ASSESS SALMONIDS IN THE ASOTIN CREEK WATERSHED

2005 ANNUAL REPORT

Reporting period: June 2004 – December 2005

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Abstract

The goal of this project is to assess the status of anadromous salmonid populations in the Asotin Creek watershed. This project implements the research, monitoring and evaluation (RM&E) criteria specified in the Asotin Subbasin Plan by providing estimates of abundance, productivity, survival rates, and temporal and spatial distribution of ESA-listed species, primarily summer steelhead (*Oncorhynchus mykiss*) and secondarily spring Chinook salmon (*O. tshawytscha*). The project also implements reasonable and prudent alternative (RPA) 180 in the NMFS 2000 and 2004 Federal Columbia River Power System (FCRPS) Biological Opinions (BiOp) for population status monitoring and review of status change over time. This project is designed to enumerate adult salmonids entering Asotin Creek to spawn and to estimate the juvenile migrant population and emigration patterns. The mean juvenile steelhead population was estimated at 45,744 juveniles for 2004 and 27,287 juveniles for 2005. More than 500 adult steelhead were captured in 2005 (the first season of adult trapping in Asotin Creek), resulting in a population estimate of 653 adults, spawning in approximately 46 km of accessible steelhead habitat above the trapping location (near river km 7.0). In addition, there was a significant population of steelhead spawning in the 2.4 km between the adult trap and George Creek. The data suggests that the Asotin Creek summer steelhead – above eight mainstem dams on the Snake and Columbia Rivers – are a productive, naturally-producing population of the Snake River steelhead ESU.

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Introduction

This Asotin Creek 2005 Annual Report includes the data collected under two contract periods: Contract No. 00018229, covering the period from June 1, 2004 to May 31, 2005, and Contract No. 00022720, covering the period from June 1, 2005 to December 31, 2005. The Asotin Creek 2004 Annual Report was submitted to BPA on November 23, 2004, as a deliverable under Contract No. 00014059. The FY04 Annual Report did not include data from the fall of 2004, which was subsequently covered in the FY05 contract, due to a change in contract period, and to changes in the BPA work element (statement of work) process and reporting requirements.

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 supported summer steelhead, spring Chinook salmon, fall Chinook salmon, bull trout, and lamprey sp. (*Petromyzontidae*). The Washington Department of Fish and Wildlife (WDFW) designated the Asotin Creek Subbasin a wild steelhead refuge in 1997 and has planted no hatchery fish in Asotin Creek since 1998. Limited, but continuous, efforts have been made to assess salmonid populations in the Subbasin since 1984.

Critical uncertainties must be answered if populations are to be rebuilt and de-listed. Such uncertainties may include habitat/life history stage relationships, causal relationships for degraded habitat and depressed or extirpated populations, and understanding the relationship between resident and anadromous *O. mykiss* subpopulations (ASP 204, p. 173). Critical uncertainties for the Asotin Creek Subbasin include: 1) Is the steelhead population parent-to-progeny ratio above the replacement [≥1.0]? 2) How can managers intervene to rebuild steelhead populations that may be at marginally successful productivity above eight FCRPS dams, if necessary? 3) Are bull trout functionally extinct, and if not, does the migrating life form still exist in the basin? And 4) Can habitat recovery efforts and careful use of hatchery-produced spring Chinook salmon effectively reestablish a self-sustaining population of spring Chinook salmon in Asotin Creek? (ASP 2004, p. 173; ASP, App. M, p. 3).

The genetic nature of naturally-producing (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, and potentially to determine the origin of spring Chinook salmon that may be using Asotin Creek opportunistically. Samples from this project, coupled with genetic sampling in adjacent subbasins, will aid in understanding the effect of lower Snake River hatchery supplementation, and describe population genetic similarities and differences for recovery planning. Understanding the origin and genetic composition of colonizing stray hatchery or natural-origin spring Chinook salmon will be critical in developing a spring Chinook salmon reintroduction plan that managers have identified as a priority for the Asotin Creek Subbasin (ASP 2004, p. 162).

This project also implements reasonable and prudent alternative (RPA) 180 in the NMFS 2000 and Action 180 in the 2004 Federal Columbia River Power System (FCRPS) Biological Opinions (BiOp) for a basin-wide hierarchical monitoring program. This program is expected to determine population and environmental status (including assessment of performance measures and standards), and review of status change over time. The Asotin Assessment project was selected for implementation under this RPA 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 juvenile Chinook salmon were captured during the spring of 2004 near Headgate Dam (near river km (rkm) 14.5), which provided a population estimate of 4,121 juvenile Chinook salmon emigrating from the Asotin Creek Subbasin (Schuck and Mayer 2004). This suggests that spring Chinook salmon can spawn successfully in Asotin Creek, but there is insufficient information to infer a re-established population.

Bull trout populations in the Columbia River Basin were listed as threatened in June 1998. The Asotin Creek population is part of the Columbia Basin Distinct Population Segment (DPS) for bull trout. Although once believed to be nearly extinct in the basin, redd surveys conducted by the U.S. Forest Service (USFS) found bull trout spawning in the upper North Fork Asotin Creek in 1996 (D. Groat, USFS, pers. comm.). Since that time, the USFS and WDFW have conducted bull trout spawning surveys in portions of the upper North and South forks of Asotin Creek. Four juvenile bull trout were captured in the Project's smolt trap in 2004.

Despite the extirpation of spring Chinook salmon and near loss of bull trout, there is currently a significant population of naturally producing steelhead in Asotin Creek. We captured 8,028 juvenile steelhead in the Project's smolt trap during the spring of 2004 (Schuck and Mayer 2004). The estimated population of juvenile steelhead from the spring 2004 migration season was 43,457 (95% CI = 37,972 – 48,942 juveniles), which was about 1,129 juveniles per rkm (1,818 juveniles per mile), above the spring 2004 trapping site near rkm 14.5.

This project is a logical extension of limited past and present biological monitoring efforts in the Asotin Creek Subbasin. The expanded baseline data collected for each focal species under this project is needed to refine fish return and management goals, and to assist in the establishment of future numeric fish population goals as outlined in the Asotin Subbasin Plan (ASP 2004, p. 160). In addition, assessing the Asotin Creek steelhead population may provide a better understanding of limiting factors that affect similar or adjacent populations. Moreover, data from this project could be used to help determine if regional recovery efforts to stabilize and rebuild steelhead populations would be best spent on within-subbasin projects or out-of subbasin actions (i.e., FCRPS modifications). Rebuilding the bull trout population and eventually reintroducing spring Chinook are goals for the Subbasin.

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. This project implements the research, monitoring and evaluation (RM&E) criteria specified in the Asotin Subbasin Plan (ASP 2004), by providing estimates of abundance, productivity, survival rates, and additional information on temporal and spatial distribution of ESA-listed species, primarily summer steelhead, and secondarily spring Chinook salmon. In addition, this project will document the abundance and migratory behavior of bull trout captured at the trapping locations, by counting, sampling and tagging bull trout with passive integrated transponder (PIT) tags. 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: Document juvenile steelhead life history patterns, survival rate and smolt production in the Asotin Creek watershed above George Creek.

- Objective 2: Estimate escapement of hatchery and wild steelhead and salmon into the Asotin Creek watershed above George Creek; Measure adult trap fallback and adult trap capture efficiency.

- Objective 3: Estimate spawner abundance and adults per redd.

- Objective 4: Collect genetic samples.

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). 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). Major tributaries of George Creek include Pintler Creek, Rockpile Creek, Wormell Creek, Heffelfinger Creek and Coombs Canyon.

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. More than $2 million has been spent in the watershed to address habitat problems, focusing mainly on habitat restoration (Brad Johnson, ACCD, pers. comm.).

United States Geological Survey (USGS) records (from 1929–1960) indicate a mean annual flow of 2.1 cms (74 cfs) upstream of Headgate Dam (rkm 14.5). Normal low flow in late summer is 0.4 – 0.85 cms (15-30 cfs, and 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 vary widely by location and land use.

The WDOE classifies Asotin Creek and its tributaries as Class A (excellent) surface waters, and waters within the National Forest in the subbasin are considered Class AA (extraordinary). About 130 stream kilometers (81 miles) of anadromous fish accessible habitat (primarily steelhead) in the Asotin Creek watershed were identified in the Asotin Subbasin Plan (ASP 2004). About 46 km (28.6 miles) are regularly surveyed by WDFW, and is the area that is the focus of work conducted under this project. 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).

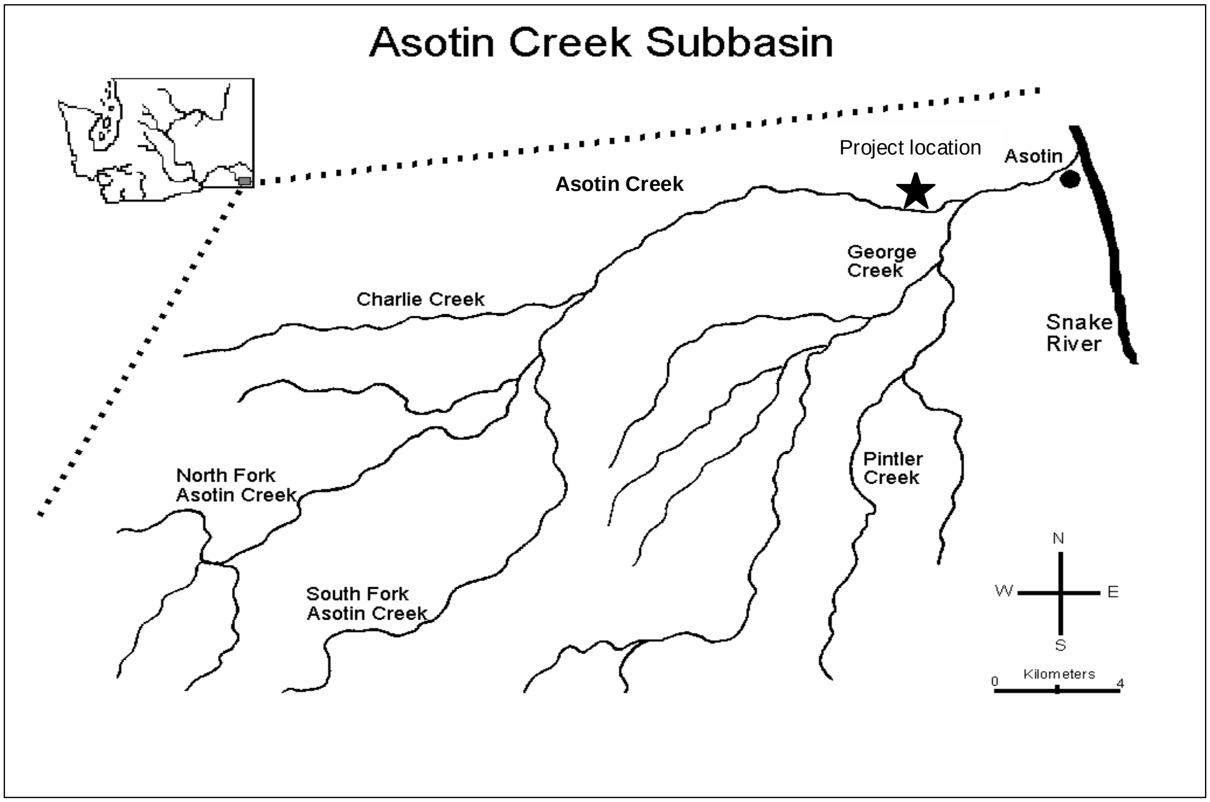

Figure 1. The Asotin Creek Subbasin in Southeastern Washington.

Methods and Materials

Objective 1: Document juvenile steelhead life history patterns, survival rate and smolt production in the Asotin Creek watershed above George Creek. To estimate the number of emigrating juvenile salmonids, a 1.52 meter (m) (5-foot) rotary screw (smolt) trap was placed in Asotin Creek in the fall of 2004 near river km 7.0. The primary trapping season was in the spring, from March to June. A secondary trapping season occurred in the fall, from September to December. However, the smolt trap was also operated at other times of the year to help establish a baseline of juvenile salmonid migration patterns.

The smolt trapping procedures and statistical analyses used in the Asotin Creek project are similar to those used on the Cedar River (Seiler *et al*. 2003), Wind River (Rawding *et al*. 1999) and the Tucannon River (Gallinat *et al*. 2003; Bumgarner *et al.* 2000). This project is intended to be consistent with Washington's Comprehensive Monitoring Strategy (Crawford et al. 2002).

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: enumeration, species, length, weight, scale sampling for age structure and age at migration, and fin clipping for trap efficiency testing. Twenty to 30% of the juvenile steelhead, in three size categories (82-119 mm, 120-149 mm, and >150 mm) were tagged with 12 mm PIT tags, using the same individuals as those used for scale sampling (see below). PIT tag data from Asotin Creek was uploaded to the PTAGIS database. Body condition factor (K) was calculated as a measure of general degree of health for migrants and was calculated as:

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

Scale samples were collected from a sub-sample of juveniles to estimate the age proportion of emigrants. The goal was to collect 1,250 readable scales from about 1,600 fish (assuming a 78% readable scale rate based on 2004 Asotin Creek Project data), to provide an estimate of weekly 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 (usually twice) a week. The size of juvenile steelhead used for trap efficiency testing corresponded with the three size categories used for PIT tagging. Trap efficiency, based on the proportion of fish recaptured, was calculated using the equation:

$E = R/M;$

Where: E 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 trap efficiency testing.

Juvenile steelhead population estimate

Juvenile population estimates were calculated using the sum of weekly estimates, or using weighted mean trap efficiencies. The number of migrants was estimated using the equation:

$$N = U/E;$$

Where: N is the estimated number of out-migrants,
U is the total unmarked catch, and
E is the estimated trap efficiency.

For juvenile steelhead, the variance for N was calculated with a bootstrapping method (Efron and Tibshirani 1986). Confidence limits were calculated using the equation:

$$95\%\ CL=1.96*\sqrt{V};$$

Where: V is the variance determined from bootstrapping.

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, at a location 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 efficiencies were calculated (see above).

Objective 2: Estimate escapement of hatchery and wild steelhead and salmon into the Asotin Creek watershed above George Creek; Measure adult trap fallback and adult trap capture efficiency. A 4.9–7.3 m resistance board floating weir with two integrated 1.8 m x 1.2 m x 1.1 m adult salmonid traps was 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). The main trapping season was from mid-December of 2004 to July of 2005. However, the traps were also operated at other times of the year to help establish a baseline of adult salmonid spawning patterns. When not in use, sections of the adult trap were disabled to allow unrestricted passage.

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: enumeration, species, origin, sex, length, scales for age at spawning, and DNA sampling. All adult salmonids were tagged with a colored, numbered Floy® tag.

Sight surveys of Floy-tagged adults were conducted at least once a week on a 2.4 km river reach below the adult trap to assess fallback, from March through the end of spawning in May. Sight surveys were also conducted above the adult trap to assess trap efficiency/leakage (Objective 3).

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 taht 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:

P = The population of available spawners above the weir

Population estimates for each sex were added together to yield an estimate the total number of potential spawners above the weir. Confidence intervals for the population estimates were calculated by first calculating 95% confidence intervals around estimates for P_R. Confidence intervals for P_R were calculated. Confidence intervals for U were then calculated as follows:

$$U_{LCL} = \frac{R_U}{P_{ULC}} \quad \text{and} \quad U_{ULC} = \frac{R_U}{P_{LCL}}$$

The upper and lower confidence limits for U were then added to M in order to construct 95% confidence intervals for P.

Objective 3: Estimate spawner abundance and adults per redd. Sight surveys for yellow Floy®-tagged adults were conducted on index reaches covering about 50% of the spawning areas above the adult trap to verify spawner abundance, to estimate escapement and to assess trap efficiency (related to Objective 2), and to estimate the number of adults per redd. Spawning surveys were conducted about twice a month from March to May. Index area counts and redd visibility duration were used to estimate total number of redds. (Note: This work was conducted jointly with funds from this project and from LSRCP Monitoring funds for SE Washington).

Objective 4: Collect genetic samples. DNA samples were collected from migrating adult spring Chinook salmon, steelhead and bull trout. Steelhead genetic sampling was continued within the basin to determine the genetic status of naturally-producing steelhead and to determine if hatchery fish have significantly altered the Asotin Creek stock. Genetic samples were archived and will be sent to the WDFW genetics lab, or other appropriate regional labs for future analysis.

Data were entered into spreadsheets and metadata was created, using quality assurance/quality control methods, including documentation and archival of data for subsequent analyses. (Rapid sharing of the data, in electronic and hardcopy formats, from this project will continue to be emphasized.) An Annual Report, which includes an abstract, introduction, description of project area, methods and materials, results and discussion, and a summary and conclusions, is to be submitted in PDF format to the BPA as a deliverable work product. Quarterly status reports were also submitted in Pisces format to BPA. The data from this project will also be submitted to the WDFW and StreamNet databases, if possible.

Results and Discussion

Juveniles

Steelhead

Fall 2004

The fall 2004 juvenile salmonid trapping season was from 3 November to 12 December 2004 (5 weeks) (Figure 2). We captured 478 juvenile steelhead during the fall 2004 migration, yielding a population estimate of 2,287 (95% CI = 1,771 – 2,805 juveniles), representing 3.0% of the juvenile steelhead migration in 2004. Combined with the spring 2004 population estimate of 43,457 juveniles, the estimated population of juvenile steelhead in Asotin Creek for 2004 was 45,744 (95% CI = 39,743 – 51,747 juveniles) above the trapping sites. (Note: This estimate is exclusive of production from the George Creek watershed, a major tributary of Asotin Creek.)

Of the juvenile steelhead captured in fall 2004, 95.6% were parr and 4.2% were transitional smolts. Biological data is presented in Table 1. No age data were collected.

Table 1. Summary of biological data collected of juvenile steelhead captured during the fall of 2004. Mean values for length, weight and condition are provided for each smoltification index. The total sample size (N, number sampled) is for length data only.

Smoltification Index	Fork Length (mm)	N	Body Weight (g)	Condition Factor (K)
Parr	116.2	321	15.5	0.96
Transitional	139.6	251	32.3	0.96
Smolt	227.0	1	103.6	0.89

Three trap efficiency tests were conducted in the fall of 2004 with 63 juveniles, representing 13.2% of the run. Mean smolt trap efficiency was 35.1% (range 31.3-39.3%, median = 35.3%).

2005

During the spring and fall migration seasons in 2005, we captured 7,214 juvenile steelhead in the smolt trap. The estimated population of juvenile steelhead in Asotin Creek for 2005 was 27,287 (95% CI = 18,777 – 37,788 juveniles), which was about 593 juveniles per rkm (964 juveniles per mile), above the trapping site near rkm 7.0.

Seasonal trapping summaries are as follows:

The spring 2005 juvenile salmonid trapping season was from 19 January to 25 June 2005 (23 weeks). We captured 6,606 juvenile steelhead during the spring migration season, representing 93.1% of the juvenile steelhead migration in 2005 (Figure 3). Twenty-seven percent (27%) were parr, 62.7% were transitional smolts, 9.9% were smolts (i.e., fully-smolted), and 0.1% were of undetermined development (Figure 4).

During the spring of 2005, 26 trap efficiency tests were conducted with 1,057 juveniles, representing 16.0% of the run. Mean smolt trap efficiency for the spring 2005 migration season was 28.3% (range 8.3-47.0%, median = 28.3%, SD = 10.1%) (Table 2). Smolt trap efficiency for fish in 10 mm increments is presented in Table 3. There was no significant difference in trap efficiency between the three size categories (82-119 mm, 120-149 mm and >150 mm) of the juvenile steelhead tested (Table 4).

The difference in length at migration and size at migration between the spring of 2004 and spring of 2005 is presented in Figures 5 & 6, respectively. The length and timing of the two juvenile migration seasons is similar. However, the number of juveniles less than 110 mm was higher in the spring of 2004 than in the spring of 2005. The percentage of juveniles less than 110 mm was 45.5% in 2004 and 30.0% in 2005 – the area between the curves for fish less than 110 mm in Figure 6 – appeared to be the main influence on the difference in the population estimates (18,457) between the two years.

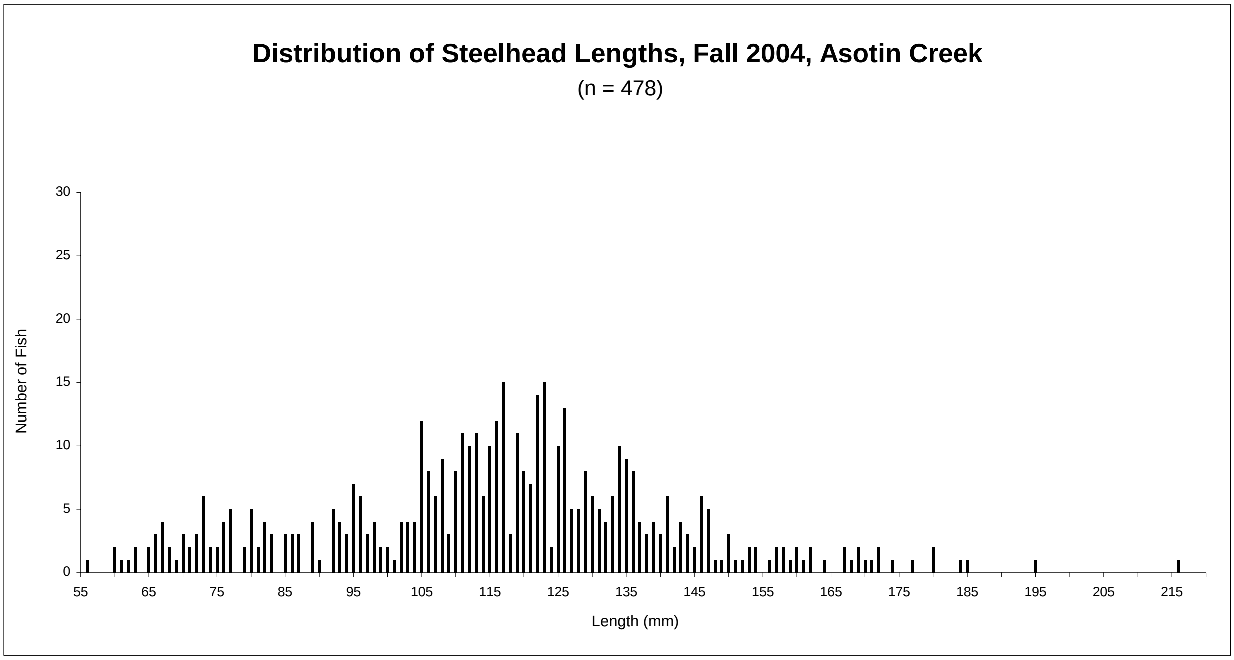

Figure 2. Length distribution of juvenile steelhead captured in Asotin Creek during the fall 2004 migration.

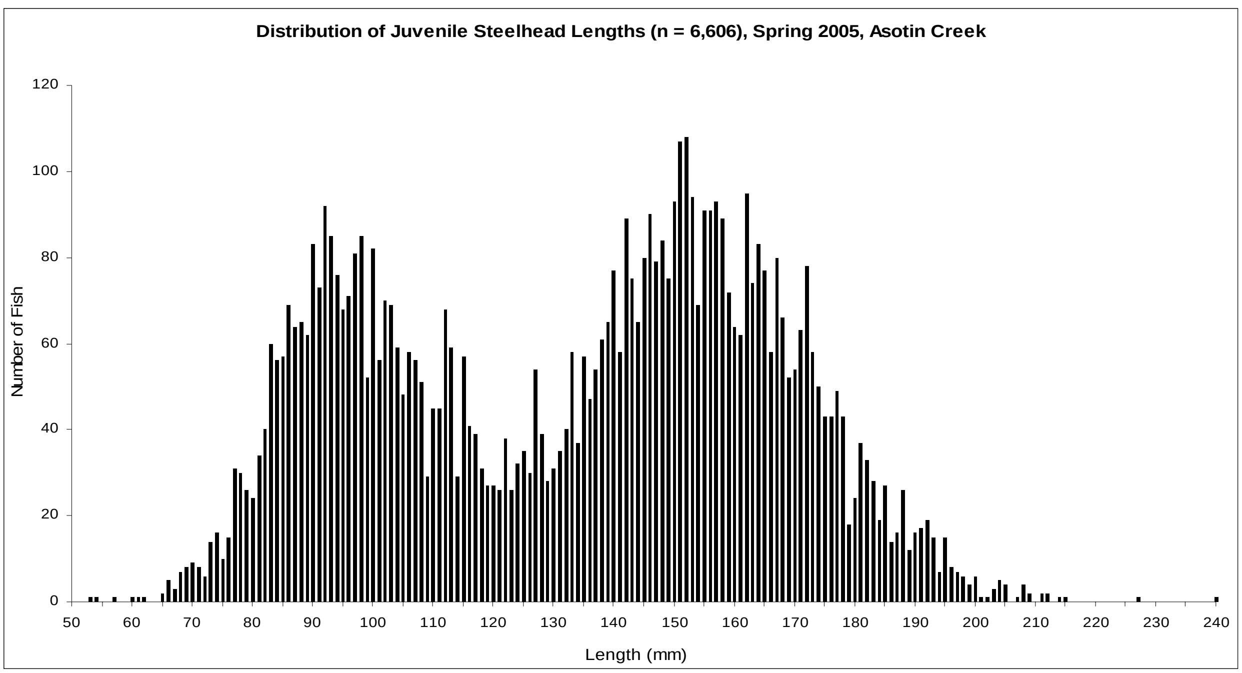

Figure 3. Length distribution of juvenile steelhead captured in Asotin Creek during the spring 2005 migration.

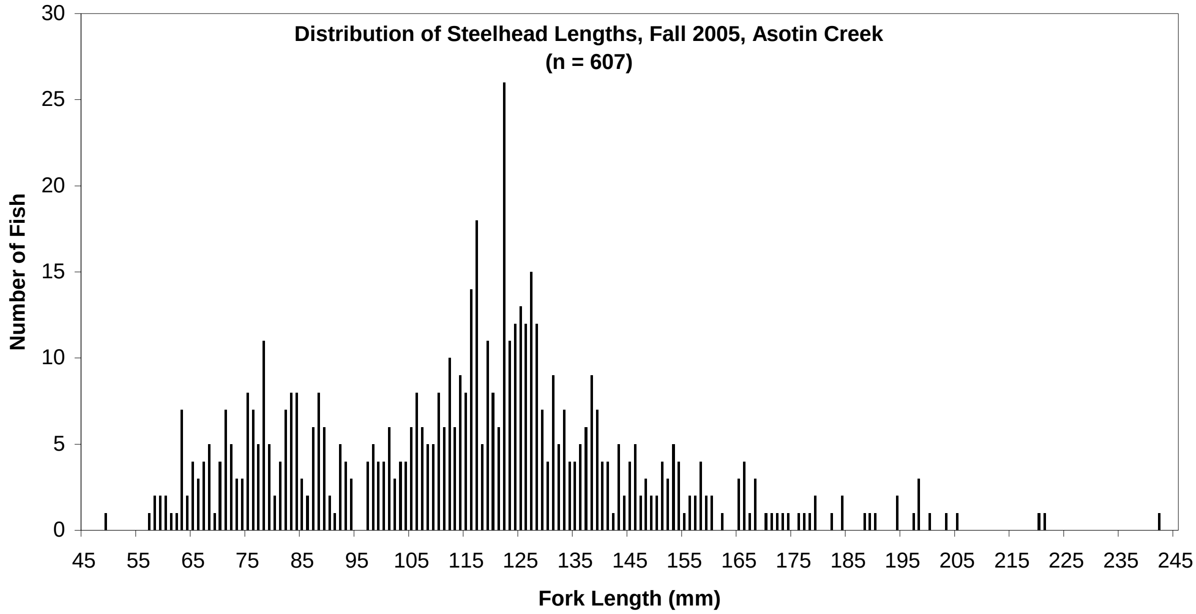

Figure 4. Length distribution of juvenile steelhead captured in Asotin Creek during the fall 2005 migration.

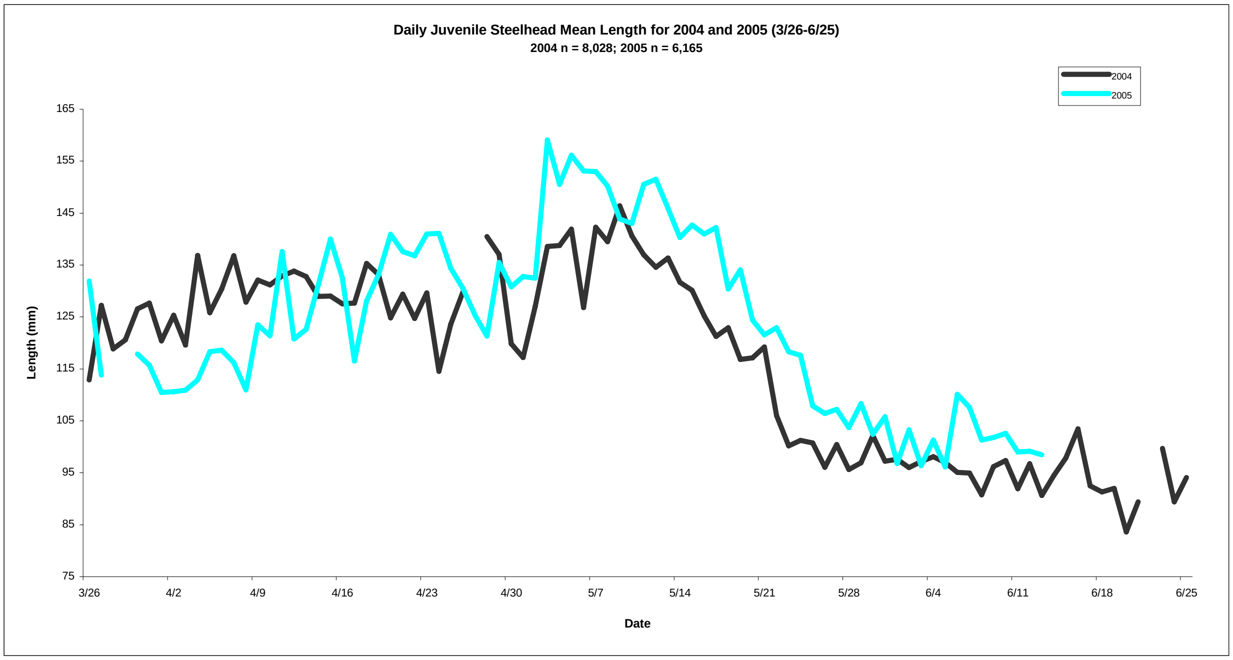

Figure 5. Mean lengths of the daily catch of juvenile steelhead captured in Asotin Creek during the spring 2004 and spring 2005 migration seasons.

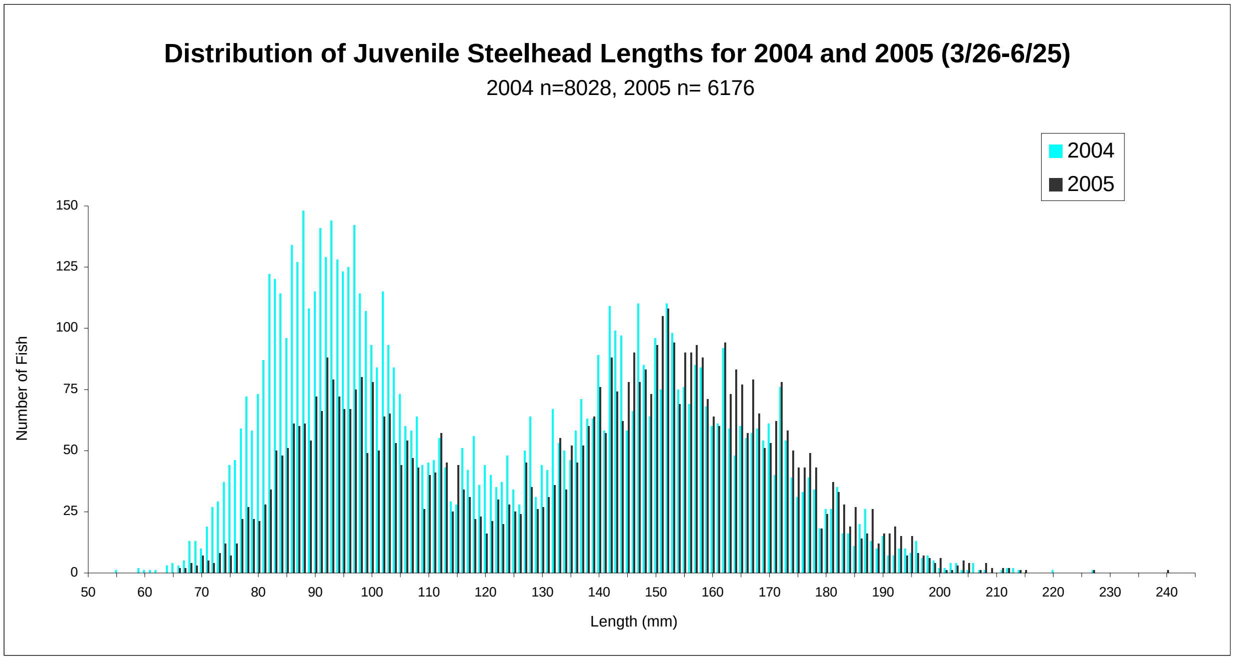

Figure 6. Length distribution of juvenile steelhead captured in Asotin Creek during the spring 2004 and spring 2005 migration seasons.

Table 2. Trapping efficiency for juvenile steelhead during the spring 2005 migration season.

Efficiency Test Date	Efficiency (%)	No. Fish Tested
3/10	33.3	15
3/17	38.5	13
3/21	20.0	15
3/30	14.3	28
4/1	16.0	25
4/4	30.6	36
4/6	14.3	28
4/12	39.3	28
4/16	20.0	20
4/20	27.0	37
4/23	31.7	60
4/27	41.2	17
4/30	45.5	11
5/4	17.5	63
5/7	37.0	100
5/10	33.3	87
5/14	47.0	100
5/19	21.0	100
5/22	27.3	99
5/25	27.9	68
5/28	23.3	43
6/1	37.0	27
6/4	8.3	12
6/8	28.6	7
6/11-12	27.3	11
6/18-19	28.6	7

Table 3. Trapping efficiencies for juvenile steelhead based on fork length, including number of fish tested, and 95% lower (LCL) and upper (UCL) confidence limits of the efficiency estimate.

Fork Length (mm)	Efficiency (%)	No. Fish Tested	LCL	UCL
82-89	49.0	49	35.5%	62.6%
90-99	37.4	139	29.8%	45.7%
100-109	26.5	98	18.8%	36.1%
110-119	27.7	83	19.2%	38.2%
120-129	23.8	84	16.0%	34.0%
130-139	30.9	97	22.6%	40.7%
140-149	33.6	125	25.9%	42.3%
150-159	36.4	140	29.0%	44.7%
160-169	24.1	108	17.0%	33.0%
170-179	19.7	76	12.4%	30.1%
180-189	9.4	32	3.4%	24.3%
190-199	27.8	18	12.6%	51.2%
200+	na	8	0.2%	33.6%
Overall	30.0	1057	27.3%	32.8%

Table 4. Trapping efficiencies for three size ranges of juvenile steelhead based on fork length, including the number marked (N), standard deviation of the efficiency estimate, and 95% lower (LCL) and upper (UCL) confidence limits of the efficiency estimate.

Fork Length (mm)	Efficiency (%)	No. Fish Tested	LCL	UCL
82-114	35.4	325	30.4%	40.7%
115-149	29.1	350	24.6%	34.1%
150+	26.2	382	22.0%	30.8%
Overall	30.0	1057	27.3%	32.8%

Run timing of the spring 2005 juvenile steelhead migration, based on the estimated juvenile steelhead population, was as follows: 50% migrated past the trapping location by 5/6/05, 75% by 5/14/05, and 90% by 5/23/05. Peak emigration occurred in May when 4,489 juvenile steelhead (68.0% of the spring migrants) were captured. Approximately 15.2% (1,003) of the spring migrants were captured during a 2-day period on May 7-8.

Scale samples were collected from 2,279 juvenile steelhead in the spring of 2005, representing 34.5% of the run. The majority (82.4%) of the scales were readable. Scale aging indicated that 34.7% of the spring 2005 juvenile steelhead migrants were age 1, 48.2% were age 2, 16.9% were age 3, and 0.1% were age 4 (Table 5). Mean fork length began to increase in April, reached its highest point in early May (coinciding with the peak migration), and then began to decline in late May following peak migration (Table 6).

Table 5. Summary of biological data collected on juvenile steelhead captured during the spring of 2005. Mean values for length, weight, condition, and age are provided for each smoltification index. The total sample size (N, number sampled) is for length data only.

Smoltification Index	Fork Length (mm)	N	Body Weight (g)	Condition Factor (K)	Age (years)
Parr	93.8	1,805	9.3	1.09	1.1
Transitional	143.4	4,140	30.9	1.02	2.0
Smolt	174.0	656	55.5	1.01	2.2

Table 6. Summary of biological data collected of juvenile steelhead captured during the spring of 2005. Mean values for length, weight, condition, and age are provided for each week. The total sample size (N, numbered sampled) is for length data only. ("-"means data not available.)

Week	Date (Week of)	Fork Length (mm)	N	Body Weight (g)	Condition Factor (K)
1	1/19	105.1	65	12.7	0.99
2	1/23	105.5	45	14.3	0.96
3	1/30	102.6	19	-	-
4	2/6	102.7	15	-	-
5	2/13	103.9	19	-	-
6	2/20	119.1	21	-	-
7	2/27	107.3	28	-	-
8	3/6	101.9	79	12.5	1.05
9	3/13	106.9	63	14.9	1.03
10	3/20	113.9	61	17.9	1.07
11	3/27	113.5	230	17.8	1.05
12	4/3	115.6	521	18.1	1.02
13	4/10	125.5	247	22.6	1.02
14	4/17	137.3	269	29.2	1.00
15	4/24	132.3	234	27.6	1.05
16	5/1	152.9	1050	39.2	1.01
17	5/8	147.4	1543	32.7	1.01
18	5/15	134.9	1180	28.3	1.02
19	5/22	113.9	588	18.1	1.09
20	5/29	103.2	234	13.5	1.22
21	6/5	102.8	54	14.9	1.22
22	6/12	99.0	28	12.7	1.25
23	6/19	109.2	13	15.7	1.16

The fall 2005 juvenile salmonid trapping season was from 27 September to 7 December 2005 (11 weeks). We captured 608 juvenile steelhead during the fall migration, yielding a population estimate of 2,865 (95% CI = 1,772 – 4,347 juveniles), representing 6.9% of the juvenile steelhead migration in 2005. Fifty-two point eight percent (52.8%) were parr, 41.3% were transitional smolts, 0.3% were smolts, and 5.6% were of undetermined development (Table 7).

Table 7. Summary of biological data collected of juvenile steelhead captured during the fall of 2005. Mean values for length, weight, condition, and age are provided for each smoltification index. The total sample size (N, number sampled) is for length data only.

Smoltification Index	Fork Length (mm)	N	Body Weight (g)	Condition Factor (K)	Age (years)
Parr	99.3	321	12.0	1.02	1.1
Transitional	134.7	251	26.3	1.00	1.1
Smolt	231.5	2	125.0	1.00	2.0

Five trap efficiency tests were conducted in the fall of 2005 with 122 juveniles, representing 20.1% of the run (Table 8). Mean smolt trap efficiency was 35.1% (range 30.8-46.2%, median = 33.3%, SD = 6.3%). There was no significant difference in trap efficiency between the three size categories (82-119 mm, 120-149 mm and >150 mm) of the juvenile steelhead tested (Table 9).

Table 8. Trapping efficiency for juvenile steelhead captured during the fall of 2005.

Efficiency Test Date	Efficiency (%)	No. Fish Tested
10/28	33.3	18
11/1	33.9	62
11/4	46.2	13
11/9	31.3	16
11/11	30.8	13

Table 9. Trapping efficiencies for three size ranges of juvenile steelhead based on fork length, including the number marked (N), standard deviation of the efficiency estimate, and 95% lower (LCL) and upper (UCL) confidence limits of the efficiency estimate.

Fork Length (mm)	Efficiency (%)	No. Fish Tested	LCL	UCL
82-114	38.5%	39	24.9%	54.2%
115-149	30.4%	79	21.3%	41.3%
150+	20.8%	24	9.4%	40.7%
Overall	31.0%	142	24.0%	39.0%

Scale samples were collected from 173 juvenile steelhead, representing 28.5% of the run. Most, (90.8%) of the scales were readable. Five point one percent were age 0, 71.3% were age 1, 19.7% were age 2, and 3.8% were age 3. Mean fork length did not change significantly during the fall 2005 migration season.

A summary of total catch and population estimates (with 95% upper and lower confidence interval) for juvenile steelhead from the fall 2005, spring 2005, fall 2004 and spring 2004 migrations is presented in Table 10.

Table 10. Total catch and population estimates (with 95% confidence intervals) for juvenile steelhead emigrating from Asotin Creek for four migration seasons in 2004 and 2005.

	Fall 2005	Spring 2005	Fall 2004	Spring 2004*
Catch	608	6,606	478	8,028
Estimate	2,865	24,422	2,287	43,457
Lower CI	1,772	17,005	1,771	37,972
Upper CI	4,347	33,441	2,805	48,942

*In the spring of 2004, the juvenile trap was located 7.5 rkm above the fall 2004 and 2005 trapping location.

There were a total of 56 (0.8%) juvenile steelhead mortalities from trapping operations. Fifty-nine percent (33 fish) of the mortalities were due to a high fall debris flow on a single day.

We tagged 2,462 juvenile steelhead, representing 34.6% (2,290) of the spring 2005 migrants and 28.3% (172) of the fall migrants, with PIT tags in 2005. Over half (54.6%) of the juvenile steelhead tagged in the spring of 2005 were detected at dams on the Snake and Columbia Rivers (Tables 11 & 12).

Table 11. Numbers of juvenile steelhead PIT tagged during the spring of 2005 that were detected while migrating past the mainstem dams on the Snake and Columbia Rivers.

Age	1	2	3	4	Undetermined	Total
Number Tagged	642	755	252	2	639	2,290
Number Detected	50	579	223	2	396	1,250
Detection Rate	7.8%	76.6%	88.5%	100%	62.0%	-

PIT tag detection rates of juvenile steelhead appeared to be strongly related to size and age (Table 12). Juvenile steelhead greater than 125 mm in length were more likely to be detected at the dams than steelhead less than 125 mm (Figures 7, 8, 9 and 10).

Table 12. Numbers of juvenile steelhead PIT tagged during the spring of 2005, and detection rates of tagged fish migrating past the mainstem dams on the Columbia and Snake Rivers. Number of fish tagged and the corresponding detection rate is given for smoltification index and size range. ("Trans" means transitional smolt index classification; "-"means data not available.)

Fork Length (mm)	Smoltification Index / Tag Status - Detection	Parr	Trans	Smolt	Overall
82-114	Tagged (n)	591	195	0	784
	Detection Rate	2.5%	3.1%	-	2.7%
115-149	Tagged (n)	31	609	18	658
	Detection Rate	12.9%	74.4%	94.4%	72.0%
150+	Tagged (n)	0	650	196	846
	Detection Rate	-	87.4%	86.2%	87.1%
Overall	Tagged (n)	622	1454	214	2290
	Detection Rate	3.1%	70.6%	86.9%	54.6%

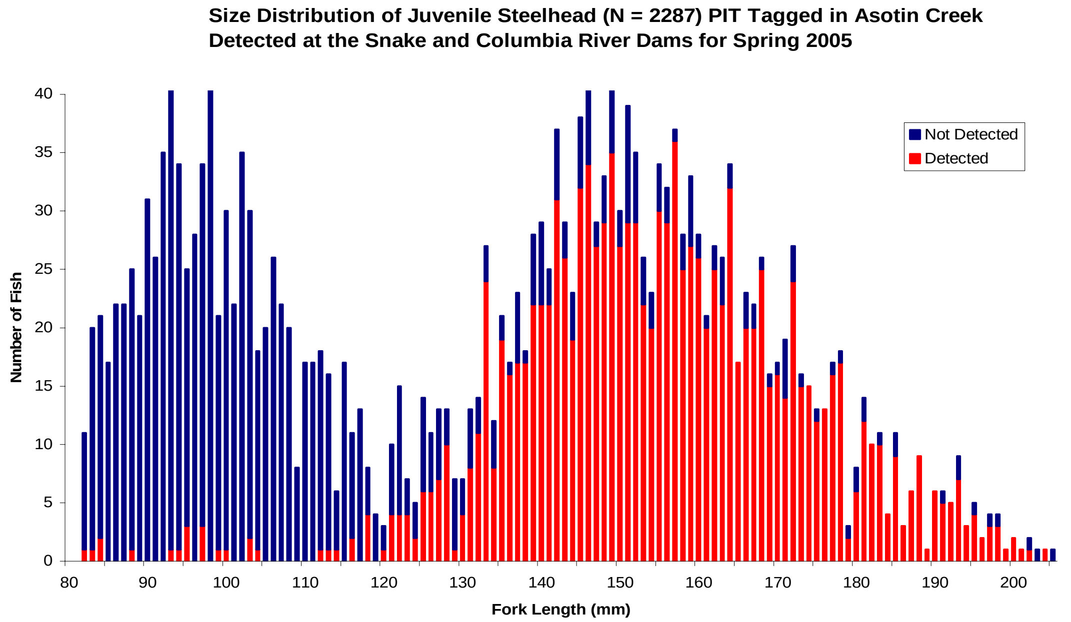

Figure 7. Length distribution of juvenile steelhead PIT tagged in Asotin Creek during the spring of 2005. "Detected" is from detections at mainstem dams on the Snake and Columbia Rivers.

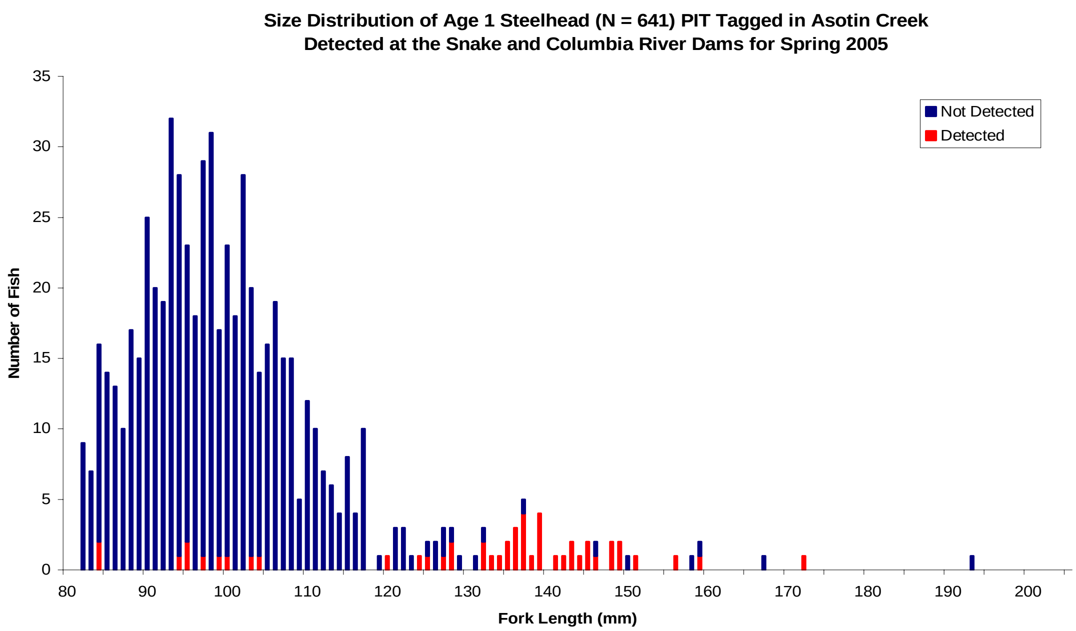

Figure 8. Length distribution of age 1 steelhead PIT tagged in Asotin Creek during the spring of 2005. "Detected" is from detections at mainstem dams on the Snake and Columbia Rivers.

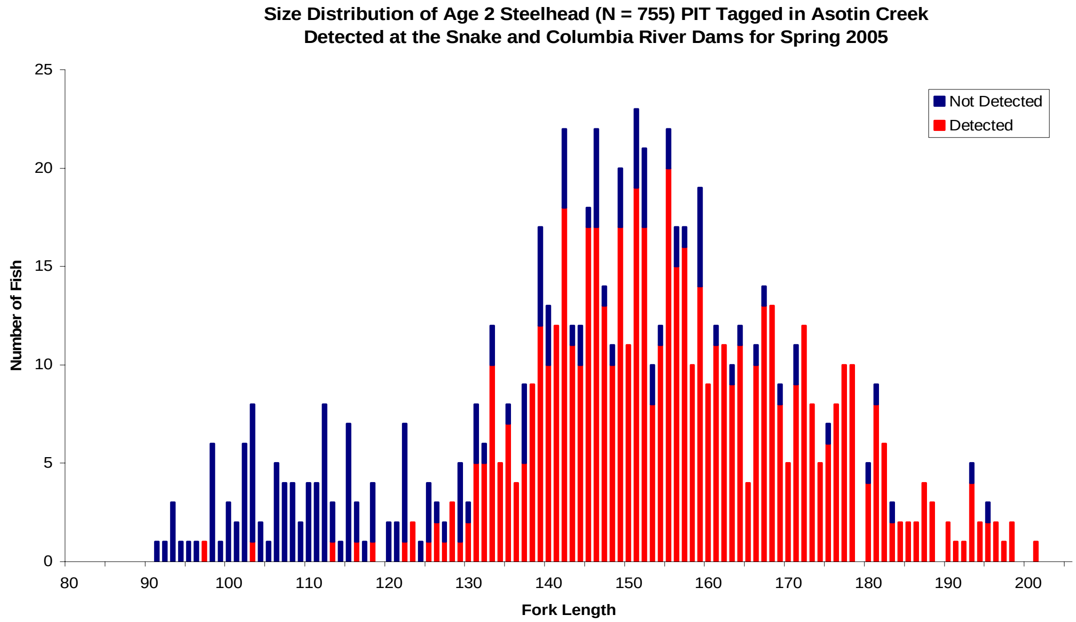

Figure 9. Length distribution of age 2 steelhead PIT tagged in Asotin Creek during the spring of 2005. "Detected" is from detections at mainstem dams on the Snake and Columbia Rivers.

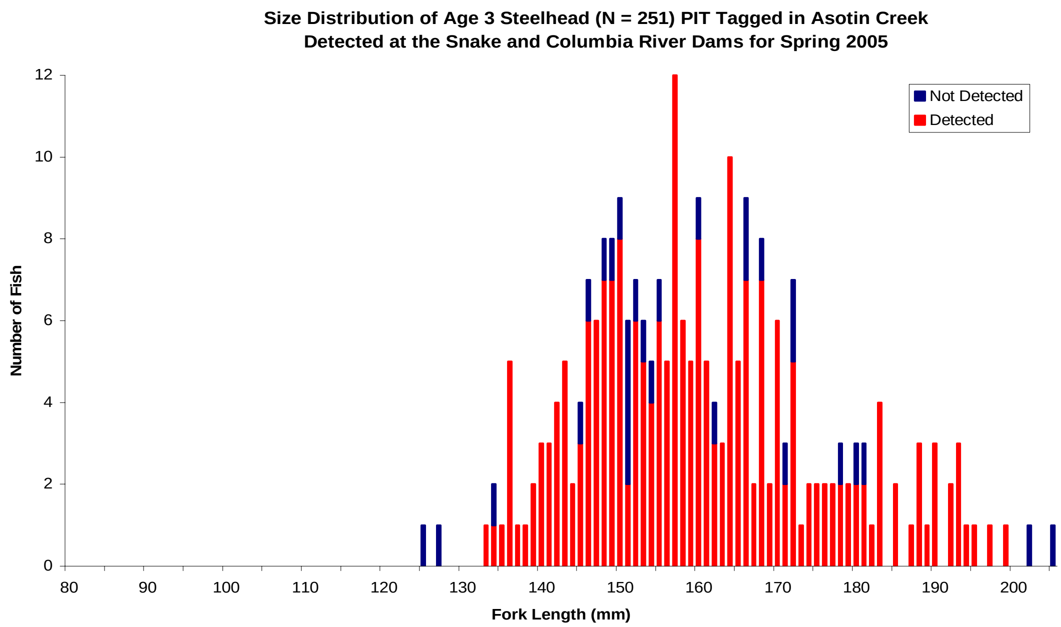

Figure 10. Length distribution of age 3 steelhead PIT tagged in Asotin Creek during the spring of 2005. "Detected" is from detections at mainstem dams on the Snake and Columbia Rivers.

Other juvenile species of interest

The fall 2004 juvenile Chinook salmon trapping season was from 3 November to 12 December 2004 (5 weeks). We captured 11 juvenile Chinook salmon during the fall run, representing 0.6% of the juvenile Chinook salmon run in 2004. Mean length was 83.1 mm (range = 76-91 mm), mean weight was 6.0 grams the mean condition factor was 1.13. No age data were collected. Assuming the same smolt trap efficiency (45.7%) as in the spring of 2004, the population estimate for the 2004 fall Chinook salmon run was 24 juveniles.

Fewer juvenile Chinook salmon (yearlings and sub-yearlings) were captured in 2005 than in 2004 (Schuck and Mayer 2004). Most (83.1%: 201) juvenile Chinook salmon captured in 2005 were from the spring migration season (Figure 11), resulting in a population estimate of 292 juvenile Chinook salmon emigrating from the Asotin Creek Subbasin above the trapping site in 2005. The difference in the number of juvenile Chinook salmon captured between the spring of 2004 and the spring of 2005 (March 26 to June 25) is presented in Figure 12.

During the spring 2005 juvenile Chinook salmon migration season, seven trap efficiency tests were conducted with 39 juveniles, representing 21.4% of the run (Table 13). Mean smolt trap efficiency was 64.7% (range 40.0-83.3, median = 66.7%, SD = 15.7%).

Table 13. Trapping efficiency for juvenile Chinook captured during the spring of 2005.

Efficiency Test Date	Efficiency (%)	No. Fish Tested
5/23	83.3%	6
5/24	66.7%	6
5/25	75.0%	4
6/1	60.0%	5
6/4	77.8%	9
6/8	50.0%	4
6/11	40.0%	5

Scale samples were collected from 60 juvenile Chinook salmon, representing 33.0% of the run: 98.3% of the scales were readable. Most (88%) were age 0 and 12% were age 1.

We captured 37 juvenile Chinook salmon during the fall of 2005, representing 16.9% of the juvenile Chinook run in 2005. No trap efficiency trials were conducted due to the low number of juvenile Chinook salmon in the fall. Assuming the same smolt trap efficiency (64.7%) as in the spring of 2005, the population estimate for the fall 2005 Chinook salmon emigration was 57.

The mean length, weight and condition factor of juvenile Chinook salmon sub-yearling and yearling migrants from the spring and fall 2005 migrations are presented in Table 14. A 0-age mature (precocious) male spring Chinook salmon parr was captured on October 10, 2005, which was 83 mm in length and expressed milt upon handling.

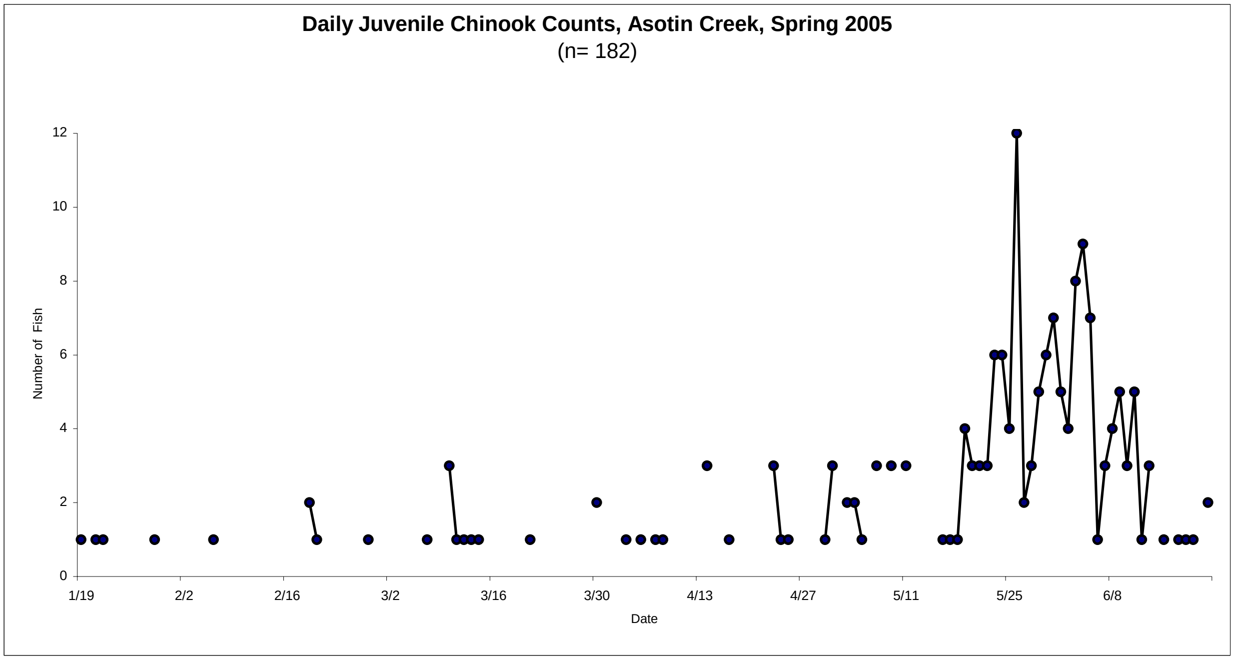

Figure 11. Daily catch of juvenile Chinook salmon captured in Asotin Creek during the spring of 2005.

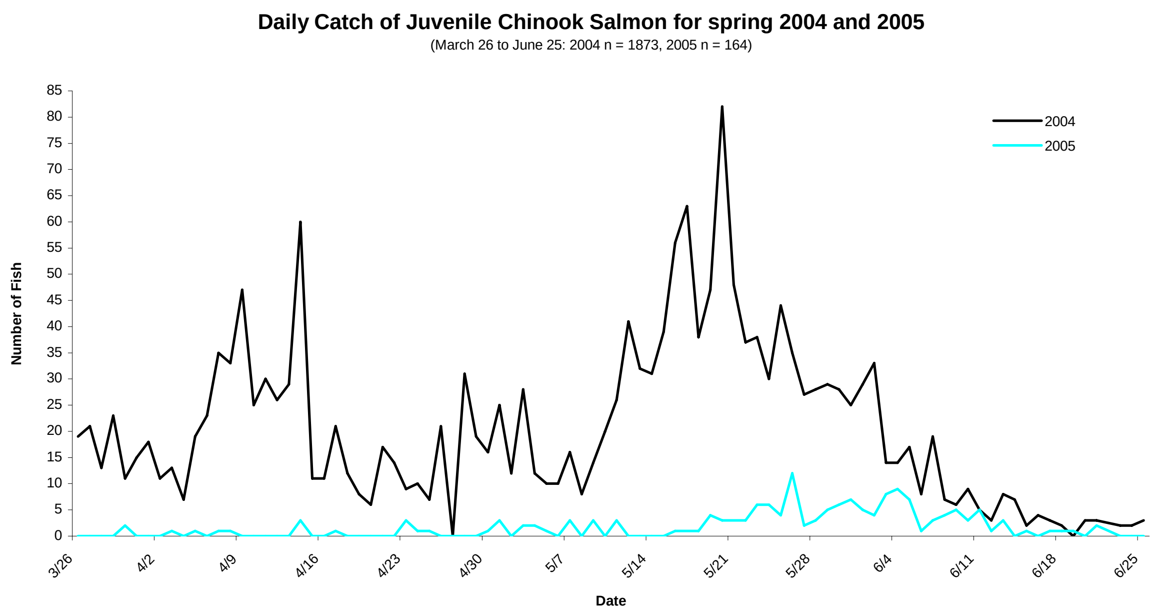

Figure 12. Daily catch of juvenile Chinook salmon captured in Asotin Creek during the spring 2004 and spring 2005 migration seasons

Table 14. Summary of biological data collected for juvenile Chinook salmon captured during 2005. Mean values for length, weight, condition, and age are provided for each age class and season. The total sample size (N, number sampled) is for length data only.

Run Timing	Age Class	Fork Length (mm)	N	Body Weight (g)	Condition Factor (K)
Spring	Sub-yearling	70.5	151	4.2	1.14
	Yearling	86.4	31	8.2	1.13
Fall	Sub-yearling	80.4	37	5.7	1.11

Ten bull trout were captured in 2005. Biological data for all bull trout captured in 2005 are presented in Table 15.

Table 15. Biological data collected for juvenile bull trout captured during 2005.

Date Captured	Fork Length (mm)	Body Weight (g)	Condition Factor (K)	Age (years)
5/5	126	17.6	0.88	2
5/9	117	12.6	0.79	1
5/28	132	25.3	1.10	2
5/30	135	22.7	0.92	-
6/2	115	15.3	1.01	2
6/3	132	23.4	1.02	2
6/11	129	23.6	1.10	2
6/12	125	21.0	1.08	2
6/21	151	30.6	0.89	2
10/31	250	186.1	1.19	3

Other fish species captured in the smolt trap in 2004-2005 include sculpin, dace and bridgelip suckers.

Adults

Steelhead

We captured 513 adult steelhead at the adult trap in 2005, yielding a population estimate of 653 adult steelhead spawning in 46 km of accessible steelhead habitat above the trapping location near river km 7.0. We estimated that 611 (92.4%) naturally produced fish [332 (57.4%) females and 279 (42.6%) males] and 42 (7.6%) hatchery fish [26 (61.9%) females and 16 (38.1%) males] passed the trap to spawn in Asotin Creek in 2005.

The 2005 adult salmonid trapping season was from 19 January to 27 May, 2005 (19 weeks), and was the first season of adult trapping in Asotin Creek. The floating weir was submerged during a 3-day period, from March 27-29, because of a rapid increase in creek discharge (i.e., freshet). We captured 391 fish (367 wild and 24 hatchery) as pre-spawners at the weir during their upstream migration (Figure 13). Two-hundred and forty-three adult steelhead (62.1% of the spawning population in 2005) were captured in March, with 92 (23.5% of the spawning population) captured during a 3-day period, from March 27-29.

Run timing of the 2005 adult steelhead spawning migration, based on estimated adult steelhead passage, is presented in Table 16. Wild males appeared to migrate upstream past the trapping location about one week earlier in the spawning season than females. Installation of the weir was completed and the trapping operation began on January 18, 2005. However, we have strong indications that a small, early component of the spawning population in 2005 was not captured. An unmarked female kelt was recovered on January 22, 2005. Fifty-two point seven percent (52.7%) of the wild pre-spawners and 86.8% of the hatchery pre-spawners were re-captured as kelts ("returns") at the weir location upon their out-migration following spawning (Figure 14). We had a 94.9% Floy® tag retention rate for adult steelhead re-captured at the weir as kelts.

Table 16. Run timing of adult steelhead captured at the weir in 2005.

Run Timing	Entire Run	Male	Female
First capture	1/19	1/19	2/15
50% at weir	3/27	3/23	3/29
75% at weir	4/4	3/30	4/7
90% at weir	4/22	4/18	4/23

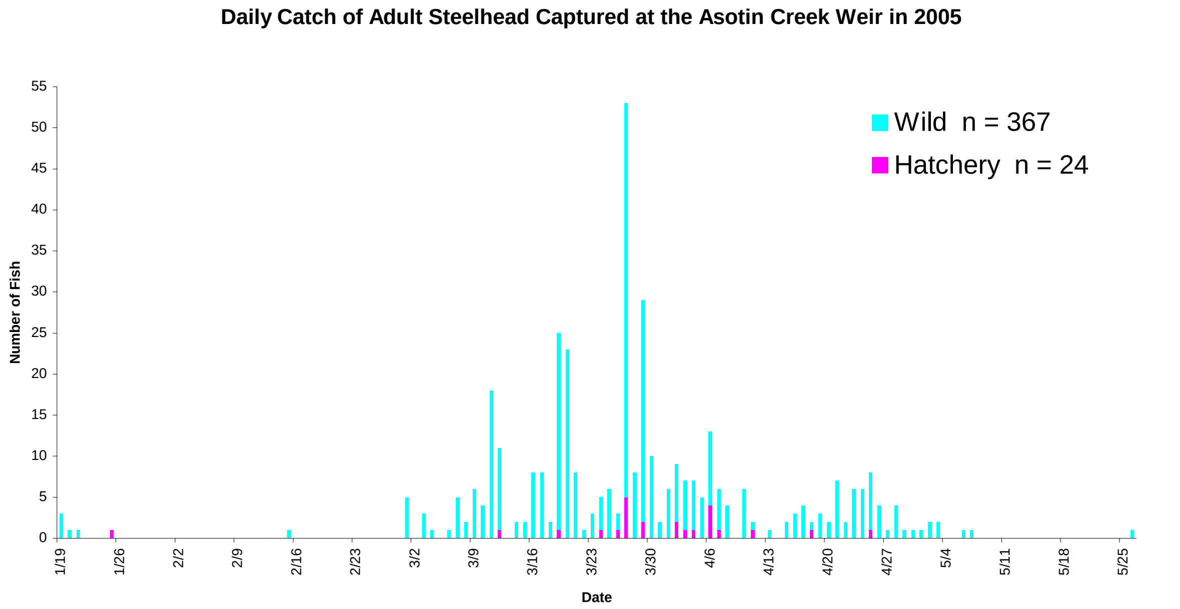

Figure 13. Daily catch of adult steelhead captured at the Asotin Creek weir in 2005 by origin.

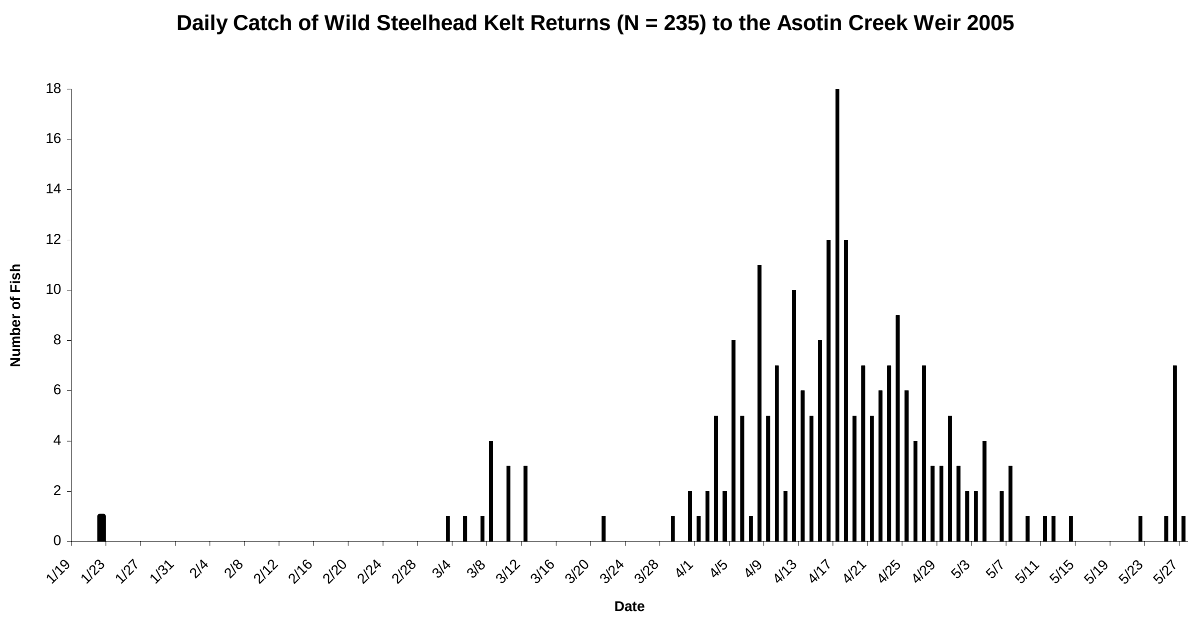

Figure 14. Daily catch of steelhead kelts re-captured at the Asotin Creek weir in 2005.

Over half (53.3%) of all marked females returned and were captured at the weir after spawning. The median time spent by marked wild females above the weir location was 16.0 days (range 5-41 days (Table 17). The median time spent by marked hatchery females above the weir was 12.0 days (range 7-20 days). Substantially fewer (23.7%) marked males returned to the weir as kelts and were recaptured. The median time spent by marked wild males above the weir was 27 days (range 4-56 days) (Table 17). The median time spent by marked hatchery males above the weir was 20 days (range 11-27 days).

Table 17. Summary statistics of days spent above weir for adult females and males in 2005.

	Wild			**Hatchery**		
Statistic	Female	Male	Total	Female	Male	Total
N	271	177	448	23	14	37
Median Days Up	16	27	17	12	20	13
Mean Days Up	18.3	27.9	20.7	11.8	19.3	14.9
Std Dev (days)	8.8	12.7	10.7	3.8	6.4	6.2

We collected scale samples from 99.6% of all adult steelhead captured at the weir. Scale age data from juveniles and adults indicates that smolts leave the subbasin (or possibly the Snake River drainage) at ages 1 to 4 and returned as adults after 1 to 3 years in the ocean, but most adults returned (88%) as age 3 and 4-year olds (Table 18). (For additional information about scale ages, see the juvenile scale age results above.) The proportion of wild adult female repeat spawners was 2.9%. There were no male repeat spawners.

Table 18. Total age of adult steelhead captured in 2005.

Total Age	**Wild**		**Hatchery**		**Total**	
(years)	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
2	9	2.6%	20	54.1%	29	7.6%
3	126	36.4%	14	37.8%	140	36.6%
4	192	55.5%	3	8.1%	195	50.9%
5	19	5.5%	0	0.0%	19	5.0%
Unreadable	113	24.5%	1	2.6%	114	22.8%
Total	461	-	38	-	499	-

Most wild females (73.5%) returned to spawn after spending 2 years in the ocean (Figure 15). The rest (16.5%) returned after one year in the ocean (Table 19). Conversely, most wild male steelhead (61.7%) returned after spending 1 year in the ocean and 38.3% of the wild males returned after 2 years in the ocean (Figure 16). We collected length data on 99.6% of all adult (100% of the wild) steelhead captured at the weir in 2005. Mean adult steelhead lengths by saltwater age and origin are presented in Table 20.

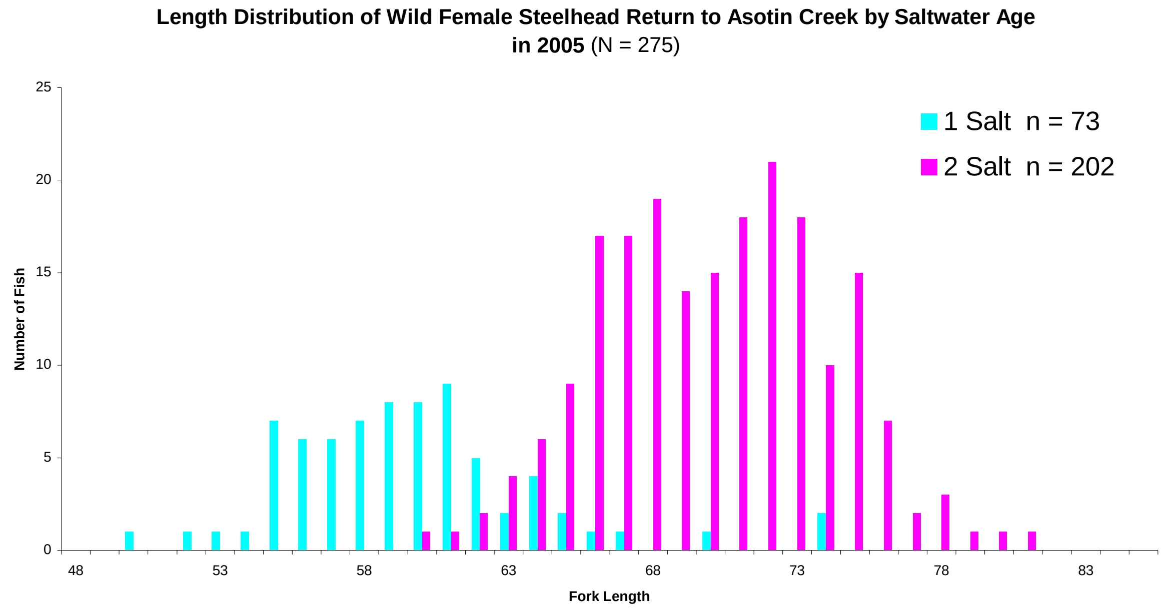

Figure 15. Length distribution of wild adult female steelhead spawning in Asotin Creek in 2005 by ocean (salt) age.

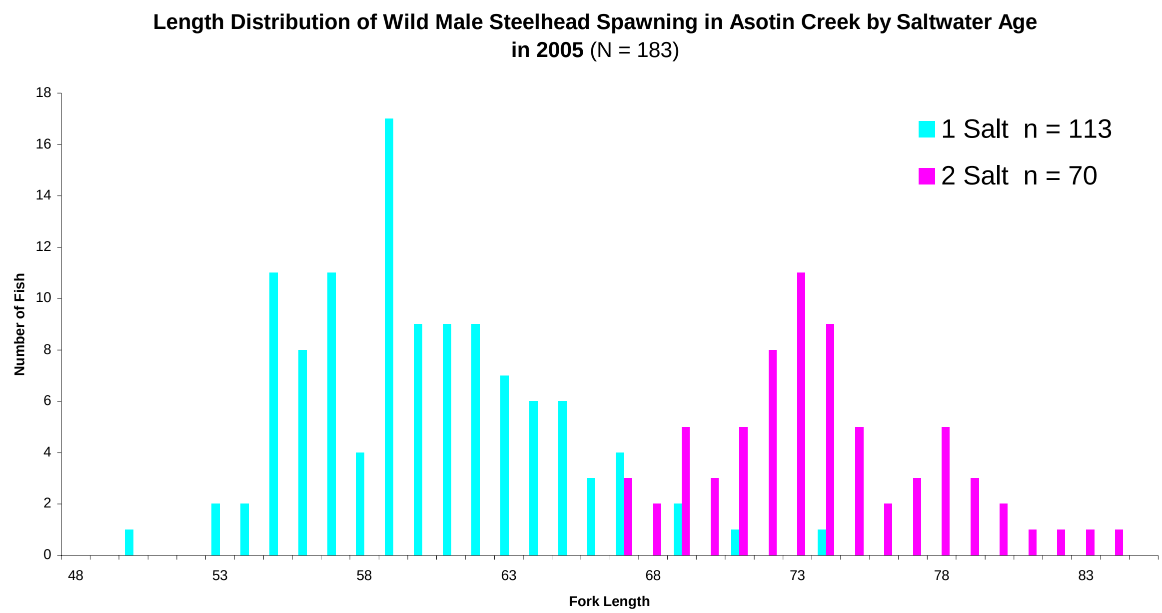

Figure 16. Length distribution of wild adult male steelhead spawning in Asotin Creek in 2005 by ocean (salt) age.

Table 19. Age composition of adult (wild and hatchery) steelhead captured in 2005 by origin and sex. The percentage of each age class and percentage of unreadable scales is included.

Origin	Age (fresh.salt)	Male		Female		Total	
		Number	Percent	Number	Percent	Number	Percent
Wild	1.1	8	5.7	1	0.5	9	2.6
	1.2	4	2.9	10	4.9	14	4.0
	2.1	68	48.6	44	21.4	112	32.4
	2.2	43	30.7	118	57.3	161	46.5
	3.1	14	10.0	17	8.3	31	9.0
	3.2	2	1.4	16	7.8	18	5.2
	4.1	1	0.7	0	0.0	1	0.3
	Total	140	-	206	-	346	-
	Unreadable	46	24.7	69	25.1	115	24.9
Hatchery	1.1	10	76.9	10	41.7	20	54.1
	1.2	2	15.4	10	41.7	12	32.4
	2.1	1	7.7	1	4.2	2	5.4
	2.2		0.0	3	12.5	3	8.1
	Total	13	-	24	-	37	-
	Unreadable	1	7.1	0	0.0	1	2.6

Table 20. Mean fork length of adult steelhead captured in 2005. Lengths are given in centimeters by origin, sex and saltwater age.

Origin	Saltwater Age	Length Measurement	Female	Male	Combined
Wild	1	N	73	113	186
		Fork Length	57.5	58.0	57.8
		Std. Dev.	4.3	4.2	4.2
	2	N	202	70	272
		Fork Length	68.0	71.8	69.0
		Std. Dev.	3.9	3.9	4.2
Hatchery	1	N	11	12	23
		Fork Length	57.0	55.1	56.0
		Std. Dev.	3.0	2.5	2.8
	2	N	13	2	15
		Fork Length	68.5	67.0	68.3
		Std. Dev.	2.8	2.8	2.8

The median length of repeat spawners was 69.0 cm (range = 61-77 cm). Repeat spawners spent an average of 1.8 years in salt water prior to first spawning (n = 8), and an additional 0.8 years in salt water after first spawning (between first and second spawnings). Eight females died prior to spawning and were checked for fecundity (Table 21). The mean and median fecundity of wild females was 4,396 eggs and 3,628 eggs, respectively) (range = 3,047-7,161 eggs).

Table 21. Fecundity (number of eggs) of adult steelhead from Asotin Creek in 2005.

Date Sampled	Fork Length (cm)	Age	Fecundity
3/5	69	r.2	3412
3/8	63	2.2	6643
3/8	77	2.2	7161
3/12	71	2.2	3151
4/13	61	r.2	3844
4/25	67	r.2	4548
4/9	59	3.1	3047
5/12	65	r.2	3365

Carcasses were recovered from 19 (50%) of the hatchery-origin spawners, and 12 had coded wire tags (CWT). Of the CWT tags recovered, 8 (66.7%) were from WDFW's Lyons Ferry hatchery stock and 4 (33.3%) were from hatchery-reared Tucannon stock.

There were a total of seven adult steelhead mortalities from trapping operations in 2005. Four resulted from impingement between weir pickets. After picket modifications and the installation of additional stringers and netting, there were no further mortalities due to equipment design.

Steelhead spawning ground surveys were performed over most of the available spawning habitat above the weir location in the Asotin Creek watershed (about 46 km; 28.6 miles) in 2005 (Table 22). Because not all stream reaches were walked for their entire length, index and reach lengths were estimated using Terrain Navigator® computer mapping software (Maptech 2004). There was an estimated total of 396 redds above the weir location in 2005. Based on the estimated total number females that spawned above the weir in 2005, there were 0.904 females per redd.

There were 92 redds in the mainstem Asotin Creek in the 2.4 rkm (1.5 mile) reach below the weir downstream to George Creek. The incidence of redds per km below the weir was relatively high compared to above the weir. We believe this may have resulted from two primary reasons: First, some fish may have rejected the weir and turned back downstream to spawn in this reach. Secondly, insufficient flows in George Creek and other nearby streams did not allow spawning steelhead access to the entire system in 2005. Fish destined for but unable to enter George Creek would likely have spawned near the mouth of George Creek in mainstem Asotin Creek below the weir.

Other fish species captured at the adult trap in 2005 included a 69 cm (age undetermined) female Coho salmon (*O. Kisutch*) captured on 11/9/05, a 41 cm (age undetermined) bull trout captured on 12/28/05, and >250 migrating adult (spawning) bridgelip suckers.

Table 22. Steelhead redds identified during surveys for the reaches listed in the spring of 2005.

Reach	Location Description	River Km	River Mile	No. Redds	Redds per km	Redds per mile
Mainstem: Below trap	George Creek to Trap	2.4	1.5	92	38.3	61.3
Mainstem: Above trap	Trap to Confluence	18.1	11.2	266	14.7	23.8
North Fork (NF)	Middle Fork (of NF) to NF/SF confluence	16.0	9.9	70	4.4	7.1
South Fork (SF)	Below beaver dams	1.5	0.9	19	12.7	21.1
Charley Creek	Old Corral to Mainstem	10.3	6.4	41	4.0	6.4
Summary						
Total redds above rkm 7.0	Above trap: Mainstem, NF, SF, Charley	45.9	28.4	396	8.6	13.9
Total redds above rkm 4.6	Above George Creek (includes below weir)	48.3	29.9	488	10.1	16.3

Other adult species of interest

In 2005, 17 adult Chinook salmon were captured (Table 23). Fifteen were captured as pre-spawners, and two were captured as post-spawners. Thirteen (81.2%) of the spring Chinook salmon captured were naturally-produced and 3 (18.8%) were strays of unknown (but likely Snake River) hatchery origin. A 47 cm male "jack" captured on 16 November was believed to be a stray hatchery fall Chinook salmon.

Table 23. Biological data for adult Chinook salmon captured in 2005. ("u" undetermined.)

Date	Condition	Origin	Sex	Length (cm)	Age
5/14	Pre-spawn	wild	female	63	u.u
5/18	Pre-spawn	wild	male	69	1.2
5/19	Pre-spawn	wild	unknown	66	1.2
5/21	Pre-spawn	wild	female	72	1.2
5/21	Pre-spawn	wild	male	57	1.2
5/22	Pre-spawn	wild	female	69	1.2
5/23	Pre-spawn	wild	unknown	62	1.2
5/24	Pre-spawn	wild	female	71	1.2
5/25	Pre-spawn	wild	unknown	72	1.2
5/29	Pre-spawn	wild	female	68	1.2
6/18	Pre-spawn	hatchery	female	80	1.3
6/27	Pre-spawn	wild	male	70	u.2
7/13	Pre-spawn	hatchery	male	50	0.2
7/18	Pre-spawn	wild	male	54	1.2
9/12	Post-spawn	hatchery	male	72	1.2
10/2	Post-spawn	wild	female	72	u.2
11/16	Pre-spawn	hatchery	male	47	0.1

Summary and Conclusions

The current abundance of steelhead in Asotin Creek is notable in the Snake River basin. They have shown a resiliency to habitat degradation and a persistence of significant adult numbers (>700 in 2005), when other Snake River steelhead populations have slipped toward extinction. Such persistence suggests that the steelhead population in Asotin Creek may be at or above VSP thresholds. Prior to initiation of this project there were limited, but consistent, efforts to estimate adult abundance, collect baseline data on population dynamics and life stage survival (smolt-to-adult, adult-to-adult survival, smolt production by brood year), and collect life history diversity information on Asotin Creek steelhead from summer juvenile sampling. A sizeable investment has now been made toward an increased understanding of the salmonid population in Asotin Creek with this project. Allowing the project to continue until relevant metrics can be described for a small river system with a relatively large steelhead population has potential significant value. This is underscored by early project data that show substantially more adults and juvenile out-migrants in the system than were expected from habitat capacity estimators used in the Subbasin planning process (ASP 2004, p5. 15; 45). Understanding the population dynamics of the Asotin Creek steelhead population can be instructive for understanding small-river summer steelhead biology throughout southeast Washington, and possibly the Interior Columbia basin.

The NOAA Fisheries Viable Salmonid Population (VSP) document (McElhany, et. al. 2000) identified four key parameters for assessing the long-term viability of a population: abundance, population growth rate, population spatial structure and diversity. The prioritization approach used in the Snake River Recovery Plan (and based on the VSP concept) proposes that Asotin Creek be intensively monitored; including estimates of smolt production, smolt-to-adult survival, and adult return, which is critical for determining the effectiveness of proposed recovery actions in the Asotin Creek Subbasin and for tracking the progress of the Snake River Salmon Recovery Plan (Snake River Salmon Recovery Board 2005, p.362).

Project data has provided researchers and managers information that more closely match perceptions based on available empirical information than from supposition and habitat modeling used in the Subbasin planning process. Data collected by this project indicates that current adult steelhead abundance (estimated to be more than 653 adults) is substantially greater than what was estimated (about 200 fish adults) with habitat modeling, but nearly identical to estimates using empirical data collected by WDFW (≈651 adults in the Asotin Creek watershed above George Creek) in the Asotin Subbasin Plan. In addition, the proportion of repeat spawners (2.9%) was higher than expected for a watershed above eight mainstem dams. The estimate of 0.904 females per redd for Asotin Creek summer steelhead may have implications for other eastside, summer-run steelhead populations.

The abundance of out-migrating steelhead smolts, and more interestingly, out-migrating parr and pre-smolts, is higher than expected, but proportionally similar to limited data collected from Charley Creek (a tributary of Asotin Creek) in the mid-1980's. Juvenile steelhead lengths appear to show a bi-modal distribution, with a separation occurring around 125 mm. For example, about 3% and 7% of the juvenile steelhead out-migrated in October and November, in 2004 and 2005, respectively. In addition, the average condition factor of these fall migrants is 9.2% lower than that of spring (2004 & 2005) migrants. Juvenile steelhead could be leaving Asotin Creek because of limited carrying capacity, limited habitat during critical low flow periods in fall and early winter, or they may be utilizing multiple life-history pathways, including the possible use of the Lower Granite dam reservoir or other streams as their final, pre-smolt rearing location.

Asotin Creek steelhead exhibit an array of life history patterns — An indicator of a healthy population. Scale age data from juveniles and adults indicates that smolts leave the Subbasin (and possibly the Snake River drainage) at ages 1 to 4 and return as adults after 1 to 3 years in the ocean. Although no direct supplementation from hatcheries occurs in Asotin Creek, a proportion (7.6%) of the adult steelhead captured in 2005 were hatchery strays that appear to be using Asotin Creek opportunistically for spawning. Additional scenarios exist to explain Asotin Creek steelhead abundance and life history pathways, but several more years of data are needed for a better understanding of how Asotin Creek is being utilized by the present population.

Significant effort has been spent in the Asotin Creek Subbasin to improve and restore fish habitat, improve water quality, decrease sedimentation, and respond to ESA requirements. Most of this activity has taken place after spring Chinook salmon were extirpated from the Asotin Creek Subbasin in the early 1990's. Managers have identified a goal of re-introducing spring Chinook salmon into the basin. The population status monitoring data under this project, and its ability to show a trend relationship to the habitat improvement work, will be critical if there is a re-introduction of spring Chinook salmon into the Asotin Creek Subbasin.

This project will provide more refined and accurate population baselines for steelhead and Chinook salmon, and supplement the efforts of other agencies by providing detailed salmonid data for resource planning, management decisions and salmonid restoration efforts in the Asotin Creek Subbasin. Several projects that are co-occurring in the Asotin Creek Subbasin have referenced the need to utilize data collected over time (i.e., trend analysis). Rather than describing a direct cause-and-effect relationship for any one project, the data from this project will be used as a generalized indicator of improving watershed health resulting from collective actions (e.g. habitat improvement).

Asotin Creek also offers a unique opportunity to serve as a reference stream for evaluating ongoing hatchery supplementation in Southeast Washington streams. Experimental development of endemic broodstocks to aid in the recovery of steelhead is occurring in the Tucannon and Touchet Rivers in an effort to minimize genetic effects from hatchery programs. These rivers are somewhat similar geologically and biologically to Asotin Creek. However, unlike Asotin Creek, all other streams in Southeast Washington have a history of long-term hatchery steelhead releases. Therefore, conducting monitoring and evaluation activities in the Asotin Creek Subbasin will allow managers to compare relative productivity and life history pathways of supplemented and un-supplemented populations with different FCRPS and hatchery impacts.

We believe that the Asotin Creek Project has provided more accurate and refined estimates of adult escapement and juvenile out-migration during the reporting period than has previously been available. However, we consider the results to still be preliminary – Significant biological revelations about the Asotin Creek steelhead population remain to be understood. The answers about the Asotin Creek steelhead population may be provided with additional years of data.

Summary of project accomplishments for the 2004-2005 reporting period

All required ESA and state environmental permits were obtained for the work in this project.

Installed a 1.52-meter (m) rotary screw trap in the fall to capture, sample and estimate the juvenile steelhead and Chinook salmon populations in Asotin Creek emigrating from Asotin Creek in October, November and December.

Submitted the first Annual Report (for FY04) to BPA.

Submitted quarterly status reports to BPA, using the new BPA Pisces format in 2005.

Fabricated and installed a resistance board, floating weir with integrated traps to capture, sample, tag and estimate adult steelhead and Chinook salmon escapement in Asotin Creek.

Completed the first season of adult salmonid trapping in Asotin Creek.

Conducted sight-recapture and redd surveys to assess adult trap efficiency and to estimate the number of adults (females) per redd and spawner abundance in Asotin Creek. These data were analyzed and an estimator of the number of adults per redd for eastside, summer-run steelhead from Asotin Creek was developed (see "Results and Discussion").

Steelhead spawning ground surveys were performed over the entire (100%) range of the available spawning habitat in the Asotin Creek watershed above George Creek.

Completed the second season (and the first full season) of juvenile salmonid (smolt) trapping. Juveniles were tagged with PIT tags and the tag data was uploaded to the PTAGIS database.

Recommendations

1. We propose a refinement of ongoing project activities under objective 1 (estimating the abundance of juvenile salmonids emigrating from Asotin Creek) in order to assess potential bias in standard smolt trapping methodology that could affect the estimate of juvenile out-migration. Weekly estimates of rotary screw trap efficiencies are used at the end of the migration season to estimate total juvenile productivity. One critical assumption of the mark-recapture method is the equal catchability of marked and unmarked (i.e., "naïve") animals (White et al. 1982). Mesa and Schreck (1989), and Peterson et al. (2004), found that juvenile salmonids captured and handled in electrofishing surveys exhibited altered behavior and that the assumption of equal catchability had not been met. Therefore, the population estimator was biased.

Traditionally, the methods used to generate population estimates based on smolt trapping are presumed to meet standard assumptions. However, recent work done on the Deschutes River of Western Washington suggested that fish marked with a fin clip used for capture efficiency trials may have been recaptured at a substantially higher rate than naïve fish (Sharpe et al. 2005). If true, this would constitute a significant violation of method assumptions. A positively-biased capture efficiency would skew the out-migrant population estimate lower, which would lead to a misrepresentation of actual productivity. We reviewed the potential for using PIT tag technology to test the assumption of equal capture (trap) efficiency. Due to the relatively low cost and rapid migration of efficiency test fish (juvenile out-migrants) past our smolt trap (generally 1-5 days), we have proposed to use PIT tag technology with in-river loop detection arrays (Zydlewski et. al. 2002; Steve Anglea, Biomark, Inc. pers. comm.) in spring 2008.

2. We propose an expansion of the current project to fill data gaps in the estimates of anadromous salmonid escapement and population status for adult salmonids in the George Creek watershed. Accurate documentation of anadromous salmonid escapement (abundance) in George Creek is needed for planning and implementation of habitat projects, to assess species response to habitat improvements in the George Creek watershed, and to more fully describe the status of anadromous salmonid populations in the Asotin Creek watershed.

So far, the Asotin Creek project has focused on estimating adult salmonid escapement and juvenile production in Asotin Creek above George Creek. However, the George Creek watershed is a significant portion of the basin, but logistical limitations because of the flashy nature of the system and access for adult and juvenile trapping below the mouth of George Creek, have caused WDFW to forego including this watershed in the original statement of work. New technology is now available that could allow us to enumerate adult escapement, which would significantly improve adult monitoring efforts by accounting for well over 90% of the entire Asotin Subbasin. A resistivity counter (developed in Scotland and used extensively throughout the UK, Canada, Northern Europe, and in the Touchet River in SE Washington) installed in George Creek would be capable of enumerating migrating adult salmonids at variable flows and/or in turbid waters (McCubbing et al. 2000, Aprahamian et al. 1996), without affecting fish migration. The counter, when linked to a video monitoring system, could provide fish counts, and allow for size and species identification of adult salmonids moving into and out of the George Creek watershed. The counter would also complement existing project efforts to estimate escapement in the Asotin Creek watershed above George Creek.

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