Document ID #P118378
Report covers work performed under BPA contract #22180
Report was completed under BPA contract #38968

MID-COLUMBIA COHO REINTRODUCTION FEASIBILITY STUDY:

2009 ANNUAL REPORT
October 1, 2008 through September 30, 2009

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October 2010

Prepared for

Project # 1996-040-00
Contract #00022180
U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
P.O. Box 3621
Portland, Oregon 97283-3621

And

Public Utility District No. 1 of Chelan County
Wenatchee, WA 98801

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Public Utility District No. 2 of Grant County
Ephrata, Washington 98823

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1.0 INTRODUCTION

Wild stocks of coho salmon *Oncorhynchus kisutch* were once widely distributed within the Columbia River Basin (Fulton 1970; Chapman 1986). Since the early 1900s, the native stock of coho had been extirpated from the tributaries of the middle reach of the Columbia River (the Wenatchee, Entiat, and Methow rivers; Mullan 1983). Efforts to restore coho within the mid and upper Columbia Basin rely heavily upon hatchery coho releases. The feasibility of re-establishing coho within 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 resolved in a positive sense, therefore allowing the project to continue forward in achieving its ultimate goal of coho restoration through the implementation of the Mid Columbia Coho Reintroduction Plan (MCCRP).

If coho re-introduction efforts in mid-Columbia tributaries are to succeed, parent stocks must possess sufficient genetic variability to allow for phenotypic plasticity in response to ever changing selective pressures between environmental conditions of the lower Columbia River and mid-Columbia tributaries. Both the Mid-Columbia Coho Hatchery and Genetic Management Plan (HGMP 2002) and Master Plan for Coho Restoration (YN FRM 2008) describe strategies that will be implemented to facilitate the local adaptation process.

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

If 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 role in the coho re-introduction program.

This report documents coho restoration activities and results for the performance period of fall 2008 through the summer 2009, to include broodstock collection, spawning, egg incubation and transportation, spawning ground surveys, acclimation, and survival. In addition, the Yakama Nation (YN) operated a 5-foot rotary smolt trap to estimate the number of naturally produced coho emigrating from Nason Creek in 2008-2009. This trap is operated with joint funding from Grant County Public Utility District (GCPUD, #430-2365) and two BPA projects (#2003-017-00, and #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, 2009) 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 significant as program collections shift toward incorporating more upper basin returning adults which have successfully ascended Tumwater Canyon to Tumwater Dam. The emphasis on collecting coho salmon at Tumwater Dam is described in the Mid-Columbia Coho Restoration Master Plan (Broodstock Development Phase II; YN FRM 2009).

Coho returning to the Wenatchee River in 2008 were comprised of brood year (BY) 2005 adults and BY2006 jacks from mid-Columbia hatchery and natural origin returns. The Wenatchee program was comprised of 1st, 2nd and 3rd generation Mid-Columbia River (MCR) returns with the majority stemming from 1st generation fish. The Dryden Dam fish traps were passively operated five days per week, 24-hours per day from September 2 through November 12. 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) steelhead broodstock collection until October 24 when WDFW's broodstock collection quota was met.

Coho broodstock was concurrently collected at Tumwater Dam up to five days per week, 8 hours per day, between September 26 and November 12, 2008. All coho encountered at Tumwater Dam were assessed for condition and if deemed suitable, incorporated into the broodstock. Unsuitable individuals consisted of any fish with signs of significant abrasions or wounds, fungus, and/or were overripe (factors that would decrease the likelihood of an individual to survive to spawning) were passed upstream. 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 secondary mark in the event that a floy tag became dislodged during holding. A small proportion (n=16) of coho collected at Tumwater Dam had been previously floy tagged at Dryden Dam as a part of an ongoing YN mark-recapture study.

In addition to Dryden and Tumwater collections, a v-trap weir in the upper bay of the LNFH ladder was installed the first week of October and operational between October 10 and November 17. 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 28.6% and 8.8 % 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, 2008

Location	Coho (*broodstock*)	Steelhead	Sockeye	Chinook	Bull Trout
Dryden Dam	696* (*580*)	92	3	464	0
Tumwater Dam	146* (82)	NA	NA	NA	NA
LNFH ladder trap	352* (265)	0	0	0	1

**Actual number of coho handled during trapping at Dryden Dam, Tumwater Dam, and LNFH during broodstock collection efforts for 2008.*

2.1.2 Spawning

Of the 927 coho collected for broodstock needs, 48.7% were females (n=451) and 51.3% were males (n=476), which included both three-year old and two-year old fish. The pre-spawn mortality rate at ENFH was 3.1% in 2008. This was an increase of 1.1% compared to the previous year but still representing the second-lowest observed pre-spawn mortality rate since the program's inception as well within program standards. Sodium chloride, Poly Aqua® and MS-222 were used to decrease stress during transport.

A total of 898 coho adults (445 F and 453 M) were spawned between October 14 and November 25, 2008. Of the 445 total female coho spawned, 443 (99.5%) 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 USFWS and YN staff and their ability to determine appropriate maturation levels for these fish. Peak spawn occurred on November 4 with 154 viable females (Figure 1).

Spawn timing for the 2008 brood was similar when compared to the program average from 2000-2007 except during week six (Figure 2). In mid-November, YN incorporated a large proportion of coho that were trapped at the LNFH ladder. These collections were necessary to meet program goals because the number of coho being encountered at both Dryden and Tumwater dams had decreased dramatically to a few fish per day. Since these individuals, primarily mature females, were collected in a very brief time period and not collected from throughout the run, this could have artificially skewed the spawn timing and resulted in the week six observations.

Coded-wire tag analysis showed that 57.9% (*n*=537; 533 adults, 4 jacks) of fish spawned were LNFH origin returns from 2007 (BY2005) and 2008 (BY2006) releases, while 27.6% (*n*=256; 255 adults, 1 jack) were fish acclimated and released from upper Wenatchee River basin ponds during the same time period (Table 2). One adult incorporated into the brood was released from Winthrop National Fish Hatchery (WNFH) in 2007. After scale analysis, the remaining 14.3% (*n*=133) consisted of ninety-two hatchery origin fish with unknown release locations, thirty-seven natural origin and four 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 2008.

Juvenile Release Location		BY2005 Adults	BY2006 Jacks	Percentage of Brood by Release Site
Leavenworth National Fish Hatchery	*Small Foster-Lucas Ponds*	238	1	25.8%
	Large Foster-Lucas Ponds	295	3	32.1%
Upper Wenatchee River Basin	*Coulter Pond*	75	0	8.1%
	Butcher Creek Pond	48	0	5.2%
	Beaver Creek Pond	96	1	10.5%
	Rohlfing's Pond	36	0	3.9%
Winthrop National Fish Hatchery		1	0	0.1%
Unknown Origin	*Unknown Hatchery*	88	4	9.9%
	Unknown	4	0	0.4%
Wild		37	0	4.0%
Totals		**918**	**9**	**100.0%**

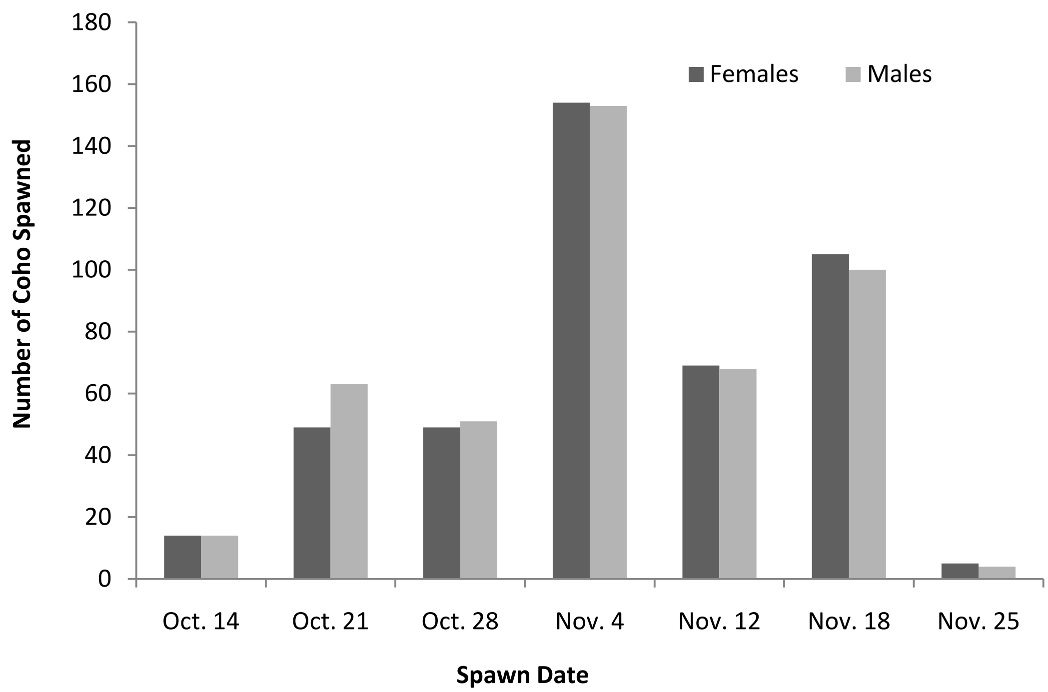

Figure 1. Number of coho spawned at Entiat National Fish Hatchery, 2008.

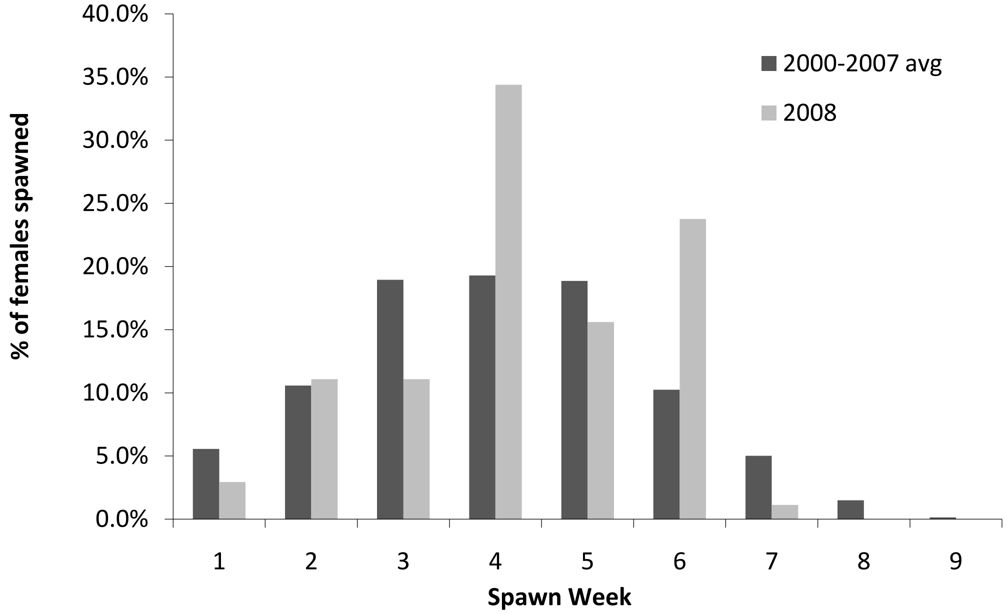

Figure 2. Temporal spawning distribution for brood years 2000-2007 and 2008.

2.1.3 Incubation

A total of 1,436,443 green eggs were collected from the 2008 coho broodstock. Of the total green eggs, 1,172,215 (81.6%) were incubated at ENFH while the remaining 264,227 (18.4%) were transported to YN's Peshastin Incubation Facility (PIF). ENFH incubated larger egg takes since spawns occurred on-station and gametes could be fertilized and placed into incubation units immediately; 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. 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. Once the eggs were held for a minimum of 2-3 minutes to allow for maximum fertilization success, excess milt, ovarian fluid, and other organics were decanted from the eggs 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 914,565 and 219,114, respectively. Average eye-up rate for the 2008 brood was 78.9% (Table 3). This eye-up rate was lower than expected and attributed to a low eye-up rate of 59.9% on the third spawn. The exact cause of this extremely low eye-up rate was unknown, however, spawning procedures and protocols will be reviewed in order to eliminate substandard eye-up rates in future broods.

Approximately 21.0% (*n*=238,733) of the 2008 brood eyed eggs remained at ENFH for hatching and rearing prior to being transported back to the Wenatchee basin as pre-smolts. Juvenile coho rearing at ENFH had been an opportunistic arrangement for the YN coho program as the United States Fish and Wildlife Service (USFWS) continues its programmatic change from spring Chinook to summer Chinook. Infectivity studies were also established to determine if coho were susceptible to a strain of *Myxobulus cerebralis* that resided in Entiat River and had been identified at ENFH in past years; reportedly causing severe mortality within several brood years of spring Chinook in the mid 80's.

The remaining 2008 brood coho eyed-eggs (*n*=894,946) from both ENFH and PIF were transported to Cascade FH and Willard NFH between mid-November and early January for long-term rearing. 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, 2008.

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
PIF	14-Oct	14-Dec	11.5	25,082	6,930	32,012	2,783.63	2,181.04	78.3	Willard NFH
PIF	21-Oct	21-Dec	48	124,607	27,445	152,052	3,167.75	2,595.98	82.0	Willard NFH
ENFH	28-Oct	12-Dec	49	95,036	63,612	158,648	3,237.71	1,939.52	59.3	Willard NFH
ENFH	4-Nov	19-Dec	152	404,472	100,259	505,002	3,322.38	2,662.78	80.1	Cascade FH
ENFH	12-Nov	28-Dec	69	176,053	59,136	234,189	3,394.04	2,551.49	75.2	Cascade FH
ENFH	18-Nov	31-Dec	79	226,546	34,337	260,885	3,432.83	3,006.16	86.8	Entiat FH
PIF	18-Nov	9-Jan	25	69,425	10,739	80,164	3,206.56	2,777.00	86.6	Cascade FH
ENFH	25-Nov	7-Jan	5	12,188	1,306	13,416	2,698.61	2,437.50	90.3	Entiat FH
Total			**438.5**	**1,133,679**	**302,764**	**1,436,443**	**3,275.80**	**2,585.40**	**78.9**	

2.2 METHOW RIVER BASIN

2.2.1 Broodstock Collection

Coho broodstock were collected at WNFH, Wells Dam (east and west ladders) and Wells FH adult trap. Fish returning to WNFH were collected volitionally as swim-ins entered the hatchery holding pond. The WNFH ladder was opened on September 21 and remained open until program goals were met on November 17. A total of 199 adult coho volitionally entered the hatchery (89 F and 110 M). Supplemental collections occurred concurrently at Wells Dam between September 22 and November 11 and Wells FH between September 23 and 29. Thirteen females and nineteen males entered the Wells FH adult trap during the on-going WDFW summer Chinook broodstock collection.

At Wells Dam and Wells FH, a combined total of 318 (195 F and 123 M) adult coho were intercepted. Of these, 312 (192 F and 120 M) were tagged with sequentially numbered floy tags in the dorsal sinus and given an opercule punch prior to transport to WNFH. The marks were used to differentiate fish collected at the Columbia River collection points from volitional swim-ins at WNFH during spawning and post-spawn data collection. A total of six adults (3 F and 3 M) were passed upstream during the last week of collections due to increased numbers of adults arriving at WNFH. The majority of adults handled originated from the west ladder facility (*n*=268). The high proportion of fish intercepted at the west ladder may have be attributed to; a) the proximity of Wells FH complex and the influence of on-station, acclimated coho juveniles and/or b) the influence of chemical signatures disseminating downstream from the Methow River located on the west bank of the Columbia River. The Wells Dam ladder traps were operated no more than three days per week concurrently with WDFW's steelhead collections until October 10. After October 10, trapping activities increased to seven days a week through November 11. Fish returning to WNFH were prioritized during broodstock collection and spawning since they demonstrated the necessary energetic fitness and homing fidelity required to complete the migration up the Methow River to their point of release. All fish encountered during trapping efforts at Wells Dam/Wells FH are listed in Table 4.

Of the 517 adult coho encountered during the 2008 brood collections, 98.1% (*n*=507) were used for broodstock, 1.2% (*n*=6) were passed up-stream at Wells Dam and 0.8% (*n*=4) were released back into the Methow River to spawn naturally. Passed coho and non-target species diverted back to the adult ladders can also be found in Table 4. Bull trout were not observed during trapping at Wells Dam or WNFH.

Table 4. Methow Basin coho salmon trapped and incidentals diverted back to the river, 2008.

Location	**Coho (*broodstock*)**	**Steelhead**	**Sockeye**	**Chinook**	**Bull Trout**
WNFH	199* (195)	0	0	0	0
Wells Dam East ladder	18* (18)	7	0	0	0
Wells Dam West ladder and Wells FH ladder	300* (294)	101	0	160	0

**Total number of coho encountered during broodstock collection efforts for 2008. Passed coho were recorded and allowed to migrate upstream.*

2.2.2 Spawning

Coho broodstock collected from Wells Dam, Wells FH and WNFH were spawned at WNFH. A total of 457 viable adult coho (238 F and 219 M) were successfully spawned between October 20 and November 17. Spawn timing for the 2008 brood was similar to the 2004 - 2007 average (Figure 4) with peak spawning occurring on November 10 with 81 viable females (Figure 3). Forty-two percent (87 F and 108 M) of the broodstock were volitional swim-ins to WNFH while the remaining fifty-eight percent (192 F and 120 M) were fish intercepted at Columbia River collection points. Pre-spawn mortalities totaled 50 fish (41 F and 9 M) and was an increase from 4.0% in 2007 to 9.9% in 2008. The cause for the increased mortality was unknown but speculations were that artificially low water levels at the mouth of the Methow River in the fall may have delayed up-river migration and contributed to an overall reduced condition prior to arrival at WNFH. Four fish (2 F and 2 M) were in excess of program goals and placed back into Spring Creek on November 24. Coded-wire tag analysis showed that 54.4% (*n*=276) of fish spawned were WNFH origin adults returning from the (BY2005) 2007 release while 37.5% (*n*=190) were fish acclimated and released from Wells FH in 2007. Additionally, four male jacks, originating from the (BY2006) 2008 on-station release and one adult male, released from the Beaver Creek acclimation site in the Wenatchee basin were incorporated into the 2008 brood. Of the remaining thirty-six individuals that did not have a CWTs present, scale analysis determined that thirty-five were hatchery reared adults with an unknown release location and one was natural origin. For a complete summary of broodstock composition and collection locations, please refer to Table 5.

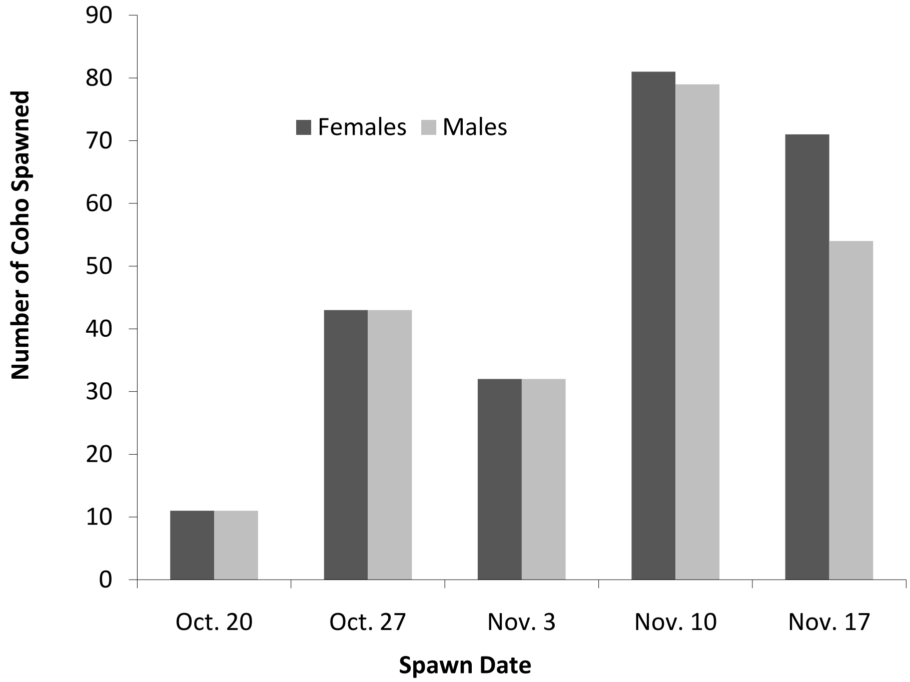

Figure 3. Number of coho spawned at Winthrop National Fish Hatchery, 2008.

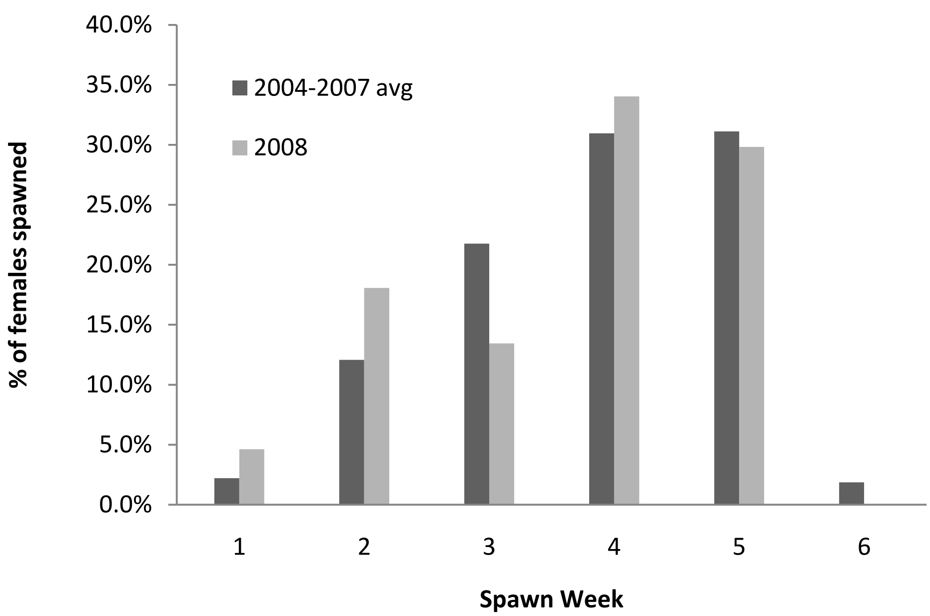

Figure 4. Temporal spawning distribution: brood years 2000-2007 and 2008 at WNFH.

Table 5. Broodstock composition and collection locations for fish spawned at WNFH, 2008.

Juvenile Release Location		BY2005 Adults	BY2006 Jacks	Total
Winthrop National Fish Hatchery	*On-Station*	256	4	260
	Back-channel	20	0	20
Wells Fish Hatchery	*On-station*	190	0	190
Beaver Creek/Wenatchee Basin		1	0	1
Unknown Hatchery		35	0	35
Natural Production		1	0	1
Totals		**503**	**4**	**507**

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 into the fertilization buckets, could cause a potential obstruction of the egg's micropyle and prohibiting fertilization. During fertilization, a 1.0% saline solution was used to increase sperm motility. The eggs were allowed to stand for a minimum of 2-3 minutes until fertilization was complete. Once fertilized, excess milt, ovarian fluid and other organics were strained from the eggs and then soaked in a 75 (part-per-million) ppm concentration of iodine for 30 minutes. After the disinfectant treatment had been completed, a freshwater rinse was administered prior to placing gametes in the incubators.

A total of 751,032 green eggs were collected from the 2008 Methow broodstock. The average eye up rate was 84.7%. Since WNFH had limited full-term rearing capabilities for the coho program, approximately 356,981eyed eggs were transferred to Willard NFH between December 18 and 23 for hatching and full-term rearing. Transportation of these eyed eggs occurred at approximately 600 temperature units (°F). The total number of eggs hatched and held full-term at WNFH was 267,125. A summary of spawn dates, number of eggs collected, fecundity and the eye-up rate at WNFH can be found in Table 6.

Table 6. **Spawn dates, number of eggs collected, and eye-up rate at Winthrop NFH, 2008.**

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	20 Oct	N/A	11	27,538	5,850	33,388	3,035	2,503	82.5	WNFH
WNFH	27 Oct	N/A	43	120,000	23,107	143,107	3,328	2,791	83.9	WNFH
WNFH	03 Nov	N/A	32	76,950	19,222	96,172	3,005	2,405	80.0	WNFH
WNFH	10 Nov	17 Dec	81	218,536	43,346	261,882	3,233	2,698	83.4	WNFH/Willard NFH
WNFH	17-Nov	23 Dec	71	193,445	23,038	216,483	3,049	2,725	89.4	WNFH/Willard NFH
Totals			**238**	**636,469**	**114,563**	**751,032**	**3,156**	**2,674**	**84.7**	

3.0 SPAWNING GROUND SURVEYS

The 2008 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 close proximity to release sites (e.g.- middle reaches of the Wenatchee River). Surveys were also conducted on Chiwawa River, Chiwaukum, Mission/Brender and Peshastin creeks; where coho had not been released but known to spawn naturally. 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 both peak spawning and spawning distribution, both spatially and temporally, for specific tributaries as well as basin wide watersheds.

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 both inter- and intraspecific competition via nest superimposition. Weekly surveys in these reaches proved to be frequent enough to clearly identify individual redds. Weekly surveys were conducted on Beaver, Chiwaukum, Chiwawa, 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. Survey reaches for both basins are identified in Table 5.

Methow River Basin survey efforts concentrated on the mainstem Methow River. In addition to mainstem surveys, lower reaches of multiple tributaries, to include Chewuch and Twisp rivers were also surveyed. Reaches M1-M4 on the mainstem were surveyed weekly to account for the high densities of spawning coho adults while the middle and upper mainstem reaches (M5-M9) were surveyed within 14 day intervals. High water events in mid November suspended all mainstem spawning ground surveys until December 3. Tributary surveys varied and were prioritized by spawning densities observed in previous years; ensuring staff time was used efficiently. Tributaries where spawning densities were relatively abundant (>20 redds; WNFH and WDFW Methow Hatchery outfalls), 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 surveyed within 7-14 day intervals. Periodic surveys were conducted in tributaries where historical redd data demonstrated low counts of redds (<5 redds) or had not been surveyed in previous years. These reaches included lower Twisp and Chewuch rivers, Wolf Creek and Hancock Springs Creek. Additionally, out-of-basin survey efforts were conducted above and below Wells Dam, Chelan FH outfall and two small ponds (Star Road Ponds) located at RK 854.44 on the Columbia River. Complete survey records 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 flagged in the field by tying surveyor's tape to nearby riparian vegetation. Each marker listed the date, redd location, redd number, agency and the surveyor's initials. Global positioning (GPS) was used to record the exact location of individual redds on all surveys. 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 were generally more reliable than those of FL since many recovered carcasses were found with substantially worn snouts 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. 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 the known number of eggs remaining in an individual female from the average fecundity of 2008 coho broodstock for both basins and expressed 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 2008.

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 RM 1.6	0.0-2.6
	Beaver Creek (MET)	
BM1	Mouth to RM 1.6	0.0-2.6
	Libby Creek	
L1	Mouth to RM 1.0	0.0-1.6
	Gold Creek	
G1	Mouth to RM 1.5	0.0-2.4
	Chewuch River	
CR1	Mouth to RM 1.0	0.0-1.6
	Twisp River	
T1	Mouth to RM 2.0	0.0-3.2
	Spring Creek	
S1	Mouth to WNFH	0.0-0.4
	Methow River	
M1	Mouth to Steel Br.	0.0-8.1
M2	Steel Br. to Methow	8.1-23.8
M3	Methow to Lower Gold Cr. Br.	23.8-34.3
M4	Lower Gold Cr. Br. to Carlton	34.3-44.4
M5	Carlton to Twisp	44.4-63.7
M6	Twisp to Winthrop	63.7-80.2
M7	Winthrop to Wolf Cr.	80.2-85.0

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

3.2 WENATCHEE BASIN REDD COUNTS

In 2008, YN identified a total of 346 redds in the Wenatchee River basin. The majority of redds (n=343) were identified below Tumwater Canyon near the town of Leavenworth. Upstream of Tumwater Dam, a total of three redds were identified. Low numbers of spawning coho above Tumwater Dam were resulting from changing broodstock collection protocols that targeted an increase in collections at this facility while a potential velocity barrier within the canyon and below the collection site may inhibit successful migrants to access the upper watershed. YN collected 59 spawned carcasses for an overall sample rate of 8.1% in the Wenatchee River basin (Table 8).

Table 8. Summary of Wenatchee River coho redd counts, distribution and carcass recovery in 2008. Sample rate based on sex ratio of 1:1.1.

River	Number of Redds	Proportion of Redds in Basin	Recovered Carcasses	Sample Rate %
Beaver Creek	0	0.0%	0	—
Brender/Mission Creeks	52	15.0%	12	11.0%
Chiwaukum Creek	0	0.0%	0	—
Chumstick Creek	0	0.0%	0	—
Icicle Creek	202	58.4%	25	5.9%
Nason Creek	3	0.9%	0	—
Peshastin Creek	19	5.5%	8	20.1%
Wenatchee River	70	20.2%	14	9.5%
Total	**346**	**100%**	**59**	**8.1%**

Coded-wire-tag analysis revealed that of the 16 identified tags codes from fish released in the upper basin as juveniles, only one was recovered in the upper basin as an adult (Table 9). Although sample sizes were small, CWT analysis suggested that fish released from lower basin release location (e.g. Leavenworth National Fish Hatchery) generally return to that location. In contrast, fish released from upper basin locations strayed to lower basin locations. It was speculated that the latter fish did not possess adequate energy reserves to complete the migration through the arduous reaches of the Wenatchee River through Tumwater Canyon. Recapture rates of both male and female coho released as juveniles from the upper basin are being assessed to determine what level of migratory success is being obtained. Also, physiological, energetic and hormonal indicators are being evaluated to see if a correlation can be made between these quantitative traits and environmental factors, such as stream discharge, to generate possible selection criteria for determining successful vs. unsuccessful migrants.

Table 9. Summary of coded-wire-tag analysis from coho carcasses recovered throughout the Wenatchee River Basin in 2008.

Juvenile Release Location	# of CWTs	Adult Recovery Location	# of CWTs
Upper Wenatchee Basin Female	11	Mission Nason Wenatchee	5 1 5
Upper Wenatchee Basin Male	5	Peshastin Wenatchee	1 4
Lower Wenatchee Basin Female	14	Icicle Mission Peshastin Wenatchee	8 3 2 1
Lower Wenatchee Basin Male	6	Icicle Wenatchee	5 1
Methow Basin Female	1	Mission	1
Methow Basin Male	1	Mission	1

3.2.1 Icicle Creek

YN conducted 11 weekly spawning ground surveys in the main channel (hatchery to mouth) of Icicle Creek between October 9 and December 3 (Figure 5); weekly surveys were conducted on seven occasions in the restored side channel (hatchery to headgate) between October 16 and December 4. YN recorded 173 redds in the main channel and 29 redds in the restored channel (Icicle Creek total =202). Redds recorded in Icicle Creek represented 58.4% of the total number of redds found in the Wenatchee River basin (Table 8).

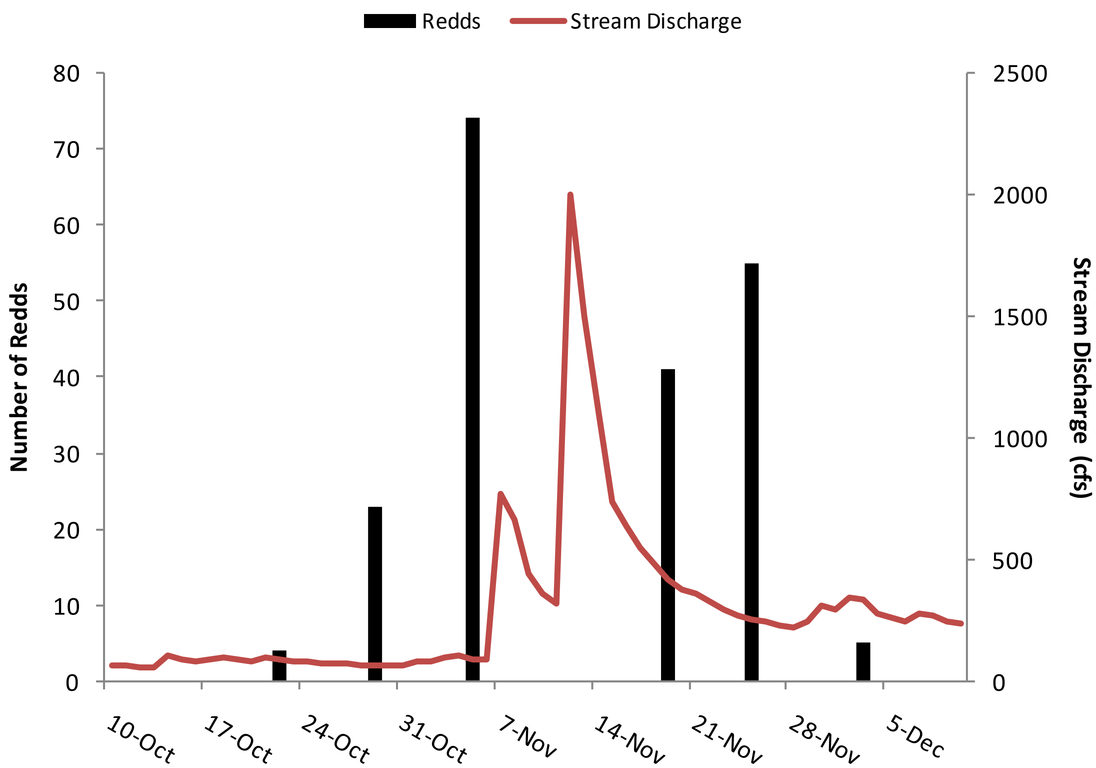

Figure 5. Weekly redd counts conducted in Icicle Creek with mean daily stream discharge from October 10 through December 10, 2008.

Peak spawn occurred during the first week of November. We recovered 25 coho carcasses for a sample rate of 5.9%. Heavy precipitation and a substantial increase in stream discharge on November 13, 2008 carried a large portion of post-spawned carcasses downstream and resulted in the low recovery rate.

The mean POH lengths for male and female carcasses were 58.3cm (*n*=6; *SD*=4.4*)* and 55.8cm (*n*=9; *SD*=3.3), respectively. All females with intact body cavities were examined for the presence of eggs. Mean egg voidance was 97.9% (*n*=10). Three carcasses did not possess CWTs (one male, two females). Pending scale analysis will determine the origin of these unmarked adults.

3.2.2 Nason Creek

Fifteen spawning ground surveys were conducted in Nason Creek between October 8 and December 5; a total of three redds were recorded (Table 8). All were located within Reach 1. No carcasses were recovered. Nason Creek redds represented less than 1% of the coho redds identified in the Wenatchee River basin.

3.2.3 Mainstem Wenatchee

A total of 70 redds were recorded during 27 surveys of the mainstem Wenatchee River from Lake Wenatchee to the Columbia River confluence, between October 9 and January 11 (Table 8). Redds located on the mainstem Wenatchee River accounted for 20.2% of the total observed coho redds in the Wenatchee River basin. YN recovered 14 carcasses along the mainstem Wenatchee for a sample rate of 9.5%. The mean POH lengths for male and female carcasses were 53.2cm (n=6: SD =4.4) and 54.9cm (n=8; SD=1.9), respectively. Egg voidance was 97.9% (n=9) among females.

3.2.4 Mission/Brender creeks

YN conducted 10 surveys of Mission/Brender Creeks between October 2 and December 6 and recorded 52 redds. Redds located in Mission and Brender Creeks represented 15.0%, of the total number of coho redds recorded in the Wenatchee River basin (Table 8). YN recovered 13 carcasses for a sample rate of 11.0%. The mean POH lengths for males and females were 48.0cm (n=2) and 55.1cm (n=11; SD=4.6), respectively. Egg voidance was 90.5% (n=11) which included one pre-spawned female carcass. Scale analysis is pending.

3.2.5 Peshastin Creek

YN conducted seven surveys on Peshastin Creek and recorded 19 coho redds between October 6 and January 28 (Table 8). Eight carcasses were recovered for a sample rate of 20.1%. Redds located in Peshastin Creek represented 5.5% of the coho redds recorded in the Wenatchee River basin. The mean POH lengths for males and females were 49.0cm (n=1) and 55.7cm (n=6; SD=5.5), respectively. Egg voidance was 97.0% among females sampled.

3.2.6 Other Tributaries

Surveys were also conducted in Beaver Creek on October 12 and 26, as well as December 8. A survey was conducted in Chiwawa River on October 24. Surveys of Chiwaukum Creek were conducted on October 16 and 23, as well as November 6 and 24. No redds were identified and no carcasses were recovered from these tributaries.

3.2 METHOW BASIN REDD COUNTS

In the Methow River basin, a total of 159 coho redds were identified. The majority of redds observed (71.1%; *n*=113) were located within the mainstem while the remaining (28.9%; *n*= 46) were identified in select tributaries including WNFH and Methow FH outfalls. Most redds observed on the mainstem Methow River were found within the lower reaches, below RK 33.9. YN collected a total of 46 spawned carcasses for an overall basin sample rate of 13.2% (Table 10).

Spawning ground surveys were also conducted within select tributaries located in close proximity both above and below Wells Dam. These were initiated in an effort to account for fish returning from Wells FH releases and straying associated with the program. A total of 52 redds were identified and 49 carcasses were sampled for an overall, out-of - basin sample rate of 55.4% (Table 11).

Table 10. Summary of coho redd counts, distribution in the Methow River Basin and adjacent tributaries, and carcass recovery in 2008. Sample rate based on sex ratio of 1:1.2.

River	Number of Redds	% of Redds in Methow Basin	Recovered Carcasses	Sample Rate %
Methow River	113	71.1%	29	11.7%
WNFH Spring creek	25	15.7%	15	27.3%
WDFW Outfall	15	9.4%	1	3.0%
Twisp River	1	0.6%	0	0.0%
Chewuch River	4	2.5%	1	11.4%
Libby Creek	1	0.6%	0	0.0%
Total	**159**	**100%**	**46**	**13.2%**

Table 11. Summary of coho redd counts, distribution in Columbia River (out-of basin) tributaries, and carcass recovery in 2008. Sample rate based on sex ratio of 0.7:1.0.

River	Number of Redds	% of Redds Out-of-Basin	Recovered Carcasses	Sample Rate %
Beebee Springs	49	94.2%	28	33.6%
Chelan River	3	5.7%	9	_
Similkameen River	0	0.0%	1	0.0%
Star Road Ponds	0	0.0%	11	0.0%
Total	**52**	**100%**	**49**	**55.4%**

3.2.1 Methow River

Methow River redd surveys in 2008 occurred between October 20 and December 10. The surveys included nine reaches (M1-M9) on the Methow River extending from Weeman Bridge (RK 98.6) to the Columbia River confluence (RK 0.0). High flow events suspended the majority of main-stem surveys from November 12 to December 1.

Of the 113 coho redds identified on the mainstem, 71.7% (*n*=81) were located in reaches M1-M4 (RK 0.0-33.9) while the remaining 28.3% (*n*=32) were distributed in the middle and upper reaches M5-M9 (RK 33.9-98.6). The high proportion of redds identified within the lower reaches of the Methow River was attributed to straying adults from the 2007 release at Wells FH, located approximately 12.3 RK downstream from the confluence of the Methow and Columbia rivers. Data collected from recovered carcasses and subsequent coded-wire tag analysis indicated that 64.7 % (*n*=11) of carcasses found within the first two reaches (RK 0.0 – RK 16.1) originated from this Columbia River release.

A total of 29 carcasses were recovered within the Methow River mainstem in 2008, of which, nineteen were female, nine were male and one was unidentifiable due to predation. Mean fork length for male and female carcasses were 67.2cm (*SD*=16.6) and 70.1cm (*SD*=3.7), respectively. Mean POH for both male and female carcasses were 51.9cm (*SD*=12.6) and 56.2cm (*SD*=3.1), respectively. All females with intact body cavities (*n*=19) were examined for the presence of eggs. Mean egg voidance for females recovered was 76.3%. Four of these females had intact, green egg skeins and were determined to be pre-spawn mortalities.

Coded-wire tag analysis indicated that 42.9% (*n*=12) originated from the 2007 Wells FH release, 28.6% (*n*=8) originated from the 2007 WNFH on-station release, 25.0% (*n*=7) were either lost during extraction, un-readable or did not possess a coded wire tag and 3.5% (*n*=1) originated from the 2007 WNFH back-channel (Spring Creek) release. The sample rate for the mainstem Methow River was 13.4%. Future scale analysis will determine the origin of the unknown portion of carcasses recovered. For a summary of coded-wire-tag origins from coho carcasses recovered throughout the Methow River basin in 2008, please refer to Table 12.

3.2.2 Spring Creek (WNFH) and Methow FH (WDFW) Outfalls

The WNFH and Methow FH outfalls were surveyed weekly beginning October 20 and ending December 8. The first redds found in both locations were observed on October 27. WNFH was the only coho release site within the Methow River basin in 2007, 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 (less than 2 RK) and use of the same surface water source (Spring Creek via Foghorn Irrigation Division) produces very similar imprinting signatures. Limited spawning habitat within these outfalls presumably contributes to low egg-to-immigrant survival due to superimposition of nesting adults and intraspecific competition for food and space as juveniles.

A total of 25 redds were located within Spring Creek between October 27 and December 8. These redds accounted for 15.7% of all coho redds identified within the basin and 54.3% of all Methow basin tributaries (Table 8). A total of 14 (6 M and 8 F) carcasses were recovered. Mean POH for both males and females was 47.0cm (*SD* =17.6) and 55.7cm (*SD* =2.1), respectively. Coded wire tag analysis revealed that 57.2% (3 M and 5 F) originated from the WNFH, on-station releases, 14.3% (2 M) originated from the WNFH back-channel release and 28.6% (1 M and 3 F) either did not possess a CWT or was lost during extraction (Table 12). Scale analysis will determine the origin of the unknown portion of the recovered carcasses. Mean egg voidance was 98.3% and the carcass sample rate was 26.1% for Spring Creek.

Fifteen redds were identified in the Methow FH outfall between October 27 and November 17. These redds accounted for 9.4% of all redds found in the Methow basin and 32.6% found within tributaries (Table 10). One female carcass was sampled with a POH of 56.0cm. Coded wire tag analysis indicated that this female originated from the 2007 WNFH on-station release. Egg voidance was unable to be accurately assessed due to predation. The carcass sample rate was 3.0% for the Methow FH outfall.

3.2.3 Chewuch River

Chewuch River surveys were conducted as one reach from RK 15.0 to the confluence of Methow River and occurred between October 24 and December 4. A total of four redds were identified in 2008. These were the first redds to be documented within this reach since spawning ground surveys were initiated in the Chewuch River in 2006. One male carcass was recovered with a fork length of 64.0cm and POH of 49.0cm. Coded wire tag analysis proved that the male originated from the WNFH back-channel release in 2007 (Table 12).

3.2.4 Twisp River

One redd survey was conducted on November 24 on the Twisp River; from RK 24.3 to the confluence of the Methow River. High water levels during peak spawn reduced visibility and delayed surveys until after peak spawn occurred. One redd was observed in this lower reach. No live fish or carcasses were observed or sampled. Redds located within the Twisp River accounted for 0.6% of the total redds found in the Methow basin and 2.2% found within tributaries (Table 10).

3.2.5 Libby Creek

Libby creek surveys were conducted as one reach (RK 1.0 - confluence of Methow River; Table 5) and occurred between October 27 and December 4. Redds located within Libby Creek accounted for 0.6% of the total redds found in the Methow basin and 2.2% found within tributaries (Table 10). There were zero live fish observed or carcasses sampled. This was the second recorded coho redd to be observed in Libby creek since comprehensive surveys were initiated.

3.2.6 Chelan FH Outfall and Chelan Falls, Foster Creek and Similkameen River

In 2008, YN continued survey efforts in areas downstream and upstream of Wells Dam to account for fish returning from Wells FH smolt releases as well as document dropouts associated with in-basin releases. Surveys were conducted once before, during, and after peak spawn 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). High abundance of spawning summer Chinook continued to make identifying coho redds difficult at Chelan Falls. Surveys conducted after peak summer Chinook spawning allowed for a higher probability of discerning coho redds but was still likely an underestimate of the total spawning aggregate in this location.

Redds identified within Beebe Springs accounted for 94.2% (n=49) of the total redds found outside the Methow basin (Table 11). Nine males and nineteen females were sampled with a mean POH of 46.9cm (SD=10.2) and 54.2cm (SD=4.2), respectively.

The carcass sample rate was 33.6%. Coded wire tag analysis showed that 92.9% (*n*=26) originated from the 2007 Wells FH releases while 7.1% (*n*=2) originated from the 2007 WNFH on-station releases. Seven completed redds were located in the newly restored channel, while19 redds were identified in the original channel and 23 were identified above the culvert within the outfall of the Chelan FH. Mean egg voidance was 65.0%.

The Chelan River is a fast flowing, large stream connecting Lake Chelan to the Columbia River. Chelan Falls is the lowermost portion of this river where summer Chinook and coho spawn concurrently. Three redds were identified and nine carcasses were recovered in Chelan Falls. The carcass sample rate was likely inflated due to an underestimate of discernable redds within this river system. Five male and four female carcasses were sampled with a mean POH of 51.6 cm (*SD*=11.2) and 61.1 (*SD*=2.9), respectively. Mean egg voidance was 25.0%.

3.2.7 Star Road Ponds

Star Road Ponds, located just upstream of Wells Dam, was spot checked once during peak spawn. The location was investigated when Methow staff observed several adult coho carcasses lying out of water on dry substrate within the ponds. Fish entered the ponds through an unscreened culvert and were stranded when water levels were reduced to a point where exiting was not possible. A total of eleven carcasses (7 males and 4 females) were recovered. Mean fork length for male and female carcasses were 63.9cm (*SD*=15.6) and 72.8cm (*SD*=5.0), respectively. Mean POH for both male and female carcasses were 52.9cm (*SD*=16.1) and 58.8cm (*SD*=5.0), respectively. All four females had intact egg skeins and were considered to be pre-spawn mortalities. Coded-wire tag analysis indicated that 81.8% (*n=*9) originated from the 2007 Wells FH release and 18.2% (*n*=2) were jacks originating from the (BY2006) 2008 Wells FH release. Identification of these fish was likely a result of Wells programmed fish attempting to locate suitable spawning habitats, which these ponds do not fall in that category.

3.2.8 Similkameen River

One female carcass was found in the Similkameen River, approximately 6.72 RK upstream from the confluence with the Okanogan River at RK 121.36. The carcass was located by BioAnalyst staff while conducting summer Chinook spawning ground surveys on November 6. This female was found with an intact egg skein and considered to be a pre-spawn mortality. Coded- wire tag analysis indicated that she originated from the 2007 Wells FH release. This female was found approximately152.52 RK past the point of release; a remarkable accomplishment and a trend observed in 2008 (e.g.- Wenatchee fish at Wells Dam, Wells releases @ Star Road Ponds and the lower Methow River, etc.) This “overshooting” ability could demonstrate an inherent increase in fitness originating from multiple generations of locally adapting families and be a testament to the success of the broodstock development process.

3.2.8 Other Tributaries

Surveys were also conducted on Hancock Springs Creek, Beaver Creek, Wolf Creek and Foster Creek; no coho redds, carcasses or live fish were observed. Survey reaches within these tributaries can be found in Table 7.

Table 12. Summary of coded-wire-tag analysis from coho carcasses recovered throughout the Methow River basin and out-of-basin tributaries in 2008.

Juvenile Release Location	# of CWTs	Adult Recovery Location*	# of CWTs
Winthrop NFH Female	15	WNFH Spring creek	6
		WDFW outfall	0
		Methow	6
		Out of basin	3
Winthrop NFH Male	5	WNFH Spring creek	3
		WDFW outfall	1
		Methow	1
		Out of basin	0
Winthrop NFH back-channel Female	2	WNFH Spring creek	0
		WDFW outfall	0
		Methow	1
		Out of basin	1
Winthrop NFH back-channel Male	3	WNFH Spring creek	2
		WDFW outfall	0
		Out of basin	0
		Chewuch	1
Wells NFH Female	31	Methow	8
		Out of basin	23
Wells NFH Male	23	WNFH Spring creek	0
		Methow	4
		Out of basin	19

SUMMARY

• During spawning ground surveys in Icicle Creek, we observed 202 coho redds and recovered 25 coho carcasses. The mean egg voidance was of 97.9% (*n*=10).

• During spawning ground surveys in Nason Creek, we counted three coho redds and no recovered carcasses were recovered.

• Aside from Icicle Creek, we found a total of 141 redds in the lower Wenatchee River basin. A total of 34 carcasses were recovered in Mission/Brender Creeks (*n*= 12), Peshastin (*n*= 19), and the mainstem of the lower Wenatchee River (*n*= 70).

• A total of 211 redds were identified and 95 carcasses were recovered in the Methow River basin and out-of-basin tributaries in 2008. A total of 159 redds and 47 carcasses were located within the Methow River basin while 52 redds and 48 carcasses were identified outside of the target basin.

• Total redd counts in the Methow River basin were the second highest since the inception of the coho program; to include both in-basin and out of basin surveys. The record escapement was established in 2007 with a total of 306 redds.

• Spawning distribution data in the Methow River basin demonstrated that of the 113 redds observed in the mainstem Methow River, 71.7% (*n*=81) were located within the lower reaches (RK 0.0 - 33.90) while 28.3% (*n*=32) were located in the middle and upper reaches (RK 33.90 – 98.6). Redds identified within tributaries accounted for 28.9% (*n*= 46) of all redds observed in the Methow basin.

4.0 SMOLT ACCLIMATION: WENATCHEE AND METHOW

4.1 ACCLIMATION SITES

In 2009, within the Wenatchee River basin, YN acclimated coho pre-smolts at the LNFH, Beaver Creek and three sites on Nason Creek. For the Methow River broodstock development program, YN acclimated coho pre-smolts at WNFH, Spring Creek back-channel and Wells FH.

4.1.1 Leavenworth National Fish Hatchery

LNFH is located at river kilometer (RK) 4.5 on Icicle Creek. Coho smolts were acclimated in refurbished raceways, also known as small and large Foster-Lucas (SFL & LFL) ponds. Originally, these Foster-Lucas ponds were designed for rearing steelhead, sockeye, and spring Chinook. The intent for the oval-shape design of the ponds 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 small and large Foster-Lucas ponds were partially refurbished by Yakama Nation Fisheries and supplied with re-use water for coho acclimation. The water source for the large ponds originates from the hatchery's 10'x100' juvenile spring Chinook raceway effluent. Re-use water supplied to the small Foster-Lucas ponds 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 2009, acclimation for both coho and spring Chinook 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, which were not captured for broodstock, would either spawn in Beaver Creek or the upper Wenatchee River watershed. The resulting natural production would continue to build our ongoing broodstock development process.

4.1.3 Nason Creek

In 2009, acclimated coho pre-smolts were reared and released from three sites on Nason Creek; Butcher Creek, Coulter Creek and Rohlfing's Pond. Coho smolts were also direct planted into a forth location, the Nason Creek Wetlands, to test the survival of direct releases into an off channel habitat. The assumption here was that fish would acclimate within the oxbow and leave at the onset of high flows. All acclimation sites in Nason Creek are natural or semi-natural earthen ponds. Natural and earthen ponds may have advantages over conventional, hatchery raceways such as lower rearing densities, supplemental natural food sources and other environmental conditions (e.g. natural temperature and flow regimes, increased water quality, volitional pond migration, etc.) that should produce a juvenile that will acclimatize 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. The 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. 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 2009 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. 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 2009 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 Coast Salmon Recovery Funds (PCSRF) to preserve wetland habitat. These creeks converge to form a complex series of natural beaver ponds that eventually empty into Nason Creek at RK 13.7. In 2009, coho smolts were released directly into the wetlands without containment or feeding (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 2010 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 (WNFH)

Coho smolts released into the Methow River from WNFH, located at RK 80.6, were reared from the fingerling stage to release within seven on-station raceways as well as the back-channel. Although five raceways were typically used to rear coho juveniles on-station, unforeseen shortfalls in the WNFH spring Chinook program in 2007 provided the additional raceway space for rearing BY2007 coho juveniles. Prior to acclimating fish in the back-channel in 2009, two PIT tag detections systems were installed in series below the outfall of the back-channel acclimation pond.

4.1.5 Wells Fish Hatchery

In 2009, 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 2009 were intended to assist broodstock development phases (YN FRM 2009) until additional acclimation facilities are 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 regular collection facilities.

4.1.6 Twisp Ponds Complex

The Twisp Ponds Complex, 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 initiating broodstock adaptation in the Twisp River drainage. Prior to fish arrival, wood structures and shade covers were installed to enhance rearing conditions and minimize predation.

4.2 TRANSPORTATION AND VOLITIONAL RELEASE

4.2.1 Wenatchee River Basin

Mid-Columbia coho pre-smolts (BY2007) were transported to the Wenatchee basin from rearing facilities at Willard NFH and Cascade FH between February 24 and April 2, 2009. Coho were acclimated between 9 and 11 weeks at five acclimation sites within the Wenatchee River basin (Table 13). Because some of the upper basin sites (e.g. Coulter Nason Creek Wetlands and/or Beaver Creek) were inaccessible in the early springtime, LNFH served as an intermediate, in-basin rearing location for four to seven weeks prior to being transferred to their final destination. 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 basin. Transportation from LNFH to the upper basin sites occurred between March 10 and April 16.

All coho smolts acclimated in the SFL's and LFL's were force-released on April 23 and 27, respectively. During 2009, coho acclimated at LNFH presented several fish health challenges. Several ponds were infected with *Trichodina sp.* and *Flavobacterium psychrophilum* (bacteria coldwater disease). Timely identification and treatment of these infections significantly reduced the potential mortality that would have occurred if gone unchecked.

Volitional releases began at Butcher Creek Pond, Coulter Creek Pond, Rohlfing's Pond and Beaver Creek Pond on May 6 and 7. Coho released into Nason Wetlands were direct planted on April 2 (Table 13). All acclimation facilities were deemed empty by June 15.

Coho released in 2009 were coded-wire tagged with retention sampling ranging from 96.0-100% (*n*=13,101). In addition to CWTs, all upper Wenatchee basin released coho (*n*= 412,302) had a secondary, blank wire inserted into the adipose fin with retentions ranging from 93.4-98.4% (*n*=5,500). This secondary mark provided the means to implement "Broodstock Development Phase II" (YN FRM 2009) by selectively passing returning adult coho destined for the upper basin at the Dryden Dam broodstock collection facility (lowermost collection point to Wenatchee coho program) for potential recapture at Tumwater Dam. By demonstrating that a large portion of these fish can navigate above the facility, whether collected into broodstock or passed upstream, would be beneficial for continual broodstock development and adaptation towards the upper watershed.

During 2009, 29,611 juveniles were marked with PIT tags. Of these, 17,924 PIT tagged fish were released from LNFH, 5,822 from Butcher Creek Pond and 5,865 from Rohlfing's Pond (Table 13). These PIT tagged fish were used to measure survival from release point to McNary Dam and determine in-pond survival at select release sites (see Section 4.4). Two PIT tag detection systems were installed in series at each of the upper basin acclimation sites (Butcher Pond and Rohlfing's Pond) to ensure maximum detection efficiency.

In total, 974,378 hatchery produced coho smolts were released from the Wenatchee River basin in 2009. Release numbers, size-at-release, and release locations can be found in Table 13. For detailed mark information, see Appendix C.

4.2.2 Methow River Basin

Mid-Columbia River juvenile transports from lower Columbia River facilities to the Methow basin for acclimation were not needed in 2009. Unforeseen shortfalls in the BY2007 WNFH spring Chinook program provided additional raceway space for rearing BY2007 coho juveniles. A total of nine raceways were used for rearing coho juveniles to the pre-smolt stage. YN and WNFH staff transferred coho pre-smolts from two of these raceways to the WNFH back-channel and the Twisp Ponds Complex on March 26 and April 7, respectively. Coho pre-smolts were held until release within the remaining seven raceways. Additional improvements were made to the WNFH on- station raceways and the back-channel acclimation pond in 2009 that focused on reducing predation. High-tension strength bird netting was installed on all raceways and a one piece, net canopy was installed over the back-channel. These new nets proved to drastically reduce the high predation rates seen in previous years. Large Woody Debris (LWD) was placed within the Twisp ponds prior to fish arriving in February to provide additional cover. Floating covers were installed at the WNFH back-channel and Twisp Ponds to further improve rearing through minimizing predation and providing shade.

Coho pre-smolts were transported by ODFW personnel to Wells FH on March 12, 2009. The juveniles were approximately 23.0 FPP at arrival. The juveniles acclimated at Wells FH were 100%, 2nd generation MCR progeny from the Methow program. These juveniles were acclimated for approximately seven weeks and released on April 22 at 15.1 fish per pound (Table 13).

All on-station MCR juveniles at WNFH were force released on April 22. Volitional releases began on May 1 at both the WNFH back channel and Twisp Ponds Complex and concluded on June 1 when snorkeling observations determined the pond empty. Coho acclimated at Wells FH were force released on April 22. All releases were CWT'ed. Coded-wire tag retentions from coho at WNFH, both on-station and back-channel releases, were 98.5% (*n*=500) and 100% (*n*=100), respectively. Coded-wire tag retentions for the Twisp Ponds Complex were 100% (*n*=100) while retentions from Wells FH were 97.2% (*n*=100). Release summary information in provided in Table 13.

In 2009, 12.4% (*n*= 5,938) and 2.8% (*n*= 5,486) of juveniles released from the backchannel and on-station raceways were PIT tagged. Two PIT tag detection systems were installed, in series, downstream of the back-channel pond to increase overall detection efficiencies. PIT tagged fish will be used to address metrics measuring survival from release to McNary Dam, calculating in-pond survival and downstream migration timing (see section 4.4 and 5.0).

A combined total of 469,102 coho juveniles were released for the Methow program (Table 13). For detailed mark information, see Appendix C. Juvenile releases in 2009 marked the second year that 100% of the smolts were progeny of locally returning adults to the Methow basin. The development of a local broodstock is critical for achieving program goals within the Methow River basin (YN FRM 2009).

Table 13. Mid-Columbia coho smolt release summary, 2009.

Location	Release Date	Release Number	Size @ release (FPP)	No. PIT Tags
Beaver Pond	May 7	76,168	15.1	0
Coulter Creek	May 6	73,822	16.1	0
Rolfing's Pond	May 6	97,402	16.7	5,865
Butcher Pond	May 7	126,312	16.7	5,822
Nason Creek Wetlands	April 2	38,589	18.1	0
Leavenworth NFH LFL's (large Foster-Lucas Ponds)	April 23	219,009	20.2	8,927
Leavenworth NFH SFL's (small Foster-Lucas Ponds)	April 27	343,076	15.6	8,997
Wenatchee Total		**974,378**		**29,611**
Winthrop NFH (on-station)	April 22	328,345	15.9	5,486
Winthrop NFH (back-channel)	May 1	48,048	16.6	5,938
Twisp Ponds Complex	May 1	48,289	16.7	0
Wells FH	April 22	44,420	15.1	0
Methow Total		**469,102**		**11,424**

Wenatchee/Methow Totals		1,443,480		41,035

4.3 FISH CONDITION ASSESSMENT

At all Wenatchee and Methow basin acclimation sites, coho were sampled weekly to measure growth and estimate the degree of smoltification (n=*100*). Prior to release, fish condition was assessed (n=*20*) to establish overall health by evaluating the normality of external features (eyes, fins, opercules, etc.) as well as internal organs and blood components. The purpose of the fish condition assessment was to note gross abnormalities, rather than diagnose the cause of certain conditions. If abnormalities were observed, USFWS fish health staff was notified so that additional testing could be conducted. All Wenatchee and Methow basin 2009 pre-release growth and condition assessments demonstrated that the smolts were in good condition (Table 14). Beginning in 2010, pre-release OSIs will be discontinued in favor of incorporating external observations into the weekly growth sampling and relying on fish health professional's pre-release reports.

Coho reared in the WNFH back-channel had a mean condition factor (measure of relative robustness or degree of well-being) of 1.05 in 2008, higher than observed in 2007 (0.96). This increase was presumably due to increased efforts to reduce predation related stress and mortality. Increased hazing efforts and rearing condition improvements in the WNFH back-channel and on-station raceways may have contributed to the increased condition factor of the coho in 2008.

Table 14. Pre-release fish condition assessment, 2009.

Acclimation Location	Cond. Factor	Eyes[1]	Gill[1]	Psuedo-branchs[1]	Thymus[1]	Mes. Fat[2]	Spleen[1]	Hind Gut[1]	Kidney[1]	Liver[1]	Gender M/F	Fin Cond.[1]	Opercle[1]
LNFH-LFL's	1.11	97.5	100	100	100	1.2	100	100	100	100	26/14	77.5	100
LNFH-SFL's	1.23	100	100	100	100	1.8	100	98.8	100	96.3	40/40	72.5	100
Beaver Creek	1.16	95	100	100	100	2.3	100	100	100	90	8/12	85	100
Coulter Creek	1.09	100	100	100	100	2.1	100	100	100	90	6/14	95	100
Rolfing's pond	1.13	95	100	100	100	2.1	100	100	100	80	11/9	80	100
Butcher pond	1.20	100	100	100	100	1.2	100	100	100	100	11/9	100	100
Winthrop NFH (on-station)	1.00	93	95	100	100	2.9	100	99.3	100	93.5	79/61	90.7	100
Winthrop NFH (back-channel)	1.08	95	97	100	100	3.4	100	100	100	100	13/7	100	100
Twisp Ponds	1.17	100	100	100	100	3.2	100	100	100	100	12/8	100	100

Wells FH	1.07	100	90	100	100	3.9	100	100	100	100	13/7	65.0	100

1- *All components were based on a normality index (% norm). Variance in organ color and size was not looked at.*
2- *Mesenteric fat was based on a 0-3 numerical system average. A value of 2 equals more than 50% of the ceaca covered with fat, which is healthy.*

4.4 PREDATION ASSESSMENT

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

4.4.1 Estimated Mortality-Predator Consumption Model versus PIT tag Detection

4.4.1.1 Predation Model

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

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

C_e= Estimated consumption for an individual predator

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

FPP= Fish per pound

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

D_p= Duration of same species predators observed

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

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

In the Methow basin, the 2009 acclimation season was the second consecutive year that the aforementioned predation assessment model was employed at WNFH. Results from observations in 2008 underlined the importance of the information this model provides in accounting for both observed and unobserved predation. Estimated predation losses at WNFH in 2008 totaled approximately 9.9% (*n*=26,700) of the total population of fish acclimating within the on-station raceways; and was significantly higher than all other Upper Columbia acclimation locations. In response to high numbers of predators observed in 2008 and in previous years, YN and WNFH staff installed new high-tension netting with lead lined edges around each individual raceway in the spring of 2008. Custom net hooks were fabricated to ensure that each raceway was completely covered so that no gaps existed between the nets and sides of the raceways. WNFH staff also installed several electronic, rotating predator deterrents. Predation observations in 2009 significantly decreased to 0.3 % (*n*=822) of the total population because of these efforts and very few sightings of active predation by avian or mammalian species were documented.

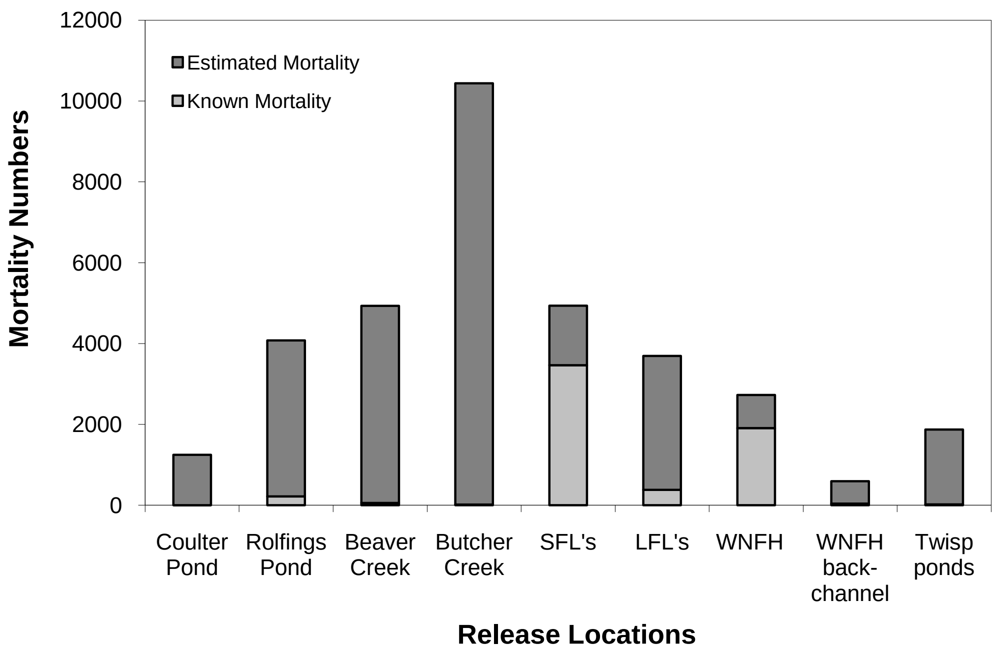

Figure 6. Known and estimated mortality at all acclimation sites in the Methow and Wenatchee river basins, 2009.

4.4.1.2 PIT tag Detection

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

Prior to the 2009 acclimation, we installed PIT tag antenna arrays at Rohlfing's Pond, Butcher Pond, and WNFH Spring Creek back channel. These sites will be repeated in 2010 to provide multiple years of data. Only sites with maintained outlet detection systems could be used for measuring in-pond survival with PIT tags and for a comparison of methods to measure in-pond survival (PIT tag vs. predation model).

In-pond survival was estimated by the following formula:

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

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

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

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

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

Table 15. Estimates of in-pond survival and PIT tag detection efficiency, 2009.

	Butcher Creek Pond	Rohlfing's Pond	WNFH Spring Creek Channel	WNFH on-station
Total PIT tags	5,862	5,873	5,938	5,433
Unique detections at outlet	4,233	5,340	5,162	3,273
Proportion of tags detected at outlet	0.722	0.909	0.869	0.602
Total unique downstream detections	1,183	1,887	858	1,167
Downstream detections also detected at pond outlet	1,123	1,870	804	712
Est. Detection Efficiency	**0.949**	**0.991**	**0.937**	**0.610**

Est. Total Tags exiting the pond	4,461	5,388	5,509	5,365
Est. In-Pond Survival	**0.766**	**0.919**	**0.928**	**0.987**

A comparison of in-pond mortality estimates based upon PIT tags and the predator consumption model can be found in Figure 7 & 8. Typically, the predator consumption model underestimates the in-pond mortality rate as measured with PIT tags, however, since it is not possible to install PIT tag detection capabilities at all release locations, we will continue to estimate in-pond mortality using both methods.

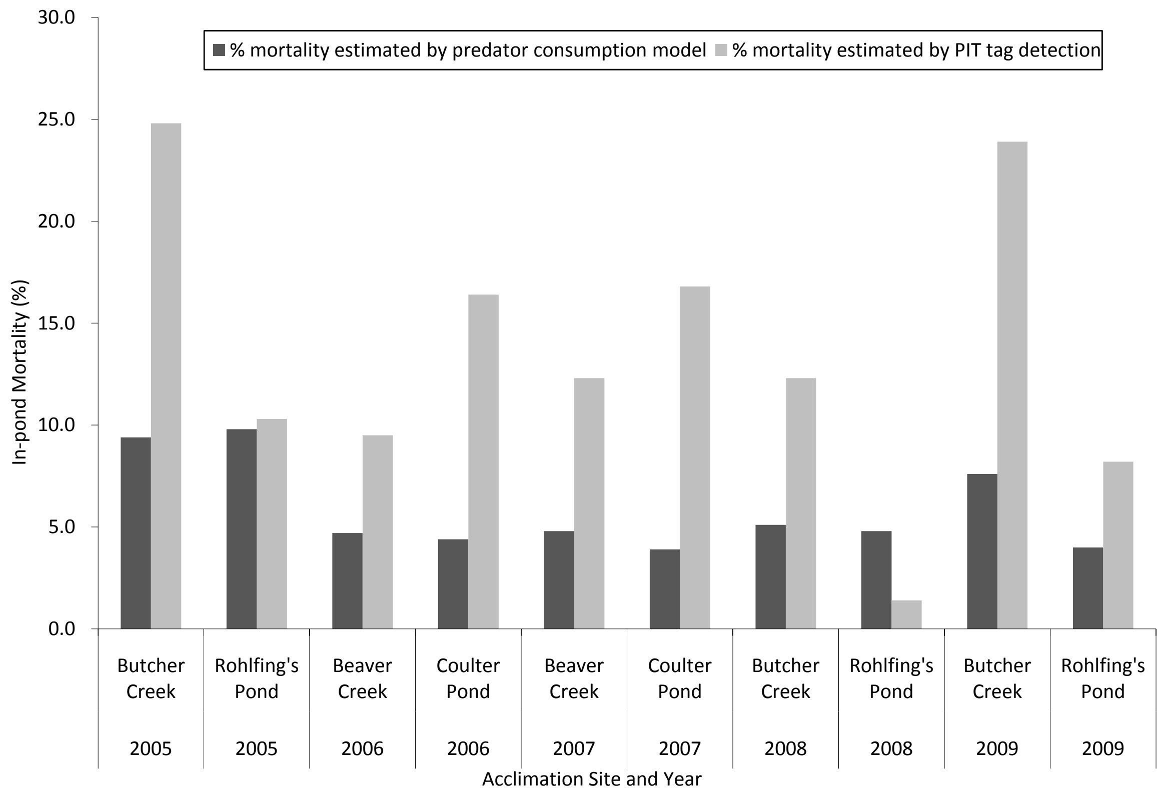

Figure 7. Comparison of in-pond mortality estimation methods; PIT tag versus a predator consumption model within the Wenatchee basin (2005-2009).

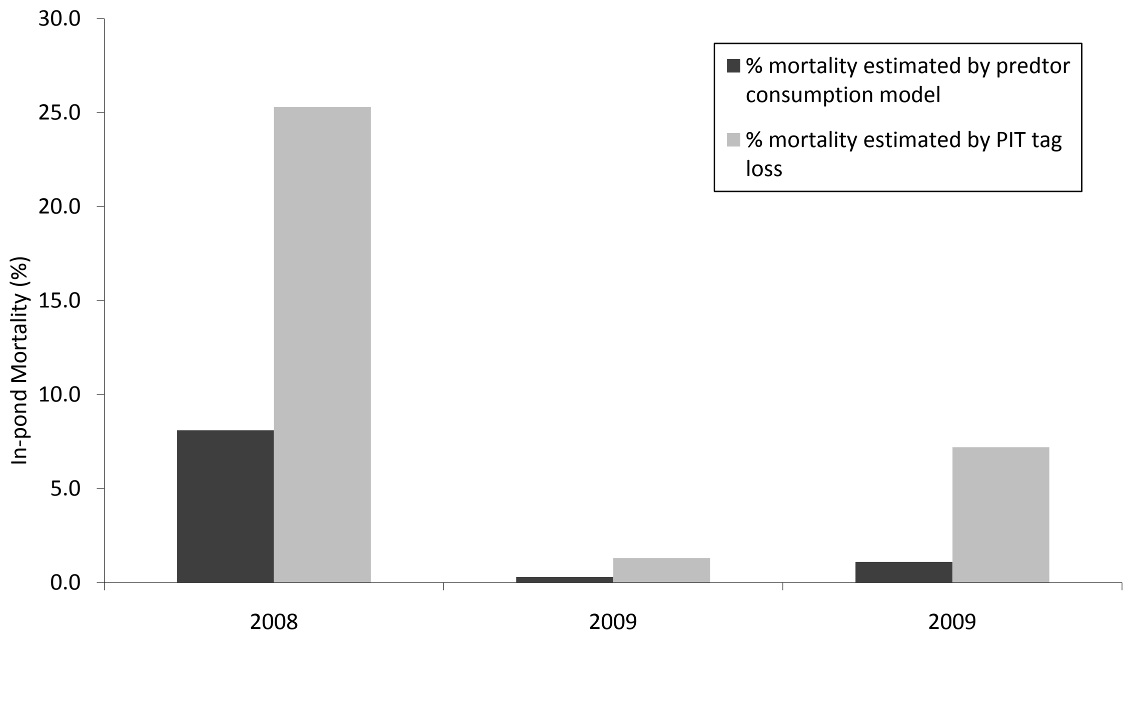

Figure 8. Comparison of in-pond mortality estimation methods; PIT tag versus a predator consumption model within the Methow basin (2008-2009).

5.0 SURVIVAL RATES

5.1 Smolt Survival Rates – Release to McNary Dam

5.1.1 2008 Methow and Wenatchee Smolt Survival

As mentioned in the 2008 annual report, analyses of previous years' (BY2006) migratory releases would be incorporated into this document. To obtain a McNary passage index of PIT-tagged fish released into the Wenatchee and Methow basins, the number of McNary Dam PIT tag detections were expanded by dividing by an estimate of the McNary detection-rate (efficiency). The McNary detection rate is the proportion of total PIT-tagged fish passing the dam that are detected by the dam's PIT tag detectors. McNary passage is stratified into sequential days having similar detection rates. The McNary detection rate was calculated by summing the number of PIT-tagged fish detected at McNary and at a downstream dam and dividing by the total number detected at the downstream dam. An index of survival to McNary Dam is the estimated total passage (stratum passage estimates added over all the strata) divided by either the number of tagged fish or the number of fish detected leaving the acclimation pond (number released). Data suggests that coho juveniles reared full-term at Cascade FH appear to have a increased release-to-McNary survival when compared to the other primary, full-term rearing facility (Willard NFH) at both upper and lower basin release locations. A summary of release-to-McNary survival rates for the 2008 releases (BY2006) in the Methow and Wenatchee river basins can be found in Table 16.

Table 16. PIT tag release numbers and locations, 2008.

Basin	Release Tributary	Release Location	Rearing Facility	Brood Origin	*n*	Survival to McNary
Methow	Spring Creek	Back-channel	Willard NFH	MCR	6,724	28.3%
Wenatchee	Nason Creek	Rohlfing's Pond	Willard NFH	MCR	5,894	46.3%
		Butcher Creek Pond	Cascade FH	MCR	5,745	71.2%
	Icicle Creek	SFL	Cascade FH	MCR	2,667	67.8%
		SFL	Willard NFH	MCR	2,955	45.1%
		LFL	Cascade FH	MCR	2,938	63.4%
		LFL	Willard NFH	MCR	2,875	40.5%

5.1.2 2009 Methow and Wenatchee Smolt Survival

Release-to-McNary survival rates for the 2009 release (BY2007) were calculated following the same methodology reported in 5.1.1 "2007 Methow and Wenatchee Smolt Survival". Similar trends were observed with increased survival of Cascade FH full-term reared individuals when compared to Willard NFH within the current release year and between years as well. One hypothesis is that Cascade reared juveniles are exposed to a more "natural" temperature regime, influenced largely by surface water, which may impact the overall "smolting" of these fish. Fish demonstrating slow growth rates during cold time periods followed by rapid spring growth may have an advantage in assimilating rapid physiological processes that dictate the readiness of fish to emigrate, which allow for a quick migration. Studies to determine the cause of this increased survival will be looked at through future investigations. Release-to-McNary survival rates of the 2009 releases (BY2007) in the Methow and Wenatchee river basins can be found in Table 17.

Table 17. PIT tag release numbers and locations, 2009.

Basin	Release Tributary	Release Location	Rearing Facility	Brood Origin	*n*	Survival to McNary
Wenatchee	Nason Creek	Rohlfing's Pond	Cascade FH	MCR	3,000	59.0%
		Rohlfing's Pond	Willard NFH	MCR	2,628	34.2%
		Butcher Pond	Cascade NFH	MCR	2,861	60.2%
		Butcher Creek	Willard NFH	MCR	3,001	36.3%
	Icicle Creek	SFL	Willard NFH	MCR	9,007	50.5%
		LFL	Entiat NFH	MCR	8,929	43.8%
Methow	Methow River	WNFH back-channel	Willard NFH	MCR	5,484	49.1%
		WNFH on-station	Willard NFH	MCR	5,997	40.5%

5.2 Smolt-to-Adult Survival Rates (SAR) for Brood Year 2005

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

1) Dryden Dam counts expanded by linear regression for non-trapping days, plus redd counts downstream from Dryden Dam
2) Broodstock collected at Dryden Dam plus all redd counts
3) Broodstock collected at Dryden Dam, Tumwater Dam counts, and redds counted downstream of Tumwater Dam

4) Mainstem dam counts (Rock Island Dam – Rocky Reach Dam).

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

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

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

Estimated run size for the Wenatchee and Methow basins in 2008, 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 18. Estimated coho run size to the Wenatchee River, 2008.

Method	Est. Run Size
1) Dryden Dam counts expanded for non-trapping days plus redds located below Dryden Dam[1]	1,037 (1,026 adults & 11 jacks)
2) Redd counts plus broodstock collected[1]	1,493 (1,482 adults & 11 jacks)
3)Tumwater Dam counts, redds below Tumwater Dam, and broodstock collected[1]	1,546 (1,539 adults & 7 jacks)
4) Mainstem Dam Counts	3,426 (3,394 adults & 32 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.

Table 19. Estimated coho run size to the Methow River, 2008.

Method	Est. Run Size
1) Redd counts plus broodstock collected [1]	867 (867 adults & 0 jacks)
2) Wells Dam Counts plus Wells Dam broodstock collected[2]	1,457 (1,456 adults & 1 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 2008. Broodstock collected only reflects the proportion of fish taken at Wells Dam and not volunteer swim-ins at Winthrop NFH.

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

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

Table 20. Wenatchee River brood year 2005 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 Ck. Pond	6 weeks	MCR	Cascade FH	215	65,045	0.33%
	6 weeks	MCR	Willard NFH	11	31,594	0.03%
Coulter Ck. Pond	3 weeks	MCR	Cascade FH	139	66,168	0.21%
	3 weeks	MCR	Willard NFH	21	33,212	0.06%
Rolfing's Pond	21 weeks (16 int. rear @ LNFH)	MCR	Cascade FH	51	62,014	0.08%
	6 weeks	MCR	Willard NFH	30	98,139	0.03%
Butcher Ck. Pond	6 weeks	MCR	Willard NFH	115	132,473	0.09%
Leavenworth NFH: Large Foster Lucas Ponds	7 weeks	MCR	Cascade FH	346	167,135	0.21%
	7 weeks	MCR	Willard NFH	127	128,588	0.10%

Leavenworth NFH: Small Foster Lucas Ponds	17 weeks	MCR	Cascade FH	99	64,340	0.15%
	7 weeks	MCR	Willard NFH	202	161,185	0.13%
	17 weeks	MCR	Willard NFH	99	63,614	0.15%
TOTAL		**MCR**		**1,455**	**1,073,507**	**0.14%**
Naturally Produced Coho[c]		**MCR**	**N/A**	**72**	**48,708**	**0.15%**

[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 5,031 fish (method 3) was used in the calculation of BY2004 SARs.
[c] Naturally produced coho were positively identified through scale analysis.

A comparison of smolt-smolt survival and smolt-to-adult survival across years (1999 through 2008) can be found in Table 22.

Table 21. Methow River brood year 2005 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	300	265,892	0.13%
WNFH Back Channel	4 weeks	MCR (Wenatchee)	Cascade FH	24	68,965	0.24%
Wells FH	6 weeks	MCR (Wenatchee)	Cascade FH	550	138,895	0.38%
Total				**867**	**286,337**	**0.37%**
Naturally Produced Coho[c]			**N/A**	**N/A**	**N/A**	**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] A estimated return to the basin of 1,601 fish (method 1) was used in the calculation of BY2004 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 22. 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	N/A	N/A
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 harvest for tribal and non-tribal fishers.

We are optimistic that the project will continue to observe positive trends in hatchery coho survival as developing local broodstock continues to adapt to conditions in mid-Columbia tributaries. Therefore it is important to measure hatchery fish performance not only to use as an indicator of project performance but to track potential short-and long-term program benefits. This document reports the coho restoration activities completed in 2008-2009; results are briefly summarized below.

- Between September 2 and November 12, YN collected 927 coho at Dryden Dam, Leavenworth NFH, and Tumwater Dam on the Wenatchee River. At Winthrop NFH and Wells Dam, 507 coho were collected for the Methow River program between September 21 and November 17. 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 898 coho at Entiat NFH and 457 at Winthrop NFH. An eye-up rate of 78.9% was calculated for the Wenatchee program and 84.7% for the Methow program. Increased eye-up rates and improved eyed-egg quality should lead to improved survival from the eyed stage to smolt release.

- During spawning ground surveys in the Wenatchee Basin for 2008, YN found a total of 346 coho redds; 202 redds in Icicle Creek, 70 redds in the Wenatchee River, 3 redds in Nason Creek and a combined 71 redds in Brender, Mission, and Peshastin creeks.

- During spawning ground surveys in the Methow Basin for 2008, YN found a total of 211 coho redds, of which, 159 were identified in-basin. Of the total in-basin redds, 113 were on the Methow River, 25 in Spring Creek (WNFH back-channel), 15 in the WDFW Methow FH outfall, 4 in the Chewuch River, 1 in the Twisp River and 1 in Libby Creek. Out-of-basin totals were as follows: 49 redds in Beebee Springs (Chelan FH outfall), 3 in Chelan Falls, 1 in Foster Creek and 1 in the Similkameen River.

- Acclimating pre-smolts on local waters is an essential component to the restoration program. Smolt release numbers for the Methow and Wenatchee rivers in 2009 were 469,102 and 974,378 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 92.4% 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 2008 (Appendix C).

- The presence of *Trichodina* and *Flavobacterium psychrophilum* (coldwater disease) in select ponds at LNFH increased overall mortality for this release group in 2009. At release, both outbreaks had been treated with no deleterious, long-term effects expected post-release.

- Based on juvenile PIT-tag detections in the Wenatchee basin during the spring of 2008, we estimate that 40.5%-67.8% of brood year 2006 mid-Columbia River coho survived from release in Icicle Creek to McNary Dam. We also estimated that 46.3%-71.2% of fish released into Nason Creek (Butcher Creek Pond and Rolfing's Pond) survived to McNary Dam. For the Methow basin, PIT tagged fish were released from the Winthrop NFH back-channel in 2008 with an estimated survival from release to McNary of 28.3%.

- Similar survival analyses were conducted in 2009 in the Wenatchee basin using juvenile PIT tag detections. We estimate that 43.8%-50.5% of brood year 2007 mid-Columbia River coho survived from release in Icicle Creek to McNary Dam. We also estimated that 34.2%-60.2% of fish released into Nason Creek (Butcher Creek Pond and Rolfing's Pond) survived to McNary Dam. In addition to the Icicle and Nason creek releases, PIT tagged fish were also released in the Methow basin from the Winthrop NFH back-channel and on-station in 2009. Estimated survival for these respective groups from release to McNary was 49.1% and 40.5%.

- YN estimated that in-basin SARs for BY2005 hatchery coho smolts released in the Wenatchee River basin was 0.14% (1,546 adults and jacks) for all release groups. However, the smolt-to-adult survival rate varied between release groups (range 0.03% - 0.33%). Using scale analysis for verification of fish origin, we estimated the SAR for naturally produced coho to be 0.15%.

- In the Methow River, we estimate that the overall smolt-to-adult survival rate (SAR) for brood year 2005 hatchery coho was 0.37%. The SARs for each release group ranged from 0.13% to 0.38%. These SAR calculations included releases from Wells FH that contributed to the majority of fish collected in the analysis. Scale analysis verification of potential natural origin fish has not been completed but will be available in future analyses and reports.

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. Garrett Rains, Lily Sampson-Ohms, Andrea Henton, Luke Gauthier, Matt Clubb, Krista Ervin, Barry Hodges, Paula Turner, Dan Mellenberger, Surya DiMonica and Robert Farley 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: 2008 NASON CREEK SMOLT TRAP REPORT

Integrated Status & Effectiveness Monitoring Program

Population Estimates for Juvenile Salmonids in Nason Creek, WA

2008 Annual Report

May 2009

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Public Utility District No. 2 of Grant County
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and

U.S Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
Portland OR, 97208-3621

Project No. 2003-017-00 and No. 1996-040-00
Contract No. 38410 and No. 38968

ABSTRACT

This report summarizes juvenile coho, spring Chinook, and steelhead salmon migration data collected at a 1.5m diameter cone rotary fish trap on Nason Creek during 2008; providing abundance and freshwater productivity estimates. We used species enumeration at the trap and efficiency trials to describe emigration timing and to estimate the number of emigrants. Trapping began on March 2, 2008 and was suspended on December 11, 2008 when snow and ice accumulation prevented operation.

During 2008, 0 brood year (BY) 2006 coho, 1 BY2007 coho, 906 BY2006 spring Chinook, 323 BY2007 fry Chinook, 2,077 BY2007 subyearling Chinook, 169 steelhead smolts, 414 steelhead fry and 2,390 steelhead parr were trapped.

Mark-recapture trap efficiency trials were performed over a range of stream discharge stages. A total of 2,639 spring Chinook, 2,154 steelhead and 12 bull trout were implanted with Passive Integrated Transponder (PIT) tags. Most PIT tagged fish were used for trap efficiency trials. We were unable to identify a statistically significant relationship between stream discharges and trap efficiency, thus, pooled efficiency estimates specific to species and trap size/position were used to estimate the number of fish emigrating past the trap. We estimate that 5,259 (± 359; 95% CI) BY2006 Chinook, 16,816 (± 731; 95% CI) BY2007 Chinook, and 47,868 (± 3,780; 95% CI) steelhead parr and smolts emigrated from Nason Creek in 2008.

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1.0 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 Feasibility Study (BPA project #1996-040-00), extending 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 production and productivity of spring Chinook, steelhead (BPA #2007-017-00, and GCPUD), and coho salmon (BPA #1996-040-00) in Nason Creek.

2) Describe the temporal variability of spring Chinook, steelhead (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 providing data to develop a spawner-recruit relationship in Nason Creek. Tissue samples are collected from Chinook, steelhead smolts 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 Chinook and steelhead 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 of juvenile spring Chinook and steelhead in the Wenatchee Basin (Murdoch et al. 2005). Beginning in 2008, PIT tags were also implanted into bulltrout >70mm in length to support GCPUD's bull trout planning and monitoring.

The work captured in this report is one component of three monitoring programs (ISEMP, GCPUD, and YN's mid-Columbia coho reintroduction project), 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 is done so here, and in annual and triennial summary reports that present all of the overall project components in their 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.

This document reports data collected from the Nason Creek smolt trap between March 2 and December 11, 2008. Data collected during fall of 2007 is presented with the spring 2008 data to produce a complete population estimate for the BY 2006 spring Chinook salmon and an estimate of egg-to-emigrant survival. Emigration estimates are also provided for steelhead and coho salmon.

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 control the hydrology and aquatic communities (USFS et al. 1996). Nason Creek originates near the Cascade crest at Stevens Pass and flows approximately 37 river kilometers (RK) until joining the Wenatchee River at RK 86.3 just below Lake Wenatchee. The smolt trap is located below the majority of spring Chinook and steelhead spawning grounds at RK 0.8 (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).

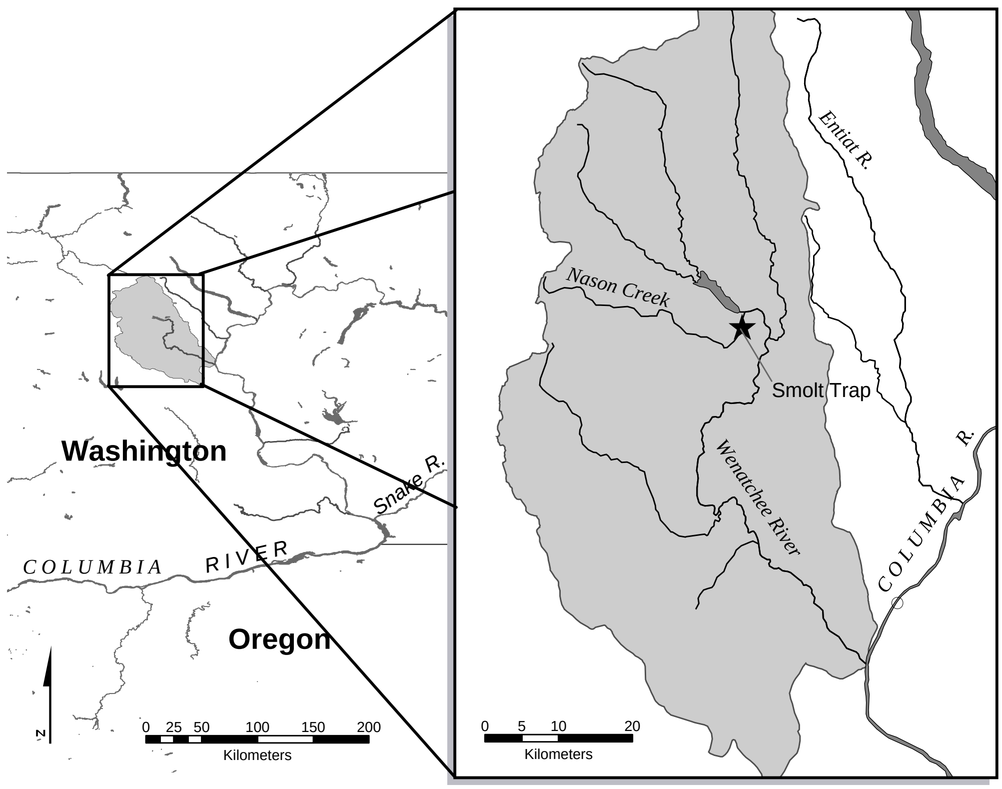

Figure 9. Nason Creek Smolt trap location.

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 length to valley length ratio), and mainly depositional channel (USFS et al. 1996).

The Washington State Department of Ecology (DOE) began operating a stream monitoring station at RK 1.0 of Nason Creek in May of 2002. The mean daily discharge during the 2008 trapping season (March 2, 2008 through December 12, 2008) was 410 cfs (Figure 2 and Appendix A). The discharge and temperature data provided by DOE should be considered provisional. Peak runoff typically occurs in May and June with occasional high water produced by rain on snow events in October and November.

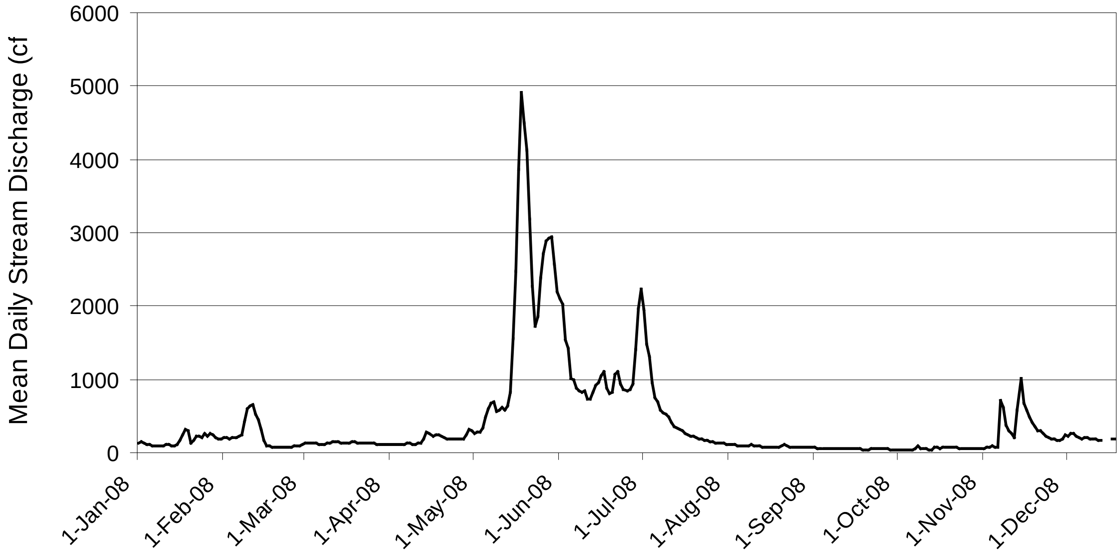

Figure 10. Mean daily stream discharge at the Nason Creek DOE stream monitoring station, RK 1, January 1, 2008 through December 18, 2008.

During the months we operated the trap, the mean daily water temperatures recorded at the DOE monitoring station ranged from a low of 0.01 °C to a high of 18.2°C (Figure 3). Daily mean stream temperature measurements taken by the Washington State DOE during water years 2008 are provided in Appendix A.

The maximum safe fish handling temperature (as defined in Section 10 Permit # 1493) is 21° C. Fish were handled in the morning when temperatures were at a minimum. The mean daily water temperatures did not reach 21° C in 2008 (Figure 3).

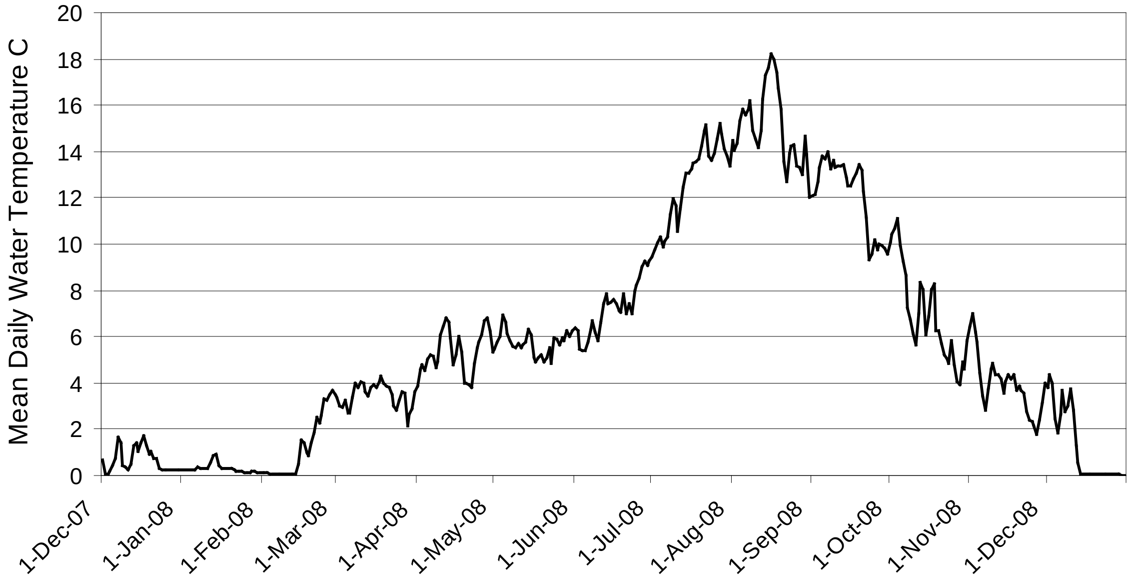

Figure 11. Mean daily water temperature at the Nason Creek DOE stream monitoring station, RK 1, January 1, 2008 through December 18, 2008.

2.0 Methods

2.1 Trapping Equipment and Operation

A floating rotary smolt trap with a 1.5m diameter cone, manufactured by EG Solutions of Eugene, OR, was used to capture fish moving downstream. The trap retains live fish in a holding box until they are removed. A rotating drum screen constantly removes 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. We used two main trap positions during 2008; a 'back' position during high water (~110 to 2720 cfs) in the spring and 'forward' position located10 meters upstream during low water (~ 30 to 110 cfs) in the summer/fall. Trap operation was suspended occasionally due to both high and low stream flows, debris, or hatchery releases. Stream discharge lower than 40 cfs necessitated raising the cone slightly to avoid touching the streambed and trap operations were generally suspended when stream discharge approached ~2000 cfs to avoid the influx of potentially hazardous debris (See '**Appendix B: Daily Trap Operating Status'**).

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 et al. (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 trough type measuring board. Scale samples were collected from steelhead measuring ≥ 90 mm FL to facilitate assigning these fish to age-classes and brood years. The scale samples were provided to WDFW for analysis. Anesthetized fish received oxygen through aquarium bubblers and were allowed to fully recover before being released downstream from the trap.

Fin clips of naturally produced spring Chinook, steelhead, and bull trout were retained for genetics research and reproductive success evaluation being conducted by WDFW, NMFS and GDPUD. Fin clips from Chinook and steelhead also facilitated trap efficiency trials (See '**Mark-Recapture Trials'**).

Length and weight were recorded for all fish except on days when large numbers of fry from a single species were collected; a sub-sample 25 fry of each species were measured and weighed while the rest were tallied. Fork length (FL) 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.

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.

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 '**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.

We typically combined the catch over a maximum of 3-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. Mark groups were released regardless of sample size but only those groups counting ≥25 fish of a single size class and species were used in the linear regression model (See '**Emigration Estimate and Expansion of Daily Catch'**). All marked groups were used to support a pooled estimate if needed.

2.3.1 Marking and PIT tagging

Fish used in efficiency trials were marked with an upper or lower caudal fin clip, a PIT tag, or both. PIT tags were included as a marks for naturally produced spring Chinook, steelhead and coho measuring 60 mm FL and greater. Fin clips of naturally produced spring Chinook and steelhead were retained for genetics research and reproductive success evaluation being conducted by WDFW and NMFS. Bull trout were PIT tagged to support GCPUD bull trout monitoring and planning efforts.

Fish to be PIT tagged were handled as described above (See '**Biological Sampling'**). Once anesthetized, each fish was examined for any wounds or descaling, then scanned for the presence of a previously implanted PIT tag. A 12mm Digital Angel 134.2 kHz type TX 1411ST PIT tag was inserted into the body cavity using a 12-gauge hypodermic needle. To prevent disease transmission, each hypodermic needle was soaked in ethyl alcohol for approximately 10 minutes prior to use and re-use. Each unique tag code was electronically recorded along with date of tag implantation, date of fish release, tagging personnel, fork length, weight, and water temperature. These data were entered into a data base and submitted to the PIT Tag Information System (PTAGIS). PIT tagging methods were consistent with methodology described in the PIT Tag Marking Procedures Manual (CBFWA 1999) as well as with 2008 ISEMP protocols.

After marking and/or PIT tagging, fish were held for a minimum of 24-hours in holding boxes at the trap to ensure complete recovery, assess tagging mortality and to recover any shed tags. Fish were then transported in 5-gallon buckets 1.4 km upstream to the release site. At the release site, marked and/or PIT tagged fish were held until dark in an automated-mechanical release box.

A timer on the box was set to release marked fish directly from the box between 10pm and 12am. The live box was located on the right bank which was accessible by vehicle. The left bank is not accessible, and we were unable to cross the creek at higher flows. During 2004, we compared marked groups released from the right bank, stream center, and both banks and found no difference in the 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:

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

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

A linear regression was used to correlate trap efficiency from individual efficiency trials (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 form the following formulas:

Variance of daily migration estimate = $$\text{var}\left[\hat{N}_i\right] = \hat{N}_i^2 \frac{MSE\left(1 + \frac{1}{n} + \frac{\ldots}{(n-1)s_X^2}\right)}{\hat{e}_i^2}$$

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), a pooled trap efficiency was used to estimate daily emigration:

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

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

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

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

Total emigration estimate = $\sum N_i$

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

The following assumptions must be made for the population estimated to be valid (Everhart and Youngs 1953):

1) All marked fish passed the trap or were recaptures during time period *i*.
2) The probability of capturing a marked or unmarked fish is equal.
3) All marked fish recaptured were identified.

3.0 Results

3.1 Dates of Operation

We deployed the trap and began operating on March 2. We fished the trap continuously 24 hours a day 7 days per week, except during periods of extreme high flows, or large hatchery smolt releases upstream of the trap (Table 1). Detailed documentation of operating dates can be found in Appendix B.

Table 23. Summary of Nason Creek rotary trap operation, 2008.

Trap Status	Description	Days Operating	Days Not Operating
Operating	Continuous	263	
Interrupted	Stopped by Debris		11
Not Operating	High Flow		19
Not Operating/ Interrupted	Low Flow		0
Not Operating	Hatchery Release		3
	Total Days 290	**257 (88.6%)**	**33 (11.4%)**

3.2 Emigration Timing

3.2.1 Coho Yearlings (BY 2006)

No yearling coho were captured at the Nason Creek trap in 2008.

3.2.2 Coho Subyearlings (BY 2007)

We collected one subyearling coho on October 13, 2008. There were no mortalities for this species. Fork length (mm), weight (g), and K-factor can be found in Table 2.

Table 24. Summary of length and weight sampling conducted on subyearling coho captured at the Nason Creek rotary trap in 2008.

Brood	Origin/Stage	Fork length (mm)			Weight (g)			K-factor
		Mean	N	Mean	Mean	N	SD	
2007	Wild Parr	87	—	—	6.4	—	—	1.0

3.2.3 Spring Chinook Yearlings (BY 2006)

We collected 906 yearling Chinook between March 2 and May 30. Peak catch occurred on April 29 (n = 77; Figure 5). We estimate that an additional 12 yearlings would have been captured if the trap had operated without interruption during the entire period. Four Chinook yearling mortalities were found in the trap (see '**3.6 ESA Compliance**'). Fork Length (mm), weight (g), and K-factor at the time of migration can be found in Table 3.

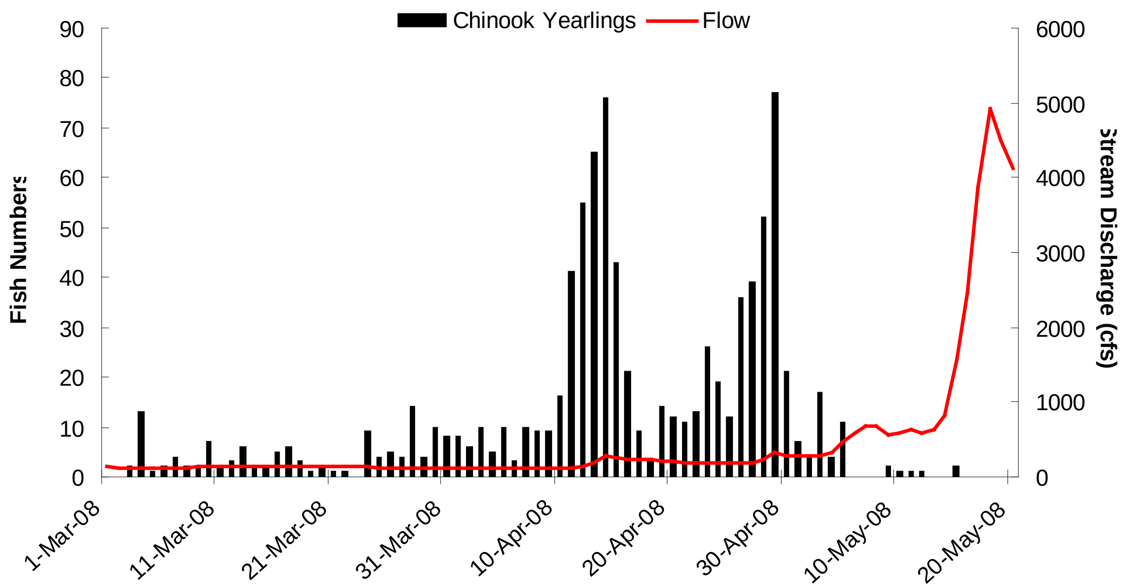

Figure 12. Spring Chinook yearling counts, run timing, and mean daily stream discharge at the Nason Creek rotary trap, March 1 through May 20, 2008.

Table 25. Summary of length and weight sampling conducted on spring Chinook captured at the Nason Creek rotary trap in 2008.

Brood	Origin/Stage	Fork Length (mm)			Weight (g)			K-Factor
		Mean	N	SD	Mean	N	SD	
2006	Wild Yearling	96.1	904	6.6	9.5	904	2.1	1.1
2007	Wild Fry	42.8	127	4.6	0.8	127	0.4	1.0
2007	Wild Parr	75.8	2049	12.5	5.2	2049	2.4	1.2

3.2.4 Spring Chinook Fry (BY2007)

We collected 323 fry Chinook during 2008 between March 3 and June 30. Peak capture occurred on June 8 (n = 16). We estimated that an additional 19 fry would have been captured if the trap had been operated without operation for the duration of this period. Spring Chinook fry were not included in population estimates. After July 1, all BY2006 spring Chinook were considered subyearling parr. There were 11 fry mortalities; these were likely caused by woody debris collected by the cone and inadvertently circulated with trapped fish (see '**3.6 ESA compliance**'). Fork Length (mm), weight (g), and K-factor at the time of migration can be found in Table 3.

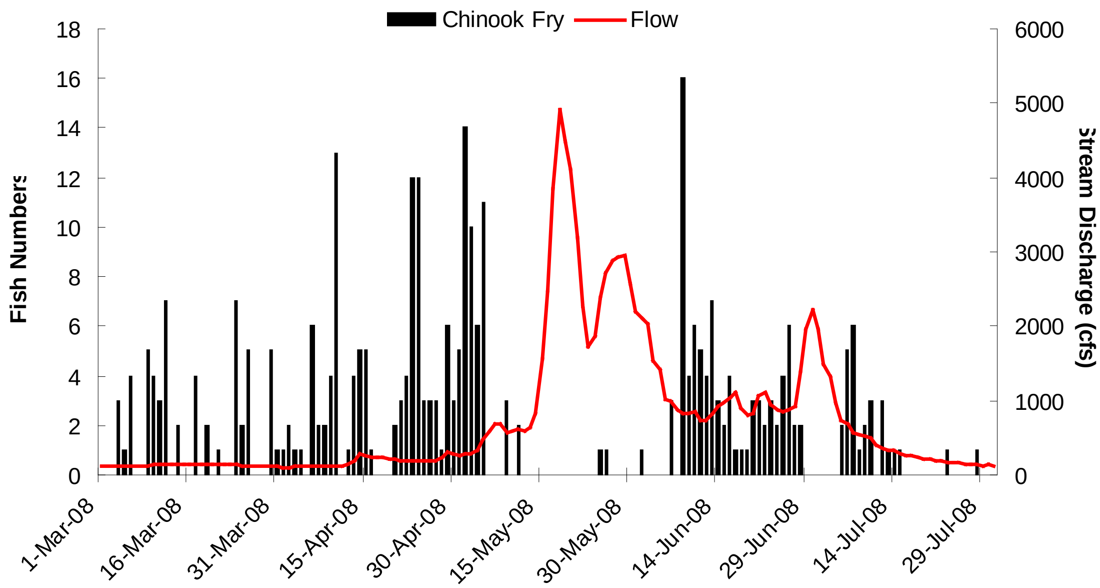

Figure 13. Spring Chinook fry counts, run-timing, and mean daily stream discharge at the Nason Creek rotary trap, March 1 through July 30, 2008.

3.2.5 Spring Chinook Subyearling (BY 2007)

We collected 2077 subyearling Chinook between May 31 and December 12, 2008 (Figure 6). The distribution of the subyearling Chinook catch was somewhat bimodal with the first peak occurring on Aug 9 (n = 60) and the second peak occurring on November 10 (n = 89). We estimate that an additional 290 subyearlings would have been captured if the trap had been operated without interruption during this period. There were 16 spring Chinook subyearling mortalities; these were likely caused by woody debris collected by the cone and inadvertently circulated with trapped fish (see '**3.6 ESA compliance**'). Fork length (mm), weight (g), and K-factor at the time of migration can be found in Table 3.

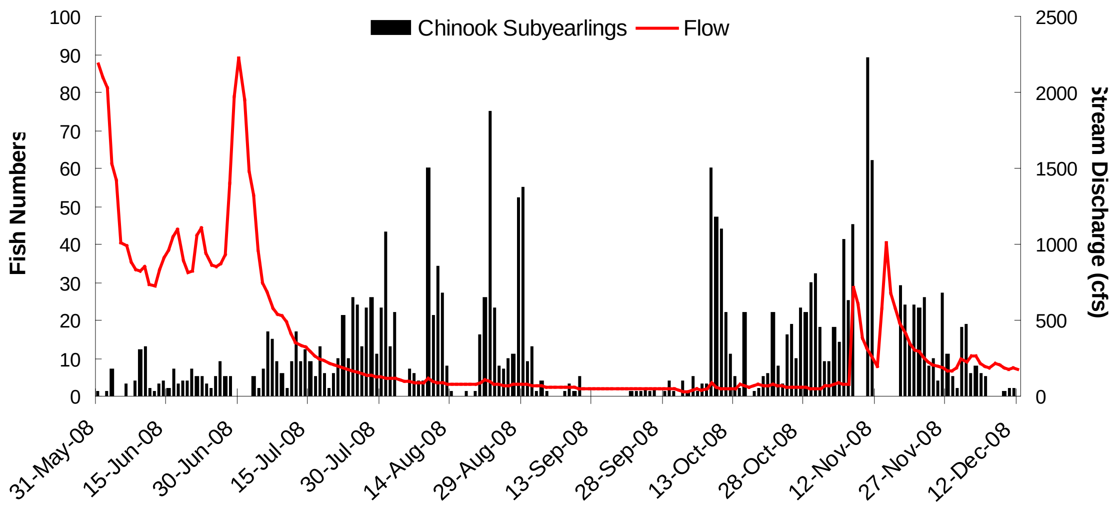

Figure 14. Spring Chinook subyearling counts, run-timing, and mean daily stream discharge at the Nason Creek rotary trap, May 31 through December 12, 2008.

3.2.6 Steelhead/Rainbow Trout Smolts

We collected 169 steelhead smolts and transitional smolts between March 2 and June 30 (Figure 7). Peak capture occurred on May 5 (n = 18). We estimated that an additional 24 smolts would have been captured if the trap had been operated without interruptions during this period. No steelhead smolt mortalities occurred due to trapping. Additionally, 2,036 hatchery steelhead smolts were captured between April 12 and December 4. At the time of this draft, length at age data from scale analysis was not yet available. Table 4 provides the mean length and k-factor for emigrating steelhead. This report will be revised when scale/age data becomes available.

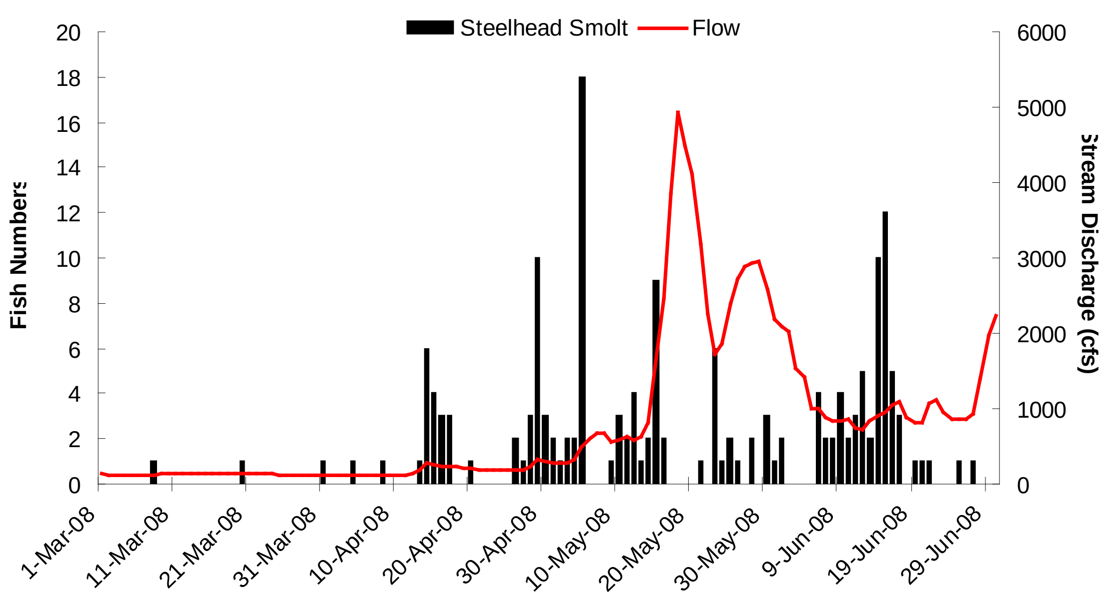

Figure 15. Steelhead smolt counts, run-timing, and mean daily stream discharge at the Nason Creek rotary trap, March 1 through June 30, 2008.

Table 26. Summary of length and weight sampling conducted on multiple year class steelhead at the Nason Creek rotary trap in 2008.

Brood Year[1]	Origin/Stage	Fork Length (mm)			Weight (g)			K-Factor
		Mean	N	SD	Mean	N	SD	
N/A	Wild Smolt	128.5	169	33	25.3	169	18.3	1.2
N/A	Wild Fry	42.7	390	5.0	0.8	390	0.5	1.0
N/A	Wild Parr	79.8	2380	21.0	6.7	2380	7.9	1.3

[1]Year-class size data is pending scale analysis

3.2.7 Steelhead/Rainbow Trout Fry

We collected 414 BY 2007 steelhead/rainbow trout fry between July 1 and December 11 (Figure 8). The first fry was trapped on July 25. Peak capture occurred on August 28 (n = 46). We estimated that and additional 7 fry would have been captured if there had been no interruption to trapping during this period. There were no mortalities. Fork length (mm), weight (g), and K-factor at the time of migration can be found in Table 4.

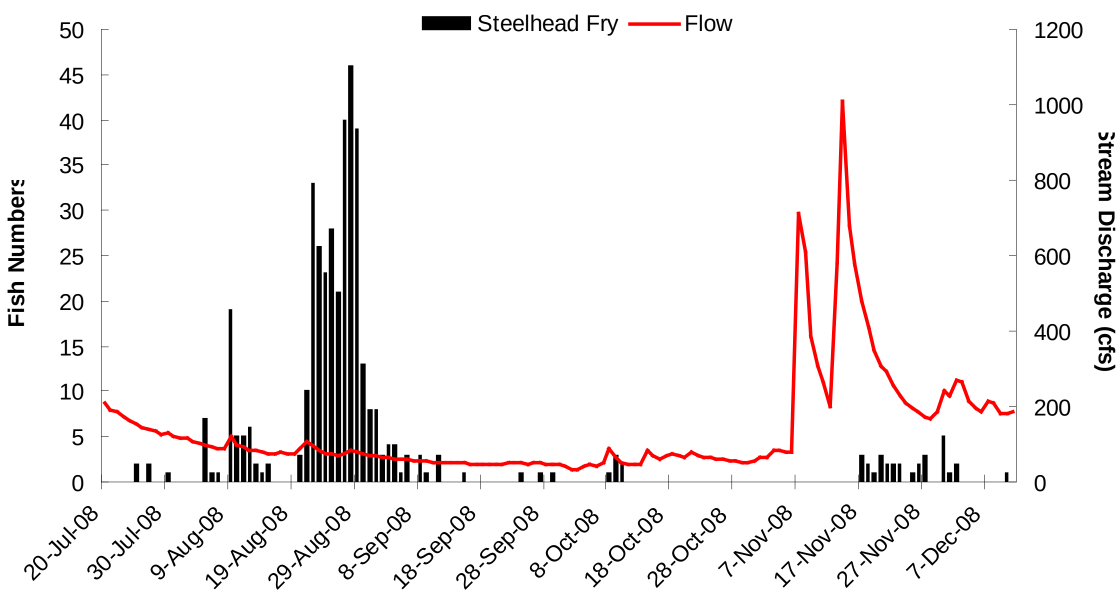

Figure 16. Steelhead/rainbow trout fry counts, run-timing, and mean daily stream discharge at the Nason Creek smolt trap, July 20 through December 12, 2008.

3.2.8 Steelhead/Rainbow Trout Parr

We collected 2390 steelhead parr from multiple age classes between March 2 and December 11 (Figure 9). The first parr was trapped on March 2, with peak emigration occurring on April 29 (n = 119) with relatively moderate numbers trapped throughout the trapping season. We estimated that an additional 326 parr would have captured if there had been no interruptions to trapping during this period. There were 21 summer steelhead parr mortalities; these were likely caused by woody debris collected by the cone and inadvertently circulated with trapped fish (see ‘**3.6 ESA compliance**’). Fork Length (mm), weight (g), and K-factor at the time of migration can be found in Table 4.

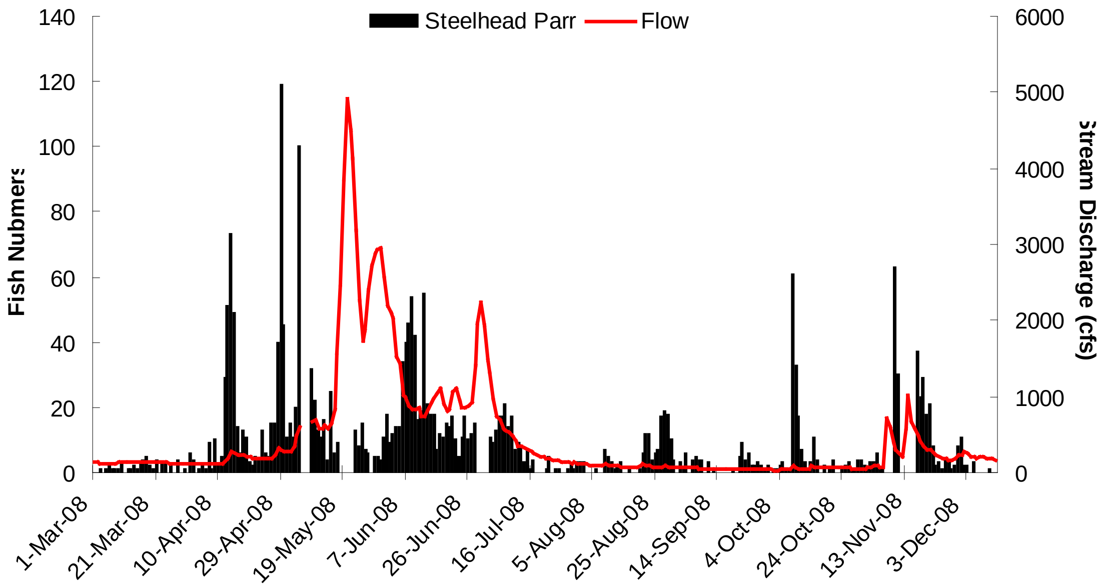

Figure 17. Steelhead parr counts, run-timing, and mean daily stream discharge at the Nason Creek rotary trap, March 1 through December 12, 2008.

3.3 Trap Efficiency Calibration and Population Estimates

3.3.1 Coho Yearlings (BY 2006)

No yearling coho were trapped in 2008. Brood year population estimates and estimated egg-to-emigrant survival rates can be found in Table 5. .

Table 27. Estimated egg-to-emigrant survival and smolts per redd for Nason Creek coho. Emigrant-per-redd values were not calculated for incomplete brood years.

Brood Year	Number of Redds	Estimated number of Eggs[a]	Number of Emigrants			Egg-to-Emigrant (%)	Emigrants per redd
			Age-0[b]	Age-1	Total		
2003	6	12,543	0	120	120	0.96	20
2004	35	107,940	224	431	655	0.61	18.7
2005	41	117,547	88	557	645	0.55	15.7
2006	4	12,504	5	0	5	0.04	1.3
2007	3	9,669	1	—	—	—	—

[a] Mean annual fecundity based on hatchery egg counts was used to estimate the number of eggs.

[b] Estimate is based on capture of summer/fall parr and does not include captures of fry prior to July 1.

3.3.2 Spring Chinook Yearlings (BY 2006)

We completed 24 marked group releases using 759 yearling Chinook in 2008 (Table 6). Of these releases six had sample sizes greater than 25 and were included in the linear regression analysis. Releases in 2007 were combined with previously collected mark recapture data to increase the sample size and statistical power. The result of the linear regression was not significant (p=0.80, r^2=0.001). A pooled trap efficiency of 17.4% (Table 7) was used to estimate yearling Chinook production in Nason Creek. From July through November 2007, we estimated that 5,295 (± 930 95% CI) BY2006 subyearling Chinook emigrated from Nason Creek. In spring of 2008, we estimate that 5,259 (± 359; 95% CI) BY2006 yearling Chinook emigrated from Nason Creek from March 1 through May 30 (Table 7). The total population estimate for BY2006 juvenile Chinook emigrants is 10,554 (± 597; 95% CI) (Table 8).

Table 28. Mark/recapture efficiency trials used to estimate emigration of yearling Chinook in Nason Creek. All releases were used for a pooled estimate; Only releases with >25 fish were used in the regression analysis.

Date	Trap Position	Yearling Chinook Released	Yearling Chinook Recaptured	Yearling Chinook Efficiency (%)	Nason Creek Discharge (cfs)
4-Mar	Back	2	0	0.0	125
5-Mar	Back	13	3	23.1	123
6-Mar	Back	1	1	100.0	120
7-Mar	Back	2	0	0.0	117
8-Mar	Back	2	1	50.0	120
9-Mar	Back	2	0	0.0	129
10-Mar	Back	2	0	0.0	130
12-Mar	Back	11	4	36.4	145
17-Mar	Back	12	3	25.0	137
20-Mar	Back	6	1	16.7	140
24-Mar	Back	10	3	30.0	131
27-Mar	Back	13	2	15.4	120
31-Mar	Back	23	3	13.0	108
3-Apr	Back	24	4	16.7	109
7-Apr	Back	23	0	0.0	123
10-Apr	Back	18	8	44.4	118
14-Apr	Back	195	40	20.5	282
17-Apr	Back	72	13	18.1	235
21-Apr	Back	36	3	8.3	194
24-Apr	Back	57	8	14.0	186
28-Apr	Back	127	19	15.0	235

1-May	Back	102	16	15.7	271
12-May	Back	4	0	0.0	582
15-May	Back	2	0	0.0	1560

Table 29. Estimated egg-to-emigrant survival and smolts per redd for Nason Creek spring Chinook. Emigrant-per-redd values were not calculated for incomplete brood years.

Brood Year	Number of Redds	Estimated number of Eggs[a]	Number of Emigrants			Egg-to-Emigrant (%)	Emigrants per redd
			Age-0[b]	Age-1	Total		
2002	294	1,477,056	DNOT[c]	9,084	9,084	--	--
2003	111	484,515	7,899	2,096	9,995	2.06	90
2004	159	770,514	12,569	3267	15,836	2.05	100
2005	186	811,890	24,348	7,893	32,241	3.97	173
2006	152	726,256	5,295	5,259	10,554	1.45	69
2007	101	476,922	16,279	--	--	--	--

[a] Mean annual fecundity based on Chiwawa River hatchery egg counts from wild broodstock to estimate the number of eggs.
[b] Estimate is based on capture of parr collected during summer/fall and does not include captures of fry prior to July
[c] Data not collected

3.3.3 Spring Chinook Subyearlings (BY 2007)

We completed 44 marked group releases using 1,406 subyearling Chinook in 2008. Of these releases, 22 had sample sizes greater than 25 and were included in the linear regression analysis (Appendix E). These trial were combined with past year's trials to increase the sample size and statistical power. The result of the linear regression was significant (p = 0.03), however an r^2 value of 0.09 did not sufficiently explain the relationship between efficiency and discharge. A pooled trap efficiency of 11.9% ('back' trap position) and 14.5% ('forward' trap position; Table 8) was used to estimate the production of subyearling Chinook (BY 2007) in Nason Creek. We estimate that 16,816 (± 533; 95% CI) subyearling spring Chinook emigrated from Nason Creek in 2008.

Table 30. Mark/recapture efficiency trials used to estimate emigration of subyearling Chinook in Nason Creek. All releases were used for a pooled estimate; Only releases with >25 fish were used in the regression analysis.

Date	Trap Position	Subyearling Chinook Released	Subyearling Chinook Recaptured	Subyearling Chinook Efficiency (%)	Nason Creek Discharge (cfs)
9-Jun	Back	3	2	66.7	826
16-Jun	Back	3	0	0	1050

7-Jul	Back	1	0	0	576
10-Jul	Back	4	0	0	488
14-Jul	Back	10	3	30	320
17-Jul	Back	12	1	8.3	250
21-Jul	Back	12	0	0	193
24-Jul	Back	43	0	0	163
28-Jul	Back	54	8	14.8	134
31-Jul	Forward	60	15	25	121
4-Aug	Forward	16	0	0	101
7-Aug	Forward	14	2	14.3	89.4
12-Aug	Forward	103	2	1.9	85.6
14-Aug	Forward	31	2	6.5	79.6
21-Aug	Forward	42	8	19	107
22-Aug	Forward	75	11	14.7	97
25-Aug	Forward	33	2	6.1	73.5
28-Aug	Forward	72	7	9.7	81.9
1-Sep	Forward	23	4	17.4	68
4-Sep	Forward	3	1	33.3	61.3
8-Sep	Forward	2	0	0	56.2
11-Sep	Forward	5	0	0	52.3
22-Sep	Forward	1	0	0	51.3
25-Sep	Forward	4	1	25	47.9
29-Sep	Forward	4	1	25	45.7
2-Oct	Forward	5	2	40	33.3
6-Oct	Forward	7	2	28.6	42.3
9-Oct	Forward	110	22	20	63.5
13-Oct	Forward	36	3	8.3	46.6
16-Oct	Forward	24	2	8.3	62.6
20-Oct	Forward	12	3	25	65.7
23-Oct	Forward	33	5	15.2	65
27-Oct	Forward	51	12	23.5	56.1
30-Oct	Forward	84	15	17.9	53
3-Nov	Forward	35	10	28.6	82.1
6-Nov	Forward	78	8	10.3	77.7
13-Nov	Back	62	0	0	581
17-Nov	Back	29	8	27.6	480
20-Nov	Back	60	7	11.7	305
24-Nov	Back	43	9	20.9	210
27-Nov	Back	46	2	4.3	171
1-Dec	Back	38	10	26.3	226
4-Dec	Back	20	3	15	216
8-Dec	Back	3	0	0	207

3.3.5 Steelhead/Rainbow Trout Smolts and Parr

We completed 82 marked group releases for emigrating steelhead in 2008. Of the releases only 19 met the criteria to be included in the analysis (n≥25). The results of the regression were not significant (p = 0.08; r^2 = 0.28); pooled trap efficiencies of 1.8% ('upper' position), and 11.6% ('back' position; Table 9) were used to estimate the production of emigrating steelhead in Nason Creek. We estimate that 47,868 (± 3,780; 95% CI) steelhead emigrated from Nason Creek in 2008. At the time of this draft, scale analysis data was not available to calculate a brood year emigration estimate.

Table 31. Mark/recapture efficiency trials used to estimate emigration of steelhead in Nason Creek. All releases were used for a pooled estimate; Only releases with >25 fish were used in the regression analysis.

Date	Trap Position	Steelhead Released	Steelhead Recaptured	Steelhead Efficiency (%)	Discharge (cfs)
4-Mar	Back	1	1	100	125
6-Mar	Back	1	0	0	120
7-Mar	Back	2	0	0	117
8-Mar	Back	1	0	0	120
9-Mar	Back	2	0	0	129
10-Mar	Back	1	0	0	130
12-Mar	Back	2	0	0	145
17-Mar	Back	6	1	16.7	137
20-Mar	Back	9	0	0	140
24-Mar	Back	6	0	0	131
27-Mar	Back	2	0	0	120
31-Mar	Back	2	1	50	108
3-Apr	Back	10	3	30	109
7-Apr	Back	11	1	9.1	123
10-Apr	Back	10	1	10	118
14-Apr	Back	149	46	30.9	282
17-Apr	Back	75	3	4	235
21-Apr	Back	17	1	5.9	194
24-Apr	Back	18	4	22.2	186
28-Apr	Back	74	11	14.9	235
1-May	Back	176	29	16.5	271
12-May	Back	55	8	14.5	582
15-May	Back	57	1	1.8	1560
26-May	Back	33	1	3	2720
29-May	Back	18	0	0	2950
2-Jun	Back	39	4	10.3	2030
5-Jun	Back	39	6	15.4	1010
9-Jun	Back	142	20	14.1	826
12-Jun	Back	83	10	12	727

16-Jun	Back	81	8	9.9	1050
19-Jun	Back	33	0	0	811
23-Jun	Back	34	3	8.8	943
26-Jun	Back	42	3	7.1	870
30-Jun	Back	17	0	0	2230
4-Jul	Back	9	2	22.2	961
7-Jul	Back	45	1	2.2	576
10-Jul	Back	49	2	4.1	488
14-Jul	Back	20	0	0	320
17-Jul	Back	12	0	0	250
21-Jul	Back	1	0	0	193
24-Jul	Back	6	0	0	163
28-Jul	Back	1	0	0	134
13-Nov	Back	24	0	0	581
17-Nov	Back	28	2	7.1	480
20-Nov	Back	47	1	2.1	305
24-Nov	Back	8	1	12.5	210
27-Nov	Back	6	0	0	171
1-Dec	Back	10	1	10	226
4-Dec	Back	3	0	0	216
31-Jul	Forward	6	0	0	121
4-Aug	Forward	3	0	0	101
7-Aug	Forward	1	0	0	89.4
12-Aug	Forward	15	0	0	85.6
14-Aug	Forward	5	0	0	79.6
18-Aug	Forward	2	0	0	75.8
21-Aug	Forward	1	1	100	107
25-Aug	Forward	5	0	0	73.5
28-Aug	Forward	4	0	0	81.9
1-Sep	Forward	3	0	0	68
4-Sep	Forward	1	0	0	61.3
8-Sep	Forward	2	0	0	56.2
15-Sep	Forward	1	0	0	49.1
22-Sep	Forward	5	0	0	51.3
25-Sep	Forward	6	0	0	47.9
29-Sep	Forward	3	1	33.3	45.7
2-Oct	Forward	2	0	0	33.3
6-Oct	Forward	1	0	0	42.3
9-Oct	Forward	54	2	3.7	63.5
13-Oct	Forward	5	0	0	46.6
16-Oct	Forward	15	0	0	62.6
20-Oct	Forward	2	0	0	65.7
23-Oct	Forward	3	0	0	65
27-Oct	Forward	6	0	0	56.1
30-Oct	Forward	7	0	0	53

3-Nov	Forward	6	0	0	82.1
6-Nov	Forward	6	0	0	77.7
10-Nov	Forward	43	0	0	309

3.4 PIT Tagging

During the 2008 trapping season we PIT tagged 2,639 spring Chinook, 2,154 steelhead,1 wild coho and 12 bull trout. This equates to 88.5% of Chinook, 84.2% of steelhead, 100% of wild coho and 80% of bull trout captured at the trap. All tagging files have been reported to the PTAGIS database. There were no mortalities associated with tagging operations. Tag loss during the first 24 hours per holding period was limited to 6 tags (0.1%) for all species during the 2008 trapping season.

3.5 Incidental Species

Along with Chinook, coho and steelhead/rainbow trout, all other known fish species present in Nason Creek were represented in the trap catch: hatchery coho salmon *Oncorhynchus kisutch*, bull trout *Salvelinus confluentus*, cutthroat trout *Oncorhynchus clarki lewisi*, longnose dace *Rhinichthys sp.*, northern pikeminnow *Ptychocheilus oregonensis*, red-sided shiner *Richardsonius balteatus*, sculpin *Cottus sp., sucker Catostomus sp.*, and mountain whitefish *Prosopium williamsoni*. Incidental species were enumerated and sampled for length and weight (Table 10).

Table 32. Summary of length and weight sampling conducted on incidental species captured at the Nason Creek rotary trap in 2008.

Species	Total Count	Length (mm)			Weight (g)		
		Mean	N	SD	Mean	N	SD
Hatchery Coho Salmon *Oncorhynchus kisutch*	3947	130.2	843	10.4	23.6	843	6.2
Bull Trout *Salvelinus confluentus*	15	155.7	15	20.9	39.5	15	21.9
Cutthroat Trout *Oncorhynchus clarki*	2	152	2	—	42.3	2	—
Longnose Dace *Rhinichthys sp.*	222	71.2	218	29.6	6.6	218	6.6
Northern Pikeminnow *Ptychocheilus oregonensis*	6	153.2	6	78.9	73.7	6	100.8
Redsided Shiner *Richardsonius balteatus*	57	54.9	56	22.1	3.2	56	3.9
Sculpin *Cottus sp.*	150	104.9	149	38.4	23.3	149	22.5
Sucker *Catostomas sp.*	230	77.5	225	40.1	11.2	225	26.5

Whitefish *Prosopium sp.*	384	63.6	316	21.0	3.2	316	6.4

3.6 ESA Compliance

The Nason Creek smolt trap is operated under consultation with the NMFS (permit no. 1493) and under consultation with the USFWS (permit no. TE037151-3). In 2008 we remained in compliance with all permits. The observed trap efficiencies were well within the acceptable level of the ESA permit conditions (i.e., <20%). Numbers of mortalities for each species and life stage, are listed in Table 12 and were within acceptable limits (<2% for Chinook and steelhead; <2 individuals for bull trout).

Table 33. Nason Creek ESA listed species handling and mortality summary.

Species	Total Collected	Total Mortality	% Handled Mortality
Spring Chinook Subyearlings/Fry (BY 2007)	3000	27	0.9%
Spring Chinook Yearling (BY 2006)	906	4	0.4%
Steelhead Fry and Parr	2804	23	0.8%
Steelhead Smolt	169	0	0.0%
Hatchery Steelhead	2036	2	0.0%
Bull Trout	12	0	0.0%

4.0 Discussion

The trap location on Nason Creek appears appropriate for the target species and anticipated environmental conditions. At RK 8.0, the trap has been positioned as low as possible in the watershed to ensure that the majority of spawning occurs upstream of the trap. Low juvenile abundance continues to limit our ability to conduct trap efficiency trials over a broad range of river conditions. As a result, inadequate trap efficiency-to-discharge regression models require the use of pooled trap efficiencies to generate population estimates for this watershed. Once regression models have been developed, population estimates may be recalculated. Until such time, all estimates of salmon and steelhead production estimates should be considered provisional. Observed pooled trap efficiencies continue to be within the acceptable level of the ESA permit conditions (i.e., <20%).

Within the Wenatchee River basin, comparisons between Nason Creek and White River can be made regarding BY2006 spring Chinook production. In both streams, there appears to be two distinct emigrations of spring Chinook; a group of yearlings which over wintered and emigrated in the spring and a subyearling group of emigrants during summer and fall. While the overall emigration estimate for Nason Creek (10,554) was greater than for the White River (2,200), egg-to-emigrant survival (Nason =1.4; White =1.5) and the number of emigrants per redd (Nason = 69; White = 71) were quite similar. More data is needed to better understand the differences in productivity between populations and overall juvenile production in these streams.

Currently, population estimates for Chinook in Nason Creek assume that the population is entirely comprised of spring Chinook. In recent years, summer Chinook have been observed spawning upstream of the trap in Nason Creek. Although there have been no observations of summer Chinook subyearlings emigrating in the spring, the extent to which this population contributes to overall Chinook numbers in Nason Creek is unknown. Likewise, the proportion of hatchery spring Chinook that spawn in Nason Creek is also unknown. Results of ongoing studies (DNA analysis) may help to differentiate spring Chinook from summer Chinook parr and smolt. In such a case, retrospective analysis of data from previous years will be necessary to correct population estimates for spring Chinook and establish estimates for summer Chinook.

Steelhead emigrate at different life stages, some as smolts in the spring and others as parr throughout the year. With multiple age classes of steelhead emigrating as both parr and smolt, scale sample analysis is necessary to calculate brood year population estimates. Scale sampling of steelhead smolts began in spring of 2005. Scales were taken from all steelhead parr ≥90 mm. Results from 2006-2008 have not yet been analyzed. Therefore it was not possible to calculate brood years based on emigration estimates and measures of productivity at the time of this draft. As results become available, brood year survival and productivity estimates will be reported in future documents.

5.0 Literature Cited

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APPENDIX A: Nason Creek Temperature and Discharge Data

APPENDIX A: 2008 Nason Creek Discharge and TemperatureData

Date	Mean Daily Discharge (cfs)	Mean Daily Water Temp (°C)	Date	Mean Daily Discharge (cfs)	Mean Daily Water Temp (°C)
1-Jan-08	140	0.23	15-Feb-08	164	0.51
2-Jan-08	153	0.24	16-Feb-08	92.5	1.53
3-Jan-08	131	0.24	17-Feb-08	86.6	1.40
4-Jan-08	120	0.23	18-Feb-08	84.2	1.01
5-Jan-08	110	0.25	19-Feb-08	83.1	0.87
6-Jan-08	101	0.27	20-Feb-08	81.7	1.41
7-Jan-08	92.8	0.36	21-Feb-08	82.2	1.83
8-Jan-08	94	0.30	22-Feb-08	81.8	2.50
9-Jan-08	95.2	0.30	23-Feb-08	81.4	2.28
10-Jan-08	94.9	0.31	24-Feb-08	82.2	2.60
11-Jan-08	108	0.31	25-Feb-08	83	3.29
12-Jan-08	107	0.53	26-Feb-08	85.8	3.26
13-Jan-08	102	0.84	27-Feb-08	89.7	3.49
14-Jan-08	102	0.92	28-Feb-08	103	3.69
15-Jan-08	107	0.40	29-Feb-08	115	3.52
16-Jan-08	174	0.32	1-Mar-08	129	3.38
17-Jan-08	244	0.31	2-Mar-08	127	3.03
18-Jan-08	311	0.31	3-Mar-08	123	2.95
19-Jan-08	294	0.31	4-Mar-08	125	3.22
20-Jan-08	137	0.30	5-Mar-08	123	2.69
21-Jan-08	176	0.25	6-Mar-08	120	2.73
22-Jan-08	223	0.21	7-Mar-08	117	3.36
23-Jan-08	224	0.21	8-Mar-08	120	3.98
24-Jan-08	215	0.21	9-Mar-08	129	3.79
25-Jan-08	262	0.15	10-Mar-08	130	4.06
26-Jan-08	231	0.11	11-Mar-08	141	3.99
27-Jan-08	270	0.15	12-Mar-08	145	3.63
28-Jan-08	250	0.16	13-Mar-08	143	3.43
29-Jan-08	201	0.15	14-Mar-08	140	3.80
30-Jan-08	191	0.15	15-Mar-08	139	3.95
31-Jan-08	196	0.14	16-Mar-08	138	3.81
1-Feb-08	198	0.12	17-Mar-08	137	4.02
2-Feb-08	199	0.10	18-Mar-08	143	4.27
3-Feb-08	196	0.10	19-Mar-08	142	4.00
4-Feb-08	197	0.09	20-Mar-08	140	3.87
5-Feb-08	212	0.07	21-Mar-08	135	3.80
6-Feb-08	231	0.06	22-Mar-08	132	3.50
7-Feb-08	240	0.06	23-Mar-08	135	3.01
8-Feb-08	439	0.06	24-Mar-08	131	2.84
9-Feb-08	598	0.05	25-Mar-08	126	3.24
10-Feb-08	629	0.05	26-Mar-08	124	3.64
11-Feb-08	657	0.06	27-Mar-08	120	3.58
12-Feb-08	532	0.06	28-Mar-08	119	2.16
13-Feb-08	441	0.06	29-Mar-08	115	2.64
14-Feb-08	315	0.08	30-Mar-08	111	2.91

Data provided by DOE and should be considered provisional.

Date	Mean Daily Discharge (cfs)	Mean Daily Water Temp (°C)	Date	Mean Daily Discharge (cfs)	Mean Daily Water Temp (°C)
31-Mar-08	108	3.62	21-Apr-08	194	3.92
1-Apr-08	106	3.85	22-Apr-08	187	3.82
2-Apr-08	106	4.59	23-Apr-08	187	4.82
3-Apr-08	109	4.81	24-Apr-08	186	5.50
4-Apr-08	114	4.56	25-Apr-08	184	5.79
5-Apr-08	115	5.00	26-Apr-08	183	6.05
6-Apr-08	118	5.20	27-Apr-08	194	6.70
7-Apr-08	123	5.13	28-Apr-08	235	6.82
8-Apr-08	123	4.65	29-Apr-08	318	6.28
9-Apr-08	118	4.90	30-Apr-08	292	5.37
10-Apr-08	118	6.05	1-May-08	271	5.48
11-Apr-08	123	6.45	2-May-08	272	5.75
12-Apr-08	140	6.81	3-May-08	279	6.01
13-Apr-08	187	6.61	4-May-08	336	6.95
14-Apr-08	282	5.95	5-May-08	480	6.63
15-Apr-08	261	4.77	6-May-08	596	6.12
16-Apr-08	232	5.20	7-May-08	680	5.85
17-Apr-08	237	6.02	8-May-08	686	5.61
18-Apr-08	235	5.35	9-May-08	566	5.54
19-Apr-08	218	3.97	10-May-08	579	5.72
20-Apr-08	205	4.01	11-May-08	623	5.53
21-Apr-08	194	3.92	12-May-08	582	5.63
22-Apr-08	187	3.82	13-May-08	636	5.75
23-Apr-08	187	4.82	14-May-08	825	6.34
24-Apr-08	186	5.50	15-May-08	1560	6.06
25-Apr-08	184	5.79	16-May-08	2470	5.11
31-Mar-08	108	3.62	17-May-08	3860	4.93
1-Apr-08	106	3.85	18-May-08	4920	5.07
2-Apr-08	106	4.59	19-May-08	4500	5.24
3-Apr-08	109	4.81	20-May-08	4120	4.90
4-Apr-08	114	4.56	21-May-08	3190	5.08
5-Apr-08	115	5.00	22-May-08	2260	5.49
6-Apr-08	118	5.20	23-May-08	1720	4.83
7-Apr-08	123	5.13	24-May-08	1860	5.93
8-Apr-08	123	4.65	25-May-08	2390	5.89
9-Apr-08	118	4.90	26-May-08	2720	5.63
10-Apr-08	118	6.05	27-May-08	2880	5.98
11-Apr-08	123	6.45	27-May-08	2880	5.98
12-Apr-08	140	6.81	28-May-08	2930	5.83
13-Apr-08	187	6.61	29-May-08	2950	6.27
14-Apr-08	282	5.95	30-May-08	2570	6.03
15-Apr-08	261	4.77	31-May-08	2190	6.27
16-Apr-08	232	5.20	1-Jun-08	2100	6.40
17-Apr-08	237	6.02	2-Jun-08	2030	6.27
18-Apr-08	235	5.35	3-Jun-08	1530	5.45
19-Apr-08	218	3.97	4-Jun-08	1420	5.39
20-Apr-08	205	4.01	5-Jun-08	1010	5.40

Data provided by DOE and should be considered provisional.

Date	Mean Daily Discharge (cfs)	Mean Daily Water Temp (°C)	Date	Mean Daily Discharge (cfs)	Mean Daily Water Temp (°C)
6-Jun-08	994	5.75	22-Jul-08	184	15.16
7-Jun-08	882	6.33	23-Jul-08	173	13.83
8-Jun-08	835	6.67	24-Jul-08	163	13.61
9-Jun-08	826	6.18	25-Jul-08	154	13.95
10-Jun-08	851	5.81	26-Jul-08	146	14.57
11-Jun-08	739	6.60	27-Jul-08	139	15.24
12-Jun-08	727	7.40	28-Jul-08	134	14.76
13-Jun-08	831	7.87	29-Jul-08	126	14.12
14-Jun-08	915	7.45	30-Jul-08	131	13.83
15-Jun-08	965	7.50	31-Jul-08	121	13.38
16-Jun-08	1050	7.63	1-Aug-08	118	14.51
17-Jun-08	1100	7.40	2-Aug-08	114	14.08
18-Jun-08	890	7.09	3-Aug-08	106	14.34
19-Jun-08	811	7.06	4-Aug-08	101	15.32
20-Jun-08	825	7.88	5-Aug-08	96	15.83
21-Jun-08	1060	6.97	6-Aug-08	92.3	15.61
22-Jun-08	1110	7.44	7-Aug-08	89.4	15.81
23-Jun-08	943	7.01	8-Aug-08	90.4	16.22
24-Jun-08	863	7.98	9-Aug-08	120	14.92
25-Jun-08	849	8.20	10-Aug-08	98.6	14.53
26-Jun-08	870	8.52	11-Aug-08	91.5	14.16
27-Jun-08	933	9.00	12-Aug-08	85.6	14.89
28-Jun-08	1400	9.25	13-Aug-08	81.9	16.24
29-Jun-08	1970	9.10	14-Aug-08	79.6	17.30
30-Jun-08	2230	9.24	15-Aug-08	76.4	17.63
1-Jul-08	1950	9.44	16-Aug-08	76.2	18.20
2-Jul-08	1480	9.78	17-Aug-08	77.7	18.00
3-Jul-08	1320	10.09	18-Aug-08	75.8	17.43
4-Jul-08	961	10.30	19-Aug-08	74.6	16.77
5-Jul-08	743	9.87	20-Aug-08	86.4	15.83
6-Jul-08	690	10.12	21-Aug-08	107	13.53
7-Jul-08	576	10.31	22-Aug-08	97	12.73
8-Jul-08	543	11.29	23-Aug-08	82.7	13.91
9-Jul-08	529	11.96	24-Aug-08	75.8	14.24
10-Jul-08	488	11.65	25-Aug-08	73.5	14.30
11-Jul-08	407	10.55	26-Aug-08	71.2	13.40
12-Jul-08	355	11.53	27-Aug-08	75.8	13.31
13-Jul-08	337	12.44	28-Aug-08	81.9	13.01
14-Jul-08	320	13.06	29-Aug-08	77.7	14.67
15-Jul-08	294	13.04	30-Aug-08	73.7	13.89
16-Jul-08	269	13.26	31-Aug-08	70.7	12.03
17-Jul-08	250	13.48	1-Sep-08	68	12.06
18-Jul-08	231	13.55	2-Sep-08	65	12.16
19-Jul-08	218	13.67	3-Sep-08	63	12.69
20-Jul-08	207	14.24	4-Sep-08	61.3	13.32
21-Jul-08	193	14.92	5-Sep-08	59.3	13.81
			6-Sep-08	58.9	13.65

Data provided by DOE and should be considered provisional.

Date	Mean Daily Discharge (cfs)	Mean Daily Water Temp (°C)	Date	Mean Daily Discharge (cfs)	Mean Daily Water Temp (°C)
7-Sep-08	57.9	14.00	24-Oct-08	63.2	4.87
8-Sep-08	56.2	13.26	25-Oct-08	60	5.84
9-Sep-08	55.1	13.64	26-Oct-08	58.5	4.76
10-Sep-08	53.3	13.31	27-Oct-08	56.1	4.02
11-Sep-08	52.3	13.36	28-Oct-08	54.4	3.90
12-Sep-08	51.2	13.40	29-Oct-08	53.2	4.93
13-Sep-08	50.3	13.46	30-Oct-08	53	4.62
14-Sep-08	50	12.88	31-Oct-08	53.5	5.86
15-Sep-08	49.1	12.51	1-Nov-08	63.8	6.45
16-Sep-08	48.1	12.53	2-Nov-08	65.9	6.98
17-Sep-08	47.3	12.85	3-Nov-08	82.1	6.20
18-Sep-08	46.3	13.09	4-Nov-08	85.4	5.77
19-Sep-08	45.2	13.41	5-Nov-08	77.8	4.40
20-Sep-08	44.4	13.17	6-Nov-08	77.7	3.45
21-Sep-08	48.5	12.29	7-Nov-08	712	2.83
22-Sep-08	51.3	11.16	8-Nov-08	611	3.76
23-Sep-08	53.2	9.34	9-Nov-08	384	4.61
24-Sep-08	49.3	9.58	10-Nov-08	309	4.85
25-Sep-08	47.9	10.19	11-Nov-08	265	4.33
26-Sep-08	50.3	9.75	12-Nov-08	198	4.34
27-Sep-08	49.3	10.01	13-Nov-08	581	4.15
28-Sep-08	46.7	9.94	14-Nov-08	1010	3.56
29-Sep-08	45.7	9.79	15-Nov-08	679	4.08
30-Sep-08	44.8	9.59	16-Nov-08	575	4.36
1-Oct-08	43.5	10.06	17-Nov-08	480	4.18
2-Oct-08	33.3	10.42	18-Nov-08	410	4.37
3-Oct-08	34.2	10.65	19-Nov-08	348	3.69
4-Oct-08	41.1	11.13	20-Nov-08	305	3.87
5-Oct-08	46.7	9.95	21-Nov-08	291	3.69
6-Oct-08	42.3	9.25	22-Nov-08	258	3.56
7-Oct-08	52.2	8.67	23-Nov-08	230	2.76
8-Oct-08	90.4	7.24	24-Nov-08	210	2.37
9-Oct-08	63.5	6.78	25-Nov-08	196	2.32
10-Oct-08	53	6.16	26-Nov-08	185	2.14
11-Oct-08	48.2	5.63	27-Nov-08	171	1.78
12-Oct-08	46.1	7.00	28-Nov-08	166	2.38
13-Oct-08	46.6	8.33	29-Nov-08	184	3.11
14-Oct-08	82.7	8.06	30-Nov-08	242	3.97
15-Oct-08	67.6	6.10	1-Dec-08	226	3.81
16-Oct-08	62.6	6.88	2-Dec-08	268	4.34
17-Oct-08	70.3	8.03	3-Dec-08	263	3.97
18-Oct-08	76.2	8.27	4-Dec-08	216	2.44
19-Oct-08	70.8	6.26	5-Dec-08	197	1.82
20-Oct-08	65.7	6.28	6-Dec-08	187	2.65
21-Oct-08	78.5	5.74	7-Dec-08	212	3.68
22-Oct-08	69.9	5.23	8-Dec-08	207	2.76
23-Oct-08	65	5.06	9-Dec-08	182	3.00

Data provided by DOE and should be considered provisional.

Date	Mean Daily Discharge (cfs)	Mean Daily Water Temp (°C)
10-Dec-08	181	3.74
11-Dec-08	184	2.83
12-Dec-08	173	1.27
13-Dec-08	165	0.53
14-Dec-08	--	0.07
15-Dec-08	--	0.04
16-Dec-08	--	0.04
17-Dec-08	183	0.04
18-Dec-08	186	0.04

APPENDIX B: Daily Trap Operating Status

APPENDIX B: Daily Operating Status

Date	Trap Status	Comments
3-Mar-08	Operating	
4-Mar-08	Operating	
5-Mar-08	Operating	
6-Mar-08	Operating	
7-Mar-08	Operating	
8-Mar-08	Operating	
9-Mar-08	Operating	
10-Mar-08	Operating	
11-Mar-08	Operating	
12-Mar-08	Operating	
13-Mar-08	Operating	
14-Mar-08	Operating	
15-Mar-08	Operating	
16-Mar-08	Interrupted	Debris Stop
17-Mar-08	Operating	
18-Mar-08	Operating	
19-Mar-08	Operating	
20-Mar-08	Operating	
21-Mar-08	Operating	
22-Mar-08	Operating	
23-Mar-08	Operating	
24-Mar-08	Operating	
25-Mar-08	Operating	
26-Mar-08	Operating	
27-Mar-08	Operating	
28-Mar-08	Operating	
29-Mar-08	Operating	
30-Mar-08	Operating	
31-Mar-08	Operating	
1-Apr-08	Operating	
2-Apr-08	Operating	
3-Apr-08	Operating	
4-Apr-08	Operating	
5-Apr-08	Operating	
6-Apr-08	Operating	
7-Apr-08	Operating	
8-Apr-08	Operating	
9-Apr-08	Operating	
10-Apr-08	Operating	
11-Apr-08	Operating	
12-Apr-08	Operating	
13-Apr-08	Operating	
14-Apr-08	Operating	
15-Apr-08	Operating	
16-Apr-08	Operating	
17-Apr-08	Operating	

Date	Trap Status	Comments
18-Apr-08	Operating	
19-Apr-08	Operating	
20-Apr-08	Operating	
21-Apr-08	Operating	
22-Apr-08	Operating	
23-Apr-08	Operating	
24-Apr-08	Operating	
25-Apr-08	Operating	
26-Apr-08	Operating	
27-Apr-08	Operating	
28-Apr-08	Operating	
29-Apr-08	Operating	
30-Apr-08	Operating	
1-May-08	Operating	
2-May-08	Operating	
3-May-08	Operating	
4-May-08	Operating	
5-May-08	Pulled	Hatch. Release
6-May-08	Pulled	Hatch. Release
7-May-08	Pulled	Hatch. Release
8-May-08	Operating	
9-May-08	Operating	
10-May-08	Operating	
11-May-08	Operating	
12-May-08	Operating	
13-May-08	Operating	
14-May-08	Operating	
15-May-08	Pulled	High Flows
16-May-08	Pulled	High Flows
17-May-08	Pulled	High Flows
18-May-08	Pulled	High Flows
19-May-08	Pulled	High Flows
20-May-08	Pulled	High Flows
21-May-08	Pulled	High Flows
22-May-08	Pulled	High Flows
23-May-08	Operating	
24-May-08	Operating	
25-May-08	Operating	
26-May-08	Operating	
27-May-08	Operating	
28-May-08	Operating	
29-May-08	Operating	
30-May-08	Operating	
31-May-08	Operating	
1-Jun-08	Operating	
2-Jun-08	Operating	

Date	Trap Status	Comments
3-Jun-08	Operating	
4-Jun-08	Operating	
5-Jun-08	Operating	
6-Jun-08	Operating	
7-Jun-08	Operating	
8-Jun-08	Operating	
9-Jun-08	Operating	
10-Jun-08	Operating	
11-Jun-08	Operating	
12-Jun-08	Operating	
13-Jun-08	Operating	
14-Jun-08	Operating	
15-Jun-08	Operating	
16-Jun-08	Operating	
17-Jun-08	Operating	
18-Jun-08	Operating	
19-Jun-08	Operating	
20-Jun-08	Operating	
21-Jun-08	Operating	
22-Jun-08	Operating	
23-Jun-08	Operating	
24-Jun-08	Operating	
25-Jun-08	Operating	
26-Jun-08	Operating	
27-Jun-08	Operating	
28-Jun-08	Operating	
29-Jun-08	Pulled	High Flows
30-Jun-08	Pulled	High Flows
1-Jul-08	Pulled	High Flows
2-Jul-08	Pulled	High Flows
3-Jul-08	Operating	
4-Jul-08	Operating	
5-Jul-08	Operating	
6-Jul-08	Operating	
7-Jul-08	Operating	
8-Jul-08	Operating	
9-Jul-08	Operating	
10-Jul-08	Operating	
11-Jul-08	Operating	
12-Jul-08	Operating	
13-Jul-08	Operating	
14-Jul-08	Operating	
15-Jul-08	Operating	
16-Jul-08	Operating	
17-Jul-08	Operating	
18-Jul-08	Operating	
19-Jul-08	Operating	
20-Jul-08	Operating	

Date	Trap Status	Comments
21-Jul-08	Operating	
22-Jul-08	Operating	
23-Jul-08	Operating	
24-Jul-08	Operating	
25-Jul-08	Operating	
26-Jul-08	Operating	
27-Jul-08	Operating	
28-Jul-08	Operating	
29-Jul-08	Operating	
30-Jul-08	Operating	
31-Jul-08	Operating	
1-Aug-08	Operating	
2-Aug-08	Operating	
3-Aug-08	Interrupted	Debris Stop
4-Aug-08	Interrupted	Debris Stop
5-Aug-08	Operating	
6-Aug-08	Operating	
7-Aug-08	Operating	
8-Aug-08	Operating	
9-Aug-08	Operating	
10-Aug-08	Operating	
11-Aug-08	Operating	
12-Aug-08	Operating	
13-Aug-08	Operating	
14-Aug-08	Operating	
15-Aug-08	Operating	
16-Aug-08	Operating	
17-Aug-08	Operating	
18-Aug-08	Operating	
19-Aug-08	Operating	
20-Aug-08	Operating	
21-Aug-08	Operating	
22-Aug-08	Operating	
23-Aug-08	Operating	
24-Aug-08	Operating	
25-Aug-08	Operating	
26-Aug-08	Operating	
27-Aug-08	Operating	
28-Aug-08	Operating	
29-Aug-08	Operating	
30-Aug-08	Operating	
31-Aug-08	Operating	
1-Sep-08	Operating	
2-Sep-08	Operating	
3-Sep-08	Operating	
4-Sep-08	Operating	
5-Sep-08	Operating	
6-Sep-08	Operating	

Date	Trap Status	Comments
7-Sep-08	Operating	
10-Sep-08	Operating	
11-Sep-08	Operating	
12-Sep-08	Operating	
13-Sep-08	Operating	
14-Sep-08	Operating	
15-Sep-08	Operating	
16-Sep-08	Operating	
17-Sep-08	Operating	
18-Sep-08	Operating	
19-Sep-08	Operating	
20-Sep-08	Interrupted	Debris Stop
21-Sep-08	Operating	
22-Sep-08	Operating	
23-Sep-08	Operating	
24-Sep-08	Operating	
25-Sep-08	Operating	
26-Sep-08	Operating	
27-Sep-08	Operating	
28-Sep-08	Operating	
29-Sep-08	Operating	
30-Sep-08	Operating	
1-Oct-08	Operating	
2-Oct-08	Operating	
3-Oct-08	Operating	
4-Oct-08	Operating	
5-Oct-08	Operating	
6-Oct-08	Operating	
7-Oct-08	Operating	
8-Oct-08	Operating	
9-Oct-08	Operating	
10-Oct-08	Operating	
11-Oct-08	Operating	
12-Oct-08	Operating	
13-Oct-08	Operating	
14-Oct-08	Operating	
15-Oct-08	Operating	
16-Oct-08	Operating	
17-Oct-08	Operating	
18-Oct-08	Operating	
19-Oct-08	Operating	
20-Oct-08	Operating	
21-Oct-08	Operating	
22-Oct-08	Operating	
23-Oct-08	Operating	
24-Oct-08	Operating	
25-Oct-08	Operating	
26-Oct-08	Operating	

Date	Trap Status	Comments
27-Oct-08	Operating	
28-Oct-08	Operating	
29-Oct-08	Operating	
30-Oct-08	Operating	
31-Oct-08	Operating	
1-Nov-08	Operating	
2-Nov-08	Operating	
3-Nov-08	Operating	
4-Nov-08	Operating	
5-Nov-08	Operating	
6-Nov-08	Operating	
7-Nov-08	Interrupted	Debris Stop
8-Nov-08	Pulled	High Flows
9-Nov-08	Pulled	High Flows
10-Nov-08	Operating	
11-Nov-08	Operating	
12-Nov-08	Pulled	High Flows
13-Nov-08	Pulled	High Flows
14-Nov-08	Pulled	High Flows
15-Nov-08	Pulled	High Flows
16-Nov-08	Pulled	High Flows
17-Nov-08	Operating	
18-Nov-08	Operating	
19-Nov-08	Operating	
20-Nov-08	Operating	
21-Nov-08	Operating	
22-Nov-08	Operating	
23-Nov-08	Operating	
24-Nov-08	Operating	
25-Nov-08	Operating	
26-Nov-08	Operating	
27-Nov-08	Operating	
28-Nov-08	Operating	
29-Nov-08	Operating	
30-Nov-08	Operating	
1-Dec-08	Operating	
2-Dec-08	Operating	
3-Dec-08	Operating	
4-Dec-08	Operating	
5-Dec-08	Operating	
6-Dec-08	Operating	
7-Dec-08	Interrupted	Debris Stop
8-Dec-08	Operating	
9-Dec-08	Operating	
10-Dec-08	Operating	
11-Dec-08	Operating	
12-Dec-08	Operating	

APPENDIX B: SPAWNING GROUND SURVEY RECORDS FOR THE WENATCHEE AND METHOW RIVERS, 2008

APPENDIX B: Spawning ground survey records for the Wenatchee and Methow rivers in 2008

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 Fish Weir	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**	**3605**	**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			**1601**	**5101**	**1042**

Stream	Reach Description	Date	Surveyors	New Redds	Live Fish	Dead Fish
Methow River M 1	RK 0.0 – 9.49	10/21/2008	SDS	0	0	0
		10/31/2008	BioAnalysts	0	0	3
		11/4/2008	AM, SD	14	26	0
		11/10/2008	BioAnalysts	0	0	9
		11/18/2008	AM, SD	4	6	1
		12/2/2008	AM, SD	2	1	0
		12/8/2008	AM, SD	0	0	0
	Total			20	33	13
Methow River M 2	RK 9.49 – 17.54	10/28/2008	PH, SD	2	1	0
		10/31/2008	BioAnalysts	0	0	2
		11/5/2008	SD, AM	24	51	0
		11/7/2008	BioAnalysts	0	0	1
		11/18/2008	SD, AM	7	9	1
		12/2/2008	SD, AM	1	3	1
		12/8/2008	SD, AM	2	2	0
	Total			36	66	5
Methow River M 3	RK 17.54 – 26.87	10/28/2008	RA, AM	0	0	0
		11/3/2008	BioAnalysts	0	0	1
		11/7/2008	KM, BF, JP	8	24	0
		11/18/2008	PH, JP	3	9	0
		12/1/2008	AM, JP	0	1	0
		12/8/2008	BF, JP	0	0	0
	Total			11	34	1
Methow River M 4	RK 26.87 – 38.94	10/29/2008	PH, SD	4	13	0
		11/8/2008	BF, JP	9	19	0
		11/18/2008	PH, JP	1	5	0
		12/1/2008	AM, JP	0	0	2
		12/8/2008	BF, JP	0	0	0
	Total			14	37	2
Methow River M 5	RK 38.97 – 44.25	10/29/2008	AM, RA	1	0	0
		11/3/2008	BioAnalysts	0	0	2
		11/9/2008	KM, BF, JP	6	3	0
		11/19/2008	PH, JP	0	0	0
		12/2/2008	BF, JP	4	0	0
		12/9/2008	AM, JP	0	0	0
	Total			11	3	2
Methow River M 6	RK 44.42 – 52.62	10/31/2008	KM, BF, JP	2	0	0
		11/13/2008	SD, AM	0	1	0
		11/19/2008	SD, AM	10	2	0
		12/3/2008	SD, AM	3	0	1
		12/9/2008	PH, SD	0	0	0
	Total			15	3	1

Methow River M 7	RK 52.62 – 76.28	11/1/2008	KM, BF, JP	0	0	0
		11/12/2008	SD, AM	0	0	0
		11/20/2008	SD, AM	1	0	0
		12/3/2008	BF, JP	0	0	0
		12/10/2008	SD, AM	0	0	1
	Total			1	0	1
Methow River M 8	RK 76.28 – 86.42	11/2/2008	KM, BF, JP	1	0	0
		11/12/2008	SD, AM	0	0	0
		11/20/2008	SD, AM	1	0	1
		12/3/2008	BF, JP	0	0	1
		12/10/2008	SD, AM	0	0	0
	Total			2	0	2
Methow River M 9	RK 86.42 – 98.60	10/30/2008	PH, SD	0	1	1
		11/3/2008	PH, JP	1	4	1
		11/14/2008	JP	1	0	0
		11/20/2008	JP	1	0	0
		12/4/2008	JP	0	0	0
		12/10/2008	JP	0	0	0
	Total			3	5	2
WNFH Spring Creek	Mouth to fish ladder	10/20/2008	KM,AM,SD	0	0	0
		10/27/2008	SD, PH	5	7	0
		11/3/2008	PH, JP	2	5	1
		11/10/2008	PH, SD	1	14	4
		11/17/2008	PH, SD	4	10	3
		11/20/2008	PH	0	3	0
		12/1/2008	PH, JP	10	1	7
		12/8/2008	KM, PH	3	0	0
	Total			25	40	15
WDFW Outfall	Mouth to fish ladder	10/20/2008	KM,RA,AM,SD	0	1	0
		10/27/2008	PH, SD	5	3	0
		11/3/2008	PH, JP	4	15	1
		11/10/2008	PH, SD	2	6	0
		11/17/2008	PH, SD	4	1	0
		11/20/2008	PH	0	2	0
		12/1/2008	PH	0	0	1
		12/8/2008	PH	0	0	0
	Total			15	28	2
Twisp River	Mouth to RK 9.1	11/24/2008	AM, PH	1	0	0
	Total			1	0	0
Libby Creek	Mouth to RK 2.7	10/27/2008	PH	0	0	0
		11/10/2008	PH	0	0	0
		11/17/2008	PH	0	0	0
		12/4/2008	BF, SD, AM	1	0	0
	Total			1	0	0
Beaver	Mouth to RK 3.8	10/29/2008	SD, AM	0	0	0

Creek		11/10/2008	SD	0	0	0
		11/17/2008	PH	0	0	0
		12/4/2008	BF, AM, SD	0	0	0
	Total			0	0	0
Wolf Creek	Mouth to RK 1.4	10/30/2008	AM	0	0	0
		11/20/2008	JP	0	0	0
		12/4/2008	JP	0	0	0
	Total			0	0	0
Hancock Springs	Entire system	11/14/2008	JP	0	0	0
		12/4/2008	KM, JP	0	0	0
	Total			0	0	0
Chewuch River	Mouth to Fulton Dam	10/27/2008	JP	1	0	0
		11/20/2008	PH	0	0	0
		12/4/2008	JP	3	0	1
	Total			4	0	1
Chelan FH outfall		10/30/2008	AM, SD, PH	13	61	18
		11/20/2008	KM, BF	35	9	35
		12/4/2008	BF, AM, SD	1	1	10
	Total			49	71	63
Chelan River Outfall	Mouth to 800m upstream	10/10/2008	BioAnalysts	0	0	1
		10/24/2008	BioAnalysts	0	0	1
		10/30/2008	AM, SD, PH	3	12	0
		11/7/2008	BioAnalysts	0	0	4
		11/14/2008	BioAnalysts	0	0	3
		12/4/2008	AM, SD, BF	0	7	0
	Total			3	19	9
Foster Creek	Mouth to RK 1.9	10/30/2008	AM, SD, PH	0	0	0
	Total			0	0	0
Similkameen River		11/6/2008	BioAnalysts	0	0	1
	Total			0	0	1
Star Road Ponds		11/4/2008	AM, PH, SD	0	0	10
		11/14/2008	BioAnalysts	0	0	1
	Total			0	0	11

APPENDIX C: Wenatchee and Methow Basin Coho Release Numbers and Mark Groups, 2009

APPENDIX C: Wenatchee and Methow Basin Coho Release Numbers and Mark Groups, 2009.

Basin	River	Acclimation Site	Rearing Hatchery	Brood Source	Release Date	CWT Code	Retention	Total Smolts Received	Total Smolts Released *	CWTs Released	PIT tags
Wenatchee	Nason Cr	Coulter Pond	Cascade FH	MCR-WEN	May 6	190140+BT	99.2%	77,392	73,822	73,231	0
							Total	**77,392**	**73,822**	**73,231**	**0**
Wenatchee	Nason Cr	Nason Wetlands	Cascade FH	MCR-WEN	Apr-2	190143+BT	98.2%	38,589	38,589	37,894	0
							Total	**38,589**	**38,589**	**37,894**	**0**
Wenatchee	Nason Cr	Rolfing's Pond	Willard NFH	MCR-WEN	May 6	190149+BT	97.8%	24,110	23,171	22,661	2,874
Wenatchee	Nason Cr	Rolfing's Pond	Cascade FH	MCR-WEN	May 6	190141+BT	99.6%	77,369	74,231	73,934	3,000
							Total	**101,479**	**97,402**	**96,595**	**5,874**
Wenatchee	Beaver Cr	Beaver Creek	Willard NFH	MCR-WEN	May 6	190147+BT	96.8%	17,315	16,234	15,715	0
Wenatchee	Beaver Cr	Beaver Creek	Cascade FH	MCR-WEN	May 6	190139+BT	99.2%	64,000	59,934	59,425	0
							Total	**81,315**	**76,168**	**75,139**	**0**
Wenatchee	Nason Cr.	Butcher Creek	Willard NFH	MCR-WEN	May 6	190148+BT	98.4%	20,565	18,999	18,695	3,001
Wenatchee	Nason Cr.	Butcher Creek	Cascade FH	MCR-WEN	May 6	190142+BT	99.6%	116,185	107,313	106,884	2,861
							Total	**136,750**	**126,312**	**106,884**	**5,862**
Wenatchee	Icicle Cr	LNFH SFL 9-12	Willard NFH	MCR-WEN	Apr-27	190146	97.3%	107,082	105,834	102,976	3,001
Wenatchee	Icicle Cr	LNFH SFL18-21	Willard NFH	MCR-WEN	Apr-27	190145	96.0%	119,915	118,830	114,077	6,012
Wenatchee	Icicle Cr	LNFH SFL 22-25	Willard NFH	MCR-WEN	Apr-27	190144	97.7%	119,575	118,412	115,689	0
							Total	**346,572**	**343,076**	**332,742**	**9,013**
Wenatchee	Icicle Cr	LNFH LFL 1	Entiat NFH	MCR-WEN	Apr-23	054814	99.4%	25,965	25,922	25,766	0
Wenatchee	Icicle Cr	LNFH LFL 1	Entiat NFH	MCR-WEN	Apr-23	054815	98.8%	26,017	25,974	25,662	0
Wenatchee	Icicle Cr	LNFH LFL 1	Entiat NFH	MCR-WEN	Apr-23	054816	100.0%	26,096	26,053	26,053	0
Wenatchee	Icicle Cr	LNFH LFL 1	Entiat NFH	MCR-WEN	Apr-23	054639	99.0%	11,182	11,163	11,051	0
Wenatchee	Icicle Cr	LNFH LFL 1	Entiat NFH	MCR-WEN	Apr-23	053736	99.9%	25,033	24,991	24,966	0

Wenatchee	Icicle Cr	LNFH LFL 2	Entiat NFH	MCR-WEN	Apr-23	054818	99.8%	14,784	14,757	14,727	4,500
Wenatchee	Icicle Cr	LNFH LFL 2	Entiat NFH	MCR-WEN	Apr-23	054817	99.4%	25,018	24,973	24,823	4,430
Wenatchee	Icicle Cr	LNFH LFL 2	Entiat NFH	MCR-WEN	Apr-23	053499	99.6%	32,313	32,255	32,126	0
Wenatchee	Icicle Cr	LNFH LFL 2	Entiat NFH	MCR-WEN	Apr-23	053498	99.6%	32,981	32,921	32,789	0
							Total	**219,389**	**219,009**	**217,965**	**8,930**

Methow	Methow	Winthrop NFH C6,C8	Winthrop NFH	MCR-MET	Apr-22	190136	98.0%	90,105	88,596	86,824	0
Methow	Methow	Winthrop NFH C11	Winthrop NFH	MCR-MET	Apr-22	190137	98.0%	45,017	44,828	43,931	0
Methow	Methow	Winthrop NFH C12, 14-16	Winthrop NFH	MCR-MET	Apr-22	190135	99.5%	197,211	194,921	193,946	5,433
Methow	Methow	Twisp Ponds	Winthrop NFH	MCR-MET	May 1	190138	100.0%	50,551	48,289	48,289	0
Methow	Methow	Winthrop NFH BC	Willard NFH	MCR-MET	May 1	190135	100.0%	48,816	48,048	48,048	5,938
							Total	**431,700**	**424,682**	**421,039**	**11,371**

Methow	Columbia	Wells FH	Willard NFH	MCR-MET	22-Apr	190150	97.2%	44,689	44,420	43,438	0
							Total	**44,689**	**44,420**	**43,438**	0

	Total Coho	**Total CWTs**
Wenatchee Basin	**974,378**	**940,451**
Methow Basin (+ Wells FH)	**469,102**	**464,477**