# ASSESS SALMONIDS IN THE ASOTIN CREEK WATERSHED

**2006 ANNUAL REPORT**

**Reporting period: January 1, 2006 – December 31, 2006**

Prepared by:

Kent Mayer
Mark Schuck
Darin Hathaway

Washington Department of Fish & Wildlife
Fish Program / Science Division
Hatchery – Wild Interactions Unit
Asotin Creek Project Office
1049 Port Way
Clarkston, WA 99403

Prepared For

U.S. Department of Energy
Bonneville Power Administration
Environment, Fish and Wildlife
P.O. Box 3621
Portland, OR 97208

Project Number 2002-053-00
Contract Number 00025282 (Reporting period: 1/01/06 to 12/31/06)

**March 30, 2007**

**Acknowledgements**

We would like to thank the Bonneville Power Administration (BPA) for funding this project. In addition, we would like to thank Roy Beaty of the BPA for his valuable feedback on project activities. We would also like to extend our appreciation to the employees of the WDFW's Dayton Lab for their help in many aspects of this project. Specifically, Joe Bumgarner for his input and assistance. We thank Sean Wilson for helping us collect data in 2006. Finally, we would like to express our gratitude to Tom Hendrickson, who allows us to work on his property.

## Abstract

The goal of this project is to assess the status of anadromous salmonid populations in Asotin 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 migrant population was estimated using a rotary screw trap. Four-hundred and seventy seven (477) adult steelhead were captured in 2006 (the second season of adult trapping in Asotin Creek), resulting in population estimate of 555 adults, spawning in 46 kilometers of habitat above the trapping site. The juvenile steelhead population was estimated at 36,568 (95% CI = 30,822 – 43,436 juveniles) from the combined spring and fall out-migrations in the 2006 calendar year. In addition, 1,035 juvenile spring Chinook salmon were captured in 2006, resulting in a population estimate of 2,358 individuals. Passive integrated transponder tagging of out-migrating juvenile steelhead in 2006 indicted that 3.4% of the age 1 fish were detected at a mainstem dam during the outmigration year, while 78.0% and 84.3% of the age 2 and age 3 fish were detected, respectively. This report also provides a multi-year data comparison of project data collected to date: two years of adult data from 2005 and 2006, and three years of juvenile data from 2004, 2005 and 2006. Data suggests that the Asotin Creek summer steelhead – above eight mainstem dams on the Snake and Columbia Rivers – is a productive, naturally sustaining population of the Snake River steelhead ESU. The Asotin Creek project may provide data to assess the population response to habitat recovery actions in the subbasin. We also believe that Asotin Creek is an important reference stream for ESA-listed steelhead populations, because it may be the only unsupplemented, eastern Washington steelhead population that can provide data to evaluate supplementation programs on the eastside of the Columbia River basin.

# Table of Contents

## Introduction

Most 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*) has 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. 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. Limited, but continuous, efforts have been made to assess salmonid populations in the subbasin since 1984 (M. Schuck, pers. comm.).

Critical uncertainties must be answered if salmonid populations are to be rebuilt and 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 204, p. 173). Critical uncertainties for the Asotin Creek Subbasin include: 1) Is the steelhead population parent-to-progeny ratio above the replacement [$\geq$1.0]? 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, if necessary? (Asotin Subbasin Plan (ASP) 2004). 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 may be spawning in 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 efforts.

Prior to this project, there were consistent, but limited efforts to determine adult abundance, collect data on population dynamics and estimate life stage survival (smolt-to-adult, adult-to-adult survival, and smolt production by brood year), and obtain life history diversity information on Asotin Creek steelhead by sampling juveniles in the summer.

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. 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 Creek Assessment project was selected for implementation in 2002 and was fully funded 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 and 219 juvenile Chinook salmon were captured in 2004 and 2005, respectively, providing estimates of 4,145 and 349 juvenile Chinook, emigrating from Asotin Creek (Mayer and Schuck 2004; Mayer, et al., 2005). This suggests that spring Chinook salmon can spawn successfully in Asotin Creek, but there is insufficient information to infer population status.

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 2004 and eleven were captured in 2005.

Despite the 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 and 7,214 in 2005 (Mayer and Schuck 2004; 2005). The estimated population of juvenile steelhead for the 2004 calendar year out-migration was 43,327 (95% CI = 38,009 – 50,796 juveniles) and 26,462 (95% CI = 22,443 – 32,746 juveniles) in 2005, which is about 742 juveniles per rkm (1,220 juveniles/mile) above the trapping site at rkm 7.0.

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 establishing a baseline of the salmonid population in Asotin Creek to provide 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 of bull trout captured at the trapping locations. 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.

- 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 the focal species.

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

The expanded population baseline data collected for each focal species in the Asotin Creek Subbasin 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).

We received a national Conservation Partnership Award from the U.S. Department of Agriculture for our work with the Asotin Conservation District to restore and protect the Asotin Creek watershed in 2006.  The award was presented on October 26 in Walla Walla, Washington, by the USDA Under Secretary for Natural Resources and Environment, Mark Rey, who oversees the U.S. Forest Service and Natural Resources Conservation Service.

## 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. BPA has allocated almost $7 million to the Asotin Creek Subbasin 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. Roughly 90% of the riparian areas are fenced and free from concentrated livestock grazing (B. Johnson, Asotin County PUD, pers. comm.).

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) 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 at rkm 4.6). However, about 40% (23 km / 14 miles) of Asotin Creek are regularly surveyed by WDFW, which is the area that is the focus of work conducted under this project.

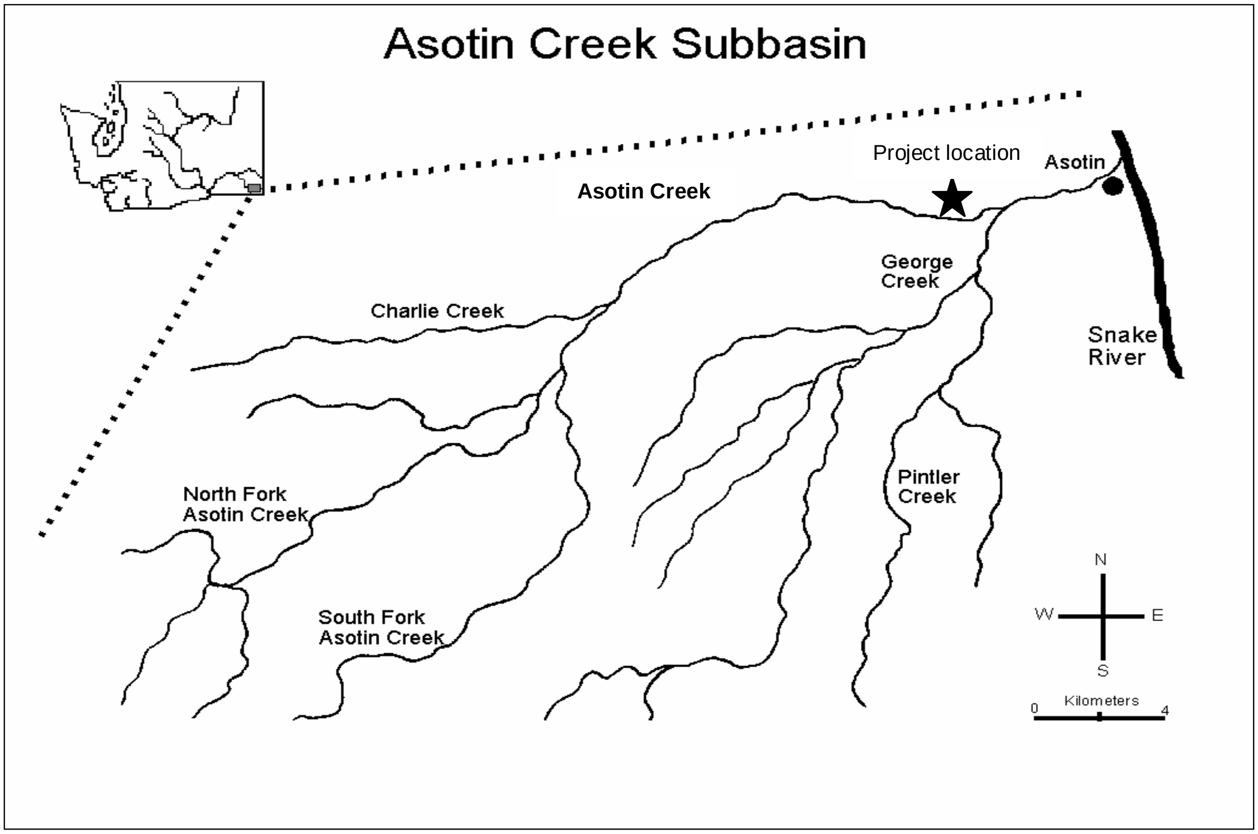


**Figure 1**. The Asotin Creek Subbasin in Southeastern Washington.

## **Methods and Materials**

*Objective 1: Estimate escapement of wild and hatchery steelhead and Chinook salmon into the Asotin Creek watershed, above George Creek.* A 4.9–7.3 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 at 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 was integrated into the weir in April to assist in the capture of kelts. The main trapping season was from mid-December of 2005 to June of 2006. 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 on a 2.4 km river reach below the adult trap to assess fallback, between March and the end of May, when possible. Sight surveys were also conducted above the trap to assess trap efficiency/leakage, when possible.

*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:

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.

*Objective 2: 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, estimate escapement, assess trap efficiency, and to estimate the number of adults per redd between March and the end of May, when possible. 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 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.* To estimate the number of emigrating juvenile salmonids, a 1.52 meter (m) rotary screw (smolt) trap was placed in Asotin Creek in March of 2006 at river km 7.0. The spring trapping season was from March through June. The fall trapping season was from October through December 2006.

The smolt trapping procedures 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). Statistical analyses were conducted using software for estimating emigrant populations with a rotary screw trap developed by the University of Idaho and the Idaho Department of Fish and Game (Steinhorst, et al., 2004).

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. Approximately 20%-30% of the juvenile steelhead in three size categories (82-119 mm, 120-149 mm, >150 mm) that were tagged with 12 mm passive integrated transponder (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 2004-05 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 (see above). 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.

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

$$\hat{N}_i = \frac{C_i}{\hat{e}_i}$$

Where, for each stratum:

$$\frac{1}{\hat{e}_i} = \frac{M+1}{r+1}$$

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 was collapsed and combined with similar, nearby test periods (thereby reducing the total number of strata), to meet this criteria.

*Objective 4: Genetic sampling.* DNA samples were collected from migrating adult steelhead, spring Chinook salmon, and bull trout. The purpose of steelhead genetic sampling is 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.

*Objective 5: Deliverables. Annual report: Abstract, introduction, description, methods, results, discussion, summary, and significant expenditures.*

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. This project is intended to be consistent with Washington's Comprehensive Monitoring Strategy (Crawford et al. 2002).

## Results and Discussion

### *Adults*

### Steelhead

The 2006 adult salmonid trapping season started on December 27, 2005, which was the second season of trapping in Asotin Creek. The adult trapping season was 21 weeks long and ended on May 17, 2006, when large storm inundated the weir and traps. [It should be noted that only 2 adult fish were captured after May 17 in 2005.]

We captured 477 adult steelhead at the adult trap in 2006. Four-hundred and four (404) fish (370 wild and 34 hatchery) were captured as pre-spawners during their upstream migration (Figure 2). Seventy (70) fish were captured as post-spawned adults (kelts), and three fish were determined to be non-spawners.

We estimated a population of 555 adult steelhead spawning in 46 km of accessible steelhead habitat above the trapping location in 2006. Five hundred and nine 509 (91.7%) naturally-produced fish [303 females and 206 males] and 46 (8.3%) hatchery fish [27 females and 19 males] were estimated to have spawned above rkm 7.0. The sex ratio of adult steelhead, based on the number of pre-spawning adults captured in 2006, was 59.7% females to 40.3% males.

Run timing of the 2006 adult steelhead spawning migration, based on estimated adult steelhead passage of pre-spawners, for both wild and hatchery origin fish, is presented in Table 1. Wild males migrated upstream past the trapping location an average of two days earlier in the spawning season than females. Forty-four point seven percent (44.7%) of the wild pre-spawners and 61.8% of the hatchery pre-spawners were re-captured as kelts (i.e., “marked returns”) at the weir location upon their out-migration following spawning (Figure 2). We had a 90.9% Floy tag retention rate for adult steelhead (wild and hatchery origin) re-captured at the weir as kelts.

Table 1. Run timing of adult steelhead captured at the weir during the 2006 trapping season.

| Run Timing | Entire Run | Female | Male |
|---|---|---|---|
| First capture | 12/27/05 | 12/27/05 | 12/30/05 |
| 50% at weir | 3/25/06 | 3/29/06 | 3/20/06 |
| 75% at weir | 4/4/06 | 4/4/06 | 4/2/06 |
| 90% at weir | 4/9/06 | 4/10/06 | 4/8/06 |

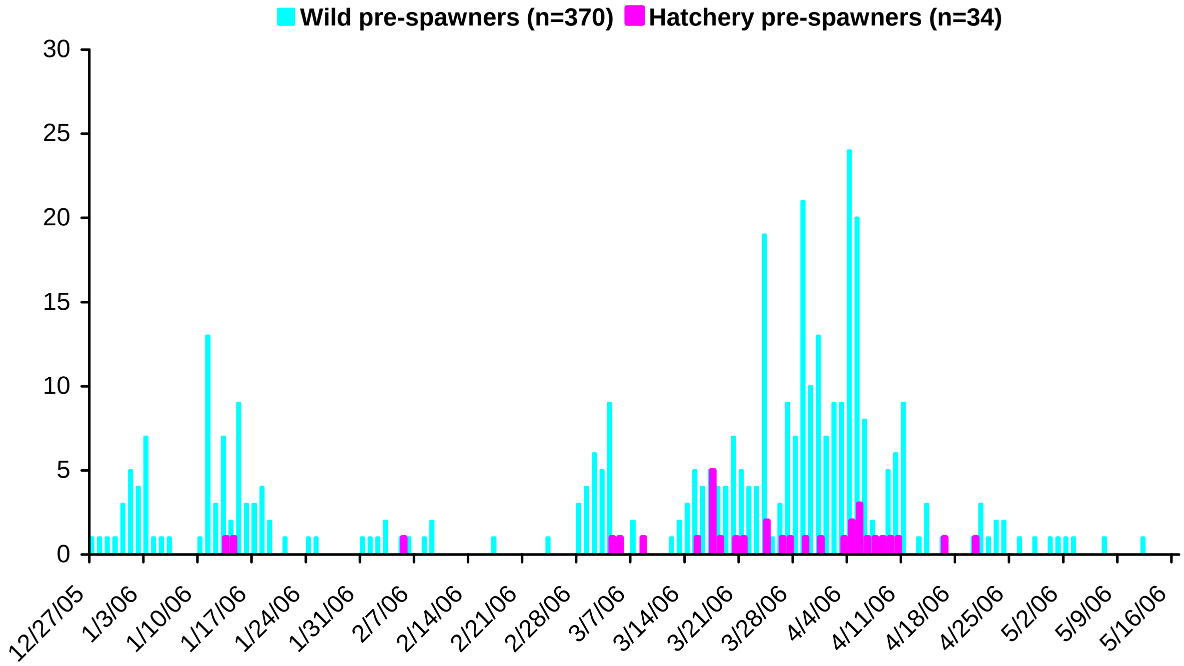


**Figure 2.** Daily catch of pre-spawning steelhead by origin at the Asotin Creek weir in 2006.

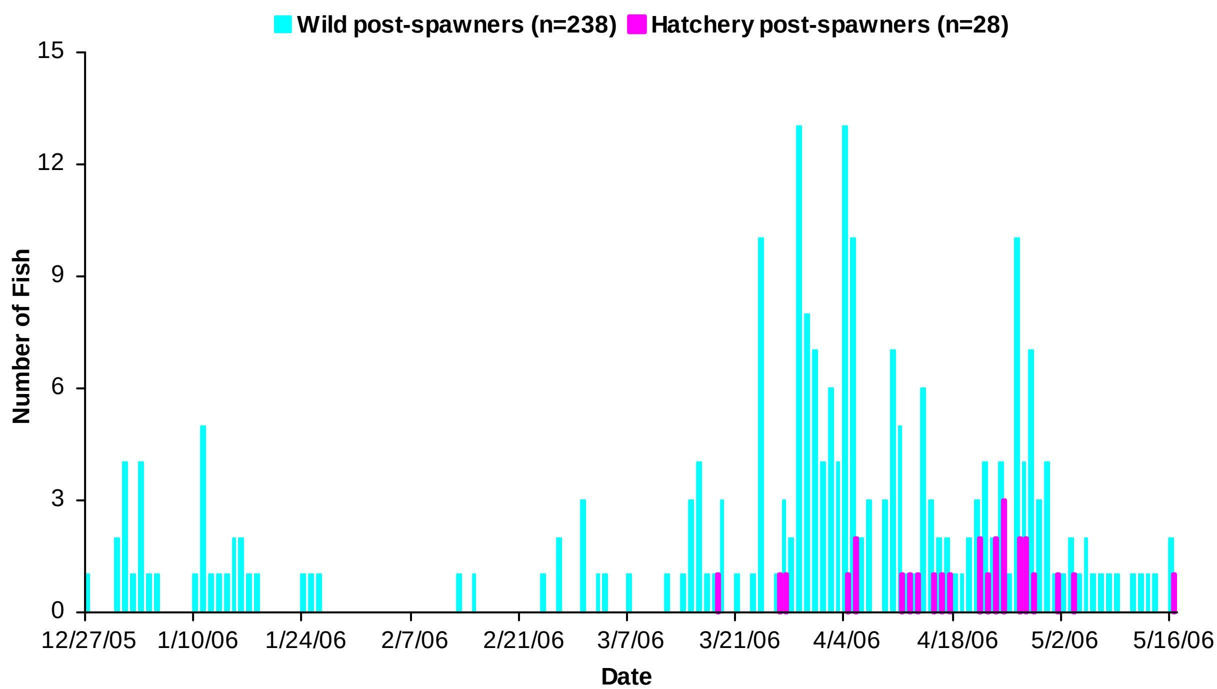


**Figure 3.** Daily catch of post-spawning steelhead by origin at the Asotin Creek weir in 2006.

Over half (54.8%) of all marked females returned and were captured at the weir after spawning as kelts. Fewer (29.7%) marked 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 2006.

| | **Wild** | | | **Hatchery** | | |
|---|---|---|---|---|---|---|
| Statistic | Female | Male | Total | Female | Male | Total |
| N | 120 | 44 | 164 | 10 | 10 | 20 |
| Median Days Up | 21 | 25 | 22 | 13 | 23 | 18 |
| Mean Days Up | 24.3 | 33.5 | 26.8 | 15.2 | 29.5 | 22.4 |
| Std Dev (days) | 15.3 | 28.6 | 20.2 | 4.9 | 27.0 | 20.2 |

We collected scale samples from 99.8% of all adult steelhead captured at the weir. Adult and juvenile scale age data indicate that juveniles leave the subbasin (or the Snake River drainage) at ages 1 to 4 and return as adults to spawn after 1-2 years in the ocean (Table 3). The proportion of adult female repeat spawners in 2006 was 2.1%. There were no male repeat spawners.

Table 3. Total age of adult steelhead captured at the weir during the 2006 trapping season.

| **Total Age** | **Wild** | | **Hatchery** | | **Total** | |
|---|---|---|---|---|---|---|
| **(Years)** | **Number** | **Percent** | **Number** | **Percent** | **Number** | **Percent** |
| 2 | 4 | 1.2% | 21 | 53.9% | 25 | 6.7% |
| 3 | 100 | 29.8% | 16 | 41.0% | 116 | 31.0% |
| 4 | 205 | 61.2% | 2 | 5.1% | 207 | 55.3% |
| 5 | 25 | 7.5% | - | - | 25 | 6.7% |
| 6 | 1 | 0.3% | - | - | 1 | 0.3% |
| Unreadable | 98 | 22.6% | 2 | 4.9% | 100 | 21.1% |
| **Total** | 433 | - | 41 | - | 474 | - |

Most wild females (74.5%) returned to spawn the first time in 2006 after spending 2 years in the ocean (Figure 4). The rest (25.5%) returned after one year in the ocean (Table 4). More wild male steelhead (47.3%) returned after spending 1 year in the ocean, and 52.7% of the wild males returned after 2 years in the ocean (Figure 5). There were no ocean age 3 spawners. Mean spawning adult steelhead lengths by saltwater age, origin and sex are presented in table 5.

Three females died prior to spawning and were checked for fecundity (Table 6). The mean fecundity of wild females was 5,470 eggs (range = 4,767-5,921). The mean length of repeat spawners was 69.8 cm (range = 68-71 cm), including one hatchery fish (68 cm, age 1.1).

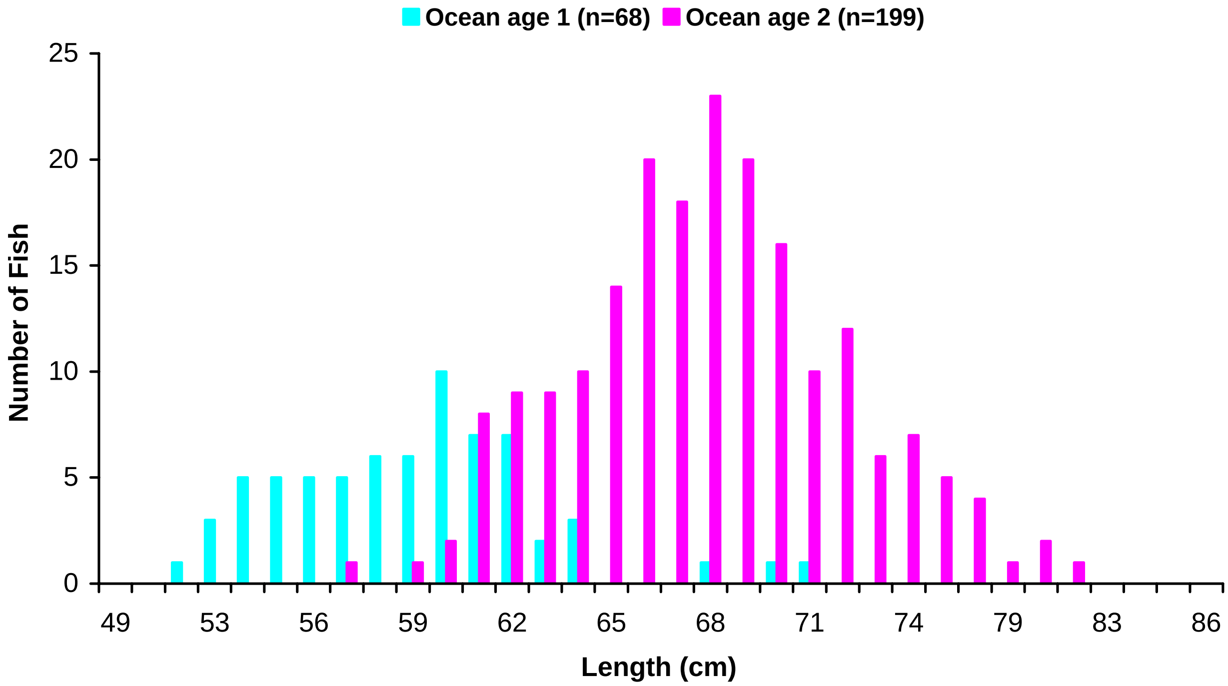


**Figure 4.** Length distribution of wild adult female steelhead by ocean age spawning in 2006.

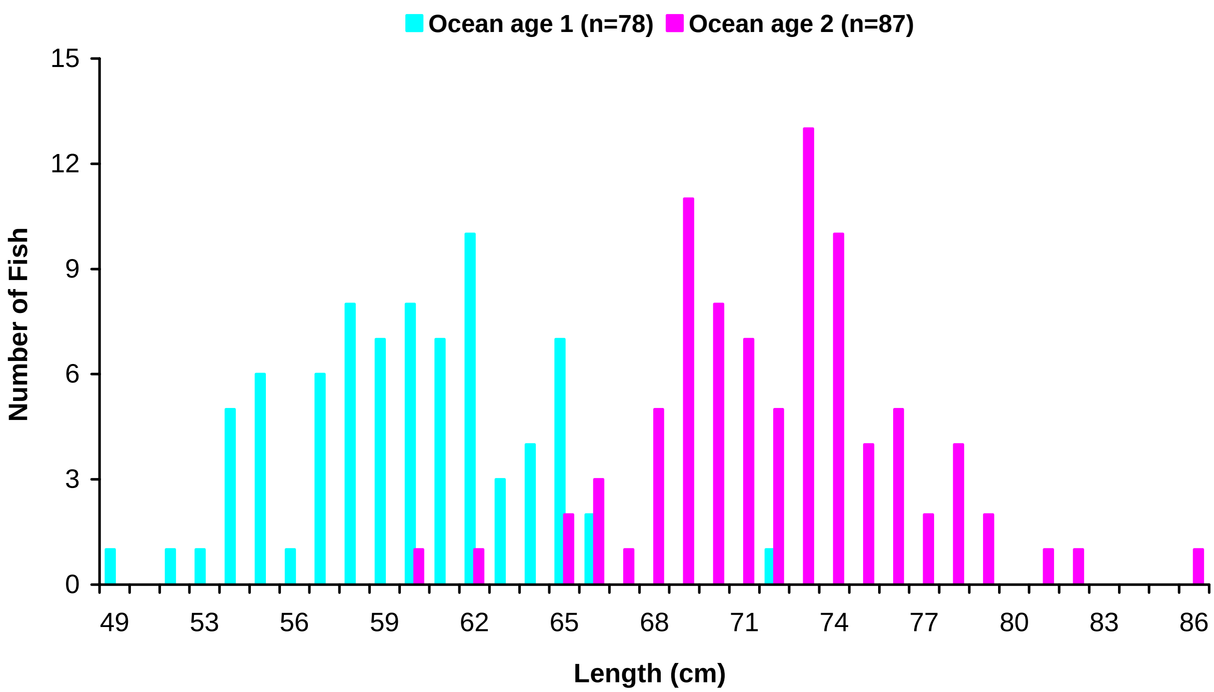


**Figure 5.** Length distribution of wild adult male steelhead by ocean age spawning in 2006.

Table 4. Age composition of adult (wild and hatchery) steelhead captured in 2006 by sex and origin. The percentage of each age class and percentage of unreadable scales is included.

| Origin | Age (Fresh.Salt) | Male Number | Male Percent | Female Number | Female Percent | Total Number | Total Percent |
|---|---|---|---|---|---|---|---|
| **Wild** | 1.1 | 3 | 2.4% | 1 | 0.5% | 4 | 1.2% |
| | 1.2 | 1 | 0.8% | 6 | 2.9% | 7 | 2.1% |
| | 2.1 | 50 | 39.4% | 46 | 22.1% | 96 | 28.7% |
| | 2.2 | 51 | 40.1% | 132 | 63.5% | 183 | 54.6% |
| | 3.1 | 11 | 8.6% | 8 | 3.8% | 19 | 5.7% |
| | 3.2 | 10 | 7.9% | 15 | 7.2% | 25 | 7.4% |
| | 4.1 | - | - | - | - | - | - |
| | 4.2 | 1 | 0.8% | - | - | 1 | 0.3% |
| | **Total** | 127 | - | 208 | - | 335 | - |
| | Unreadable | 39 | 23.5% | 59 | 22.1% | 98 | 22.6% |
| **Hatchery** | 1.1 | 12 | 75.0% | 10 | 43.5% | 22 | 56.4% |
| | 1.2 | 3 | 18.8% | 11 | 47.8% | 14 | 35.9% |
| | 2.1 | 1 | 6.2% | - | - | 1 | 2.6% |
| | 2.2 | - | - | 2 | 8.7% | 2 | 5.1% |
| | **Total** | 16 | - | 23 | - | 39 | - |
| | Unreadable | 2 | 11.1% | - | - | 2 | 4.9% |

Table 5. Mean fork length of adult steelhead captured in 2006. Lengths are given in centimeters by saltwater age, sex and origin.

| Origin | Saltwater Age | Length Measurement | Female | Male | Combined |
|---|---|---|---|---|---|
| **Wild** | 1 | N | 68 | 78 | 146 |
| | | Fork length | 59.0 | 59.7 | 59.4 |
| | | Std. Dev. | 3.9 | 4.0 | 3.9 |
| | 2 | N | 198 | 87 | 285 |
| | | Fork length | 68.0 | 72.1 | 69.3 |
| | | Std. Dev. | 4.2 | 4.2 | 4.6 |
| **Hatchery** | 1 | N | 10 | 15 | 25 |
| | | Fork length | 59.7 | 58.0 | 58.7 |
| | | Std. Dev. | 4.7 | 3.0 | 3.7 |
| | 2 | N | 13 | 3 | 16 |
| | | Fork length | 67.6 | 67.0 | 67.5 |
| | | Std. Dev. | 4.3 | 6.6 | 4.5 |

Table 6. Fork length, age and fecundity (eggs) of three steelhead from Asotin Creek in 2006.

| Date Sampled | Fork Length (cm) | Ocean Age | Total Age | Fecundity (# eggs) |
|---|---|---|---|---|
| 3/12 | 66 | 2 | 4 | 5,722 |
| 4/1 | 65 | 2 | - | 5,921 |
| 4/1 | 65 | 2 | 4 | 4,767 |

Out of the 41 hatchery-origin spawners, 39 (95.1%) had external marks (i.e., visual implant tags, fin clips). Carcasses were recovered from 16 (39.0%) of the 41 hatchery-origin spawners, and nine had coded wire tags (CWT). Of the CWTs recovered, seven (77.8%) were from WDFW's Tucannon hatchery stock and two (22.2%) were from WDFW's Lyons Ferry hatchery stock.

There were two adult steelhead mortalities from trapping operations in 2006. Both occurred at the same time when the two fish swam onto a weir panel being used as barrier. The panel was immediately removed and no additional mortalities were observed.

Due to high and off-color water conditions during the 2006 spawning season, spawning ground surveys were not performed in the mainstem of Asotin Creek in 2006.

**Other adult species of interest**

No adult Chinook salmon were captured in 2006 due to water conditions (see above) and weir-related maintenance activities, which occurred during the same time of year that Chinook salmon were observed in Asotin Creek in 2005.

Other fish species captured at the adult trap in 2006 included a 41 cm bull trout (age 5, 642 grams) captured on 5/10/06. About 500 migrating adult (pre-spawning) bridgelip suckers (*Catastomas columbianus*) were also captured in 2006.

*Juveniles*

**Steelhead**

During the 2006 spring and fall migration seasons, we captured 5,829 juvenile steelhead in the smolt trap. The juvenile steelhead population was estimated at 36,568 (95% CI = 30,822 – 43,436 juveniles) from the combined spring and fall out-migrations for the 2006 calendar year. This estimate translates to approximately 778 juveniles per rkm (1,279 juveniles per mile), above the trapping location at rkm 7.0. Seasonal trapping summaries are presented below.

*Spring 2006*

The spring 2006 juvenile trapping season was from March 19, 2006 to June 30, 2006 (17 weeks). We captured 4,170 juvenile steelhead during the spring migration, yielding a population estimate of 25,741 (95% CI = 21,771 – 30,584 juveniles), which represented 73.8% of the juvenile steelhead out-migration in 2006 (Figure 6). Thirty-five point three percent (35.3%) were parr, 61.0% were transitional smolts, and 3.7% were fully-smolted (Table 7). Run timing of the spring 2006 juvenile steelhead out-migration was as follows: 50% migrated past the trapping location by 5/3/06, 75% by 5/27/06, and 90% by 6/02/06.

Table 7. Summary of biological data collected of juvenile steelhead captured during the spring of 2006. 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 (cm) | N | Body Weight (g) | Condition Factor (K) |
|---|---|---|---|---|
| Parr | 99.4 | 1,461 | 11.2 | 1.08 |
| Transitional | 153.9 | 2,529 | 38.2 | 1.02 |
| Smolt | 179.2 | 155 | 60.6 | 1.01 |

We conducted 26 trap efficiency tests with 1,116 juveniles, representing 26.8% of the run during the spring of 2006. Mean smolt trap efficiency for the spring 2006 migration season was 20.2% (range 2.9-60.0%, median = 18.8%, SD = 12.7%) (Table 8). Smolt trap efficiency for fish grouped in 10 mm increments (82-119 mm, 120-149 mm, >150 mm) is presented in Table 9. There was no significant difference (p=0.501) in trap efficiency between three size categories of juvenile steelhead tested (Table 10). Eighty-six (86%) of the fish marked for efficiency testing were recaptured within one day of release, 95% within seven days and 99% within 21 days.

Scale samples were collected from 1,556 juvenile steelhead, representing 37.3% of all juveniles captured in the spring of 2006. The majority (1,210 or 77.8%) of the scales were readable. Scale aging from the spring of 2006 indicated that 39.2% juvenile steelhead migrants were age 1, 46.6% were age 2, 13.8% were age 3, and 0.4% were age 4. Age 0 juveniles were not enumerated and are not part of the population estimate. Mean fork length began increasing in early-April, reached its highest point between mid-April and early-May, and then began to decline in mid-May following peak migration (Table 11) in the spring of 2006.

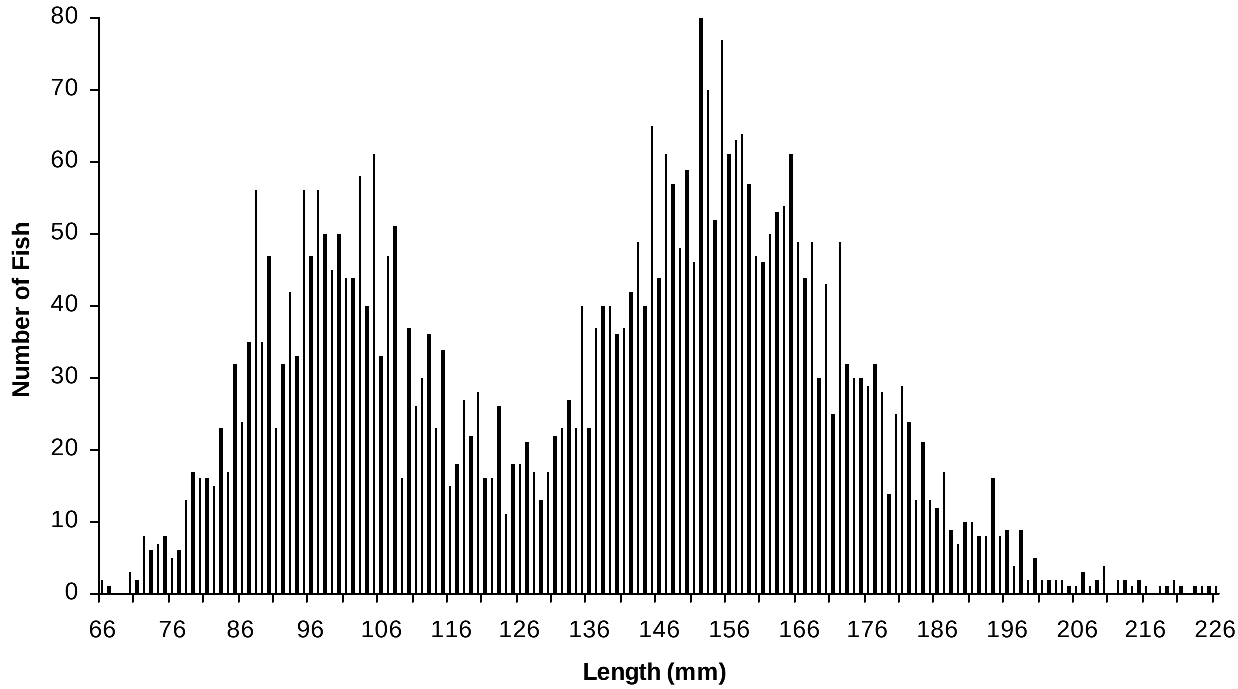


**Figure 6**. Length distribution of juvenile steelhead captured (n = 4,170) during the spring of 2006 in Asotin Creek.

Table 8. Trap efficiency for juvenile steelhead trapping during the spring 2006 migration season.

| Test Date | No. Fish Tested | No. Fish Recaptured | Efficiency (%) |
|---|---|---|---|
| 3/26 | 10 | 6 | 60.0 |
| 3/30 | 12 | 3 | 25.0 |
| 4/2 | 17 | 1 | 5.9 |
| 4/5 | 13 | 5 | 38.5 |
| 4/8 | 17 | 3 | 17.6 |
| 4/12 | 27 | 8 | 29.6 |
| 4/15 | 84 | 20 | 23.8 |
| 4/19 | 18 | 14 | 22.2 |
| 4/22 | 64 | 19 | 29.7 |
| 4/26 | 58 | 17 | 29.3 |
| 4/29 | 58 | 8 | 13.8 |
| 5/3 | 90 | 15 | 16.7 |
| 5/6 | 70 | 5 | 7.1 |
| 5/10 | 15 | 3 | 20.0 |
| 5/13 | 13 | 0 | 0.0 |
| 5/16 | 92 | 11 | 12.0 |
| 5/23 | 49 | 2 | 4.1 |
| 5/25 | 76 | 20 | 26.3 |
| 5/28 | 80 | 18 | 22.5 |
| 5/31 | 100 | 15 | 15.0 |
| 6/3 | 76 | 10 | 13.2 |
| 6/7 | 35 | 1 | 2.9 |
| 6/10 | 13 | 1 | 7.7 |
| 6/14-15 | 8 | 1 | 12.5 |
| 6/17-18 | 14 | 4 | 28.6 |
| 6/21 | 7 | 0 | 0.0 |
| Total | 1,116 | 200 | - |

Table 9. Trapping efficiencies for juvenile steelhead based on fork length, including number of fish tested and number recaptured, during the spring 2006 trapping season.

| **Fork Length (mm)** | **No. Fish Tested** | **No. Fish Recaptured** | **Efficiency (%)** |
|---|---|---|---|
| 82-89 | 15 | 3 | 20.0% |
| 90-99 | 120 | 33 | 27.5% |
| 100-109 | 157 | 31 | 19.7% |
| 110-119 | 114 | 22 | 19.3% |
| 120-129 | 66 | 8 | 12.1% |
| 130-139 | 49 | 12 | 24.5% |
| 140-149 | 104 | 21 | 20.2% |
| 150-159 | 154 | 38 | 24.7% |
| 160-169 | 146 | 16 | 11.0% |
| 170-179 | 103 | 10 | 9.7% |
| 180-189 | 63 | 5 | 7.9% |
| 190-199 | 21 | 3 | 14.3% |
| 200-209 | 11 | 1 | 9.1% |
| 210-219 | 4 | 0 | 0.0% |
| 220+ | 3 | 0 | 0.0% |
| Total | 1,116 | 200 | 18.8% |

Table 10. Trapping efficiencies for three size ranges of juvenile steelhead based on fork length, including the number of fish tested and the number of fish recaptured, during the spring of 2006.

| **Fork Length (mm)** | **No. Fish Tested** | **No. Fish Recaptured** | **Efficiency (%)** |
|---|---|---|---|
| 82-114 | 349 | 78 | 22.3% |
| 115-149 | 276 | 52 | 18.8% |
| 150+ | 505 | 73 | 14.5% |
| Total | 1,116 | 200 | - |

Table 11. Summary of biological data collected of juvenile steelhead captured during the spring of 2006. Mean values for length, weight, condition, and age are provided for each week. Total sample size (N) is for length data only.

| Week | Date (Week of) | N | Fork Length (mm) | Body Weight (g) | Condition Factor (K) |
|---|---|---|---|---|---|
| 1 | 3/6 | 32 | 120.7 | 19.9 | 1.02 |
| 2 | 3/12 | 20 | 122.0 | 21.3 | 1.10 |
| 3 | 3/19 | 26 | 119.6 | 23.0 | 1.10 |
| 4 | 3/26 | 91 | 125.0 | 23.0 | 1.04 |
| 5 | 4/2 | 186 | 135.0 | 30.1 | 1.03 |
| 6 | 4/9 | 296 | 142.7 | 32.5 | 1.02 |
| 7 | 4/16 | 255 | 146.1 | 34.5 | 1.00 |
| 8 | 4/23 | 569 | 151.1 | 36.5 | 0.98 |
| 9 | 4/30 | 776 | 153.3 | 37.7 | 1.01 |
| 10 | 5/7 | 197 | 147.5 | 36.1 | 1.04 |
| 11 | 5/14 | 320 | 156.1 | 45.1 | 1.08 |
| 12 | 5/21 | 366 | 126.4 | 25.2 | 1.08 |
| 13 | 5/28 | 738 | 109.3 | 15.9 | 1.06 |
| 14 | 6/4 | 204 | 101.0 | 12.2 | 1.11 |
| 15 | 6/11 | 35 | 98.5 | 11.6 | 1.17 |
| 16 | 6/18 | 41 | 97.3 | 10.9 | 1.12 |
| 17 | 6/25 | 13 | 88.2 | 9.1 | 1.12 |

We tagged 1,552 juvenile steelhead, representing 37.2% of the spring 2006 out-migrants, with PIT tags. Just under half (49.5%) of the juvenile steelhead that were tagged in the spring of 2006 were detected at dams on the Snake and Columbia Rivers (Tables 12 & 13) in 2006. Fish that were PIT tagged but were of undetermined age (i.e., unreadable scales), with a mean length of 160.5 mm, median = 158.0 mm, range = 125-223), had a detection rate of 76.1%.

PIT tag detection rates of juvenile steelhead appeared to be strongly related to size and age (Table 12; Figures 7 & 8). Eighty-one point six percent (81.6%) of juvenile steelhead greater than 125 mm in length were detected at mainstem Snake and Columbia River dams, while only 3.9% of juvenile steelhead less than 125 mm were detected at the dams.

Table 12. Number of juvenile steelhead PIT tagged by age during the spring of 2006 that were detected migrating past mainstem dams on the Snake and Columbia Rivers.

| Age | 1 | 2 | 3 | 4 | Undetermined | Total |
|---|---|---|---|---|---|---|
| Number Tagged | 474 | 563 | 166 | 5 | 343 | 1,552 |
| Number Detected | 16 | 439 | 140 | 4 | 261 | 595 |
| Detection Rate | 3.4% | 78.0% | 84.3% | 80.0% | 76.1% | - |

Table 13. Number of juvenile steelhead PIT tagged (by length) during the spring of 2006 and detection rate of tagged fish at mainstem dams on the Columbia and Snake Rivers.

| Fork Length (mm) | Tags / Detection rate | Parr | Transitional smolt | Smolt | Total |
|---|---|---|---|---|---|
| 82-114 | Tagged (n) / Detected | 433 / 8 | 26 / 4 | 0 | 459 / 12 |
| | Detection Rate | 1.9% | 15.4% | - | 2.6% |
| 115-149 | Tagged (n) / Detected | 72 / 6 | 329 / 248 | 0 | 401 / 254 |
| | Detection Rate | 8.3% | 75.4% | - | 63.3% |
| 150+ | Tagged (n) / Detected | 1 / 1 | 606 / 515 | 85 / 78 | 692 / 594 |
| | Detection Rate | 100% | 85.0% | 91.8% | 85.8% |
| Totals | Tagged (n) / Detected | 506 / 15 | 961 / 767 | 85 / 78 | 1,552 / 860 |
| | Detection Rate | 3.0% | 79.8% | 91.8% | 55.4% |

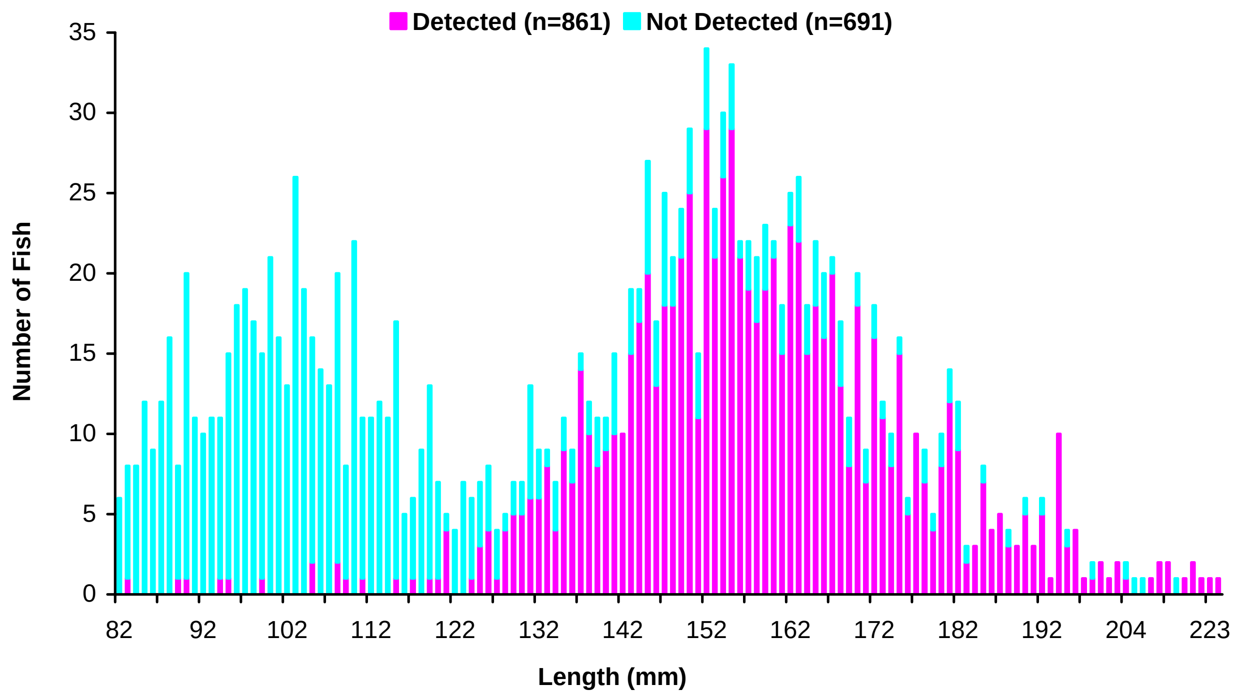


**Figure 7.** Length distribution of juvenile steelhead PIT tagged (n=1,552) in Asotin Creek during the spring of 2006, with detections at mainstem dams on the Snake and Columbia Rivers.

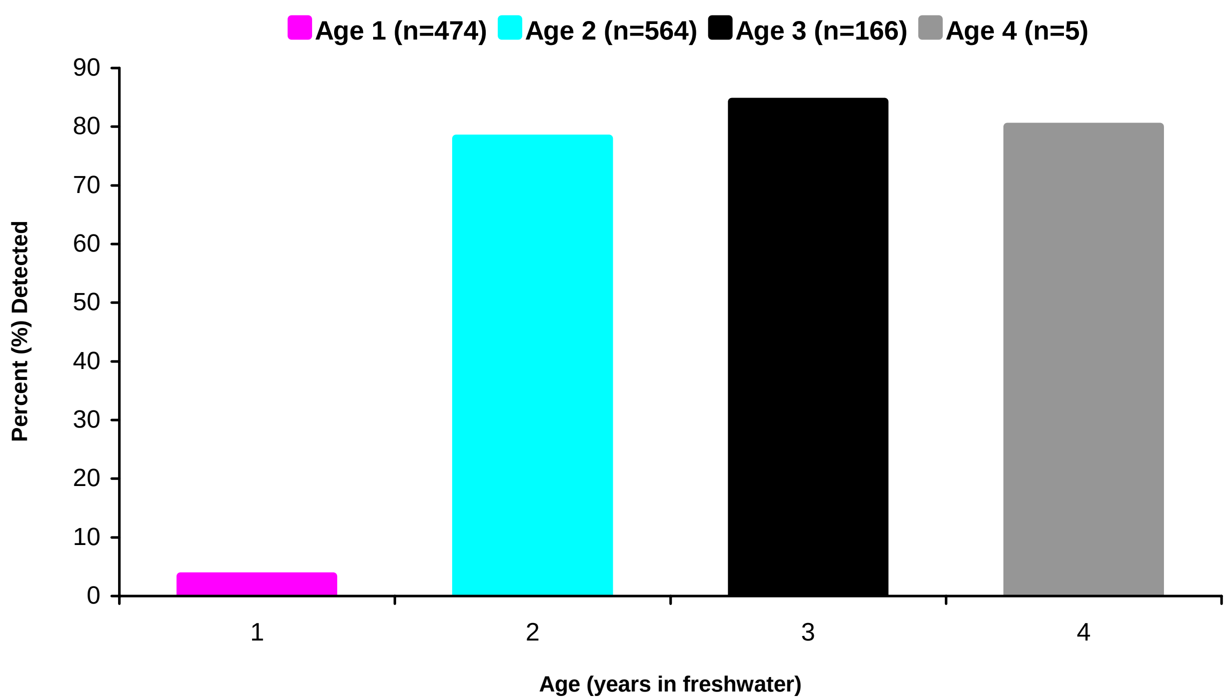


**Figure 8.** Detection rate by age of steelhead PIT tagged in Asotin Creek during the spring of 2005, with detections at mainstem dams on the Snake and Columbia Rivers in 2005.

*Fall 2006*

The fall 2006 juvenile salmonid trapping season was from October 5, 2006 to December 29, 2006 (12 weeks). We captured 1,658 juvenile steelhead during the fall migration, yielding a population estimate of 10,827 (95% CI = 9,051 – 12,852 juveniles), which represented 26.2% of the juvenile steelhead out-migration in 2006. Fifty-nine point seven percent (59.7%) were parr and 38.1% were transitional smolts (Table 14). There were no fully-smolted out-migrants. No scales were collected from juvenile steelhead during the fall 2006 trapping season. No juveniles were PIT tagged during the fall 2006 out-migration.

Table 14. Summary of biological data collected of juvenile steelhead captured during the fall of 2006. 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 Weight (g)** | **Condition Factor (K)** |
|---|---|---|---|---|
| Parr | 95.3 | 991 | 9.7 | 1.13 |
| Transitional | 132.0 | 632 | 24.8 | 1.08 |

Fourteen trap efficiency tests were conducted in the fall of 2006 with 387 juveniles, representing 23.3% of the run (Table 15). Mean smolt trap efficiency was 30.4% (range 8.6-55.6%, median = 25.9%, SD = 17.1%). Table 16 shows the trap efficiency for three size categories (82-119 mm, 120-149 mm, >150 mm) of the juvenile steelhead used for efficiency testing in the fall of 2006. Ninety percent (90%) of the fish marked for efficiency testing were recaptured within one day of release, 95% within six days and 99% within 7 days of release for trap efficiency testing.

Table 15. Trap efficiency for juvenile steelhead trapping during the fall 2006 migration season.

| **Test Date** | **No. Fish Tested** | **No. Fish Recaptured** | **Efficiency (%)** |
|---|---|---|---|
| 10/5 | 32 | 10 | 31.3% |
| 10/11 | 17 | 9 | 52.9% |
| 10/15 | 29 | 4 | 13.8% |
| 10/17 | 36 | 9 | 25.0% |
| 10/21 | 9 | 1 | 11.1% |
| 10/26 | 56 | 15 | 26.8% |
| 10/29 | 35 | 3 | 8.6% |
| 11/4 | 55 | 28 | 50.9% |
| 11/15 | 24 | 6 | 25.0% |
| 11/20 | 34 | 8 | 23.5% |
| 11/27 | 12 | 7 | 58.3% |
| 12/6 | 13 | 2 | 15.4% |
| 12/18 | 26 | 7 | 26.9% |
| 12/27 | 9 | 5 | 55.6% |
| Total | 1,116 | 200 | - |

Table 16. Trapping efficiencies for three size ranges of juvenile steelhead based on fork length, including the number of fish tested and the number of fish recaptured, during the fall of 2006.

| Fork Length (mm) | No. Fish Tested | No. Fish Recaptured | Efficiency (%) |
|---|---|---|---|
| 82-114 | 211 | 73 | 34.6% |
| 115-149 | 144 | 34 | 23.6% |
| 150+ | 32 | 7 | 21.9% |
| Total | 387 | 114 | - |

There were a total of 62 juvenile steelhead mortalities in 2006. Thirty-nine occurred on two days (5/17/06 & 10/31/06) due to debris-related circumstances. The smolt trap was immediately stopped and then restated after the debris had cleared the system and/or temperatures rose above freezing, so that no additional mortalities occurred.

**Other juvenile species of interest**

*Spring 2006*

The spring 2006 juvenile trapping season was from March 19, 2006 to June 30, 2006 (17 weeks). We captured 1,020 juvenile Chinook salmon during the spring migration season, representing 98.6% of the juvenile Chinook salmon out-migration in 2006. The estimated population of juvenile Chinook migrating from above the Asotin Creek trapping site for 2006 was 2,358. Seasonal trapping summaries are presented below.

Median fork length of juvenile spring Chinook salmon during the spring of 2006 was 90.0 mm (range = 48-117), and represented both yearling and sub-yearling classes of Chinook (Figure 9). Median weight of the juvenile Chinook salmon captured was 8.0 grams (range = 1.1-19.2). Median condition factor was 1.10 (range = 0.78-1.59).

During the spring 2006 juvenile Chinook salmon migration season, twenty-one trap efficiency tests were conducted with 274 juveniles, representing 26.9% of the run (Table 17). Mean smolt trap efficiency was 43.2% (range 16.7-76.9, median = 41.2%, SD = 19.7%).

Age data was taken on 89 juvenile Chinook salmon, representing 8.7% of the spring 2006 out-migration. Nineteen point one percent (19.1%) were 0-age fish and 80.9% were age 1 fish.

*Fall 2006*

We captured 15 juvenile Chinook salmon during the fall 2006 migration season, representing 1.4% of the juvenile Chinook salmon out-migration in 2006. No trap efficiency trials were conducted due to the low number of juvenile Chinook salmon in the fall 2006 migration season. Assuming the same smolt trap efficiency as in the spring of 2006 (43.2%), the population estimate for the fall 2006 juvenile Chinook salmon out-migration was 35 fish.

Table 17. Trapping efficiency for juvenile Chinook salmon trapping during the spring of 2006.

| Test Date | No. Fish Tested | No. Fish Recaptured | Efficiency (%) |
|---|---|---|---|
| 3/7 | 8 | 2 | 25.0% |
| 3/10 | 13 | 8 | 61.5% |
| 3/22 | 13 | 10 | 76.9% |
| 3/25 | 10 | 7 | 70.0% |
| 3/29 | 32 | 20 | 62.5% |
| 4/1 | 26 | 11 | 42.3% |
| 4/5 | 40 | 17 | 42.5% |
| 4/8 | 12 | 2 | 16.7% |
| 4/12 | 17 | 5 | 29.4% |
| 4/15 | 15 | 3 | 20.0% |
| 4/19 | 9 | 2 | 22.2% |
| 4/22 | 7 | 3 | 42.9% |
| 4/26 | 6 | 4 | 66.7% |
| 5/25 | 11 | 3 | 27.3% |
| 5/28 | 10 | 6 | 60.0% |
| 5/31 | 9 | 2 | 22.2% |
| 6/3 | 8 | 3 | 37.5% |
| 6/7 | 11 | 3 | 27.3% |
| 6/14 | 5 | 2 | 40.0% |
| 6/17 | 7 | 5 | 71.4% |
| 6/21 | 5 | 0 | 0.0% |
| Total | 274 | 118 | - |

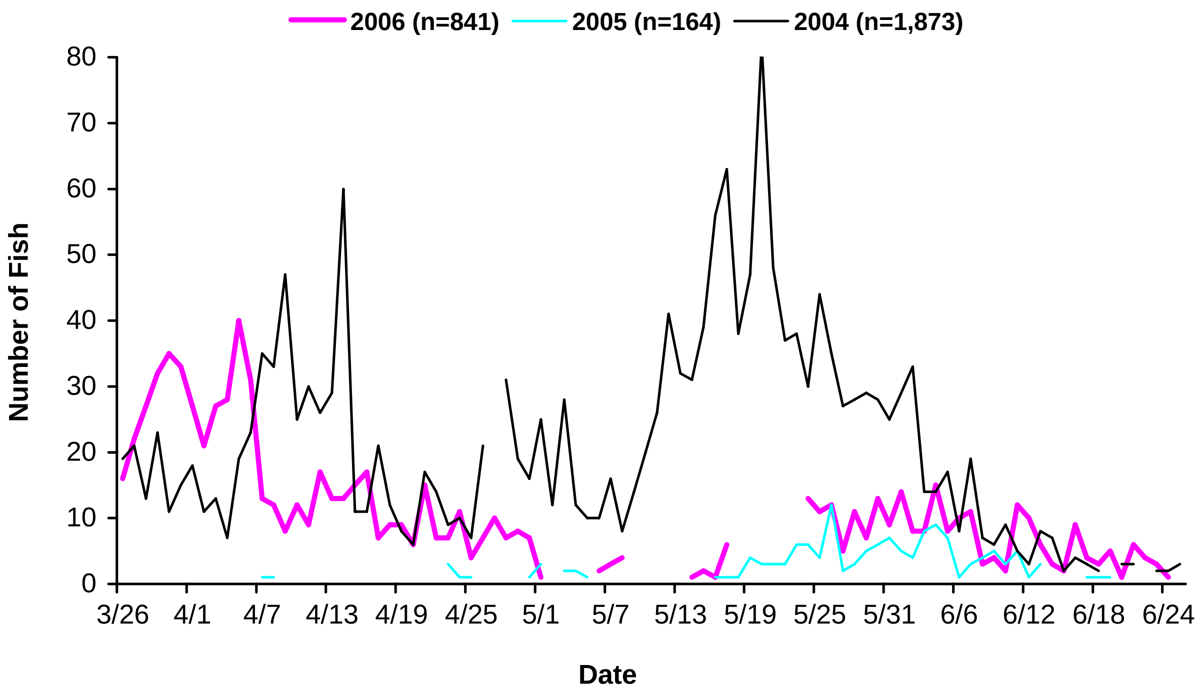


**Figure 9.** Daily catch of juvenile Chinook salmon captured in Asotin Creek during the spring of 2006 compared to the daily catch of juvenile Chinook salmon from the spring of 2004 and 2005.

Ten bull trout were captured in 2006. Biological data for all bull trout captured are presented in Table 18. All bull trout were PIT tagged and had DNA samples collected and archived.

Table 18. Summary of biological data collected of bull trout captured during 2006.

| Date Captured | Fork Length (mm) | Body Weight (g) | Condition Factor (K) | Age (years) |
|---|---|---|---|---|
| 5/10 | 380 | 642.0 | 1.17 | 5 |
| 6/29 | 163 | 42.5 | 0.98 | 2 |
| 10/14 | 263 | 181.2 | 1.00 | - |
| 10/14 | 323 | 355.6 | 1.06 | - |
| 10/15 | 263 | 179.7 | 0.99 | - |
| 10/29 | 255 | 157.5 | 0.95 | - |
| 10/31 | 257 | 168.6 | 0.99 | - |
| 11/20 | 234 | 135.0 | 1.05 | - |
| 12/19 | 249 | 143.0 | 0.93 | - |
| 12/22 | 232 | 120.3 | 0.96 | - |

Other fish species captured in the smolt trap in 2006 include sculpin, dace and bridgelip suckers.

*__Multiple-Year Data Comparisons__*

**Adults**

A comparison of the cumulative catch (run timing) of the steelhead spawning seasons in 2005 and 2006 is presented in Figure 10. There were nine adults captured by March 1 in 2005 and 99 adults captured by March 1 in 2006. 2005 was generally considered to be a low water year and 2006 was considered a high water year, based on USGS stream gage data. Table 19 presents the number of adult steelhead captured, the proportion of hatchery fish (by pre-spawner counts), and the population estimate of adult steelhead in Asotin Creek above the trap site for 2005 and 2006.

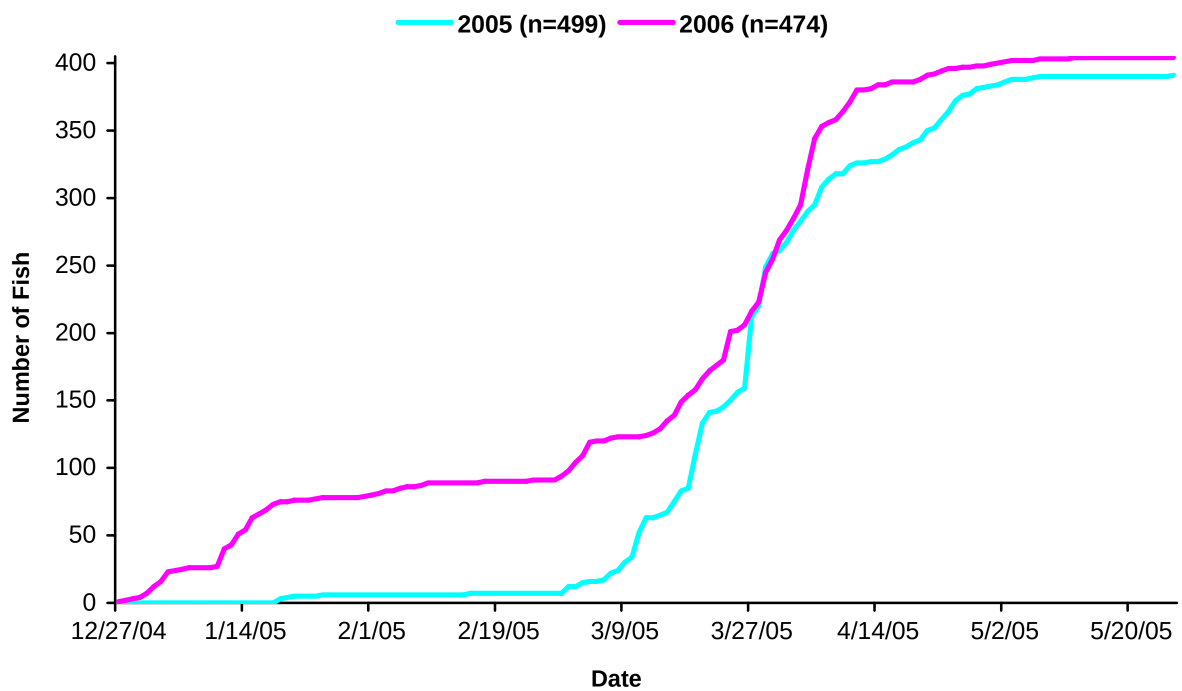


**Figure 10.** Cumulative catch (run timing) of pre-spawning adult steelhead captured at the Asotin Creek weir in 2005 and 2006.

**Table 19**. Number of adult steelhead captured, percent (%) hatchery fish (as pre-spawners), and population estimate for 2005 and 2006 in Asotin Creek above the WDFW trap site.

| Statistic | 2005 | 2006 |
|---|---|---|
| Adults captured | 499 | 474 |
| % Hatchery fish | 6.5 | 8.6 |
| Population estimate | 653 | 555 |

### Juveniles

The juvenile steelhead population estimate for 2006 was approximately the average (within 5%) of the previous two years (2004 and 2005)[1]. (There was a 39% difference between 2004 and 2005.) Table 20 shows the total number of juvenile steelhead captured and the 95% upper and lower confidence intervals for the population estimates for calendar years 2004, 2005 and 2006.

Table 21 presents the parr-smolt transformation index as a proportion of the juvenile steelhead spring out-migration for 2004, 2005 and 2006 in Asotin Creek. The proportion of juveniles migrating as parr in 2006 was approximately the average (within 2%) of the previous two years. There was a 15% difference in the proportion migrating parr between spring 2004 and 2005.

**Table 20**. Total number of juvenile steelhead captured, population estimate and 95% confidence intervals (bounded estimates) for the calendar years 2004, 2005 and 2006 in Asotin Creek.

| Statistic | 2004 | 2005 | 2006 |
|---|---|---|---|
| Juveniles captured | 8,506 | 7,214 | 5,829 |
| Population estimate | 43,327 | 26,462 | 36,568 |
| 95% CI: Lower | 38,009 | 22,443 | 30,822 |
| Upper | 50,796 | 32,746 | 43,436 |

**Table 21**. Smoltification index (percent of run) of juvenile steelhead during the spring out-migration in 2004, 2005 and 2006 in Asotin Creek.

| Stage (%) | 2004 | 2005 | 2006 |
|---|---|---|---|
| Parr | 42.0 | 27.4 | 35.3 |
| Transitional smolts | 55.9 | 62.7 | 61.0 |
| Fully-smolted juveniles | 2.1 | 9.9 | 3.7 |

A comparison of the cumulative catch (run timing) for the juvenile spring out-migration and daily catch by length of juvenile steelhead captured in Asotin Creek for 2004, 2005 and 2006 is presented in Figures 12 and 13, respectively. Figure 14 shows the length distribution of juvenile steelhead (n = 18,774) captured in Asotin Creek in the spring of 2004, 2005 and 2006 combined.

Six hundred and forty two (642) age 1 juvenile steelhead were PIT tagged in the spring of 2005. Of those, 7.8% were detected in 2005 at dams on the Snake and Columbia Rivers (Mayer and Schuck, 2005). In 2006, an additional 10.2% were detected. As of December 2006, 18.0% of all age 1 fish tagged in 2005 have been detected at dams on the Snake and Columbia Rivers.

A significant proportion (up to 26%) of the annual out-migration of juvenile steelhead from Asotin Creek can occur during the fall months (September-December). A comparison of the length distribution of the fall migrants compared to spring migrants is shown in Figure 15. It is unknown whether the number of fall out-migrants is related to the out-migration from the previous spring or to the following spring, if at all.

[1] Juvenile population estimates for 2004 and 2005 were refined using the Steinhorst program (see Methods section).

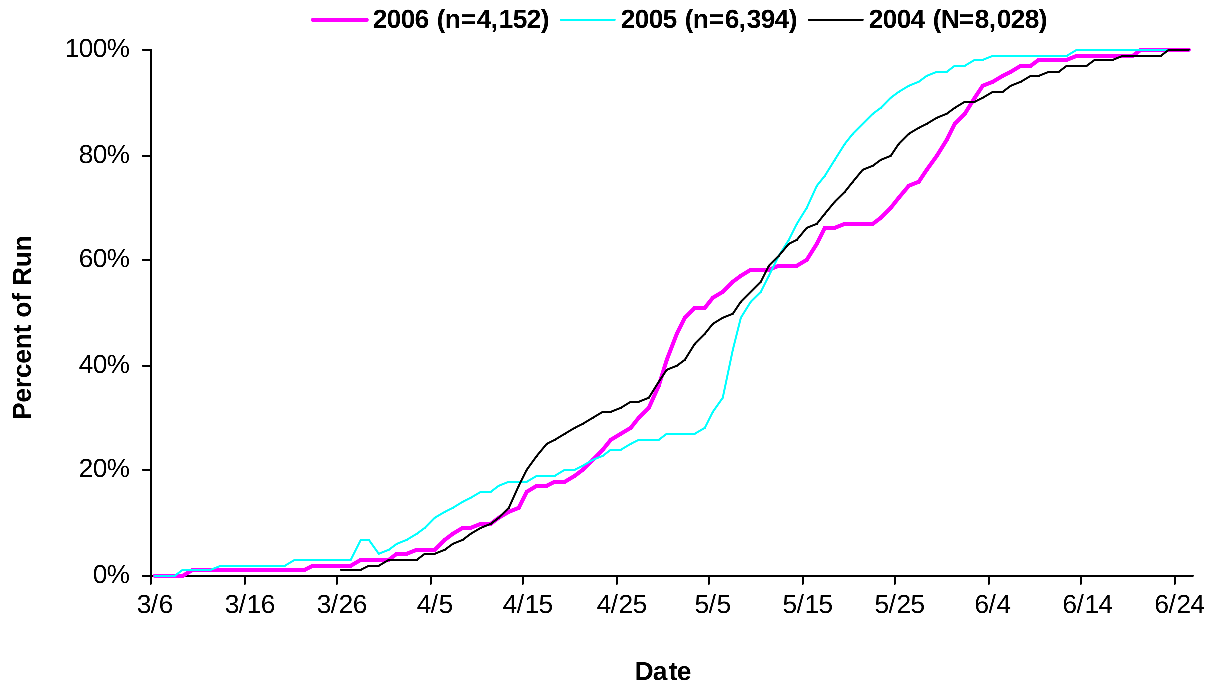


**Figure 12.** Cumulative catch (run timing) of juvenile steelhead captured in Asotin Creek during the spring of 2006 compared to the catch of juvenile steelhead from the spring of 2004 and 2005.

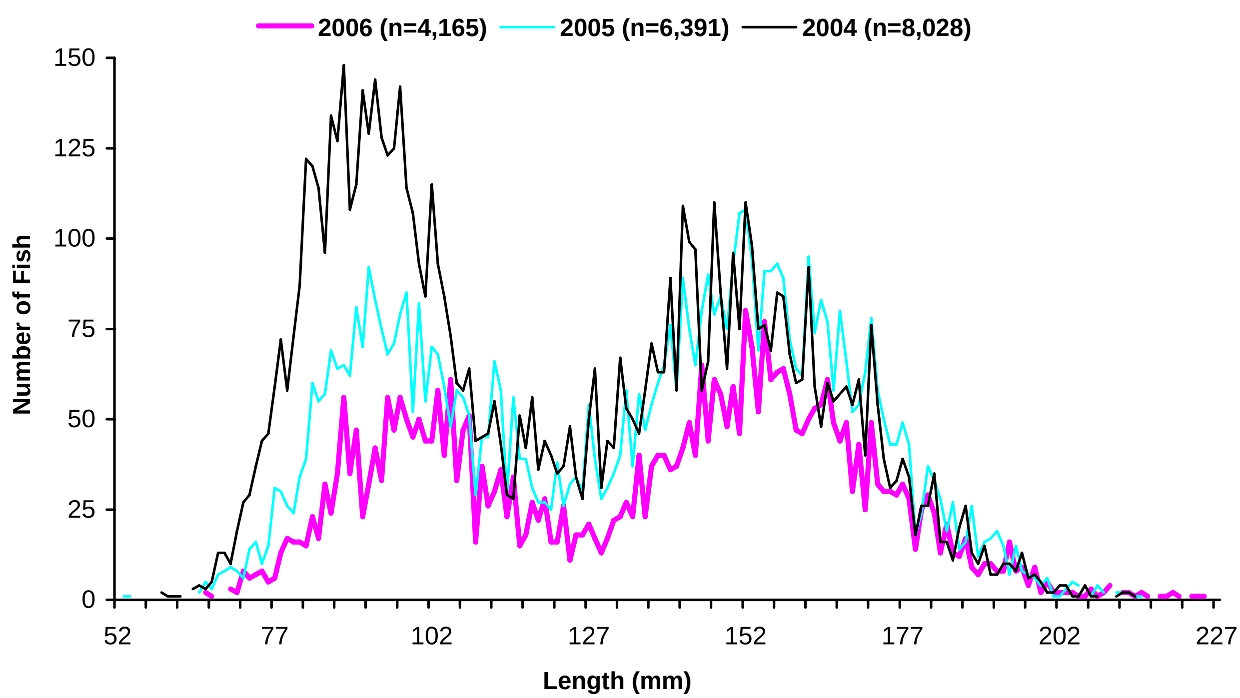


**Figure 13.** Daily catch of juvenile steelhead captured in Asotin Creek during the spring of 2006, compared to the daily catch of juvenile steelhead from the spring of 2004 and 2005.

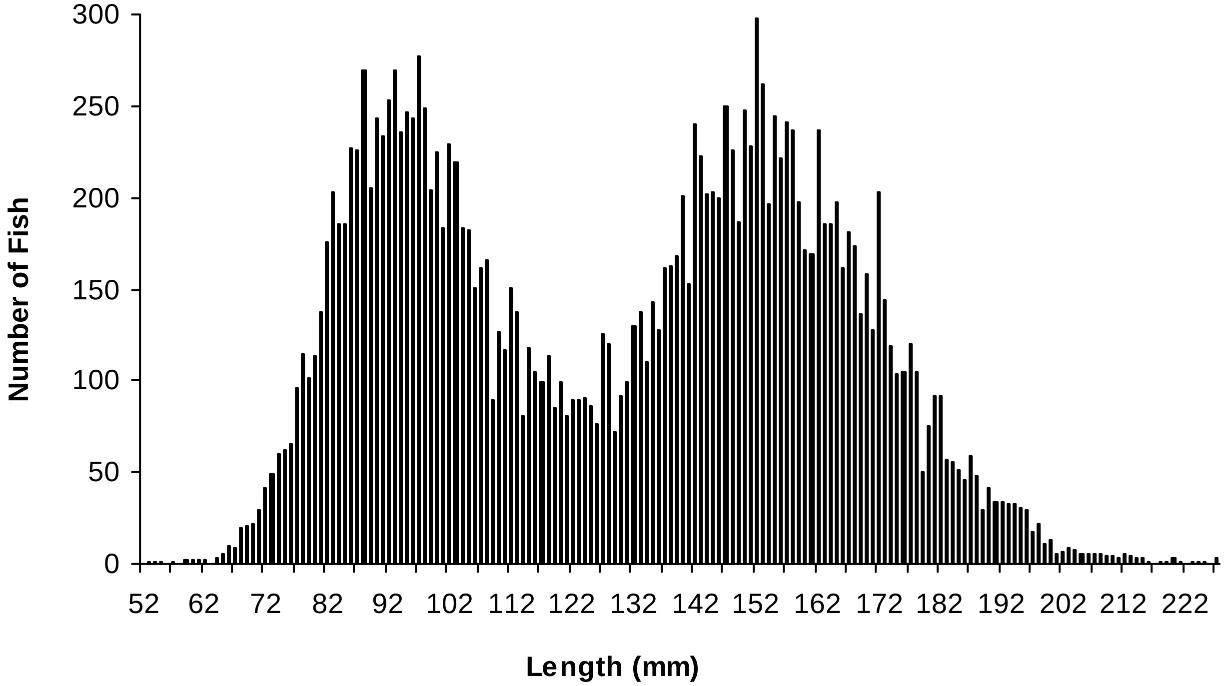


**Figure 14.** Length distribution of juvenile steelhead captured in Asotin Creek during the spring 2004, 2005 and 2006 trapping seasons (n = 18,774).

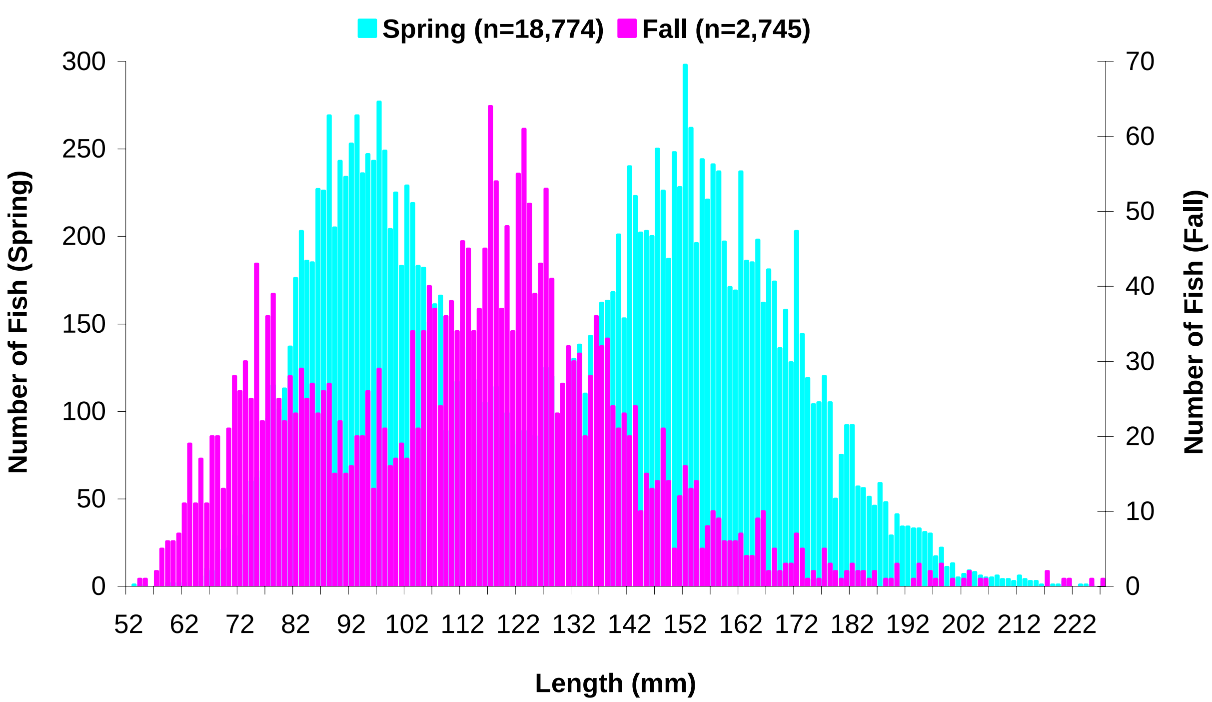


**Figure 15.** Length distributions of juvenile steelhead captured in Asotin Creek during the spring and fall out-migrations from 2004, 2005 and 2006 (combined).

## Summary and Conclusions

The current abundance of steelhead in Asotin Creek is unusual in the Snake River basin. The steelhead population in Asotin Creek has shown a resiliency to habitat degradation. Further, the Asotin Creek steelhead population persists in significant adult numbers (greater than 650 in 2005 and greater than 550 in 2006 above the trapping location[2]), suggesting that it may be above the TRT's threshold for delisting. In addition, Asotin creek is an unsupplemented, wild steelhead refuge and no other species are supplemented in Asotin Creek.

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 Snake River Recovery Plan uses a prioritization approach based on the VSP concept (Snake River Salmon Recovery Board 2005). The plan proposes that Asotin Creek be intensively monitored to establish a population baseline, including estimates of smolt production, smolt-to-adult survival, and adult returns. These metrics are deemed critical for determining the effectiveness of recovery actions in the Asotin Creek Subbasin, and for tracking the progress of the Snake River Recovery Plan.

This project has provided empirical data about the steelhead population in Asotin Creek. Fisheries researchers and managers have direct estimates of the current steelhead population in Asotin Creek, and do not have to rely on the suppositions and habitat modeling that was used in the subbasin planning process. This is underscored by project data that show substantially more spawning adults and juvenile out-migrants in Asotin Creek than were expected. Such data can be valuable in refining habitat capacity estimators used in the Asotin Creek Subbasin planning process (ASP 2004, p5. 15; 45) and in other Columbia River subbasins.

The abundance of out-migrating steelhead smolts, and more interestingly, out-migrating parr and pre-smolts, is greater than expected, but proportionally similar to limited data collected from Charley Creek (a tributary of Asotin Creek) in the 1980's (Mendel and Schuck, 1986). Juvenile steelhead lengths show a bi-modal distribution, with a separation occurring around 124 mm. Further, about 26% of the juvenile steelhead out-migrated in the fall of 2006. Juvenile steelhead could be leaving Asotin Creek because of limited carrying capacity, limited habitat during critical flow periods, or they may be utilizing multiple life-history pathways, including the use of the Lower Granite Dam reservoir or other streams as their final, pre-smolt rearing location.

Asotin Creek steelhead exhibit a complex array of life history patterns: an indicator of a healthy salmonid population. 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 one or two years in the ocean. Although no direct supplementation from hatcheries occurs in Asotin Creek, a proportion (6.5% in 2005 and 8.6% in 2006) of the adult steelhead captured were hatchery origin strays that appear to be using Asotin Creek opportunistically for spawning.

Significant investments have been made 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 became extirpated in the early

[2]Additional steelhead spawn in Asotin Creek below the weir and in the George Creek subbasin at rkm 4.6.

1990’s from the Asotin Creek Subbasin.  Fisheries managers have identified a goal of re-introducing spring Chinook salmon into the Asotin Creek basin.  Establishing a baseline of salmonid population data under this project will be critical if there is a re-introduction of spring Chinook salmon.  Moreover, accurate baseline population data for steelhead and Chinook salmon can be used to assess the population response to BPA-funded habitat recovery projects in the Asotin Creek subbasin.  For example, several projects that are co-occurring in the subbasin have referenced the need to utilize baseline population data for trend analysis.

This project supports the efforts of other agencies by providing detailed data from a wild steelhead population for resource planning, fisheries management decision-making and for the evaluation of supplementation programs.  Asotin Creek offers an important opportunity to serve as a reference stream for evaluating the effectiveness of ongoing hatchery supplementation (see Recommendations Section below).  Development of endemic broodstocks to aid in the recovery of ESA-listed steelhead has been strongly proposed by NOAA in an effort to minimize genetic effects from hatchery programs, and which is already occurring in the Tucannon and Touchet Rivers (see Recommendations section).  These rivers are 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, establishing a baseline of ESA-listed steelhead in the Asotin Creek Subbasin will allow fisheries managers to compare relative productivity and demographics of supplemented versus unsupplemented populations.

## Recommendations

When this project was submitted to BPA for funding for the FY07-09 budget period, it was narrowly defined as a stock status monitoring project. The project was deemed "fundable" by the Independent Scientific Review Panel (ISRP) and approved by the Northwest Power and Conservation Council (NPCC). However, BPA has proposed terminating funding of this project, because of BPA's belief that it is not responsible to fund stock status monitoring. The two recommendations below highlight the continued need for data from Asotin Creek, because of its important role in effectiveness monitoring: 1) Data from Asotin Creek will be used as reference data to evaluate supplementation programs in the eastern Columbia Basin, and 2) the data will be used to evaluate the effectiveness of habitat improvement projects in the Asotin Creek Subbasin.

1. The ISRP and the Independent Scientific Advisory Board (ISAB) have stated the need for a comprehensive evaluation of the use of supplementation as a recovery tool for depressed steelhead populations in the Columbia River basin (ISRP and ISAB 2005). This recommendation supports the NPCC's desire to provide a quantifiable assessment of progress towards program goals.

In order to assess the effects of supplementation, comparisons of a number of treated versus untreated streams may be the best method of detecting differences in long-term fitness attributable to supplementation programs (Galbreath, et al., 2006). One approach is to analyze data for parameters collected from a number of treated (supplemented) and reference (i.e., non-supplemented) streams across the basin. Galbreath, et al. (2006) noted that one of the difficulties in evaluating monitoring data for supplementation programs is the limited availability of reference streams. Specifically, few projects have more than one or two reference streams (if any), and "a substantial increase in the number of designated reference (non-supplemented) streams will be required" (Galbreath, et al., 2006). Furthermore, Hesse (2007) states that since supplementation generally targets declining populations, genetic variation within supplemented populations should be compared to reference populations. These reference streams provide the best opportunity to determine if there is a change in reproductive success or productivity as a result of supplementation (Hesse, 2007).

Development of a comprehensive supplementation evaluation plan was undertaken in 2006 and 2007 by fisheries researchers and managers (Galbreath, et al., 2006, 2007). As a result of this on-going process, Asotin Creek was identified as an important steelhead reference stream – It has a medium size, wild population of summer-run steelhead, and is above eight mainstem dams. "Very importantly, designation of additional reference streams will require increased funding to perform the requisite M&E of those streams" (Galbreath, et al., 2006). There is an "insufficient effort within the basin" to obtain estimates for relative reproductive success (RRS) from non-supplemented (reference) streams, against which RRS values for natural origin fish in supplemented populations can be compared (Galbreath, et al., 2007).

There are additional supplemented steelhead populations that may need reference data from Asotin Creek to evaluate the effects of specific supplementation programs. Table 22 presents a partial list of streams with steelhead stocks that have hatchery/supplementation programs and/or are supplemented for other species, and potential reference streams that may be used to evaluate the effects of supplementation. However, as stated above, the choice of reference streams in the Columbia Basin is severely limited due to widespread use of hatchery releases in the basin. This M&E project in Asotin Creek provides a robust dataset on a unique population of steelhead, which can be used to evaluate supplementation programs throughout the eastern Columbia River basin. In addition, Asotin Creek is one of two streams in southeast Washington that have been proposed to be an intensively monitored watershed (IMW). The proposed designation of Asotin Creek as a reference stream will require continued funding to ensure that an uninterrupted reference dataset is available to fisheries managers.

**Table 22**. Partial list of streams with steelhead stocks that have hatchery/supplementation programs and/or are supplemented for other species, and potential reference streams that may be used to evaluate the effects of supplementation.

| Hatchery/Supplementation Program Streams | Existing Data (Y/N) | Potential Reference Streams[1] | Existing Data (Y/N) |
|---|---|---|---|
| Tucannon River | Y | Asotin Creek | Y |
| Touchet River | Y | South Fork Walla Walla | N[2] |
| Walla Walla River | Y | | |
| Umatilla River | Y | | |
| Imnaha River | Y | | |
| Grande Ronde | Y | | |

[1]Joeseph Creek (Oregon) was excluded because of basin characteristics and lack of data.

[2]The data set for the South Fork of the Walla Walla River is incomplete. The Walla Walla has a large hatchery program and is four mainstem dams below Asotin Creek.

Asotin Creek can be used as a reference stream to evaluate the effects of supplementation by comparing relative metrics, because it has a complete data set for both adult and juvenile steelhead. For example, the Tucannon and Touchet Rivers have an adult steelhead population of approximately 200 and 300 fish, respectively (J. Bumgarner, pers. comm.). Asotin Creek has an unsupplemented population of greater than 600 adult steelhead. A list of metrics for comparing and contrasting the unsupplemented steelhead population in Asotin Creek (the reference stream) with a supplemented stream – the Tucannon River – in southeast Washington are presented in Table 23.

**Table 23**. A comparison and contrast of metrics between Asotin Creek (an unsupplemented, reference stream) and a supplemented stream (the Tucannon River) in southeast Washington to evaluate the effects of a supplementation program.

| Metric | Asotin | Tucannon |
|---|---|---|
| Number of wild adults | >600 | ~200 |
| % Wild adults | 92% | 36.8% |
| % Hatchery adults | 8% | 63.2% |
| Sex ratio (% Wild female/male) | 58.5 / 41.5 | 50.8 / 49.2 |
| Age of adult males (% Ocean age 1, 2) | 55.5, 45.5 | 69.3, 30.7 |
| Age of adult females (% Ocean age 1, 2) | 26.4, 74.6 | 31.9, 68.1 |
| Adult age at migration (% Freshwater age 1, 2, 3, 4) | 5.0, 81.0, 13.7, 0.3 | 15.5, 77.1, 7.4, 0.0 |
| Juvenile age at migration (% Freshwater age 1, 2, 3, 4) | 32.9, 49.4, 17.3, 0.4 | 28.5, 62.3, 9.0, 0.2 |
| Fecundity (Ocean Age 1/2) | 3,047 / 4,853 | 4,680 / 6,370 |

2. This project helps fulfill the need for monitoring the effectiveness of habitat improvement projects in the Asotin Creek Subbasin by providing quantitative population metrics. Therefore, we recommend that the data from this project be utilized to establish a relationship between habitat improvement projects and population response, which is supported by the ISRP, NPPC and the BPA. This response will necessitate that WDFW project staff collaborate with entities implementing habitat projects, and link quantifiable habitat changes to salmonid population response over time (such as the smolt/female adult ratio), to evaluate the effectiveness of habitat improvement projects and return on investment.

A significant investment has been made in the Asotin Creek Subbasin for habitat improvement projects – BPA has allocated about $7 million, and more than $2 million has been spent by the State of Washington (Salmon Recovery Fund Board), the Washington State Conservation Commission, Washington Department of Ecology and private landowners in the subbasin since 1996 to improve fish habitat. We believe that it is important to re-evaluate the use of the data from this Asotin Creek M&E project.

## References

Asotin County Conservation District (ACCD). 1994. Asotin Creek Model Watershed Plan. Bonneville Power Administration, Portland, OR.

Asotin Subbasin Plan (ASP). May 2004. Asotin County Conservation District, Clarkston, WA.

Bumgarner, J. 2007. Washington Department of Fish and Wildlife Biologist, Dayton, WA. Personal communication.

Crawford, B.A., C. Drivdahl, S. Leider, C. Richmond, and S. Butkus. 2002. The Washington Comprehensive Monitoring Strategy for Watershed Health and Salmon Recovery, Vol. 2. Olympia, WA, 377 p.

Galbreath, P.F., Roger, P.B., and M.J. Ford. 2006. Report of the Supplementation Monitoring and Evaluation Workshop. Columbia River Inter-Tribal Fish Commission, Portland, OR.

Galbreath, P.F., Roger, P.B., and M.J. Ford. 2007. Report of the Supplementation Monitoring and Evaluation Workshop II. Columbia River Inter-Tribal Fish Commission, Portland, OR.

Groat, D.  2004. U.S. Forest Service, Pomeroy Ranger District.  Pomeroy, WA. Personal communication.

Hesse, J. 2007. Towards a Comprehensive and Integrated Regional Hatchery RME and Hatchery Effectiveness Evaluation (*Draft*), for the Collaborative System-wide Monitoring and Evaluation Project (CSMEP) Hatchery subgroup. Nez Perce Tribe, Lapwai, ID.

Independent Science Review Panel (ISRP) and Independent Scientific Advisory Board (ISAB). 2005. Monitoring and Evaluation of Supplementation Projects. ISRP & ISAB Report 2005-15. Northwest Power and Conservation Council, Portland, Oregon. 15 p.

Jearld, A., Jr. 1983. Age determination. *In* Fisheries Techniques. Ed. L.A. Nielson and D. L. Johnson. American Fisheries Society, Bethesda, Maryland, pp301-324.

Johnson, B.  2007. Asotin County PUD. WRIA 35 Watershed Planning Director, Clarkston, WA. Personal communication.

Mayer, K., and M. Schuck. 2004. Assess Salmonids in the Asotin Creek Watershed, 2003-2004, Annual Report, Project No. 200205300, 24 electronic pages, BPA Report DOE/BP-00014059-1.

Mayer, K., Schuck, M., Wilson, S., and B. Johnson. 2005. Assess Salmonids in the Asotin Creek Watershed, 2004-2005, Annual Report, Project No. 200205300, 40 electronic pages, BPA Report No. DOE/BP-00018229 and No. DOE/BP-00022720.

McElhany, P., M.H. Rucklelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units." U.S. Dept. of Commerce, NOAA. Tech Memorandum, NMFS-NWFSC-42, 156 p.

Mendel and Schuck. 1986. LSRCP report, including juvenile trapping data from Charley Creek. Personal communication.

Peven, C., Murdoch, A., Murdoch, K., Lenz, B., Lanshaw, R., Klinge, R., Kahler, T., Hillman, T., and S. Hays. 2007. Steps in Determining Use of Reference Streams. Hatchery Effectiveness Technical Team. Wenatchee, WA.

Snake River Salmon Recovery Board. 2005. Technical Document: Snake River Salmon Recovery Plan for SE Washington. Governor's Salmon Recovery office. Olympia, WA.

Kirk Steinhorst, Yingqin Wu, Brian Dennis, and Paul Kline. 2004. Confidence Intervals for Fish Out-migration Estimates using Stratified Trap Efficiency Methods. Journal of Agricultural, Biological, and Environmental Statistics 9:284-299.

Stewart, M. 2007. ACCD, District Office Manager, Clarkston, WA. Personal communication.