ASSESS SALMONIDS IN THE ASOTIN CREEK WATERSHED

2007 ANNUAL REPORT

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Abstract

The goal of this project is to assess the status of anadromous salmonid populations in Asotin Creek above George Creek. This research, monitoring and evaluation project provides estimates of abundance, productivity, survival rates, and temporal and spatial distribution of ESA-listed species: Summer steelhead *Oncorhynchus mykiss* and spring Chinook salmon *O. tshawytscha*. Adult salmonids entering Asotin Creek to spawn were enumerated using a floating, resistance board weir. The juvenile emigrant population was estimated using a rotary screw (smolt) trap. In 2007 (the third season of adult trapping in Asotin Creek), two hundred and ninety-four (294) adult steelhead were captured, resulting in a population estimate of 342 adults, which is a significant decrease from the previous two years. A substantially greater number of hatchery stray steelhead (17.5%) were identified this year than in previous years. There were two hundred and sixty-nine (269) redds in the 46 kilometers of spawning habitat above the adult trapping site in 2007, which generated an estimate of 0.64 females per redd. The juvenile steelhead population was estimated at 50,375 (95% CI = 43,517 – 59,289 juveniles) from the combined spring and fall out-migrations in 2007. Thirteen paired smolt trap efficiency tests with fin-clipped and PIT-tagged fish indicated a significant difference (p=0.048) in capture efficiencies between the two mark types. Passive integrated transponder tagging of out-migrating juvenile steelhead in 2007 indicated that only 3.1% of the age 1 fish were detected at a mainstem dam during the 2007 outmigration year, while 46.3% and 52.3% of the age 2 and age 3 fish were detected, respectively. In addition, 1,173 juvenile spring Chinook salmon were captured in 2007, resulting in a population estimate of 2,553 individuals. This report also provides a multi-year data comparison of project data collected to date: three years of adult steelhead data from 2005, 2006 and 2007, and four years of juvenile steelhead data from 2004, 2005, 2006 and 2007. These data have described a persistent steelhead population, which is variably affected by stray hatchery steelhead, but remains large for a subbasin its size when compared to other steelhead populations in the Columbia Basin. The Asotin Creek steelhead population is possibly at or above Viable Salmonid Population thresholds. These facts make it a potentially desirable control/reference stream population for evaluation of supplementation effectiveness monitoring; a critical unknown within the Columbia basin.

Table of Contents

Introduction

All populations of anadromous salmonids in the Snake River have been listed as threatened under the Endangered Species Act (ESA) by the National Marine Fisheries Service, including steelhead *Oncorhynchus mykiss* and spring/summer Chinook salmon *O. tshawytscha*. Bull trout *Salvelinus confluentus* have been listed as threatened by the U.S. Fish and Wildlife Service. Historically, Asotin Creek is known to have supported summer steelhead, spring Chinook salmon, fall Chinook salmon, bull trout, and lamprey sp. *Petromyzontidae* populations. Some limited, but continuous, efforts have been made to assess salmonid populations in the subbasin since 1984 (M. Schuck, pers. comm.). The Washington Department of Fish and Wildlife (WDFW) designated the Asotin Creek subbasin a wild steelhead refuge in 1997, and no hatchery fish have been planted in Asotin Creek since 1998.

Critical uncertainties must be answered if salmonid populations are to recover and be de-listed. Such uncertainties may include habitat/life history stage relationships, causal relationships between degraded habitats and depressed or extirpated populations, and understanding the relationship between resident and anadromous *O. mykiss* subpopulations (ASP 2004). Critical uncertainties for the Asotin Creek Subbasin include: 1) Is the steelhead population parent-to-progeny ratio above replacement? 2) How can fisheries managers intervene to rebuild steelhead populations that may be at marginally successful productivity above eight Federal Columbia River Power System (FCRPS) dams (ASP 2004)? Whether a wild population above eight mainstem dams can be recovered through habitat and mainstem actions and without hatchery supplementation is a critical uncertainty that has basin-wide relevance. Moreover, measuring the effects of recovery actions on these populations is extremely difficult due to out-of-subbasin-effects on anadromous salmonids (e.g., hydrosystem operational changes, ocean survival, and between year environmental conditions).

The genetic nature of naturally-produced (presumed wild origin) salmonids in the Snake River Basin is a critical concern under the ESA. This project provides the opportunity to contribute tissue samples to regional efforts to better describe steelhead and bull trout population structure, and potentially to determine the origin of spring Chinook salmon that are spawning in Asotin Creek. Samples from this project, coupled with genetic sampling in adjacent subbasins, will aid in understanding the effect of lower Snake River hatchery supplementation programs and describe population genetic similarities and differences for recovery planning efforts.

This project was implemented under reasonable and prudent alternative (RPA) 180 in the NMFS 2000 and Action 180 in the 2004 FCRPS Biological Opinions (BiOp) for hierarchical basin-wide measurement. The Asotin Creek Assessment Project was selected by the Bonneville Power Administration (BPA), the Northwest Power Planning Council (NPPC) and the Independent Science Review Panel (ISRP) for implementation in 2002, with full funding beginning in 2004.

The WDFW and the NOAA Fisheries Interior Columbia Technical Recovery Team (TRT) considers the population of spring Chinook salmon to be functionally extinct in Asotin Creek. However, 1,884, 219 and 1,035 juvenile Chinook salmon were captured in 2004, 2005 and 2006, respectively, providing estimates of 4,145, 319 and 2,358 juvenile Chinook salmon emigrating from Asotin Creek (Mayer and Schuck 2004; Mayer, et al., 2005, 2006). The data suggest that spring Chinook salmon can spawn successfully in Asotin Creek, but there are currently few adults spawning in Asotin Creek and their origin is unknown.

Despite the functional extirpation of spring Chinook salmon and depressed status of bull trout, there is currently a significant population of naturally producing steelhead in Asotin Creek. We captured 8,506 juvenile steelhead in 2004, 7,214 in 2005 and 5,829 in 2006 (Mayer and Schuck 2004; Mayer, et al., 2005, 2006). The estimated population of juvenile steelhead for 2004 was 45,744, 27,287 for 2005 and 36,568 for 2006, which was an average of 36,533 juveniles, or about 794 juveniles per river kilometer (rkm) above the trapping site.

The goal of this project is to determine the abundance and current productivity of anadromous adult and juvenile salmonids in Asotin Creek (primarily summer steelhead) above George Creek and to estimate life stage survival rates. Under the ESA, the TRT and NOAA Fisheries, have included other small adjacent Snake River tributaries (Couse, Tenmile, Alpowa and Almota creeks) as part of the overall Asotin Steelhead population. There is no effort under this project to sample these small populations.

This project also implements the research, monitoring and evaluation (RM&E) criteria specified in the Asotin Subbasin Plan (ASP 2004), by establishing a baseline of the salmonid population in Asotin Creek, above George Creek. The project provides estimates of abundance, productivity, survival rates, and additional information on temporal and spatial distribution of ESA-listed species, primarily summer steelhead, and secondarily on spring Chinook salmon. In addition, this project will document the abundance of bull trout captured at the trapping locations. Future estimates of smolt-to-adult and adult-to-adult survival for the natural steelhead population in Asotin Creek will provide the data necessary to help determine if salmonid production in the subbasin is being limited by within- or out-of-basin factors.

The objectives for this project are:

- Objective 1: Estimate escapement of wild and hatchery steelhead and Chinook salmon into Asotin Creek, above George Creek.

- Objective 2: Estimate spawner abundance and adults per redd.

- Objective 3: Document juvenile steelhead life history patterns, survival rates and estimate juvenile emigrant production.

- Objective 4: Collect DNA samples for future genetic characterization of focal species.

- Objective 5: Report and disseminate Asotin Creek salmonid assessment data.

The expanded population baseline data collected for summer-run steelhead in the Asotin Creek Subbasin under this project are needed to refine fish return and management goals, and to assist in the establishment of future numeric fish population goals as outlined in the Subbasin Plan (ASP 2004). Moreover, the relatively high abundance and productivity of Asotin Creek steelhead is significant within the Snake and Columbia River basins. As such, this population can be used as a reference for the evaluation of the effects of hatchery supplementation on other steelhead populations (Galbreath et al., 2006). Such evaluations are of great interest to managers in their attempts to understand how best to recover ESA-listed species, and will require unsupplemented populations to serve as a control/reference, if robust supplementation evaluation results are expected (Galbreath et al., 2007).

Description of Project Area

The Asotin Creek Subbasin is located in the southeast corner of Washington and drains about 84,000 hectares of the northeast corner of the Blue Mountains. Asotin Creek is a third order tributary of the Snake River, joining it at the town of Asotin (Figure 1). Asotin Creek has two major watersheds: The mainstem and George Creek. The mainstem (above George Creek) drains about 48,000 hectares (118,000 acres) and is the area of focus for this project. Major tributaries of the mainstem include Charley Creek, North Fork, South Fork, and Lick Creek. George Creek drains about 36,000 hectares (89,000 acres).

Much of Asotin Creek and its tributaries have been straightened, diked or relocated. Many habitat restoration projects have been completed or are on-going in the Asotin Creek watershed with state (Salmon Recovery Funding Board, Washington Conservation Commission) and federal (BPA) funding. Almost $7 million has been allocated to the watershed to address habitat problems, focusing mainly on habitat restoration (M. Stewart, Asotin County Conservation District (ACCD), pers. comm.).

United States Geological Survey (USGS) records from 1929 to 1960 indicate a mean annual flow of 2.1 cms (74 cfs) above Headgate Dam (at rkm 14.5) in Asotin Creek. Normal low flow in late summer is from 0.4 – 0.85 cms (15-30 cfs). Normal high flow in the spring and early summer (February to June) is from 5.67 – 11.3 cms (200- 400 cfs). Riparian conditions in the Asotin Creek Subbasin have varied historically by location and land use. However, with the implementation of the Asotin Creek Model Watershed Plan beginning in 1996 (ACCD, 1994), and related riparian restoration projects undertaken by agencies and local landowners, most of the riparian zone above the trap site has been protected and restored. More than 90% of the riparian areas have been fenced and are protected from concentrated livestock grazing (B. Johnson, Asotin County PUD, pers. comm.).

The WDOE classifies Asotin Creek basin and its tributaries as Class A (excellent) surface waters, and waters within the National Forest in the subbasin are considered Class AA (extraordinary) surface waters. Selected salmon and steelhead habitat is excluded from consideration under this project: Primarily within the George Creek basin, which drains into Asotin Creek near rkm 4.6, and the mainstem below the mouth of George Creek. However, 23-46 km are regularly surveyed by WDFW, which is the area of focus for the work being conducted under this project.

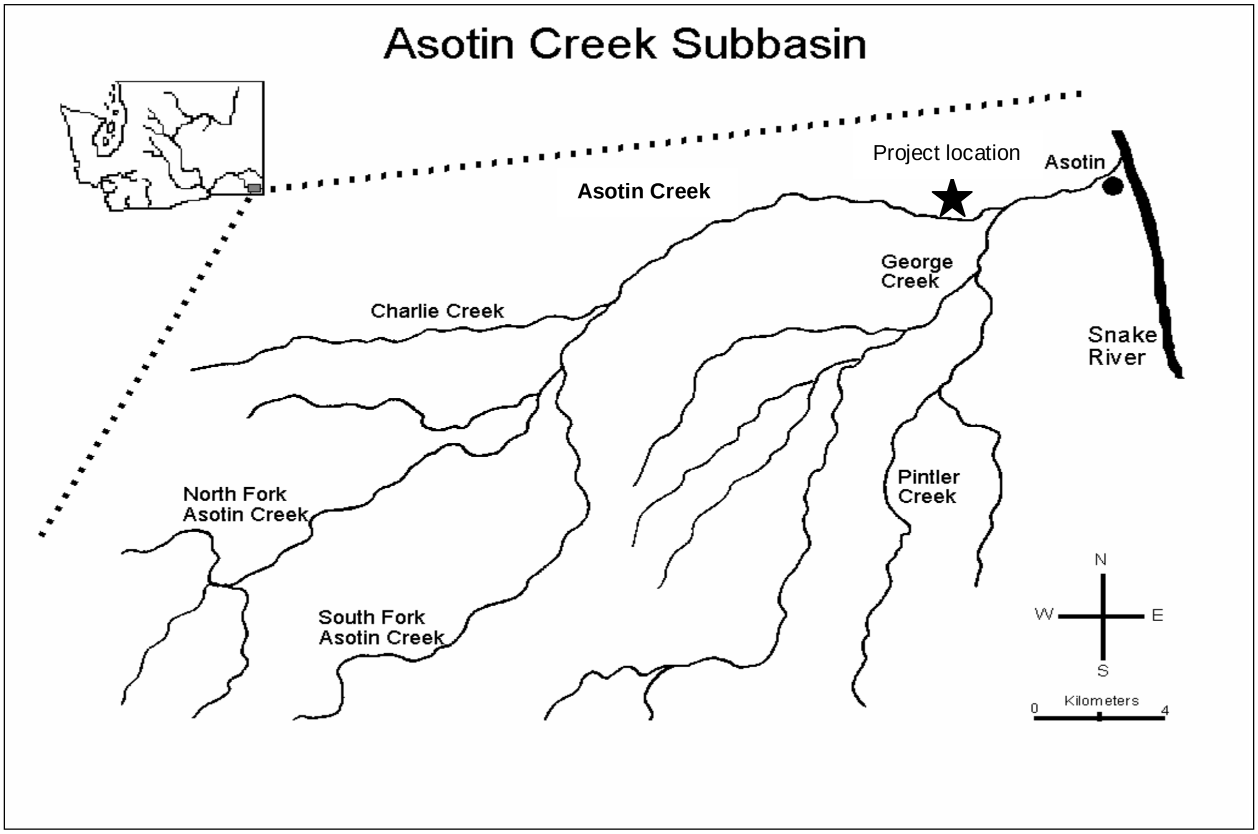

Figure 1. The Asotin Creek Subbasin in Southeastern Washington.

Methods and Materials

Objective 1: Estimate escapement of wild and hatchery steelhead and Chinook salmon into the Asotin Creek watershed, above George Creek. A 6.1 meter (m) x 6.4 m resistance board floating weir, made of high-density polyethylene (HDPE), with two 1.8 m x 1.2 m x 1.1 m aluminum adult salmonid traps were placed in Asotin Creek near river km 7.0. One trap was used to capture adult pre-spawners and the second trap was used to capture post-spawned steelhead (kelts). A third, "pass-through" trap is also integrated into the weir to assist in the capture of kelts. The 2007 adult trapping season was from early-January to late-May. When not in use, sections of the adult traps were disabled to allow unrestricted passage upstream and downstream.

When the adult trap was operating, the trap operated 24-hours a day and was checked once or more daily, depending on stream flow, debris or number of fish present. Data collected from adult salmonids included: Number, species, origin, sex, fork length, scales for determining age at spawning, freshwater and ocean ages, and numbers of repeat spawners, and DNA samples. All adult salmonids were tagged with a colored, numbered Floy® anchor tag.

Sight surveys of Floy-tagged adults were conducted on a 1.7 km river reach below the adult trap to assess fallback, between March and the end of May. Sight surveys were also conducted above the trap to assess trap efficiency/leakage.

Adult steelhead population estimate

To provide the best estimate of spawners above the weir, the population was first stratified by sex. The return rate for each sex was independently calculated as:

$$\hat{P}_R = \frac{R_M}{M}$$

Where:

P_R = The proportion of the population that returned to the weir,
R_M = The number of marked fish that returned to the weir, and
M = The number of marked fish that passed above the weir.

The number of unmarked fish above the weir was estimated as:

$$\hat{U} = \frac{R_U}{\hat{P}_R}$$

Where:

U = The number of unmarked fish above the weir, and
R_U = The number of unmarked fish that returned to the weir

The estimated number for each sex above the weir was then calculated as:

$$\hat{P} = \hat{U} + M$$

Where:

$\hat{P}$ = The population of available spawners above the weir.

Population estimates for each sex were added together to yield an estimate of the total number of potential steelhead spawners above the weir, above George Creek.

Objective 2: Estimate spawner abundance and adults per redd. When creek conditions allowed, sight surveys for Floy-tagged adults were conducted on index reaches covering at least 50% of the spawning areas above the adult trap, to verify spawner abundance, estimate escapement, assess trap efficiency, and to estimate the number of adults per redd between March and the end of May. Index area counts and redd visibility duration (redd life) were used to estimate total number of redds. Redd life estimates were calculated from surveyors' observations in index areas over the course of the season, and applied to final survey walks for all reaches. Reaches not part of index areas were walked once at the end of the survey/spawning season. (Note: This work was conducted jointly with funds/personnel from this project and from LSRCP funds for southeast Washington).

Objective 3: Document juvenile steelhead life history patterns, survival rate and smolt production in the Asotin Creek watershed, above George Creek. The smolt trapping procedures used in the Asotin Creek project are similar to those used on the Tucannon River (Gallinat *et al*. 2003; Bumgarner *et al*. 2000). Statistical procedures were conducted using software developed by the University of Idaho and Idaho Department of Fish and Game (Steinhorst and Kline, 2006) for estimating emigrants with a rotary smolt trap. A brief description of these methods follows.

To estimate the number of emigrating juvenile salmonids, a 1.52 meter (m) rotary screw (smolt) trap was placed in Asotin Creek in 2007 near river km 7.0 in March. The spring trapping season was from early-March to late-June. The fall trapping season was from early-October to late-December (2007)/early-January (2008). The beginning and end of each juvenile trapping season was established when the average catch was less than five juveniles per day over a 5-day period.

When the smolt trap was operating, the trap operated 24-hours a day, 7 days a week, and was checked daily. Data collected from juvenile salmonids included: Number, species, length, weight, scales for age structure and age at migration. Body condition factor (K) was calculated as a measure of general health of migrants and was calculated as:

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

About 30% of the spring juvenile steelhead, in two size categories: 82-124 mm and >125 mm, were tagged with 12 mm passive integrated transponder (PIT) tags, which were also used for scale sampling. PIT tag data from Asotin Creek were uploaded to the PTAGIS database.

Scale samples were collected from about 30% of the spring juvenile steelhead to estimate the age composition of emigrants. The goal was to collect about 1,550 readable scales from about 2,000 fish (assuming a 78% readable scale rate based on data from 2004, 2005 and 2006), to provide an estimate of age at migration. Random scale samples were also collected on Chinook salmon to verify age. All scale samples were handled according to WDFW protocols. WDFW personnel made age determinations by counting annuli as described by Jearld (1983).

Trap efficiency testing was done at least once, but usually twice, a week. Fish used for trap efficiency testing were tagged with a 12 mm passive integrated transponder (PIT) tags or fin clipped for identification. The size of juvenile steelhead used for trap efficiency testing corresponded with the two size categories used for PIT tagging (82-124 mm and >125 mm).

Test groups for capture efficiency of at least 10 fish were anesthetized and marked by clipping a small portion of the upper or lower lobe of the caudal fin. Test fish were allowed to recover from the effects of anesthesia before being released back into the creek about 200 m above the smolt trap in an area of quiet water. This location is close enough to minimize predation loss, but far enough away from the trap to allow the fish to distribute naturally in the creek following release. Recapture data were collected and capture (trap) efficiencies were calculated, based on the following equation:

$$p = r/m;$$

Where p is the estimated trap efficiency (percent), r is the number of marked fish recaptured, and m is the total number of fish marked and released for the trap efficiency test.

Juvenile steelhead population estimate

Juvenile population estimates with 95% confidence intervals were generated using a stratified Bailey-modified Lincoln-Peterson estimator with bootstrap confidence intervals, as follows:

$$\hat{N}_i = \frac{c_i}{\hat{p}_i}$$

Where N is the number of emigrating fish, and c is the number of fish captured in the trap.

And for each stratum:

$$\frac{1}{\hat{p}_i} = \frac{m+1}{r+1}$$

The number of bootstrap iterations was set at 1,000. Steinhorst, et al. (2004) states that seven or more recaps are necessary to provide reasonably unbiased estimates and confidence interval coverage. Therefore, for efficiency tests that did not produce the required minimum number of recaptured fish, data were collapsed and combined with similar, nearby test periods (thereby reducing the total number of strata) to meet this criterion.

Objective 4: Genetic sampling. DNA samples were collected from migrating adult steelhead to help determine the genetic status of naturally-producing steelhead and to determine if hatchery fish have significantly altered (or contributed to) the Asotin Creek stock. DNA was also collected from Chinook salmon and bull trout when captured. Genetic samples were archived and will be sent to the WDFW genetics lab, or other regional labs, for future analysis.

Objective 5: Deliverables. Annual report. The Annual Report includes an abstract, introduction, description, methods, results, discussion, summary and references.

Results and Discussion

Adults

Steelhead

The 2007 adult salmonid trapping season started on January 4, 2007, and was the third season of adult trapping on Asotin Creek. The adult trapping season was 20 weeks long and ended on May 21, 2007.

We captured 294 adult steelhead in 2007. The majority (82.3%) of the adults (198 wild and 44 hatchery fish) were captured as pre-spawners during their upstream migration (Figure 2). The remainder (43 wild and 9 hatchery fish) were captured as post-spawned adults (kelts).

We estimated a population of 342 adult steelhead spawning in 46 km of accessible steelhead habitat above the trapping location in 2007. Two hundred and eighty-three (82.5%) naturally-produced fish [147 females and 135 males] and 60 (17.5%) hatchery fish [26 females and 34 males] were estimated to have spawned above rkm 7.0. The sex ratio of wild adult steelhead, based on the number of pre-spawning adults captured in 2007, was 52.0% females to 48.0% males. The sex ratio of hatchery-origin adult steelhead, based on the number of pre-spawning adults captured in 2007, was 34.1% females to 65.9% males.

Run timing of the 2007 adult steelhead spawning migration was based on the estimated adult wild and hatchery origin steelhead captured as pre-spawners (Table 1). Wild males migrated upstream past the trapping location an average of seven days earlier in the spawning season than females. Fifty-four percent of the wild pre-spawners and 54.6% of the hatchery pre-spawners were re-captured as kelts (marked and unmarked returns) at the weir location upon their out-migration following spawning (Figure 3).

Table 1. Run timing of adult steelhead captured at the weir during the 2007 trapping season.

Run Timing	Entire Run	Male	Female
First capture	1/4/07	1/4/07	2/7/05
50% at weir	3/20/07	3/18/07	3/23/07
75% at weir	4/5/07	3/30/07	4/6/07
90% at weir	4/23/07	4/17/07	4/27/07

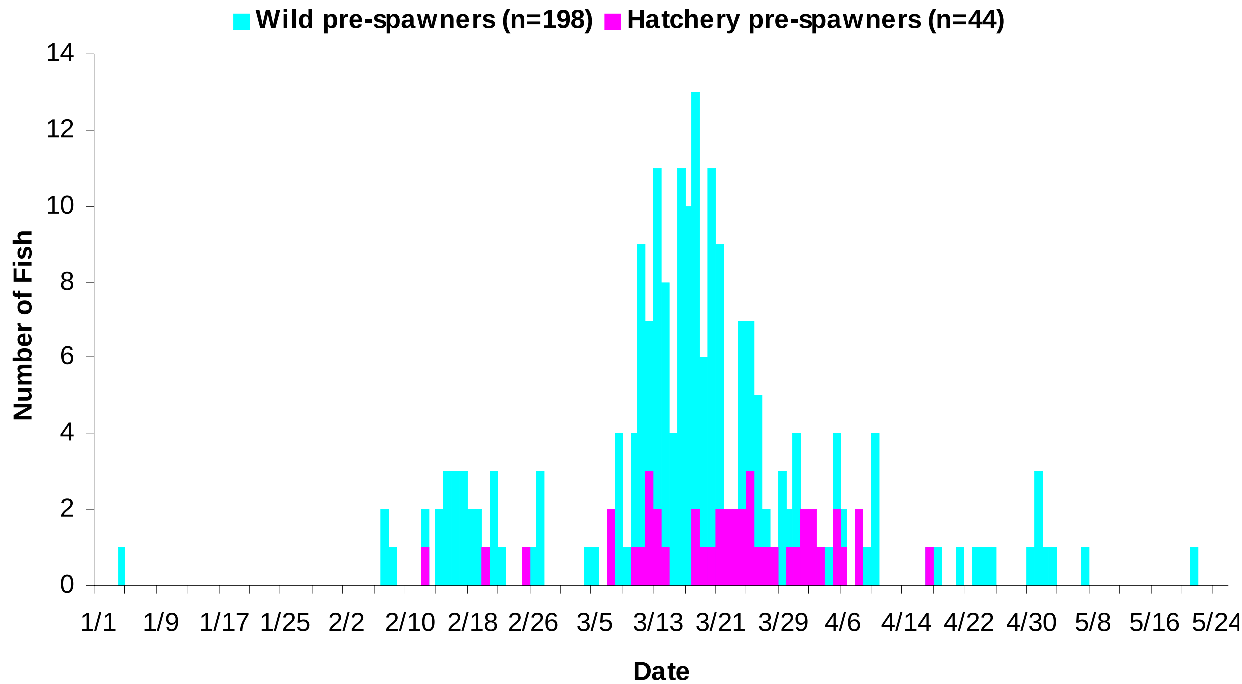

Figure 2. Daily catch of pre-spawning steelhead by origin at the Asotin Creek weir in 2007.

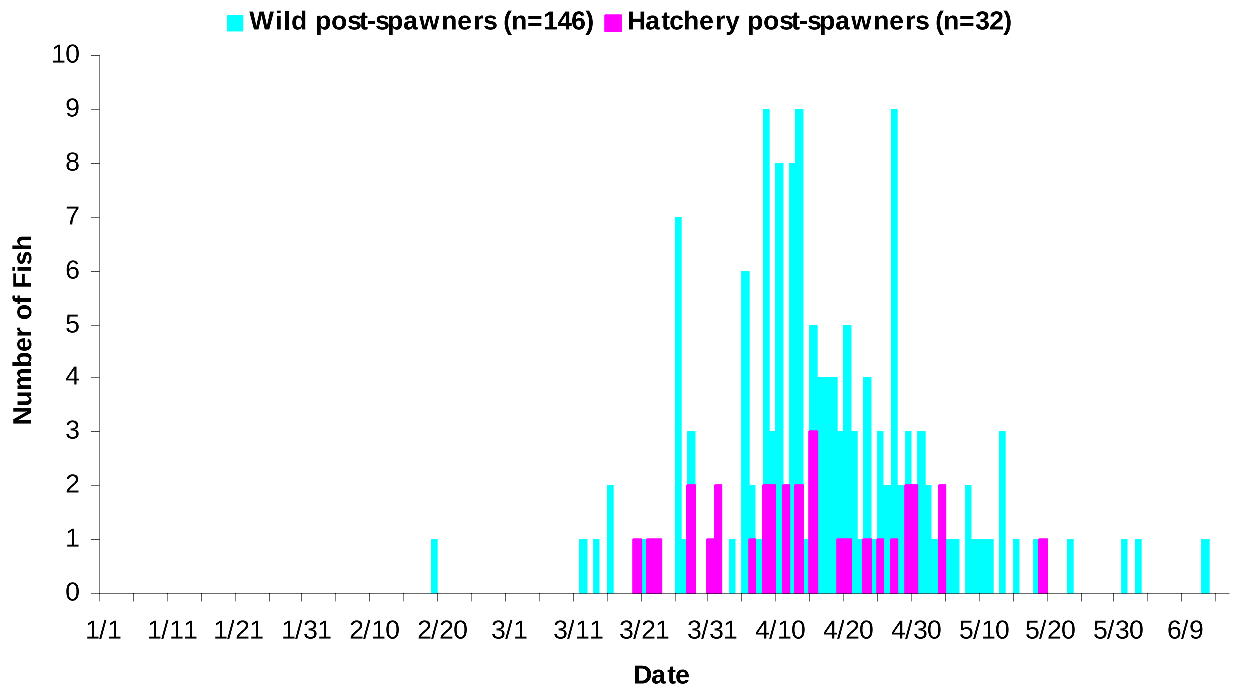

Figure 3. Daily catch of post-spawning steelhead by origin at the Asotin Creek weir in 2007.

Almost two-thirds (64.4%) of all marked females (66.0% wild and 53.3% hatchery females) returned and were captured at the weir after spawning in 2007. Fewer (44.4%) marked males (41.1% wild and 55.2% hatchery males) were recaptured as kelts. Summary statistics for wild and hatchery, male and female residence time above the weir are provided in Table 2.

Table 2. Summary statistics of days spent above weir for adult females and males in 2007.

	Wild			**Hatchery**		
Statistic	Female	Male	Total	Female	Male	Total
N (sample size)	68	39	107	8	16	24
Median Days Up	18.5	40	24	14	16	15
Mean Days Up	21.7	38	27.6	20.3	23.1	22.1
Std Dev (days)	14.7	21.9	19.2	11.3	20.4	17.7

We collected scale samples from 99.7% of all adult steelhead captured at the weir. Adult and juvenile scale age data indicate that juveniles leave the subbasin (or the Columbia River basin) at ages 1 to 4 and return as adults after 1 or 2 years in the ocean (Table 3). The proportion of wild female repeat spawners was 1.5% in 2007. There were no male repeat spawners.

Table 3. Total age of adult steelhead captured at the weir during the 2007 trapping season.

Total Age	**Wild**		**Hatchery**		**Total**	
(years)	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
2	4	2.7%	38	86.4%	42	21.6%
3	49	32.7%	6	13.6%	55	28.4%
4	91	60.7%	-	-	91	46.9%
5	6	4.0%	-	-	6	3.1%
Unreadable	91	37.8%	9	17.0%	100	34.1%
Total	241	-	53	-	294	-

In 2007, most wild females (65.2%) returned to spawn the first time after spending 2 years in the ocean (Figure 4). The rest (34.8%) returned after one year in the ocean (Table 4). A majority of wild male steelhead (56.9%) returned after spending one year in the ocean, while 43.1% of the wild males returned after two years in the ocean (Figure 5). There were no ocean age 3 spawners. Mean adult steelhead lengths by ocean age, origin and sex are presented in Table 5. Ocean age 2 females were an average of 13.3% (9.2 cm) longer than ocean age 1 females. Ocean age 2 males were an average of 18.7% (10.9 cm) longer than ocean age 1 males.

Three wild females died prior to spawning and were checked for fecundity (Table 6). The mean fecundity of females was 4,479 eggs (range = 3,427-5,608). There were two repeat spawners in 2007, which were 67 and 68 cm in length.

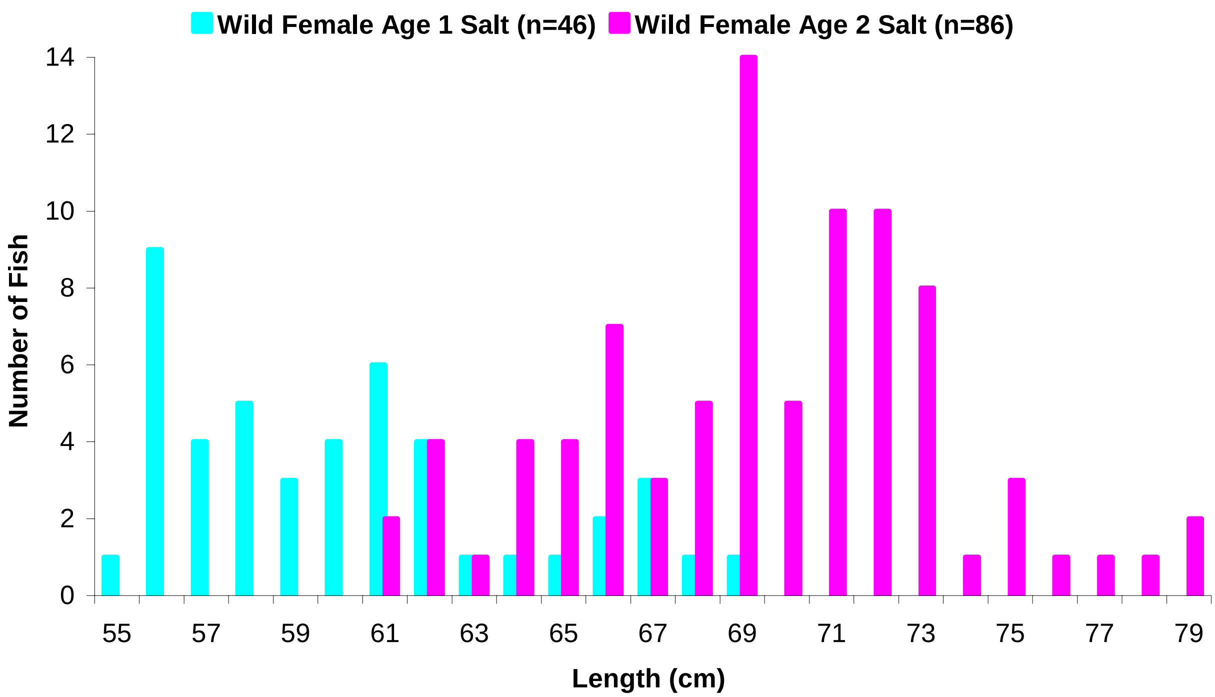

Figure 4. Length distribution of wild adult female steelhead by ocean age spawning in 2007.

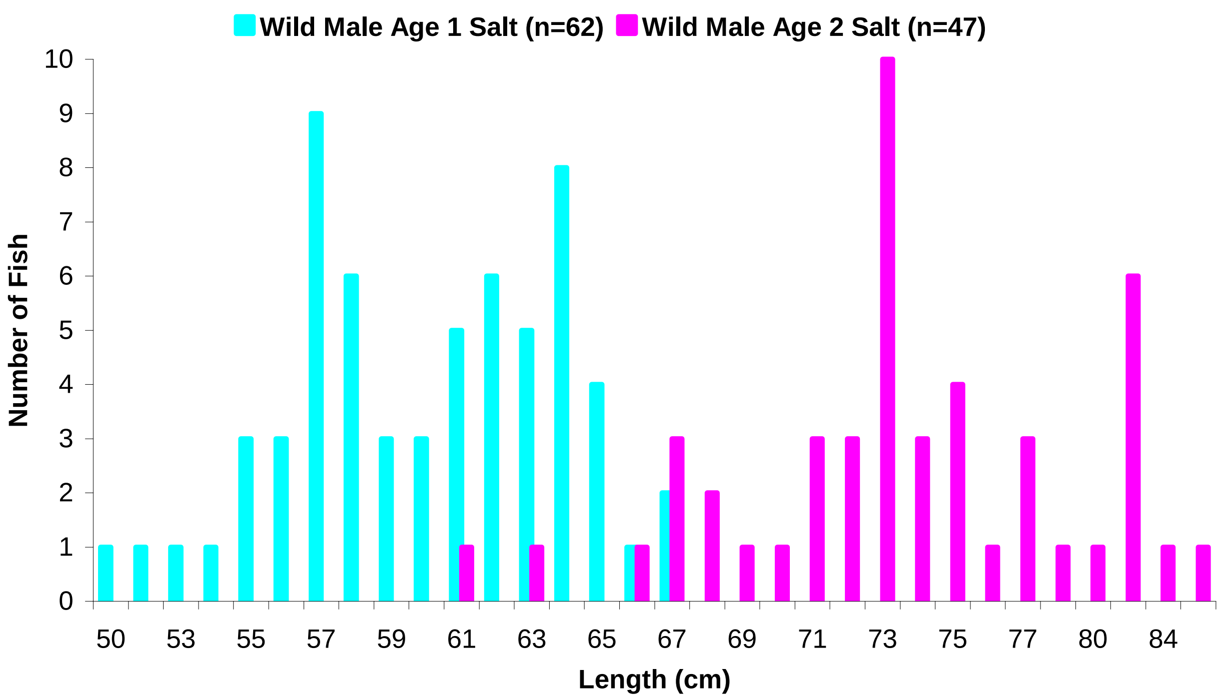

Figure 5. Length distribution of wild adult male steelhead by ocean age spawning in 2007.

Table 4. Age composition of adult (wild and hatchery) steelhead captured in 2007 by sex and origin. The percentage of each age class and percentage of unreadable scales is included.

Origin	Age (Fresh.Ocean)	Female Number	Female Percent	Male Number	Male Percent	Total Number	Total Percent
Wild	1.1	1	0.5%	3	4.6%	4	2.7%
	1.2	3	2.9%	1	1.5%	4	2.7%
	2.1	23	22.1%	23	35.4%	46	30.6%
	2.2	45	63.5%	27	41.5%	72	48.0%
	3.1	8	3.8%	11	16.9%	19	12.7%
	3.2	5	7.2%	0	0%	5	3.3%
	Total	85	100.0%	65	100.0%	150	100.0%
	Unreadable	47	35.6%	44	40.4%	91	38.1%
Hatchery	1.1	13	76.5%	25	43.5%	38	56.4%
	1.2	4	23.5.8%	2	47.8%	6	35.9%
	Total	17	100.0%	27	100.0%	44	100.0%
	Unreadable	4	12.9%	4	19.1	8	15.4%

Table 5. Mean fork length of adult steelhead captured in 2007. Lengths are given in centimeters by ocean age, sex and origin.

Origin	Ocean Age	Length Measurement	Female	Male	Combined
Wild	1	N (sample size)	46	62	108
		Fork length	60.2	60.1	60.1
		Std. Dev.	3.8	3.9	3.9
	2	N	86	47	133
		Fork length	69.4	73.9	71.0
		Std. Dev.	4.0	5.5	5.1
Hatchery	1	N	16	27	43
		Fork length	57.7	59.0	58.5
		Std. Dev.	2.7	3.1	3.0
	2	N	4	7	7
		Fork length	68.0	76.0	71.4
		Std. Dev.	2.9	5.4	5.4

Table 6. Fork length, age and fecundity (eggs) of three steelhead from Asotin Creek in 2007.

Date Sampled	Fork Ln. (cm)	Ocean Age	Total Age	Fecundity (# Eggs)
3/11/07	74	2	4	4,402
3/15/07	72	2	5	5,608
3/22/07	55	1	-	3,427

Of the 53 hatchery-origin spawners, 51 (96.2%) had external marks (i.e., fin clips, tags, etc.). Carcasses were recovered from 18 (34.0%) of the hatchery-origin spawners, and 16 of those had coded wire tags (CWT). Of the 16 CWT's recovered, nine (56.3%) were from WDFW's Tucannon hatchery stock, six (37.5%) from Lyons Ferry hatchery stock, and one (6.3%) was from Touchet hatchery stock. In addition, PIT tag data indicated that there was one hatchery stray each from the Cottonwood/Wallowa, Walla Walla River and Ringold Hatchery releases.

There were two adult steelhead mortalities from trapping operations in 2007. Both occurred at the same time when the two fish swam onto the weir via a gap in the side panel. The hole was immediately plugged and no additional mortalities were observed.

Steelhead spawning ground surveys were performed over all available spawning habitats in the Asotin Creek watershed (about 46 km; 28.6 miles) above the weir location in 2007 (Table 7). There were an estimated 269 redds above the weir. Based on the total estimated number females (173) that spawned above the weir, there were 0.64 females per redd. In addition, there were 23 redds in the mainstem in the 1.7 rkm reach below the weir to George Creek in 2007. Water conditions were good to excellent for foot-based spawning ground surveys during the season, and surveyors were confident that all redds were documented within the survey areas.

Table 7. Number of steelhead redds identified from surveys of specific reaches in 2007.

Reach	Location Description	Dist. (km)	No. Redds	Redds per km	Dist. (mi.)	Redds per mile
Mainstem: Below trap	George Creek to Trap	1.7	23	13.5	1.0	23.0
Above trap	Trap to Confluence	18.6	135	7.3	11.6	11.6
North Fork (NF)	Middle Fork (of NF) to NF/SF confluence	12.8	32	2.5	8.0	4.0
South Fork (SF)	Below/above beaver dams (1.5/8.7 km)	3.4	37	10.9	2.0	18.5
Charley Creek	Old Corral to Mainstem	10.6	42	4.0	6.6	6.4
Summary Totals						
Total redds above rkm 7.0	Above trap: Mainstem, NF, SF, Charley	45.4	246	5.6	28.2	8.7
Total redds above rkm 4.6	Above George Creek (including below weir)	47.1	269	5.9	29.2	9.2

Other adult species of interest

Seventeen (17) adult Chinook salmon were captured as pre-spawners in 2007 (Table 8). Thirteen (76.5%) of the spring Chinook salmon captured were unmarked (either naturally-produced or hatchery fish) and 4 (23.5%) were marked hatchery strays of unknown (but likely Snake River) origin.

Table 8. Biological data for adult Chinook salmon captured in 2007. ("-" undetermined.)

Date	Origin	Sex (jack)	Length (cm)	Fresh Age	Ocean Age	Total Age
5/13/07	wild	-	69	1	2	3
5/15/07	wild	-	70	1	2	3
5/17/07	wild	-	70	1	2	3
5/18/07	wild	-	74	1	2	3
5/19/07	wild	-	67	1	2	3
5/20/07	wild	-	81	1	3	4
5/21/07	wild	jack	48	1	1	2
5/24/07	hatchery	-	69	1	2	3
5/25/07	wild	-	67	1	2	3
5/27/07	wild	-	66	1	2	3
5/29/07	hatchery	-	74	1	2	3
6/5/07	wild	-	73	1	2	3
6/5/07	wild	f	74	r	r	-
6/11/07	wild	jack	40	1	1	2
6/19/07	hatchery	jack	50	1	0	1
6/26/07	hatchery	jack	44	r	r	-
6/27/07	wild	-	72	1	2	3

Other species of interest captured at the adult trap in 2007 included 881 migrating adult (pre-spawning) bridgelip suckers *Catastomas columbianus*, six mountain whitefish *Prosopium williamsoni* averaging 36 cm in length, two rainbow trout *O. mykiss* averaging 29 cm, and one chislemouth chub *Acrocheilus alutaceus* that was 33 cm in length.

Juveniles

Steelhead

During the 2007 spring and fall migration seasons, we captured 12,507 juvenile steelhead in the rotary trap. The estimated population of juvenile steelhead emigrating from Asotin Creek in 2007 was 50,375 (95% CI = 43,517 – 59,289 juveniles), which is about 1,072 juveniles per rkm. Seasonal trapping summaries are presented below.

Spring 2007

The spring 2007 juvenile trapping season was from March 7, 2007 to June 28, 2007. We captured 5,727 juvenile steelhead during the spring out-migration, yielding a population estimate of 22,848 (95% CI = 19,211 – 27,755 juveniles), which represented 45.4% of all migrating juvenile steelhead in 2007 (Figure 6). Twenty-eight percent were parr, 62.5% were transitional smolts, and 9.5% were fully-smolted (Table 9). For the spring 2007 juvenile out-migration: 50% migrated past the trapping location by May 10, 75% by May 17 and 90% by May 24, 2007.

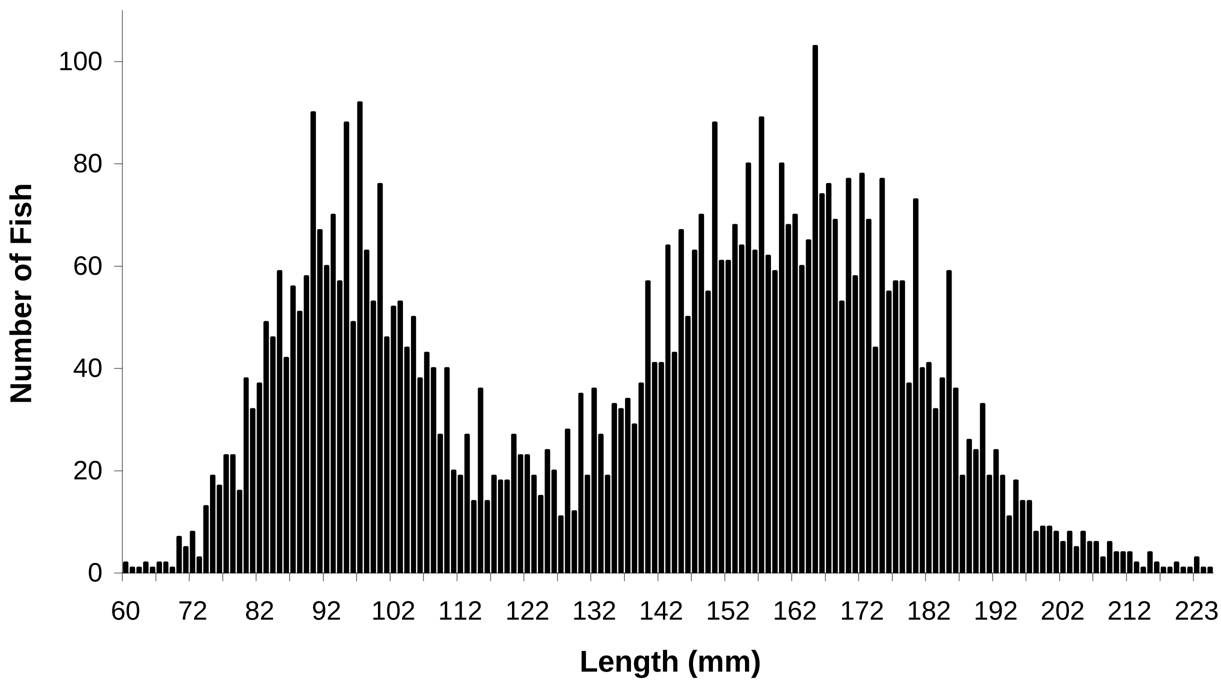

Figure 6. Length distribution of juvenile steelhead (n = 5,727) captured in the spring of 2007.

Table 9. Summary of biological data collected of juvenile steelhead captured during the spring of 2007. Mean values for length, weight and condition factor are provided for each smoltification index category. The number sampled (N) is for fork length data only.

Smoltification Index	Fork Length (mm)	N	Body Wt. (g)	Condition Factor
Parr	95.3	1,601	9.9	1.14
Transitional	151.6	3,507	37.9	1.09
Smolt	176.2	543	57.3	1.05

We conducted 18 trap efficiency tests with 588 fin-clipped juveniles, representing 10.3% of the run during the spring of 2007. Mean smolt trap efficiency for the spring season was 23.8% (range 5.4-38.0%, median = 25.5%, SD = 10.0%) (Table 10). There was no significant difference (p=0.322) in trap efficiency between the two fish size categories (82-124 mm and >125 mm) tested (Table 11). Eighty-one point six percent of all fin-clipped fish used for efficiency testing in the spring were recaptured within one day of release, 95% within four days and 99% within 13 days of release.

Table 10. Trap efficiency for juvenile steelhead trapping during the spring 2007 season.

Test Date	No. Fish Tested	No. Fish Recaptured	Efficiency (%)
3/18	29	8	27.6%
3/21	28	5	17.9%
3/26	32	12	37.5%
3/29-30	25	2	8.0%
4/2-3	26	8	30.8%
4/5-7	42	5	11.9%
4/10	32	8	25.0%
4/19	24	6	25.0%
4/27	50	13	26.0%
5/1	37	2	5.4%
5/4	28	5	17.9%
5/7-8	38	5	13.2%
5/10	35	12	34.3%
5/18	50	19	38.0%
5/21	38	13	34.2%
5/24-25	17	5	29.4%
5/28-6/2	30	5	16.7%
6/4-6	27	8	29.6%
Total	588	141	23.8%

Table 11. Trapping efficiencies for the two size ranges of juvenile steelhead based on fork length, including number of fish tested and number of fish recaptured, during the spring of 2007.

Fork Length (mm)	**No. Fish Tested**	**No. Fish Recaptured**	**Efficiency (%)**
82-124	141	35	24.8%
>125	447	106	23.7%
Total	588	141	-

Scale samples were collected from 1,693 juvenile steelhead >82 mm, representing 29.6% of all juveniles captured in the spring of 2007. The majority (1,333 or 78.7%) of the scales were readable. Scale aging from the spring of 2007 indicated that 51.1% juvenile steelhead migrants >82 mm were age 1, 39.0% were age 2, 9.8% were age 3, and 0.1% were age 4. Mean fork length began increasing in early-March, reached its highest point in early-May, and then began to decline in mid-May following peak migration.

We also conducted 13 paired trap efficiency tests with 427 fin-clipped and 430 PIT-tagged fish, representing 15.0% of the spring run in 2007. There was a significant difference (paired t-test, p=0.048) in capture efficiencies between the fin-clipped fish (mean = 22.3%, range 0-38.0%, median = 25.0%, SD = 11.5%) and PIT-tagged fish [mean = 28.5%, range 18.3-45.5%, median = 28.0%, SD = 8.2%)] (Table 12). Seventy-seven percent of the fin-clipped fish were recaptured within one day of release, 95% within six days and 99% within 13 days of release. Seventy-eight point five percent of the PIT tagged fish were recaptured within one day of release, 95% within three days and 99% within six days of release. There was no significant difference (p=0.539) in the size of fish used in each of the mark group-type efficiency tests.

We are unclear if there is a marking effect that accounts for the greater recapture efficiency of PIT tagged fish. We suspect that some of the difference is due to our ability to assign PIT tagged fish that are recaptured long after most recaptures for individual efficiency tests occur. This failure to properly assign fin-clipped test fish to the appropriate test period, could account for some of this difference. We will repeat this comparison in 2008 to attempt to determine which methodology provides the most bias-free estimator.

Table 12. Data from 13 paired trap efficiency tests with fin-clipped and PIT-tagged fish.

	Fin-clipped Fish			PIT-Tagged Fish		
Test Date	**No. Fish Tested**	**No. Fish Recaptured**	**Efficiency (%)**	**No. Fish Tested**	**No. Fish Recaptured**	**Efficiency (%)**
4/10/07	32	32	25.0%	33	8	24.2%
4/15-16/07	21	21	0.0%	28	6	21.4%
4/19/07	24	24	25.0%	25	8	32.0%
4/27/07	50	50	26.0%	50	14	28.0%
5/1/07	37	37	5.4%	37	7	18.9%
5/4/07	28	28	17.9%	31	10	32.3%
5/7-5/8	38	38	13.2%	39	8	20.5%
5/10/07	35	35	34.3%	60	11	18.3%
5/18/07	50	50	38.0%	46	17	37.0%
5/21/07	38	38	34.2%	37	13	35.1%
5/24-25/07	17	17	29.4%	12	4	33.3%
5/28-6/2/07	30	30	16.7%	21	5	23.8%
6/4-6/07	27	27	29.6%	11	5	45.5%
Totals	427	101	22.7%	430	116	28.5%

We tagged 1,853 juvenile steelhead, representing 32.4% of the spring 2007 out-migrants, with PIT tags. Almost a third (32.4%) of all juvenile steelhead that were tagged in the spring of 2007 were detected at dams on the Snake and Columbia Rivers (Tables 13 & 14) in 2007. PIT tag detection rates of juvenile steelhead are strongly related to size and age (Table 13 and Figure 7). Fifty point nine percent (50.9%) of juvenile steelhead greater than 125 mm in length were detected at Snake and Columbia River dams, while only 0.9% of juvenile steelhead less than 125 mm were detected at the same dams (Table 14).

Table 13. Number of juvenile steelhead PIT tagged by age during the spring of 2007 that were detected migrating past dams on the Snake and Columbia Rivers in 2007.

Age	**1**	**2**	**3**	**4**	**Undetermined**	**Total**
Number Tagged	680	518	130	2	523	1853
Number Detected	21	240	68	1	235	565
Detection Rate	3.1%	46.3%	52.3%	50.0%	76.1%	30.5%

Table 14. Number of juvenile steelhead PIT tagged by length (82-124 mm and >125mm) in the spring of 2007, and detection rate of tagged fish at dams on the Columbia and Snake Rivers.

Fork Length (mm)	Tags / Detection rate	Parr	Transitional smolt	Smolt	Total
82-124	Tagged (n) / Detected	666 / 2	90 / 5	0	756 / 7
	Detection Rate	0.3%	5.6%	-	0.9%
>125+	Tagged (n) / Detected	7 / 0	954 / 476	136 / 82	1097 / 558
	Detection Rate	0%	49.9%	91.8%	50.9%
Totals	Tagged (n) / Detected	673 / 2	1044 / 481	136 / 82	1853 / 565
	Detection Rate	0.3%	46.1%	60.3%	30.5%

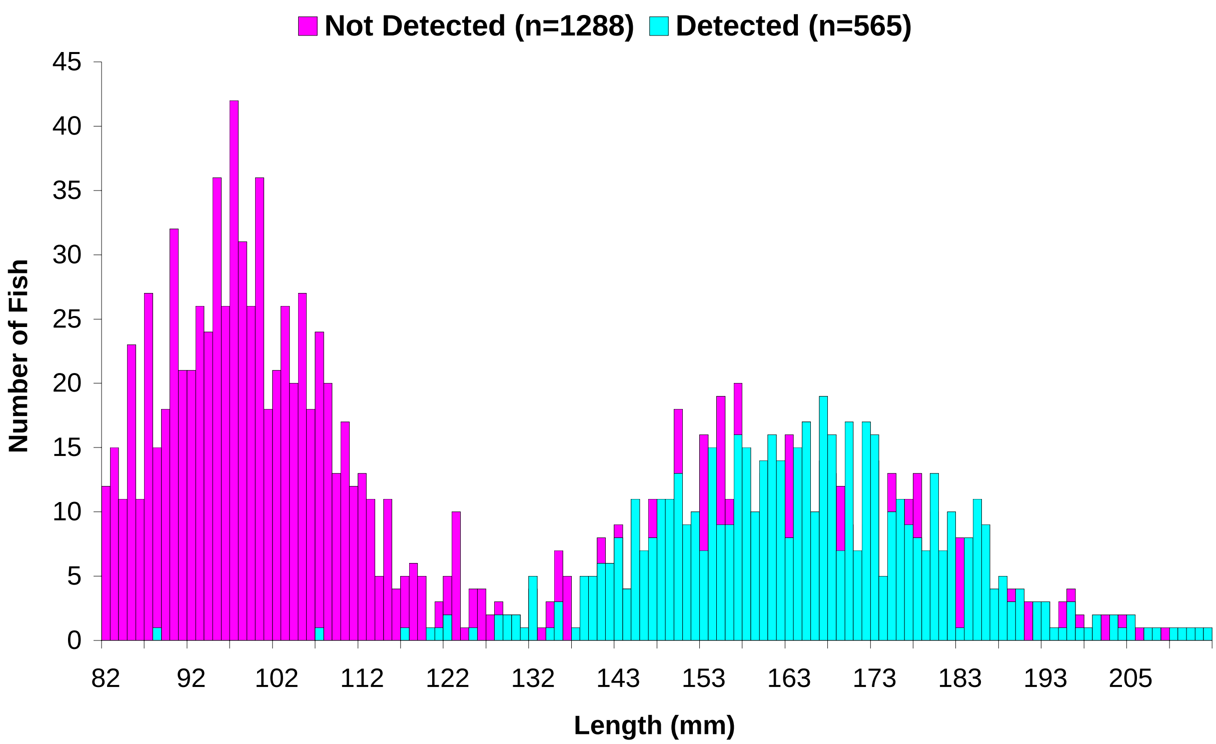

Figure 7. Length distribution of juvenile steelhead PIT tagged (n=1,853) in Asotin Creek during the spring of 2007, with detections at mainstem dams on the Snake and Columbia Rivers.

Fall 2007

The fall 2007 juvenile salmonid trapping season was from October 3, 2007 to January 12, 2008. We captured 6,780 juvenile steelhead during the fall migration, yielding a population estimate of 27,527 (95% CI = 24,306 – 31,534 juveniles), which represented 54.6% of all out-migrating juvenile steelhead in 2007 (Figure 8). Most (58.4%) were parr, while 41.6% were transitional smolts (Table 15). There were no fully-smolted out-migrants. No juveniles were PIT tagged during the fall 2007 out-migration.

Table 15. Summary of biological data collected of juvenile steelhead captured during the fall of 2007. Mean values for length, weight, condition, and age are provided for each smoltification index category. (Total sample size (N) is for fork length data only.)

Smoltification Index	Fork Length (mm)	N	Body Wt (g)	Condition Factor
Parr	88.5	3,908	7.8	1.13
Transitional	131.2	2,780	23.9	1.06

Twenty-two efficiency tests were conducted in the fall of 2007 with 1,215 juveniles, representing 17.9% of the run (Table 16). Mean smolt trap efficiency was 33.5% (range 6.8-64.7%, median = 34.4%, SD = 15.3%). Two size categories (82 mm and >125 mm) of juvenile steelhead were used for efficiency testing in the fall of 2007 (Table 17). There was a significant difference (p=0.016) in trap efficiency between the two size categories tested. Eighty-six point six percent of the fin-clipped fish used for efficiency testing in the fall were recaptured within one day of release, 95% within three days and 99% within 14 days of release.

The first day of trapping in the fall (October 3, 2007) yielded 107 juveniles in the smolt trap. We assume that the fall trapping season started late, relative to the early stages of the fall 2007 outmigration. Therefore, the fall 2006 catch data might be instructive for estimating the number of out-migrating juvenile steelhead due to the delayed start. A similar peak was found in the fall 2006 data (112 fish at day 26 of the outmigration), which indicated that, prior to the peak, an estimated 1,083 fish passed the trap prior to the peak. Therefore, if the 1,083 fish (at a trap efficiency of 43.2%) were added to the first strata to complete the fall 2007 dataset, then the new total population estimate for fall 2007 would be 29,948 (95% CI = 26,432–34,632) juveniles.

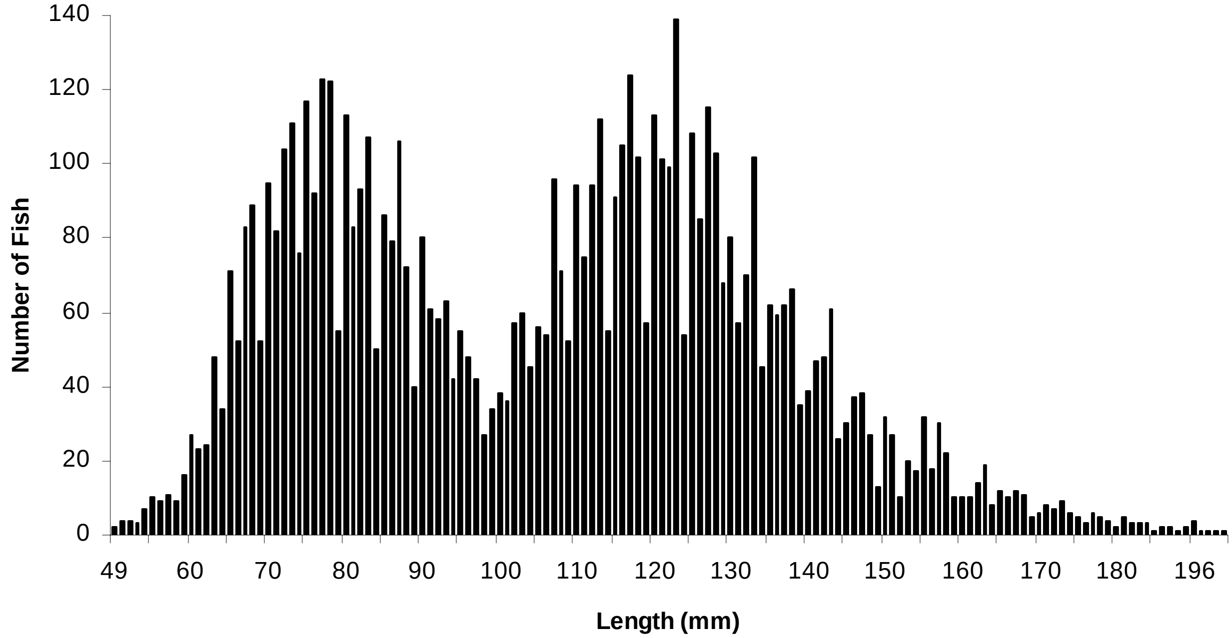

Figure 8. Length distribution of juvenile steelhead captured (n = 6,780) during the fall of 2007.

Table 16. Trap efficiency for juvenile steelhead trapping during the fall 2007 season.

Test Date	No. Fish Tested	No. Fish Recaptured	Efficiency (%)
10/4	37	16	43.2%
10/8	100	10	10.0%
10/11	67	11	16.4%
10/18	99	22	22.2%
10/22	43	17	39.5%
10/27	72	17	23.6%
10/29	59	4	6.8%
11/1	80	19	23.8%
11/5	40	8	20.0%
11/8	37	5	13.5%
11/15	50	25	50.0%
11/24	53	18	34.0%
11/26	34	22	64.7%
11/29	30	12	40.0%
12/7	100	43	43.0%
12/10	93	30	32.3%
12/15	73	29	39.7%
12/17	29	13	44.8%
12/20	30	10	33.3%
12/24	23	8	34.8%
12/2627	40	24	60.0%
1/3-4/08	26	11	42.3%
Total	1,215	374	33.5%

Table 17. Trapping efficiencies for the two size ranges of juvenile steelhead based on fork length, including number of fish tested and number of fish recaptured, during the fall of 2007.

Fork Length (mm)	**No. Fish Tested**	**No. Fish Recaptured**	**Efficiency (%)**
82-124	737	284	38.5%
>125	478	90	21.9%
Total	1,215	374	-

There were a total of 94 juvenile steelhead mortalities in 2007. Sixty-four occurred on five days due to debris-related circumstances. In each instance, the smolt trap was immediately stopped and then restated after the debris had cleared the system.

Other juvenile species of interest

Spring 2007

We captured 223 juvenile Chinook salmon during the spring migration season, representing 19.8% of the juvenile Chinook salmon out-migration in 2007. The estimated population of juvenile Chinook migrating from above the Asotin Creek trapping site for the spring was 505 individuals. The median fork length of juvenile Chinook salmon during the spring of 2007 was 71.0 mm (range = 56-109), and represented both yearling and sub-yearling classes of Chinook. Median weight of the juvenile Chinook salmon captured was 4.0 grams (range = 1.9-14.4). The median condition factor was 1.11 (range = 0.89-1.29).

We conducted five trap efficiency tests with 78 juveniles, representing 35.0% of the spring emigrants captured (Table 18). The mean smolt trap efficiency was 44.2% (range 10.0%-78.9%, median = 42.9%, SD = 25.0%).

Table 18. Trapping efficiency for juvenile Chinook salmon trapping during the spring of 2007.

Test Date	No. Fish Tested	No. Fish Recaptured	Efficiency (%)
5/22	23	12	52.2%
5/26	10	1	10.0%
5/31	7	3	42.9%
6/5	19	15	78.9%
6/7	19	7	36.8%
Total	78	38	44.2%

Age data was taken on 28 juvenile Chinook salmon, representing 12.6% of the spring 2007 out-migration. Eighty-nine point three percent were 0-age fish and 10.7% were age 1 fish.

Fall 2007

We captured 950 juvenile Chinook salmon during the fall 2007 migration season, representing 80.2% of the juvenile Chinook salmon out-migration in 2007. The population estimate for the fall 2007 juvenile Chinook salmon out-migration was 2,048 individuals. The median fork length of juvenile Chinook salmon during the fall of 2007 was 84.0 mm (range = 57-105), and represented both yearling and sub-yearling classes of Chinook. Median weight of the juvenile Chinook salmon captured was 6.2 grams (range = 2.0-12.7). The median condition factor was 1.06 (range = 0.61-1.51).

We conducted 19 trap efficiency tests with 337 juveniles, representing 35.5% of the run (Table 19). The mean smolt trap efficiency was 54.1% (range 33.3%-87.5%, median = 53.8%, SD = 13.6%). Scales were taken from 17 juvenile Chinook salmon, but the results were not read.

Table 19. Trapping efficiency for juvenile Chinook salmon trapping during the fall of 2007.

Test Date	No. Fish Tested	No. Fish Recaptured	Efficiency (%)
10/27	12	6	50.0%
10/29	22	8	36.4%
11/1	11	5	45.5%
11/5	11	6	54.5%
11/8	13	7	53.8%
11/15	9	3	33.3%
11/24	26	17	65.4%
11/26	17	10	58.8%
11/29	14	11	78.6%
12/7	61	28	45.9%
12/10	24	9	37.5%
12/15	24	14	58.3%
12/20	14	9	64.3%
12/24	9	4	44.4%
12/26	12	7	58.3%
01/3-4	8	4	50.0%
10/27	12	6	50.0%
10/29	22	8	36.4%
11/1	11	5	45.5%
Total	337	178	54.1%

Seven bull trout were captured in 2007. Biological data for all bull trout captured are presented in Table 20. All bull trout were PIT tagged, and DNA samples collected and archived.

Table 20. Summary of biological data collected of bull trout captured in 2007.

Date Captured	Fork Length (mm)	Body Weight (g)	Condition Factor (K)
5/4/07	390	678.2	1.14
5/10/07	380	-	-
6/6/07	153	37.0	1.03
6/6/07	160	40.0	0.98
11/15/07	358	448.0	0.98
11/20/07	345	420.5	1.02
12/3/07	302	274.4	1.00

Other species captured in the smolt trap in 2007 included dace, sculpin, bridgelip suckers, chiselmouth and lamprey.

Multiple-Year Data Comparisons

Adults

In 2007, we captured 294 adult steelhead, resulting in a population estimate of 342 adults, above George Creek, compared to 653 and 555 adults in 2005 and 2006, respectively. We calculated an estimate of 0.64 females per redd from our 2007 data, compared to an estimated 0.92 females per redd in 2005. These are the only two years under this project so far in which 100% of the spawning habitat could be surveyed based on acceptable stream flow conditions.

A comparison of the cumulative catch (run timing) for the steelhead spawning seasons in 2005, 2006 and 2007 is presented in Figure 9. The number of adult steelhead captured, the proportion of hatchery fish (based on pre-spawner counts), and the population estimate of adult steelhead in Asotin Creek above our trap site for 2005, 2006 and 2007 are also compared (see Table 21).

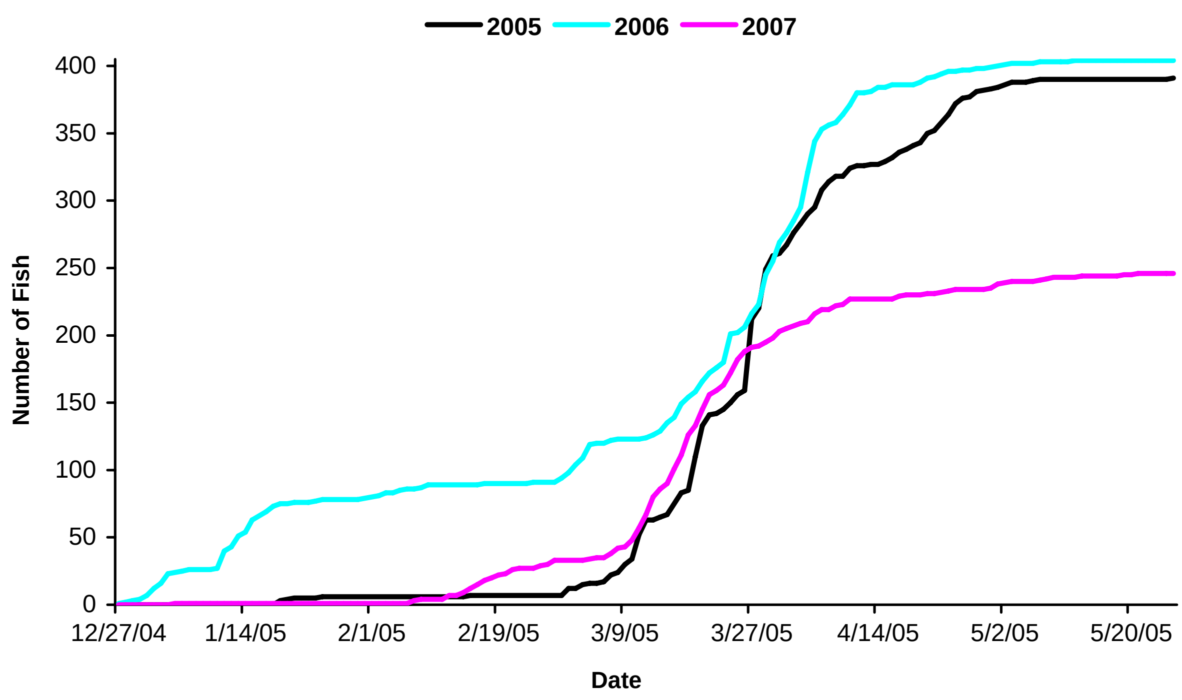

Figure 9. Cumulative catch (run timing) of pre-spawning adult steelhead captured at the Asotin Creek weir in 2005, 2006 and 2007.

Table 21. Number of adult steelhead captured, percent (%) hatchery fish, and population estimate for 2005, 2006 and 2007 in Asotin Creek above the WDFW trap site.

Statistic	2005	2006	2007
Adults captured	499	474	294
% Hatchery fish	6.5	8.6	17.5
Population estimate	653	555	342

Juveniles

The juvenile steelhead population was estimated at 50,375 from the combined spring and fall out-migrations in the 2007 migration year, compared to 45,744, 27,287 and 36,568 juveniles in 2004, 2005 and 2006, respectively. The juvenile steelhead population estimate for 2007 was approximately 38% larger than the previous three-year (2004-2006) average of 36,533 juveniles. Table 22 shows the total number of juvenile steelhead captured and the 95% upper and lower confidence intervals for the juvenile population estimates for the years sampled.

Table 23 presents the proportions of parr, transitional smolts, and smolts of the total juvenile steelhead spring out-migration in Asotin Creek for years sampled. The proportion of juveniles migrating as parr or fully-smolted fish appears to change the most between years.

Table 22. Total number of juvenile steelhead captured, population estimate and 95% confidence intervals (bounded estimates) during the years 2004, 2005, 2006 and 2007 in Asotin Creek.

Statistic	2004	2005	2006	2007
Juveniles captured	8,506	7,214	5,829	12,507
Population estimate	45,744	27,287	36,568	50,375
95% CI: Lower	39,743	22,454	30,822	43,517
95% CI: Upper	51,747	33,980	43,436	59,289

Table 23. Smoltification index (stage by percentage) of the juvenile steelhead out-migrations from the spring and fall of 2004, 2005, 2006 and 2007 in Asotin Creek.

Season	Stage (%)	2004	2005	2006	2007
Spring	Parr	42.0	27.4	35.3	28.0
	Transitional smolts	55.9	62.7	61.0	62.5
	Fully-smolted	2.1	9.9	3.7	9.5
Fall	Parr	95.6	55.9	61.1	58.4
	Transitional smolts	4.2	43.7	38.9	41.6
	Fully-smolted	0.2	0.4	0	0

Figures 10 and 11 show the length distribution and age at length comparison of fish ages 1, 2 and 3 for fish <220 mm (age 4 fish data were not included to simplify the illustration), respectively, of juvenile steelhead captured in Asotin Creek for the 2004-2007 spring outmigrations combined.

Figure 12 shows the length distribution of juvenile steelhead captured in Asotin Creek during the 2004-2007 fall outmigrations combined. Up to 55% of the annual out-migration of juvenile steelhead from Asotin Creek can occur during the fall months (approximately September-December). A comparison of the length distribution of fall migrants <209 mm from 2004-2007 is shown in Figure 13. It is unknown whether the number of fall out-migrants is related to the out-migration from the previous spring (i.e., late migrants) or to the following spring (i.e., early migrants), if at all.

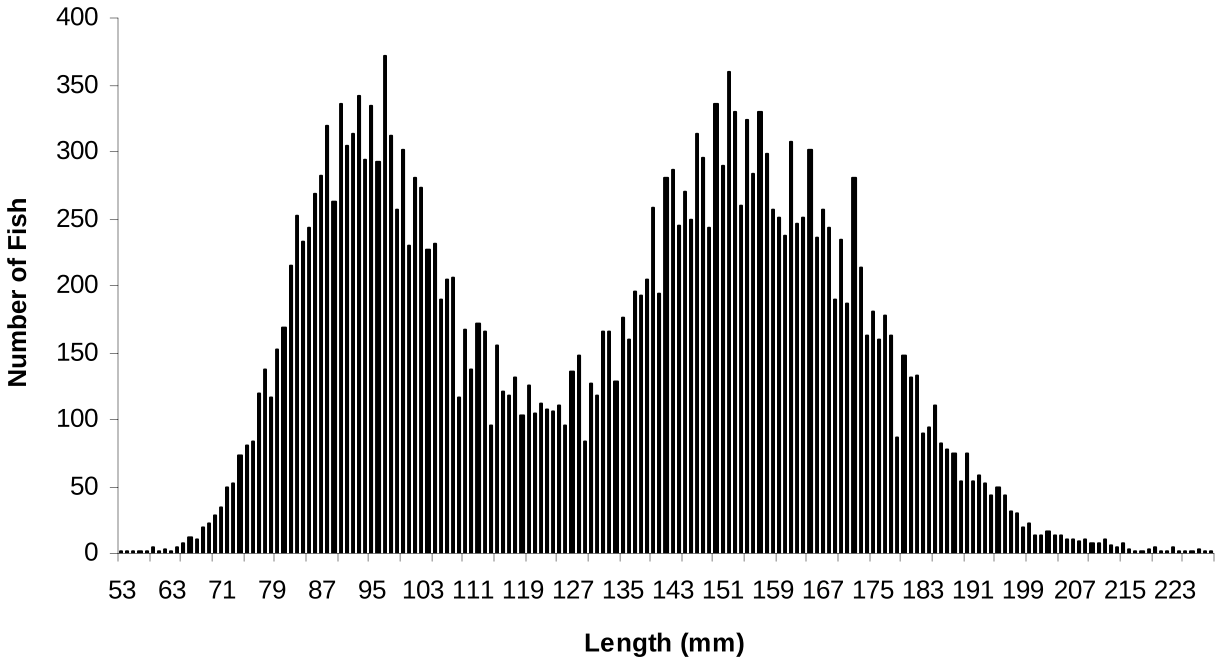

Figure 10. Length distribution of juvenile steelhead captured in Asotin Creek during the 2004-2007 spring outmigrations combined (n = 24,531).

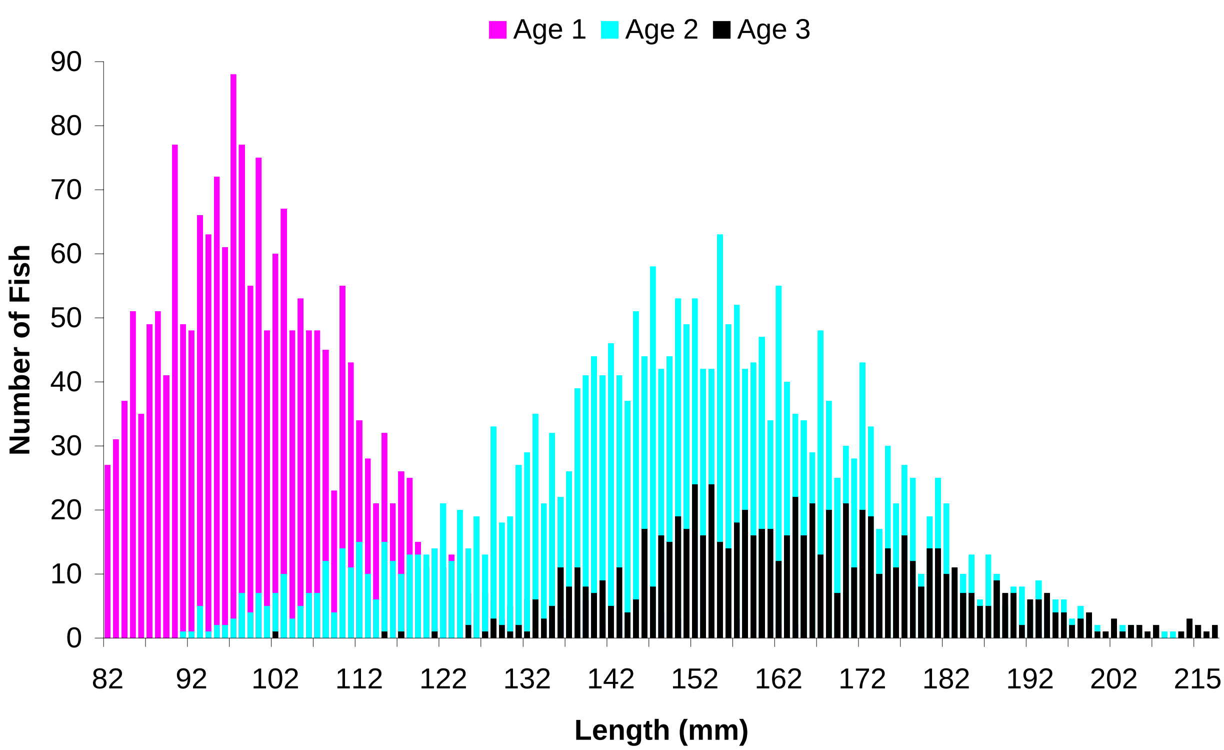

Figure 11. Age at length comparison of age 1, 2 and 3 for fish <220 mm juvenile steelhead captured in Asotin Creek during the 2004-2007 spring outmigrations combined (n = 5,263).

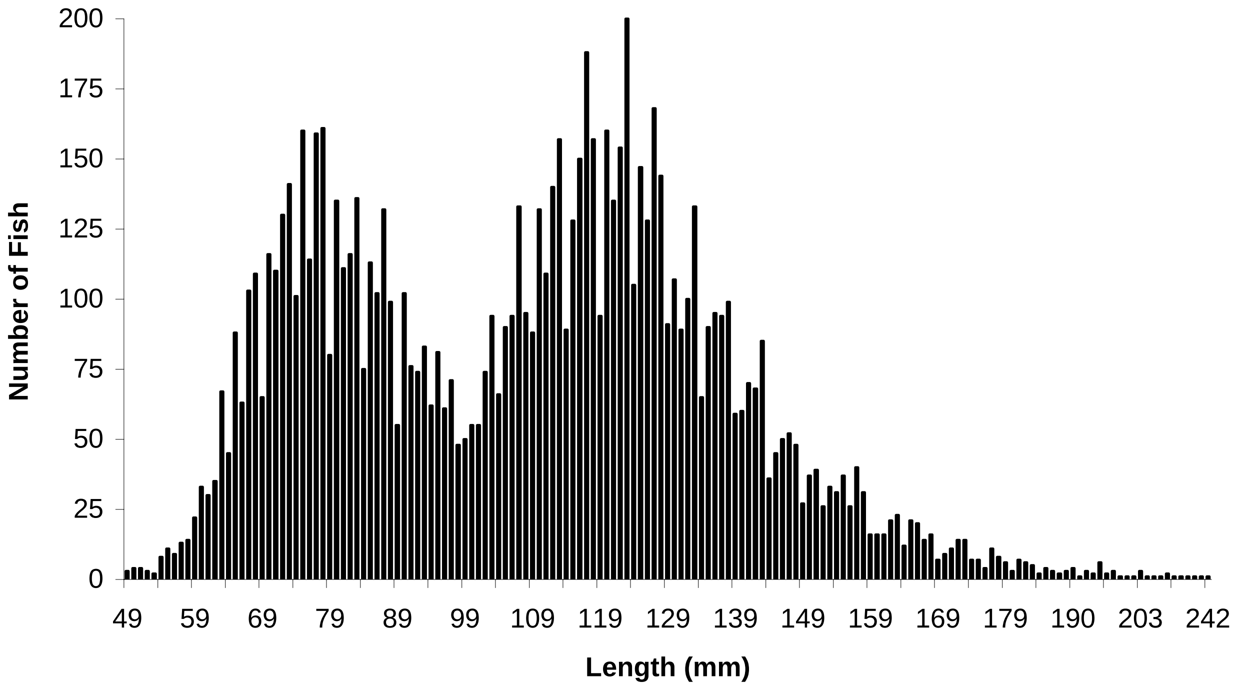

Figure 12. Length distribution of juvenile steelhead captured in Asotin Creek during the fall outmigrations of 2004-2007 combined (n = 9,525).

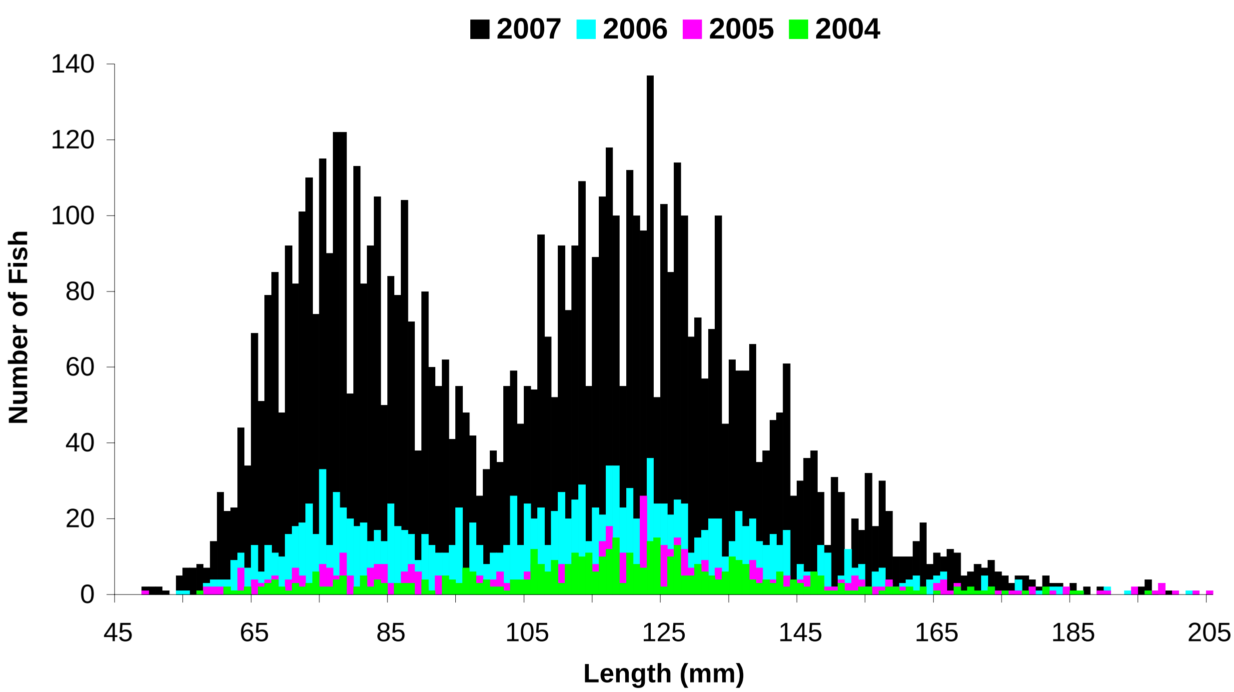

Figure 13. Length distribution of juvenile steelhead <209mm, captured in Asotin Creek during the fall 2004, 2005, 2006 and 2007 trapping seasons (n = 9,375).

Summary and Conclusions

The current abundance of steelhead in Asotin Creek is encouraging. The NOAA Fisheries Viable Salmonid Population document (McElhany, et. al. 2000) identified four key parameters for assessing the long-term viability of a population: Abundance, growth rate, population spatial structure and diversity. The prioritization approach used in the Snake River Recovery Plan, which is based on the VSP concept, proposes that Asotin Creek be intensively monitored to establish a population baseline (Snake River Salmon Recovery Board 2005).

This project continues to provide empirical data about steelhead and salmon populations in Asotin Creek, above George Creek. Fisheries researchers and managers have direct estimates of the current steelhead population in Asotin Creek, and do not have to rely on a population estimate built from habitat modeling that was used in the subbasin planning process (ASP 2004). Such data can be valuable in refining habitat capacity estimators used in the Asotin Creek Subbasin planning process, and in evaluating the effects of hatchery supplementation in other systems where Asotin Creek can serve as a control/reference stream. Such evaluations will require a suite of reference stream data if difficult questions regarding the efficacy and impacts of hatchery supplementation as a recovery tool are to be answered efficiently and confidently.

The abundance of out-migrating steelhead smolts and, more interestingly, out-migrating parr and pre-smolts, from Asotin Creek remains higher than expected for the fourth year. Interestingly, more than half of the 2007 juvenile steelhead out-migration. While such behavior is common to many rivers, such large fall emigrations may suggest several life history responses to variable habitat conditions: Juvenile steelhead are leaving Asotin Creek because of limited carrying capacity, limited over-wintering habitat, limited habitat during critical low flow periods in the fall or early winter, or they may be utilizing Lower Granite dam reservoir or other streams as their final, pre-smolt rearing location. We conducted expanded rotary smolt trap efficiency studies in 2007 to examine the potential for bias in these estimates. The use of PIT tags for these studies has been exceptionally helpful, and our results suggest that some of the underlying statistical assumptions in our estimator (specifically that fish used for efficiency tests continue to emigrate within a reasonable and non-overlapping time with subsequent efficiency tests) are being violated. We will repeat our capture efficiency studies in spring 2008 and provide a more complete discussion of the results in next year's report.

Fish scale samples collected in 2007 are generally consistent with previous year's data showing that Asotin Creek steelhead exhibit a complex array of life history patterns. Scale age data from adults and juveniles indicate that juveniles leave the subbasin (and the Snake River drainage) at ages 1 to 4 and return as adults after 1 or 2 years in the ocean. Although there is no direct supplementation of hatchery fish into Asotin Creek, a significantly greater proportion of hatchery origin strays used Asotin Creek opportunistically for spawning in 2007 (17.5%) than in previous years (6.5% in 2005 and 8.6% in 2006). Such data are valuable in evaluating the incidental effects of hatchery programs within the Snake and Columbia basins. Establishing a baseline of the Asotin Creek steelhead population through future data collection is needed for a better understanding of how Asotin Creek is being utilized by local and regional steelhead populations.

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