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MID-COLUMBIA COHO REINTRODUCTION FEASIBILITY STUDY:

2010 ANNUAL REPORT
October 1, 2009 through September 30, 2010

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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 Columbia river's middle and upper tributaries, which included the Wenatchee, Entiat, and Methow rivers; Mullan 1983. Efforts to restore coho within the Columbia basin will rely heavily upon hatchery coho releases. The feasibility of re-establishing coho within the tributaries of the mid-Columbia initially depended upon the resolution of two central issues; (1) the adaptability of domesticated lower Columbia coho stocks used in the re-introduction efforts measured through their associated survival rates and (2) the ecological risk to other species of concern, such as ESA listed spring Chinook, steelhead and bull trout. To date, both of these two key issues have been positively resolved, allowing the project to continue forward in achieving the goal of coho restoration through implementation of the Mid Columbia Coho Reintroduction Plan (MCCRP).

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

We are optimistic that the project will observe positive trends in hatchery coho survival as the transition is made from exclusively utilizing lower Columbia River hatchery coho to the exclusive use of in-basin locally adapted broodstock and are already seeing limited natural production contribution within both the Methow and Wenatchee subbasins. Therefore, it is important to measure hatchery fish performance, not only as an indicator of project performance, but to track potential short- and long-term program benefits from the outlined strategies.

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

This report documents coho restoration activities and results for the performance period of fall 2009 through the summer 2010, to include broodstock collection, spawning, egg incubation and transportation, spawning ground surveys, acclimation, and survival analyses. In addition, the Yakama Nation (YN) operated a 5-foot rotary smolt trap to estimate juvenile productivity of several salmonid species, to include naturally produced coho, emigrating from Nason Creek in 2009-2010. This trap is operated with joint funding from Grant County Public Utility District (GCPUD, #430-2365) and the BPA coho project (#1996-040-00); therefore detailed smolt trapping results are not included in the body of this report but included as a supplemental document (Murdoch and Collins, 2010) and provided in Appendix A.

2.0 BROODSTOCK COLLECTION AND SPAWNING

2.1 WENATCHEE RIVER BASIN

2.1.1 Broodstock Collection

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

Coho returning to the Wenatchee River in 2009 were comprised of brood year (BY) 2006 adults and BY2007 jacks from mid-Columbia hatchery and natural origin returns. The Wenatchee program consisted of 100%, 3rd generation Mid-Columbia River (MCR) returns. These adults were the progeny of two successful generations of MCR returns which had originated from Lower Columbia River (LCR) lineage. Both Dryden Dam fish traps (also known as right bank and left back) were passively operated five days per week, 24-hours per day from September 1 through November 23. On Saturdays and Sundays, both facilities were opened, allowing unimpeded upstream passage. Coho trapping at Dryden Dam occurred concurrently with the Washington Department of Fish and Wildlife's (WDFW) summer steelhead broodstock collection and the Chelan PUD funded steelhead and summer Chinook stock assessment.

Coho broodstock was concurrently collected at Tumwater Dam up to five days per week, 8 hours per day, between September 1 and November 6, 2009. All coho encountered at Tumwater Dam were assessed for condition and if deemed suitable, incorporated into the broodstock. Unsuitable individuals consisted of any fish with signs of significant abrasions or wounds, fungus, and/or too mature (factors that would decrease the likelihood of an individual to survive to spawning) were passed upstream. Coho collected at Tumwater Dam were externally marked with a green floy tag in the left dorsal sinus and given a left-side opercule punch for later identification during spawning and post-spawn data collection. The opercule punch served as a secondary mark in the event that the floy tag became dislodged during holding. A small proportion (n=44) of coho collected at Tumwater Dam had been previously floy tagged at Dryden Dam as a part of an ongoing YN mark-recapture study. Study results are pending and will be analyzed at a later date.

In addition to Dryden and Tumwater collections, a v-trap weir in the upper bay of the LNFH ladder was installed the first week of October and operational between November 6 and November 23. This site has been and will continue to be utilized as a back-up broodstock collection site, ensuring that overall goals are met while transitioning through Broodstock Development Phase II (YN FRM 2009). Coho collected at LNFH were externally marked with an orange floy tag in the right dorsal sinus and given a right-side opercule punch to allow for later identification during spawning and post-spawn data collection.

The differential marking schemes at multiple trap locations provided the necessary evaluation tools to parse out supplemental collections when evaluating smolt-to-adult survivals rates as well as determine migratory success for coho. Approximately 12.9% and 35.1 % of the total broodstock were collected at the LNFH ladder trap and Tumwater Dam, respectively.

A summary of broodstock collection and fish handled at all trapping sites can be found in Table 1. All coho broodstock were transported to Entiat National Fish Hatchery (ENFH) and held until spawning.

Table 1. Coho salmon and incidentals handled during trapping, 2009

Location	**Coho (*broodstock*)**	**Steelhead**	**Sockeye**	**Chinook**	**Bull Trout**
Dryden Dam	1798* (*549*)	271	11	259	0
Tumwater Dam	1040* (371*)*	N/A	N/A	N/A	N/A
LNFH ladder trap	250* (136)	0	0	0	2

**Actual number of coho handled during trapping at Dryden Dam, Tumwater Dam, and LNFH during broodstock collection efforts for 2009.*

2.1.2 Spawning

Of the 1,056 coho collected for broodstock needs, 48.3% were females (*n*=510) and 51.7% were males (*n*=546), which included both three-year old and two-year old fish. The pre-spawn mortality rate at ENFH was 5.1% in 2009. This was an increase of 2.0% compared to the previous year but still well within program standards (< 10%). Sodium chloride, Poly Aqua® and MS-222 were used to decrease stress during transport.

A total of 1,002 coho adults (483 F and 519 M) were spawned between October 13 and November 24, 2009. Of the 483 total female coho spawned, 471 (97.5%) were considered viable. Non-viable females were either over-ripe or green at the time of spawning. The overall high female viability was a testament to both United States Fish and Wildlife Service (USFWS) and YN staff and their ability to determine appropriate maturation levels for these fish. Peak spawn occurred on October 27 with 143 viable females (Figure 1).

Spawn timing for the 2009 brood was similar when compared to the program average from 2000-2008 except during week six (Figure 2). YN collection protocols used a variety of estimators to determine collection numbers for both programs. Two of the largest values that impacted production were fecundity and pre-spawn mortality. Based on a five year mean of the previous broodstocks (2004-2008), an estimated fecundity of

2,995 eggs per female and a pre-spawn mortality rate of 2.5% were established. Even though the applied fecundity estimate resulted in an over allocation of available eggs (2009 brood fecundity was 2,691), an increase in pre-spawn mortalities (+ 2.6%) led to a limited number of females available during the week 6 spawn. YN used the last spawn that occurred on November 24 to compensate for this female shortage and spawned 40 females; most of these individuals being collected from the LNFH adult ladder trap. YN personnel determined that program goals had been met and an eighth spawn was not necessary.

Coded-wire tag analysis showed that 470 fish spawned were LNFH origin returns from 2008 (BY2006) and 2009 (BY2007) releases, while 440 (438 adults and 2 jacks) were fish acclimated and released from upper Wenatchee River basin ponds during the same time period (Table 2). After scale analysis, the remaining 92 fish consisted of 60 hatchery origin fish with unknown release locations, 29 natural origin and three were unknown origin as scale analyses were inconclusive.

Table 2. Summary of coded-wire-tag and scale analysis from coho spawned at Entiat National Fish Hatchery in 2009.

Juvenile Release Location		BY2006 Adults	BY2007 Jacks	Percentage of Brood by Release Site
Leavenworth National Fish Hatchery	*Small Foster-Lucas Ponds*	283	0	28.2%
	Large Foster-Lucas Ponds	187	0	18.6%
Upper Wenatchee River Basin	*Coulter Pond*	52	1	5.3%
	Butcher Creek Pond	180	0	18.0%
	Beaver Creek Pond	105	1	10.6%
	Rohlfing's Pond	91	0	9.1%
	Nason Creek Wetlands	10	0	1.0%
Unknown Origin	*Unknown*	63	0	6.3%
Wild		29	0	2.9%
Totals		**1,000**	**2**	**100.0%**

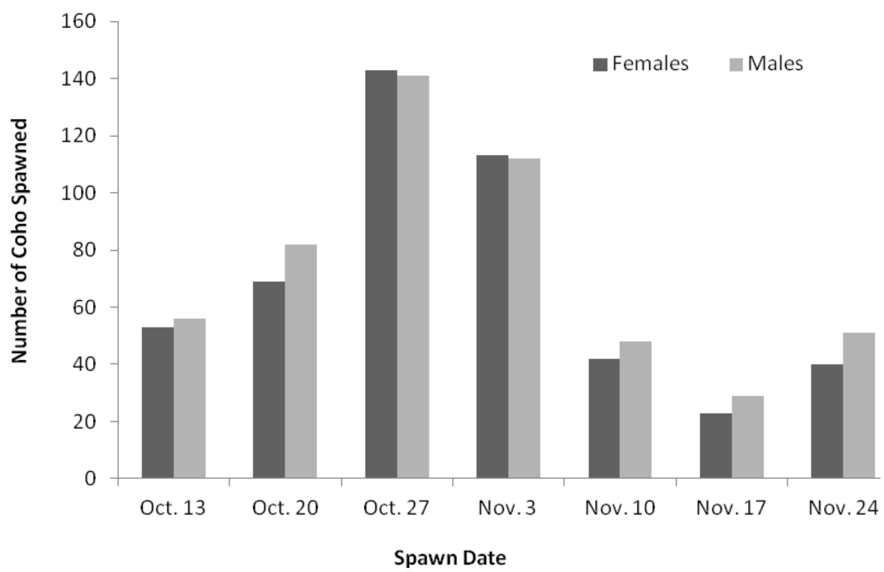

Figure 1. Number of coho spawned at Entiat National Fish Hatchery, 2009.

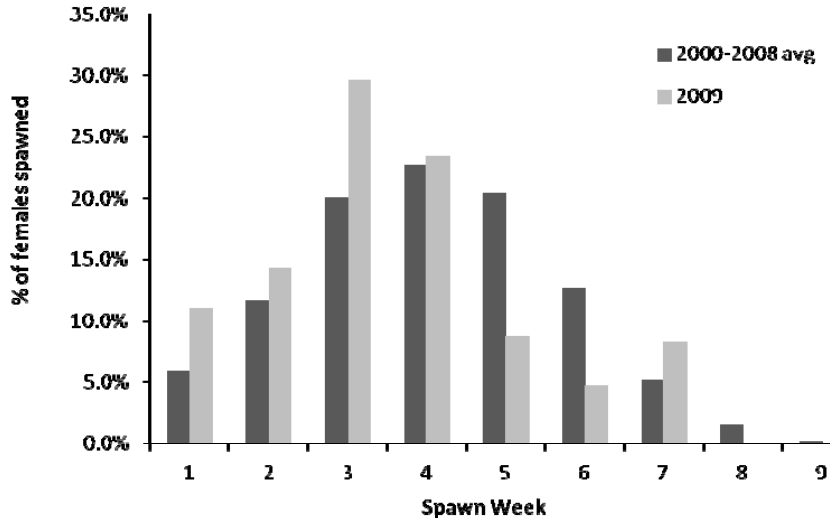

Figure 2. Temporal spawning distribution for brood years 2000-2008 and 2009.

2.1.3 Incubation

A total of 1,260,959 green eggs were collected from the 2009 coho broodstock. Of these, 792,816 (62.8%) were incubated at ENFH while the remaining 468,143 (37.1%) were transported to YN's Peshastin Incubation Facility (PIF). ENFH incubated larger egg takes since spawns occurring on-station would allow for immediate gamete fertilization; limiting exposure time for unfertilized gametes and increasing eye-up rates. Both facilities incubated coho eggs in a deep trough, bulk incubation system supplied with 4-5 gal/minute of chilled water however ENFH also incubated in vertical stacks incubation systems. Coho eggs were incubated on 100% groundwater at ENFH while non-chlorinated city water with a groundwater backup was used at PIF. This bulk incubation system has been efficient for coho since it allows for a relative large number of eggs to be successfully incubated in a cost-effective manner while using low volumes of water.

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

Eyed-egg totals for ENFH and PIF were 693,045 and 412,370, respectively. Average eye-up rate for the 2009 brood was 87.7% (Table 3). The 2009 brood coho eyed-eggs from both ENFH and PIF were transported to Cascade FH and Willard NFH between mid-November and early January for long-term rearing until they reached the pre-smolt stage. A summary of spawn dates, number of green eggs collected, eye-up rate at ENFH and PIF, and transport to the rearing facility can be found in Table 3. Transportation from the incubation facilities to the rearing facilities occurred between 550 and 600 temperature units (°F).

Table 3. Spawn dates, number of eggs collected, and eye-up rate at ENFH and PIF, 2009.

Incubation Location	Spawn Date	Trans. 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
ENFH	13-Oct	2-Dec	51.5	108,471	22,485	130,956	2,542	2,106	82.8	Willard NFH
PIF	20-Oct	7-Dec	66.5	139,070	23,127	162,197	2,476	2,123	85.7	Willard NFH
ENFH	27-Oct	16-Dec	142	314,627	43,443	358,070	2,521	2,215	87.9	Willard/Cascade
ENFH	3-Nov	23-Dec	109.5	269,947	33,843	303,790	2,812	2,499	88.9	Cascade FH
PIF	10-Nov	28-Dec	41	116,079	9,781	125,860	3,069	2,831	92.2	Cascade FH
PIF	17-Nov	6-Jan	21.5	52,035	10,074	62,110	2,888	2,420	83.8	Cascade FH
PIF	24-Nov	13-Jan	39	105,186	12,791	117,976	3,025	2,697	89.2	Cascade FH
			471	**1,105,415**	**155,544**	**1,260,959**	**2,691**	**2,359**	**87.7**	

2.2 METHOW RIVER BASIN

2.2.1 Broodstock Collection

Coho broodstock were collected at Winthrop National Fish Hatchery (NFH), Wells Dam west ladder and Wells Fish Hatchery (FH) volunteer trap. The east ladder was not used for 2009 broodstock collections due to ongoing maintenance at Wells Dam.
Fish returning to Winthrop NFH were collected volitionally as they entered the hatchery holding pond and will be referred to as “swim-ins” throughout the remainder of the document. The Winthrop NFH ladder was opened on September 23 and remained open until collection goals were met on December 5. Supplemental collections occurred concurrently at Wells Dam west fish ladder and Wells FH volunteer trap, herein after referred to as the “Wells complex”, between September 23 and November 24. The west ladder was actively operated by YN and Wells FH staff concurrently with WDFW’s steelhead broodstock collection no more than three days per week between September 23 and October 10. After October 10, YN trapping activities continued and allowable up to 7 days a week until November 13. Trapping efforts at these facilities were concluded at this time due to insufficient numbers of adult migrants over the dam as well as an expected increase of Winthrop NFH 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 total of 231 coho (135 M and 96 F) swim-ins were collected at Winthrop NFH while a combined total of 363 (168 M and 195 F) adult were intercepted at the Wells complex. Of the fish handled at Wells complex, 328 (166 M and 162 F) individuals were tagged in the dorsal sinus with sequentially numbered floy tags and given an opercule punch prior to transport to Winthrop NFH. The marks were used to differentiate fish collected at Columbia River collection points versus swim-ins at Winthrop NFH during spawning and post-spawn data collection. Sodium chloride, Poly Aqua® and MS-222 were used to decrease stress during transport from Wells Dam to Winthrop NFH. No mortalities occurred during transportation. A total of 35 adult coho (2 M and 33 F) were passed upstream of the west ladder as program excess and/or unsuitable (e.g.- over maturation or excessive physical damage) for our broodstock needs. As increasing numbers of swim-ins were observed at Winthrop NFH, previously collected adults from the Wells complex were in-excess of program needs and returned to the river to spawn naturally.

In summary, 594 fish were encountered as swim-ins to Winthrop NFH, trapped at Wells Dam and Wells FH, or allowed to pass upstream for natural production. Of these, 66.2% (*n*=393) were used for broodstock, 2.9% (*n*=17) were non viable females at the time of spawning, 15.7% (*n*=93) were attributed to pre-spawn mortality, 9.4% (*n*=56) were released back into the Methow River to presumably spawn and 5.9% (*n*=35) were allowed to pass upstream of Wells Dam. All fish encountered during trapping efforts at the Well complex are listed in Table 4. Bull trout were not observed or handled at Wells Dam, Wells FH or Winthrop NFH.

Table 4. Methow basin coho salmon trapped and incidentals diverted back to river, 2009.

Location	Coho (*broodstock*)	Steelhead	Sockeye	Chinook	Bull Trout
Winthrop NFH	231* (179)	0	0	0	0
Wells Dam West ladder Trap	272* (*160*)	251	0	147	0
Wells FH Volunteer. Channel	91* (54)	0	0	0	0

*Actual trappable coho numbers during broodstock collection efforts for 2009. Passed coho were fish that were recorded and allowed to migrate upstream.

2.2.2 Spawning

Coho broodstock collected from all facilities were spawned at Winthrop NFH. Spawning activities occurred on a weekly basis between October 19 and November 30. The one exception to this occurred the week of November 15; two spawns were conducted as a precautionary measure to retain gametes and remove individuals observed to be affected by the dermal fungus *Saprolegnia* (Joy Evered, USFWS Fish Health Specialist, pers. comm.). A total of 393 viable adult coho (198 F and 195 M), including one partial female, were successfully spawned during the eight week period. Spawn timing for the 2009 brood was protracted overall when compared to the 2004 - 2008 average (Figure 4), however peak spawn was similar; occurring on November 16 with 82 viable females (Figure 3). This extended spawn timing for the Methow program may be a result of individuals returning to Winthrop NFH over a broader period of time while exhibiting the ability to successfully complete their migration while retaining sufficient energy reserves until spawning. Forty-six percent (71 F and 108 M) of the broodstock were swim-ins to Winthrop NFH while the remaining fifty-four percent (126 F and 87 M) were fish intercepted at the Wells complex. Pre-spawn mortality increased from 10.3% in 2008 to 16.6 % in 2009. This increase in pre-spawn mortality was presumably attributed to observed high levels of a *Saprolegnia* fungal infection. Results from tissue samples taken by Joy Evered (USFWS Fish Health Specialist) during spawning activities indicated low to moderate levels of *Furunculosis* and *Flavobacterium psychrophilum* (Bacterial Cold-Water Disease; BCWD) in a portion of adults that may have also contributed to the increased mortality. Exact causes for the high rates of infections are unknown, however it is speculated that these pathogens may have spread from many of the individuals observed to be in a deteriorating condition arriving as swim-ins to the adult holding pond. Pre-spawn sorting activities to determine ripeness could have also contributed to the high loss since these individuals were handled without anesthesia, which could drastically increase the likelihood of injury and/or create stress levels detrimental to the individuals. Formalin treatments were increased to five days a week; however mortality continued to persist until the conclusion of spawning activities. The

2010 handling procedures will be modified significantly in order to decrease stress incurred within the holding pond as well as to provide an adequate means of assessing female maturity.

Fifty-six males were program excess; of which eight were released into Spring Creek on November 23 and forty-eight individuals were released into the Methow River (RK 28.8) on December 8.

Coded-wire tag analysis showed that 53.1% (*n*=267; 129 M and 138 F) of the fish spawned were Winthrop NFH on-station releases (BY2006), 34.6% (*n*=174; 76 M and 98 F) were fish acclimated and released from Wells FH, 6.4% (*n*=32; 16 M and16 F) were fish acclimated and released from Winthrop NFH back-channel in 2008. A total of 4.4% (*n*=22; 13 M and 9 F) did not possess a CWT and 1.6% (*n*=8; 4 M and 4 F) were lost during the extraction process. Scale analysis from carcasses recovered determined that 5.0% (*n*=25) were unknown hatchery origin and 1.0% (*n*=5) were naturally reproduced individuals. For a complete summary of broodstock composition and collection locations, please refer to Table 5.

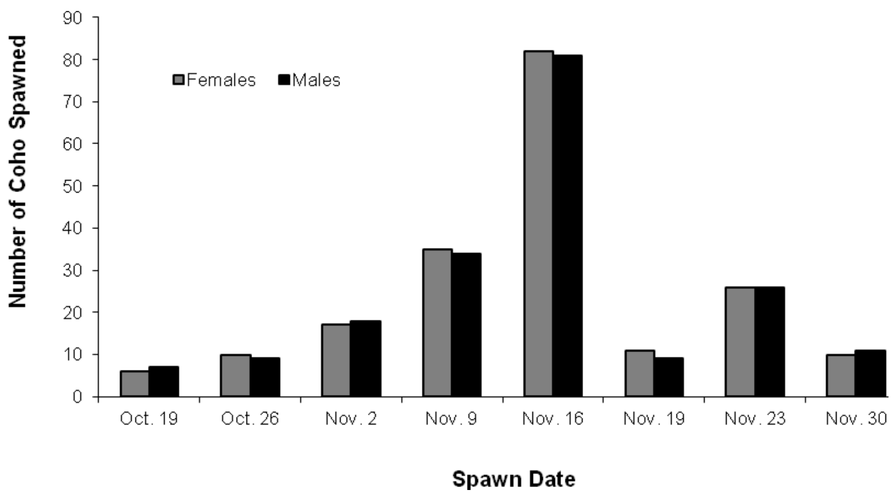

Figure 3. Number of coho spawned at Winthrop National Fish Hatchery.

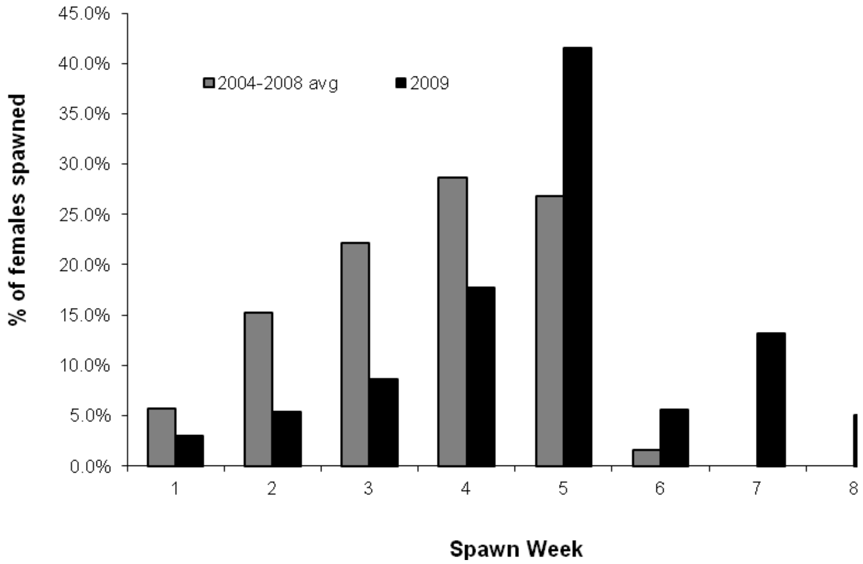

Figure 4. Temporal spawning distribution for brood years 2000-2008 and 2009, Winthrop National Fish Hatchery.

Table 5. Broodstock composition and collection locations for fish spawned at Winthrop National Fish Hatchery, 2009.

Juvenile Release Location		BY2006 Adults	BY2007 Jacks	Total
Winthrop National Fish Hatchery	*On-Station*	267	0	267
	Back-channel	32	0	32
Wells Fish Hatchery	*On-station*	174	0	174
Unknown Hatchery		25	0	25
Natural Production		5	0	5
Totals		**503**	**0**	**503**

2.2.3 Incubation

During spawning, eggs from each female were mated with one primary male and one back-up male. Females were "bled out" prior to extracting gametes from the body cavity. Bleeding out females reduced the amount of excess organic matter, which if incorporated during fecundation, could cause an obstruction to the egg's micropyle and prohibit fertilization. During fertilization, a 1.0% saline solution was used to promote sperm motility while eggs were allowed to stand for a minimum of 2-3 minutes. Once fertilized, excess milt, ovarian fluid, and other organics were strained from the eggs and then soaked in a 75 ppm (part-per-million) concentration of iodine for 30 minutes. After the disinfectant treatment had been completed, a freshwater rinse was administered prior to placing gametes into vertical stack incubators.

A total of 539,961 green eggs were collected from the 2009 Methow broodstock between October 19 and November 30. Eyed-egg totals for Winthrop NFH incubation facility was 453,848; of which 257,797 (56.8%) eyed eggs remained at Winthrop NFH for full term, in-basin rearing while 196,051 (43.2%) eyed-eggs were transported to Willard NFH between December 2, 2009 and January 8, 2010 for incubation and full-term rearing until transported as pre-smolts to the Methow basin. Mean fecundity was 2,741 green eggs per female. Average eye-up for the 2009 brood was 84.1 %; a decrease of 0.9% over the previous years' brood but meeting the standards set for the Methow program. Transportation of these eyed eggs occurred at approximately 600 temperature units (°F). A summary of spawn dates, number of eggs collected, fecundity and the eye-up rate at Winthrop NFH can be found in Table 6.

Table 6. Spawn date, number of eggs collected, and eye-up rate at Winthrop NFH, 2009.

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
WNFH	19-Oct	N/A	6	15,963	5,235	21,198	3,533	2,616	75.3	Winthrop NFH
WNFH	26-Oct	2-Dec	11	22,414	5,186	27,600	2,760	2,241	81.2	Willard NFH
WNFH	02-Nov	10-Dec	17	40,415	8,404	48,819	2,872	2,377	82.8	Willard NFH
WNFH	09-Nov	18-Dec	35	78,996	16,657	95,653	2,733	2,257	82.6	Willard NFH
WNFH	16-Nov	N/A	82	183,608	37,845	221,453	2,701	2,239	82.9	Winthrop NFH
WNFH	19-Nov	29-Dec	11	29,024	1,789	30,813	2,801	2,639	94.2	Willard NFH
WNFH	23-Nov	N/A	26	58,226	10,333	68,559	2,637	2,239	84.9	Winthrop NFH
WNFH	30-Nov	8-Jan	10	25,202	664	25,866	2,587	2,520	97.4	Willard NFH
Totals			**197**	**453,848**	**86,113**	**539,961**	**2,741**	**2,304**	**84.1**	

3.0 SPAWNING GROUND SURVEYS

The 2009 Wenatchee River basin spawning ground survey efforts focused on select tributaries where current juvenile releases occur (e.g.-Beaver, Nason & Icicle creeks) as well as areas in proximity to large hatchery release sites (e.g.- middle reaches of the Wenatchee River). Additional surveys were also conducted on Chiwawa River, Chiwaukum, Chumstick, Mission/Brender and Peshastin creeks; where coho had not been released but known to spawn naturally to determine the extent of spawner distribution. Methow River surveys efforts concentrated on the mainstem Methow River and lower portions of tributaries identified as primary coho spawning areas. Survey reaches for both Wenatchee and Methow River subbasins can be found in Table 7. Adult spawning ground surveys provide the ability to estimate annual abundance, determine homing fidelity and level of straying, and document the special and temporal distribution of the overall spawning population for both specific tributaries as well as basin wide. Spawning ground surveys for coho are comprehensive and will remain that way until the long-term program can establish consistent, observable distributions that would warrant a change in methodology towards indexing reaches for determining spawner escapement.

Within the Wenatchee drainage, in areas where spawning densities were relatively high (e.g. - Icicle Creek and reach W4), redd identification tended to be difficult because of nest superimposition amongst and between species. Weekly surveys in these reaches proved to be frequent enough to clearly identify individual redds. Weekly surveys were conducted on Beaver, Chiwaukum, Mission, Peshastin, Nason, and Icicle creeks as well as reach W4 on the Wenatchee River. Surveys on Beaver and Chiwaukum creeks were discontinued once water levels prevented fish passage. On the mainstem Wenatchee River, reaches W1-W3 and W5-W7 were surveyed every 14 days; which included tributaries such as the Chiwawa River considering the limited number of redds observed within this tributary over the years. Chumstick Creek was surveyed on a single occasion. A concerted effort will be made in the future to increase the frequency of mainstem and specific tributary spawning surveys in an attempt to identify redds that are potentially being missed during these prolonged periods. Survey reaches for both basins are identified in Table 7.

Methow River basin survey efforts concentrated on the mainstem Methow River. In addition to mainstem surveys, the lower reaches of several tributaries, including Chewuch and Twisp rivers, were also surveyed. Mainstem Methow reaches (M1-M11) were surveyed weekly. High water events in late November suspended all mainstem spawning ground surveys until December 6. Tributary surveys varied and were prioritized by spawning densities and proportion of spawners observed in previous years; ensuring staff time was used efficiently. In tributaries where spawning densities were relatively abundant (>20 redds), such as in Spring Creek/Winthrop NFH outfall and

WDFW Methow Hatchery outfall, weekly surveys were necessary to clearly identify individual redds before superimposition occurred. Tributaries that consistently yielded some level of natural production (5-20 redds; Libby and Beaver creeks) were also surveyed every 7-10 days. Periodic surveys, typically at or near peak spawning, were conducted in tributaries where annual historical redd data demonstrated low counts of redds (<5 redds) or had not been surveyed in previous years. These reaches included lower Twisp and Chewuch rivers, Wolf Creek, Gold Creek and Hancock Springs Creek. Additional out-of-basin survey efforts were conducted above and below Wells Dam, Chelan FH outfall and Foster Creek. Complete survey records for both basins can be found in Appendix B.

Spawning ground surveys were conducted either by foot or raft, depending upon the size of the stream and the terrain. Foot surveys were conducted by a single person. Raft surveys were performed by two people; one person rowing while the other person surveyed. Individual redds were either recorded on a map or flagged in the field by tying surveyor's tape to nearby riparian vegetation. Each marker listed the date, redd location, redd number, agency and the surveyor's initials. A Global Positioning System (GPS) was used to record the exact location of individual redds on all surveys where redd mapping did not occur. After each survey, we recorded the number of new redds, live and dead fish, time required to complete the survey, and the stream temperature.

Coho carcasses were recovered during each survey with fork length (FL) and post-orbital-hypural lengths (POH) measured to the nearest centimeter. Measurements of POH tended to be more useful for analysis purposes versus 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 subsequent coded-wire-tag (CWT) analysis. The sex of each carcass was recorded, if discernable at the time of sampling. Females were checked for egg retention by visual estimation of the number of eggs present in the body cavity. Egg voidance was calculated by subtracting known egg retention (number of eggs remaining in an individual female cavity) from the average fecundity of the 2009 coho broodstock, which was dependent upon collection basin. This egg-voidance value was reported as a percentage. To prevent re-sampling, the caudal fin was removed before discarding the carcass along the stream bank.

Table 7. Spawning ground survey reaches for the Wenatchee and Methow river subbasins in 2009.

Reach Designation	Reach Description	Reach Location (RK)
	Wenatchee River Basin	
	Icicle Creek	
1	Mouth to Hatchery	0.0 - 4.5
2	Hatchery to Head Gate	4.5 – 6.2
3	Headgate to LNFH intake	6.2 – 8.0
	Nason Creek	
1	Mouth to Coles Corner	0.0 - 7.0
2	Coles Corner to Butcher Pond	7.0 - 14.3
3	Butcher Pond to Rayrock	14.3 – 20.0
4	Rayrock to Whitepine Creek	20.0 – 22.0
	Wenatchee River	
1	Mouth to Cashmere Park	0.0 – 13.4
2	Cashmere to Dryden Dam	13.4 – 28.0
3	Dryden Dam to Boat Ramp	28.0 – 38.0
4	Boat Ramp to Leavenworth Bridge	38.0 – 41.7
5	Leavenworth Br. to Tumwater Bridge	41.7 – 56.2
6	Tumwater Bridge to Plain Bridge	56.2 – 69.2
7	Plain to Lake Wenatchee	69.2 – 86.0
	Beaver Creek (WEN)	
1	Mouth to Acclimation Pond	0.0-2.4
	Brender Creek	
1	Mouth to Mill Road	0.0 - 0.3
	Chiwaukum Creek	
1	Mouth to Hwy 2 Bridge	0.0 – 1.0
	Chiwawa River	
1	Mouth to Weir	0.0 – 1.0
	Chumstick Creek	
1	Mouth to North Road	0.0 – 0.5
	Mission Creek	
1	Mouth to Residential Area	0.0 – 1.0
	Peshastin Creek	
1	Mouth to YN Office	0.0 – 3.5
2	YN Office to Mountain Home Road	3.5 – 8.0
3	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 2009, YN identified a total of 1,601 redds in the Wenatchee River basin. The majority of redds (*n*=1,586) were identified below Tumwater Canyon from the mouth of the Wenatchee River, upstream to the town of Leavenworth. Upstream of Tumwater Dam, a total of 15 redds were identified, with 14 of those redds being located in Nason Creek. Low coho spawning escapement above Tumwater Dam resulted from an increase in broodstock collections at this facility as we continue to implement Broodstock Development Phase II (YN FRM 2009). In addition to increased collection efforts, it is theorized that a velocity barrier may exist below Tumwater Dam which may inhibit migrants from accessing the upper watershed. YN collected 1,033 spawned carcasses for an overall sample rate of 30.8% in the Wenatchee River basin (Table 8).

Table 8. Summary of Wenatchee River coho redd counts, distribution and carcass recovery in 2009. Sample rate based on sex ratio of 1F:1.1M.

River	Number of Redds	Proportion of Redds in Basin	Recovered Carcasses	Sample Rate
Beaver Creek	1	0.1%	0	0.0%
Brender/Mission Creeks	72	4.5%	24	15.9%
Chiwaukum Creek	0	0.0%	0	0.0%
Chumstick Creek	0	0.0%	0	0.0%
Icicle Creek	818	51.1%	563	32.8%
Nason Creek	14	0.9%	2	6.8%
Peshastin Creek	214	13.4%	56	12.5%
Wenatchee River	482	30.1%	387	38.2%
Total	**1,601**	**100%**	**1,033**	**30.8%**

Of the 1,033 carcasses sampled, 836 coded wire tags (CWT) were recovered in the Wenatchee River subbasin during 2009 (Table 9). Analysis revealed that of these CWT'ed fish, 33.4% were from fish released into upper Wenatchee River tributaries as juveniles; 65.8% were from fish released into lower Wenatchee River tributaries as juveniles; and 0.8% from fish outside the basin. Scale analysis determined that of the remaining 197 carcasses recovered without CWTs, 79.7% were of unknown hatchery origin, 10.2% were of natural origin, and 10.2% were undetermined (Table 10).

Table 9. Summary of coded-wire tag analysis from adult coho carcasses recovered throughout the Wenatchee River basin in 2009.

Juvenile Rearing/Release	# of CWT's Recovered	Spawning Location/CWT Recovery			
		Lower Basin		Upper Basin	
Beaver Pond	52	Icicle	18	Wenatchee	1
		Mission	1		
		Peshastin	4		
		Wenatchee	28		
Butcher Pond	105	Icicle	31		
		Mission	5		
		Peshastin	7		
		Wenatchee	62		
Coulter Pond	34	Icicle	18		
		Mission	1		
		Peshastin	1		
		Wenatchee	14		
Nason Wetlands	7	Icicle	2		
		Wenatchee	5		
Rolfing's Pond	81	Icicle	29		
		Mission	3		
		Peshastin	2		
		Wenatchee	47		
LNFH LFL's 1&2	215	Icicle	137		
		Mission	3		
		Peshastin	12		
		Wenatchee	63		
LNFH SFL's 9&10	86	Icicle	56		
		Mission	2		
		Peshastin	4		
		Wenatchee	24		
LNFH SFL's 11,12,24,25	171	Icicle	119		
		Mission	1		
		Peshastin	8		
		Wenatchee	43		
LNFH SFL's 20-30	78	Icicle	57		
		Mission	1		
		Peshastin	2		
		Wenatchee	18		
WELLS	3	Peshastin	1		
		Wenatchee	2		

WNFH	3	Peshastin	1	
		Wenatchee	2	
Unknown	1	Wenatchee	1	
Other Basin Total			**7**	**0**
Grand Total			**828**	**1**

Table 10. Scale analysis results of carcasses recovered without CWTs in the Wenatchee River basin, 2009.

Carcass Recovery Location	Origin			
	Unknown Hatchery	Naturally Spawned	Unknown	TOTAL
Icicle Creek	73	13	8	94
Mission Creek	6	1	0	7
Nason Creek	2	0	0	2
Peshastin Creek	13	0	1	14
Wenatchee River	62	6	11	79
White River	1	0	0	1
Total	**157 (79.7%)**	**20 (10.2%)**	**20 (10.2%)**	**197**

3.1.1 Icicle Creek

YN conducted nine weekly spawning ground surveys in the main channel (hatchery to mouth) of Icicle Creek between October 7 and December 2 (Figure 5); weekly surveys were conducted on 10 occasions in the restored side channel (headgate to hatchery) between October 4 and December 10. YN recorded 636 redds in the main channel and 182 redds in the restored channel (Icicle Creek total = 818). Redds recorded in Icicle Creek represented 51.1% of the total number of redds found in the Wenatchee River basin (Table 8).

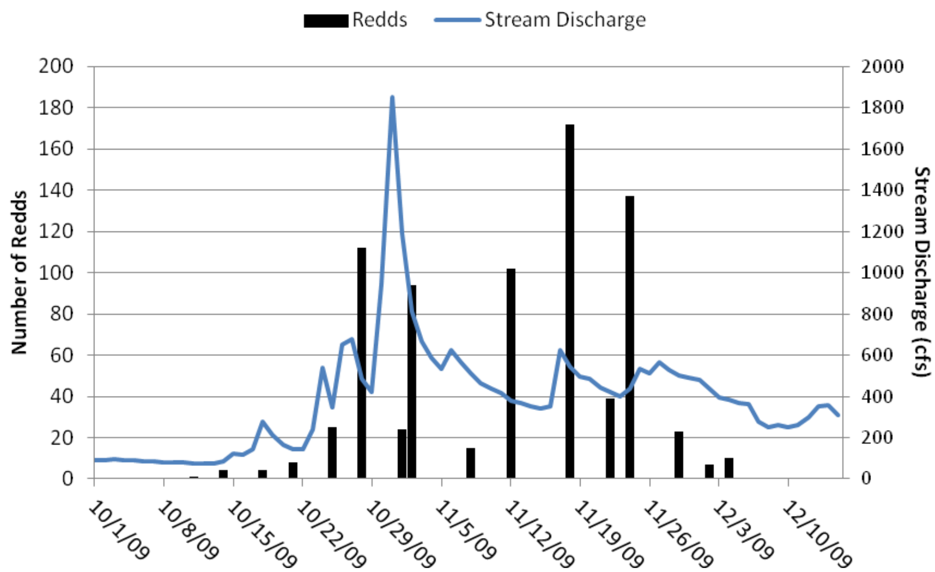

Figure 5. Weekly redd counts conducted in Icicle Creek with mean daily stream discharge from Oct. 1 through Dec. 15, 2009.

YN recovered 563 coho carcasses from Icicle Creek for a sample rate of 32.8% during 2009 surveys. Heavy precipitation and a substantial increase in stream discharge on October 31 resulted in a temporary decline in spawning activity for approximately one week. As flows subsided in November, spawning increased and then peaked during the second week of November.

The mean POH lengths for male and female carcasses were 52.9cm (*n*= 437; *SD*= 3.9) and 49.3cm (*n*= 110; *SD*= 5.2), respectively. All females with intact body cavities were examined for the presence of eggs. Mean egg voidance was 94.1% (*n*= 300). A total of 94 carcasses did not possess CWTs (Table 10).

3.1.2 Nason Creek

Nine spawning ground surveys were conducted in Nason Creek between October 5 and December 8; a total of 14 redds were recorded (Table 8). Nason Creek redds represented 0.9% of the coho redds identified in the Wenatchee River basin. Two male carcasses were recovered for a sample rate of 6.8%. The POH of one male was 41cm; the other was badly decomposed and a length measurement was not possible. Scale analysis revealed that both were of unknown hatchery origin (Table 10).

3.1.3 Wenatchee River

A total of 482 redds were recorded during 55 surveys (result of multiple reach surveys during any given week) of the mainstem Wenatchee River from Lake Wenatchee to the Columbia River confluence, between September 30 and January 9 (Table 8). Redds located on the mainstem Wenatchee River accounted for 30.1% of the total observed coho redds in the Wenatchee River basin. YN recovered 387 carcasses along the mainstem Wenatchee for a sample rate of 38.2%. The mean POH lengths for male and female carcasses were 49.4cm (*n*= 92; *SD*= 3.7) and 49.4cm (*n*= 229; *SD= 5.5*), respectively. Egg voidance was 91.8% (*n*= 56) among females. A total of 79 carcasses did not possess CWTs (Table10).

3.1.4 Mission/Brender creeks

YN conducted 12 surveys of Mission/Brender Creeks between September 26 and December 4 and recorded 72 redds. Redds located in Mission and Brender Creeks represented 4.5% of the total number of coho redds recorded in the Wenatchee River basin (Table 8). YN recovered 24 carcasses for a sample rate of 15.9%. The mean POH lengths for males and females were 48.1cm (*n*= 10; *SD*= 4.2) and 50.8 cm (*n= 9*; *SD*= 4.5), respectively. Egg voidance was 84.4% (*n*= 11). A total of seven carcasses did not possess CWTs (Table 10).

3.1.5 Peshastin Creek

YN conducted 14 surveys on Peshastin Creek and recorded 214 coho redds between September 9 and December 2 (Table 8). Fifty six carcasses were recovered for a sample rate of 12.5%. Redds located in Peshastin Creek represented 13.4% of the coho redds recorded in the Wenatchee River basin. The mean POH lengths for males and females were 48.0cm (*n= 14; SD= 4.5*) and 51.0 cm (*n*= 31; SD= 4.7), respectively. Egg voidance was 93.1% among females sampled (*n*= 16). A total of 14 carcasses did not possess CWTs (Table 10).

3.1.6 Other Tributaries

Surveys were also conducted in Beaver Creek between October 10 and November 21. A single redd was discovered in Beaver Creek; no carcasses were recovered. Surveys were also conducted in Chiwaukum and Chumstick creeks. No redds were identified and no carcasses were recovered from these tributaries. Fish from the Methow River coho population were recovered in Peshastin Creek (*n*= 2) and Wenatchee River (*n*= 4; Table 9). A single male carcass without a CWT was recovered in the White River (Table 10).

3.2 METHOW BASIN REDD COUNTS

In the Methow River basin, a total of 269 coho redds were identified. The majority of redds observed (n=151; 56.1%) were located within the mainstem while the remaining (n=118; 43.9%) were identified in select tributaries including Spring Creek and Methow FH outfalls. The majority of redds (n= 98; 64.9%) observed on the mainstem Methow River were found within the lower reaches, below RK 33.9. A total of 212 carcasses were collected for an overall basin sample rate of 32.8% (Table 11).

Spawning ground surveys were also conducted within select tributaries located in proximity both above and below Wells Dam. These were initiated in an effort to account for adults returning from 2008 Wells FH releases selecting spawning habitat in tributaries near their release point. A total of 14 redds were identified and 16 carcasses were sampled for an overall, out-of -basin sample rate of 63.5% (Table 12).

Table 11. Summary of coho redds, distribution, and carcass recovery in the Methow River basin in 2009. Sample rate based on a sex ratio of 1F:1.4M.

River	Number of Redds	% of Redds in Methow Basin	Recovered Carcasses	Sample Rate %
Methow River	151	56.1%	142	39.2%
Winthrop NFH Spring creek	77	28.6%	60	32.5%
WDFW Outfall	35	13.0%	9	10.7%
Twisp River	0	0.0%	0	0.0%
Beaver Creek	2	0.7%	0	0.0%
Chewuch River	0	0.0%	0	0.0%
Gold Creek	3	1.1%	0	0.0%
Libby Creek	1	0.4%	1	41.7%
Total	**269**	**100%**	**212**	**32.8%**

Table 12. Summary of coho redd counts, distribution, and carcass recoveries in non-target tributaries for 2009. Sample rate based on a sex ratio of 1.0F:0.8M as observed at Wells Dam.

River	Number of Redds	% of Redds Out-of-Basin	Recovered Carcasses	Sample Rate %
Beebee Springs	12	85.7%	9	41.7%
Chelan River	0	0.0%	6	0.0%
Foster Creek	2	14.3%	0	0.0%
Okanogan River	0	0.0%	1	0.0%
Total	**14**	**100.0%**	**16**	**63.5%**

Table 13. Summary of coded-wore tag analysis from coho carcasses recovered in the Methow subbasin and non-target, out-of-basin tributaries in 2009.

Juvenile Release Location	# of CWTs	Adult Recovery Location*	# of CWTs
Winthrop NFH Female	78	Spring Creek	25
		WDFW outfall	3
		Methow	47
		Libby Creek	1
		Out of basin	2
Winthrop NFH Male	47	Spring Creek	17
		WDFW outfall	2
		Methow	27
		Out of basin	1
Winthrop NFH back-channel Female	16	Spring Creek	5
		WDFW outfall	1
		Methow	10
Winthrop NFH back-channel Male	2	Spring Creek	1
		Methow	1
Wells FH Female	19	Methow	18
		Out of basin	1

		Methow Other basin	15 9
Leavenworth NFH Female	1	Methow	1
Leavenworth NFH Male	1	Out of basin	1
Out of Basin Total			**14**
Grand Total			**189**

3.2.1 Methow River

Methow River redd surveys in 2009 occurred between October 14 and December 15. The 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). The majority of main-stem surveys were suspended between November 25 and December 6 due to inclement weather conditions (e.g. sub-zero temperatures, non navigable survey reaches due to ice accumulation).

Of the 151 coho redds identified on the mainstem, 64.9% (*n*=98) were located in reaches M1-M4 (RK 0.0-33.9) while the remaining 35.1% (*n*=53) were distributed in the middle and upper reaches M5-M11 (RK 33.9-98.6). The high proportion of redds identified within the lower reaches of the Methow River was attributed to adults returning from the Wells FH 2008 release demonstrating the ability to migrate to preferred habitat upstream of their release point. This "overshooting" could exhibit an innate adaptation in effectively utilizing energy reserves originating from multiple generations of locally adapting families and be a testament to the success of the broodstock development process. Data collected from recovered carcasses and subsequent coded-wire tag analysis indicated that 35.0 % (*n*=29) of carcasses found within the first four reaches (RK 0.0 – RK 33.9) originated from this Columbia River release.

Fifty-four males and eighty-eight females were sampled with a mean FL of 68.3cm (*SD*=5.5) and 65.2cm (*SD*=4.3) and a POH of 49.5cm (*SD*=4.0) and 53.5cm (*SD*=4.8), respectively. All females with intact body cavities (*n*=88) were examined for the presence of eggs. Mean egg voidance for females recovered was 70.5%. Nineteen of these females possessed intact egg skeins and were determined to be pre-spawn mortalities. The sample rate for the mainstem Methow River was 39.2% (Table 11).

Coded-wire tag analysis indicated that 52.1% (27 M and 47 F) originated from the 2008 Winthrop NFH on-station release, 23.2% (15 M and 18F) originated from the 2008 Wells FH release, 7.7% (1 M and 10 F) originated from the 2008 Winthrop NFH back-channel release, 0.7% (1 F) originated from the 2008 Leavenworth NFH release, 16.2% (*n*=23) were either lost during extraction, un-readable or did not possess a CWT. Scale analysis determined that of these 23 fish, 14.1% (7 M and 13 F) were of unknown hatchery origin and 2.1% (2 M and 1 F) were of natural origin. For a summary of coded-wire-tag origins from coho carcasses recovered throughout the Methow River basin in 2009, please refer to Table 13.

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

Spring Creek and Methow FH outfall were surveyed weekly beginning October 19 and ending December 16. The first redds found in both locations were observed on October 19. Winthrop NFH (on-station and back- channel pond) was the only coho release site within the Methow River basin in 2008, resulting in unnaturally high spawning densities surrounding the hatchery outfall. Similarly, high spawning densities were observed around the outfall to the Methow FH. Although coho were not released from the Methow FH, the facilities' proximity to one another (< 2.0 RK) and use of the same surface water source (Spring Creek via Foghorn Irrigation Diversion) produced very similar imprinting signatures. Limited spawning habitat within these outfalls presumably contributed to low egg-to-immigrant survival due to superimposition of nesting adults and potential competition for food and space as juveniles through limited rearing habitat.

A total of 77 redds were located within Spring Creek between October 19 and December 15. These redds accounted for 28.6% of all coho redds identified within the basin and 65.3% of all Methow basin tributaries (Table 11). Twenty-two males and thirty-eight females were sampled with a mean FL of 68.0cm (*SD*=7.7) and 66.1cm (*SD*=5.2) and a POH of 47.6cm (*SD*=5.0) and 48.3cm (*SD*=3.7), respectively. Coded wire tag analysis revealed that 70.0% (17 M and 25 F) originated from the WNFH on-station releases, 10.0% (1 M and 5 F) originated from the Winthrop NFH back-channel release and 20.0% (4 M and 8 F) were either lost during extraction, un-readable or did not possess a CWT (Table 13). Scale analysis from unknown carcasses recovered determined that 15.0% (2 M and 7 F) were of unknown hatchery origin and 5.0% (2 M and 1F) were of natural origin. Mean egg voidance was 86.2% and the carcass sample rate was 32.5% for Spring Creek.

Thirty-five redds were identified in the Methow FH outfall between October 19 and December 16. These redds accounted for 13.0% of all redds found in the Methow basin and 29.7% found within tributaries (Table 11). Three males and six females were sampled with a mean FL of 66.3cm (*SD*=13.9) and 59.7cm (*SD*=9.9) and a POH of 49.0cm (*SD*=7.9) and 50.7cm (*SD*=8.5), respectively. Coded wire tag analysis revealed that 55.6% (2 M and 3 F) originated from the 2008 Winthrop NFH on-station release, 11.1% (1 F) originated from the 2008 Winthrop NFH back-channel release, 11.1% (1 M) originated from 2008 Wells FH release and 22.2% (2 F) did not possess a CWT. Scale analysis determined that both females were of unknown hatchery origin. Egg voidance was 82.8% and the carcass sample rate was 10.7% for the Methow FH outfall.

3.2.3 Chewuch River

Chewuch River surveys were conducted as three reaches from RK 13.2 to the confluence of the Methow River between October 20 and December 6. Surveys were suspended between November 18 and December 5 due to hazardous winter weather conditions. There were no redds identified, live fish observed, or carcasses recovered within this reach.

3.2.4 Twisp River

Surveys on the Twisp River were conducted as three reaches from RK 11.2 to the confluence of the Methow River between October 20 and December 6. Surveys were suspended between November 18 and December 5 due to hazardous winter weather conditions. There were no redds identified, live fish observed, or carcasses recovered within this reach.

3.2.5 Libby Creek

Libby creek surveys were conducted as one reach (RK 1.00 - confluence of Methow River) and occurred between October 19 and December 6. One redd was located within Libby Creek and accounted for 0.4% of the total redds found in the Methow basin and 0.8% found within tributaries (Table 10). Three live fish observed and one female carcass was sampled with a FL of 72.0cm and a POH of 55.0cm. Coded wire tag analysis indicated the female originated from the Winthrop NFH on-station release in 2008 (Table 13). The one female sample was void of eggs and the carcass sample rate was 41.7%. This was the third recorded coho redd observed in Libby creek since comprehensive surveys were initiated in 2005.

3.2.6 Beaver Creek

Beaver Creek surveys were conducted as one reach from RK 1.4 to the confluence of the Methow River between October 19 and December 6. Two redds were identified and two live fish were observed; carcasses were not found. Redds located in Beaver Creek represented 0.7% of the total redds found in the Methow basin and 1.7% found within tributaries.

3.2.6 Gold Creek

Gold Creek was surveyed once from RK 1.65 to RK 2.21 as a "spot-check" from an adjacent public road due to private property boundaries. We are currently working with various landowners in an effort to gain full access so that complete reach surveys can be conducted. Three redds were located and two live fish were observed on November 4. Redds located in this reach represented 1.1% of the total redds found within the Methow basin and 2.5% found within tributaries.

3.2.7 Chelan FH Outfall and Chelan Falls

In 2009, YN continued survey efforts in areas downstream and upstream of Wells Dam to account for fish returning from 2008 release to include Wells FH smolt releases as well as document dropouts associated with in-basin releases. Surveys were conducted once before, during, and after peak spawn between October 14 and November 12 so that increased focus could be given to the target basin. Areas surveyed included Chelan FH outfall (Columbia RK 808; Beebee Springs), Chelan Falls (Columbia RK 806) and Foster Creek (Columbia RK 870).

Redds identified within Chelan FH outfall accounted for 85.7% (n=12) of the total redds found outside the Methow basin (Table 12). Five males and four females were sampled with a mean FL of 64.6cm (SD=8.3) and 66.5cm (SD=2.4) and a POH of 44.0cm (SD=5.8) and 49.8cm (SD=1.5), respectively. Two of these females were found with intact egg skeins and considered to be pre-spawn mortalities. Coded wire tag analysis indicated that 55.6% (n=5) originated from the 2008 Wells FH releases, 22.2% (n=2) originated from the Winthrop NFH on-station 2008 release, 11.1% (n=1) originated from the 2008 Leavenworth NFH on-station release and 11.1% (n=1) did not possess a CWT (Table 13). Scale analysis determined the non-CWT'ed fish to be of an unknown hatchery origin. Mean egg voidance was 45.4% and the carcass sample rate was 41.7%.

The Chelan River is a fast flowing, large body of water connecting Lake Chelan to the Columbia River. The lowermost portion of this river is where summer Chinook and coho spawn concurrently. The high abundance of spawning summer Chinook prevented YN staff from accurately documenting coho redds in 2009. In past years, surveys conducted after peak summer Chinook spawning allowed for a higher probability of discerning coho redds, however persistent, high densities of these fish prohibited coho redd identification. Six male carcasses were sampled with a mean FL of 66.7cm (SD=6.3) and a POH of 48.2cm (SD=5.49). Coded wire tag analysis revealed that 83.3% (n=5) originated from the 2008 Wells FH release and 16.7% (n=1) originated from the 2008 Winthrop NFH on-station release (Table 13).

3.2.8 Foster Creek

Foster Creek, located at the base Chief Joseph Dam (RK 870) on the left bank of the Columbia River, was surveyed once during peak spawn on November 3. Two redds were identified and three live fish were observed on November 3. This is the second year since the inception of the program that spawning activity was observed at this location. Zero carcasses were recovered. Redds identified within Foster Creek accounted for 14.3% found outside the Methow basin.

3.2.9 Okanogan River

One male carcass was recovered from BioAnalyst personnel during summer Chinook surveys in the Okanogan River (RK 47.5). No CWT was found due to predation; subsequent scale analysis determined the adult was of unknown hatchery origin. This was the second consecutive year (one female found in the Similkameen River in 2008) adult coho have been observed in the Okanogan River basin and may offer another example of a potential increase in energetic fitness as a result of the broodstock development process.

3.2.10 Other Tributaries

Surveys were also conducted on Hancock Springs Creek and Wolf Creek; zero coho redds, carcasses or live fish were observed. Survey reaches within these tributaries can be found in Table 7.

SUMMARY

• During spawning ground surveys in Icicle Creek, we observed 818 coho redds and recovered 564 coho carcasses. The mean egg voidance was of 94.1% (*n*=300).

• During spawning ground surveys in Nason Creek, we counted 14 coho redds and 2 carcasses were recovered; both males.

• Aside from Icicle Creek, we found a total of 768 redds in the lower Wenatchee River basin. A total of 467 carcasses were recovered in Mission/Brender Creeks (*n*= 24), Peshastin (*n*= 56), and the mainstem of the lower Wenatchee River (*n*= 387).

• A total of 283 redds were identified and 228 carcasses were recovered in both the Methow River basin and out-of-basin tributaries in 2009. A total of 269 redds and 212 carcasses were located within the Methow River basin while 14 redds and 16 carcasses were identified outside the target watershed.

• Spawning distribution data in the Methow River basin demonstrated that of the 151 redds observed in the mainstem Methow River, 64.9% (*n*=98) were located within the lower reaches (RK 0.0 - 33.90) while 35.1% (*n*=53) were located in the middle and upper reaches (RK 33.90 – 98.6). Redds identified within tributaries accounted for 43.9% (*n*= 118) of all redds observed in the Methow basin.

4.0 SMOLT ACCLIMATION: WENATCHEE AND METHOW

4.1 ACCLIMATION SITES

In 2010, within the Wenatchee River basin, YN acclimated coho pre-smolts at the LNFH, Beaver Creek, and four sites on Nason Creek. For the Methow River broodstock development program, YN acclimated coho pre-smolts at Winthrop NFH, Winthrop NFH back-channel pond, the Twisp Ponds Complex (Twisp ponds), and Wells FH.

4.1.1 Leavenworth National Fish Hatchery

LNFH is located at RK 4.5 on Icicle Creek. Coho smolts were acclimated in refurbished raceways, also known as small and large Foster-Lucas (SFL & LFL) ponds. Originally, these Foster-Lucas ponds were designed for rearing steelhead, sockeye, and spring Chinook. The intent for the oval-shape design was to create a low-maintenance raceway. These ponds were discontinued by USFWS staff due to insufficient turnover rates and maintenance difficulties in favor of more widely used 8x100 and 10x100-foot raceways. Both the SFL's and LFL's were partially refurbished by Yakama Nation Fisheries and supplied with re-use water for coho acclimation. The water source for the LFL's originates from the hatchery's 10'x100' juvenile spring Chinook raceway effluent. Re-use water supplied to the SFL's was pumped from a sump below the adult holding ponds, which doubles as a rearing/acclimation pond for juvenile spring Chinook until release in late-April. Water to each Foster-Lucas pond was manually adjusted to achieve flow requirements needed for coho densities on-hand. In 2010, acclimation for both coho and spring Chinook was extended until the end of April.

4.1.2 Beaver Creek

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

4.1.3 Nason Creek

In 2010, acclimated coho pre-smolts were reared and released from four sites on Nason Creek; Butcher Creek, Coulter Creek, Rohlfing's Pond and the Nason Creek Wetlands. All acclimation sites in Nason Creek are natural or semi-natural earthen ponds. Natural and earthen ponds may have advantages over conventional, hatchery raceways by providing lower rearing densities, access to a variety of invertebrates for diet supplementation and other improved environmental conditions (e.g. natural temperature and flow regimes, increased water quality, volitional pond migration, etc.) that should produce a juvenile with adequate imprinting capabilities and persist during springtime rearing and subsequent downstream migration.

4.1.3.1 Rohlfing's Pond

Rohlfing's Pond acclimation site is located on an unnamed, seasonal creek which connects to the lower end of Mahar Creek before reaching Nason Creek at RK 20.3. This earthen pond was constructed and developed by the property owner. In 2003, to create a more suitable acclimation environment, YN enlarged the pond and planted native riparian vegetation. Again in 2010, the pond was enlarged and native riparian vegetation planted. This expansion was largely to facilitate a multi-species acclimation opportunity with ESA listed steelhead as a part of the YN's Expanded and Multispecies Acclimation project (BPA Project #-2009-001-00). Pond flow and area 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. Two passive integrated transponder (PIT) tag detection systems were installed in 2010 to monitor the release and provide emigration timing, determine residence time, calculate in-pond survival and provide accurate release numbers for a smolt-to-smolt survival analysis (Section 4.4 and 5.0).

4.1.3.2 Coulter Pond

The Coulter Pond acclimation site is located at RK 1.6 on Coulter Creek. Fish released from Coulter Pond immigrate through the Nason Creek Wetlands at the easternmost point of the complex just prior to entering Nason Creek at RK 13.7. This natural beaver pond contains multiple braided channels which coalesce into one, large, widened waterway. We used a barrier net to encircle the majority of the channel to try and ensure containment during the acclimation period. Upon release, a 10-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 affect 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, which was once the original channel of Nason Creek, is now a beaver pond at the mouth of Butcher Creek. Coho smolts were volitionally released directly into Nason Creek from the pond. Prior to transportation, a net was placed upstream of the beaver's natural barrier to contain coho during acclimation. Floating and submerged structures were installed to provide protection from predators and reduce in-pond stress.
Two PIT tag detection systems were installed in 2010 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 Roaring and Coulter creeks and was purchased by YN in 2005 through Pacific Coastal Salmon Recovery Funds (PCSRF) to preserve wetland habitat. These creeks converge to form a complex series of natural beaver ponds that eventually empty into Nason Creek at RK 13.7. In 2010, coho smolts were contained within a portion of the wetland with a barrier net and acclimated three weeks (Table 13). The fish released into the complex were allowed to volitionally immigrate into Nason Creek. Returning survival for this release was minimal and alterations are being discussed to include a more conventional acclimation program. Plans are being developed to provide short-term, springtime acclimation within the wetlands in 2011 which would encompass partitioning off a small portion of the wetland with a seine while providing unimpeded upstream and downstream movement of endemic stocks.

4.1.4 Winthrop National Fish Hatchery (Winthrop NFH)

Coho smolts released into the Methow River from Winthrop NFH, located at RK 80.6, were acclimated from the fingerling stage to release within five on-station raceways as well as the Winthrop NFH back-channel pond. The back-channel pond is located on Spring Creek (Winthrop NFH outfall) and functions as a semi-natural acclimation site. Prior to acclimation, a one piece, net canopy was installed over the back-channel acclimation pond. Floating covers were also installed to enhance the rearing environment by providing cover and shade. Two PIT tag detections systems were installed in series below the outfall of the back-channel acclimation pond. In addition, United States Fish and Wildlife Service (USFWS) personnel installed a Multi-plex PIT tag detection system with two "hybrid" antennas downstream of YN's detection systems in early March to assess effectiveness and potential future use. This system will function as the primary PIT tag data monitoring system in future years; which will be essential for managing the large number of PIT tags deployed from the Winthrop NFH complex.

4.1.5 Wells Fish Hatchery

In 2010, coho were acclimated at Wells Fish Hatchery (FH) located at RK 829.0 on the Columbia River. Wells FH is funded by Douglas County PUD and operated by WDFW. Under contract with YN, WDFW acclimated coho pre-smolts within an on-station, concrete holding pond that was previously used to rear summer Chinook. Coho acclimated and released at Wells FH in 2010 were intended to assist broodstock development phases until additional acclimation facilities were permitted within the Methow River basin. Adults returning from Wells FH releases will provide a backup brood source, should a broodstock shortfall occur at the targeted collection facilities.

4.1.6 Twisp Ponds Complex (Twisp ponds)

Twisp Ponds, located at RK 1.6 on the Twisp River, functions as a semi-natural acclimation facility that is owned and operated by the Methow Salmon Recovery Foundation (MSRF). The site was constructed in 2004 and comprised of a series of five ponds. The pond complex receives surface water from the Twisp River at an inlet, located at RK 2.5, just upstream of the first pond. A ground water pump system is also available for use if needed. Coho acclimation occurs in the furthest downstream pond. The pond is approximately 42.0 meters in length and includes a small outlet back to the Twisp River. Coho acclimation at this location is intended to help reach phased goals (YN FRM 2009) by increasing in-basin production. Prior to fish arrival, additional large woody debris (LWD) and shade covers were placed within the ponds to enhance rearing conditions and minimize predation. In addition, three automatic, sensory triggered sprinklers were installed to deter predation. Acclimation at this location in 2010 marked the second consecutive year the ponds were utilized by the MCCRP.

4.2 TRANSPORTATION AND VOLITIONAL RELEASE

4.2.1 Wenatchee River Basin

Mid-Columbia coho pre-smolts (BY2008) were transported to the Wenatchee basin from rearing facilities at Willard NFH and Cascade FH between October 28, 2009 and April 6, 2010. Coho were acclimated between 4 and 25 weeks at six acclimation sites within the Wenatchee River basin (Table 14). SFLs 8-12 were acclimated 25 weeks, with fish in SFLs 8 and 9 being transferred to Nason Wetlands for the final month of acclimation. These fish were part of an ongoing evaluation to determine whether extended imprinting to basin-specific water, albeit not the final acclimated source, would result in improved return rates to the Wenatchee River subbasin.

All coho smolts acclimated at LNFH were force-released between April 19, 2010 and April 23, 2010. During 2010, coho acclimated at LNFH presented several fish health challenges. Several ponds were infected with *Trichodina sp.* and *Flavobacterium psychrophilum* (bacteria coldwater disease; BCWD). Timely treatment of these infections and culling of diseased fish significantly reduced the potential mortality that would have occurred if gone unchecked.

Volitional releases began at the Nason Creek Wetlands, Butcher Creek Pond, Coulter Creek Pond, Rohlfing's Pond, and Beaver Creek Pond between April 28 and May 7. All acclimation facilities were deemed empty by June 16.

Coho released in 2010 were CWT'ed with a 97.9% retention rate (*n*=13,005). In addition to CWTs, all upper Wenatchee basin released coho (*n*=461,638) had a secondary, blank wire inserted into the adipose region with 94.1% retention (*n*=8,000). This secondary mark will provide a means to implement Broodstock Development Phase II (YN FRM 2009) by allowing for returning adults to be selectively passed at the Dryden Dam broodstock collection facility (lowermost brood collection point) for potential recapture at Tumwater Dam (uppermost brood collection point). If we can demonstrate that a sufficient proportion of adults (# of trappable adults to achieve 50% of broodstock needs) can navigate to and above Tumwater Dam, it would trigger specific management objectives towards establishing a viable, natural population within the upper watershed, as designed through YN's reintroduction phased approach.

In 2010, 22,501 coho juveniles were marked with PIT tags. Of these, 10,796 PIT tagged fish were released from LNFH, 5,891 from Butcher Creek Pond, and 5,814 from Rohlfing's Pond (Table 14). These PIT tagged fish were used to measure survival from release to McNary Dam and determine in-pond survival at select acclimation sites (see Section 4.4). A minimum of two PIT tag detection systems were installed in series at each of the upper basin acclimation sites (Butcher Pond and Rohlfing's Pond) to ensure maximum detection efficiency.

A total of 1,025,622 hatchery produced coho smolts were released from the Wenatchee River basin in 2010. Release numbers, size-at-release, and release locations can be found in Table 13. For detailed mark and release information, please see Appendix C.

4.2.2 Methow River Basin

In the Methow basin, Mid-Columbia River juveniles (BY2008) were acclimated at Winthrop NFH (on-station releases), Winthrop NFH back-channel pond, and the Twisp ponds. Juvenile coho were transported from Willard NFH to the Winthrop NFH back-channel and Twisp ponds for acclimation on March 22 and April 6, respectively. All juvenile releases were 100%, 2nd generation MCR progeny from the Methow program.

On April 20 at Winthrop NFH, elevated mortality, as a result of a re-emergence of BCWD, initiated an early release in raceway C-12. The remaining four raceways were force released on April 23. Volitional releases were initiated at the Winthrop NFH back-channel and Twisp ponds on April 29 and May 8, respectively. Releases concluded on June 14 when snorkel observations determined both ponds empty. All releases were 100% CWT'ed but retentions for juveniles at Winthrop NFH were not conducted in 2010. In past years, USFWS staff conducted these retentions; YN will assume responsibility beginning in 2011. CWT retentions from juveniles acclimating within the Winthrop NFH back-channel and Twisp ponds were 95.6% (*n*=1,039) and 95.3% (*n*=1,005), respectively. Release summary information is provided in Table 14.

In 2010, 10.2% (*n*= 5,993) and 2.3% (*n*= 5,958) of juveniles released from the back-channel and on-station raceways were PIT tagged and will be used to evaluate metrics measuring release to McNary Dam survival, in-pond survival, and downstream migration timing (see section 4.4 and 5.0).

Coho pre-smolts were transported by Oregon Department of Fish and Wildlife (ODFW) to Wells FH on March 8 at 23.6 fpp and acclimated for approximately six weeks until released on April 21 at 13.8 fpp (Table 14). CWT retentions were 95.2% for this release group (*n*=1,032).

A combined total of 529,984 Methow coho juveniles were released in 2010 (Table 14). The 2010 juvenile releases marked the third consecutive year that 100% of the smolts were progeny of locally returning adults. The development of a local broodstock is critical for achieving program goals within the Methow River basin (YN FRM 2009). For detailed mark information, see Appendix C.

Table 14. Mid-Columbia coho juvenile release summary, 2010.

Location	Release Date	Release Number	Size @ release (FPP)	No. PIT Tags
Beaver Pond	April 29	114,539	13.9	0
Coulter Creek	May 7	64,128	17.4	0
Rolfing's Pond	May 7	85,045	16.7	5,814
Butcher Pond	May 7	140,345	15.7	5,891
Nason Creek Wetlands	April 28	54,140	18.9	0
Leavenworth NFH LFL's (large Foster-Lucas Ponds)	April 22	209,262	16.4	5,483
Leavenworth NFH SFL's (small Foster-Lucas Ponds)	April 19	358,163	17.2	5,313
Wenatchee Total		**1,025,622**		**22,501**
Winthrop NFH (on-station)	April 23	258,077	16.9	5,958
Winthrop NFH (back-channel pond)	April 29	58,976	14.2	5,993
Twisp Ponds Complex	May 8	86,669	14.1	0
Wells FH	April 21	126,262	13.8	0
Methow Total		**529,984**		**11,958**
Wenatchee/Methow Totals		**1,559,426**		**34,449**

4.4 PREDATION ASSESSMENT

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

4.4.1 Estimated Mortality-Predator Consumption Model versus PIT tag Detection

4.4.1.1 Predation Model

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

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

C_e= Estimated consumption for an individual predator

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

FPP= Fish per pound

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

D_p= Duration of same species predators observed

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

Various predators were observed at all of the upper basin acclimation locations. YN personnel estimated predation in order from least to greatest in the following ponds: Rohlfings Pond, Beaver Creek Pond, Butcher Creek Pond, Nason Wetlands, and Coulter Creek Pond. Coulter Creek Pond had the second lowest number of sightings yet the highest amount of predation; a result of multiple river otters observed. Once a river otter is observed, regardless if there are subsequent sightings, it is assumed that individuals continue to prey on juveniles until all the fish have emigrated from the pond. In addition to river otter, juveniles in Coulter Creek Pond were preyed on by hooded mergansers, belted kingfishers, mallard ducks, great blue heron, and osprey. Butcher Creek Pond had the third lowest amount of predation but had the greatest number of predator sightings. This was caused by piscivorous avian predators which included hooded mergansers, belted kingfishers, blue herons, and mallard ducks. Observed predators at LNFH included great blue heron, osprey, and mallard duck. Estimated predation was much higher in the SFL's than the LFL's primarily caused by exposing the coho to six months of pressure in contrast to the LFL's that were only exposed two months.

Comment [CK1]: Greatest number of predators sighted but I count 5 including otters…..look at Coulter, I count 6 different predators. Also, include something about the other sights, even if brief.

In the Methow basin, species of piscivorous avian and mammalian predators observed at acclimation locations included both common and hooded mergansers, belted kingfishers, blue herons, mallards, mink, and osprey. Predator sightings were highest at the Twisp ponds; primarily belted kingfishers and blue herons. Observed predation at Winthrop

NFH on-station raceways and Winthrop NFH back-channel pond continues to be significantly less than in years prior to 2009 and may be attributed to the protection provided by custom, predation netting installed in 2008. Common mergansers, belted kingfishers and blue herons were the most commonly observed at this location.

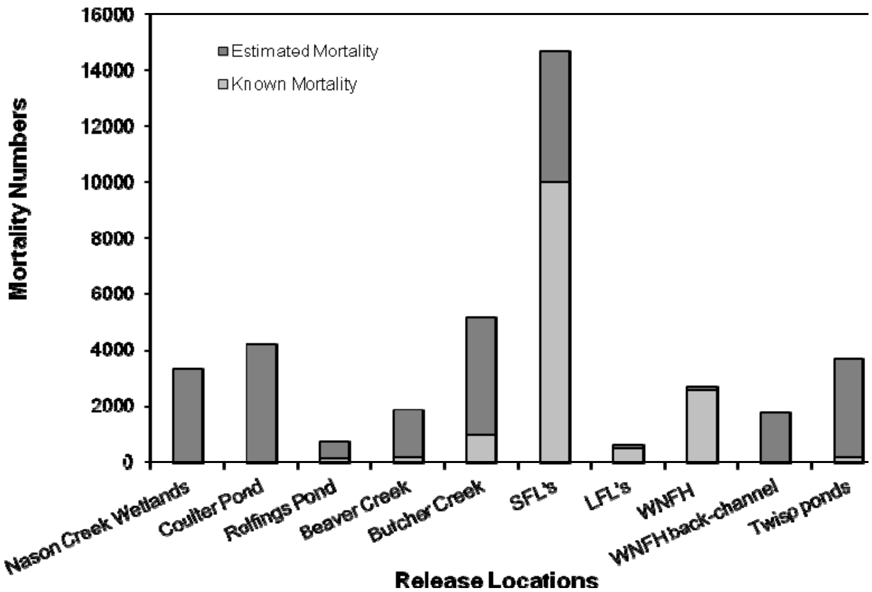

Figure 6. Known and estimated mortality at all acclimation sites in the Methow and Wenatchee river basins, 2010.

4.4.1.2 PIT tag Detection

In addition to documenting predator abundance and estimating juvenile mortality, select locations had an in-pond survival estimate measured through the use of PIT tags. Each selected group that was tagged varied in the proportion of PIT tagged fish, but a minimum of 6,000 tags were designated for target acclimation ponds to provide for both estimates of in-pond survival and release-to-McNary Dam survival.

Prior to the 2010 acclimation, we installed PIT tag antenna arrays at Rohlfing's Pond, Butcher Pond, and WNFH Spring Creek back channel. Considering the extensive data collection that has been acquired from these release locations, sites may be repeated in 2011 to provide additional years of data or relocated to acclimation locations with fewer data points. Only sites with maintained outlet detection systems could be used for comparison with predation estimates.

In-pond survival was estimated by the following formula:

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

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

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

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

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

Table 15. Estimated in-pond survival and PIT tag detection efficiencies, 2010.

	Butcher Creek Pond	Rohlfing's Pond	WNFH Spring Creek Channel	WNFH on-station
Total PIT tags	5,891	5,814	5,993	5,958
Unique detections at outlet	5,183	5,396	5,450	5,501
Proportion of tags detected at outlet	88.0%	92.8%	90.9%	92.3%
Total unique downstream detections	1,117	1,981	2,179	3,025
Downstream detections also detected at pond outlet	1,110	1,944	2,143	2,817
Est. Detection Efficiency	**99.4%**	**98.1%**	**98.3%**	**93.1%**
Est. Total Tags exiting the pond	5,216	5,499	5,542	5,907

Est. In-Pond Survival	**88.5%**	**94.6%**	**92.5%**	**99.1%**

A comparison of in-pond mortality estimates based upon PIT tag and predator consumption expansions can be found in Figures 7 & 8. Typically, the predator consumption model underestimated mortality (unobserved mortality) as compared with PIT tags. However, PIT tag estimates could overestimate loss since the starting PIT values encompasses all cumulative, unobserved loss from the time of tagging throughout acclimation. Beginning in 2011, a pre-transport, PIT tag monitoring plan will be implemented to partition estimated loss prior to juveniles being transported to upper basin acclimation sites.

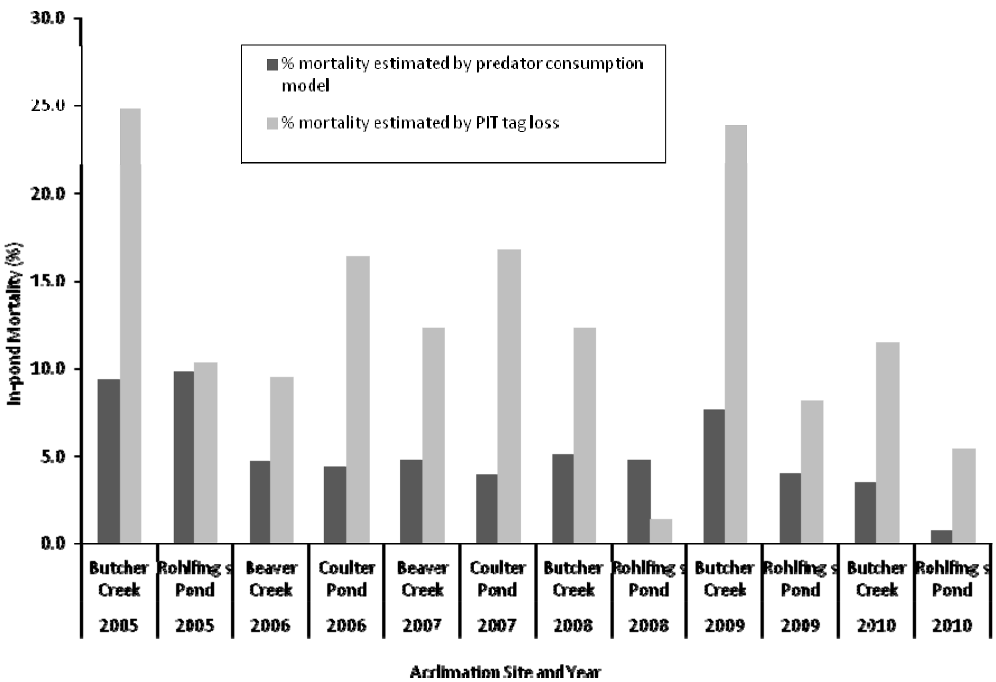

Figure 7. Comparison of in-pond mortality estimation methods; PIT tag versus predator consumption model within the Wenatchee basin (2005-2010).

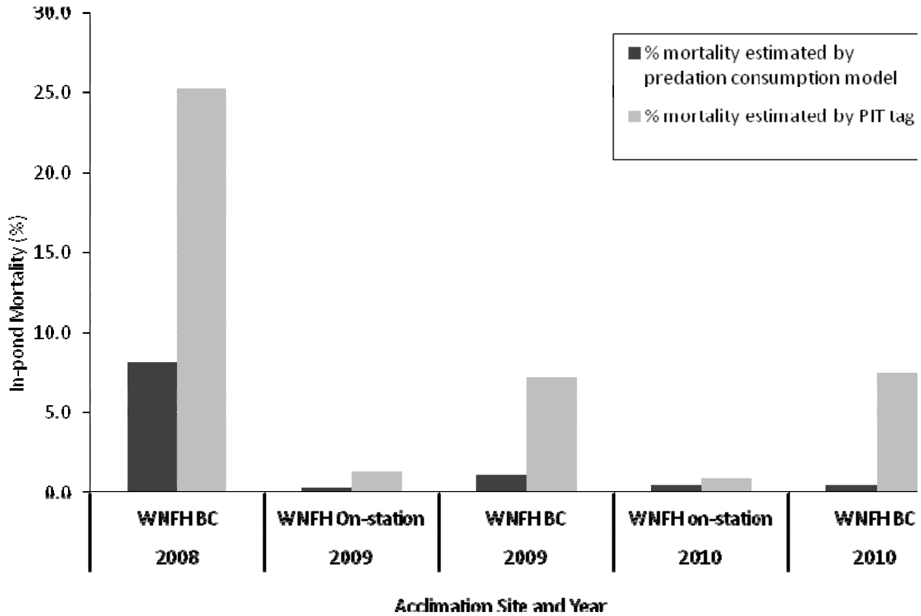

Figure 8. Comparison of in-pond mortality estimations; PIT tag versus predator consumption model within the Methow basin (2008-2010).

5.0 SURVIVAL RATES

5.1 Smolt Survival Rates – Release to McNary Dam

5.1.1 2010 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 is 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 is 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 calculated by determining 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 releases have not been finalized and are pending additional analysis (BY2008) in the Methow and Wenatchee river basins. Once results have been finalized, an amended report will be submitted. PIT tag release numbers and locations of release can be found in Table 16.

Table 16. PIT tag release numbers and locations, 2010.

Basin	Release Tributary	Release Location	Rearing Facility	Brood Origin	*n*	Survival to McNary
Methow	Spring Creek	Back-channel	Willard NFH	MCR	5,993	TBD
	Winthrop NFH	On-station	Winthrop NFH	MCR	5,957	TBD
Wenatchee	Nason Creek	Rohlfing's Pond	Cascade FH	MCR	2,901	TBD
			Willard NFH	MCR	2,913	
		Butcher Creek Pond	Cascade FH	MCR	2,904	TBD
			Willard NFH	MCR	2,987	TBD
	Icicle Creek	SFL	Cascade FH	MCR	2,911	TBD
		SFL	Willard NFH	MCR	2,401	TBD
		LFL	Entiat NFH	MCR	5,483	TBD

5.2 Smolt-to-Adult Survival Rates (SAR) for Brood Year 2006

For coho returning to the Wenatchee River, YN 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 into the broodstock are high. Method two and three may also underestimate the number of coho returns because it does not take into account pre-spawn mortalities or unidentified coho redds. Method four is likely an overestimate, as it assumes no fallbacks or drop-outs occurred between Rock Island and Rocky Reach dams and that all fish enter the targeted tributaries. SARs calculated using methods one, two, and three for total escapement have been consistent in previous years.

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

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

Estimated run size for the Wenatchee and Methow basins in 2009, using the aforementioned methods, can be found in Tables 18 and 19. Smolt-to-adult survival rates for the Wenatchee and Methow basins are summarized in Tables 20 and 21.

Table 17. Estimated coho run size to the Wenatchee River, 2009.

Method	Est. Run Size
1) Dryden Dam counts expanded for non-trapping days plus redds located below Dryden Dam[1]	3,484 (3,416 adults & 68 jacks)
2) Redd counts plus broodstock collected[1]	4,515 (4,420 adults & 95 jacks)
3)Tumwater Dam counts, redds below Tumwater Dam, and broodstock collected[1]	5,017 (4,922 adults & 95 jacks)
4) Mainstem Dam Counts[2]	16,230 (15,781 adults & 449 jacks)

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

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

Table 18. Estimated coho run size to the Methow River, 2009.

Method	Est. Run Size
1) Redd counts plus broodstock collected [1]	1,680 (1,669 adults & 11 jacks)
2) Wells Dam Counts plus Wells Dam broodstock collected[2]	3,197 (3,187 adults & 10 jack)

[1] Each redd count was expanded by 2.3 fish per redd based on the sex ratio of coho observed at Winthrop National Fish Hatchery, 1.3M:1.F
[2] Coho collected for broodstock at Wells Dam were not incorporated into daily fish passage counts for 2009. Broodstock collected only reflects the proportion of fish taken at Wells Dam and not volunteer swim-ins at Winthrop NFH.

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

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

A comparison of smolt-smolt survival and smolt-to-adult survival across years (1999 through 2007) can be found in Table 21.

Table 19. Wenatchee River brood year 2006 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	338	58,510	0.58%
	7 weeks	MCR	Willard NFH	32	26,627	0.12%
Coulter Cr. Pond	16 weeks (6 int. rear @ LNFH)	MCR	Willard NFH	218	64,246	0.34%
Nason Creek Wetlands	Truck plant	MCR	Willard NFH	46	32,253	0.14%
Rohlfing's Pond	14 weeks (7 int. rear @ LNFH)	MCR	Cascade FH	322	65,008	0.50%
	7 weeks	MCR	Willard NFH	82	29,470	0.28%
Butcher Cr. Pond	6 weeks	MCR	Cascade FH	815	139,537	0.58%
Leavenworth NFH: Large Foster Lucas Ponds	7 weeks	MCR	Cascade FH	874	146,140	0.60%
	7 weeks	MCR	Willard NFH	236	70,267	0.34%
Leavenworth NFH: Small Foster Lucas Ponds	8 weeks	MCR	Cascade FH	421	71,841	0.59%
	13 weeks	MCR	Willard NFH	831	144,176	0.58%
TOTAL		**MCR**		**4,787**	**978,057**	**0.49%**
Naturally Produced Coho[c]		**MCR**	**N/A**	**228**	**16,753**	**1.36%**

[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 5,017 fish (method 3) was used in the calculation of BY2006 SARs.
[c] Naturally produced coho were positively identified through scale analysis.

Table 20. Methow River brood year 2006 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	553	231,533	0.24%
WNFH Back Channel	8 weeks	MCR (Methow)	Willard NFH	117	76,026	0.16%
Wells FH	8 weeks	MCR (Methow)	Willard NFH	997	209,535	0.47%
Total				**1,647**	**517,094**	**0.32%**
Naturally Produced Coho[c]			**N/A**	**N/A**	**412**	**N/A**

[a] Minimum acclimation duration is based on transport to release dates and does not account time required for all volitionally released fish to leave the acclimation pond.

[b] An estimated return to the basin of 1,680 fish (method 1) was used in the calculation of BY2006 SARs. All SARs should be considered provisional until the natural origin run component is determined.

[c] SARs for naturally produced coho are not available at this time. Result will be included in future drafts a will likely decrease hatchery survivals.

Table 21. Hatchery comparison of smolt-to-smolt and smolt-to-adult survival rates, brood years 1997-2007.

Brood Year	Release Year	Methow R. Smolt Survival	Icicle Creek Smolt Survival	Nason Creek Smolt Survival	Return Year	Methow R. Smolt-Adult Survival	Wenatchee R. Smolt-Adult Survival
1997	1999	N/A	53.9%	N/A	2000	N/A	0.21% - 0.38%
1998	2000	33.3%	63.0%	N/A	2001	0.17% - 0.27%	0.17% - 0.86%
1999	2001	9.9%	21.6%	N/A	2002	0.03%	0.03%- 0.13%
2000	2002	N/A	87.4% - 78.5%	39.3%	2003	0.15%	0.32%- 0.51%
2001	2003	N/A	62.8%	37.2%	2004	0.16%	0.33% - 0.55%
2002	2004	26.1% - 29.5%	56.3% - 60.8%	30.5%- 36.2%	2005	0.19%	0.29%- 0.47%
2003	2005	N/A	34% - 44%	16%- 18%	2006	0.18%	0.15% - 0.37%
2004	2006	N/A	37% - 51%	16% - 47%	2007	0.13%- 0.47%	0.11% - 0.74%
2005	2007	N/A	39.4% - 86.7%	45.0% - 53.5%	2008	0.13%- 0.38%	0.03%- 0.33%

2006	2008	28.3%	40.5%-63.4%	46.3%-71.2%	2009	0.16%-0.47%	0.12%-0.60%
2007	2009	40.5%-49.1%	43.8%-50.5%	34.2%-60.2%	2010	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 tribal and recreational harvest.

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 2009-2010; results are briefly summarized below.

- Between September 1 and November 6, YN collected 1,056 coho at Dryden Dam, Leavenworth NFH, and Tumwater Dam on the Wenatchee River. At Winthrop NFH and Wells Dam, 445 coho were collected for the Methow River program between September 23 and December 5. Excess coho for the Methow program were returned to the river to naturally spawn. Broodstock goals for both basins were to collect enough females to fulfill future acclimation release needs of 500,000 juveniles in the Methow River and 1,000,000 juveniles in the Wenatchee River.

- YN spawned 1,002 coho at Entiat NFH and 393 at Winthrop NFH. An eye-up rate of 87.7% was calculated for the Wenatchee program and 84.1% for the Methow program. Increased eye-up rates and improved eyed-egg quality should lead to improved survival from the eyed stage to smolt release.

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

- During spawning ground surveys in the Methow Basin for 2009, YN found a total of 283 coho redds, of which, 269 were identified in-basin. Of the total in-basin redds, 151 were on the Methow River, 77 in Spring Creek (WNFH back-channel), 35 in the WDFW Methow FH outfall, 1 in Gold Creek, 2 in Beaver Creek, and 1 in Libby Creek. Out-of-basin totals were as follows: 12 redds in Beebee Springs and 2 in Foster Creek.

- Acclimating pre-smolts on local waters is an essential component to the restoration program. Smolt release numbers for the Methow and Wenatchee rivers in 2010 were 529,984 and 1,025,622 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 98.7% transport-to-release survival for the on-station releases. This was lower than previous year's survival but was likely because predation observations were conducted and documented at Winthrop NFH and Wells FH. In the Wenatchee basin, overall survival was 97.7% from transport to release, a slight increase from 2009 (Appendix C).

- YN estimated that in-basin smolt to adult survival rates (SARs) for BY2006 hatchery coho smolts released in the Wenatchee River basin was 0.49% (4,787 adults and jacks) for all release groups. However, the smolt-to-adult survival rate varied between release groups (range 0.12% - 0.60%). Using scale analysis for verification of fish origin, we estimated the SAR for naturally produced coho to be 1.36%.

- In the Methow River, we estimate that the overall SARs for brood year 2006 hatchery coho was 0.32%. The SARs for each release group ranged from 0.16% to 0.47% (1,647 adults and jacks). These SARs calculations included releases from Wells FH that contributed to the majority of fish collected in the analysis. Natural origin verification has not been finalized yet and will be submitted in an amended report once completed.

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. Ben Truscott, Barry Hodges, Paula Turner, Dan Mellenberger, Garrett Rains, Lily Sampson-Ohms, Andrea Henton, Luke Gauthier, Ed Gutzwiler, Michelle Teo, Neville Benson, Matt Clubb, Krista Ervin, Bryan Ishida, Nikole Offutt, Robert Farley, Joe Cocco, Jason Hickman, Ashlie Simmons, Eugene Billy, Kayla Truscott, Lauren Singleton and Surya DiMonica assisted with field data collection. Debbie Azure, Loverne George, Monica Clark and Louiza Umtuch provided much needed administrative support for this program. Doug Neeley (International Statistical Training and Technical Services) provided statistical consultation for survival estimates of PIT-tagged fish. Several employees at WDFW provided assistance throughout the year, including the Eastbank FH crew during broodstock collection; Todd Miller and Charlie Snow provided the population estimates of naturally produced coho emigrating from the Wenatchee and Methow rivers as well as adult coho carcass information.

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APPENDIX A: 2010 NASON CREEK SMOLT TRAP REPORT

Population Estimates for Juvenile Salmonids in Nason Creek, WA

2010 Annual Report

March 2011

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Project No. 2003-017-00 and No. 1996-040-00
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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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, 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).

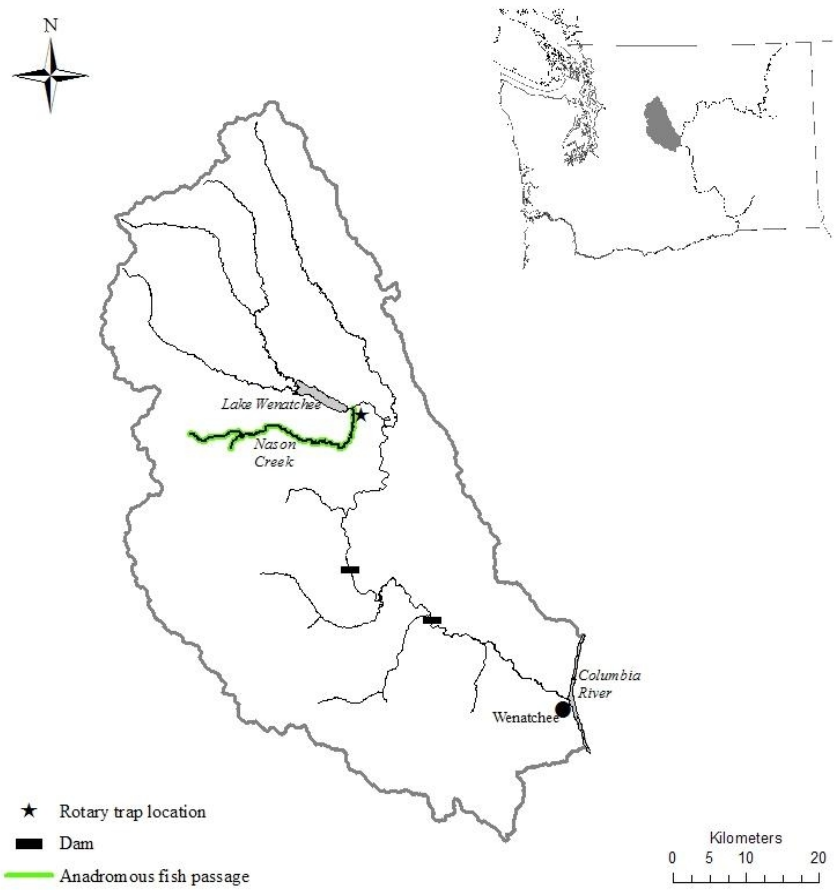

Figure 9. Map of Wenatchee River subbasin with Nason Creek rotary trap location.

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**).

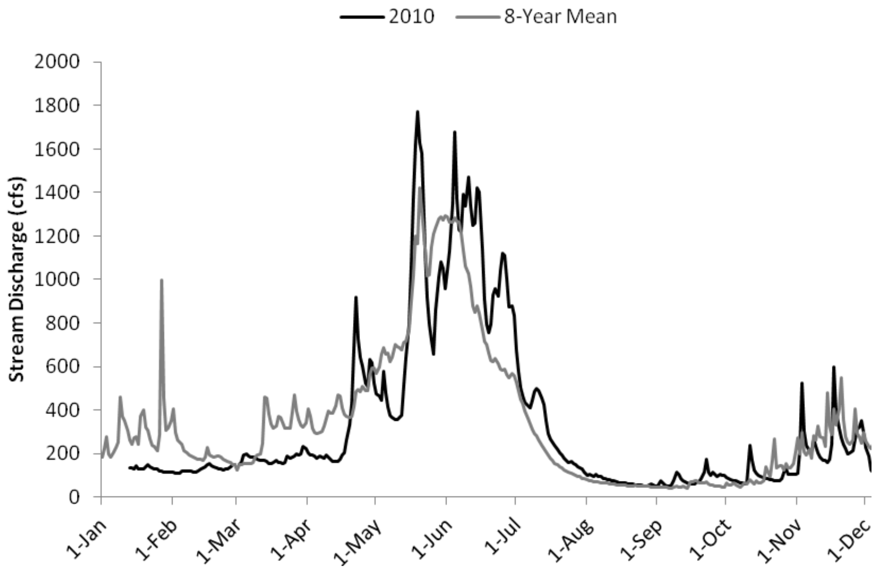

Figure 10. Mean daily stream discharge at the Nason Creek WDOE stream monitoring station in 2010.

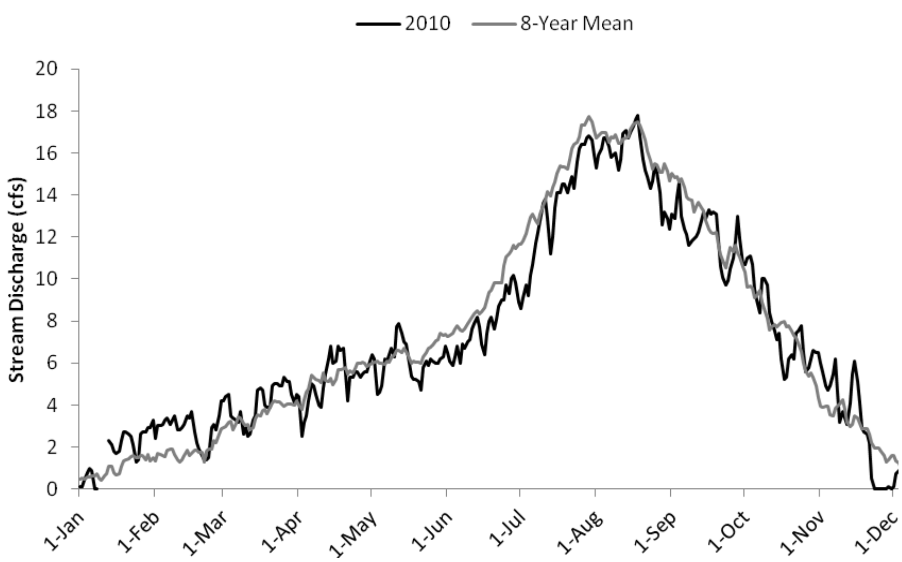

Figure 11. Mean daily water temperature at the Nason Creek DOE stream monitoring station in 2010.

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:

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

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*.

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:

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

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 (dependant 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 =

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

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

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

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

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

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 22. 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.

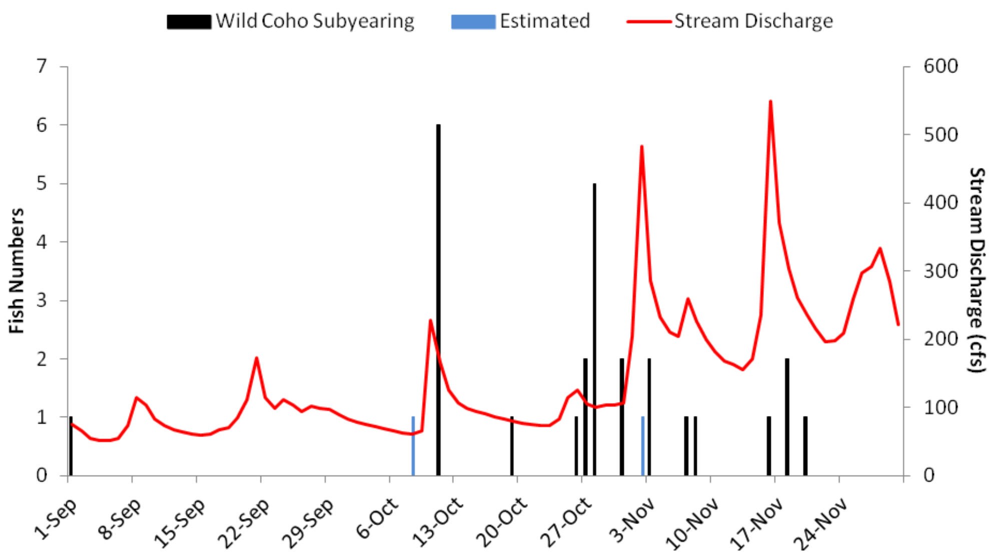

Figure 12. Daily catch of wild coho subyearlings with mean daily stream discharge at the Nason Creek rotary trap, July 1 to November 23, 2010.

Table 23. 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**).

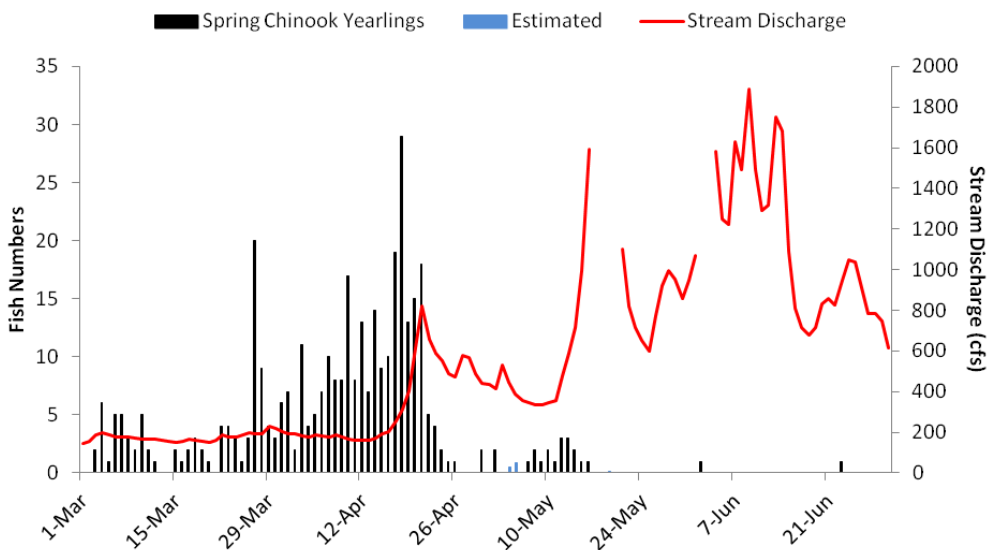

Figure 13. Daily catch of spring Chinook yearlings with mean daily stream discharge at the Nason Creek rotary trap, March 2 to June 30, 2010.

Table 24. 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**).

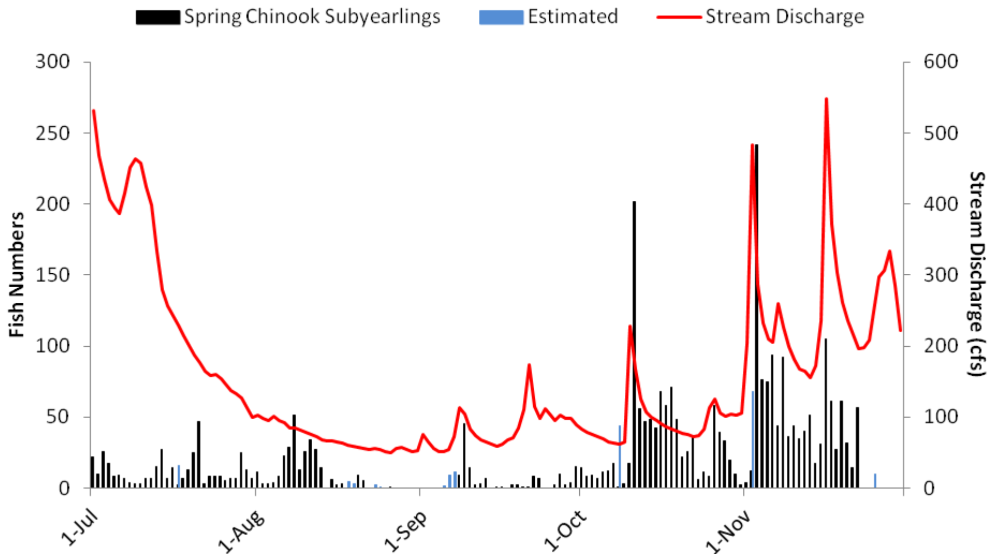

Figure 14. Daily catch of spring Chinook subyearlings with mean daily stream discharge at the Nason Creek rotary trap, July 1 to November 23, 2010.

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.

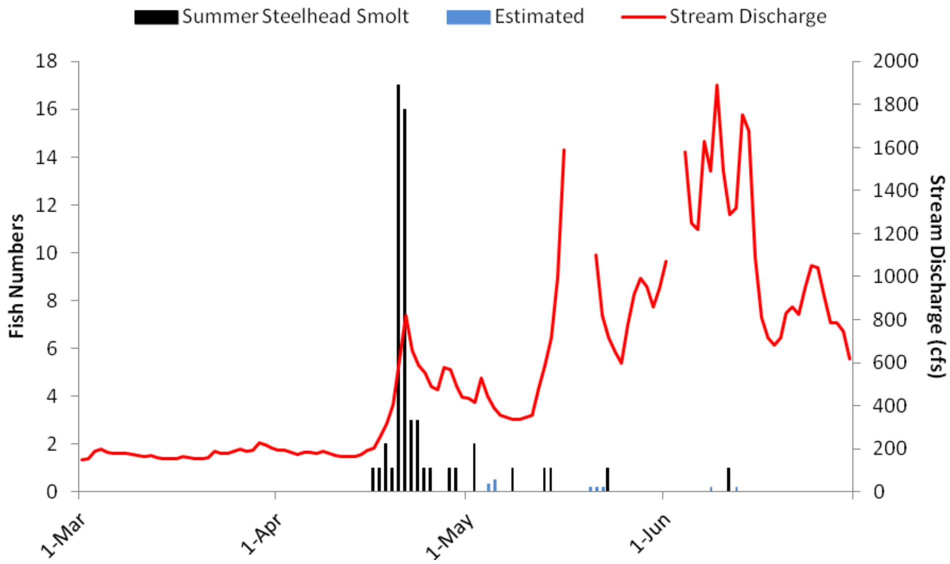

Figure 15. Daily catch of summer steelhead smolt with mean daily stream discharge at the Nason Creek rotary trap, March 2 to June 30, 2010.

Table 25. 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**).

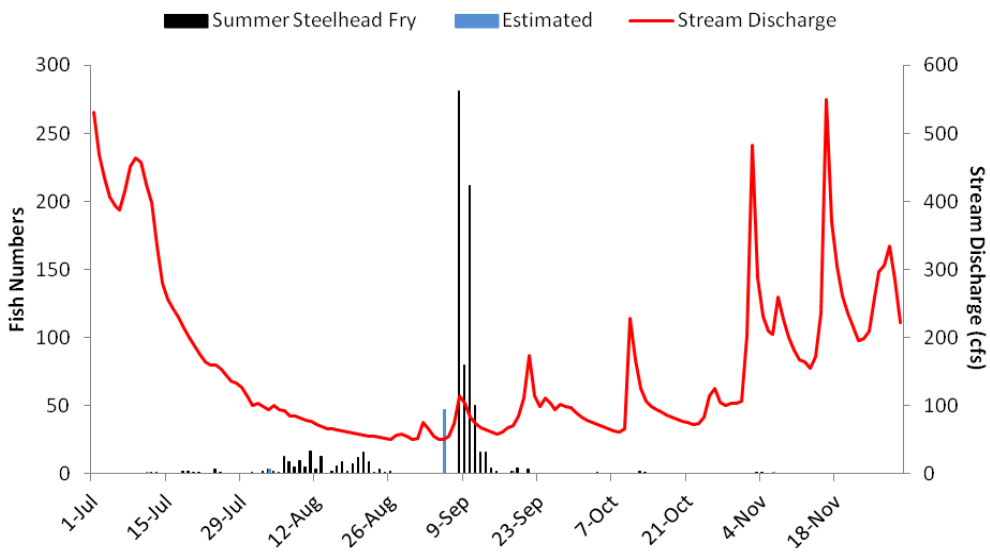

Figure 16. Daily catch of summer steelhead fry with mean daily stream discharge at the Nason Creek rotary trap, July 1 to November 23, 2010.

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.

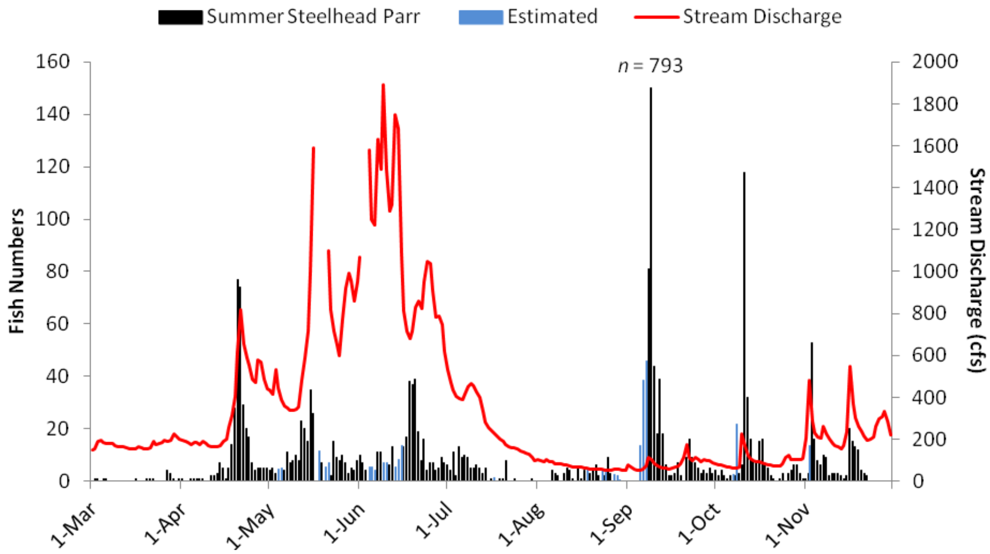

Figure 17. Daily catch of summer steelhead parr with mean daily stream discharge at the Nason Creek rotary trap, March 2 to November 23, 2010.

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 26. 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 27. 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 28. 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 29. 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 30. 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 31. 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 32. 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 33. 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 34. 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.

5.0 LITERATURE CITED

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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	5/4/2010	577	4.5
3/23/2010	190	5.0	5/5/2010	479	4.6
3/24/2010	179	5.0	5/6/2010	414	4.9
3/25/2010	181	4.9	5/7/2010	377	6.2
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

6/16/2010	1140	6.9	7/29/2010	134	16.7
6/17/2010	907	6.4	7/30/2010	129	16.8
6/18/2010	796	7.4	7/31/2010	115	16.6
6/19/2010	754	8.0	8/1/2010	101	15.9
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

9/10/2010	105	11.8	10/23/2010	74	7.4
9/11/2010	84	11.9	10/24/2010	74	7.5
9/12/2010	75	12.0	10/25/2010	84	7.8
9/13/2010	68	12.2	10/26/2010	115	6.5
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

12/5/2010	110	1.0	12/24/2010	179	2.2
12/6/2010			12/25/2010	167	2.1
12/7/2010					
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			
12/26/2010	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	7/3/2010	Op.	
5/22/2010	Op.		7/4/2010	Op.	
5/23/2010	Op.		7/5/2010	Op.	
5/24/2010	Op.		7/6/2010	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.	

8/15/2010	Op.		9/27/2010	Op.	
8/16/2010	Op.		9/28/2010	Op.	
8/17/2010	No Op.	Stopped: debris	9/29/2010	Op.	
8/18/2010	No Op.	Stopped: debris	9/30/2010	Op.	
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.	

11/9/2010	Op.	
11/10/2010	Op.	
11/11/2010	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 B: SPAWNING GROUND SURVEY RECORDS FOR THE WENATCHEE AND METHOW RIVERS, 2009

APPENDIX B: Spawning ground survey records for the Wenatchee and Methow rivers in 2009

Stream	Reach & Description	Surveyors	Date	New Redds	Live Fish	Carcasses Recovered
Beaver	Mouth to Pond	BI MWC	10/10/09	0	1	0
		BI MWC	10/17/09	0	0	0
		BI MWC	10/24/09	0	1	0
		BI MWC	10/31/09	0	8	0
		BI MWC	11/7/09	1	0	0
		BI MWC	11/14/09	0	0	0
		BI MWC	11/21/09	0	0	0
	Beaver Total			**1**	**10**	**0**
Chumstick	Mouth to North Rd. Bridge	BI MWC	12/4/09	0	0	0
	Chumstick Total			**0**	**0**	**0**
Chiwaukum	Mouth to US 2 bridge	BH LG	10/15/09	0	0	0
		BH LG	10/23/09	0	0	0
		LG GR	11/4/09	0	1	0
		LG BH	11/19/09	0	0	0
		LG BH	12/3/09	0	0	0
	Chiwaukum Total			**0**	**1**	**0**
Icicle	1- Mouth to Hatchery	NO CK	10/7/09	0	25	2
		NO CK	10/14/09	4	55	4
		NO CK	10/21/09	8	171	7
		NO CK	10/28/09	112	180	4
		MC CK NO	11/2/09	94	250	23
		NO MC	11/12/09	102	350	73
		NO MC	11/18/09	172	320	92
		NO CK	11/24/09	137	250	192
		NO CK	12/2/09	7	78	84
	2 - Hatchery to Headgate	KE	10/4/09	0	3	0
		KE BI	10/11/09	1	41	1
		BI KE	10/18/09	4	63	0
		BI KE	10/25/09	25	220	2
		BI KE	11/1/09	24	328	9
		BI KE	11/8/09	15	274	10
		BI KE	11/15/09	41	232	24
		BI KE	11/22/09	39	365	20
		BI KE	11/29/09	23	208	12
		BI KE	12/4/09	10	141	10
		BI KE	12/10/09	0	51	0
	3 - Headgate to Intake	BH LG	10/9/09	0	0	0
		LG BH	11/19/09	0	0	0
		MWC	12/4/09	0	0	0
	Icicle Total			**818**	**3,605**	**569**
Mission/Brender	Mouth to Residential/Mill	MWC	9/26/09	0	0	0

	Rd.	MWC	10/3/09	1	1	0
		MWC BI	10/10/09	1	0	0
		MWC BI	10/17/09	5	11	0
		MWC BI	10/24/09	25	33	3
		MWC BI	10/31/09	9	23	2
		BI KE	11/4/09	17	23	10
		MWC BI	11/7/09	7	27	0
		MWC BI	11/14/09	5	8	6
		MWC BI	11/21/09	1	3	1
		MWC BI	11/28/09	1	3	0
		MWC BI	12/4/09	0	0	1
	Mission/Brender Total			**72**	**132**	**23**
Nason	1 - Mouth to Coles Corner	MC BI	10/5/09	1	0	0
		BI	10/12/09	0	2	0
		BI	10/19/09	1	5	0
		MWC	10/29/09	2	7	0
		MC	11/4/09	2	23	0
		BI	11/9/09	1	4	0
		BI	11/16/09	1	2	1
		BI	11/23/09	0	2	0
		BI	11/30/09	0	0	0
	2 - Coles Corner to Butcher Pond	NO	10/5/09	0	0	0
		NO	10/12/09	0	0	0
		NO	10/19/09	1	0	0
		NO	10/29/09	0	1	0
		NO	11/4/09	0	2	0
		NO	11/9/09	0	0	0
		NO	11/16/09	0	0	0
		NO	11/23/09	0	0	0
		NO	11/30/09	0	0	0
	3 - Butcher Pond to Ray Rock	KE	10/5/09	0	0	0
		KE	10/12/09	1	0	0
		KE	10/19/09	0	2	0
		KE	10/29/09	1	7	0
		MWC	11/4/09	0	7	0
		KE	11/9/09	1	2	1
		KE	11/16/09	0	1	0
		KE	11/23/09	1	3	0
		KE	11/30/09	1	1	0
	4 - Ray Rock to White Pine Creek	BI KE	12/8/09	0	0	0
	Nason Total			**14**	**71**	**2**
Peshastin	1 - Mouth to YN Office	NO	9/29/09	1	1	0
		NO	10/9/09	2	0	1
		NO	10/16/09	3	4	2
		NO	10/23/09	33	51	3

		KE	11/2/09	8	17	1
		NO	11/3/09	37	44	3
		NO	11/10/09	41	62	11
		NO	11/17/09	7	13	10
		NO	11/25/09	2	1	7
		NO	12/3/09	1	2	0
	2 - YN Office to Mountain Home Rd.	KE	9/29/09	0	0	0
		MC	10/9/09	0	0	0
		MC	10/16/09	5	5	2
		MC	10/23/09	22	33	1
		Land owner	10/26/09	0	0	1
		BI	11/2/09	11	17	0
		MC	11/3/09	12	40	2
		MC	11/10/09	10	25	5
		MC	11/17/09	4	4	4
		MC	11/25/09	1	3	1
		MC	12/2/09	0	0	0
	3 - Mountain Home Rd. to Valley High Bridge	MWC	9/29/09	0	0	0
		MWC	10/9/09	0	0	0
		MWC	10/16/09	0	0	1
		MWC	10/23/09	2	3	0
		MWC	10/30/09	7	8	0
		MWC	11/6/09	5	6	0
		MWC	11/10/09	0	2	0
		MWC	11/17/09	0	1	0
		MWC	11/25/09	0	0	0
		MWC	12/2/09	0	0	0
	Peshastin Total			**214**	**342**	**55**
Wenatchee	1 - Mouth to Cashmere	NO MWC	10/2/09	0	5	0
		KE MWC	10/13/09	2	6	2
		KE MWC	10/20/09	3	7	1
		KE MWC	11/5/09	12	21	0
		KE MWC	11/13/09	17	17	13
		KE MWC	11/30/09	1	1	6
		KE MC MWC	12/7/09	0	1	3
	Wenatchee 1 Total			**35**	**58**	**25**
	2- Cashmere to Dryden Dam	MWC KE	10/1/09	0	0	0
		BH GR	10/6/09	0	0	0
		BH GR	10/12/09	0	0	1
		BI NO	10/13/09	0	2	0
		BH LG	10/15/09	0	0	0
		NO BI	10/20/09	0	3	0
		BH	10/22/09	0	0	0
		BH GR	10/23/09	5	2	0
		LG GR	10/30/09	0	2	0
		LG GR	11/4/09	2	6	0
		KE MWC	11/5/09	3	7	1

		BH LG	11/12/09	15	8	41
		BI KE	11/17/09	6	7	15
		BH LG	11/19/09	2	0	4
		BH	11/20/09	4	1	4
		BH GR	11/30/09	1	1	13
		BI NO	12/7/09	0	1	2
	Wenatchee 2 Total			**38**	**40**	**81**
	3 - Dryden Dam to Leavenworth Boat Launch	NO BH	10/1/09	0	0	0
		MWC NO	10/16/09	0	5	0
		NO BI	10/20/09	0	4	1
		MC NO	11/10/09	2	13	11
		LG GR	11/23/09	24	2	22
		BH GR	12/1/09	1	5	29
		BH GR	12/10/09	0	0	0
	Wenatchee 3 Total			**27**	**29**	**63**
	4 - Leavenworth Boat Launch to Icicle Rd. Bridge	KE MWC	9/30/09	0	12	2
		KE MWC	10/7/09	0	26	1
		BI KE	10/14/09	0	20	5
		KE MWC BI	10/21/09	35	110	4
		KE MWC BI	10/28/09	73	139	4
		CK MC	11/2/09	9	0	0
		KE MWC BI	11/3/09	70	173	3
		KE MWC BI	11/10/09	84	107	14
		NO MC	11/12/09	13	20	20
		BI KE	11/18/09	48	84	69
		KE MWC BI	11/24/09	43	69	64
		KE MWC BI	12/2/09	7	17	35
		KE MWC BI	12/9/09	0	0	1
	Wenatchee 4 Total			**382**	**777**	**222**
	5 - Icicle Rd. Bridge to Chiwaukum Bridge	BH LG	10/7/09	0	0	0
		BH LG	10/15/09	0	0	0
		BH LG	10/23/09	0	2	0
		BH LG	11/19/09	0	0	0
		BH LG	12/3/09	0	0	0
	Wenatchee 5 Total			**0**	**2**	**0**
	6 - Chiwaukum Bridge to Plain	NO MC	10/22/09	0	2	0
		MC BH	12/4/09	0	0	1
		ALL Crew	11/19/09	0	3	0
	Wenatchee 6 Total			**0**	**5**	**1**
	7 - Plain to Lake Wenatchee	KE MWC	10/8/09	0	17	0
		KE MWC	10/22/09	0	10	0
		KE MWC	11/12/09	0	2	0
		GR BH	11/25/09	0	0	1
	Wenatchee 7 Total			**0**	**29**	**1**
	Wenatchee Basin Total			**1,601**	**5,101**	**1,042**

Stream	Reach Description	Date	Surveyors	New Redds	Live Fish	Dead Fish
Methow	1 - Mouth to Steel Bridge	KM, SD	10/14/2009	0	0	0
		SD, LS	10/21/2009	0	4	0
		SD, LS	10/23/2009	0	0	1
		SD, KT	10/28/2009	0	2	0
		SD, KT	11/5/2009	6	21	0
		SD, KT	11/12/2009	2	1	0
		SD, KT	11/19/2009	4	13	2
		SD, KT	11/24/2009	7	21	2
		SD, KT	12/3/2009	0	4	1
		SD, KT	12/8/2009	0	0	0
	Methow 1 Total			**19**	**66**	**7**
	2 - Steel Bridge to Lower Burma Bridge	SD, LS	10/21/2009	7	19	0
		KT, SD	10/28/2009	0	6	0
		SD, KT	11/5/2009	7	23	2
		Bio Analysts	11/6/2009	0	0	5
		SD, KT	11/12/2009	20	27	7
		SD, KT	11/19/2009	2	13	4
		SD, KT	11/24/2009	4	8	2
		SD, KT	12/3/2009	0	0	0
		SD, KT	12/8/2009	0	0	0
	Methow 2 Total			**40**	**96**	**20**
	3 - Lower Burma Bridge to Upper Burma Bridge	SD, AD,KT	10/15/2009	0	0	0
		Bio-A	10/16/2009	0	0	1
		SD, LS	10/22/2009	1	2	0
		SD, LS	10/28/2009	0	70	0
		SD, KT	11/3/2009	5	54	1
		Bio- A	11/6/2009	0	0	1
		Bio-A	11/9/2009	0	0	1
		AS, JH	11/10/2009	10	27	9
		Bio-A	1/12/2009	0	0	5
		AS, JH	11/17/2009	2	2	6
		AS, JH	11/23/2009	0	4	9
		AS, JH	12/1/2009	0	0	4
		SD, KT	12/7/2009	0	0	0
	Methow 3 Total			**18**	**159**	**37**
	4 - Upper Burma Bridge to Lower Gold Creek Bridge	KT, SD, AS	10/15/2009	0	5	1
		SD, LS	10/22/2009	1	3	0
		JH, EB	10/28/2009	1	29	1
		KM, JH	10/29/2009	5	5	0
		AS, JH	11/4/2009	1	42	0
		AS, JH	11/11/2009	9	28	1
		KM, JH	1/18/2009	3	4	3
		AS, JH	11/24/2009	1	5	3

	AS, JH	12/2/2009	0	3	10
	SD, KT	12/7/2009	0	0	0
Methow 4 Total			**21**	**124**	**19**
5 - Lower Gold Creek Bridge to Carlton	JH, EB	10/22/2009	0	1	0
	JH, KT	10/30/2009	2	3	0
	Bio-A	11/2/2009	0	0	4
	AS,JH	11/5/2009	2	5	0
	Bio-A	11/9/2009	0	0	6
	AS, JH	11/12/2009	1	6	0
	AS, JH	11/19/2009	1	4	3
	AS, JH	11/24/2009	0	3	0
	AS, JH	12/3/2009	0	0	4
	AS, JH	12/8/2009	0	0	0
Methow 5 Total			**6**	**22**	**17**
6 - Carlton to Holterman's Hole	JH, EB	10/20/2009	0	0	0
	SD, LS	10/27/2009	0	0	0
	Bio-A	10/30/2009	0	0	1
	KT, SD	11/3/2009	3	6	1
	KT, SD/Bio-A	11/10/2009	6	0	1
	KT, SD	11/17/2009	9	13	1
	KT, SD	12/1/2009	0	0	3
	AS, JH	12/8/2009	0	0	0
Methow 6 Total			**18**	**19**	**7**
7 - Holterman's Hole to MVID dam	JH, EB	10/20/2009	0	0	0
	JH, EB	10/27/2009	0	3	0
	SD, LS	11/2/2009	0	0	0
	JH, LS	11/9/2009	3	7	0
	KT, JH	11/16/2009	1	3	0
	BF, LS	11/24/2009	1	2	1
	AS, JH	11/30/2009	0	1	0
	AS, JH	12/7/2009	0	0	0
Methow 7 Total			**5**	**16**	**1**
8 - MVID dam to Red barn	KM	10/20/2009	0	0	0
	JH, EB	10/27/2009	0	1	0
	JH, JC	11/2/2009	0	1	1
	JH, JC	11/9/2009	2	5	6
	KT, JH	11/16/2009	12	7	10
	KM, LS	11/23/2009	1	4	1
	AS, JH	11/30/2009	0	1	13
	AS, JH	12/7/2009	0	0	0
Methow 8 Total			**15**	**19**	**31**
9 - Red barn to Wolf Creek	KT, AS, EB, JH	10/21/2009	0	0	0
	RA, BF, LS	10/29/2009	1	0	0
	LS, JC	11/5/2009	0	1	0
	SD, EB	11/11/2009	0	0	0
	KT, SD	11/18/2009	5	1	0
	LS	12/3/2009	0	0	0

		BF, LS	12/7/2009	0	0	0
	Methow 9 Total			**6**	**2**	**0**
	10 - Wolf Creek to Rip Rap	KT, AS, EB, JH	10/21/2009	0	0	0
		RA, BF, LS	10/29/2009	1	0	0
		SD, JC	11/5/2009	1	0	1
		SD, LS	11/11/2009	0	0	0
		KT, SD	11/18/2009	0	0	0
		KT, SD	12/2/2009	0	0	0
		BF, LS	12/7/2009	0	0	0
	Methow 10 Total			**2**	**0**	**1**
	11 - Rip Rap to Weeman Bridge	KT, AS, EB, JH	10/21/2009	0	0	0
		KT, SD	10/29/2009	1	1	0
		LS, JC	11/5/2009	0	0	0
		KT, SDSK, LS	11/11/2009	0	0	0
		KTKT, SD	11/18/2009	0	0	0
		KT, SD	12/2/2009	0	0	0
		BF, LS	12/7/2009	0	0	0
	Methow 11 Total			**1**	**1**	**0**
Winthrop NFH Spring Creek	Mouth to Irrigation Diversion	NA	10/19/2009	4	6	0
		AS, JH	10/26/2009	4	33	1
		AS, JH	11/2/2009	7	41	1
		AS, JH	11/9/2009	8	55	12
		RA, KM	11/11/2009	0	0	1
		BF, SD	11/16/2009	12	38	6
		KT	11/23/2009	27	45	20
		KT, SD	11/30/2009	15	10	19
		KT, SD	12/7/2009	0	1	0
		KT, JH	12/15/2009	0	0	0
	Winthrop Total			**77**	**229**	**60**
WDFW Outfall	Mouth to Adult Weir	KM	10/19/2009	2	0	0
		AS, JH	10/26/2009	2	9	0
		KT, AS	11/2/2009	0	31	3
		KT,AS	11/9/2009	15	22	2
		BF, SD	11/16/2009	4	14	0
		KT	11/23/2009	8	25	2
		KT	11/30/2009	4	22	2
		AS, JH	12/7/2009	0	0	0
		SD, JC	12/16/2009	0	0	0
	WDFW Total			**35**	**123**	**9**
Twisp	1 - Mouth to Lower Poorman Bridge	KT, AS	10/20/2009	0	0	0
		KT	11/4/2009	0	0	0
		KT, LS	11/11/2009	0	0	0
		LS	11/17/2009	0	0	0
		KT, AS	12/6/2009	0	0	0
	2 - Lower Poorman Bridge to Upper Poorman Bridge	KT, AS	10/20/2009	0	0	0
		KT, LS	11/4/2009	0	0	0

		KT, LS	11/11/2009	0	0	0
		LS	11/17/2009	0	0	0
		KT, AS	12/6/2009	0	0	0
	3 - Upper Poorman Bridge to Twisp River weir	KT	11/4/2009	0	0	0
	Twisp Total			**0**	**0**	**0**
Libby	Mouth to Hwy 153 Bridge	KT, SD	10/19/2009	0	1	0
		KT, SD	10/26/2009	1	1	0
		AS, KT	11/2/2009	0	1	1
		AS, JH	11/24/2009	0	0	0
		AS, JH	12/3/2009	0	0	0
		AS, JH	12/6/2009	0	0	0
	Libby Total			**1**	**3**	**1**
Beaver	1 - Mouth to culvert	KT, SD	10/19/2009	0	0	0
		KT, SD	10/26/2009	0	0	0
		AS, KT	11/2/2009	2	2	0
		AS, KT	11/9/2009	0	0	0
		SD, KT	11/17/2009	0	0	0
		AS, JH	12/6/2009	0	0	0
	2 - Culvert to Hwy. 20	KT, SD	10/26/2009	0	0	0
		AS, KT	11/9/2009	0	0	0
		AS, JH	12/06/2009	0	0	0
	Beaver Total			**0**	**0**	**0**
Wolf	Mouth to Biddle Acclimation Ponds	KM	10/19/2009	0	0	0
		AS, JH	10/26/2009	0	0	0
		BF, SD	11/16/2009	0	0	0
		KT, SD	11/30/2009	0	0	0
		AS, JH	12/6/2009	0	0	0
	Wolf Total			**0**	**0**	**0**
Gold Creek	Mouth to Rip Rap	RA	11/4/2009	3	2	0
	Gold Total			**3**	**2**	**0**
Hancock Creek	Mouth to Source	AS, JH	11/4/2009	0	0	0
		KM, BF	11/30/2009	0	0	0
	Hancock Total			**0**	**0**	**0**
Chewuch	1 - Mouth to Fulton Dam	KT, AS	10/20/2009	0	0	0
		AS, JC	10/29/2009	0	0	0
		JC, SD	11/4/2009	0	0	0
		KT, LS	11/11/2009	0	0	0
		LS, BF	12/6/2009	0	0	0
	2 - Fulton Dam to Co. Hwy 1613	KT, AS	10/20/2009	0	0	0
		AS, JC	10/29/2009	0	0	0
		JC, SD	11/4/2009	0	0	0
		KT, LS	11/11/2009	0	0	0
		LS, BF	12/6/2009	0	0	0
	3 - Co. Hwy 1613 to Eastside Chewuch Road	AS	11/18/2009	0	0	0
	Chewuch Total			**0**	**0**	**0**
Chelan FH	Outfall of hatchery to confluence	KM, and all	10/14/2009	0	6	0

outfall	with the Columbia River	BF, LS	11/3/2009	5	15	6
		KM, BF	11/12/2009	7	4	3
	Chelan FH Total			**12**	**25**	**9**
Chelan River Outfall	Mouth to 800 meters upstream	KM, BF	11/12/2009	0	0	6
	Chelan River Total			**0**	**0**	**6**
Foster	Mouth to first bridge	BF, LS, EB	11/3/2009	2	3	0
	Foster Total			**2**	**3**	**0**

APPENDIX C: Wenatchee and Methow Basin Coho Release Numbers and Mark Groups, 2010

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 SFH	MCR-WEN	May 7	June 16	**190186+BT**	98.8%	58,402	54,841	54,183	
Wenatchee	Nason Cr	Coulter Pond	Willard NFH	MCR-WEN	May 7	June 16	**190177+BT**	96.5%	9,890	9,287	8,962	
									68,292	**64,128**	**63,145**	
Wenatchee	Nason Cr	Nason Wetlands	Willard NFH	MCR-WEN	April 28	April 29	**190171+BT**	97.4%	57,413	54,140	52,732	
									57,413	**54,140**	**52,732**	
											-	
Wenatchee	Nason Cr	Rolfing's Pond	Willard NFH	MCR-WEN	May 7	June 12	**190176+BT**	97.3%	27,025	26,813	26,089	2,913
Wenatchee	Nason Cr	Rolfing's Pond	Cascade FH	MCR-WEN	May 7	June 12	**190187+BT**	99.2%	58,692	58,232	57,766	2,901
									85,717	**85,045**	**83,855**	**5,814**
Wenatchee	Beaver Cr	Beaver Creek	Cascade FH	MCR-WEN	April 29	June 7	**190188+BT**	99.1%	116,373	114,539	113,508	
									116,373	**114,539**	**113,508**	
Wenatchee	Nason Cr.	Butcher Creek	Willard NFH	MCR-WEN	May 7	June 7	**190175+BT**	99.3%	29,625	28,580	28,380	2,987
Wenatchee	Nason Cr.	Butcher Creek	Cascade FH	MCR-WEN	May 7	June 7	**190189+BT**	99.3%	115,855	111,765	110,983	2,904
									145,480	**140,345**	**139,363**	**5,891**
Wenatchee	Icicle Cr	LNFH SFL 10-12	Willard NFH	MCR-WEN	Apr 19	Apr 19	**190174**	95.0%	93,343	90,794	86,254	
Wenatchee	Icicle Cr	LNFH SFL 16 & 17	Willard NFH	MCR-MET	Apr 19	Apr 19	**190182**	97.7%	57,243	57,038	55,726	
Wenatchee	Icicle Cr	LNFH SFL 18-25	Cascade FH	MCR-WEN	Apr 20	Apr 20	**190190**	98.6%	219,408	210,331	207,386	5,313
									369,994	**358,163**	**349,367**	**5,313**
Wenatchee	Icicle Cr	LNFH LFL 1 & 2	Entiat NFH	MCR-WEN	Apr 22	Apr 22	**190185**	99.2%	44,090	43,929	43,578	
Wenatchee	Icicle Cr	LNFH LFL 2	Entiat NFH	MCR-WEN	Apr 22	Apr 22	**190183**	98.9%	77,824	77,434	76,582	
Wenatchee	Icicle Cr	LNFH LFL 1	Entiat NFH	MCR-WEN	Apr 23	Apr 23	**190184**	98.9%	88,147	87,899	86,932	5,483
									210,061	**209,262**	**207,092**	**5,483**
Methow	Methow	Winthrop NFH C12-16	Winthrop NFH	MCR-MET	Apr 23	Apr 23	**190173**	99.0%	261,180	258,077	258,077	5,958
Methow	Methow	Twisp Ponds	Willard NFH	MCR-MET	May 8	June 2	**190181**	95.3%	90,285	86,669	82,596	
Methow	Methow	Winthrop NFH BC	Willard NFH	MCR-MET	Apr 29	June 14	**190180**	95.6%	59,120	58,976	56,381	5,993
									410,585	**403,722**	**397,054**	**11,951**
Methow	Methow	Wells FH	Willard NFH	MCR-MET	Apr 21	Apr 21	**190179**	95.2%	126,481	126,262	120,201	
									126,481	**126,262**	**120,201**	
								Total	**1,590,396**	**1,555,606**	**1,526,317**	**34,452**