discharge at the Nason Creek rotary trap, March 2 to November 23, 2010.

3.3 Trap Efficiency Calibration and Population Estimates

3.3.1 Coho (BY2008)

No coho yearlings were captured in spring of 2010 (Table 6). However, in the fall of 2009 we estimated the BY2008 subyearling coho emigration to be 92 (± 14; 95% CI; Table 5). This represents the total emigration of BY2009 wild coho from Nason Creek.

Table 42. Estimated egg-to-emigrant survival percentage and smolts-per-redd for Nason Creek coho. Values were not calculated for incomplete brood years.

Brood Year	No. of Redds[a]	Fecundity[b]	No. of Eggs	No. of Emigrants			Egg-to Emigrant Survival	Emigrants per Redd
				Age-0[c]	Age-1	Total		
2003	6	2,091	12,543	0	120	120	1.0 %	20
2004	35	3,084	107,940	224	431	655	0.6 %	19
2005	41	2,867	117,547	88	557	645	0.5 %	16
2006	4	3,126	12,504	5	0	5	0.0 %	1
2007	3	3,223	9,669	7	67	74	0.8 %	25
2008	14	2,692	37,688	92	0	92	0.2 %	7
2009	8	3,396	27,168	213	—	—	—	—

[a] Number of complete redds in Nason Creek.
[b] Mean annual fecundity of YNF hatchery coho broodstock.
[c] Estimate based on capture of summer/fall parr and does not include captures of fry prior to July 1.

3.3.2 Coho (BY2009)

Low numbers of subyearling coho (*n* = 28) were not sufficient to conduct trap efficiency trials for wild coho. Therefore, a pooled trap efficiency of 13.3% derived from subyearling spring Chinook capture during the fall was used to expand catch estimates for coho. We estimated that 213 (± 9; 95% CI; Table 5) BY2009 subyearling coho emigrated from Nason Creek in 2010.

3.3.3 Spring Chinook (BY2008)

We completed 15 efficiency trials with 315 marked yearling Chinook in 2010. Due to low abundance and high flows, it was not possible to conduct efficiency trials across the full range of river discharge levels at which the trap was operated. A regression model used to determine trap efficiency for yearlings was not significant ($P = 0.5$, $r^2 = 0.09$). Therefore, a pooled trap efficiency of 4.8% was used to expand catch estimates for yearlings (Table 6). Between July1 and November 30, 2009, we estimated 41,839 (±2,639; 95% CI) BY2008 subyearling spring Chinook emigrated from Nason Creek. From March 2 to June 30, 2010, we estimated that an additional 7,812 (±672; 95% CI) BY2008 yearling spring Chinook emigrated as well; for a total emigration estimate of 49,651 (±2,723; 95% CI) BY2008 wild spring Chinook from Nason Creek (Table 7).

Table 43. Trap efficiency trials conducted with BY2008 Chinook yearlings in Nason Creek.

Date	Trap Position	Released	Recaptured	Efficiency (%)	Discharge (cfs)
3/21/10	Back	6	0	0.0%	181
3/25/10	Back	11	1	9.1%	193
3/29/10	Back	36	0	0.0%	204
4/2/10	Back	16	2	12.5%	181
4/6/10	Back	24	3	12.5%	181
4/10/10	Back	43	0	0.0%	163
4/14/10	Back	42	4	9.5%	216
4/18/10	Back	67	2	3.0%	613
4/20/10	Back	28	0	0.0%	689
4/22/10	Back	23	1	4.3%	543
4/25/10	Back	7	0	0.0%	540
4/29/10	Back	1	0	0.0%	430
5/8/10	Back	2	0	0.0%	345
5/12/10	Back	7	2	28.6%	766
6/20/10	Back	2	0	0.0%	877
Pooled		**315**	**15**	**4.8%**	

Table 44. Estimated egg-to-emigrant survival percentage and smolts per redd for Nason Creek spring Chinook. Emigrant-per-redd values were not calculated for incomplete brood years.

Brood Year	No. of Redds[a]	Fecundity[b]	No. of Eggs	No. of Emigrants			Egg-to Emigrant Survival	Emigrants per Redd
				Age-0[c]	Age-1	Total		
2002	294	5,024	1,477,056	DNOT[d]	9,084	9,084	—	—
2003	83	6,191	513,853	7,899	2,096	9,995	1.9%	120
2004	169	4,846	818,974	12,569	3,267	15,836	1.9%	94
2005	193	4,365	842,445	24,348	7,888	32,236	3.8%	167
2006	152	4,773	725,496	5,300	5,279	10,579	1.5%	70
2007	101	4,722	476,922	19,374	3,621	22,995	4.8%	228
2008	336	4,757	1,598,352	41,839	7,812	49,651	3.1%	148
2009	167	4,533	757,011	35,280	—	—	—	—

[a] Number of complete redds in Nason Creek (Hillman et al. 2010).
[b] Mean annual fecundity of spring Chinook broodstock at Chiwawa River Hatchery (Hillman et al. 2009).
[c] Estimate based on capture of parr collected during summer/fall and does not include fry prior to July 1.
[d] Did not operate trap.

3.3.4 Spring Chinook (BY 2009)

We completed 29 marked group releases with 2,538 marked subyearling Chinook in 2010 (Table 8). Despite high numbers of marked fish, it was not possible to conduct trials over the full range of discharge levels at which the trap was operated. Regression models used to determine trap efficiencies for subyearlings at ‘back’ and ‘forward’ positions were not significant (back, P = 0.08, r^2 = 0.41; forward, P = 0.03, r^2 = 0.36). Therefore, pooled trap efficiencies of 2.2%, 13.3% and 16.9% were used to expand catch estimates for subyearlings (Table 8). We estimated that 35,280 (±; 4,018; 95% CI; Table 7) subyearling spring Chinook emigrated from Nason Creek between July 1 and November 23, 2010.

Table 45. Trap efficiency trials conducted with BY2009 Chinook subyearling in Nason Creek.

Date	Trap Position	Released	Recaptured	Efficiency (%)	Discharge (cfs)
7/2/2010	Back	12	2	16.7%	412
7/6/2010	Back	26	1	3.8%	444
7/10/2010	Back	9	0	0.0%	386
7/14/2010	Back	28	0	0.0%	243
7/22/2010	Back	57	0	0.0%	158
Pooled		**132**	**3**	**2.2%**	
7/30/2010	Forward	47	0	0.0%	100
8/3/2010	Forward	21	1	4.8%	96
8/8/2010	Forward	58	1	1.7%	79
8/10/2010	Forward	113	8	7.1%	72

8/15/2010	Forward	41	0	0.0%	63
9/11/2010	Forward	68	9	13.2%	65
9/15/2010	Forward	11	0	0.0%	67
9/19/2010	Forward	5	0	0.0%	133
9/23/2010	Forward	16	4	25.0%	103
9/28/2010	Forward	12	1	8.3%	90
10/1/2010	Forward	34	4	11.8%	76
10/9/2010	Forward	34	10	29.4%	173
10/12/2010	Forward	216	42	19.4%	100
10/15/2010	Forward	192	37	19.3%	86
10/18/2010	Forward	193	36	18.7%	77
10/22/2010	Forward	92	18	19.6%	90
10/25/2010	Forward	60	7	11.7%	111
10/29/2010	Forward	127	0	0.0%	138
Pooled		**1340**	**178**	**13.3%**	
11/4/2010	Back	254	42	16.5%	225
11/7/2010	Back	287	49	17.1%	203
11/10/2010	Back	168	32	19.0%	162
11/13/2010	Back	74	7	9.5%	319
11/15/2010	Back	98	15	15.3%	408
11/18/2010	Back	185	35	18.9%	238
Pooled		**1066**	**180**	**16.9%**	

3.3.5 Steelhead/Rainbow Trout

Due to low numbers of emigrating summer steelhead smolt, trap efficiency trials for summer steelhead were conducted with a combination of 1,290 marked parr and smolt (Table 9). Despite moderate numbers of marked fish, it was not possible to conduct trials over the full range of discharge levels at which the trap was operated. Regression models used to determine trap efficiencies for steelhead at 'back' and 'forward' positions were not significant (back, P = 0.3, r^2 = 0.07; forward, P = 0.9, $r^2 < 0.00$). Therefore, pooled trap efficiencies of 6.0%, 9.5% and 6.5% were used to expand catch estimates for steelhead parr/smolt. We estimate that 40,693 (± 2,971; 95% CI) steelhead parr/smolt emigrated from Nason Creek in 2010. No estimates of fry movement were made. At the time of this draft, scale analysis data was not available to calculate emigration by brood year; results from scale analyses may facilitate this.

Table 46. Trap efficiency trials conducted with steelhead parr/smolt in Nason Creek.

Date	Trap Position	Released	Recaptured	Efficiency (%)	Discharge (cfs)
3/21/10	Back	2	0	0.0%	168
3/25/10	Back	1	0	0.0%	190

3/29/10	Back	8	0	0.0%	218
4/2/10	Back	2	0	0.0%	192
4/6/10	Back	3	0	0.0%	183
4/10/10	Back	3	0	0.0%	172
4/14/10	Back	14	0	0.0%	177
4/18/10	Back	29	0	0.0%	341
4/20/10	Back	121	11	9.1%	675
4/22/10	Back	121	10	8.3%	763
4/25/10	Back	49	1	2.0%	545
4/29/10	Back	20	1	5.0%	539
5/8/10	Back	23	3	13.0%	358
5/12/10	Back	48	1	2.1%	512
5/26/10	Back	41	1	2.4%	841
6/20/10	Back	128	11	8.6%	893
6/24/10	Back	46	3	6.5%	1090
6/28/10	Back	23	1	4.3%	863
7/2/10	Back	25	2	8.0%	515
7/6/10	Back	32	0	0.0%	425
7/10/10	Back	29	2	6.9%	481
7/14/10	Back	18	0	0.0%	303
7/23/10	Back	10	1	10.0%	163
Pooled		**796**	**48**	**6.0%**	
7/30/10	Forward	1	0	0.0%	115
8/8/10	Forward	2	0	0.0%	84
8/11/10	Forward	2	0	0.0%	76
8/15/10	Forward	1	0	0.0%	66
9/11/10	Forward	83	14	16.9%	76
9/15/10	Forward	9	1	11.1%	61
9/19/10	Forward	7	2	28.6%	90
9/23/10	Forward	20	3	15.0%	109
9/28/10	Forward	14	0	0.0%	100
10/1/10	Forward	10	0	0.0%	84
10/5/10	Forward	4	0	0.0%	69
10/9/10	Forward	4	1	25.0%	122
10/12/10	Forward	105	9	8.6%	135
10/15/10	Forward	49	1	2.0%	96
10/18/10	Forward	32	3	9.4%	83
10/22/10	Forward	6	0	0.0%	74
10/25/10	Forward	4	0	0.0%	109

10/29/10	Forward	10	0	0.0%	104
11/1/10	Forward	7	1	14.3%	282
Pooled		**370**	**35**	**9.5%**	
11/4/10	Back	43	1	2.3%	251
11/7/10	Back	34	4	11.8%	237
11/10/10	Back	3	0	0.0%	186
11/13/10	Back	5	0	0.0%	166
11/15/10	Back	5	0	0.0%	339
11/18/10	Back	34	3	8.8%	393
Pooled		**124**	**8**	**6.5%**	

3.4 PIT Tagging

During the 2010 trapping season we PIT tagged 26 coho, 3,417 spring Chinook, 2,573 steelhead, and 10 bull trout (Table 10). All tagging files have been submitted to the PTAGIS database. There were no mortalities associated with tagging operations. A total of 14 shed PIT tags were recovered in holding boxes where fish had been held for 24 hours after tagging.

Table 47. Number of PIT tagged coho, Chinook, steelhead and bull trout with shed rates at the Nason Creek rotary trap in 2010.

Species	Year-to-date Catch	Year-to-date PIT Tagged	No. of shed tags	Percent Tags Shed
Yearling Coho	0	0	0	0.0%
Subyearling Coho	27	26	0	0.0%
Yearling Chinook	371	364	1	0.2%
Subyearling Chinook	3,172	2,828	11	0.4%
Parr Steelhead	2,617	1,503	2	0.1%
Smolt Steelhead	56	54	0	0.0%
Bull Trout	11	10	0	0.0%

3.5 Incidental Species

Along with wild coho, spring Chinook and wild steelhead/rainbow trout, other fish species incidentally captured at the Nason Creek rotary trap included: hatchery coho and steelhead, bull trout, cutthroat trout, longnose dace (*Rhinichthys sp.*), northern pikeminnow (*Ptychocheilus oregonensis*), red-sided shiner (*Richardsonius balteatus*), sculpin (*Cottus sp.*), *sucker* (*Catostomus sp.*), and mountain whitefish. Incidental species were enumerated and sampled for length and weight (Table 11).

Table 48. Summary of length and weight sampling of incidental species captured at the Nason Creek rotary trap in 2010.

Species	Total Count	Length (mm)			Weight (g)		
		Mean	N	SD	Mean	N	SD
Hatchery Coho Salmon	6,763	129.5	1,049	12.6	23.8	1,049	5.3
Hatchery Steelhead	3,724	183.5	526	19.5	61.3	526	19.6
Bull Trout	11	180.1	11	26.2	59.6	11	25.4
Cutthroat Trout	11	183.2	11	56.4	82.9	11	66.1
Longnose Dace	257	75.2	228	26.7	7.8	228	7.4
Northern Pikeminnow	21	147.2	20	63.6	71.0	20	77.9
Redsided Shiner	18	84.0	17	17.3	8.9	17	5.3
Sculpin	105	109.0	93	32.7	23.9	93	20.0
Sucker	122	106.2	120	32.0	18.9	120	18.4
Whitefish	396	75.1	380	32.4	7.8	380	23.0

3.6 ESA Compliance

The Nason Creek smolt trap is operated under consultation with NMFS and USFWS. Total numbers of UCR spring Chinook and UCR summer steelhead that were captured or handled at the trap was less than the permitted level of 20% of each species (Table 12). Lethal take for each species remained below 2% for the entire season. Stream temperatures remained below 18°C for the entire trapping season.

Table 49. Summary of ESA species mortality at the Nason Creek rotary trap in 2010.

Species	Total Collected	Total Mortality	% Handled Mortality
Yearling Spring Chinook (BY2008)	371	0	0.0
Fry Spring Chinook (BY2009)	126	0	0.0
Subyearling Spring Chinook (BY2009)	3,046	8	0.3
Total Spring Chinook	**3,543**	**8**	**0.2%**
Smolt Steelhead	57	0	0.0
Fry Steelhead	842	3	0.4
Parr Steelhead	2,617	10	0.4
Hatchery Steelhead	3,751	0	0.0
Total Summer Steelhead	**7,267**	**13**	**0.2%**
Total Bull Trout	**11**	**0**	**0.0%**

4.0 DISCUSSION

High river discharge and low overall juvenile abundance continued to limit efficiency trials from being conducted over the broadest range of river conditions in 2010. As a result, expanded estimates of juvenile emigration were made with pooled efficiency trials, rather than with an efficiency-to-discharge regression model. Therefore, these estimates should be considered provisional until a regression model can be established.

The practice of using pooled efficiency estimates is not without bias. Applying pooled trap efficiency trials to estimate passage assumes that there is a constant rate of emigration for a given time period. This method of estimation does not accurately reflect the dynamic nature of fish emigration and fluctuating stream discharges. For example, while the actual rate of emigration may tend to decrease during a month, using a constant efficiency rate to estimate passage during that month will over-estimate passage. Conversely, under estimation can occur if the pooled efficiency rate is lower than the actual emigration rate.

Pooling a series of trap efficiency trials increases over all sample size and improves statistical validity. Although this may not reflect true fish movement downstream, it is a good alternative to trap efficiency-to-discharge regression models when fish abundance is limited and sample sizes are small.

Although combined annual datasets are not yet robust enough to allow the use of such regression models, progress has been made towards developing consistent methods for conducting trap efficiency trials. Improvements to trap efficiency trials include; 1) pre-scanning of all marked groups prior to release, and 2) automatic timed release of marked groups. The first improvement is a verification of marked group size after combining the catch from three days of trapping. This practice improves confidence in tag retention and serves as a quality control measure prior to a mark/recapture trial. The second improvement incorporates the use of an automatic release box that ensures all marked groups are released at the same time each evening and facilitates equal chance of distribution. We believe that such improvements have strengthened the validity of previous trap efficiency trials by addressing to two of the five key assumptions used in population estimates; 1) Marked fish were randomly dispersed in the population prior to recapture, and 2) Marks were not lost between the time of release and recapture.

Six years of complete estimates suggest that there are two distinct emigration periods for each brood of spring Chinook (Table 13). Initially, downstream movement (past the traps) of subyearlings is monitored between July 1 and November 30. After this date, trapping is suspended until March of the following year. There is likely some continued downstream movement of the same brood during this time, but trends before and after the break in trapping suggest at least a bimodal pattern (in other years there may be several significant peaks) of emigration for a single brood year. Once trapping continues in the spring, movement of yearling smolts increases just prior to and during snowmelt. A portion of this component of the brood is likely not accounted for as river discharge sharply increases (trap efficiency correspondingly decreases). Emigration estimates suggest that the greater proportion of each brood exit Nason

Creek as subyearlings with the remainder of the cohort overwintering in the river and exiting in spring as yearlings.

Table 50. Proportions of subyearling and yearling emigrants from Nason Creek per brood year.

Brood Year	Subyearling Emigrants	Yearling Emigrants	Total Emigrants
2003	7,899 (79%)	2,096 (21%)	9,995 (100%)
2004	12,569 (79%)	3,267 (21%)	15,836 (100%)
2005	24,348 (76%)	7,888 (24%)	32,236 (100%)
2006	5,300 (50%)	5,279 (50%)	10,579 (100%)
2007	19,374 (84%)	3,621 (16%)	22,995 (100%)
2008	41,839 (84%)	7,812 (16%)	49,651 (100%)
2009*	35,280	—	—
Average	**75%**	**25%**	

*** BY2009 yearling data has not been collected.**

Multiple years of trapping are required to establish a baseline of data that can be used to determine trends in the freshwater production of juvenile fish in Nason Creek. Likewise, fish production estimates from adjacent tributaries, or those that are geographically similar, can provide useful comparisons that broaden the perspective of regional production estimates. Currently, data collected from Nason Creek spans only six brood years of juvenile coho and spring Chinook emigration and are not yet adequate for determining trends in production. However, comparisons of relative annual production among nearby tributaries (White River or Chiwawa) are possible. Egg-to-emigrant survival for BY2008 spring Chinook from Nason Creek was 3.1%; compared to 7.1% from White River. This would suggest that the rate of production in White River was more than twice that of Nason Creek for this brood year. This is the highest estimated rate of production in three years for the White River, and still above the 6-year average for Nason Creek. The reasons for this relatively high rate of reproductive success and the differences between tributaries are unknown and several factors likely played a role (low density dependent mortality, favorable river conditions, etc.). Continued research is necessary to address relative reproductive success and carrying capacity of spring Chinook in Nason Creek.

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APPENDIX A: Stream Discharge & Temperature Data

Date	Daily Discharge (cfs)	Daily Stream Temp. (°C)
1/1/2010		0.1
1/2/2010		0.1
1/3/2010		0.4
1/4/2010	117	0.8
1/5/2010		1.0
1/6/2010		0.9
1/7/2010		0.0
1/8/2010		0.0
1/9/2010		
1/10/2010		
1/11/2010		
1/12/2010		
1/13/2010	135	2.3
1/14/2010	135	2.1
1/15/2010	131	1.8
1/16/2010	146	1.7
1/17/2010	131	1.8
1/18/2010	129	2.3
1/19/2010	129	2.7
1/20/2010	140	2.7
1/21/2010	148	2.6
1/22/2010	141	2.5
1/23/2010	133	2.1
1/24/2010	129	1.3
1/25/2010	127	1.4
1/26/2010	121	2.6
1/27/2010	117	2.7
1/28/2010	114	2.7
1/29/2010	112	2.9
1/30/2010	114	2.9
1/31/2010	113	3.3
2/1/2010	113	2.4
2/2/2010	110	3.0
2/3/2010	110	3.0
2/4/2010	109	3.1
2/5/2010	119	3.3
2/6/2010	120	3.4
2/7/2010	118	3.1
2/8/2010	117	3.3
2/9/2010	118	3.5
2/10/2010	116	2.8
2/11/2010	116	2.8
2/12/2010	120	2.9
2/13/2010	127	3.1
2/14/2010	136	3.5
2/15/2010	141	3.4
2/16/2010	149	3.7
2/17/2010	154	2.7
2/18/2010	145	2.2
2/19/2010	139	1.9
2/20/2010	134	1.6
2/21/2010	130	1.4
2/22/2010	127	1.4
2/23/2010	126	1.5
2/24/2010	127	2.9
2/25/2010	129	3.1
2/26/2010	138	2.8
2/27/2010	151	3.5
2/28/2010	150	4.2
3/1/2010		
3/2/2010	149	4.2
3/3/2010	157	4.4
3/4/2010	191	4.5
3/5/2010	199	3.5
3/6/2010	187	3.4
3/7/2010	181	3.3
3/8/2010	182	3.2
3/9/2010	181	3.7
3/10/2010	173	2.6
3/11/2010	168	2.9
3/12/2010	166	2.5
3/13/2010	168	2.6
3/14/2010	163	3.3
3/15/2010	155	3.5
3/16/2010	154	4.7
3/17/2010	158	4.8
3/18/2010	167	4.7
3/19/2010	161	4.0
3/20/2010	157	3.9
3/21/2010	154	3.9
3/22/2010	161	4.9
3/23/2010	190	5.0
3/24/2010	179	5.0
3/25/2010	181	4.9

3/26/2010	189	4.9	5/8/2010	365	6.1
3/27/2010	199	5.3	5/9/2010	354	6.4
3/28/2010	193	5.1	5/10/2010	354	6.7
3/29/2010	196	5.1	5/11/2010	365	6.3
3/30/2010	234	4.5	5/12/2010	376	7.7
3/31/2010	223	4.1	5/13/2010	516	7.9
4/1/2010	204	4.5	5/14/2010	643	7.4
4/2/2010	195	4.4	5/15/2010	793	7.0
4/3/2010	195	2.5	5/16/2010	1060	6.9
4/4/2010	187	3.2	5/17/2010	1370	6.3
4/5/2010	178	3.5	5/18/2010	1620	5.4
4/6/2010	187	4.2	5/19/2010	1770	5.2
4/7/2010	185	5.0	5/20/2010	1630	5.2
4/8/2010	178	4.9	5/21/2010	1580	5.1
4/9/2010	192	4.5	5/22/2010	1140	4.7
4/10/2010	181	4.0	5/23/2010	916	5.8
4/11/2010	171	3.9	5/24/2010	795	6.1
4/12/2010	165	4.8	5/25/2010	719	5.9
4/13/2010	165	5.5	5/26/2010	656	6.2
4/14/2010	164	6.2	5/27/2010	858	6.1
4/15/2010	173	6.8	5/28/2010	1010	6.0
4/16/2010	194	6.0	5/29/2010	1080	6.0
4/17/2010	204	6.1	5/30/2010	1050	6.2
4/18/2010	264	6.8	5/31/2010	958	6.3
4/19/2010	330	6.6	6/1/2010	1040	6.8
4/20/2010	430	6.7	6/2/2010	1130	6.5
4/21/2010	675	5.5	6/3/2010	1350	6.1
4/22/2010	919	4.2	6/4/2010	1680	5.9
4/23/2010	726	5.3	6/5/2010	1370	6.3
4/24/2010	644	5.3	6/6/2010	1230	6.8
4/25/2010	603	5.6	6/7/2010	1220	6.0
4/26/2010	524	5.6	6/8/2010	1390	6.9
4/27/2010	508	5.3	6/9/2010	1340	6.7
4/28/2010	634	5.5	6/10/2010	1470	7.0
4/29/2010	619	5.6	6/11/2010	1340	7.1
4/30/2010	525	5.6	6/12/2010	1250	7.6
5/1/2010	472	6.1	6/13/2010	1260	7.9
5/2/2010	464	6.4	6/14/2010	1420	8.2
5/3/2010	444	6.2	6/15/2010	1400	7.7
5/4/2010	577	4.5	6/16/2010	1140	6.9
5/5/2010	479	4.6	6/17/2010	907	6.4
5/6/2010	414	4.9	6/18/2010	796	7.4
5/7/2010	377	6.2	6/19/2010	754	8.0

6/20/2010	795	8.2	8/2/2010	104	15.3
6/21/2010	926	7.6	8/3/2010	99	15.9
6/22/2010	958	8.1	8/4/2010	95	16.2
6/23/2010	921	8.7	8/5/2010	102	16.7
6/24/2010	1040	9.0	8/6/2010	96	16.7
6/25/2010	1120	9.0	8/7/2010	94	16.3
6/26/2010	1110	9.7	8/8/2010	86	15.8
6/27/2010	1000	9.3	8/9/2010	85	15.9
6/28/2010	876	10.0	8/10/2010	82	16.0
6/29/2010	879	10.2	8/11/2010	79	15.2
6/30/2010	834	9.8	8/12/2010	77	15.7
7/1/2010	678	8.9	8/13/2010	73	16.9
7/2/2010	576	8.6	8/14/2010	69	17.1
7/3/2010	504	9.1	8/15/2010	67	16.7
7/4/2010	465	9.7	8/16/2010	67	17.0
7/5/2010	433	9.2	8/17/2010	65	17.3
7/6/2010	419	10.2	8/18/2010	64	17.6
7/7/2010	411	10.7	8/19/2010	61	17.8
7/8/2010	444	11.7	8/20/2010	59	16.8
7/9/2010	485	12.2	8/21/2010	58	15.7
7/10/2010	498	12.8	8/22/2010	57	15.2
7/11/2010	491	13.6	8/23/2010	55	14.9
7/12/2010	455	13.8	8/24/2010	56	14.3
7/13/2010	425	12.9	8/25/2010	54	14.7
7/14/2010	351	11.2	8/26/2010	52	15.4
7/15/2010	292	12.0	8/27/2010	51	15.1
7/16/2010	267	13.4	8/28/2010	57	14.1
7/17/2010	251	14.1	8/29/2010	58	12.6
7/18/2010	236	14.1	8/30/2010	55	13.2
7/19/2010	219	14.5	8/31/2010	51	12.9
7/20/2010	204	14.5	9/1/2010	52	12.4
7/21/2010	191	14.1	9/2/2010	76	13.1
7/22/2010	178	14.5	9/3/2010	66	12.9
7/23/2010	167	14.9	9/4/2010	56	13.9
7/24/2010	161	14.3	9/5/2010	51	14.6
7/25/2010	162	15.6	9/6/2010	51	13.0
7/26/2010	156	16.2	9/7/2010	55	12.4
7/27/2010	147	16.4	9/8/2010	74	12.1
7/28/2010	139	16.4	9/9/2010	115	11.6
7/29/2010	134	16.7	9/10/2010	105	11.8
7/30/2010	129	16.8	9/11/2010	84	11.9
7/31/2010	115	16.6	9/12/2010	75	12.0
8/1/2010	101	15.9	9/13/2010	68	12.2

9/14/2010	65	12.8	10/27/2010	128	5.6
9/15/2010	62	13.2	10/28/2010	106	5.8
9/16/2010	59	12.9	10/29/2010	102	6.2
9/17/2010	62	13.3	10/30/2010	105	6.6
9/18/2010	68	13.1	10/31/2010	104	6.5
9/19/2010	72	13.2	11/1/2010	107	6.5
9/20/2010	86	13.1	11/2/2010	216	6.0
9/21/2010	112	11.8	11/3/2010	522	5.6
9/22/2010	175	10.6	11/4/2010	300	4.9
9/23/2010	116	10.1	11/5/2010	239	4.7
9/24/2010	99	9.7	11/6/2010	213	4.9
9/25/2010	113	9.9	11/7/2010	208	5.5
9/26/2010	105	10.5	11/8/2010	269	6.2
9/27/2010	96	11.0	11/9/2010	233	4.6
9/28/2010	103	11.8	11/10/2010	202	3.2
9/29/2010	99	13.0	11/11/2010	185	3.7
9/30/2010	99	11.9	11/12/2010	170	3.4
10/1/2010	90	10.7	11/13/2010	166	3.1
10/2/2010	84	10.7	11/14/2010	157	4.1
10/3/2010	80	11.0	11/15/2010	174	5.5
10/4/2010	76	11.1	11/16/2010	243	6.1
10/5/2010	73	10.7	11/17/2010	599	5.1
10/6/2010	70	9.5	11/18/2010	393	4.1
10/7/2010	66	9.0	11/19/2010	318	2.9
10/8/2010	64	8.4	11/20/2010	270	2.7
10/9/2010	62	10.0	11/21/2010	243	2.6
10/10/2010	66	10.0	11/22/2010	221	2.2
10/11/2010	237	9.7	11/23/2010	199	0.5
10/12/2010	170	8.4	11/24/2010	201	0.0
10/13/2010	126	8.0	11/25/2010	213	0.0
10/14/2010	108	7.5	11/26/2010	268	0.0
10/15/2010	100	7.1	11/27/2010	310	0.0
10/16/2010	96	7.4	11/28/2010	321	0.0
10/17/2010	91	6.2	11/29/2010	352	0.0
10/18/2010	87	5.2	11/30/2010	297	0.1
10/19/2010	83	5.3	12/1/2010	227	0.0
10/20/2010	80	6.2	12/2/2010	188	0.1
10/21/2010	78	6.4	12/3/2010	124	0.7
10/22/2010	75	6.2	12/4/2010	116	0.9
10/23/2010	74	7.4	12/5/2010	110	1.0
10/24/2010	74	7.5	12/6/2010		
10/25/2010	84	7.8	12/7/2010		
10/26/2010	115	6.5	12/8/2010		

12/9/2010		
12/10/2010		
12/11/2010		
12/12/2010		
12/13/2010		
12/14/2010		
12/15/2010		
12/16/2010		
12/17/2010		
12/18/2010		
12/19/2010		
12/20/2010		
12/21/2010		
12/22/2010	212	1.6
12/23/2010	198	1.5
12/24/2010	179	2.2
12/25/2010	167	2.1
12/26/2010	160	2.2
12/27/2010	154	2.4
12/28/2010	148	2.0
12/29/2010	143	1.7
12/30/2010	133	1.8
12/31/2010	127	0.1

APPENDIX B: Trap Operations

Date	Status	Comments
3/2/2010	Op.	Installed
3/3/2010	Op.	
3/4/2010	Op.	
3/5/2010	Op.	
3/6/2010	Op.	
3/7/2010	Op.	
3/8/2010	Op.	
3/9/2010	Op.	
3/10/2010	Op.	
3/11/2010	Op.	
3/12/2010	Op.	
3/13/2010	Op.	
3/14/2010	Op.	
3/15/2010	Op.	
3/16/2010	Op.	
3/17/2010	Op.	
3/18/2010	Op.	
3/19/2010	Op.	
3/20/2010	Op.	
3/21/2010	Op.	
3/22/2010	Op.	
3/23/2010	Op.	
3/24/2010	Op.	
3/25/2010	Op.	
3/26/2010	Op.	
3/27/2010	Op.	
3/28/2010	Op.	
3/29/2010	Op.	
3/30/2010	Op.	
3/31/2010	Op.	
4/1/2010	Op.	
4/2/2010	Op.	
4/3/2010	Op.	
4/4/2010	Op.	
4/5/2010	Op.	
4/6/2010	Op.	
4/7/2010	Op.	
4/8/2010	Op.	
4/9/2010	Op.	
4/10/2010	Op.	
4/11/2010	Op.	
4/12/2010	Op.	
4/13/2010	Op.	
4/14/2010	Op.	
4/15/2010	Op.	
4/16/2010	Op.	
4/17/2010	Op.	
4/18/2010	Op.	
4/19/2010	Op.	
4/20/2010	Op.	
4/21/2010	Op.	
4/22/2010	Op.	
4/23/2010	Op.	
4/24/2010	Op.	
4/25/2010	Op.	
4/26/2010	Op.	
4/27/2010	Op.	
4/28/2010	Op.	
4/29/2010	Op.	
4/30/2010	Op.	
5/1/2010	Op.	
5/2/2010	Op.	
5/3/2010	No Op.	Pulled: hatch. release
5/4/2010	No Op.	Pulled: hatch. release
5/5/2010	Op.	Trap set
5/6/2010	Op.	
5/7/2010	Op.	
5/8/2010	Op.	
5/9/2010	Op.	
5/10/2010	Op.	
5/11/2010	Op.	
5/12/2010	Op.	
5/13/2010	Op.	
5/14/2010	Op.	
5/15/2010	Op.	
5/16/2010	No Op.	Pulled: high flows
5/17/2010	No Op.	Pulled: high flows
5/18/2010	No Op.	Pulled: high flows
5/19/2010	No Op.	Pulled: high flows
5/20/2010	No Op.	Pulled: high flows
5/21/2010	Op.	Trap set
5/22/2010	Op.	
5/23/2010	Op.	
5/24/2010	Op.	

5/25/2010	Op.		7/7/2010	Op.	
5/26/2010	Op.		7/8/2010	Op.	
5/27/2010	Op.		7/9/2010	Op.	
5/28/2010	Op.		7/10/2010	Op.	
5/29/2010	Op.		7/11/2010	Op.	
5/30/2010	Op.		7/12/2010	Op.	
5/31/2010	Op.		7/13/2010	Op.	
6/1/2010	Op.		7/14/2010	Op.	
6/2/2010	Op.		7/15/2010	Op.	
6/3/2010	No Op.	Pulled: high flows	7/16/2010	No Op.	Stopped: debris
6/4/2010	No Op.	Pulled: high flows	7/17/2010	Op.	Trap set
6/5/2010	No Op.	Pulled: high flows	7/18/2010	Op.	
6/6/2010	Op.	Trap set	7/19/2010	Op.	
6/7/2010	Op.		7/20/2010	Op.	
6/8/2010	No Op.	Pulled: high flows	7/21/2010	Op.	
6/9/2010	No Op.	Pulled: high flows	7/22/2010	Op.	
6/10/2010	Op.	Trap set	7/23/2010	Op.	
6/11/2010	Op.		7/24/2010	Op.	Repositioned
6/12/2010	No Op.	Pulled: high flows	7/25/2010	Op.	
6/13/2010	No Op.	Pulled: high flows	7/26/2010	Op.	
6/14/2010	No Op.	Pulled: high flows	7/27/2010	Op.	
6/15/2010	Op.	Trap set	7/28/2010	Op.	
6/16/2010	Op.		7/29/2010	Op.	
6/17/2010	Op.		7/30/2010	Op.	
6/18/2010	Op.		7/31/2010	Op.	
6/19/2010	Op.		8/1/2010	Op.	
6/20/2010	Op.		8/2/2010	Op.	
6/21/2010	Op.		8/3/2010	Op.	
6/22/2010	Op.		8/4/2010	Op.	
6/23/2010	Op.		8/5/2010	Op.	
6/24/2010	Op.		8/6/2010	Op.	
6/25/2010	Op.		8/7/2010	Op.	
6/26/2010	Op.		8/8/2010	Op.	
6/27/2010	Op.		8/9/2010	Op.	
6/28/2010	Op.		8/10/2010	Op.	
6/29/2010	Op.		8/11/2010	Op.	
6/30/2010	Op.		8/12/2010	Op.	
7/1/2010	Op.		8/13/2010	Op.	
7/2/2010	Op.		8/14/2010	Op.	
7/3/2010	Op.		8/15/2010	Op.	
7/4/2010	Op.		8/16/2010	Op.	
7/5/2010	Op.		8/17/2010	No Op.	Stopped: debris
7/6/2010	Op.		8/18/2010	No Op.	Stopped: debris

8/19/2010	Op.	Trap set	10/1/2010	Op.	
8/20/2010	Op.		10/2/2010	Op.	
8/21/2010	Op.		10/3/2010	Op.	
8/22/2010	No Op.	Stopped: debris	10/4/2010	Op.	
8/23/2010	No Op.	Stopped: debris	10/5/2010	No Op.	Stopped: low flows
8/24/2010	Op.	Trap set	10/6/2010	No Op.	Stopped: low flows
8/25/2010	No Op.	Stopped: debris	10/7/2010	No Op.	Stopped: low flows
8/26/2010	No Op.	Pulled: low flows	10/8/2010	Op.	Trap set
8/27/2010	No Op.	Pulled: low flows	10/9/2010	Op.	
8/28/2010	No Op.	Pulled: low flows	10/10/2010	Op.	
8/29/2010	No Op.	Pulled: low flows	10/11/2010	Op.	
8/30/2010	No Op.	Pulled: low flows	10/12/2010	Op.	
8/31/2010	No Op.	Pulled: low flows	10/13/2010	Op.	
9/1/2010	No Op.	Pulled: low flows	10/14/2010	Op.	
9/2/2010	No Op.	Pulled: low flows	10/15/2010	Op.	
9/3/2010	No Op.	Pulled: low flows	10/16/2010	Op.	
9/4/2010	No Op.	Pulled: low flows	10/17/2010	Op.	
9/5/2010	No Op.	Pulled: low flows	10/18/2010	Op.	
9/6/2010	No Op.	Pulled: low flows	10/19/2010	Op.	
9/7/2010	Op.	Trap set	10/20/2010	Op.	
9/8/2010	Op.		10/21/2010	Op.	
9/9/2010	Op.		10/22/2010	Op.	
9/10/2010	Op.		10/23/2010	Op.	
9/11/2010	Op.		10/24/2010	Op.	
9/12/2010	Op.		10/25/2010	Op.	
9/13/2010	Op.		10/26/2010	Op.	
9/14/2010	Op.		10/27/2010	Op.	
9/15/2010	Op.		10/28/2010	Op.	
9/16/2010	Op.		10/29/2010	Op.	
9/17/2010	Op.		10/30/2010	Op.	
9/18/2010	Op.		10/31/2010	Op.	
9/19/2010	Op.		11/1/2010	No Op.	Stopped: debris
9/20/2010	No Op.	Stopped: debris	11/2/2010	Op.	Repositioned
9/21/2010	Op.	Trap set	11/3/2010	Op.	Flows down
9/22/2010	Op.		11/4/2010	Op.	
9/23/2010	Op.		11/5/2010	Op.	
9/24/2010	Op.		11/6/2010	Op.	
9/25/2010	Op.		11/7/2010	Op.	
9/26/2010	Op.		11/8/2010	Op.	
9/27/2010	Op.		11/9/2010	Op.	
9/28/2010	Op.		11/10/2010	Op.	
9/29/2010	Op.		11/11/2010	Op.	
9/30/2010	Op.		11/12/2010	Op.	

11/13/2010	Op.	
11/14/2010	Op.	
11/15/2010	Op.	
11/16/2010	No Op.	Stopped: debris
11/17/2010	Op.	
11/18/2010	Op.	
11/19/2010	Op.	
11/20/2010	Op.	
11/21/2010	Op.	
11/22/2010	Op.	
11/23/2010	No Op.	Stopped: frozen
11/24/2010	No Op.	Pulled: ice
11/25/2010	No Op.	Pulled: ice
11/26/2010	No Op.	Pulled: ice
11/27/2010	No Op.	Pulled: ice
11/28/2010	No Op.	Pulled: ice
11/29/2010	No Op.	Pulled: ice
11/30/2010	No Op.	Pulled: ice
12/2/2010	Removed	

Appendix A:
2010 Nason Creek Smolt Trap Report

APPENDIX B: 2011 NASON CREEK SMOLT TRAP REPORT

Population Estimates for Juvenile Salmonids in Nason Creek, WA

2011 Annual Report

March 2012

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Project No. 1996-040-00
Contract No. 38968

ABSTRACT

In 2011, Yakama Nation Fisheries Resource Management 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 December 1, 2011. We collected 11 bull trout, 17 coho salmon, 1,519 spring Chinook salmon, and 2,490 summer steelhead; all were of natural origin. Daily counts of fish caught at the trap were expanded by pooled rates of trap efficiency derived from mark and recapture trials. All estimates were made with a 95% confidence interval (CI). We estimated that 55 (± 26) BY2009 coho smolt, 242 (± 25) BY2010 coho parr, 2,573 (± 446) BY2009 Chinook smolts, 22,780 (± 1,127) BY2010 Chinook parr, 26,771 (± 3,323) steelhead parr/smolts emigrated from Nason Creek in 2011. Total emigration estimates for BY2009 coho juveniles and spring Chinook juveniles were 455 (± 27) and 36,282 (± 3,361), respectively. We estimated the entire BY2008 summer steelhead emigration to be 12,794 (± 3,576; 95% CI). Egg-to-emigrant survival rates for BY2009 coho and BY2009 Chinook were 1.0% and 4.6%, respectively. The egg-to-emigrant survival rate for BY2008 summer steelhead was 2.6%. Although overall juvenile abundance was low for all species, survival rates for coho and Chinook were as high as or higher than in previous years.

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ACKNOWLEDGEMENTS

This project is part of a basin wide monitoring program requiring close coordination between multiple agencies and contractors. We greatly appreciate the hard work of the Yakama Nation FRM crew members including Matthew Clubb, Arlene Heemsah, Barry Hodges, Bryan Ishida, Dakota Arnoux, Elaine Bianchi, Greg Robison, Michelle Teo and Tim Jeffris who maintained and operated the trap during all hours including nights/weekends and through sometimes challenging weather conditions. We would like to thank the Wenatchee River Ranger District (U.S. Forest Service) for providing use of the trapping site and accommodating the needs of this study. Thanks to Roy Beatty (Bonneville Power Administration) and Eric Lauver (Grant County PUD) for administering contracting and funding. Thanks to Todd Miller, John Walters, and Mike Haines (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. This was a cost share between the Yakama Nation's Mid-Columbia Coho Reintroduction Project (MCCRP; BPA project #1996-040-00) and the Integrated Status & Effectiveness Monitoring Program (ISEMP; BPA project #2003-017-000). In 2007, Grant County Public Utility District (GCPUD) also began funding this ongoing study as a cost-share with the entities above. In 2011, BPA #1996-040-00 and GCPUD continued funding while ISEMP reprioritized their objectives and terminated smolt trap funding. Trap operation was conducted in compliance with ESA consultation. The objectives of these projects are to:

1) Estimate the juvenile abundance and productivity of spring Chinook salmon, steelhead trout (GCPUD), and coho salmon (BPA #1996-040-00) in Nason Creek.

2) Describe the temporal variability of spring Chinook salmon, steelhead trout (GCPUD), and coho salmon (BPA #1996-040-00) emigrating from Nason Creek.

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

1.1 Watershed Description

The Nason Creek watershed drains 65,600 acres of alpine glaciated landscape where high precipitation and moderate rain on snow recurrence controls the hydrology and aquatic communities. Nason Creek originates near the Cascade crest at Stevens Pass and flows east for approximately 37 river kilometers (RK) until joining the Wenatchee River at RK 86.3 just below Lake Wenatchee. The smolt trap is located at RK 0.8; 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).

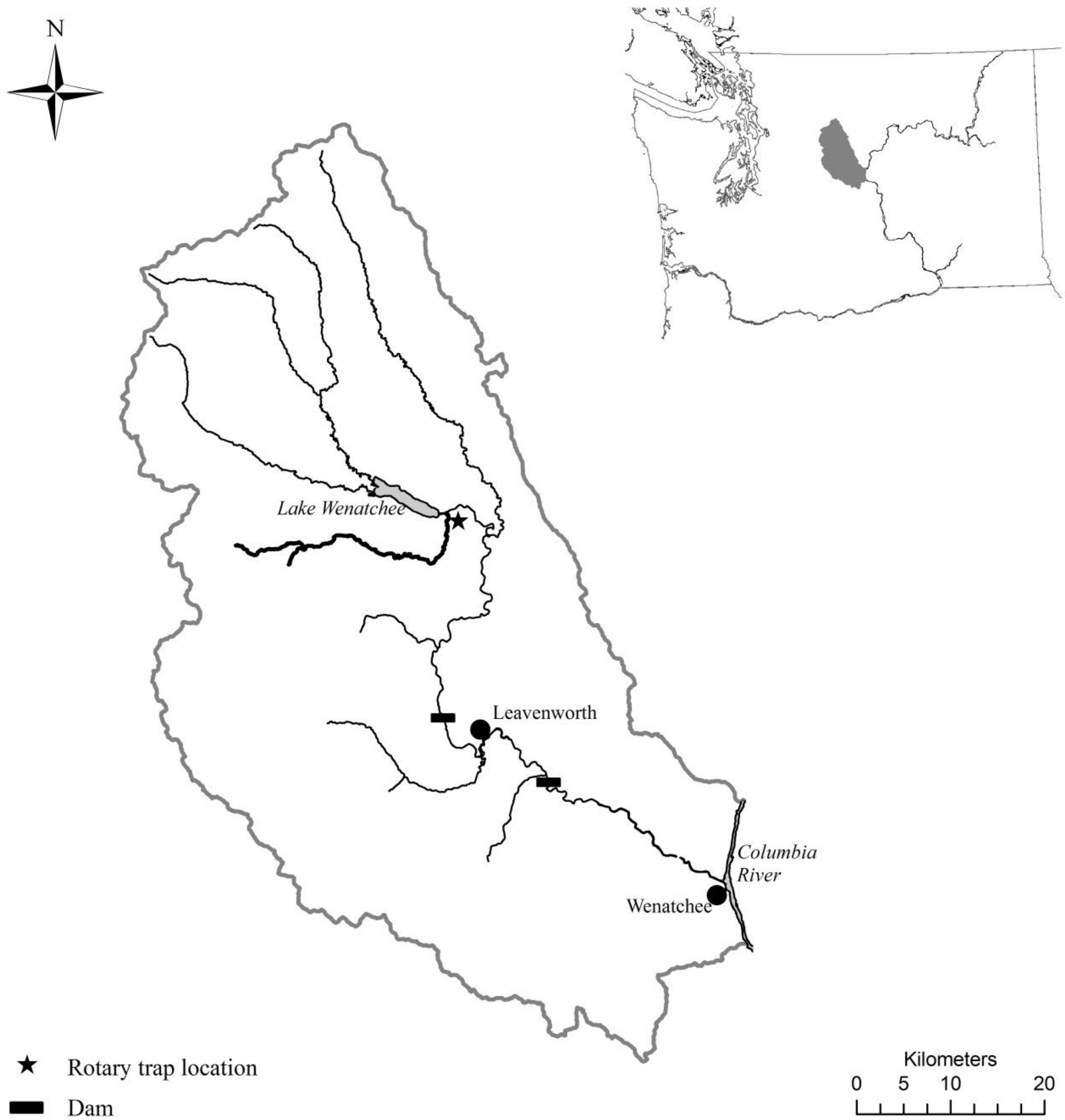

Figure 22. Map of Wenatchee River Subbasin with Nason Creek rotary trap location.

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 2011, mean daily discharge for Nason Creek was 528cfs with mean daily stream temperatures ranging from 0.0°C to 15.9°C (Figure 2 & 3). In relation to the 9-year mean, 2011 flows were somewhat higher with seasonal peaks generally occurring later by several weeks. Similarly, 2011 mean daily stream temperatures were typically lower by 0.5°C than the 9-year mean.

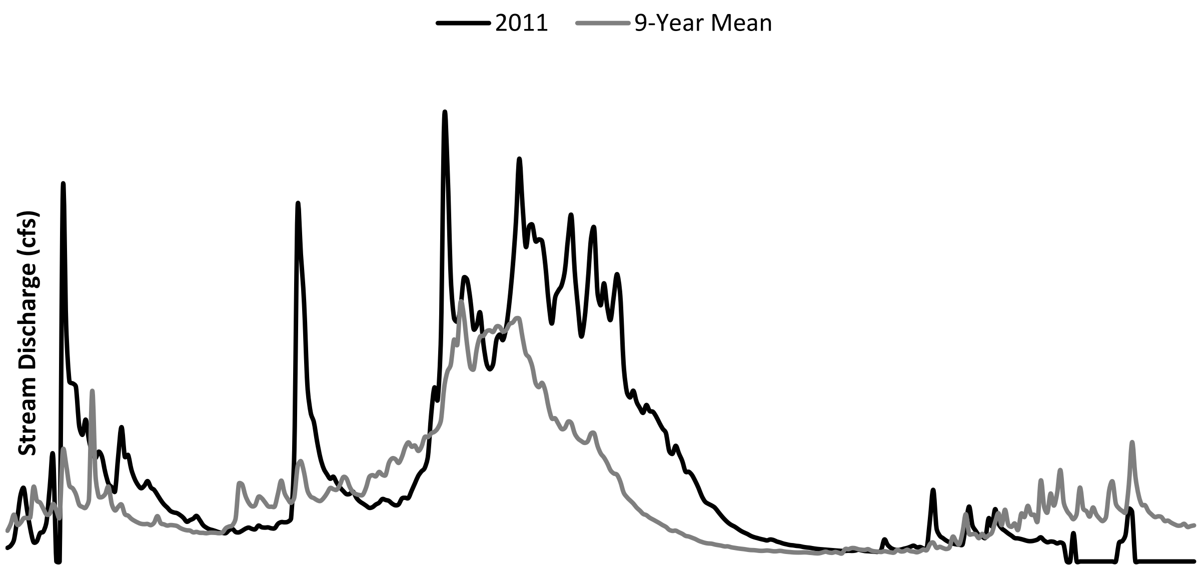

Figure 23. Mean daily stream discharge at the Nason Creek WDOE stream monitoring station in 2011.

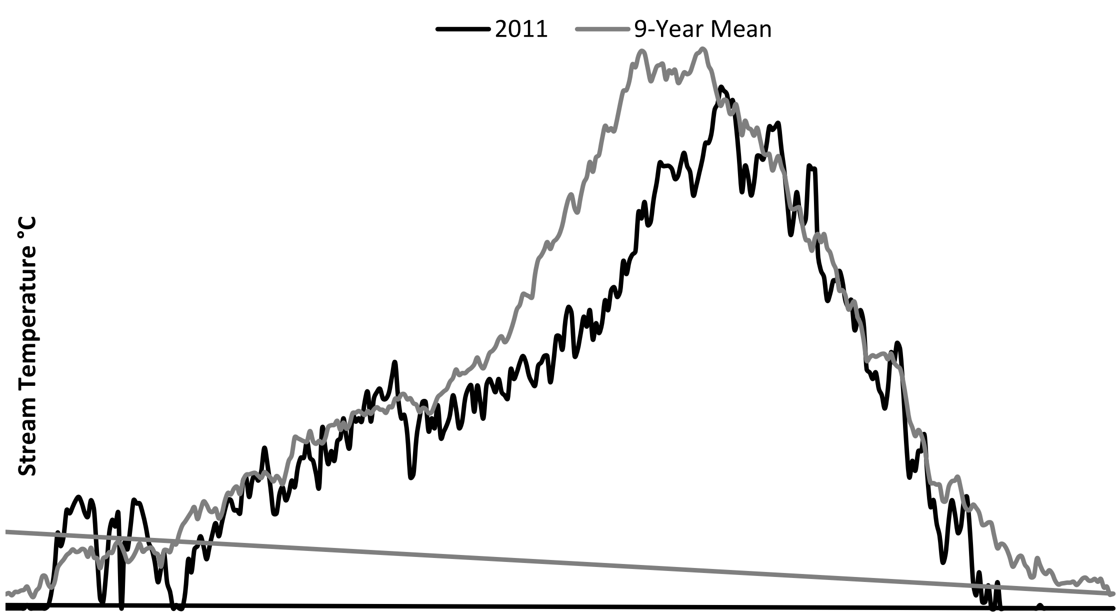

Figure 24. Mean daily water temperature at the Nason Creek DOE stream monitoring station in 2011.

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 0.8 on Nason Creek. Fish were retained in a holding box until they were removed. A rotating drum-screen constantly removed small debris from the live box. The trap was suspended with wire rope from a pulley connected to a river-spanning cable and was positioned laterally in the thalweg with a 'come-along' type puller. Two trap positions were used during 2011; a 'back' position during periods of medium to high stream discharges (> 100 cfs) in the spring and fall. The 'forward' position was used during periods of low stream discharge (< 100 cfs) in the summer. Trap operation was suspended during extremely high/low stream discharges, hatchery releases, or if floating debris prevented cone rotation. Stream discharge lower than 40 cfs required that the cone be raised incrementally to avoid touching the streambed. Trap operations were generally suspended when stream discharge approached ~2000 cfs to avoid the influx of potentially hazardous debris.

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 a portable 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 from the trap or used in trap 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 was measured and weighed while the remaining fish were tallied only. Fork length was recorded to the nearest millimeter and weight to the nearest 0.1 gram. 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 to each fish. 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. Genetic samples were collected from spring Chinook, steelhead, and bull trout. DNA 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 by their origin as natural or hatchery production by physical appearance and the 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 excluded from subyearling population estimates. All steelhead fry measuring < 50 mm were also excluded from population estimates (UCRTT, 2001).

2.3 Mark-Recapture Trials

Groups of marked juveniles were released during a range of stream discharges in order to determine the trapping efficiency following the protocol described in Hillman (2004). The protocol suggests a minimum sample size of 100 fish for each mark-recapture trial. However, due to the low abundance of fish captured during 2011, mark-recapture trials were mostly completed with substantially smaller sample sizes or with hatchery surrogates. Each mark recapture trial was conducted over a three-day period to allow time for passage or capture. Trials were considered invalid if no marked fish were recaptured or if there were significant interruptions to trap operation during the three-day period (i.e., debris/ice).

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

Typically, we combined the catch over a maximum of 72 hours to provide the largest mark group possible. Fish being held for mark-recapture trials were kept in auxiliary live boxes attached to the end of each pontoon. Marked groups were released regardless of sample size but only those groups consisting of ≥ 25 fish of a single size class and species were included in the efficiency-to-discharge regression model.

2.3.1 Marking and PIT tagging

Fish used in efficiency trials were PIT tagged and/or marked with a caudal fin clip (kept for DNA analysis). All spring Chinook, steelhead, and coho measuring ≥ 60 mm were PIT tagged; bull trout ≥ 70 mm were PIT tagged as well but were not included in efficiency trials.

Once anesthetized, each fish was examined for external wounds or descaling, then scanned for the presence of a previously implanted PIT tag. If no tag was detected, a 12 mm Digital Angel 134.2 kHz type TX 1411ST PIT tag was inserted into the body cavity using a 12-gauge hypodermic needle. Hypodermic needles were soaked in ethyl alcohol for approximately 10 minutes prior to use. Each unique tag code was electronically recorded along with date of tag implantation, date of fish release, tagging personnel, fork length, weight, and anesthetic bath temperature. Data were entered using P_3 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).

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) determining a PIT tag shed rate. Fish were then transported in 5-gallon buckets 1.4 km upstream to a release site and released at nautical twilight from an automated mechanical release box.

2.4 Data Analysis

2.4.1 Emigration Estimates

Trap efficiency was calculated with the following formula:

$$\text{Trap efficiency} = E_i = R_i / M_i$$

where E_i is the trap efficiency during time period i; M_i is the number of marked fish released during time period i; and R_i is the number of marked fish recaptured during time period i.

The daily emigration estimate was calculated by expanding the catch at the trap by trap efficiency using the following formula:

$$\text{Estimated daily migration} \quad \hat{N}_i = C_i / \hat{e}_i \quad =$$

where N_i is the estimated number of fish passing the trap during time period i; C_i is the number of unmarked fish captured during time period i; and e_i is the estimated trap efficiency for time period i.

A linear regression was used to correlate trap efficiency from individual efficiency trials (dependent variable) with discharge (cfs; independent variable). If the results of the regression were significant ($p < 0.05$; $r^2 > 0.50$), the regression equation was used to estimate daily trap efficiency.

The variance for the total daily number of fish traveling downstream past the trap was calculated from the following formulas:

Variance of daily migration estimate =

$$\operatorname{var}\left[\hat{N}_i\right] = \hat{N}_i^2 \frac{\mathrm{MSE}\left(1 + \frac{1}{n} + \frac{\left(X_i - \overline{X}\right)^2}{\left(n-1\right)s_X^2}\right)}{\hat{e}_i^2}$$

Where X_i is the discharge for time period i, and n is the sample size.

If a relationship between discharge and trap efficiency was not present (i.e., $p > 0.05$; $r^2 < 0.5$), a pooled trap efficiency was used to estimate daily emigration:

$$\text{Pooled trap efficiency} = E_p = \Sigma R / \Sigma M$$

The variance for daily emigration estimates using the pooled trap efficiency was calculated using the formula:

$$\text{Variance for daily emigration estimate} = \operatorname{var}\left[\hat{N}_i\right] = \hat{N}_i^2 \frac{E_p(1 - E_p) / \sum M}{E_p^2}$$

The total emigration estimate and confidence interval were calculated using the following formulas:

Total emigration estimate = $\sum \hat{N}_i$

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

The following assumptions regarding efficiency trials must be made for the population estimate to be valid (Everhart and Youngs 1981):

1. Marked fish were randomly dispersed in the population prior to recapture.
2. All marked fish passed the trap or were recaptured during time period *i*.
3. The probability of capturing a marked or unmarked fish is equal.
4. All marked fish recaptured were identified.
5. Marks were not lost between the time of release and recapture.

2.4.2 Juveniles Per Redd

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

3.0 RESULTS

3.1 Dates of Operation

The Nason Creek trap was installed on March 1 and operations began the same day. The trap was operated for 239 days out of a possible 276 days. Barring interruptions from floating debris, the trap was operated continuously 24 hours a day 7 days per week, except during periods of extreme high/low flows (≥ 2000 cfs; ≤ 40 cfs) or during upstream releases of hatchery steelhead (Table 1). During high flows (≥ 100 cfs; March 1 to August 5; October 13 to December 1) the trap was operated in the 'back' position. During lower flows (< 100 cfs; August 5 to October 12) it was run in the 'upper' position.

Table 51. Summary of Nason Creek rotary trap operation, 2011.

Trap Status	Description	Days
Operating	Continuous data collection.	239
Interrupted	Interrupted by debris, ice and low flows.	6
Not Operating	Intentionally pulled to avoid high/low flows, debris, ice, hatchery releases or to perform maintenance/repairs.	30

3.2 Daily Captures and Biological Sampling

3.2.1 Coho Yearlings (BY2009)

A total of 14 yearling coho were captured during the spring emigration period from March 1 to June 30 (Figure 4). The mean FL and weight for yearling coho was 100.2mm (n = 14 SD = 12.7; Table 2) and 11.3g (n = 14: SD = 3.9), respectively. There were no yearling coho mortalities.

3.2.2 Coho Subyearlings (BY2010)

A total of three subyearling coho were captured between July 1 and November 30. The mean FL and weight for subyearling coho was 64.7mm (n = 3; SD = 10.8) and 3.0g (n = 9: SD = 1.5), respectively. No subyearling fry were captured at the trap during spring emergence and snowmelt. There were no subyearling coho mortalities.

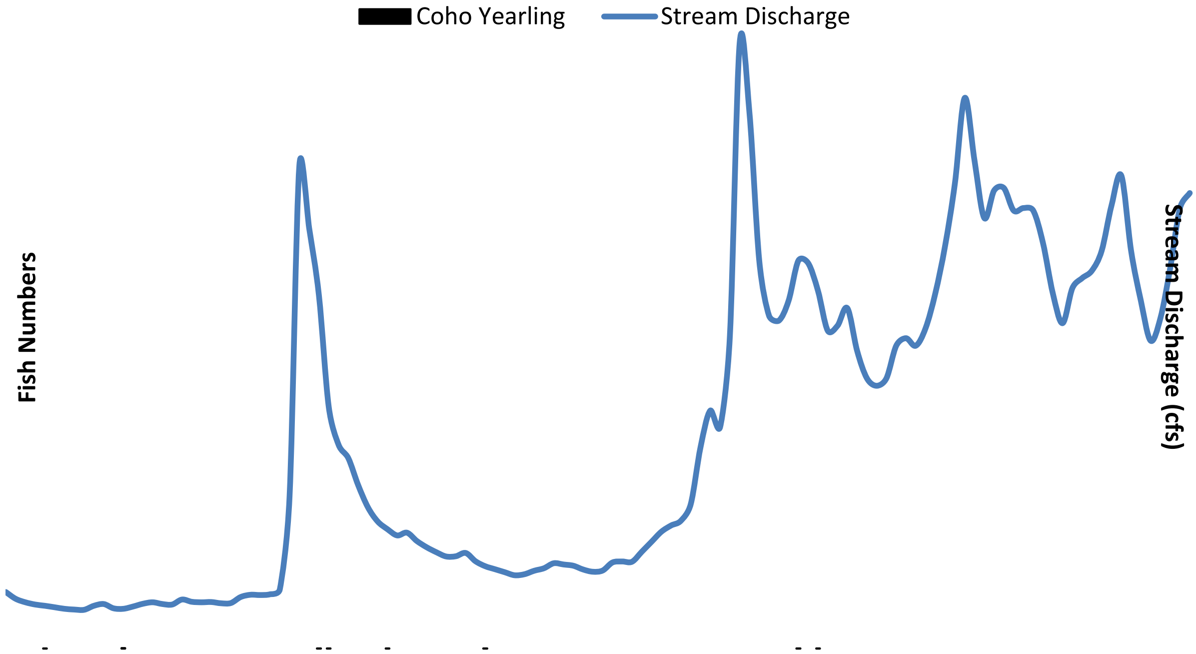

Figure 25. Daily catch of wild coho yearlings with mean daily stream discharge at the Nason Creek rotary trap, March 1 to June 30, 2011.

Table 52. Summary of length and weight sampling of juvenile coho salmon captured at the Nason Creek rotary trap in 2011.

Brood Year	Origin/Stage	Fork Length (mm)			Weight (g)			K-Factor
		Mean	N	SD	Mean	N	SD	
2009	Wild Yearling Smolt	100.2	14	12.7	11.3	14	3.9	1.1
2010	Wild Subyearling Parr	64.7	3	10.8	3	3	1.5	1.1
2009	Hatchery Yearling Smolt	124.6	969	8.6	21.0	969	4.8	1.1

3.2.3 Hatchery Coho Smolt (BY2009)

A total of 393,962 hatchery coho were released into Nason Creek above the trap in spring of 2011. All hatchery coho were acclimated in natural ponds adjacent to the stream and reared to the smolt stage before being allowed to emigrate at will. The timing of volitional coho releases was intentionally synchronized with the onset of spring snowmelt and the resulting increase in stream discharge. Daily captures at the Nason Creek rotary trap assist YN's Coho Program by recording condition factor, rate of emigration and duration of residence in Nason Creek. A total of 5,913 hatchery coho were captured at the trap with a mean FL of 124.6mm (*n* = 969; *SD* = 8.6) and a mean weight of 21.0g (*n* = 969; *SD* = 4.8; Figure 5).

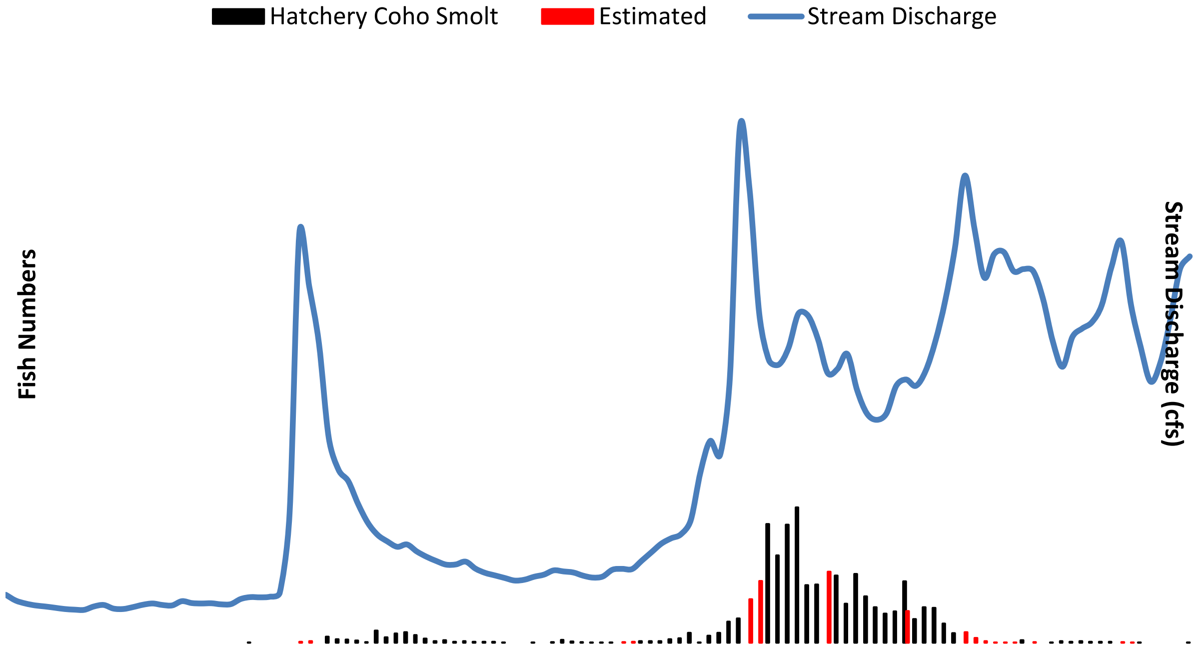

Figure 5. Daily catch of hatchery coho smolt with mean daily stream discharge at the Nason Creek rotary trap, March 1 to June 30, 2011.

3.2.4 Spring Chinook Yearlings (BY 2009)

A total of 152 yearling spring Chinook were collected between March 1 and June 30 with the peak catch occurring on April 3 (*n* = 14; Figure 6). We estimated that an additional 15 yearlings could have been captured if the trap had operated without interruption during the entire yearling emigration period. The mean FL and weight for yearling spring Chinook was 89.1mm (*n* = 152; *SD* = 9.9; Table 3) and 7.7g (*n* = 152; *SD* = 1.8), respectively. There were no yearling spring Chinook mortalities.

3.2.5 Spring Chinook Subyearling (BY2010)

A total of 1,367 subyearling spring Chinook were collected between March 1 and December 1 with the peak catch occurring on October 12 (*n* = 61; Figure 7). Young-of-the-year fry made up 21.4% (*n* = 292) of the total subyearling catch with subyearling parr comprising 78.6% (*n* = 1,075) of the total. We estimated that an additional 75 subyearling parr could have been captured if the trap had been operated without interruption from July 1 to December 1. Mean FL and weight for fry was 39.8 (*n* = 217; *SD* = 6.6) and 0.6g (*n* = 217; *SD* = 0.5), respectively. Mean FL and weight for subyearling parr was 73.4 (*n* = 1,046; *SD* = 13.1) and 4.9g (*n* = 1,046; *SD* = 2.5), respectively. There were eleven spring Chinook subyearling (fry & parr) mortalities during the trapping season (See **3.6 ESA Compliance**).

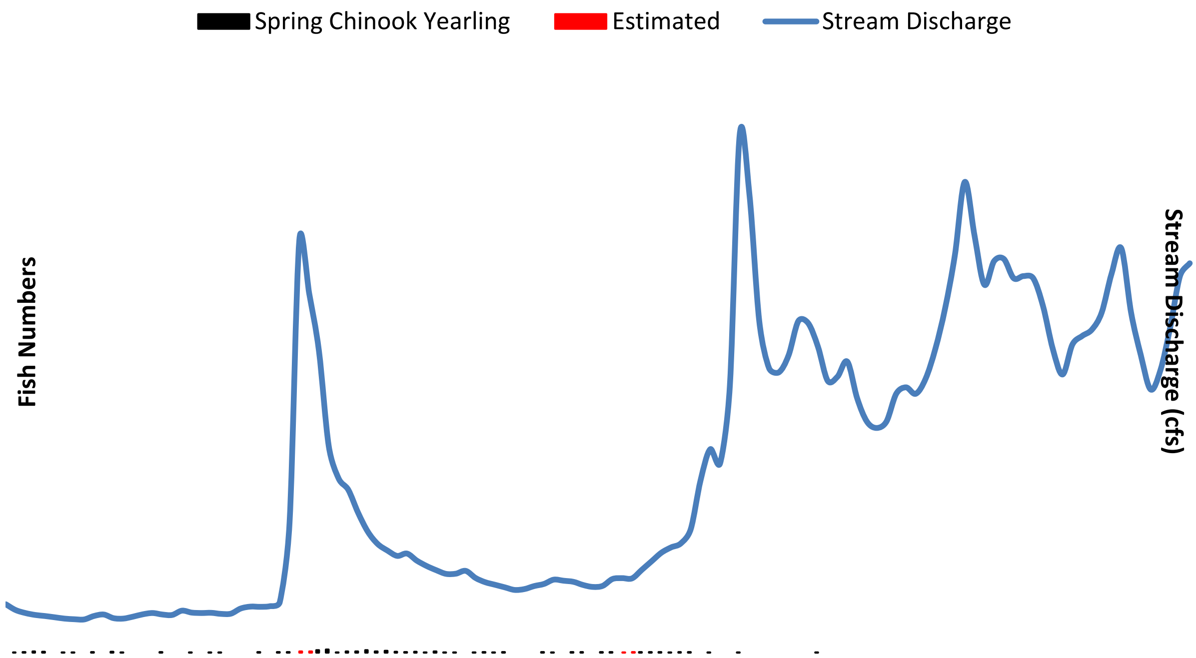

Figure 6. Daily catch of spring Chinook yearlings with mean daily stream discharge at the Nason Creek rotary trap, March 1 to June 30, 2011.

Table 53. Summary of length and weight sampling of juvenile spring Chinook captured at the Nason Creek rotary trap in 2011.

Brood Year	Origin/Stage	Fork Length (mm)			Weight (g)			K-Factor
		Mean	N	SD	Mean	N	SD	
2009	Wild Yearling Smolt	89.1	152	9.9	7.7	152	1.8	1.1
2010	Wild Subyearling Fry	39.8	217	6.6	0.6	217	0.5	1.0
2010	Wild Subyearling Parr	73.4	1,046	13.1	4.9	1,046	2.5	1.2

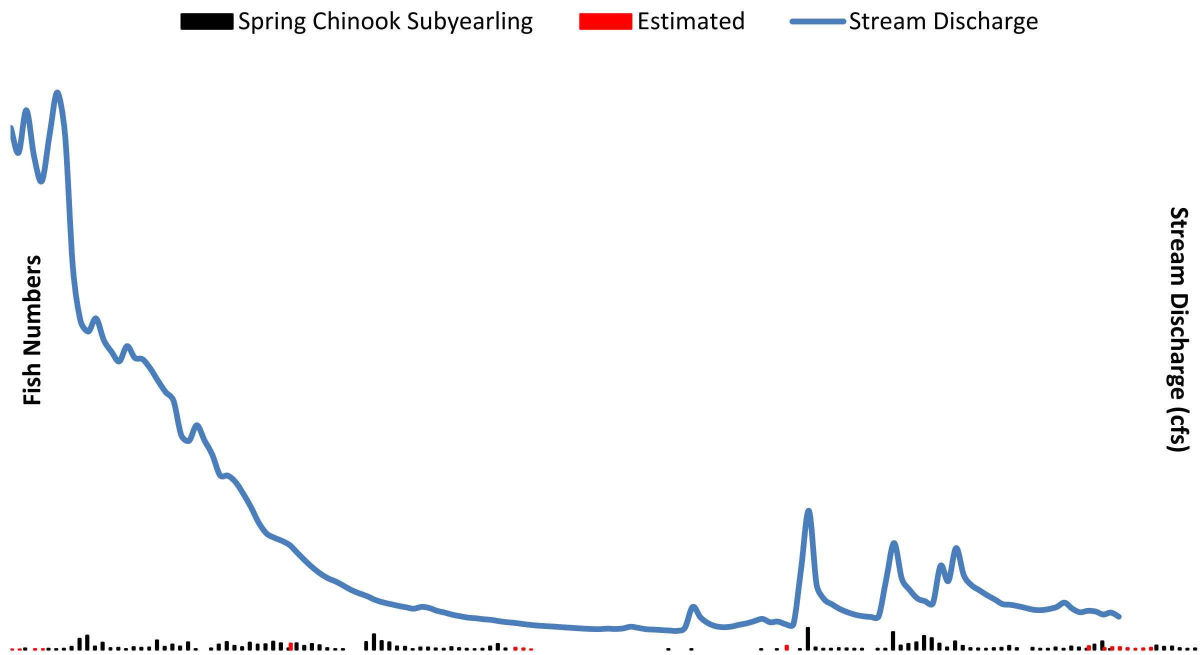

Figure 7. Daily catch of spring Chinook subyearlings with mean daily stream discharge at the Nason Creek rotary trap, July 1 to December 1, 2011.

3.2.6 Summer Steelhead

Overall catch of wild summer steelhead smolt was very low with only four smolts collected between March 1 and June 30 (Figure 8). A total of 1,092 summer steelhead parr were collected between March 1 and December 1 with a peak catch of 123 parr occurring on September 9. We estimated that an additional 155 parr could have been captured if there had been no interruptions to trapping during this period. A total of 1,295 summer steelhead fry between July 1 and December 1 with a peak catch occurring on August 31 (n = 110). We estimated that an additional 113 fry could have been captured if there had been no interruptions to trapping during this period. Most summer steelhead captured at the trap were age-0 fish with a mean fork length of 44.9mm (n = 1,646; SD = 11.7; Table 4). There were eleven parr/smolt and three fry mortalities (**3.6 ESA Compliance**).

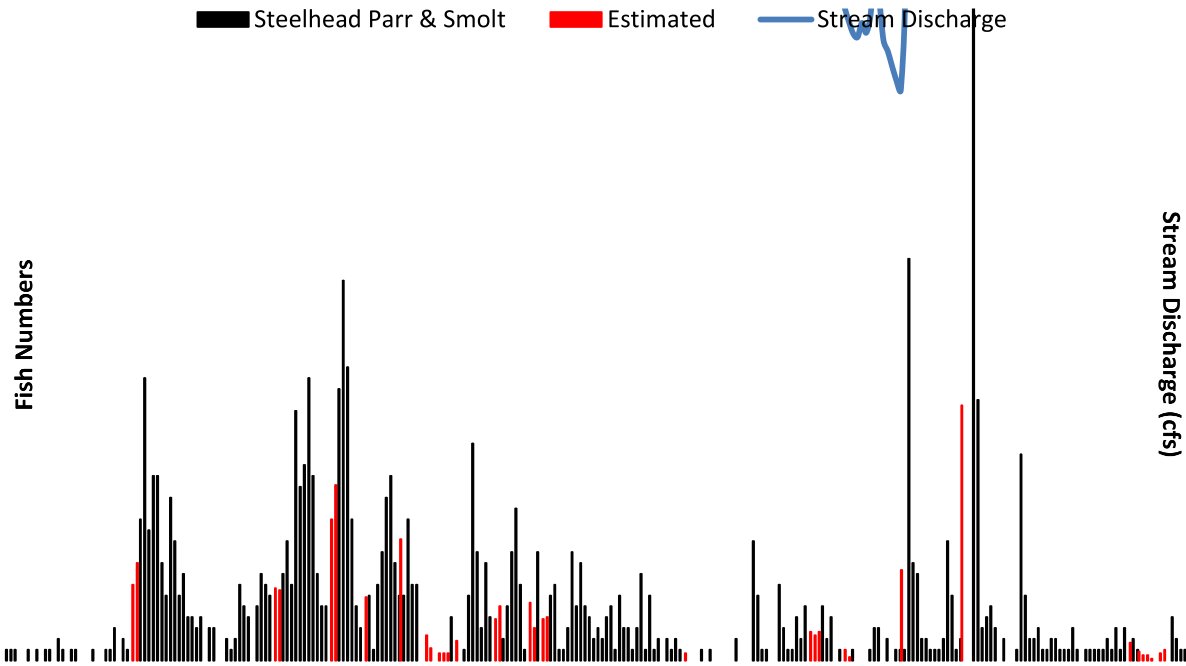

Figure 8. Daily catch of summer steelhead parr and smolt with mean daily stream discharge at the Nason Creek rotary trap, March 1 to December 1, 2011.

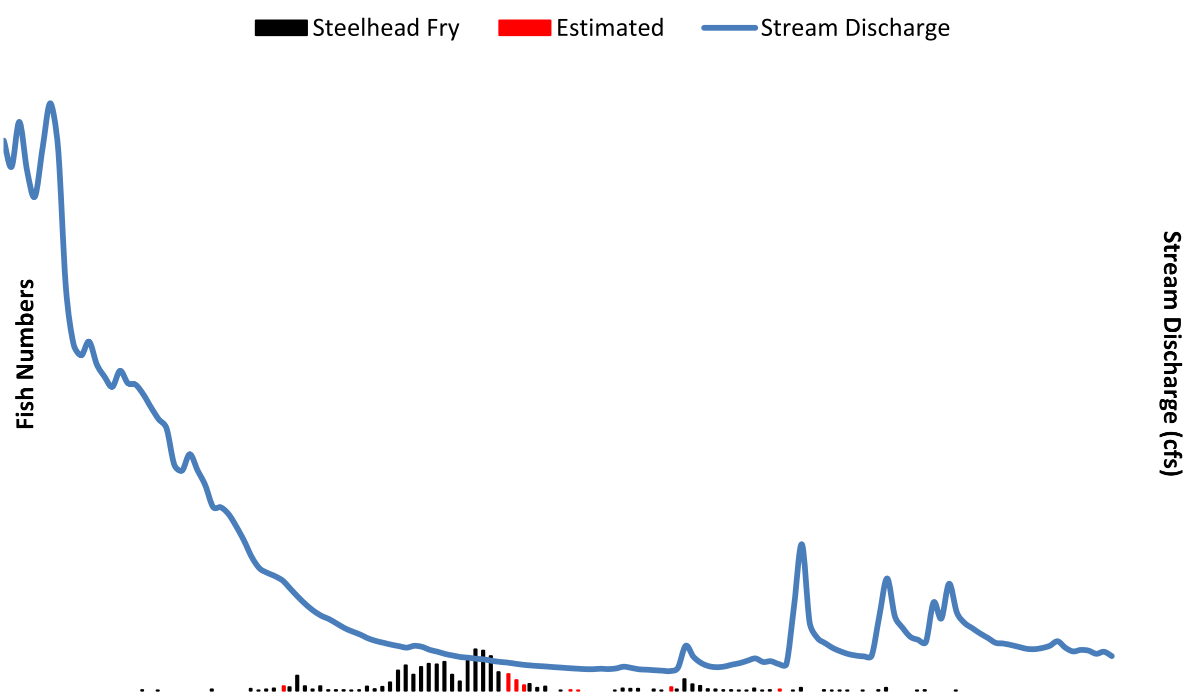

Figure 9. Daily catch of summer steelhead fry with mean daily stream discharge at the Nason Creek rotary trap, July 1 to December 1, 2011.

Table 54. 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 in 2011.

Brood Year	Age	Total Catch	Fork Length (mm)			Weight (g)			K-Factor
			Mean	N	SD	Mean	N	SD	
2011	0	1,646	44.9	785	11.7	1.1	785	1.1	1.22
2010	1	820	75.4	812	17.5	5.5	812	5.1	1.28
2009	2	22	155.7	19	22.7	42.1	19	21.6	1.12
2008	3	2	254.5	2	—	229.7	2	—	1.39
2010*	1	1,076	180.7	464	17.0	59.1	464	17.6	1.00

***Hatchery steelhead**

3.2.7 Hatchery Steelhead Smolt

Approximately 20,706 hatchery summer steelhead yearlings were acclimated at Rohlfings Pond and released volitionally on May 2 with an additional 91,000 released directly into Nason Creek above the trap on May 3. At this time, the trap was intentionally pulled from operation for 24 hours to prevent the capture and delay of fish during the initial wave of emigration. Once trapping resumed, all hatchery steelhead captured at the trap were sampled and/or tallied. A total of 1,076 hatchery steelhead were captured with a mean FL of 180.7mm (*n* = 464; *SD* = 17.0) and a mean weight of 59.1g (*n* = 464; *SD* = 17.6; Figure 10).

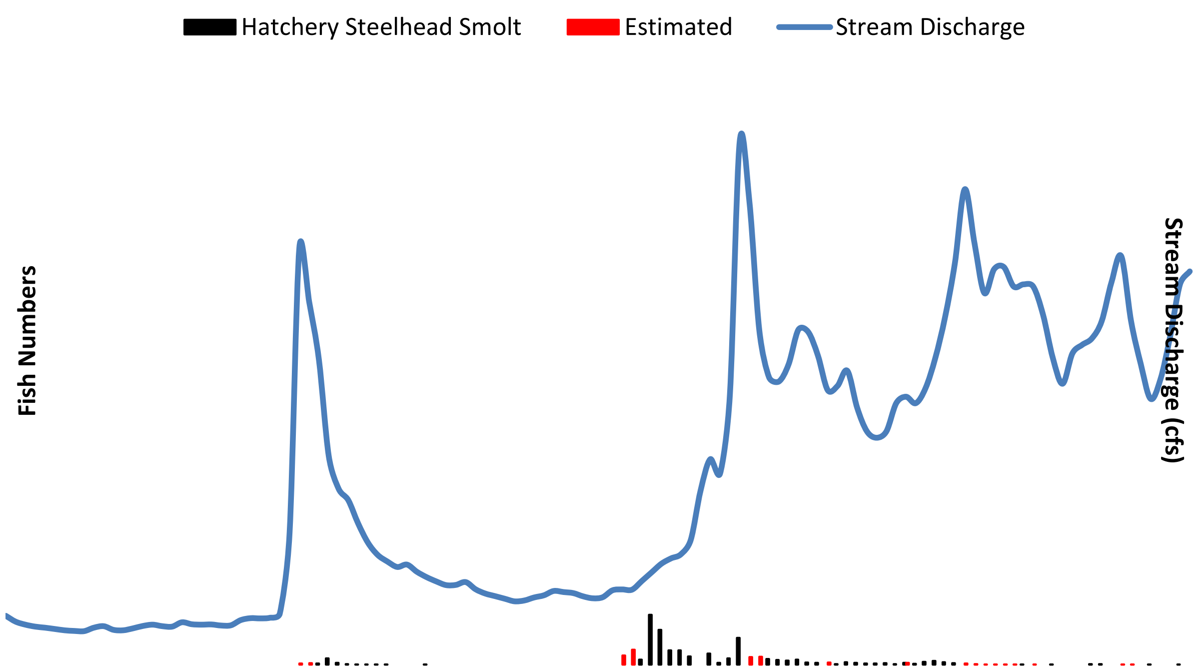

Figure 26. Daily catch of hatchery steelhead smolt with mean daily stream discharge at the Nason Creek rotary trap, March 1 to June 30, 2011.

3.2.8 Bull Trout

A total of five bull trout parr were captured with a mean fork length of 142.6mm (n = 5; SD = 22.5; Table 5). A total of six fry were also captured with a mean fork length of 32.7mm (n = 6; SD = 3.3). There were no mortalities.

Table 55. Summary of length, weight and condition factor for bull trout captured at the Nason Creek rotary trap in 2011. * Ages were unknown.

Brood Year	Origin/Stage	Total Catch	Fork Length (mm)			Weight (g)			K-Factor
			Mean	N	SD	Mean	N	SD	
*	Wild Parr	5	142.6	5	22.5	28.6	5	15.7	1.00
2010	Wild Fry	6	32.7	6	3.3	—	—	—	—

3.3 Trap Efficiency Calibration and Population Estimates

3.3.1 Coho (BY2009)

Low catch numbers of coho yearlings (n=14) required the use of hatchery coho surrogates to perform trap efficiency trials (Table 6). We conducted 13 trials with a total of 1,264 hatchery smolt. A linear regression indicated that there was no significant relationship between stream discharge and trap efficiency (r^2 = 0.35, p = 0.05). Therefore, a pooled trap efficiency of 3.7% was used to expand catch numbers and generate an emigration estimate for BY2009 yearlings. In spring of 2011, we estimated that 242 BY2009 (± 25; 95% CI) yearlings emigrated from Nason Creek (Table 7). Previously, in the fall of 2010, we estimated BY2009 subyearling emigration to be 213 (± 9; 95% CI). The estimated total BY2009 juvenile coho emigration from Nason Creek was estimated to be 455 (± 27; 95% CI).

3.3.2 Coho (BY2010)

Low numbers of subyearling coho (n = 3) were not sufficient to conduct trap efficiency trials for wild coho. Therefore, pooled trap efficiencies of 3.4% and 8.2% derived from efficiency trials conducted with subyearling spring Chinook were used to expand catch estimates for subyearling coho. We estimated that 55 (± 26; 95% CI) BY2010 subyearling coho emigrated from Nason Creek in 2011.

Table 56. Trap efficiency trials conducted with BY2009 hatchery coho yearlings in Nason Creek.

Origin/Species	Brood Year	Date	Trap Position	Released	Recaptured	Trap Efficiency	Discharge (cfs)
Hatchery Coho	2009	4/3/2011	Back	41	3	7.3%	847
Hatchery Coho	2009	4/6/2011	Back	114	7	6.1%	576
Hatchery Coho	2009	4/11/2011	Back	105	8	7.6%	433
Hatchery Coho	2009	4/13/2011	Back	114	5	4.4%	374
Hatchery Coho	2009	4/21/2011	Back	82	2	2.4%	298
Hatchery Coho	2009	4/24/2011	Back	110	5	4.5%	324
Hatchery Coho	2009	4/26/2011	Back	100	4	4.0%	336
Hatchery Coho	2009	4/29/2011	Back	100	1	1.0%	312
Hatchery Coho	2009	5/7/2011	Back	100	4	4.0%	490
Hatchery Coho	2009	5/8/2011	Back	100	1	1.0%	490

Hatchery Coho	2009	5/12/2011	Back	99	2	2.0%	1029
Hatchery Coho	2009	5/14/2011	Back	101	2	2.0%	1937
Hatchery Coho	2009	5/30/2011	Back	98	3	3.1%	1170
Pooled				**1,264**	**47**	**3.7%**	

Table 57. Estimated egg-to-emigrant survival percentage and smolts-per-redd for Nason Creek coho salmon.

Brood Year	No. of Redds	Fecundity[a]	Est. Egg Deposition	No. of Emigrants			Egg-to-Emigrant Survival	Emigrants per Redd
				Age-0[b]	Age-1	Total		
2003	6	2,091	12,546	0	120	120	1.0%	20
2004	35	3,084	107,940	224	431	655	0.6%	19
2005	41	2,867	117,547	88	557	645	0.5%	16
2006	4	3,126	12,504	5	0	5	0.0%	1
2007	10	3,223	32,230	7	67	74	0.2%	7
2008	3	2,692	8,076	92	0	92	1.1%	31
2009	14	3,396	47,544	213	242	455	1.0%	33
2010	8	3,113	24,904	55	—	—	—	—

[a] Mean annual fecundity of hatchery origin coho broodstock.
[b] Estimate based on capture of parr collected during summer/fall and does not include fry between March 1 and July 1.

3.3.3 Spring Chinook (BY2009)

We successfully completed two efficiency trials with 62 marked yearling Chinook in 2010 (Table 8). Due to low abundance and high flows, it was not possible to conduct efficiency trials across the full range of river discharge levels at which the trap was operated. A pooled trap efficiency of 6.5% was used to expand catch estimates for yearlings (Table 9). From March 1 to June 30, 2011, we estimated that 2,573 (±446; 95% CI) BY2009 yearling spring Chinook emigrated from Nason Creek. Combined with the previous year's estimate of 33,707 (±3,195; 95% CI) BY2009 subyearlings, we estimated a total emigration of 36,282 (±3,361; 95% CI) BY2009 wild spring Chinook from Nason Creek.

3.3.4 Spring Chinook (BY2010)

We successfully completed eight mark-recapture trials with 447 marked subyearling Chinook in 2011. Despite relatively high numbers of marked fish, it was not possible to conduct trials over the full range of discharge levels at which the trap was operated. Pooled trap efficiencies of 3.4%, 4.7% and 8.2% were used to expand catch estimates for subyearlings. We estimated that 22,780 (±1,127; 95% CI) subyearling spring Chinook emigrated from Nason Creek between July 1 and December 1, 2011.

Table 58. Trap efficiency trials conducted with BY2009 and BY2010 wild spring Chinook juveniles in Nason Creek.

Origin/Species	Brood Year	Date	Trap Position	Released	Recaptured	Trap Efficiency	Discharge (cfs)
Wild Chinook	2009	4/5/2011	Back	30	2	6.7%	660
Wild Chinook	2009	4/9/2011	Back	32	2	6.3%	464

Pooled				**62**	**4**	**6.5%**	
Wild Chinook	2010	7/13/2011	Back	30	1	3.3%	1710
Wild Chinook	2010	8/1/2011	Back	29	1	3.4%	1463
Pooled				**59**	**2**	**3.4%**	
Wild Chinook	2010	8/19/2011	Forward	106	5	4.7%	123
Pooled				**106**	**5**	**4.7%**	
Wild Chinook	2010	10/15/2011	Back	72	6	8.3%	58
Wild Chinook	2010	10/23/2011	Back	50	3	6.0%	54
Wild Chinook	2010	10/27/2011	Back	84	9	10.7%	95
Wild Chinook	2010	10/29/2011	Back	49	3	6.1%	238
Wild Chinook	2010	11/28/2011	Back	27	2	7.4%	—
Pooled				**282**	**23**	**8.2%**	

Table 59. Estimated egg-to-emigrant survival percentage and smolts per redd for Nason Creek spring Chinook salmon.

Brood Year	No. of Redds	Fecundity[a]	Est. Egg Deposition	No. of Emigrants			Egg-to-Emigrant Survival	Emigrants per Redd
				Age-0[b]	Age-1	Total		
2002	294	5,024	1,477,056	DNOT[c]	9,084	9,084	—	—
2003	83	6,191	513,853	7,899	2,096	9,995	1.9%	120
2004	169	4,846	818,974	12,569	3,267	15,836	1.9%	94
2005	193	4,365	842,445	24,348	7,888	32,236	3.8%	167
2006	152	4,773	725,496	5,300	5,279	10,579	1.5%	70
2007	101	4,656	470,256	19,374	3,621	22,995	4.9%	228
2008	336	4,691	1,576,176	41,839	7,812	49,651	3.2%	148
2009	167	4,691	783,397	33,707	2,573	36,280	4.6%	217
2010	187	4,548	850,476	22,780	—	—	—	—

[a] Mean annual fecundity of wild origin spring Chinook hatchery broodstock (Hillman et al. 2011).
[b] Estimate based on capture of parr collected during summer/fall and does not include fry between March 1 and July 1.
[c] Did not operate trap.

3.3.5 Summer Steelhead

Efficiency trials were conducted on eight occasions between March 1 and June 1 with a total of 355 PIT tagged, wild steelhead parr (Table 10). A single efficiency trial was conducted between July 1 and December 1 with 52 marked steelhead parr. A trap efficiency-to-discharge regression model did not yield significant results for spring trials ($r^2 = 0.06$, $p = 0.64$). Therefore, pooled trap efficiencies of 3.7% was used to expand catch estimates for steelhead parr/smolt for the spring. For the fall, an efficiency of 1.9% was used to expand catch numbers. We estimated that 26,771 (± 3,323); 95% CI; Table 11) wild summer steelhead emigrated from Nason Creek between March 1 to December 1, 2011. The majority of migrants were age-1 fish from the 2010 brood (n = 820; 97%). We summed the 2008 brood cohort from previous years (2009-2011) and estimated the entire 2008 brood emigration to be 12,794 (3,576; 95% CI).

Table 60. Trap efficiency trials conducted with wild summer steelhead parr in Nason Creek.

Origin/Species	Stage	Date	Trap	Released	Recaptured	Trap	Discharge

			Position			Efficiency	(cfs)
Wild Steelhead	Parr	4/5/2011	Back	52	1	1.9%	761
Wild Steelhead	Parr	4/9/2011	Back	29	1	3.4%	477
Wild Steelhead	Parr	5/8/2011	Back	35	2	5.7%	492
Wild Steelhead	Parr	5/11/2011	Back	33	3	9.1%	805
Wild Steelhead	Parr	5/13/2011	Back	44	2	4.5%	885
Wild Steelhead	Parr	5/22/2011	Back	84	3	3.6%	1540
Wild Steelhead	Parr	5/30/2011	Back	44	1	2.3%	1080
Wild Steelhead	Parr	6/19/2011	Back	34	1	2.9%	1480
Pooled				**355**	**13**	**3.7%**	
Wild Steelhead	Parr	10/15/2011	Back	52	1	1.9%	127
Pooled				**52**	**1**	**1.9%**	

Table 61. Estimated egg-to-emigrant survival percentage and emigrants per redd for Nason Creek summer steelhead.

Brood Year	No. of Redds	Fecundity[a]	Est. Egg Deposition	Number of Emigrants[b]				Egg-to-Emigrant Survival	Emigrants per Redd
				Age-1	Age-2	Age-3	Total		
2001	27	5,951	160,677	DNOT[c]	DNOT[c]	208	208	—	—
2002	80	5,776	462,080	DNOT[c]	3,200	63	3,263	—	—
2003	121	6,561	793,881	6,726	1,541	0	8,267	1.0%	68
2004	127	5,118	649,986	13,468	1,086	56	14,610	2.2%	115
2005*	412	5,545	2,284,540	9,760	1,167	0	10,927	0.5%	27
2006	77	5,688	437,976	16,362	1,247	101	17,710	4.0%	230
2007	78	5,840	455,520	19,241	1,813	79	21,133	4.6%	271
2008	88	5,693	500,984	11,565	1,229	0	12,794	2.6%	145
2009	126	6,199	781,074	14,873	749	—	15,622	—	—
2010	270	5,458	1,473,660	26,022	—	—	26,022	—	—

[a] Mean annual fecundity of wild origin summer steelhead hatchery broodstock (Hillman et al. 2011).
[b] Estimate based on capture of parr/smolt collected during summer/fall and does not include fry or age-0 parr captured between August 1 and December 1.
[c] Did not operate trap.
***Incomplete data.**

3.4 PIT Tagging

During the 2011 trapping season we PIT tagged 14 wild coho, 1,227 wild spring Chinook, 805 steelhead, and 5 bull trout (Table 12). All tagging files have been submitted to the PTAGIS database. A total of 6 shed PIT tags were recovered in holding boxes where fish had been held for 24 hours after tagging.

Table 62. Number of PIT tagged coho, Chinook, steelhead and bull trout with shed rates at the Nason Creek rotary trap in 2011.

Species	Year-to-date Catch	Year-to-date PIT Tagged	No. of Shed Tags	Percent Shed Tags
Coho Yearling	14	13	0	0.0%

Coho Subyearling	3	1	0	0.0%
Chinook Yearling	152	147	1	0.6%
Chinook Subyearling	1,075	822	3	0.4%
Steelhead Parr	1,192	801	2	0.2%
Steelhead Smolt	4	4	0	0.0%
Bull Trout Parr	5	5	0	0.0%

3.5 Incidental Species.

Along with wild coho, spring Chinook, and wild steelhead/rainbow trout, other fish species that typically make up a portion of the incidental catch at the Nason Creek rotary trap include: bull trout (*Salvelinus confluentus*; Table 13), cutthroat trout (*Oncorhynchus clarkii*), longnose dace (*Rhinichthys sp.*), northern pikeminnow (*Ptychocheilus oregonensis*), redside shiner (*Richardsonius balteatus*), sculpin (*Cottus sp.*), sucker (*Catostomus sp.*), and mountain whitefish (*Prosopium williamsoni*).

Table 63. Summary of length and weight sampling of incidental species captured at the Nason Creek rotary trap in 2011.

Species	Total Count	Length (mm)			Weight (g)		
		Mean	N	SD	Mean	N	SD
Cutthroat Trout	0	—	—	—	—	—	—
Longnose Dace	41	98.6	41	21.1	13.9	41	6.8
Northern Pikeminnow	2	260.0	2	—	259.1	2	—
Redside Shiner	5	70.4	5	4.6	4.6	5	1.2
Sculpin	36	107.9	36	37.5	25.6	36	21.7
Sucker	56	96.6	53	28.0	14.2	53	11.4
Whitefish Parr	6	253.8	6	35.0	159.0	6	52.3
Whitefish Fry	45	59.5	45	2.3	2.3	45	0.3

3.6 ESA Compliance

The Nason Creek smolt trap is operated under consultation with NMFS and USFWS. Total numbers of UCR spring Chinook and UCR summer steelhead that were captured or handled at the trap was less than the permitted level of 20% of each species (Table 12). Lethal take for each species remained below 2% for the entire season. Stream temperatures remained below 18°C for the entire trapping season and did not affect ESA fish handling protocols.

Table 64. Summary of ESA species mortality at the Nason Creek rotary trap in 2011.

Species/Stage/Brood Year	Total Collected	Total Mortality	% Mortality
Spring Chinook Yearling (BY2008)	152	0	0.0
Spring Chinook Fry (BY2009)	292	3	1.0
Spring Chinook Subyearling (BY2009)	1,075	8	0.1
Total Spring Chinook	**1,519**	**11**	**0.7**
Steelhead Smolt	4	0	0.0

Steelhead Fry	1,295	3	0.2
Steelhead Parr	1,092	11	0.4
Hatchery Steelhead Smolt	1,076	0	0.9
Total Summer Steelhead	**3,467**	**14**	**0.4**
Bull Trout Fry	6	0	0.0
Bull Trout Parr	5	0	0.0
Total Bull Trout	**11**	**0**	**0.0**

4.0 DISCUSSION

High river discharge and low juvenile abundance limited trap operation as well as the ability to conduct an adequate number of efficiency trials over the full range of river conditions in 2011. Catch numbers for yearling spring Chinook and summer steelhead smolts were the lowest on annual record for the Nason Creek trap. In part, this may have been influenced by several high flow events (December 13, 2010, January 16 and March 31, 2011). Such high flow events may have caused juvenile emigrants to move downstream of the trap before resuming operation on March 1. Due to the low numbers of yearling coho and spring Chinook, the number and size of efficiency trials was quite limited during spring. Thus, hatchery coho were used as surrogates in efficiency trials. Although this practice can increase sample size and frequency of trials, further examination into the differences in size and behavior between hatchery and wild smolts is warranted. In 2012, paired efficiency trials will be conducted with three release groups; 1) hatchery coho + wild Chinook, 2) hatchery steelhead + wild steelhead, and 3) hatchery coho + hatchery steelhead, in order to draw comparisons between groups and to better understand the ramifications of using hatchery surrogates (when adequate numbers of wild fish cannot be obtained).

Despite challenging environmental conditions and low abundance of wild juvenile emigrants between April 1 and June 1, thirteen trap efficiency trials were conducted over a range of flow levels (298 - 1938cfs) with ~100 hatchery coho smolts per trial. Results indicated that there was not a statistical relationship between trap efficiency and stream discharge ($r^2 = 0.03$, $p = 0.5$). Although hatchery coho used in the trials were visually observed to be smolts, these fish were not tested for their willingness to migrate downstream and it is possible that not all the fish used in trials were physiologically prepared to emigrate (i.e. smolts). In 2012, only fish that demonstrate negative rheotaxis (oriented and moving in the same direction as flow) and present visual evidence of smoltification (no parr marks, "chrome" scales) will be included in efficiency trials.

Pooling a series of trap efficiency trials increases overall sample sizes and improves statistical validity. Although this may not reflect precise downstream movement of a population, it can be a good alternative to trap efficiency-discharge regression models when fish abundance is limited, sample sizes are small, and a lack of correlation is determined. However, applying pooled trap efficiency trials to estimate passage assumes that there is a constant rate of emigration for a given time period. This is an unavoidable bias associated with this method of estimation that cannot entirely address the dynamic nature of fish emigration and fluctuating stream discharges.

Coho

A low abundance of adult coho spawners and the resulting lack of juveniles in Nason Creek currently limit an accurate assessment of the coho population. The low abundance of coho is a direct effect of YN's emphasis in collecting broodstock at Tumwater Dam as part of a phased approach to coho reintroduction program in the Wenatchee Basin. With a shift in emphasis to local adaption during the future Natural Production Phases of the restoration (YN FRM 2010), we expect to see an increase in juvenile abundance and the subsequent opportunity to more accurately assess survival and productivity within this population. For now, estimates appear to be low given the observed escapement of adult spawners and that snorkel observations throughout Nason Creek have yielded consistent sightings of juvenile coho. As would be expected, low abundance exacerbated by low trap efficiencies yielded an egg-to-emigrant survival estimate for coho (1.0%) that was lower than those observed for spring Chinook (4.6%) and summer steelhead (2.6%) in Nason Creek.

Spring Chinook
Survival and productivity of BY2009 spring Chinook in Nason Creek (4.6%; 217 emigrants) appeared to be relatively high when compared to those from the White River (2.8%; 118 emigrants), but remained consistent within the Nason watershed for the past several years. Consistent with most brood years, the majority of BY2009 emigrants were captured in the fall of 2010 as subyearling emigrants. Although this trend persists across years, the number of fish leaving Nason Creek during the winter months when the trap is not operated (December – February) remains unknown and is not accounted for in our emigration estimate.

Summer Steelhead
Knowledge about the age composition of Nason Creek summer steelhead is vital to sound management of this population. It is known that in a single year of trapping, multiple age classes are captured as they move downstream or emigrate from the watershed. Recently, sufficient data from age-verified juvenile steelhead exists and methods have been established to estimate ages for all juvenile steelhead captured at the trap.

Length–frequency distribution (histogram) has been used to determine the ages of juvenile steelhead within the Wenatchee subbasin. However, this method assumes that the lengths of each age class are normally distributed, and that there are adequate samples to represent the population. Although the majority of annual datasets collected from Nason Creek were normally distributed, sample sizes were often small and a large amount of overlap among the age classes led to a lack of precision and consistency in age estimation. Therefore, age-scale data collected from 2004-2010 was combined and subsequently split into two groups according to the season that the fish were sampled.

All fish captured from March 1 - July 31 were grouped into a *spring* dataset. Fish that were captured from August1 to November 31 were grouped into a *fall* dataset. The reason for this is that August 1 typically marks the onset of young-of-the-year fry captures at the trap; since these fish are known to be age-0 until January 1 of the following year (the birthday of all anadromous stocks), this method of 'splitting' allowed us to refine each dataset by age, capture date, and length. A linear regression was used to determine if there was a relationship between age (dependent variable) and length (independent variable) within each dataset.

For both datasets, a strong relationship between variables was confirmed (spring, $r^2 = 0.59$; $p < 0.01$; fall, $r^2 = 0.79$; $p < 0.01$) and we proceeded to test the accuracy of age estimation using the slope equation from each regression (spring, $y = 0.0127x – 0.1042$; fall, $y = 0.0141x – 0.8607$); where x equals the fork length. Solving for y, the resulting value was rounded to the nearest whole number to provide an age estimate for each fish. For age-0 to age-2 juvenile steelhead, this method proved to be more reliable in estimating the age of fish than the traditional method of using a length-frequency histogram (Table 15). However, both methods failed to accurately predict age-3 fish primarily due to low sample size (n = 18) and substantial overlap in fork lengths among age-2 and age-3 fish. Ultimately, length-frequency histograms and capture dates were used to estimate age-3 steelhead. As additional data from age-3 fish are collected, age estimation for this class using linear regression will likely improve. After testing the slope formula for each dataset for reliability, we applied the appropriate formula to all archived steelhead data. All fish were subsequently aged and assigned to a brood year.

Table 65. Actual and estimated fork lengths of wild summer steelhead using length-frequency histogram and linear regression methods.

Steelhead Age Class	Actual Mean FL (mm)	*N*	Predicted Range of FL (mm)			Accuracy of Prediction		
			Histogram	Spring (Linear)	Fall (Linear)	Histogram	Spring (Linear)	Fall (Linear)
Age 0	69	96	≤ 79	≤ 47	≤ 96	24%	*	100%
Age 1	97	1,712	80 -125	48 -126	97 - 167	95%	98%	95%
Age 2	144	315	126 -160	127- 205	168 - 238	54%	75%	61%
Age 3	171	18	≥ 161	≥ 206	≥ 239	13%	0%	**

* No data collected for Age-0 steelhead captured in spring.
** No data collected for Age-3 steelhead captured in fall.

Following the process of age estimation, we began to generate emigration estimates for each age class within the brood years. Since no statistical relationships existed between stream discharge and trap efficiency for any of the years' juvenile steelhead were captured, efficiency trials were pooled either as spring or fall within a given year. Pooled efficiency trials were then used to expand daily catch numbers and generate annual emigration estimates for juvenile steelhead (See Table 11; pg.18).

For BY2008 steelhead, estimates of egg-to-emigrant survival (2.6%) and emigrants per redd (145) appeared to be relatively consistent with estimates for past brood years in Nason Creek. For complete brood years, it appeared that the majority of fish (mean = 94.3%) were captured within the first year of life, either as age-0 fry in the fall, or as age-1 parr the following spring. Age-2 fish represented only about 5.5% of each brood; age-3 represented less than 0.2%. As previously noted with regards to spring Chinook, downstream movement of steelhead during the winter months when the trap is not operated remains unknown and is not account for.

5.0 LITERATURE CITED

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APPENDIX A: Stream Discharge & Temperature Data

Date	Daily Discharge (cfs)	Daily Stream Temp. (°C)
1/1/2011	74	0.0
1/2/2011	86	0.0
1/3/2011	119	0.0
1/4/2011	233	0.0
1/5/2011	361	0.0
1/6/2011	401	0.0
1/7/2011	283	0.0
1/8/2011	179	0.1
1/9/2011	106	0.0
1/10/2011	110	0.0
1/11/2011	155	0.0
1/12/2011	163	0.0
1/13/2011	219	0.0
1/14/2011	410	0.0
1/15/2011	576	0.1
1/16/2011		0.5
1/17/2011		1.2
1/18/2011	2030	2.3
1/19/2011	1290	1.9
1/20/2011	984	2.2
1/21/2011	973	3.0
1/22/2011	954	2.9
1/23/2011	742	3.1
1/24/2011	692	3.3
1/25/2011	775	3.4
1/26/2011	663	3.2
1/27/2011	596	2.9
1/28/2011	565	2.8
1/29/2011	600	3.3
1/30/2011	572	3.0
1/31/2011	487	1.6
2/1/2011	425	0.3
2/2/2011	406	0.2
2/3/2011	383	1.1
2/4/2011	580	2.3
2/5/2011	734	2.7
2/6/2011	572	2.5
2/7/2011	582	2.9
2/8/2011	503	
2/9/2011	452	2.0
2/10/2011	419	1.8
2/11/2011	400	2.5
2/12/2011	414	3.3
2/13/2011	439	3.2
2/14/2011	404	3.2
2/15/2011	391	2.9
2/16/2011	364	2.5
2/17/2011	336	2.0
2/18/2011	312	1.8
2/19/2011	295	1.4
2/20/2011	276	0.8
2/21/2011	268	1.2
2/22/2011	264	1.7
2/23/2011	253	0.8
2/24/2011	238	0.5
2/25/2011	217	0.0
2/26/2011	226	0.1
2/27/2011	234	0.0
2/28/2011	249	0.0
3/1/2011	226	0.1
3/2/2011	199	0.5
3/3/2011	185	1.5
3/4/2011	176	1.1
3/5/2011	171	1.8
3/6/2011	165	1.9
3/7/2011	159	2.2
3/8/2011	156	1.9
3/9/2011	155	1.5
3/10/2011	171	1.9
3/11/2011	178	2.3
3/12/2011	161	2.6
3/13/2011	159	2.2
3/14/2011	168	2.6
3/15/2011	179	3.0
3/16/2011	185	3.3
3/17/2011	178	3.3
3/18/2011	176	3.0
3/19/2011	196	3.0
3/20/2011	187	2.9
3/21/2011	185	3.9
3/22/2011	186	4.0
3/23/2011	181	3.4

3/24/2011	182	3.9	5/6/2011	427	6.4
3/25/2011	206	4.1	5/7/2011	467	6.4
3/26/2011	215	3.9	5/8/2011	492	6.6
3/27/2011	214	4.2	5/9/2011	511	7.1
3/28/2011	217	4.9	5/10/2011	577	7.5
3/29/2011	236	4.4	5/11/2011	805	6.4
3/30/2011	609	3.7	5/12/2011	951	5.8
3/31/2011	1930	2.9	5/13/2011	885	5.9
4/1/2011	1680	2.9	5/14/2011	1250	5.3
4/2/2011	1410	3.5	5/15/2011	2420	4.0
4/3/2011	966	3.7	5/16/2011	2140	4.1
4/4/2011	815	3.3	5/17/2011	1550	5.2
4/5/2011	761	3.5	5/18/2011	1330	5.8
4/6/2011	654	3.9	5/19/2011	1310	6.3
4/7/2011	565	3.7	5/20/2011	1390	6.3
4/8/2011	508	4.3	5/21/2011	1550	5.4
4/9/2011	477	4.6	5/22/2011	1540	5.8
4/10/2011	452	4.6	5/23/2011	1430	5.5
4/11/2011	463	5.1	5/24/2011	1270	6.2
4/12/2011	430	4.6	5/25/2011	1290	5.2
4/13/2011	405	4.5	5/26/2011	1360	5.4
4/14/2011	385	4.1	5/27/2011	1190	5.6
4/15/2011	368	3.7	5/28/2011	1080	5.9
4/16/2011	369	5.5	5/29/2011	1050	6.5
4/17/2011	382	4.9	5/30/2011	1080	6.1
4/18/2011	349	4.4	5/31/2011	1210	5.5
4/19/2011	329	4.8	6/1/2011	1240	5.7
4/20/2011	317	4.5	6/2/2011	1210	6.4
4/21/2011	305	5.1	6/3/2011	1280	6.7
4/22/2011	293	5.2	6/4/2011	1420	6.8
4/23/2011	297	5.8	6/5/2011	1610	6.0
4/24/2011	311	5.2	6/6/2011	1860	6.8
4/25/2011	321	4.9	6/7/2011	2200	6.3
4/26/2011	341	5.9	6/8/2011	1950	5.8
4/27/2011	336	5.7	6/9/2011	1720	6.8
4/28/2011	331	5.8	6/10/2011	1830	7.0
4/29/2011	316	5.7	6/11/2011	1840	6.8
4/30/2011	307	6.3	6/12/2011	1750	6.6
5/1/2011	312	6.6	6/13/2011	1760	7.0
5/2/2011	344	5.7	6/14/2011	1750	6.6
5/3/2011	348	6.4	6/15/2011	1620	6.5
5/4/2011	347	6.6	6/16/2011	1420	6.4
5/5/2011	387	6.7	6/17/2011	1300	7.3

6/18/2011	1440	7.0	7/31/2011	439	12.4
6/19/2011	1480	7.2	8/1/2011	401	11.7
6/20/2011	1510	7.5	8/2/2011	357	11.8
6/21/2011	1590	7.7	8/3/2011	327	12.5
6/22/2011	1770	7.5	8/4/2011	315	13.0
6/23/2011	1890	7.1	8/5/2011	306	13.6
6/24/2011	1590	6.9	8/6/2011	294	13.5
6/25/2011	1390	6.8	8/7/2011	272	13.5
6/26/2011	1230	7.4	8/8/2011	250	13.5
6/27/2011	1320	7.5	8/9/2011	230	13.4
6/28/2011	1520	7.7	8/10/2011	213	13.1
6/29/2011	1760	7.7	8/11/2011	200	13.2
6/30/2011	1820	6.9	8/12/2011	191	13.6
7/1/2011	1470	7.5	8/13/2011	179	13.9
7/2/2011	1400	8.3	8/14/2011	167	13.5
7/3/2011	1520	8.3	8/15/2011	158	13.3
7/4/2011	1390	7.9	8/16/2011	150	12.6
7/5/2011	1320	8.8	8/17/2011	140	12.9
7/6/2011	1450	9.2	8/18/2011	133	13.3
7/7/2011	1570	9.0	8/19/2011	128	13.7
7/8/2011	1450	7.7	8/20/2011	123	14.2
7/9/2011	1080	7.9	8/21/2011	119	14.2
7/10/2011	926	8.4	8/22/2011	115	14.5
7/11/2011	896	8.9	8/23/2011	120	15.2
7/12/2011	933	8.6	8/24/2011	117	15.4
7/13/2011	872	9.1	8/25/2011	109	15.9
7/14/2011	839	8.2	8/26/2011	104	15.8
7/15/2011	812	8.7	8/27/2011	98	15.7
7/16/2011	855	8.4	8/28/2011	94	15.3
7/17/2011	822	8.7	8/29/2011	90	15.5
7/18/2011	818	9.4	8/30/2011	88	14.8
7/19/2011	792	9.1	8/31/2011	85	13.8
7/20/2011	757	9.7	9/1/2011	84	12.7
7/21/2011	725	9.8	9/2/2011	80	13.5
7/22/2011	701	9.5	9/3/2011	77	13.2
7/23/2011	604	9.7	9/4/2011	75	12.6
7/24/2011	588	10.6	9/5/2011	72	13.0
7/25/2011	632	10.2	9/6/2011	69	13.8
7/26/2011	589	10.6	9/7/2011	67	13.8
7/27/2011	549	10.8	9/8/2011	66	13.7
7/28/2011	491	10.9	9/9/2011	65	14.1
7/29/2011	490	12.1	9/10/2011	63	14.7
7/30/2011	472	11.9	9/11/2011	62	14.6

9/12/2011	60	14.7
9/13/2011	59	14.8
9/14/2011	58	14.0
9/15/2011	57	13.3
9/16/2011	59	12.3
9/17/2011	58	11.4
9/18/2011	59	11.9
9/19/2011	64	12.7
9/20/2011	61	12.1
9/21/2011	57	11.7
9/22/2011	56	11.9
9/23/2011	55	13.5
9/24/2011	53	13.4
9/25/2011	53	13.4
9/26/2011	61	10.8
9/27/2011	120	10.3
9/28/2011	91	10.1
9/29/2011	74	9.4
9/30/2011	66	9.6
10/1/2011	63	10.0
10/2/2011	65	10.0
10/3/2011	70	10.3
10/4/2011	74	10.0
10/5/2011	80	9.4
10/6/2011	86	9.2
10/7/2011	77	9.4
10/8/2011	79	8.5
10/9/2011	71	8.8
10/10/2011	71	9.1
10/11/2011	228	8.7
10/12/2011	391	7.3
10/13/2011	182	7.2
10/14/2011	141	7.0
10/15/2011	127	7.2
10/16/2011	114	6.7
10/17/2011	105	6.5
10/18/2011	98	6.1
10/19/2011	94	6.7
10/20/2011	92	7.8
10/21/2011	93	7.5
10/22/2011	200	8.1
10/23/2011	300	7.9
10/24/2011	199	6.7
10/25/2011	168	5.1
10/26/2011	144	4.0
10/27/2011	136	4.5
10/28/2011	130	4.2
10/29/2011	236	4.8
10/30/2011	193	4.8
10/31/2011	286	5.3
11/1/2011	209	4.0
11/2/2011	181	3.1
11/3/2011	167	3.3
11/4/2011	153	2.6
11/5/2011	141	2.2
11/6/2011	128	1.4
11/7/2011	126	1.7
11/8/2011	122	2.7
11/9/2011	117	3.3
11/10/2011	112	2.9
11/11/2011	111	2.3
11/12/2011	114	2.5
11/13/2011	120	3.3
11/14/2011	132	3.4
11/15/2011	115	2.3
11/16/2011	105	0.8
11/17/2011	109	0.4
11/18/2011	107	1.1
11/19/2011	99	0.2
11/20/2011	104	0.2
11/21/2011	92	0.7
11/22/2011		
11/23/2011		
11/24/2011	155	0.8
11/25/2011		
11/26/2011		
11/27/2011		
11/28/2011		
11/29/2011		
11/30/2011		
12/1/2011		

APPENDIX B: Trap Operations

Date	Trap Status
3/1/2011	Operating
3/2/2011	Operating
3/3/2011	Operating
3/4/2011	Operating
3/5/2011	Operating
3/6/2011	Operating
3/7/2011	Operating
3/8/2011	Operating
3/9/2011	Operating
3/10/2011	Operating
3/11/2011	Operating
3/12/2011	Operating
3/13/2011	Operating
3/14/2011	Operating
3/15/2011	Operating
3/16/2011	Operating
3/17/2011	Operating
3/18/2011	Operating
3/19/2011	Operating
3/20/2011	Operating
3/21/2011	Operating
3/22/2011	Operating
3/23/2011	Operating
3/24/2011	Operating
3/25/2011	Operating
3/26/2011	Operating
3/27/2011	Operating
3/28/2011	Operating
3/29/2011	Operating
3/30/2011	Operating
3/31/2011	Pulled
4/1/2011	Pulled
4/2/2011	Operating
4/3/2011	Operating
4/4/2011	Operating
4/5/2011	Operating
4/6/2011	Operating
4/7/2011	Operating
4/8/2011	Operating
4/9/2011	Operating
4/10/2011	Operating
4/11/2011	Operating
4/12/2011	Operating
4/13/2011	Operating
4/14/2011	Operating
4/15/2011	Operating
4/16/2011	Operating
4/17/2011	Operating
4/18/2011	Operating
4/19/2011	Operating
4/20/2011	Operating
4/21/2011	Operating
4/22/2011	Operating
4/23/2011	Operating
4/24/2011	Operating
4/25/2011	Operating
4/26/2011	Operating
4/27/2011	Operating
4/28/2011	Operating
4/29/2011	Operating
4/30/2011	Operating
5/1/2011	Operating
5/2/2011	Operating
5/3/2011	Pulled
5/4/2011	Pulled
5/5/2011	Operating
5/6/2011	Operating
5/7/2011	Operating
5/8/2011	Operating
5/9/2011	Operating
5/10/2011	Operating
5/11/2011	Operating
5/12/2011	Operating
5/13/2011	Operating
5/14/2011	Operating
5/15/2011	Operating
5/16/2011	Pulled
5/17/2011	Pulled
5/18/2011	Operating
5/19/2011	Operating
5/20/2011	Operating
5/21/2011	Operating
5/22/2011	Operating
5/23/2011	Operating
5/24/2011	Pulled

5/25/2011	Operating	7/7/2011	Operating
5/26/2011	Operating	7/8/2011	Operating
5/27/2011	Operating	7/9/2011	Operating
5/28/2011	Operating	7/10/2011	Operating
5/29/2011	Operating	7/11/2011	Operating
5/30/2011	Operating	7/12/2011	Operating
5/31/2011	Operating	7/13/2011	Operating
6/1/2011	Stopped	7/14/2011	Operating
6/2/2011	Operating	7/15/2011	Operating
6/3/2011	Operating	7/16/2011	Operating
6/4/2011	Operating	7/17/2011	Operating
6/5/2011	Operating	7/18/2011	Operating
6/6/2011	Operating	7/19/2011	Operating
6/7/2011	Pulled	7/20/2011	Operating
6/8/2011	Pulled	7/21/2011	Operating
6/9/2011	Pulled	7/22/2011	Operating
6/10/2011	Pulled	7/23/2011	Operating
6/11/2011	Pulled	7/24/2011	Operating
6/12/2011	Pulled	7/25/2011	Operating
6/13/2011	Operating	7/26/2011	Operating
6/14/2011	Pulled	7/27/2011	Operating
6/15/2011	Operating	7/28/2011	Operating
6/16/2011	Operating	7/29/2011	Operating
6/17/2011	Operating	7/30/2011	Operating
6/18/2011	Operating	7/31/2011	Operating
6/19/2011	Operating	8/1/2011	Operating
6/20/2011	Operating	8/2/2011	Operating
6/21/2011	Operating	8/3/2011	Operating
6/22/2011	Operating	8/4/2011	Operating
6/23/2011	Pulled	8/5/2011	Operating
6/24/2011	Pulled	8/6/2011	Stopped
6/25/2011	Operating	8/7/2011	Operating
6/26/2011	Operating	8/8/2011	Operating
6/27/2011	Operating	8/9/2011	Operating
6/28/2011	Operating	8/10/2011	Operating
6/29/2011	Operating	8/11/2011	Operating
6/30/2011	Operating	8/12/2011	Operating
7/1/2011	Pulled	8/13/2011	Operating
7/2/2011	Pulled	8/14/2011	Operating
7/3/2011	Operating	8/15/2011	Operating
7/4/2011	Pulled	8/16/2011	Operating
7/5/2011	Pulled	8/17/2011	Operating
7/6/2011	Operating	8/18/2011	Operating

8/19/2011	Operating	10/1/2011	Operating
8/20/2011	Operating	10/2/2011	Operating
8/21/2011	Operating	10/3/2011	Operating
8/22/2011	Operating	10/4/2011	Operating
8/23/2011	Operating	10/5/2011	Operating
8/24/2011	Operating	10/6/2011	Operating
8/25/2011	Operating	10/7/2011	Operating
8/26/2011	Operating	10/8/2011	Operating
8/27/2011	Operating	10/9/2011	Stopped
8/28/2011	Operating	10/10/2011	Operating
8/29/2011	Operating	10/11/2011	Operating
8/30/2011	Operating	10/12/2011	Operating
8/31/2011	Operating	10/13/2011	Operating
9/1/2011	Operating	10/14/2011	Operating
9/2/2011	Operating	10/15/2011	Operating
9/3/2011	Operating	10/16/2011	Operating
9/4/2011	Pulled	10/17/2011	Operating
9/5/2011	Pulled	10/18/2011	Operating
9/6/2011	Pulled	10/19/2011	Operating
9/7/2011	Operating	10/20/2011	Operating
9/8/2011	Operating	10/21/2011	Operating
9/9/2011	Operating	10/22/2011	Operating
9/10/2011	Operating	10/23/2011	Operating
9/11/2011	Operating	10/24/2011	Operating
9/12/2011	Pulled	10/25/2011	Operating
9/13/2011	Pulled	10/26/2011	Operating
9/14/2011	Operating	10/27/2011	Operating
9/15/2011	Operating	10/28/2011	Operating
9/16/2011	Operating	10/29/2011	Operating
9/17/2011	Operating	10/30/2011	Operating
9/18/2011	Operating	10/31/2011	Operating
9/19/2011	Operating	11/1/2011	Operating
9/20/2011	Operating	11/2/2011	Operating
9/21/2011	Operating	11/3/2011	Operating
9/22/2011	Operating	11/4/2011	Operating
9/23/2011	Operating	11/5/2011	Operating
9/24/2011	Operating	11/6/2011	Operating
9/25/2011	Stopped	11/7/2011	Operating
9/26/2011	Operating	11/8/2011	Operating
9/27/2011	Operating	11/9/2011	Operating
9/28/2011	Operating	11/10/2011	Operating
9/29/2011	Operating	11/11/2011	Operating
9/30/2011	Operating	11/12/2011	Operating

11/13/2011	Operating
11/14/2011	Operating
11/15/2011	Operating
11/16/2011	Operating
11/17/2011	Stopped
11/18/2011	Operating
11/19/2011	Stopped
11/20/2011	Stopped
11/21/2011	Pulled
11/22/2011	Pulled
11/23/2011	Pulled
11/24/2011	Pulled
11/25/2011	Pulled
11/26/2011	Operating
11/27/2011	Operating
11/28/2011	Operating
11/29/2011	Operating
11/30/2011	Operating
12/1/2011	Operating

APPENDIX C: SPAWNING GROUND SURVEY RECORDS FOR THE WENATCHEE AND METHOW RIVERS, 2010

APPENDIX C: Spawning ground survey records for the Wenatchee and Methow rivers in 2010

Stream	Reach	Date	New Redds	Live Fish	Dead Fish
Beaver	Mouth to Pond	10/9/2010	0	0	0
		10/16/2010	0	0	0
		10/23/2010	0	0	0
		10/30/2010	0	0	0
		11/13/2010	0	0	0
		11/16/2010	0	0	0
		11/20/2010	0	0	0
		11/27/2010	0	0	0
		Total	**0**	**0**	**0**
Chumstick	Mouth to North River Road	11/5/2010	0	0	0
			0	0	0
Icicle	1-Mouth to Hatchery Pool	10/6/2010	0	4	1
		10/12/2010	0	19	1
		10/19/2010	1	132	2
		10/26/2010	25	88	8
		11/2/2010	0	1	3
		11/9/2010	18	57	1
		11/16/2010	13	42	2
		11/23/2010	4	5	5
		12/8/2010	2	10	14
		Total	**63**	**358**	**37**
	2-Hatchery Pool to Headgate	10/6/2010	0	1	0
		10/12/2010	0	7	0
		10/19/2010	4	88	3
		10/26/2010	22	85	3
		11/2/2010	0	4	0
		11/9/2010	5	51	2
		11/16/2010	0	3	0
		11/23/2010	6	5	5
		12/8/2010	0	30	1
		Total	**37**	**274**	**14**
Mission/Brender	Mouth to Vale Elementary	10/2/2010	0	0	0
		10/9/2010	0	0	0
		10/16/2010	0	0	0
		10/23/2010	2	2	1
		10/30/2010	4	5	1
		11/6/2010	4	10	0

		11/13/2010	5	12	1
		11/20/2010	4	9	1
		11/27/2010	0	0	0
		12/6/2010	1	1	0
		Total	**20**	**39**	**4**
Nason	1-Mouth to Kahler Bridge	10/4/2010	0	0	0
		10/13/2010	0	0	0
		10/20/2010	0	1	0
		10/27/2010	3	2	0
		11/5/2010	2	0	0
		11/10/2010	0	0	0
		11/22/2010	1	0	0
		Total	**6**	**3**	**0**
	2- Kahler Bridge to Butcher Pond	10/4/2010	0	0	0
		10/13/2010	0	1	0
		10/20/2010	0	0	0
		10/27/2010	0	0	0
		11/5/2010	0	0	0
		11/10/2010	0	0	0
		11/22/2010	0	0	0
		Total	**0**	**1**	**0**
	3- Butcher Pond to Rayrock	10/4/2010	0	0	0
		10/13/2010	0	0	0
		10/20/2010	0	1	0
		10/27/2010	0	0	0
		11/10/2010	2	2	0
		11/22/2010	0	1	0
		Total	**2**	**4**	**0**
	4- Rayrock to Whitepine Creek	10/4/2010	0	0	0
		10/13/2010	0	0	0
		11/10/2010	0	0	0
		Total	**0**	**0**	**0**
Peshastin	1- Mouth to YN office	10/3/2010	0	0	0
		10/10/2010	0	0	0
		10/17/2010	0	1	0
		10/24/2010	2	3	0
		10/31/2010	1	3	1
		11/7/2010	3	8	0
		11/14/2010	1	3	3
		11/21/2010	1	3	2
		Total	**8**	**21**	**6**

	2- YN office to Mountain Home Rd.	10/3/2010	0	0	0
		10/10/2010	0	0	0
		10/17/2010	0	0	0
		10/24/2010	0	0	0
		10/31/2010	3	3	0
		11/7/2010	2	2	0
		11/14/2010	2	6	0
		11/21/2010	0	0	2
		Total	**7**	**11**	**2**
	3- Mountain Home Rd. to Valley Hi Bridge	10/17/2010	0	0	0
		10/24/2010	0	0	0
		10/31/2010	0	0	0
		11/7/2010	0	0	0
		11/14/2010	0	0	0
		Total	**0**	**0**	**0**
Wenatchee River	1- Mouth to Cashmere	10/8/2010	0	0	0
		10/14/2010	0	1	0
		10/21/2010	2	2	1
		10/28/2010	5	8	1
		11/3/2010	0	0	0
		11/12/2010	4	1	0
		11/17/2010	4	3	1
		12/7/2010	3	1	1
		Total	**18**	**16**	**4**
	2- Cashmere to Dryden Dam	10/8/2010	0	0	0
		10/15/2010	0	1	0
		10/22/2010	0	0	0
		10/29/2010	0	0	0
		11/4/2010	0	1	0
		11/12/2010	2	2	1
		11/19/2010	0	0	0
		Total	**2**	**4**	**1**
	3- Dryden Dam to Leavenworth Boat Launch	10/8/2010	0	3	0
		10/15/2010	0	2	0
		10/24/2010	0	2	0
		10/29/2010	0	1	4
		11/4/2010	0	0	0
		11/18/2010	0	1	0
		11/18/2010	0	0	1
		11/18/2010	0	1	0
		Total	**0**	**10**	**5**

	4- Leavenworth boat launch to Icicle Rd. Br.	10/6/2010	0	16	0
		10/12/2010	0	6	0
		10/19/2010	3	23	0
		10/26/2010	5	10	0
		11/2/2010	0	4	0
		11/9/2010	2	5	0
		11/16/2010	11	20	1
		11/23/2010	12	0	0
		12/3/2010	13	6	1
		12/8/2010	4	4	0
		Total	**50**	**94**	**2**
	5- Icicle Rd. Br. To Chiwaukum Cr.	10/6/2010	0	0	0
		11/27/2010	0	0	0
		Total	**0**	**0**	**0**
	6- Chiwaukum Creek to Plain	10/5/2010	0	0	0
		10/18/2010	0	2	0
		10/25/2010	0	0	0
		11/1/2010	1	0	1
		11/8/2010	0	0	0
		11/15/2010	0	1	0
		Total	**1**	**3**	**1**
	7-Plain to Lake Wenatchee	10/5/2010	0	0	0
		10/18/2010	0	2	0
		10/25/2010	5	5	4
		11/1/2010	0	1	0
		11/15/2010	0	0	0
		Total	**5**	**8**	**4**

Stream	Reach and Description	Surveyors	Date	New Redds	Live Fish	Dead Fish
Methow	1 - Mouth to Steel Bridge	KM AC BM	10/12/2010	0	0	0
		SD BM	10/19/2010	0	0	0
		SD BM	10/26/2010	0	0	0
		SD DR	11/2/2010	0	0	0
		SD DR	11/8/2010	0	0	0
		SD DR	11/22/2010	0	0	0
	Methow 1 Total			**0**	**0**	**0**
	2 - Steel Bridge to Lower Burma Bridge	SD BM	10/19/2010	0	0	0
		SD BM	10/26/2010	2	2	0
		SD DR	11/2/2010	3	21	0
		SD DR	11/8/2010	6	8	0

		SD DR	11/17/2010	0	1	0
		SD DR	11/22/2010	0	0	0
	Methow 2 Total			**11**	**32**	**0**
	3 - Lower Burma Bridge to Upper Burma Bridge	KM BM	10/13/2010	0	0	0
		AC JH DR	10/19/2010	0	0	0
		AC JH DR	10/26/2010	5	20	0
		AC JH DR	11/2/2010	12	44	0
		KM AC BM	11/9/2010	3	2	0
		JH AC BM	11/17/2010	2	2	0
		JH AC BM	11/22/2010	0	0	0
		JH AC	12/7/2010	0	0	1
		DR BM	12/13/2010	0	0	2
	Methow 3 Total			**22**	**68**	**3**
	4 - Upper Burma Bridge to Lower Gold Creek Bridge	JH AC BM	10/13/2010	0	0	0
		JH AC DR	10/19/2010	0	0	0
		JH AC DR	10/26/2010	5	8	0
		JH AC	11/2/2010	7	24	0
		KM AC JH	11/9/2010	2	7	4
		JH AC	11/16/2010	0	0	1
		JH AC	11/22/2010	0	0	0
		BM DR	12/7/2010	0	0	2
	Methow 4 Total			**14**	**39**	**7**
	5 - Lower Gold Creek Bridge to Carlton	KM AC BM	10/6/2010	0	0	0
		KM BM	10/14/2010	0	0	0
		RA BM JH	10/20/2010	0	0	0
		JH AC	10/27/2010	2	3	0
		JH AC RA	11/3/2010	1	0	0
		JH AC	11/8/2010	2	1	1
		JH AC	1/16/2010	2	7	0
		JH BM	11/22/2010	0	0	0
		BM DR	12/7/2010	0	0	0
	Methow 5 Total			**7**	**11**	**1**
	6 - Carlton to Holterman's Hole	KM AC BM	10/6/2010	0	0	0
		BM AC	10/14/2010	0	0	0
		AC SD DR	10/20/2010	0	0	0
		BM SD DR	10/27/2010	1	2	0
		SD DR	11/3/2010	0	0	0
		SD DR	11/9/2010	0	0	0
		SD DR BM	11/16/2010	1	0	0
		SD DR BM	11/23/2010	6	6	0
		BM DR	12/6/2010	0	4	5
		BM DR	12/15/2010	0	0	0
	Methow 6 Total			**8**	**12**	**5**
	7 - Holterman's Hole to MVID dam	JH AC	10/21/2010	0	0	0
		AC BM	10/28/2010	0	0	0
		JH AC	11/4/2010	1	1	0
		JH AC	11/10/2010	1	2	0
		JH AC	11/18/2010	0	0	0

		KM AC BM	12/9/2010	0	0	1
		JH AC BM	12/16/2010	0	0	0
	Methow 7 Total			**2**	**3**	**1**
	8 - MVID dam to Red barn	JH AC	10/21/2010	0	1	0
		AC BM	10/28/2010	0	0	0
		JH AC	11/4/2010	1	0	0
		JH AC	11/10/2010	0	0	0
		JH AC	11/18/2010	0	0	0
		AC BM	12/9/2010	0	2	8
		JH AC BM	12/16/2010	0	0	1
	Methow 8 Total			**1**	**3**	**9**
	9 - Red barn to Wolf Creek	SD DR	10/21/2010	0	0	0
		SD	10/28/2010	0	0	0
		SD	11/4/2010	0	0	0
		SD	11/10/2010	0	0	0
		SD	11/18/2010	0	0	0
	Methow 9 Total			**0**	**0**	**0**
	10 - Wolf Creek to Rip Rap	SD	10/21/2010	0	0	0
		SD	10/28/2010	0	0	0
		SD	11/4/2010	1	0	0
		SD	11/10/2010	0	0	0
		SD	11/18/2010	0	0	0
	Methow 10 Total			**1**	**0**	**0**
	11 - Rip Rap to Weeman Bridge	SD	10/21/2010	0	0	0
		SD	10/28/2010	0	0	0
		SD	11/4/2010	0	0	0
		SD	11/10/2010	0	0	0
		SD	11/18/2010	0	0	0
	Methow 11 Total			**0**	**0**	**0**
Winthrop NFH Spring Creek	Mouth to Irrigation Diversion	KM AC BM	10/11/2010	0	2	0
		JC	10/18/2010	0	1	0
		JH MA	10/25/2010	2	2	0
		AC	11/1/2010	6	11	1
		JH AC	11/3/2010	0	0	1
		RA BF	11/9/2010	4	16	0
		JH AC	11/15/2010	5	6	4
		JH AC	11/23/2010	6	10	1
		JH DR	11/29/2010	2	2	2
		JH DR	12/8/2010	2	2	2
		JH AC	12/13/2010	2	0	2
		JH DR	12/20/2010	0	1	2
	Winthrop Total			**29**	**53**	**16**
WDFW Methow FH Outfall	Mouth to Adult Weir	KM AC BM	10/11/2010	0	0	0
		JC	10/18/2010	0	0	0
		JH MA	10/25/2010	2	7	0
		AC BM	11/1/2010	2	5	0
		JH AC BM	11/8/2010	3	4	0
		AC BM	11/15/2010	4	8	0

		JH SD DR	11/23/2010	10	9	1
		JH	11/30/2010	1	1	0
		JH DR	12/8/2010	0	6	2
		JH AC	12/13/2010	0	0	0
	WDFW Total			**22**	**40**	**3**
Twisp	1 - Mouth to Lower Poorman Bridge	BM MA	10/21/2010	0	0	0
		KM BM	11/2/2010	0	0	0
		SD BM	11/10/2010	0	0	0
		SD DR	11/15/2010	0	0	0
	2 - Lower Poorman Bridge to Upper Poorman Bridge	BM MA	10/21/2010	0	0	0
		KM BM	11/2/2010	0	0	0
		SD BM	11/10/2010	0	0	0
		SD DR	11/15/2010	0	0	0
	Twisp Total			**0**	**0**	**0**
Libby	Mouth to Hwy 153 Bridge	KM AC BM	10/11/2010	0	0	0
		JC	10/18/2010	0	0	0
		JH MA	10/25/2010	0	0	0
		KM	11/2/2010	0	0	0
	Libby Total			**0**	**0**	**0**
Beaver	1 - Mouth to culvert	KM AC BM	10/11/2010	0	0	0
		JH	10/18/2010	0	0	0
		JH MA	10/25/2010	0	0	0
		SD DR	11/1/2010	0	0	0
		JH AC	11/15/2010	0	0	0
		JH BM	11/22/2010	0	0	0
	2 - Culvert to Hwy. 20	JH BM	11/23/2010	0	0	0
	Beaver Total			**0**	**0**	**0**
Wolf	Mouth to Biddle Acclimation Ponds	JH	10/18/2010	0	0	0
		JH BM	10/25/2010	0	0	0
		AC BM	11/1/2010	0	0	0
		JH AC BM	11/8/2010	0	0	0
		JH AC	11/15/2010	0	0	0
		JH SD BM	11/23/2010	0	0	0
	Wolf Total			**0**	**0**	**0**
Gold	Mouth to Rip Rap	AC JH	10/27/2010	0	0	0
		AC	11/1/2010	0	0	0
		JH AC	11/8/2010	1	2	0
		JH AC	11/15/2010	1	0	1
		JH AC BM	11/17/2010	0	0	1
		JH BM SD	11/22/2010	0	0	0
	Gold Total			**2**	**2**	**2**
Hancock	Mouth to Source	KM RA	12/2/2010	0	0	0
	Hancock Total			**0**	**0**	**0**
Chewuch	1 - Mouth to Fulton Dam	BM	10/21/2010	0	0	0
		DR SD	10/25/2010	0	0	0
		DR SD	11/1/2010	0	0	0
		SD DR	11/15/2010	0	0	0
	2 - Fulton Dam to Co. Hwy 1613	DR SD	10/25/2010	0	0	0

		DR SD	11/1/2010	0	0	0
		DR SD	11/15/2010	0	0	0
	Chewuch Total			**0**	**0**	**0**
	Methow Basin Total			**119**	**263**	**47**
Chelan FH outfall	Outfall of hatchery to confluence with the Columbia River	KM BF	11/3/2010	7	4	2
		KM BF	11/12/2010	0	0	12
	Chelan FH Total			**7**	**4**	**14**
Chelan River	Mouth to 800 meters upstream	KM BF	11/18/2010	0	0	1
	Chelan Total			**0**	**0**	**1**
Foster	Mouth to first bridge	KM BF	11/12/2010	0	0	0
	Foster Total			**0**	**0**	**0**
	Out of Basin Total			**7**	**4**	**15**

APPENDIX D: SPAWNING GROUND SURVEY RECORDS FOR THE WENATCHEE AND METHOW RIVERS, 2011

APPENDIX D: Spawning ground survey records for the Wenatchee and Methow rivers in 2011

Stream	Reach	Date	New Redds	Live Fish	Dead Fish
Beaver	Mouth to Pond	10/1/2011	0	0	0
		10/8/2011	0	0	0
		10/15/2011	0	0	0
		10/22/2011	0	0	0
		11/5/2011	0	0	0
		11/12/2011	0	0	0
		11/26/2011	0	0	0
		Total	**0**	**0**	**0**
Chumstick	Mouth to North River Road	10/4/2011	0	0	0
		10/11/2011	0	0	0
		10/18/2011	0	2	0
		10/25/2011	4	17	0
		11/1/2011	3	19	0
		11/8/2011	2	26	1
		11/15/2011	4	10	2
		Total	**13**	**74**	**3**
Icicle	1-Mouth to Hatchery Pool	10/5/2011	0	9	0
		10/12/2011	2	38	1
		10/19/2011	60	388	4
		10/26/2011	233	709	17
		11/2/2011	222	640	22
		11/9/2011	199	876	90
		11/16/2011	178	675	113
		11/23/2011	106	530	143
		11/30/2011	100	425	190
		12/7/2011	31	159	13
		12/14/2011	0	20	4
		Total	**1,131**	**4,469**	**597**
	2-Hatchery Pool to Headgate	10/3/2011	0	3	0
		10/10/2011	8	19	0
		10/17/2011	24	147	1
		10/24/2011	38	999	1
		10/31/2011	75	1402	4
		11/7/2011	112	879	12
		11/14/2011	109	1575	12
		11/21/2011	65	925	9
		11/28/2011	61	740	30

		12/5/2011	40	438	16
		12/12/2011	0	157	12
		Total	**532**	**7,284**	**97**
Mission/Brender	Mouth to Vale Elementary	10/1/2011	0	0	0
		10/8/2011	0	1	0
		10/15/2011	8	5	0
		10/22/2011	15	23	0
		10/29/2011	11	21	3
		11/5/2011	11	12	1
		11/12/2011	10	23	2
		11/19/2011	8	24	1
		11/26/2011	6	20	3
		12/1/2011	13	27	1
		12/5/2011	3	16	2
		12/12/2011	0	11	6
		Total	**85**	**183**	**19**
Nason	1-Mouth to Kahler Bridge	10/6/2011	0	2	0
		10/13/2011	1	0	0
		10/20/2011	6	17	0
		10/27/2011	9	13	0
		11/3/2011	3	8	0
		11/10/2011	0	4	1
		11/17/2011	4	0	1
		11/21/2011	2	1	0
		11/29/2011	7	7	4
		12/6/2011	2	1	0
		Total	**34**	**53**	**6**
	2- Kahler Bridge to Butcher Pond	10/6/2012	0	0	0
		10/13/2011	0	0	0
		10/20/2011	4	1	0
		10/27/2011	3	3	1
		11/3/2011	3	3	0
		11/17/2011	6	12	0
		11/21/2011	6	7	0
		11/29/2011	4	4	0
		12/6/2011	1	1	0
		Total	**27**	**31**	**1**
	3- Butcher Pond to Rayrock	10/6/2011	0	1	0
		10/13/2011	0	1	0
		10/20/2011	0	0	0
		10/27/2011	1	6	0

		11/3/2011	4	9	0
		11/10/2011	10	10	0
		11/17/2011	0	1	0
		11/21/2011	5	8	0
		11/29/2011	0	1	0
		12/6/2011	0	0	0
		Total	**20**	**37**	**0**
	4- Rayrock to Whitepine Creek	10/6/2011	0	0	0
		10/12/2011	0	0	0
		10/20/2011	0	0	0
		10/27/2011	1	0	0
		11/3/2011	4	7	0
		11/10/2011	3	5	0
		11/17/2011	0	0	0
		Total	**8**	**12**	**0**
Peshastin	1- Mouth to YN office	10/7/2011	0	0	0
		10/14/2011	5	5	0
		10/21/2011	5	6	0
		10/29/2011	10	11	1
		11/4/2011	14	26	0
		11/10/2011	5	7	2
		11/18/2011	2	6	2
		12/1/2011	2	6	0
		Total	**43**	**67**	**5**
	2- YN office to Mountain Home Rd.	10/7/2011	0	0	0
		10/14/2011	0	0	0
		10/21/2011	6	10	0
		11/4/2011	3	2	0
		11/10/2011	5	4	1
		11/18/2011	0	0	1
		Total	**14**	**16**	**2**
Wenatchee River	1- Mouth to Cashmere	10/7/2011	1	1	0
		10/14/2011	0	5	0
		10/21/2011	5	46	2
		10/28/2011	23	40	2
		11/4/2011	22	33	4
		11/11/2011	36	65	9
		11/18/2011	32	35	15
		12/8/2011	12	25	29
		12/15/2011	0	2	0

	Total	**131**	**252**	**61**
2- Cashmere to Dryden Dam	10/4/2011	0	0	0
	10/11/2011	0	9	0
	10/18/2011	0	90	1
	10/25/2011	0	13	0
	11/1/2011	0	4	0
	11/8/2011	5	7	1
	11/15/2011	23	42	13
	11/22/2011	20	28	16
	11/28/2011	1	5	2
	12/8/2011	2	5	1
	Total	**51**	**203**	**34**
3- Dryden Dam to Leavenworth Boat Launch	10/2/2011	0	2	0
	10/6/2011	0	0	0
	10/9/2011	0	9	0
	10/13/2011	1	1	0
	10/16/2011	0	9	0
	10/20/2011	0	2	0
	10/23/2011	0	14	0
	10/30/2011	8	18	28
	11/13/2011	16	36	38
	11/20/2011	13	35	41
	11/27/2011	14	54	68
	12/5/2011	0	5	6
	12/12/2011	0	3	1
	Total	**52**	**188**	**182**
4- Leavenworth boat launch to Icicle Rd. Br.	10/5/2011	0	2	0
	10/12/2011	0	4	0
	10/19/2011	32	502	1
	10/26/2011	125	108	3
	11/2/2011	102	191	33
	11/9/2011	113	237	32
	11/16/2011	101	97	41
	11/23/2011	42	83	76
	11/30/2011	40	66	81
	12/7/2011	9	58	9
	12/14/2011	0	33	0
	Total	**564**	**1,381**	**276**
5- Icicle Rd. Br. To Chiwaukum Cr.	10/10/2011	0	11	0
	11/6/2011	15	28	3
	Total	**15**	**39**	**3**

	6- Chiwaukum Creek to Plain	**No surveys conducted in 2011**			
	7- Plain to Lake Wenatchee	10/3/2011	0	2	0
		10/10/2011	0	1	0
		10/17/2011	0	4	0
		10/24/2011	0	8	0
		10/31/2011	0	3	0
		11/7/2011	0	6	0
		Total	**0**	**24**	**0**

Stream	Reach Description	Surveyors	Date	New Redds	Live Fish	Dead Fish
Methow	1 - Mouth to Steel Bridge	JH JP	10/17/2011	0	10	0
		JH JP	10/26/2011	0	10	0
		JH AC	11/3/2011	1	0	1
		JH AC	11/10/2011	4	13	0
		JH AC	11/16/2011	0	20	0
	Methow 1 Total			**5**	**53**	**1**
	2 - Steel Bridge to Lower Burma Bridge	BioAnalyst	10/14/2011	0	0	1
		JH JP	10/17/2011	0	10	0
		JH JP	10/26/2011	0	15	0
		JH AC	11/3/2011	7	4	1
		JH AC	11/10/2011	1	20	0
		JH AC	11/16/2011	0	0	4
	Methow 2 Total			**8**	**49**	**6**
	3 - Lower Burma Bridge to Upper Burma Bridge	CH AC	10/17/2011	1	1	0
		JP BF	10/23/2011	0	3	0
		JP BM	10/30/2011	2	2	0
		JH AC CH	11/2/2011	17	8	2
		AC JP	11/9/2011	2	0	0
		AC JH	11/15/2011	3	1	3
		JH TS	11/21/2011	0	5	2
		BM JP AC JH	11/30/2011	6	1	9
		JH TS JP BF	12/7/2011	0	0	3
	Methow 3 Total			**31**	**21**	**19**
	4 - Upper Burma Bridge to Lower Gold Creek Bridge	JH AC BM	10/12/2011	0	20	0
		CH AC	10/17/2011	0	0	0
		JP BF	10/22/2011	0	1	0
		JP BM	10/29/2011	5	2	2
		KM TL	11/2/2011	8	64	0
		JP AC BM	11/7/2011	5	1	2
		AC JH CH	11/14/2011	3	0	3
		JP BM	11/20/2011	1	1	3
		AC JH JP BM	11/29/2011	6	2	11
		JH BF JP TS	12/6/2011	0	0	3
	Methow 4 Total			**28**	**91**	**24**
	5 - Lower Gold Creek Bridge to	BM JP TL	10/13/2011	0	0	0

	Carlton	AC JH CH	10/18/2011	2	0	0
		JP BM	10/21/2011	1	1	0
		JP BM	10/28/2011	4	35	0
		AC JH CH	11/1/2011	14	8	1
		JP TS	11/8/2011	11	38	2
		JP TS	11/14/2011	3	36	2
		JP BM	11/19/2011	4	22	2
		CH TS	11/28/2011	0	0	1
		AC BM	12/3/2011	4	2	5
	Methow 5 Total			**43**	**142**	**13**
	6 - Carlton to Holterman's Hole	AC JH CH	10/13/2011	0	5	0
		BM TL JP	10/18/2011	1	3	0
		JP CH	10/24/2011	5	12	2
		BioAnalyst	10/28/2011	0	0	4
		AC JH	10/31/2011	1	1	3
		AC JH CH	11/8/2011	4	0	3
		BM JP	11/9/2011	0	0	2
		BioAnalyst	11/10/2011	0	0	5
		BM JP	11/12/2011	4	8	6
		JH CH TL	11/16/2011	12	6	6
		KM BM CH	11/21/2011	4	0	14
		AC JH JP	11/28/2011	0	0	3
		AC BM JH TS	12/5/2011	2	0	26
	Methow 6 Total			**33**	**35**	**74**
	7 - Holterman's Hole to MVID dam	JH CH TL	10/19/2011	0	5	0
		AC TL	10/24/2011	1	1	0
		JP CH TL	10/31/2011	1	1	1
		KM BM TL	11/8/2011	4	6	6
		JP BM	11/11/2011	1	0	3
		AC JH CH TS	11/17/2011	0	0	2
		BF JP	11/21/2011	0	0	2
		BF BM	11/28/2011	0	0	0
		JP BF TS JH	12/1/2011	2	1	2
	Methow 7 Total			**9**	**14**	**16**
	8 - MVID dam to Red barn	JH CH TL	10/19/2011	0	4	0
		BioAnalyst	10/24/2011	0	0	1
		AC TL	10/24/2011	0	5	0
		JP CH TL	10/31/2011	3	10	1
		KM BM TL	11/8/2011	4	5	15
		JP BM	11/11/2011	3	2	8
		AC JH CH TS	11/17/2011	2	0	17
		JP BF	11/21/2011	0	1	9
		BF BM	11/28/2011	1	0	25
		BF JP TS JH	12/1/2011	0	0	11
		BF JP	12/5/2011	0	0	8
		AC BM	12/9/2011	0	0	11
	Methow 8 Total			**13**	**27**	**106**
	9 - Red barn to Wolf Creek	KM AC	10/19/2011	0	13	0
		JH AC	10/27/2011	1	1	0

		JP BM	11/4/2011	0	0	0
		JP BM	11/13/2011	0	2	0
		JP BM	11/18/2011	0	5	0
		AC BM	12/2/2011	3	2	5
		KM AC	12/5/2011	0	13	0
		JH AC	12/9/2011	1	1	0
	Methow 9 Total			**4**	**23**	**5**
	10 - Wolf Creek to Rip Rap	KM AC	10/19/2011	2	1	0
		JH AC	10/27/2011	1	1	0
		JP BM	11/4/2011	2	1	0
		JP BM	11/13/2011	1	0	0
		JP BM	11/18/2011	0	0	0
		AC BM	12/2/2011	0	0	0
	Methow 10 Total			**6**	**3**	**0**
	11 - Rip Rap to Weeman Bridge	KM AC	10/19/2011	1	0	0
		JH AC	10/27/2011	0	0	0
		JP BM	11/4/2011	1	0	0
		JP BM	11/13/2011	1	0	0
		JP BM	11/18/2011	0	0	0
		AC BM	12/2/2011	0	0	0
	Methow 11 Total			**3**	**0**	**0**
Winthrop NFH Spring Creek	Mouth to Irrigation Diversion	KM	10/17/2011	6	5	0
		KM BM BF	10/24/2011	15	138	1
		KM BF	10/27/2011	5	59	0
		KM TS JP TL	11/1/2011	12	13	2
		BF CH TL	11/3/2011	18	9	1
		TS TL CH	11/9/2011	3	3	1
		BF TL	11/17/2011	11	229	8
		BM CH	11/22/2011	0	165	22
		BF MA	11/29/2011	7	174	27
		AC BM	12/4/2011	0	0	38
	Winthrop Total			**77**	**795**	**100**
WDFW Methow FH Outfall	Mouth to Adult Weir	KM	10/17/2011	2	3	0
		KM BF	10/27/2011	3	5	0
		JP KM TL TS	11/1/2011	5	13	0
		BJ CH TL	11/3/2011	7	7	1
		TL TS CH	11/9/2011	10	29	1
		KM BF	11/16/2011	7	8	2
		BF MA	11/29/2011	5	6	0
	WDFW Total			**39**	**71**	**4**
Twisp	1 - Mouth to Lower Poorman Bridge	AC JH CH	10/20/2011	1	2	0
		JH JP	10/25/2011	1	5	0
		JP BM	11/6/2011	6	20	1
		BM JP	11/15/2011	1	0	0
	2 - Lower Poorman Bridge to Upper Poorman Bridge	AC JH CH	10/20/2011	0	0	0
		JH JP	10/25/2011	0	0	0
		JP BM	11/6/2011	1	0	0
		BM JP	11/15/2011	1	0	0
	3 - Upper Poorman Bridge to	AC JH CH	10/20/2011	0	0	0

	Newby Bridge	JH JP	10/25/2011	0	0	0
		BM JP	11/15/2011	0	0	0
	4 – Newby Creek Bridge to Buttermilk Creek Bridge	BM TL CH	10/25/2011	0	0	0
		KM MA	11/3/2011	0	0	0
	5 – Buttermilk Creek Bridge to War Creek Bridge	KM AC	10/25/2011	0	0	0
		KM MA	11/3/2011	0	0	0
		BM JP	11/5/2011	0	0	0
		BM JP	11/15/2011	0	0	0
	Twisp Total			**11**	**27**	**1**
Libby	Mouth to Hwy 153 Bridge	KM	11/21/2011	0	0	0
	Libby Total			**0**	**0**	**0**
Beaver	1 - Mouth to culvert	BF TL	11/3/2011	0	0	0
		AC JH	11/9/2011	0	0	0
		KM RA	12/1/2011	0	0	0
	2 - Culvert to Hwy. 20	BM CH	11/22/2011	0	0	0
	Beaver Total			**0**	**0**	**0**
Wolf	Mouth to Biddle Acclimation Ponds	JH TL	11/7/2011	0	0	0
	Wolf Total			**0**	**0**	**0**
Gold	Mouth to Rip Rap	JH AC CH	10/18/2011	0	0	0
		RA	11/2/2011	0	0	0
		RA CF	11/3/2011	2	2	0
		AC JH	11/15/2011	0	2	0
	Gold Total			**2**	**4**	**0**
Hancock	Mouth to Source	KM	10/29/2011	0	0	0
		JH TL	11/7/2011	0	0	0
		KM RA	12/1/2011	0	0	0
		KM	10/29/2011	0	0	0
		JH TL	11/7/2011	0	0	0
		KM RA	12/1/2011	0	0	0
	Hancock Total			**0**	**0**	**0**
Chewuch	1 - Mouth to Co. Hwy 1613	BF CH	10/22/2011	0	0	0
		JP BM	10/26/2011	0	0	0
		JP BM	11/5/2011	0	0	0
		JP BM	11/15/2011	0	0	0
	2 - Co. Hwy 1613 to East County Junction	BF CH	10/22/2011	0	0	0
		JP BM	10/26/2011	0	0	0
		JP BM	11/5/2011	0	0	0
		JP BM	11/15/2011	0	0	0
	3- East County Junction to Memorial Bridge	BF CH	10/22/2011	0	0	0
		JP BM	10/26/2011	0	0	0
		JP BM	11/5/2011	0	0	0
		JP BM	11/15/2011	0	0	0
	4 - Memorial Bridge to 8 Mile Station	KM RA BF	10/25/2011	0	0	0
		BF CH	11/5/2011	0	0	0
		BF CH	11/9/2011	0	0	0
		BM JP	11/15/2011	0	0	0
		BM JP	11/20/2011	0	0	0

	Chewuch Total			**0**	**0**	**0**
	Methow Basin Total			**312**	**1355**	**369**
Chelan FH outfall	Outfall of hatchery to confluence with the Columbia River	KM BF	11/5/2011	19	41	6
	Chelan FH Total			**19**	**41**	**6**
Chelan River	Mouth to 800 meters upstream	BioAnalyst	11/4/2011	0	0	1
	Chelan River Total			**0**	**0**	**1**
Foster	Mouth to first bridge	KM BF	11/5/2011	0	0	0
	Foster Total			**0**	**0**	**0**
Columbia	Base of Chief Joseph Dam	BioAnalyst	11/9/2011	1	2	0
	Columbia Total			**1**	**2**	**0**
	Out of Basin Total			**20**	**43**	**7**

APPENDIX E: Wenatchee and Methow Basin Coho Release Numbers and Mark Groups, 2011

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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	Cascade FH	MCR-WEN	May 14	June 2	**190241+ BT**	98.2%	66,565	66,165	64,974	
									66,565	**66,165**	**64,974**	
Wenatchee	Nason Cr	Nason Wetlands	Willard NFH	MCR-WEN	Apr 26	May 1	**190248+ BT**	97.0%	47,630	46,570	45,173	
									47,630	**46,570**	**45,173**	
Wenatchee	Nason Cr	Rolfing's Pond	Cascade FH	MCR-WEN	May 14	Jul 1	**190239+ BT**	99.2%	67,577	64,853	64,334	3,000
Wenatchee	Nason Cr	Rolfing's Pond	Willard NFH	MCR-WEN	May 14	Jul 1	**190251+ BT**	97.3%	26,250	25,190	24,510	2,997
									93,827	**90,043**	**88,844**	**5,997**
Wenatchee	Beaver Cr	Beaver Creek	Cascade FH	MCR-WEN	May 13	July 14	**190242+ BT**	99.2%	66,887	59,439	58,963	2,892
Wenatchee	Beaver Cr	Beaver Creek	Willard NFH	MCR-WEN	May 13	July 14	**190250+ BT**	97.2%	28,635	25,443	24,731	2,996
									95,522	**84,882**	**83,694**	**5,888**
Wenatchee	Nason Cr.	Butcher Creek	Cascade FH	MCR-WEN	May 2	Jun 30	**190240+ BT**	99.2%	67,891	62,785	62,283	3,000
Wenatchee	Nason Cr.	Butcher Creek	Willard NFH	MCR-WEN	May 2	Jun 30	**190254+ BT**	95.8%	55,320	51,142	48,994	2,994
									123,211	**113,927**	**111,277**	**5,994**

Wenatchee	Icicle Cr	LNFH SFL 9 & 10	Willard NFH	MCR-WEN	Apr 17	Apr 17	**190247**	95.1%	57,123	54,519	51,848	2,953
Wenatchee	Icicle Cr	LNFH SFL 11 & 12	Cascade FH	MCR-WEN	Apr 18	Apr 18	**190238**	93.4%	69,010	65,447	61,127	2,225
Wenatchee	Icicle Cr	LNFH SFL 17 – 24	Cascade FH	MCR-WEN	Apr 17	Apr 17	**190243**	98.8%	174,791	146,563	144,804	
									300,924	**266,529**	**257,779**	**5,178**

Wenatchee	Icicle Cr	LNFH LFL 1	Cascade FH	MCR-WEN	Apr 16	Apr 16	**190244**	99.5%	69,116	68,366	68,024	3,000
Wenatchee	Icicle Cr	LNFH LFL 2	Cascade FH	MCR-WEN	Apr 16	Apr 16	**1902**	99.5%	69,063	67,744	67,405	
Wenatchee	Icicle Cr	LNFH LFL 1	Willard NFH	MCR-WEN	Apr 16	Apr 16	**190253**	98.4%	41,543	40,792	40,139	2,981
Wenatchee	Icicle Cr	LNFH LFL 2	Willard NFH	MCR-WEN	Apr 16	Apr 16	**190253**	98.4%	28,308	26,988	26,566	
									208,030	**203,890**	**202,125**	**5,981**

Methow	Methow	Winthrop NFH C12-16	Winthrop NFH	MCR-MET	Apr 19	Apr 19	**190255**	95.1%	248,757	246,212	234,148	6,994
Methow	Methow	Twisp Ponds	Willard NFH	MCR-MET	May 5	May 15	**190252**	99.1%	85,231	83,471	82,720	6,988
Methow	Methow	Winthrop NFH BC	Willard NFH	MCR-MET	Apr 15	May 15	**190246**	98.7%	49,217	47,886	47,263	6,973
									383,205	**377,569**	**364,131**	**20,955**

Methow	Methow	Wells FH	Willard NFH	MCR-MET	Apr-11	Apr-11	**190245**	**99.6%**	50,550	50,484	50,282	
									50,550	**50,484**	**50,282**	

Total	**1,369,464**	**1,297,974**	**1,266,202**	**49,993**

Appendix E:
Wenatchee and Methow Basins Release and Mark Groups, 2011

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