Integrated Status & Effectiveness Monitoring Program

Expansion of Existing Smolt Trapping Program in Nason Creek by Yakama Nation Fisheries Resource Management

2004 Draft Annual Report

Prepared by:
Scott A. Prevatte
Keely G. Murdoch

Prepared for:
2003-017-00
Bonneville Power Administration
Portland, OR

YAKAMA NATION
FISHERIES RESOURCE MANAGEMENT

Abstract

In the fall of 2004, as one part of a Basin-Wide Monitoring Program developed by the Upper Columbia Regional Technical Team and Upper Columbia Salmon Recovery Board, the Yakama Nation Fisheries Resource Management program began monitoring downstream migration of Upper Columbia River Spring Chinook Salmon and Upper Columbia Steelhead in Nason Creek, a tributary to the Wenatchee River.

This report summarizes spring chinook salmon and steelhead trout migration data in Nason Creek during the spring and fall of 2004. We used counts at the trap and efficiency trials to describe emigration timing and to estimate population size. Data collection was divided into spring and fall sessions with a break during the summer months. The spring trapping period began on March 8th and ended on June 16th and the fall period began on September 3rd and ended on November 24th.

During the spring we collected 336 yearling (2002 brood) spring chinook salmon, 172 wild steelhead smolts and 283 steelhead parr. A total of 8 mark-recapture trap efficiency trials were performed using hatchery coho smolts as a surrogate species over a range of stream discharge stages. A pooled trap efficiency of 3.9% was used to estimate the population size of both spring chinook and steelhead smolts. We estimate that 9084 (± 410 95%CI) yearling spring chinook and 4955 (± 258 95%CI) steelhead smolts emigrated past the trap during the spring sample period between March 8th and June 19th of 2004.

During the fall we collected 1,458 subyearling (2003 brood) spring chinook salmon and 690 steelhead parr. A total of 7 mark-recapture trap efficiency trials were conducted, 5 using spring chinook and 2 with steelhead parr, over a range of stream discharge stages. A pooled trap efficiency of 20.3% was used to calculate the emigration of spring chinook and 18.8% was used for steelhead parr during the fall trapping period from September 3rd through November 24th. We estimate that 7899 (± 341 95%CI) subyearling spring chinook and 4071 (± 509 95%CI) steelhead parr migrated downstream past the trap during the fall sample period of 2004. If movements of steelhead parr between March 8th and June 19th are assumed to be fish emigrating from Nason Creek the total population estimate using the pooled trap efficiency (3.9%) is 7742 (± 339 95%CI).

Table of Contents

List of Tables

List of Figures

Acknowledgements

This project is part of a basin wide monitoring program requiring close coordination between multiple fisheries management agencies. Thanks to Thomas Randolf, WDFW, for helping secure the trap during periods of high stream flow. We would like to thank to Greg Thayer, USFS, for providing the trapping site at the Nason Creek Campground and accommodating the needs of this study. The hard work of the Yakama Nation Fisheries Technicians who operated the trap during al hours including nights and weekends is appreciated. We would like to thank Chris Jordan the project sponsor, and Gerald McClintock from the BPA for administering the funding.

Introduction

Beginning in the fall of 2004, as one task within the basin wide monitoring effort of the Bonneville Power Administration (BPA) project # 2003-017-00 Integrated Status & Effectiveness Monitoring Program, the Yakama Nation, in coordination with the Washington Department of Fish and Wildlife (WDFW), Washington State Department of Ecology (DOE), the United States Fish and Wildlife Service (USFWS), the United States Forest Service (USFS), National Oceanographic and Atmospheric Administration Fisheries (NOAA Fisheries), the BPA, began extending the current smolt trapping effort in Nason Creek from three months per year to nine months per year with the project entitled Expansion of Existing Smolt Trapping Program in Nason Creek by Yakama Nation Fisheries Resource Management. The objectives of this project are:

1) Estimate the smolt production of spring chinook salmon and steelhead for the Nason Creek watershed within the Wenatchee Subbasin.

2) Describe the temporal variability of outmigrating spring Chinook and steelhead within Nason Creek.

The data generated from this project will estimate natural spring chinook and steelhead production and productivity allowing researchers to calculate annual population estimates, egg-to-emigrant survival, and emigrant-to-adult survival rates and include colleting data and providing population estimates for ESA listed spring chinook salmon and steelhead trout. Population estimates will be used to evaluate the effects of supplementation programs in the Wenatchee River Basin as well as to begin to collect data in Nason Creek to develop a spawner-recruit relationship.

This report summarizes data collection from the Nason Creek smolt trap during the 2004 trapping periods of March 8th through June 19th, and from September 3rd through November 24th. The target species in the spring was coho salmon, hatchery and naturally produced, as part of the Mid-Columbia Coho Reintroduction project (project #1994-040-000). We targeted fall subyearling chinook and steelhead migrants during the fall under a pilot project to initiate a basin wide monitoring program (project #2003-017-000). During the summer, June 20th through September 2nd, due to the section 10 permitting process, we did not operate the smolt trap.

Juvenile chinook salmon captured in Nason Creek during 2004 represent two broodyears, 2002 and 2003. While we have previously operated the trap in the spring (2001 & 2003), 2004 was the first year that we operated the trap during the fall. A complete broodyear of emigrants will not be available for analysis until next year.

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 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 accessible to salmon. 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).

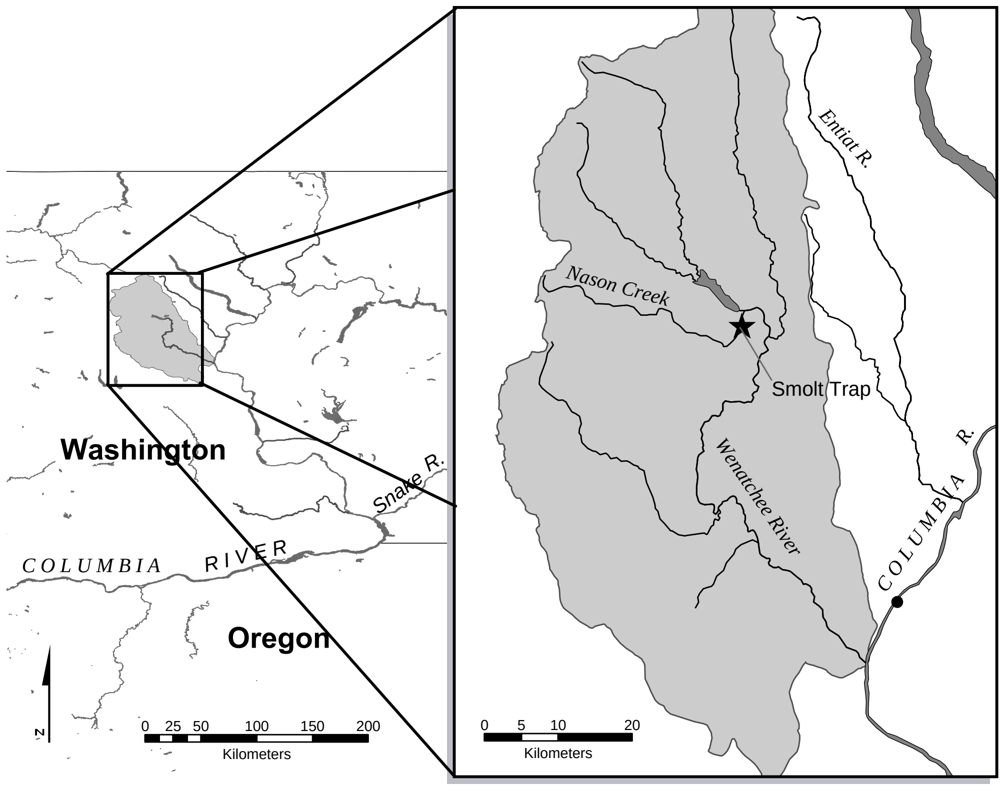

Figure 1. Nason Creek smolt trap location.

The channel morphology of the lower 25 kilometers of Nason Creek has been impacted by development of highways, railroads power lines, and houses 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 near the mouth of Nason Creek in May of 2002. The mean daily discharge for the 2004 water year (October 1, 2003 through September 31, 2004) was 338 cfs. Peak runoff typically occurs in May and June with occasional high water rain on snow events in October and November. The hydrograph observed during the 2004 smolt trapping period followed the typical discharge regime (Figure 2). Daily mean stream discharge measurements taken by the Washington State DOE during the 2004 and 2005 water years are in Appendix A.

The Nason Creek water temperature recorded at the DOE station during the 2004 smolt trapping period ranged from 3.7 °C on March 9th to 4.6 °C on November 24th. The peak temperature of 19.5 °C was reached on August 16th and the minimum water temperature was 2.1 °C on November 21st (Figure 3). The temperature regime during the 2004 smolt trapping period was similar to that of the previous 3 years of record. Daily mean stream temperature measurements taken by the Washington State DOE during the 2004 and 2005 water years are in Appendix A.

Fish present in Nason Creek are chinook salmon *Oncorhynchus tshawytscha*, steelhead trout and rainbow trout *Oncorhynchus mykiss*, coho salmon *Oncorhynchus kisutch*, cutthroat trout *Oncorhynchus clarki clarki*, bull trout *Salvelinus confluentus*, mountain whitefish *Prosopium williamsoni*, redside shiner *Richardsonius balteatus*, sucker *Catostomus sp*, sculpin *Cottus sp*, dace *Rhinichthys sp* and northern pikeminnow. Hatchery activity in Nason Creek includes the BPA funded coho reintroduction program, the Chelan County PUD funded hatchery steelhead direct plants, and the Grant County PUD funded spring chinook captive brood program (2004 marks the first captive brood release in Nason Creek).

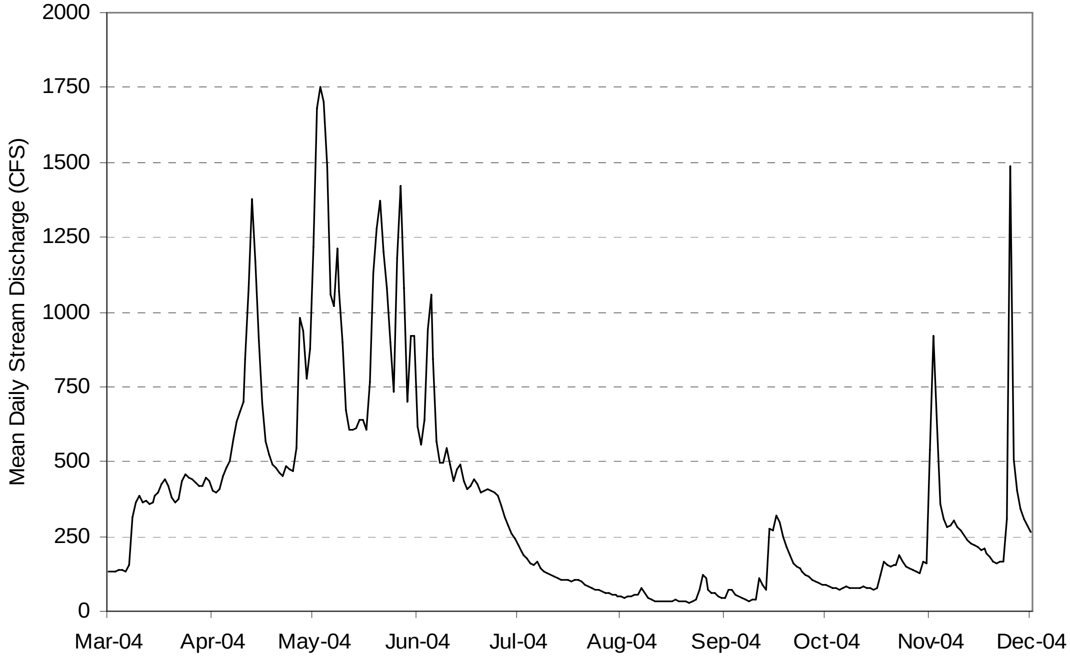

Figure 2. Mean daily stream discharge at the Nason Creek DOE stream monitoring station, RKM 1, from March 1 through December 1, 2004.

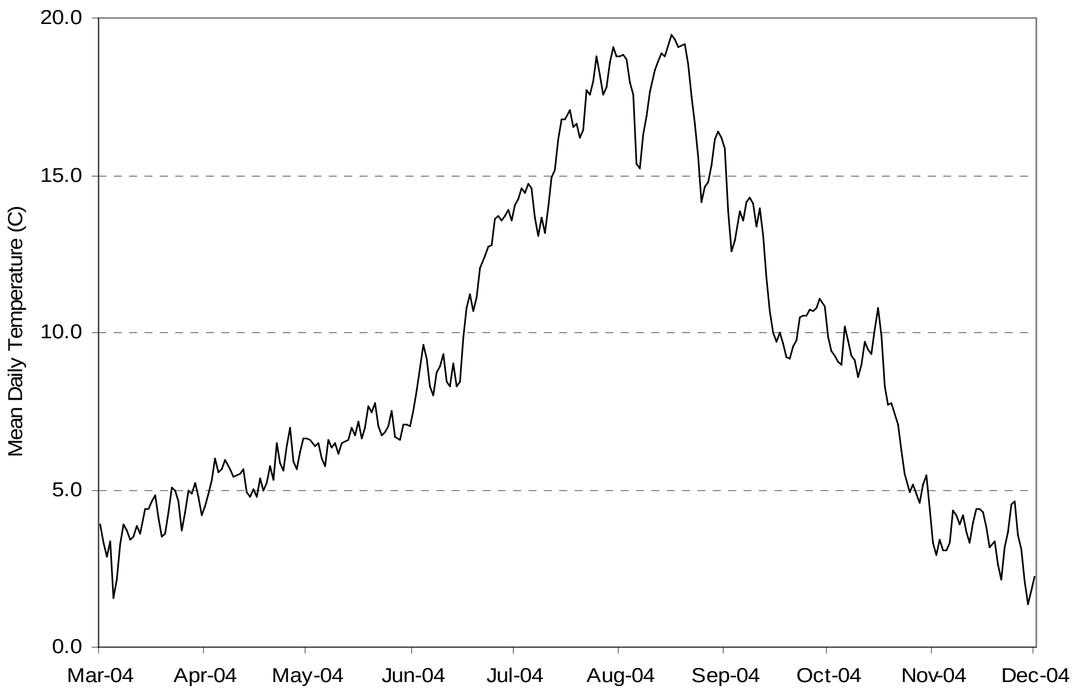

Figure 3. Mean daily water temperature at the Nason Creek DOE stream monitoring station, RKM 1, from March 1 through December 1, 2004.

Methods for Estimating Abundance of Juvenile Salmonids

Trapping Equipment and Operation

A floating rotary screw trap with a 5-foot 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 hung, with wire rope, from a snatch block connected to a stream spanning cable. We positioned the trap in the thalweg; trap position could be adjusted with a 'come-along' type puller.

Data Collection

The protocol for trap operating procedures and techniques followed the standardized basin-wide monitoring plan developed by the Upper Columbia Regional Technical Team for the Upper Columbia Salmon Recovery Board (Hillman 2004), adapted from Murdoch et al. (2000).

We used water filled sactuary nets to transfer fish from the holding box to 5 gallon plastic buckets. 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. Anesthetized fish were allowed to fully recover before being released downstream from the trap.

Length and weight measurements were recorded for all fish except on days when large numbers were collected, and then 25 of each size class of the target species were measured and weighed. Fork length was recorded to the nearest millimeter and weight to the nearest 0.1 gram. We used this data to calculate a Fulton-type condition factor (Kfactor), following methods described in the protocol, for all spring chinook and wild steelhead sampled using the formula:

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

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

Juvenile spring chinook trapped in 2004 represented two brood years and were classified by size and the time of year the fish were collected. Chinook subyearlings (BY 2003; age 0+) recorded as fry (≤ 60 mm) were captured between March and June. Chinook subyearlings classified as parr or pre-smolts (> 60 mm) were captured emigrating between September and November. Chinook yearlings (BY2002), emigrating in the spring, were identified as smolts (>60mm). Steelhead were classified by size class: fry

(≤ 60 mm), parr (61-90 mm), parr/smolt (91-125 mm), and parr/smolt (> 125 mm), and degree of smoltification (parr, transitional, smolt).

Trapping Efficiency and Emigration Estimate

Standard mark and recapture efficiency trials were conducted throughout the trapping period following the protocols and calculations described in Hillman (2004). The protocols required a minimum of 100 fish in each mark-recapture trial. When insufficient numbers of emigrating chinook or steelhead were captured, we held the fish up to three days, in live boxes, to increase the number available for the trial. If after 3 days of collection, numbers were still insufficient for an efficiency trial, the fish were released in calm water downstream from the trap. Fish used in efficiency trials were marked with either an upper or lower caudal fin clip and held for at least 8 hours of recovery before being transported in 5-gallon buckets 1.4 km upstream to the release site. We released the fish in the evening, and distributed them across the creek when stream flows allowed for wading. Only fish recaptured within the first 48 hours after release were used in the trap efficiency calculations. Trap efficiency was calculated with the following formula:

Trap efficiency = $E_i = R_i / M_i$

Where E_i is the trap efficiency during time period i; M_i is the number of marked fish released during time period i; and R_i is the number of marked fish recaptured during time period i. The frequency that trap efficiency trials were conducted was limited by the number of fish collected. 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 efficiency trials) with discharge (cfs). If a relationship was found ($p<0.05$; r^s >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 = $$\mathrm{var}\left[\hat{N}_i\right] = \hat{N}_i^2 \frac{\mathrm{MSE}\left(1 + \frac{1}{n} + \frac{\left(X_i - \overline{X}\right)^2}{(n-1)s_X^2}\right)}{\hat{e}_i^2}$$

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., $P < 0.05$; $r^2 \approx 0.5$), 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 = $\mathrm{var}\left[\hat{N}_i\right] = \hat{N}_i^2 \frac{E_p(1 - E_p)/\sum M}{E_p^2}$

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

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

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

The following assumptions must be made for the population estimated to be valid (Murdoch et al. 2001):

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.

Results

Trap Operation

We deployed the trap in Nason Creek on March 5th and began operating on March 8th. We fished the trap continuously until June 16th, except during periods of high runoff or large hatchery smolt releases upstream of the trap (Table 1). We did not operate the trap during the summer until the section 10 permitting process was complete. The permitting process led to a September 3rd trap installation date. Low water conditions delayed continuous trap operation until September 14th. During the fall, we operated the trap between September 14th and November 24th when high water and cold temperatures prohibited operation.

Table 1. Nason Creek smolt trap operating dates, 2004.

Period	Trap Status	Description	Days Operating	Days Missed	
8 Mar - 19 Apr	Operating	Continuous	43	0	
20 Apr - 23 Apr	Not Operating	Steelhead Release	0	3	
24 Apr - 28 May	Operating	Continuous	35	0	
29 May - 31 May	Not Operating	High Flow/Debris	0	3	
1 Jun - 19 Jun	Operating	Continuous	19	0	
			97 (94%)	**6 (6%)**	Spring Total
20 Jun - 2 Sep	Not Operating	Lack of Permit	0	83	
3 Sep	Operating	Continuous	1	0	
4 Sep - 13 Sep	Not Operating	Low Stream Flow	0	10	
14 Sep - 25 Oct	Operating	Continuous	43	0	
26-Oct	Not Operating	Trap Maintenance	0	1	
27 Oct - 2 Nov	Operating	Continuous	7	0	
3 Nov	Not Operating	High Flow/Debris	0	1	
4 Nov - 24 Nov	Operating	Continuous	21	0	
			72 (86%)	**12 (14%)**	Fall Total

Daily Emigration

Spring Chinook Fry (2003 Brood)

Between March 8th and June 19th, 90 newly emerged spring chinook fry were collected. Chinook fry were easily identified by size. The first BY2003 fry were captured on the first day of trapping. The majority of the chinook fry (84%) were collected before May 1st (Figure 4). High water events accounted for two chinook fry mortalities, likely caused by debris in the live box.

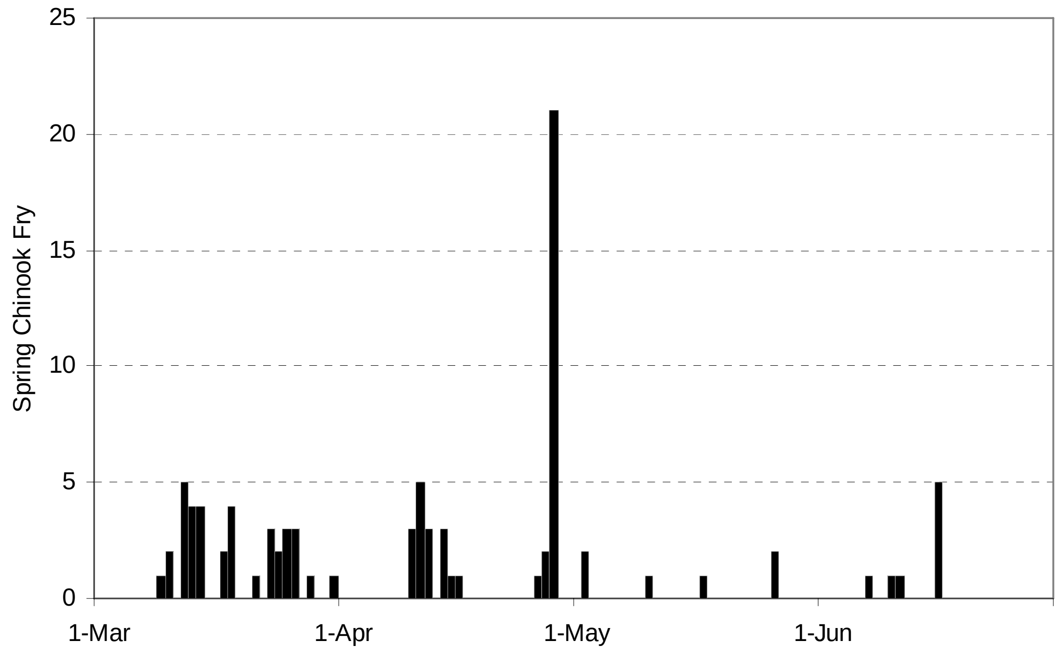

Figure 4. Spring chinook fry counts and run-timing at the Nason Creek smolt trap, March 8th through June 19th 2004.

Spring Chinook Yearlings (2002 Brood)

We collected 336 yearling spring chinook smolts (BY2002) during the spring. The first smolt was trapped on March 8th, the first day of operation. Peak emigration (38.4% of the run) occurred between April 6th and April 13th with a daily peak of 33 yearlings (9.8%) on April 8th (Figure 5). During spring high water events four chinook yearling mortalities occurred, likely due to debris in the live box. In addition to the naturally produced yearling spring chinook smolts, 110 hatchery captive brood smolts were trapped.

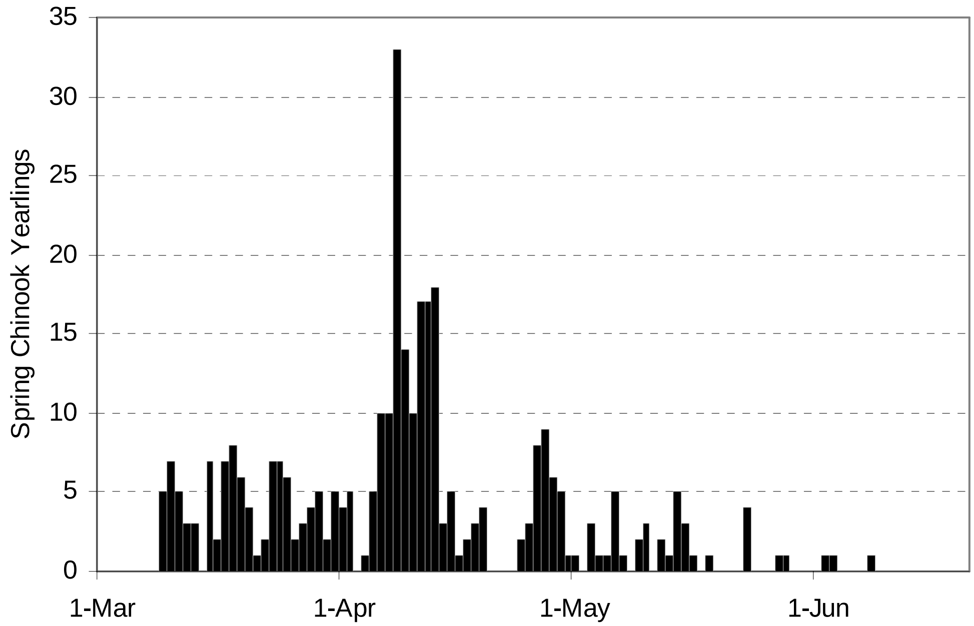

Figure 5. Yearling spring chinook smolt counts and run-timing at Nason Creek smolt trap, March 8th through June 19th 2004.

Spring Chinook Subyearlings (2003 Brood)

We collected 1,458 subyearling spring chinook during the fall. We began trapping the 2003 brood emigrants on Sept 3rd, the first day of operation. Peak emigration (42.9%) occurred between November 4th and November 9th with a daily peak of 190 subyearlings (13.0%) on November 4th (Figure 6). Most of the subyearlings, 69.5%, emigrated in November. Four chinook subyearling mortalities occurred, likely due to debris in the live box. One precocial spring chinook was captured.

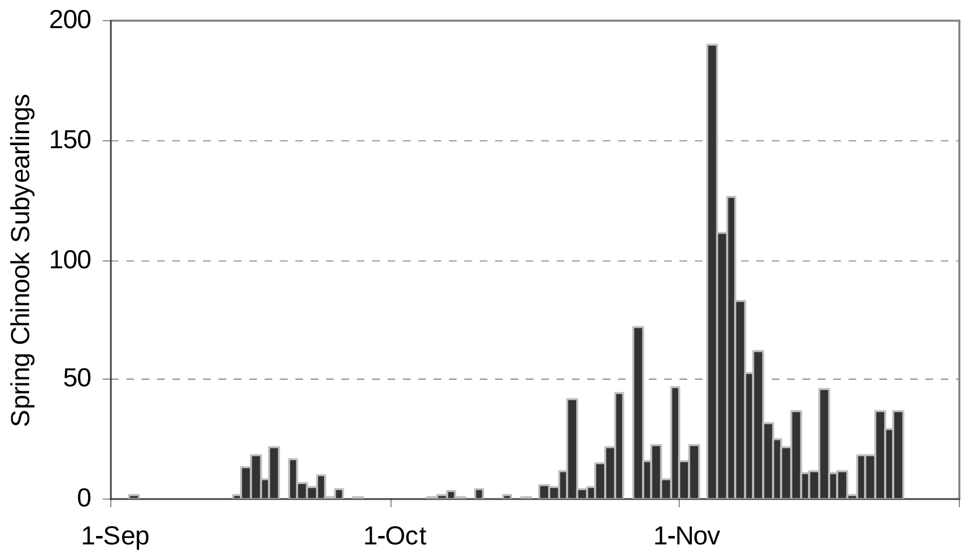

Figure 6. Spring chinook subyearling counts and run-timing at the Nason Creek smolt trap, Sept 3rd through Nov 24th 2004.

Steelhead/Rainbow Trout Fry and Parr

Between March 8th and June 19th we captured 457 wild steelhead of various age classes and smoltification stages. One fry was collected during the spring, on June 1st. A total of 283 parr emigrants were caught during April through June. Peak daily emigration occurred on April 28th when 26 parr (9.2%) were captured. The 5-days following this peak accounted for 20.8% of the total spring parr emigration (Figure 7). Steelhead parr mortality was 13 fish of which 8 were due to high water and debris in the trap.

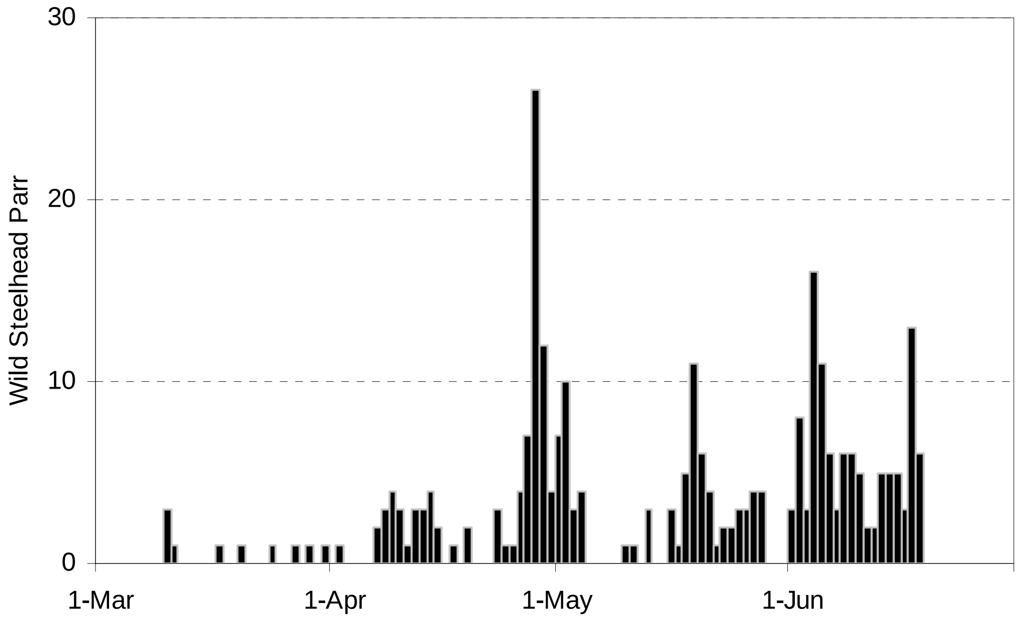

Figure 7. Steelhead parr counts and run-timing at the Nason Creek smolt trap from March 8th through June 19th 2004.

Between September 3rd and November 24th, 791 naturally produced steelhead were collected; 101 fry or sub-parr (≤ 60 mm); 572 steelhead parr (60 mm to 125 mm); and 118 steelhead parr (> 125 mm). The majority (89%) of steelhead fry were caught in September and a peak daily collection of 21 fry occurred on September 16th (Figure 8). Steelhead parr in the 61 mm to 125 mm size class totaled 572 fish with the majority (53%) captured in September. The peak daily emigration of this group occurred on September 15th when 101 fish were collected (Figure 9). Of the 118 steelhead parr > 125 mm, 53.4% were collected in November and the peak daily capture was 28 on November 4th (Figure 10). During this period 7 steelhead fry mortalities and 1 parr mortality occurred.

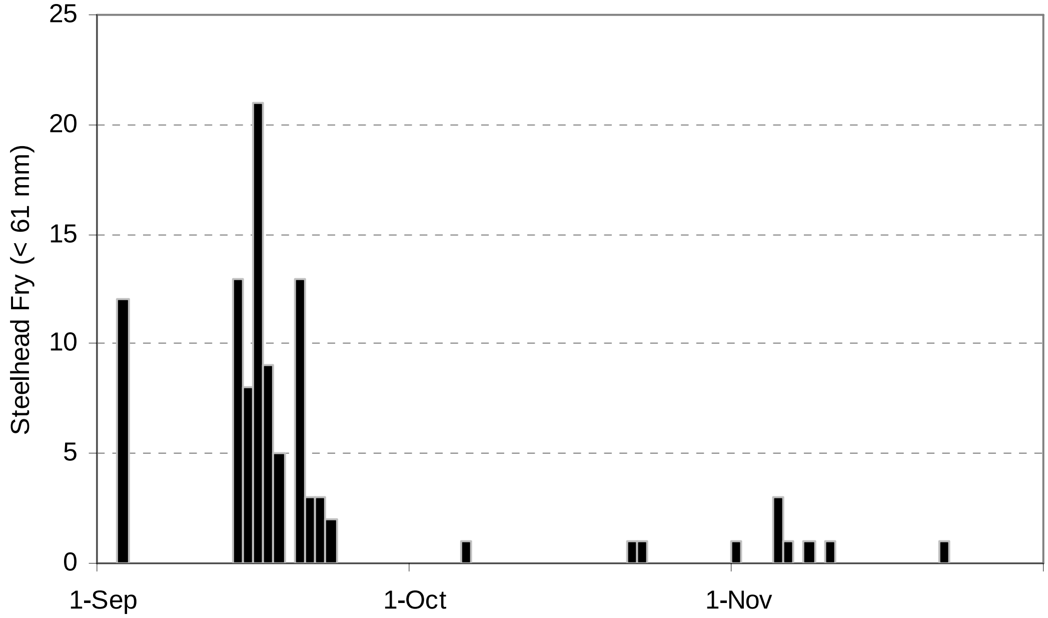

Figure 8. Steelhead fry counts and run timing at the Nason Creek smolt trap, Sept 3rd through Nov 24th 2004.

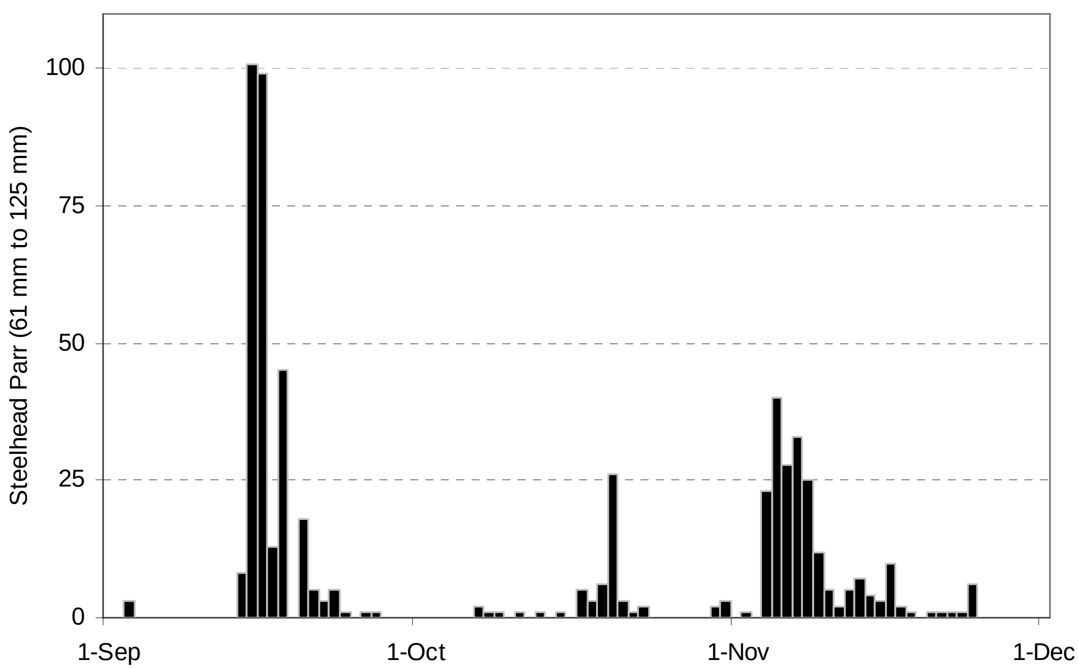

Figure 9. Steelhead parr (61 mm to 125 mm) counts and run-timing at the Nason Creek smolt trap, Sept 3rd through Nov 24th 2004.

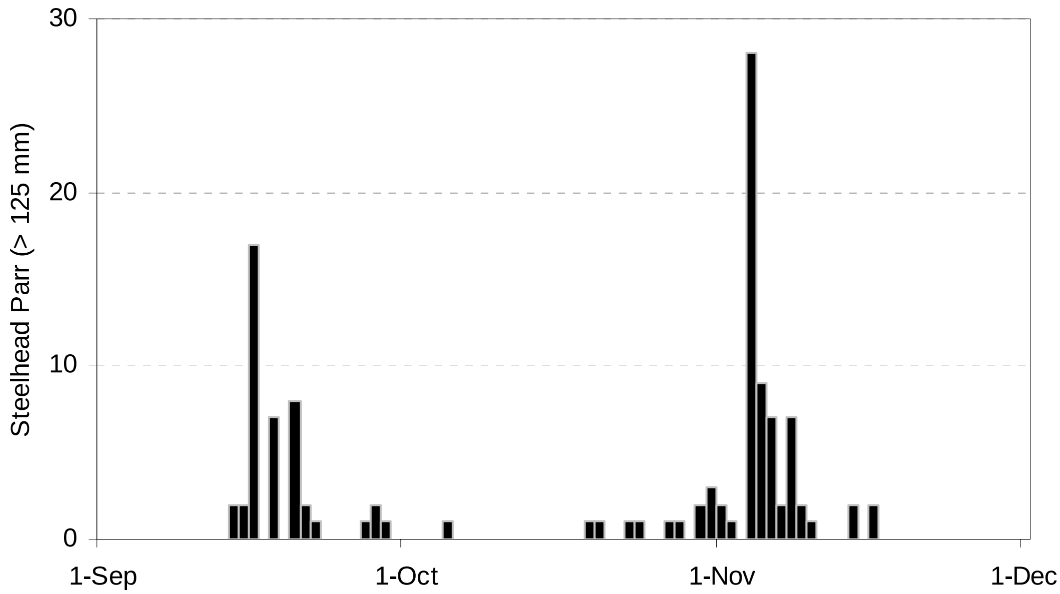

Figure 10. Steelhead parr (> 125 mm) counts and run-timing at the Nason Creek smolt trap, Sept 3rd through Nov 24th 2004.

Steelhead/Rainbow Trout Smolts

A total of 172 smolting steelhead were trapped during the spring with the first steelhead smolt on captured on March 10th (Figure 11). During March, all of the smolts were in the transitional stage. In April the ratio was 45% transitional and 55% smolt and by May it was 23.5% transitional and 76.5% smolted steelhead. Overall 67 fish (39%) were in the transitional stage and 105 (61%) were smolts. The peak smolt emigration was seen during the week of April 27th through May 3rd when 30.8% of the smolts were collected. In addition to the naturally produced steelhead smolts, 979 hatchery steelhead smolts were captured from April 9th through June 11th.

.

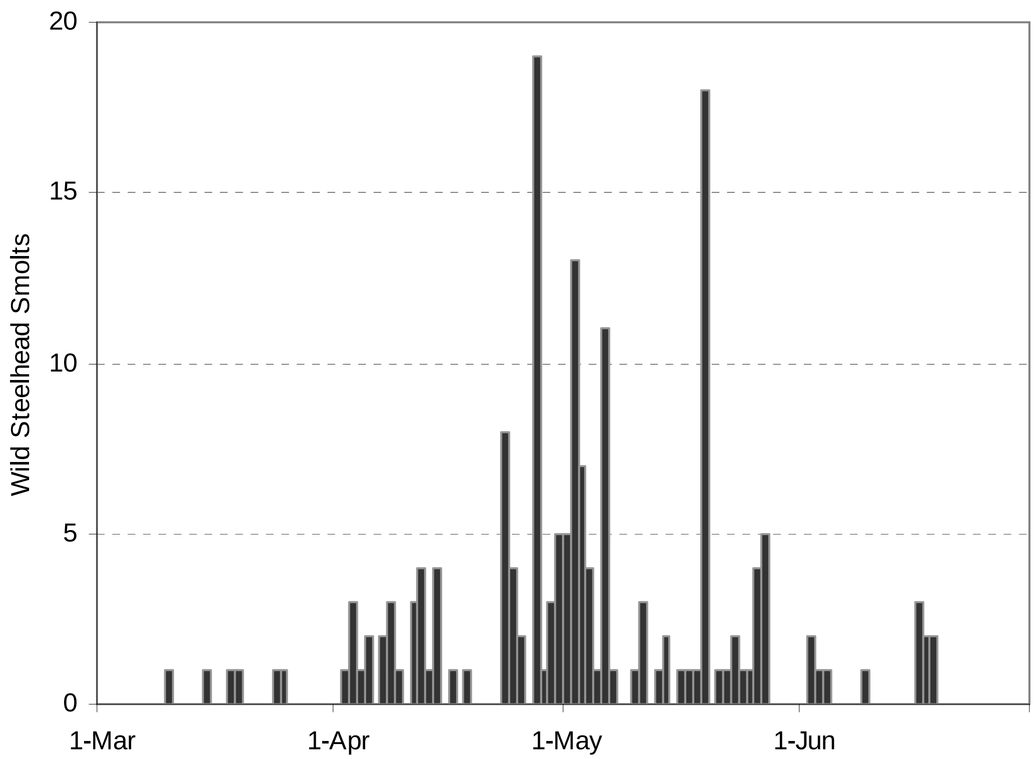

Figure 11. Steelhead smolt counts and run-timing at the Nason Creek smolt trap, March 8th through June 19th 2004.

Length and Weight

Spring Chinook Yearlings (2002 Brood) and Subyearlings (2003 Brood)

BY2003 spring chinook fry were trapped from March through June, 2004. Fork length (FL) of the fry increased during the summer months, continuing into the fall. Mean fry Kfactor increased steadily through the spring from 0.83 in March to 1.08 in June (Table 2).

BY2002 chinook yearlings were collected as soon as trapping began in March. Fall data is not available for BY2002 so we are unable to measure over-winter growth. Between March and May the mean FL of yearling emigrants increased 5.2 mm. Similarly, the mean Kfactor increased during the spring (1.01 in March; 1.11 in June) (Table 2).

Table 2. Fork length, weight and condition factor for spring chinook yearlings and subyearlings collected at the Nason Creek trap during 2004.

	Fork Length (mm)			Weight (g)			Kfactor		
Date	**Mean**	**SD**	***N***	**Mean**	**SD**	***N***	**Mean**	**SD**	***N***
				Spring Chinook Subyearling Emigrants					
Mar-04	37.8	2.5	36	0.4	0.2	33	0.83	0.33	33
Apr-04	37.5	1.4	40	0.5	0.1	40	0.88	0.16	40
May-04	44.3	9.3	6	1.1	0.4	4	0.90	0.12	4
Jun-04	49.6	5.2	9	1.3	0.4	9	1.08	0.26	9
Sep-04	75.2	8.2	108	4.3	1.6	74	1.00	0.17	74
Oct-04	82.7	6.8	239	5.9	1.6	188	1.04	0.11	188
Nov-04	83.4	6.4	421	6.2	1.6	420	1.05	0.13	419
				Spring Chinook Yearling Emigrants					
Mar-04	89.3	7.0	101	7	1.8	101	1.01	0.07	101
Apr-04	92.9	8.6	195	7.6	2.2	195	1.05	0.09	195
May-04	94.5	8.9	28	8.9	3.6	26	1.07	0.12	26
Jun-04	118		1	18.3		1	1.11		1
				Precocial					
Sep-04	163		1	46		1	1.06		1

Steelhead Fry, Parr, and Smolts

Steelhead fry that emerged in late spring and summer were trapped in September with a mean FL of 55 mm and Kfactor of 1.01. During October and November very few steelhead fry < 60 mm were collected (Table 3).

Steelhead parr measuring between 61 mm to 89 mm were trapped throughout both the spring and fall. The mean FL for this group was 71 mm in March and increasing to 85 mm by June. Similarly, the mean condition factor increased from 0.98 in March to 1.10 in June. The mean FL for steelhead parr (61mm to 89mm) increased from 68 mm in September to 74 mm in November. The Kfactor decreased from June (1.10) to September (1.03). Between September and November the Kfactor for steelhead parr (61mm to 89 mm) remained the same (Table 3).

Steelhead parr measuring 90 mm to 120 mm were also trapped throughout the entire trapping season with a definite peak emigration in June. Mean FL and Kfactor of the steelhead did not increase the spring but was slightly larger in the fall. Some of the steelhead at the upper end of this size class were showing signs of smoltification in the spring (Table 3).

Steelhead in the transitional stages of smoltification began appearing at the trap during March and continued through June of 2004 with an obvious peak emigration in May. These fish were mostly FL >120 mm with a mean fork length of 134 mm in March and increasing to 175 mm in June. The condition factor of smolts was generally less than 1.0 with a mean of 0.93 in March. Not all steelhead over 120 mm showed signs of smoltification. Many fish in this size group (FL >120mm) were collected during the fall with a mean FL of 148 mm in September (Table 3).

Table 3. Fork length, weight and condition factor for steelhead fry, parr, and smolts collected at the Nason Creek smolt during 2004.

	Fork Length (mm)			Weight (g)			Kfactor		
Date	**Mean**	**SD**	***N***	**Mean**	**SD**	***N***	**Mean**	**SD**	***N***
Steelhead Fry (≤ 60 mm)									
Sep-04	55	4	90	1.7	0.5	46	1.01	0.23	46
Oct-04	59	1	3	2.0	0.1	2	1.00	0.03	2
Nov-04	56	5	8	2.0	0.5	8	1.15	0.11	8
Steelhead Parr (61 to 89 mm)									
Mar-04	71	7	8	3.5	1.2	8	0.98	0.08	8
Apr-04	77	8	61	5.0	1.6	61	1.07	0.12	61
May-04	79	7	46	6.2	4.2	46	1.36	1.63	46
Jun-04	85	5	23	6.7	1.5	20	1.10	0.14	20
Sep-04	68	6	90	3.2	1.0	63	1.03	0.28	63
Oct-04	71	6	35	3.6	1.2	28	1.00	0.30	28
Nov-04	74	7	130	4.4	1.3	130	1.05	0.15	130
Steelhead Parr/Smolt (90 to 120 mm)									
Mar-04	106	2	3	12.0	0.5	3	1.01	0.08	3
Apr-04	104	9	22	12.2	3.5	22	1.06	0.10	22
May-04	101	8	33	11.0	3.1	33	1.04	0.19	33
Jun-04	101	8	87	10.8	3.6	86	1.02	0.25	86
Sep-04	110	8	10	12.7	3.9	4	0.87	0.34	4
Oct-04	107	12	2	12.9	6.1	2	1.02	0.15	2
Nov-04	107	9	16	12.8	3.4	16	1.02	0.06	16
Steelhead Parr/Smolt (>120 mm)									
Mar-04	134	5	5	22.7	4.6	5	0.93	0.11	5
Apr-04	165	28	71	48.9	24.4	71	1.02	0.09	71
May-04	175	23	82	53.4	19.7	82	0.96	0.18	82
Jun-04	148	30	9	29.3	16.9	9	0.94	0.32	9
Sep-04	148	21	48	36.2	16.4	25	1.00	0.14	25
Oct-04	145	26	11	32.1	24.1	11	0.94	0.06	11
Nov-04	147	18	42	33.0	13.7	40	1.00	0.07	40

Trap Efficiency Calibration and Population Estimates

Mark and Recapture Trials

Standard mark/recapture efficiency trials were conducted over a range of stream discharge stages on Nason Creek throughout the duration of trapping. Since 2004 was the first year we operated the trap with the objective of calculating population estimates for spring chinook and steelhead, an appropriate release location needed to be established. Finding a suitable release location required using the September mark groups to test multiple sites; to determine the maximum upstream distance where fish could be released and still be collected within 24 hours.

Hatchery coho smolts were the target species during the spring of 2004. We were not permitted to mark spring chinook or steelhead. We conducted 8 mark-recapture trials with hatchery coho smolts. Trap efficiencies ranged between 2.2% and 5.5%, the pooled trap efficiency was 3.9% (Table 4). Efficiency estimates for hatchery coho smolts may not apply to naturally produced chinook and steelhead.

During the fall, spring chinook and steelhead were rarely available in sufficient numbers to collect the 100 fish per mark group as described in the trapping protocol (Hillman 2004). We conducted efficiency trials with as many fish of one species as could be obtained without holding for more than 3 days. We were able to conduct a total of 5 efficiency trials between September and November. The trap efficiency ranged between 9.7% and 32% with a pooled efficiency for spring chinook of 20.3 % Steelhead parr were marked and recaptured during two trials in the fall season but did not amount to the desired sample size of 100 fish (Table 4). Efficiency testing was not done on fry of any species.

Table 4. Trap efficiency mark/recapture trials for Nason Creek 2004.

Date Released	Number Marked	Total Recaptured	Percent Recaptured	Average Daily CFS
		Spring Chinook Subyearlings		
19-Oct-04	31	3	9.7	145
27-Oct-04	72	14	19.4	132
4-Nov-04	182	45	24.7	308
11-Nov-04	25	8	32.0	254
18-Nov-04	45	2	4.4	183
Total (mean)	355	72	(20.3)	(204)
		Wild Steelhead Parr		
19-Oct-04	20	1	5.0	147
4-Nov-04	49	12	24.5	308
Total (mean)	69	13	(18.8)	(228)
		Hatchery Coho Smolts		
8-Apr	76	3	3.9	821
28-Apr	200	7	3.5	826
5-May	172	7	4.1	1040
7-May	226	5	2.2	1140
10-May	194	9	4.6	674
13-May	108	3	2.8	609
18-May	163	9	5.5	1130
20-May	203	9	4.4	1000
Total (mean)	1342	52	(3.9)	(905)

Emigration Estimates

Spring Chinook Yearling (2002 Brood)

We did not find a significant relationship (p=0.64, r^2=0.039) between trap efficiency and stream discharge during the spring. A pooled efficiency of 3.9% was used for to generate the daily emigration estimate of yearling spring chinook between March 8th and June 16th. During the spring there were 7 days out of 103 when we did not operate the trap. Daily catch for days when the trap was inoperable was estimated by averaging the 2 previous and 2 following days. We estimate that 9084 (± 410 95%CI) yearling spring chinook emigrated from Nason Creek from March 8th through June 19th.

Spring chinook fry were not included in the population estimate nor were they used in any of the marked groups released for efficiency trials. Although fry were collected during the spring it is likely that they were displaced during high flow events or emerging from redds upstream in the vicinity of the trap and not actively emigrating from Nason Creek.

Subyearling Spring Chinook (2003 Brood)

The results of the linear regression of subyearling spring chinook trap efficiencies and stream discharge indicated that the relationship was not significant (p=0.26, r^2=0.39). A pooled trap efficiency of 20.3% was used to generate the daily emigration estimate. Due to high water conditions an debris we did not operate the trap 12 days out of 83 during the fall. The daily catch was estimated for the missing days by averaging the catch from the 2 previous and 2 following days. We estimate that 7899 (± 341 95%CI) subyearling spring chinook emigrated from Nason Creek between September 3rd and November 24th. The population estimate is conservative because subyearlings were likely moving downstream before we began operating the trap in September and the after the trap was removed due to weather conditions in November. The fall migration of subyearling chinook appeared to be initiated by a decline in water temperature and an increase in stream discharge (Figure 12 and 13).

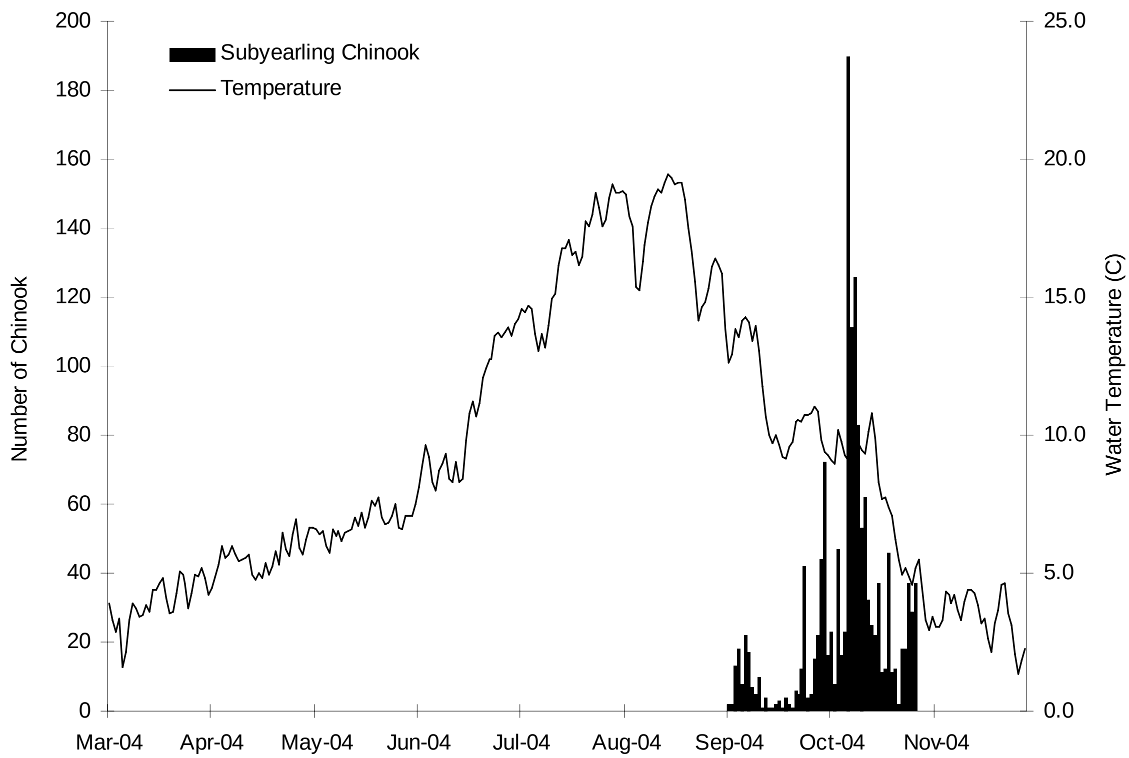

Figure 12. Stream temperature and the number of subyearling spring chinook emigrants at Nason Creek trap 2004.

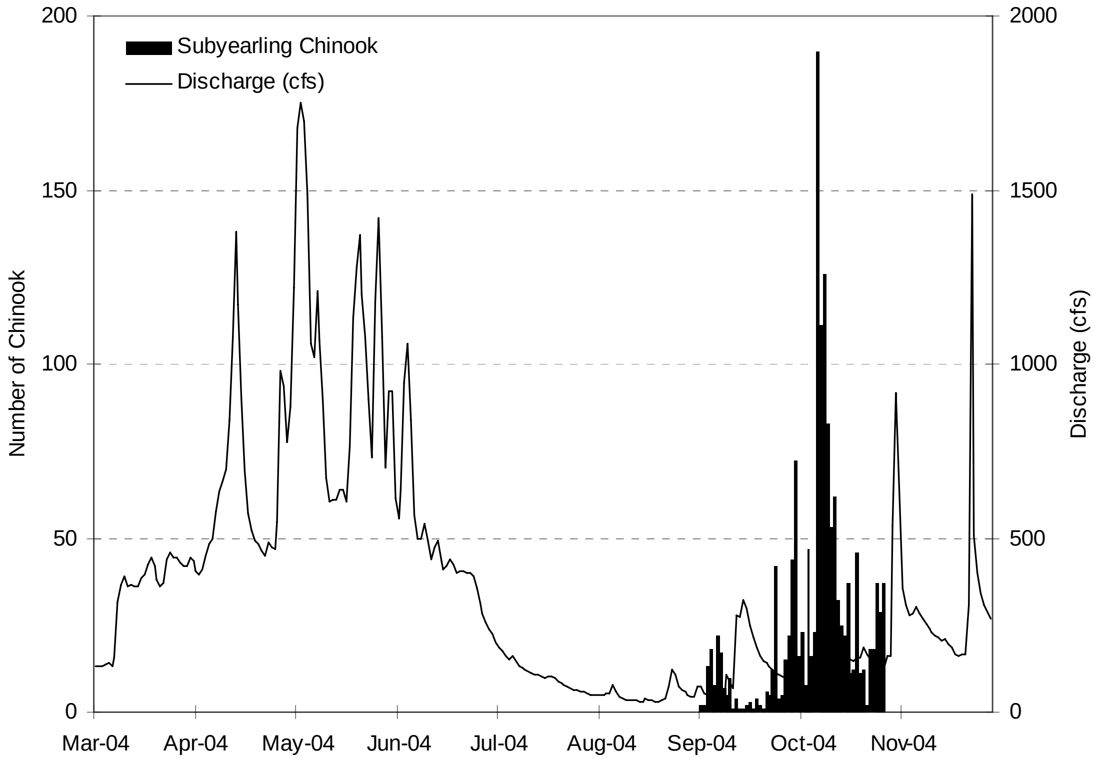

Figure 13. Stream discharge and the number of subyearling spring chinook emigrants at Nason Creek trap 2004.

<u>Steelhead Parr and Smolts</u>

Due to limitations of our trapping permit, only coho salmon could be used in efficiency trials during the spring. Using the pooled trap efficiency of 3.9% we estimate that 4955 (± 258 95%CI) steelhead smolts emigrated from Nason Creek between March 8th and June 19th.

.

We collected steelhead parr throughout the entire trapping period, spring and fall. We are unsure as to whether the parr were actively emigrating from Nason Creek, displaced during high water, or influenced by other environmental variables. Assuming the steelhead parr were emigrating, we estimate that 7742 (± 339 95%CI) passed the trap during spring operation between March 8th and June 19th.

During the fall, due to limited numbers of steelhead parr, we were only able to conduct two mark-recapture trials. We used a pooled trap efficiency, based on the two trials, of 18.8% to estimate the daily emigration. We estimate that 4071 (± 509 95%CI) steelhead parr emigrated from Nason Creek between September 3rd and November 24th.

Incidental Species

All of the fish species known to Nason Creek, except cutthroat trout, were represented in the trap catch: chinook salmon *Oncorhynchus tshawytscha*, steelhead trout and rainbow trout *Oncorhynchus mykiss*, coho salmon *Oncorhynchus kisutch*, mountain whitefish *Prosopium williamsoni*, redside shiner *Richardsonius balteatus*, sucker *Catostomus sp*, sculpin *Cottus sp*, and dace *Rhinichthys sp*,. Additionally, four juvenile northern pikeminnow *Ptychocheilus oregonensis* were captured in the fall. Hatchery chinook, steelhead, and coho were also caught. Incidental species were enumerated and sampled for length and weight as time allowed (Table 5).

Table 5. Number and fork length of incidental species collected in Nason Creek.

		Fork Length (mm)		
Species	**Total Captured**	**Mean**	**SD**	***N***
Bull trout	10	142	43.4	6
Hatchery Chinook	110	157	71.2	92
Hatchery Coho	6390	127	22.5	67
Dace	106	42	23	8
Redside Shiner	2	n/a	n/a	n/a
Sculpin	16	66	40.9	5
Hatchery Steelhead	979	187	30.3	89
Sucker	65	104	47.8	26
Northern pikeminnow	4	n/a	n/a	n/a
Whitefish	52	117	68.6	12

Discussion

This was the first year we operated the Nason Creek smolt trap for the purpose of generating population estimates for juvenile spring chinook and steelhead in Nason Creek. Data collection in the spring was focused on hatchery coho.

The juvenile freshwater life history of chinook resulted in the emigration of two brood years, yearling smolts in the spring and subyearling parr in the fall. A population estimate for a complete brood year (BY2003) will not be available until after the spring 2005 season.

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 will begin in spring 2005.

In 2005 we will continue to conduct mark-recapture trials with both chinook and steelhead. As more data is collected, we should be able to develop a model to correlate trap efficiency with stream discharge, resulting in a more accurate population estimate. Data from 2004 could be re-evaluated when efficiency curves for both steelhead and chinook are developed.

The emigrant population estimates, combined with ongoing egg deposition surveys, will allow fisheries managers to estimate egg to emigrant survival rates and emigrant-to-adult survival of Nason Creek spring chinook and steelhead. These population estimates are important tools to evaluate the effects of supplementation programs and long-term population trends in the Wenatchee River Basin.

Preliminary conclusions can be made from this year's data regarding emigration timing of spring chinook and steelhead within Nason Creek. There appear to be two distinct emigrations of spring chinook, a spring group of yearlings which overwintered and a subyearling group of migrants in the fall. This pattern is also seen in the Chiwawa River, another major tributary to the Wenatchee with a monitored spring chinook population (Murdoch et. al. 2001). It is unknown what proportion of Nason Creek chinook emigrate as subyearlings vs yearlings. In the Chiwawa River the ratio of yearlings to subyearlings varies each year. In 1993, Chiwawa River trapping data produced a total emigration estimate of 8,662 (37.6%) yearlings and 14,036 (61.0%) subyearlings. The following year the ratio was reversed with 16,472 (65.4%) yearlings and 8,595 (34.1%) subsyearlings (Murdoch et al. 2001). Factors which may influence whether a fish migrates as a subyearling or yearling may be a function of juvenile rearing densities, genetics, or environmental conditions.

Conclusions

This was the first year using a screw trap to estimate the production of juvenile spring chinook and steelhead in Nason Creek as part of an ongoing basin wide monitoring project.

- In 2004 the trap was operated from March 8th through June 19th with coho as the target species. Trapping operations were postponed during the summer due to lack of Section 10 permitting. Trapping resumed on September 3rd and continued through November 24th with spring chinook and steelhead as the target species.

- During spring trapping, 336 yearling (2002 brood) spring chinook were captured.

- During spring trapping, 1 steelhead fry, 172 steelhead smolts and 283 steelhead parr were captured.

- Trap efficiency during the spring averaged 3.9% from 8 trials with hatchery coho smolts.

- During fall trapping, 1,458 subyearling (2003 brood) spring chinook were captured.

- During fall trapping, 101 steelhead fry and 690 steelhead parr were captured.

- Trap efficiency during the spring averaged 20.3% for spring chinook and 18.8% for steelhead parr.

- There are two distinct emigrations of juvenile spring chinook in Nason Creek; subyearling parr emigrating in the fall and yearling smolts leaving the following spring.

- Nason Creek steelhead emigrate at different life stages, some as smolts in the spring and others as parr throughout the year.

References

Hillman, T.W. 2004. Monitoring strategy for the Upper Columbia Basin: Draft report February 1, 2004. Prepared for Upper Columbia Regional Technical Team, Wenatchee, Washington.

US Forest Service 1996. Nason Creek Stream Survey Report

Murdoch, A., and Peterson, K. 2000. Freshwater Production and Emigration of Juvenile Spring Chinook from the Chiwawa River in 2000. Washington State Department of Fish and Wildlife

Appendix A

Nason Creek mean daily stream discharge (cfs) and temperature (c) recorded at Rk 0.8, provided by Washington State Depart of Ecology (J. Peterson, pers. comm.).

Date	Average Daily CFS	Average Daily Temp C	Date	Average Daily CFS	Average Daily Temp C
3/1/2004	134	3.9	4/11/2004	841	5.5
3/2/2004	133	3.3	4/12/2004	1080	5.6
3/3/2004	133	2.9	4/13/2004	1380	4.9
3/4/2004	138	3.3	4/14/2004	1170	4.8
3/5/2004	140	1.6	4/15/2004	904	5.0
3/6/2004	133	2.1	4/16/2004	694	4.8
3/7/2004	156	3.3	4/17/2004	569	5.4
3/8/2004	316	3.9	4/18/2004	521	5.0
3/9/2004	366	3.7	4/19/2004	492	5.2
3/10/2004	388	3.4	4/20/2004	481	5.8
3/11/2004	363	3.5	4/21/2004	462	5.3
3/12/2004	368	3.9	4/22/2004	451	6.5
3/13/2004	360	3.6	4/23/2004	487	5.9
3/14/2004	361	4.4	4/24/2004	474	5.6
3/15/2004	383	4.4	4/25/2004	467	6.4
3/16/2004	396	4.6	4/26/2004	548	7.0
3/17/2004	426	4.8	4/27/2004	982	5.9
3/18/2004	443	4.1	4/28/2004	938	5.7
3/19/2004	419	3.5	4/29/2004	776	6.2
3/20/2004	379	3.6	4/30/2004	876	6.6
3/21/2004	362	4.3	5/1/2004	1220	6.6
3/22/2004	373	5.1	5/2/2004	1680	6.6
3/23/2004	437	5.0	5/3/2004	1750	6.4
3/24/2004	458	4.6	5/4/2004	1700	6.5
3/25/2004	445	3.7	5/5/2004	1490	6.0
3/26/2004	442	4.3	5/6/2004	1060	5.7
3/27/2004	427	5.0	5/7/2004	1020	6.6
3/28/2004	420	4.9	5/8/2004	1210	6.3
3/29/2004	421	5.2	5/9/2004	1070	6.5
3/30/2004	446	4.8	5/10/2004	896	6.2
3/31/2004	433	4.2	5/11/2004	674	6.5
4/1/2004	404	4.5	5/12/2004	607	6.5
4/2/2004	394	4.9	5/13/2004	608	6.6
4/3/2004	410	5.3	5/14/2004	609	7.0
4/4/2004	451	6.0	5/15/2004	638	6.7
4/5/2004	482	5.6	5/16/2004	640	7.2
4/6/2004	499	5.7	5/17/2004	605	6.6
4/7/2004	575	6.0	5/18/2004	764	7.0
4/8/2004	635	5.6	5/19/2004	1130	7.6
4/9/2004	664	5.4	5/20/2004	1280	7.5
4/10/2004	700	5.5	5/21/2004	1370	7.7

Date	Average Daily CFS	Average Daily Temp C	Date	Average Daily CFS	Average Daily Temp C
5/22/2004	1200	7.0	7/8/2004	146	13.1
5/23/2004	1080	6.7	7/9/2004	134	13.7
5/24/2004	900	6.8	7/10/2004	126	13.2
5/25/2004	731	7.0	7/11/2004	121	14.0
5/26/2004	1180	7.5	7/12/2004	115	14.9
5/27/2004	1420	6.7	7/13/2004	112	15.2
5/28/2004	1080	6.6	7/14/2004	105	16.2
5/29/2004	701	7.1	7/15/2004	106	16.8
5/30/2004	922	7.1	7/16/2004	102	16.8
5/31/2004	921	7.0	7/17/2004	98	17.1
6/1/2004	616	7.5	7/18/2004	103	16.5
6/2/2004	556	8.1	7/19/2004	104	16.6
6/3/2004	637	8.9	7/20/2004	98	16.2
6/4/2004	944	9.6	7/21/2004	90	16.5
6/5/2004	1060	9.2	7/22/2004	83	17.7
6/6/2004	841	8.3	7/23/2004	78	17.6
6/7/2004	568	8.0	7/24/2004	74	18.0
6/8/2004	498	8.7	7/25/2004	69	18.8
6/9/2004	498	8.9	7/26/2004	65	18.2
6/10/2004	543	9.3	7/27/2004	62	17.6
6/11/2004	492	8.4	7/28/2004	60	17.8
6/12/2004	438	8.3	7/29/2004	56	18.6
6/13/2004	472	9.0	7/30/2004	53	19.1
6/14/2004	492	8.3	7/31/2004	51	18.8
6/15/2004	433	8.4	8/1/2004	48	18.8
6/16/2004	409	9.8	8/2/2004	47	18.8
6/17/2004	420	10.8	8/3/2004	49	18.7
6/18/2004	440	11.2	8/4/2004	47	18.0
6/19/2004	424	10.7	8/5/2004	55	17.6
6/20/2004	399	11.1	8/6/2004	55	15.4
6/21/2004	403	12.0	8/7/2004	76	15.2
6/22/2004	406	12.5	8/8/2004	60	16.3
6/23/2004	402	12.7	8/9/2004	46	16.9
6/24/2004	399	12.8	8/10/2004	38	17.7
6/25/2004	388	13.6	8/11/2004	35	18.3
6/26/2004	354	13.7	8/12/2004	34	18.6
6/27/2004	314	13.5	8/13/2004	33	18.9
6/28/2004	285	13.7	8/14/2004	32	18.8
6/29/2004	260	13.9	8/15/2004	31	19.1
6/30/2004	240	13.6	8/16/2004	32	19.5
7/1/2004	223	14.0	8/17/2004	37	19.3
7/2/2004	200	14.2	8/18/2004	35	19.1
7/3/2004	185	14.6	8/19/2004	34	19.1
7/4/2004	175	14.4	8/20/2004	32	19.2
7/5/2004	159	14.7	8/21/2004	29	18.5
7/6/2004	152	14.6	8/22/2004	33	17.5
7/7/2004	163	13.7	8/23/2004	41	16.6

Date	Average Daily CFS	Average Daily Temp C	Date	Average Daily CFS	Average Daily Temp C
8/24/2004	73	15.6	10/10/2004	78	8.6
8/25/2004	122	14.2	10/11/2004	78	9.0
8/26/2004	108	14.6	10/12/2004	82	9.7
8/27/2004	73	14.8	10/13/2004	77	9.5
8/28/2004	63	15.3	10/14/2004	77	9.3
8/29/2004	59	16.1	10/15/2004	71	10.1
8/30/2004	51	16.4	10/16/2004	79	10.8
8/31/2004	45	16.2	10/17/2004	122	9.9
9/1/2004	43	15.9	10/18/2004	166	8.3
9/2/2004	73	13.8	10/19/2004	153	7.7
9/3/2004	71	12.6	10/20/2004	147	7.8
9/4/2004	55	13.0	10/21/2004	155	7.4
9/5/2004	48	13.8	10/22/2004	154	7.1
9/6/2004	45	13.6	10/23/2004	186	6.2
9/7/2004	38	14.2	10/24/2004	164	5.5
9/9/2004	38	14.1	10/25/2004	151	4.9
9/8/2004	35	14.3	10/26/2004	142	5.2
9/10/2004	40	13.4	10/27/2004	135	4.9
9/11/2004	108	14.0	10/28/2004	132	4.6
9/12/2004	88	13.1	10/29/2004	128	5.2
9/13/2004	70	11.8	10/30/2004	163	5.5
9/14/2004	276	10.7	10/31/2004	159	4.4
9/15/2004	272	10.0	11/1/2004	539	3.3
9/16/2004	321	9.7	11/2/2004	918	2.9
9/17/2004	298	10.0	11/3/2004	637	3.4
9/18/2004	247	9.7	11/4/2004	356	3.1
9/19/2004	216	9.2	11/5/2004	308	3.1
9/20/2004	186	9.2	11/6/2004	279	3.3
9/21/2004	162	9.5	11/7/2004	284	4.3
9/22/2004	148	9.8	11/8/2004	301	4.2
9/23/2004	142	10.5	11/9/2004	282	3.9
9/24/2004	131	10.6	11/10/2004	269	4.2
9/25/2004	122	10.5	11/11/2004	254	3.7
9/26/2004	114	10.7	11/12/2004	239	3.3
9/27/2004	107	10.7	11/13/2004	227	4.0
9/28/2004	101	10.8	11/14/2004	220	4.4
9/29/2004	96	11.1	11/15/2004	214	4.4
9/30/2004	91	10.8	11/16/2004	204	4.3
10/1/2004	86	9.8	11/17/2004	208	3.8
10/2/2004	82	9.4	11/18/2004	193	3.2
10/3/2004	79	9.3	11/19/2004	183	3.4
10/4/2004	76	9.1	11/20/2004	167	2.6
10/5/2004	73	9.0	11/21/2004	160	2.1
10/6/2004	76	10.2	11/22/2004	164	3.2
10/7/2004	82	9.8	11/23/2004	167	3.6
10/8/2004	75	9.3	11/24/2004	308	4.6
10/9/2004	78	9.1	11/25/2004	1490	4.6

Date	Average Daily CFS	Average Daily Temp C
11/26/2004	509	3.5
11/27/2004	401	3.1
11/28/2004	341	2.1
11/29/2004	308	1.4
11/30/2004	289	1.8
12/1/2004	267	2.3
11/26/2004	509	3.5
11/27/2004	401	3.1
11/28/2004	341	2.1
11/29/2004	308	1.4
11/30/2004	289	1.8
12/1/2004	267	2.3