

# Tucannon River Spring Chinook Salmon Hatchery Evaluation Program 2013 Annual Report



by Michael P. Gallinat and Lance A. Ross



Washington Department of  
**FISH AND WILDLIFE**  
Fish Program  
Science Division



# **Tucannon River Spring Chinook Salmon Hatchery Evaluation Program**

## **2013 Annual Report**

by

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Prepared for:

U.S. Fish and Wildlife Service  
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1387 S. Vinnell Way, Suite 343  
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Cooperative Agreement: F13AC00096

**August 2014**



# Acknowledgments

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The Tucannon River Spring Chinook Salmon Hatchery Evaluation Program is the result of efforts by many individuals within the Washington Department of Fish and Wildlife (WDFW) and from other agencies.

We would like to express our sincere gratitude to Ace Trump, Lyons Ferry Hatchery Complex Manager, and interim manager Doug Maxey for their coordination efforts. We thank Hatchery Specialists Derek Gloyn, Brad Hostetler, Doug Maxey, and Dick Rogers for their cooperation with hatchery sampling, providing information regarding hatchery operations and hatchery records, and their input on evaluation and research activities. We also thank all additional hatchery personnel who provide the day-to-day care of the spring Chinook and for their assistance with hatchery spawning, sampling, and record keeping.

We thank Lynn Anderson and the Coded-Wire Tag Lab staff for their assistance in coded-wire tag verification. We also thank Lance Campbell and John Sneva for reading scale ages, and Steve Roberts for providing information on fish health during the year.

We thank the staff of the Snake River Lab; in particular Joe Bumgarner, Jerry Dedloff, Debbie Milks, Afton Oakerman, and seasonal workers Amy Armstrong, Ashly Beebe, Doug Falkner, Michael Ryan Garton, Nathan Roueche, Sean Taylor, and Cole Webster who helped collect the information presented in this report. We also thank the staff of the Asotin Creek Field Office for assisting us with spawning ground surveys on Asotin Creek.

Special thanks to Todd Miller and Jerry Dedloff for the design, installation, and operation of the Curl Lake PIT tag array.

We thank Joe Bumgarner, Glen Mendel, Andrew Murdoch, Erik Neatherlin, and Steve Yundt for reviewing the draft report.

The United States Fish and Wildlife Service through the Lower Snake River Compensation Plan Office funded the supplementation program.

## Abstract

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Lyons Ferry Hatchery (LFH) and Tucannon Fish Hatchery (TFH) were built/modified under the Lower Snake River Fish and Wildlife Compensation Plan. One objective of the Plan is to compensate for the estimated annual loss of 5,760 (1,152 above the project area and 4,608 below the project area for harvest) Tucannon River spring Chinook caused by hydroelectric projects on the Snake River. With co-manager agreement, the conventional supplementation production goal was increased in 2006 from 132,000 to 225,000 fish for release as yearlings. This report summarizes activities of the Washington Department of Fish and Wildlife Lower Snake River Hatchery Evaluation Program for Tucannon River spring Chinook for the period May 2013 to April 2014.

A total of 539 salmon were captured in the TFH trap in 2013 (226 natural adults, 45 natural jacks, 154 hatchery adults, and 114 hatchery jacks). Of these, 158 (98 natural, 60 hatchery) were collected and hauled to LFH for broodstock and the remaining fish were passed upstream. During 2013, seven (4.4%) of the salmon that were collected for broodstock died prior to spawning.

Spawning of supplementation fish occurred between 27 August and 24 September, with peak eggtake occurring on 10 September. A total of 275,188 eggs were collected from 48 natural and 30 hatchery-origin female Chinook. Egg mortality to eye-up was 3.0% (8,357 eggs) which left 266,831 live eggs. A total of 30,000 of those eggs were transferred to TFH for full term rearing. An additional 1.2% (2,772) loss of sac-fry at LFH and 1.4% (429) loss of sac-fry at TFH left 263,630 BY 2013 fish for production (234,059 LFH, 29,571 TFH).

WDFW staff conducted spawning ground surveys in the Tucannon River between 28 August and 8 October, 2013. A total of 64 redds and 33 carcasses (23 natural, 10 hatchery) were found. While 374 (118 females) spring Chinook salmon were passed above the adult trap, only twenty-five redds and 11 carcasses were found upstream of the trap. The reason for the high pre-spawn mortality in 2013 is unknown and radio tagged fish will be tracked in 2014 to look for a potential cause. Based on redd counts, broodstock collection, and in-river pre-spawning mortalities, the estimated return to the river for 2013 was 1,117 spring Chinook (661 natural adults, 91 natural jacks and 297 hatchery-origin adults, 68 hatchery jacks).

Volitional release of the 2012 BY smolts began on 11 April and continued until 23 April, 2014 when the remaining fish were forced out. Based on detections at the Curl Lake PIT tag array, it was estimated that 129,952 BY12 LFH reared and 16,609 BY12 TFH reared fish were released.

Evaluation staff operated a downstream migrant trap to provide juvenile outmigration estimates. During the 2012/2013 emigration, we estimated that 23,376 (20,848-27,056 95% C.I.) natural spring Chinook (BY 2011) smolts emigrated from the Tucannon River.

Smolt-to-adult return rates (SAR) for natural origin salmon were over five times higher on average (based on geometric means) than hatchery origin salmon. However, hatchery salmon survive almost three times greater than natural salmon from parent to adult progeny. Based on density-dependent effects we have observed, the mitigation goal may be higher than the habitat can support under current habitat conditions.

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# Introduction

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## Program Objectives

Legislation under the Water Resources Act of 1976 authorized the establishment of the Lower Snake River Compensation Plan (LSRCP) to help mitigate for the losses of salmon and steelhead runs due to construction and operation of the Snake River dams and authorized hatchery construction and production in Washington, Idaho, and Oregon as a mitigation tool (USACE 1975). In Washington, Lyons Ferry Hatchery (LFH) was constructed and Tucannon Fish Hatchery (TFH) was modified. Under the mitigation negotiations, local fish and wildlife agencies determined through a series of conversion rates of McNary Dam counts that 2,400 spring Chinook (2% of passage at McNary Dam) annually escaped into the Tucannon River. The agencies also estimated a 48% cumulative loss rate to juvenile downstream migrants passing through the four lower Snake River dams. As such, 1,152<sup>1</sup> lost adult Tucannon River origin spring Chinook needed to be compensated for above the project area, with the expectation that the other 1,248 (52%) would continue to come from natural production. An additional 4,608 needed to be compensated for to provide harvest below the project area for a total mitigation goal of 5,760 Tucannon River spring Chinook. The agencies also determined through other survival studies at the time that a smolt-to-adult survival rate (SAR) to the project area of 0.87% was a reasonable expectation for spring and summer Chinook salmon. Based on an assumed 0.87% above project area SAR and the 1,152 above project area mitigation goal it was determined that 132,000 smolts needed to be released annually. In 1984, Washington Department of Fish and Wildlife<sup>2</sup> (WDFW) began to evaluate the success of these two hatcheries in meeting the mitigation goal, and identifying factors that would improve performance of the hatchery fish.

In an attempt to increase adult returns and come closer to achieving the LSRCP mitigation goal, the co-managers agreed to increase the conventional supplementation program goal to 225,000 yearling smolts annually beginning with the 2006 brood year. Size at release was increased to 38 g fish (12 fpp) beginning with the 2011 brood year. This report summarizes work performed by the WDFW Tucannon Spring Chinook Evaluation Program from May 2013 through April 2014.

## ESA Permits

The Tucannon River spring Chinook population is currently listed as “threatened” under the Endangered Species Act (ESA) as part of the Snake River Spring/Summer Chinook Salmon

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<sup>1</sup> The project area escapement is 1,152. It was also assumed that four times that number (4,608 fish) would be harvested below the project area. Here “project area” is defined as above Ice Harbor Dam.

<sup>2</sup> Formerly Washington Department of Fisheries.

evolutionary significant unit (ESU)(25 March 1999; FR 64(57): 14517-14528). The WDFW was issued Section 10 Permits (#1126 and #1129) to allow take for this program, but those permits have since expired. A Hatchery and Genetic Management Plan (HGMP) was originally submitted as the application for a new Section 4 (d) Permit for this program in 2005. An updated HGMP requesting ESA Section 10 permit coverage was submitted in 2011, and is currently under consultation with NOAA Fisheries. This annual report summarizes all work performed by WDFW's LSRCP Tucannon Spring Chinook Salmon Evaluation Program during 2013. Numbers of direct and indirect takes of listed Snake River spring Chinook (Tucannon River stock) for the 2013 calendar year are presented in Appendix A (Tables 1-2).

## Facility Descriptions

Lyons Ferry Hatchery is located on the Snake River (rkm 90) at its confluence with the Palouse River and has eight deep wells that produce nearly constant 11° C water (Figure 1). It is used for adult broodstock holding and spawning, and early life incubation and rearing. All juvenile fish are marked and returned to TFH in late September/October for final rearing and acclimation. Tucannon Fish Hatchery, located at rkm 59 on the Tucannon River, has an adult collection trap on site (Figure 1). Adults returning to TFH are transported to LFH and held until spawning. Juveniles are reared at TFH through the winter until release in the spring on a combination of well, spring, and river water. River water is the primary water source, which allows for a more natural winter temperature profile. In February, the fish are transported to Curl Lake Acclimation Pond (AP) located at rkm 66, a 0.85 hectare natural bottom lake with a mean depth of 2.7 m, and volitionally released during April.

## Tucannon River Watershed Characteristics

The Tucannon River empties into the Snake River between Little Goose and Lower Monumental Dams approximately 622 rkm from the mouth of the Columbia River (Figure 1). Stream elevation rises from 150 m at the mouth to 1,640 m at the headwaters (Bugert et al. 1990). Total watershed area is approximately 1,295 km<sup>2</sup>. Local habitat problems related to logging, road building, recreation, and agriculture/livestock grazing have limited the production potential of spring Chinook in the Tucannon River. Land use in the Tucannon watershed is approximately 36% grazed rangeland, 33% dry cropland, 23% forest, 6% WDFW, and 2% other use (Tucannon Subbasin Summary 2001). Five unique strata have been distinguished by predominant land use, habitat, and landmarks (Figure 1; Table 1) and are referenced throughout this report.

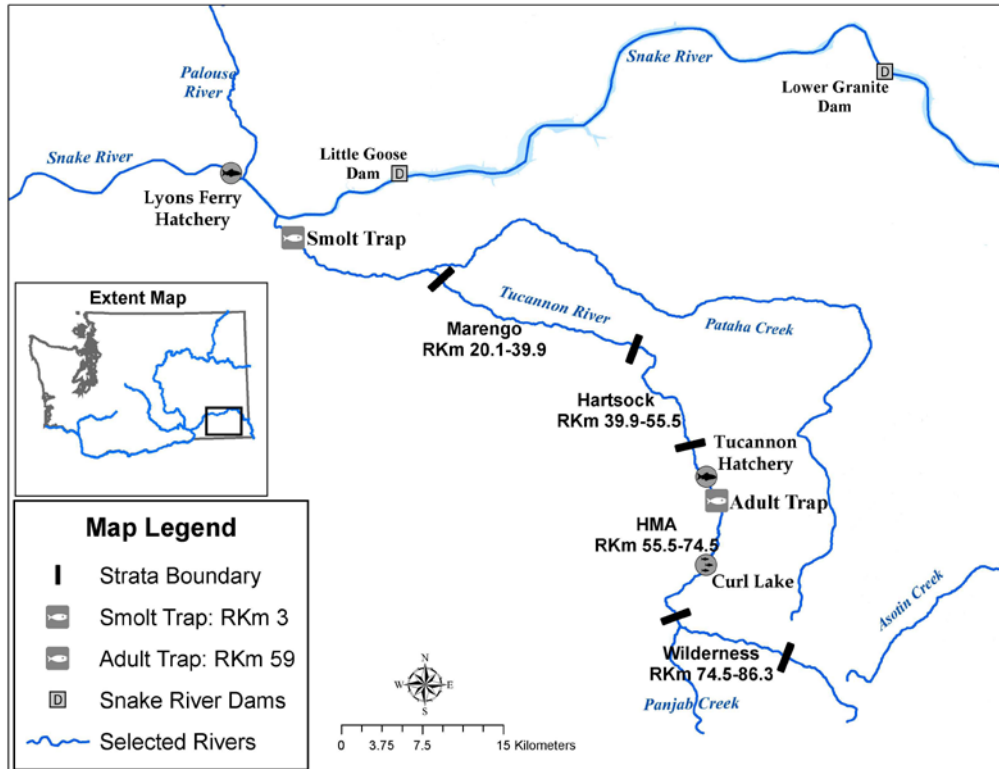


Figure 1. Location of the Tucannon River, and Lyons Ferry and Tucannon Hatcheries within the Snake River basin.

Table 1. Description of five strata within the Tucannon River.

| Strata     | Land Ownership/Usage           | Spring Chinook Habitat <sup>a</sup> | River Kilometer <sup>b</sup> |
|------------|--------------------------------|-------------------------------------|------------------------------|
| Lower      | Private/Agriculture & Ranching | Not-Usable (temperature limited)    | 0.0-20.1                     |
| Marengo    | Private/Agriculture & Ranching | Marginal (temperature limited)      | 20.1-39.9                    |
| Hartsock   | Private/Agriculture & Ranching | Fair to Good                        | 39.9-55.5                    |
| HMA        | State & Federal/Recreational   | Good to Excellent                   | 55.5-74.5                    |
| Wilderness | Federal/Recreational           | Excellent                           | 74.5-86.3                    |

<sup>a</sup> Strata were based on water temperature, habitat, and landowner use.

<sup>b</sup> Rkm descriptions: 0.0–mouth at the Snake River; 20.1–Territorial Rd.; 39.9–Marengo Br.; 55.5–HMA Boundary Fence; 74.5–Panjab Br.; 86.3–Rucherts Camp.

# Adult Salmon Evaluation

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## Broodstock Trapping

The collection goal for broodstock in 2013 was for up to 170 adult salmon, depending upon size and fecundity, collected from throughout the duration of the run to meet the smolt production/release goal of 225,000. The proportion of natural origin fish incorporated into the broodstock is based on the estimated run size and the Tucannon Spring Chinook Salmon Hatchery and Genetic Management Plan sliding scale. Additional jack salmon may be collected up to their proportion of the run with an upper limit of 10% of the broodstock. Returning Tucannon hatchery salmon were identified by coded-wire tag (CWT) in the snout or presence of a visible implant elastomer tag. Adipose clipped fish were killed outright as strays.

The TFH adult trap began operation in February (for steelhead) with the first spring Chinook captured 13 May. The trap was operated through September. A total of 539 fish entered the trap (226 natural adults, 45 natural jacks, 154 hatchery adults, and 114 hatchery jacks), and 98 natural (98 adults, 0 jacks) and 60 hatchery (60 adults, 0 jacks) spring Chinook were collected and hauled to LFH for broodstock (Table 2, Appendix B). Fish not collected for broodstock were passed upstream. Adults collected for broodstock were injected with erythromycin and oxytetracycline (0.5 cc/4.5 kg); jacks were given half dosages. Broodstock were transported to LFH and received formalin drip treatments during holding at 167 ppm every other day at LFH to control fungus.



**Table 2. Numbers of spring Chinook salmon captured, trap mortalities, strays killed outright, fish collected for broodstock, or passed upstream to spawn naturally at the TFH trap from 1986-2013.**

| Year              | Captured at Trap |          | Trap Mortalities |          | Killed Outright <sup>a</sup> | Broodstock Collected |          | Passed Upstream |          |
|-------------------|------------------|----------|------------------|----------|------------------------------|----------------------|----------|-----------------|----------|
|                   | Natural          | Hatchery | Natural          | Hatchery | Hatchery                     | Natural              | Hatchery | Natural         | Hatchery |
| 1986              | 247              | 0        | 0                | 0        | 0                            | 116                  | 0        | 131             | 0        |
| 1987              | 209              | 0        | 0                | 0        | 0                            | 101                  | 0        | 108             | 0        |
| 1988              | 267              | 9        | 0                | 0        | 0                            | 116                  | 9        | 151             | 0        |
| 1989              | 156              | 102      | 0                | 0        | 0                            | 67                   | 102      | 89              | 0        |
| 1990              | 252              | 216      | 0                | 1        | 0                            | 60                   | 75       | 192             | 140      |
| 1991              | 109              | 202      | 0                | 0        | 0                            | 41                   | 89       | 68              | 113      |
| 1992              | 242              | 305      | 8                | 3        | 0                            | 47                   | 50       | 187             | 252      |
| 1993              | 191              | 257      | 0                | 0        | 0                            | 50                   | 47       | 141             | 210      |
| 1994              | 36               | 34       | 0                | 0        | 0                            | 36                   | 34       | 0               | 0        |
| 1995              | 10               | 33       | 0                | 0        | 0                            | 10                   | 33       | 0               | 0        |
| 1996              | 76               | 59       | 1                | 4        | 0                            | 35                   | 45       | 40              | 10       |
| 1997              | 99               | 160      | 0                | 0        | 0                            | 43                   | 54       | 56              | 106      |
| 1998 <sup>b</sup> | 50               | 43       | 0                | 0        | 0                            | 48                   | 41       | 1               | 1        |
| 1999 <sup>c</sup> | 4                | 139      | 0                | 1        | 0                            | 4                    | 135      | 0               | 0        |
| 2000              | 25               | 180      | 0                | 0        | 17                           | 12                   | 69       | 13              | 94       |
| 2001              | 405              | 276      | 0                | 0        | 0                            | 52                   | 54       | 353             | 222      |
| 2002              | 168              | 610      | 0                | 0        | 0                            | 42                   | 65       | 126             | 545      |
| 2003              | 84               | 151      | 0                | 0        | 0                            | 42                   | 35       | 42              | 116      |
| 2004              | 311              | 155      | 0                | 0        | 0                            | 51                   | 41       | 260             | 114      |
| 2005              | 131              | 114      | 0                | 0        | 3                            | 49                   | 51       | 82              | 60       |
| 2006              | 61               | 78       | 0                | 1        | 2                            | 36                   | 53       | 25              | 22       |
| 2007              | 112              | 112      | 0                | 0        | 6                            | 54                   | 34       | 58              | 72       |
| 2008              | 114              | 386      | 0                | 0        | 1                            | 42                   | 92       | 72              | 293      |
| 2009              | 390              | 835      | 0                | 0        | 7                            | 89                   | 88       | 301             | 740      |
| 2010              | 774              | 796      | 0                | 0        | 9                            | 86                   | 87       | 688             | 700      |
| 2011              | 400              | 383      | 0                | 0        | 6                            | 89                   | 77       | 311             | 300      |
| 2012              | 240              | 301      | 0                | 0        | 6                            | 93                   | 77       | 147             | 218      |
| 2013              | 271              | 268      | 0                | 0        | 2                            | 98                   | 60       | 173             | 206      |

<sup>a</sup> Fish identified as strays at the adult trap are killed outright.

<sup>b</sup> Two males (one natural, one hatchery) captured were transported back downstream to spawn in the river.

<sup>c</sup> Three hatchery males that were captured were transported back downstream to spawn in the river.

## Broodstock Mortality

Seven (4.4%) of the 158 salmon collected for broodstock died prior to spawning in 2013 (Table 3). Table 3 shows that prespawning mortality in 2013 was comparable to the mortality documented since broodstock holding at LFH began in 1992. Higher mortality was experienced when fish were held at TFH (1986-1991), likely due to higher water temperatures.

**Table 3. Numbers of pre-spawning mortalities and percent of fish collected for broodstock at TFH and held at TFH (1985-1991) or LFH (1992-2013).**

| Year | Natural |        |      | % of collected | Hatchery |        |      | % of collected |
|------|---------|--------|------|----------------|----------|--------|------|----------------|
|      | Male    | Female | Jack |                | Male     | Female | Jack |                |
| 1985 | 3       | 10     | 0    | 59.1           | —        | —      | —    | —              |
| 1986 | 15      | 10     | 0    | 21.6           | —        | —      | —    | —              |
| 1987 | 10      | 8      | 0    | 17.8           | —        | —      | —    | —              |
| 1988 | 7       | 22     | 0    | 25.0           | —        | —      | 9    | 100.0          |
| 1989 | 8       | 3      | 1    | 17.9           | 5        | 8      | 22   | 34.3           |
| 1990 | 12      | 6      | 0    | 30.0           | 14       | 22     | 3    | 52.0           |
| 1991 | 0       | 0      | 1    | 2.4            | 8        | 17     | 32   | 64.0           |
| 1992 | 0       | 4      | 0    | 8.2            | 2        | 0      | 0    | 4.0            |
| 1993 | 1       | 2      | 0    | 6.0            | 2        | 1      | 0    | 6.4            |
| 1994 | 1       | 0      | 0    | 2.8            | 0        | 0      | 0    | 0.0            |
| 1995 | 1       | 0      | 0    | 10.0           | 0        | 0      | 3    | 9.1            |
| 1996 | 0       | 2      | 0    | 5.7            | 2        | 1      | 0    | 6.7            |
| 1997 | 0       | 4      | 0    | 9.3            | 2        | 2      | 0    | 7.4            |
| 1998 | 1       | 2      | 0    | 6.3            | 0        | 0      | 0    | 0.0            |
| 1999 | 0       | 0      | 0    | 0.0            | 3        | 1      | 1    | 3.8            |
| 2000 | 0       | 0      | 0    | 0.0            | 1        | 2      | 0    | 3.7            |
| 2001 | 0       | 0      | 0    | 0.0            | 0        | 0      | 0    | 0.0            |
| 2002 | 0       | 0      | 0    | 0.0            | 1        | 1      | 0    | 3.1            |
| 2003 | 0       | 1      | 0    | 2.4            | 0        | 0      | 1    | 2.9            |
| 2004 | 0       | 3      | 0    | 5.9            | 0        | 0      | 1    | 2.4            |
| 2005 | 2       | 0      | 0    | 4.1            | 1        | 2      | 0    | 5.9            |
| 2006 | 0       | 0      | 0    | 0.0            | 1        | 0      | 0    | 1.9            |
| 2007 | 0       | 2      | 1    | 5.6            | 0        | 2      | 0    | 5.9            |
| 2008 | 1       | 1      | 0    | 4.8            | 0        | 0      | 1    | 1.1            |
| 2009 | 0       | 0      | 0    | 0.0            | 0        | 2      | 0    | 2.3            |
| 2010 | 0       | 0      | 0    | 0.0            | 0        | 0      | 0    | 0.0            |
| 2011 | 0       | 0      | 0    | 0.0            | 0        | 0      | 0    | 0.0            |
| 2012 | 0       | 0      | 0    | 0.0            | 1        | 2      | 0    | 3.9            |
| 2013 | 2       | 3      | 0    | 5.1            | 0        | 2      | 0    | 3.3            |

## Broodstock Spawning

Spawning at LFH was conducted once a week from 27 August to 24 September, with peak eggtake occurring on 10 September. During the spawning process, the eggs of two females were split in half and fertilized by two males following a 2 x 2 factorial spawning matrix approach. Factorial mating can have substantial advantages in increasing the genetically effective number of breeders (Busack and Knudsen 2007). No stray hatchery fish were included in the broodstock based on CWTs.

A total of 275,188 eggs were collected (Table 4). Eggs were initially disinfected and water hardened for one hour in an iodophor (buffered iodine) solution (100 ppm). The eggs were incubated in vertical tray incubators. Fungus on the incubating eggs was controlled with formalin applied every-other day at 1,667 ppm for 15 minutes. Mortality to eye-up was 3.0% which left 266,831 live eggs. Approximately 30,000 of those eggs were transferred to TFH for full term rearing on 28 October, 2013. An additional 1.2% (2,772) loss of sac-fry at LFH and 1.4% (429) loss of sac-fry at TFH left 263,630 fish for production (234,059 LFH, 29,571 TFH).

**Table 4. Number of fish spawned or killed outright (K.O.), estimated egg collection, and egg mortality of natural and hatchery origin Tucannon River spring Chinook salmon at LFH in 2013. (Numbers in parentheses were live spawned).**

| Spawn Date    | Natural Origin  |      |         |      |         |      | Eggs Taken     |
|---------------|-----------------|------|---------|------|---------|------|----------------|
|               | Males           |      | Jacks   |      | Females |      |                |
|               | Spawned         | K.O. | Spawned | K.O. | Spawned | K.O. |                |
| 8/27          | 0 (4)           |      |         |      |         | 3    | 12,293         |
| 9/03          | 0 (11)          |      |         |      |         | 16   | 58,554         |
| 9/10          | 1 (21)          |      |         |      |         | 16   | 62,656         |
| 9/17          | 10 (15)         |      |         |      |         | 10   | 35,362         |
| 9/24          | 34 <sup>a</sup> |      |         |      |         | 3    | 10,779         |
| <b>Totals</b> | 45              | 0    | 0       | 0    | 0       | 48   | <b>179,644</b> |
| Egg Mortality |                 |      |         |      |         |      | 4,309          |
| Spawn Date    | Hatchery Origin |      |         |      |         |      | Eggs Taken     |
|               | Males           |      | Jacks   |      | Females |      |                |
|               | Spawned         | K.O. | Spawned | K.O. | Spawned | K.O. |                |
| 8/27          | 2               |      |         |      |         | 2    | 7,314          |
| 9/03          | 9               |      |         |      |         | 3    | 10,134         |
| 9/10          | 10              |      |         |      |         | 15   | 50,480         |
| 9/17          | 3               |      |         |      |         | 9    | 24,819         |
| 9/24          | 2               |      |         |      |         | 1    | 2,797          |
| <b>Totals</b> | 26              | 0    | 0       | 0    | 0       | 30   | <b>95,544</b>  |
| Egg Mortality |                 |      |         |      |         |      | 4,048          |

<sup>a</sup> Thirty-four were previously live spawned and sampled at the completion of spawning.

<sup>b</sup> Green females.

## Natural Spawning

Pre-spawn mortality walks were conducted during 8 August from Cummings Creek Bridge (rkm 56) to Camp Wooten Bridge (rkm 68). One carcass was recovered that was cut in half just in front of the dorsal fin (rkm 58.4). The front portion with the head was missing and the surveyor was unable to determine sex and origin. It was unknown whether the fish was poached or it was cut in half after it had died. Weekly spawning ground surveys were conducted from 28 August and were completed by 8 October 2013. Additional walks were conducted prior to fall Chinook spawning to count spring/summer Chinook redds below Marengo and were concluded by 11 October. Sixty-four redds were counted and 23 natural and 10 hatchery origin carcasses were recovered in the total surveyed area (Table 5). While 374 (118 females) spring Chinook salmon were passed above the adult trap, only twenty-five redds (39% of total) and 11 carcasses (33% of total) were found upstream of the trap. The reason for the high pre-spawn mortality in 2013 is unknown and radio tagged fish will be tracked in 2014 to look for a potential cause.

**Table 5. Numbers and general locations of salmon redds and carcasses recovered on the Tucannon River spawning grounds, 2013 (the Tucannon Hatchery adult trap is located at rkm 59).**

| Stratum                               | Rkm <sup>a</sup> | Number of redds | Carcasses Recovered |           |
|---------------------------------------|------------------|-----------------|---------------------|-----------|
|                                       |                  |                 | Natural             | Hatchery  |
| Wilderness                            | 84-86            | 0               | 0                   | 0         |
|                                       | 78-84            | 0               | 0                   | 0         |
|                                       | 75-78            | 3               | 1                   | 0         |
| HMA                                   | 73-75            | 0               | 0                   | 0         |
|                                       | 68-73            | 4               | 0                   | 1         |
|                                       | 66-68            | 7               | 0                   | 1         |
|                                       | 62-66            | 7               | 2                   | 0         |
|                                       | 59-62            | 4               | 4                   | 2         |
| -----Tucannon Fish Hatchery Trap----- |                  |                 |                     |           |
| Hartsock                              | 56-59            | 20              | 13                  | 6         |
|                                       | 52-56            | 7               | 1                   | 0         |
|                                       | 47-52            | 4               | 1                   | 0         |
|                                       | 43-47            | 3               | 1                   | 0         |
|                                       | 40-43            | 1               | 0                   | 0         |
| Marengo                               | 34-40            | 0               | 0                   | 0         |
|                                       | 28-34            | 0               | 0                   | 0         |
| Below Marengo                         | 0-28             | 4               | 0                   | 0         |
| <b>Totals</b>                         | <b>0-86</b>      | <b>64</b>       | <b>23</b>           | <b>10</b> |

<sup>a</sup> Rkm descriptions: 86-Rucherts Camp; 84-Sheep Cr.; 78-Lady Bug Flat CG; 75-Panjab Br.; 73-Cow Camp Bridge; 68-Tucannon CG; 66-Curl Lake; 62-Beaver/Watson Lakes Br.; 59-Tucannon Hatchery Intake/Adult Trap; 56-HMA Boundary Fence; 52-Br. 14; 47-Br. 12; 43-Br. 10; 40-Marengo Br.; 34-King Grade Br.; 28-Enrich Br. (Brines Rd.)

## Historical Trends in Natural Spawning

Two general spawning trends were evident (Figure 2) from the program's inception in 1985 through 1999:

- 1) The proportion of the total number of redds occurring below the adult trap increased; and
- 2) The density of redds (redds/km) decreased in the Tucannon River.

In part, this resulted from a greater emphasis on broodstock collection to keep the spring Chinook population from extinction. However, increases in the SAR rates beginning with the 1995 brood have subsequently resulted in increased spawning above the trap and higher redd densities (Figure 2; Table 6). Also, moving the release location from TFH upstream to Curl Lake AP in 1999 appears to have affected the spawning distribution, with higher numbers of fish and redds in the Wilderness and HMA strata compared to previous years (Table 6).

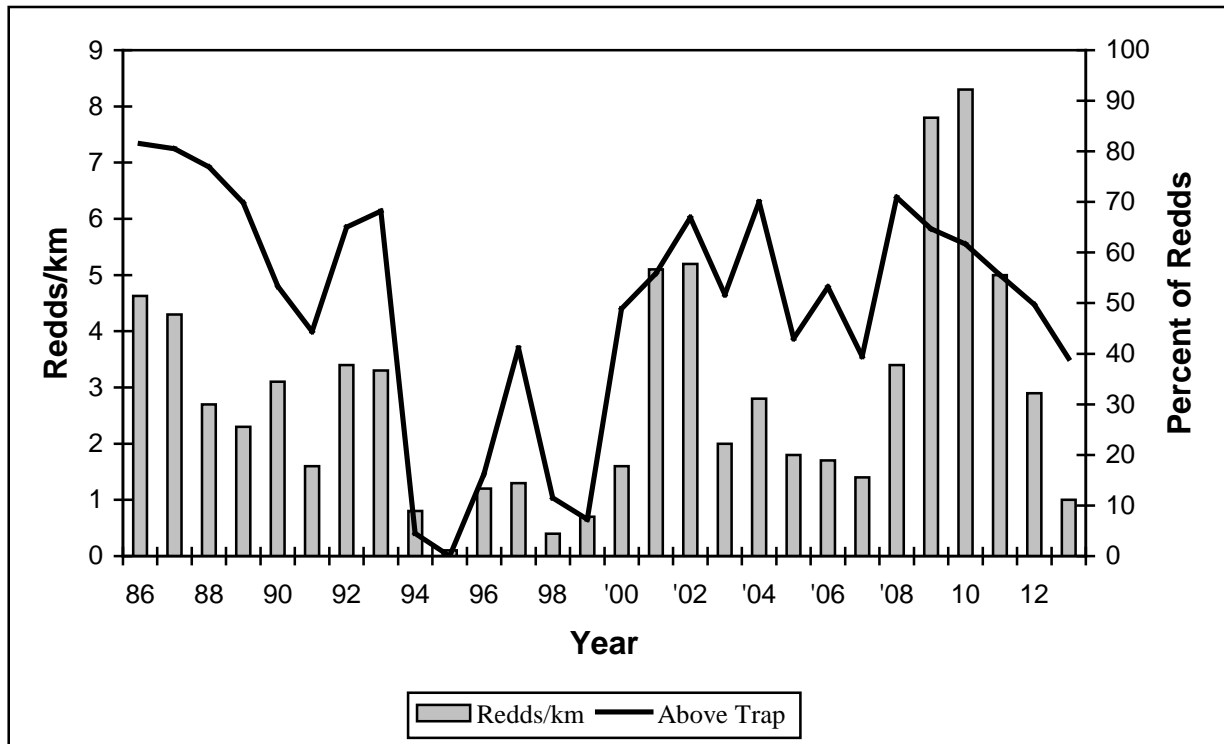


Figure 2. Number of redds/km and percentage of redds above the adult trap on the Tucannon River, 1986-2013.

**Table 6. Number of spring Chinook salmon redds and redds/km (in parenthesis) by stratum and year, and the number and percent of redds above and below the TFH adult trap in the Tucannon River, 1985-2013.**

| Year | Strata <sup>1</sup> |            |           |          | Total<br>Redds <sup>2</sup> | TFH Adult Trap <sup>2</sup> |      |       |       |
|------|---------------------|------------|-----------|----------|-----------------------------|-----------------------------|------|-------|-------|
|      | Wilderness          | HMA        | Hartsock  | Marengo  |                             | Above                       | %    | Below | %     |
| 1985 | 84 (7.1)            | 105 (5.3)  | –         | –        | 189                         | –                           | –    | –     | –     |
| 1986 | 53 (4.5)            | 117 (6.2)  | 29 (1.9)  | 0 (0.0)  | 200                         | 163                         | 81.5 | 37    | 18.5  |
| 1987 | 15 (1.3)            | 140 (7.4)  | 30 (1.9)  | –        | 185                         | 149                         | 80.5 | 36    | 19.5  |
| 1988 | 18 (1.5)            | 79 (4.2)   | 20 (1.3)  | –        | 117                         | 90                          | 76.9 | 27    | 23.1  |
| 1989 | 29 (2.5)            | 54 (2.8)   | 23 (1.5)  | –        | 106                         | 74                          | 69.8 | 32    | 30.2  |
| 1990 | 20 (1.7)            | 94 (4.9)   | 64 (4.1)  | 2 (0.3)  | 180                         | 96                          | 53.3 | 84    | 46.7  |
| 1991 | 3 (0.3)             | 67 (2.9)   | 18 (1.1)  | 2 (0.3)  | 90                          | 40                          | 44.4 | 50    | 55.6  |
| 1992 | 17 (1.4)            | 151 (7.9)  | 31 (2.0)  | 1 (0.2)  | 200                         | 130                         | 65.0 | 70    | 35.0  |
| 1993 | 34 (3.4)            | 123 (6.5)  | 34 (2.2)  | 1 (0.2)  | 192                         | 131                         | 68.2 | 61    | 31.8  |
| 1994 | 1 (0.1)             | 10 (0.5)   | 28 (1.8)  | 5 (0.9)  | 44                          | 2                           | 4.5  | 42    | 95.5  |
| 1995 | 0 (0.0)             | 2 (0.1)    | 3 (0.2)   | 0 (0.0)  | 5                           | 0                           | 0.0  | 5     | 100.0 |
| 1996 | 1 (0.1)             | 33 (1.7)   | 34 (2.2)  | 1 (0.2)  | 69                          | 11                          | 16.2 | 58    | 83.8  |
| 1997 | 2 (0.2)             | 43 (2.3)   | 27 (1.7)  | 1 (0.2)  | 73                          | 30                          | 41.1 | 43    | 58.9  |
| 1998 | 0 (0.0)             | 3 (0.2)    | 20 (1.3)  | 3 (0.5)  | 26                          | 3                           | 11.5 | 23    | 88.5  |
| 1999 | 1 (0.1)             | 34 (1.8)   | 6 (0.4)   | 0 (0.0)  | 41                          | 3                           | 7.3  | 38    | 92.7  |
| 2000 | 4 (0.4)             | 68 (3.6)   | 20 (1.3)  | 0 (0.0)  | 92                          | 45                          | 48.9 | 47    | 51.1  |
| 2001 | 22 (2.0)            | 194 (10.2) | 80 (5.0)  | 1 (0.1)  | 297                         | 166                         | 55.9 | 131   | 44.1  |
| 2002 | 29 (2.6)            | 214 (11.3) | 45 (2.8)  | 11 (0.9) | 299                         | 200                         | 66.9 | 99    | 33.1  |
| 2003 | 3 (0.3)             | 89 (4.7)   | 26 (1.6)  | 0 (0.0)  | 118                         | 61                          | 51.7 | 57    | 48.3  |
| 2004 | 24 (2.2)            | 119 (6.3)  | 17 (1.1)  | 0 (0.0)  | 160                         | 112                         | 70.0 | 48    | 30.0  |
| 2005 | 4 (0.4)             | 71 (3.7)   | 27 (1.7)  | 5 (0.4)  | 107                         | 46                          | 43.0 | 61    | 57.0  |
| 2006 | 2 (0.2)             | 81 (4.3)   | 17 (1.1)  | 1 (0.1)  | 109                         | 58                          | 53.2 | 51    | 46.8  |
| 2007 | 2 (0.2)             | 63 (3.3)   | 16 (1.0)  | 0 (0.0)  | 81                          | 32                          | 39.5 | 49    | 60.5  |
| 2008 | 30 (2.7)            | 146 (7.7)  | 22 (1.4)  | 1 (0.1)  | 199                         | 141                         | 70.9 | 58    | 29.1  |
| 2009 | 67 (6.1)            | 329 (17.3) | 52 (3.3)  | 3 (0.3)  | 451                         | 292                         | 64.7 | 159   | 35.3  |
| 2010 | 83 (7.5)            | 289 (15.2) | 106 (6.6) | 3 (0.3)  | 481                         | 297                         | 61.7 | 184   | 38.3  |
| 2011 | 35 (3.2)            | 196 (10.3) | 53 (3.3)  | 6 (0.5)  | 297                         | 165                         | 55.6 | 132   | 44.4  |
| 2012 | 11 (1.0)            | 132 (6.9)  | 23 (1.4)  | 0 (0.0)  | 169                         | 84                          | 49.7 | 85    | 50.3  |
| 2013 | 3 (0.3)             | 42 (2.2)   | 15 (0.9)  | 0 (0.0)  | 64                          | 25                          | 39.1 | 39    | 60.9  |

Note: – indicates the river was not surveyed in that section during that year.

<sup>1</sup> Excludes redds found below the Marengo stratum.

<sup>2</sup> Includes all redds counted during redd surveys.

## Genetic Sampling

During 2013, we collected 179 DNA samples (tissue samples) from hatchery broodstock and carcasses collected from the spawning grounds (113 natural origin, 64 conventional supplementation hatchery, and two hatchery origin strays). These samples were sent to the

WDFW genetics lab in Olympia, Washington for storage. Genotypes, allele frequencies, and tissue samples from previous sampling years are available from WDFW's Genetics Laboratory.

## Age Composition, Length Comparisons, and Fecundity

We determine the age composition of each year's returning adults from scale samples of natural origin fish, and both scales and CWTs from hatchery-origin fish. This enables us to annually compare ages of natural and hatchery-reared fish, and to examine trends and variability in age structure. Overall, hatchery origin fish return at a younger age than natural origin fish and have fewer age-5 fish in the population (Figure 3). This difference is likely due to larger size-at-release that results in earlier maturation (hatchery origin smolts are generally 25-30 mm greater in length than natural smolts). The age composition for natural origin fish that returned in 2013 was similar to the historical age composition (Figure 3). The hatchery origin component of the population had fewer age-3 and more age-4 fish than the historical composition. The age composition by brood year for natural and hatchery origin fish is found in Appendix C.

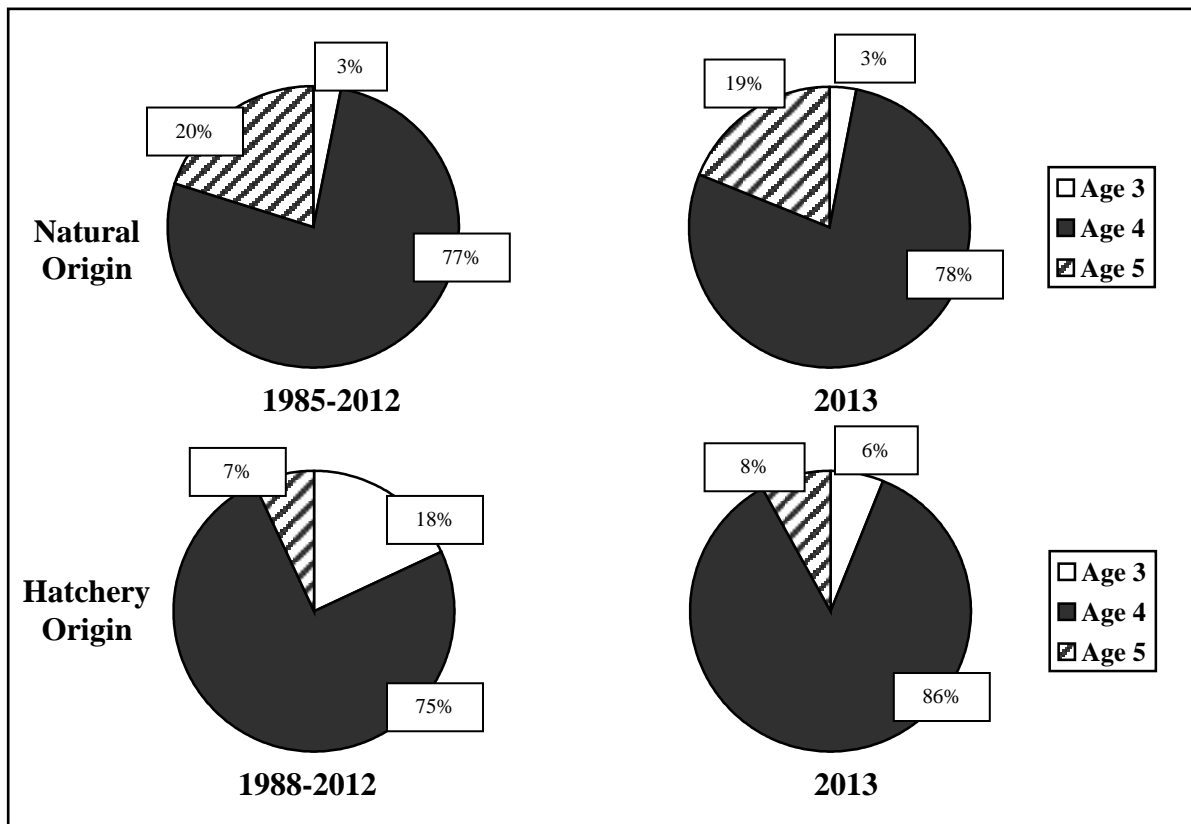
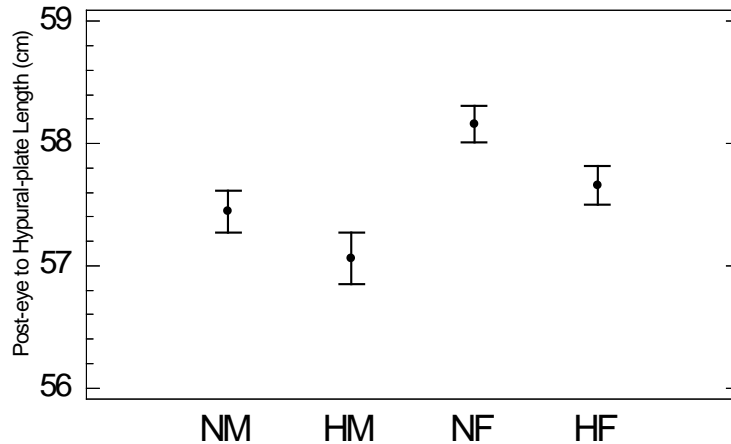


Figure 3. Historical (1985-2012), and 2013 age composition (run year) for spring Chinook in the Tucannon River.

Another metric monitored on returning adult natural and hatchery origin fish is size at age, measured as the mean post-orbital to hypural-plate (POH) lengths. We examined size at age for returns using multiple comparison analysis from 1985-2013 and found a significant difference ( $P < 0.05$ ) in mean POH length between age-4 natural and hatchery-origin female, and age-4 natural and hatchery-origin male spring Chinook salmon (Figure 4).



**Figure 4. Mean POH length comparisons between age-4 natural and hatchery-origin males (NM and HM) and natural and hatchery-origin females (NF and HF) with 95% confidence intervals for the years 1985-2013.**

To estimate fecundities (number of eggs/female) from the 2013 return year, dead eggs were counted for each female and a subsample of 100 live eyed-eggs was weighed. The total mass of live eggs was also weighed, and divided by the average weight per egg to yield total number of live eggs. This estimate was decreased by 4% to compensate for adherence of water on the eggs (WDFW Snake River Lab, unpublished data). Fecundities of natural and hatchery origin fish from the Tucannon River program have been documented since 1990 (Table 7). We performed an analysis of variance to determine if there were differences in mean fecundities of hatchery and natural origin fish. The significance level for all statistical tests was 0.05. Natural origin females were significantly more fecund than hatchery origin fish for both age-4 ( $P < 0.001$ ) and age-5 fish ( $P < 0.001$ ).

Examining Tucannon River spring Chinook salmon, Gallinat and Chang (2013) found that hatchery origin females had significantly lower fecundity than natural origin fish after correcting for body size. They also observed that the progeny of captive-reared broodstock, released as smolts and recaptured as returning age-4 adults, had a size and fecundity distribution that was



similar to the hatchery-origin adults, suggesting that the decrease in fecundity was not a genetically linked trait.

**Table 7. Average number of eggs/female (n, SD) by age group of Tucannon River natural and hatchery origin broodstock, 1990-2013 (partial spawned females are excluded).**

| Year        | Age 4              |                   | Age 5               |                    |
|-------------|--------------------|-------------------|---------------------|--------------------|
|             | Natural            | Hatchery          | Natural             | Hatchery           |
| 1990        | 3,691 (13, 577.3)  | 2,795 (18, 708.0) | 4,383 (8, 772.4)    | No Fish            |
| 1991        | 3,140 ( 5, 363.3)  | 2,649 ( 9, 600.8) | 4,252 (11, 776.0)   | 3,052 (1, 000.0)   |
| 1992        | 3,736 (16, 588.3)  | 3,286 (25, 645.1) | 4,800 (2, 992.8)    | 3,545 (1, 000.0)   |
| 1993        | 3,267 ( 4, 457.9)  | 3,456 ( 5, 615.4) | 4,470 (2, 831.6)    | 4,129 (1, 000.0)   |
| 1994        | 3,688 (13, 733.9)  | 3,280 (11, 630.3) | 4,848 (8, 945.8)    | 3,352 (10, 705.9)  |
| 1995        | No Fish            | 3,584 (14, 766.4) | 5,284 (6, 1,361.2)  | 3,889 (1, 000.0)   |
| 1996        | 3,510 (17, 534.3)  | 2,853 (18, 502.3) | 3,617 (1, 000.0)    | No Fish            |
| 1997        | 3,487 (15, 443.1)  | 3,290 (24, 923.2) | 4,326 (3, 290.8)    | No Fish            |
| 1998        | 4,204 ( 1, 000.0)  | 2,779 ( 7, 405.5) | 4,017 (28, 680.5)   | 3,333 (6, 585.2)   |
| 1999        | No Fish            | 3,121 (34, 445.4) | No Fish             | 3,850 (1, 000.0)   |
| 2000        | 4,144 (2, 1,571.2) | 3,320 (34, 553.6) | 3,618 (1, 000.0)    | 4,208 (1, 000.0)   |
| 2001        | 3,612 (27, 518.1)  | 3,225 (24, 705.4) | No Fish             | 3,585 (2, 1,191.5) |
| 2002        | 3,584 (14, 740.7)  | 3,368 (24, 563.7) | 4,774 (7, 429.1)    | No Fish            |
| 2003        | 3,342 (10, 778.0)  | 2,723 ( 2, 151.3) | 4,428 (7, 966.3)    | 3,984 (17, 795.9)  |
| 2004        | 3,376 (26, 700.5)  | 2,628 (17, 397.8) | 5,191 (1, 000.0)    | 2,151 (1, 000.0)   |
| 2005        | 3,399 (18, 545.9)  | 2,903 (22, 654.2) | 4,734 (7, 1,025.0)  | No Fish            |
| 2006        | 2,857 (17, 559.1)  | 2,590 (26, 589.8) | 3,397 (1, 000.0)    | 4,319 (1, 000.0)   |
| 2007        | 3,450 (14, 721.1)  | 2,679 ( 6, 422.7) | 4,310 (12, 1,158.0) | 3,440 (2, 997.7)   |
| 2008        | 3,698 (16, 618.9)  | 3,018 (40, 501.3) | 4,285 (1, 000.0)    | 4,430 (1, 000.0)   |
| 2009        | 3,469 (34, 628.9)  | 3,267 (52, 641.3) | 4,601 (6, 753.6)    | No Fish            |
| 2010        | 3,579 (38, 594.8)  | 3,195 (44, 640.9) | No Fish             | No Fish            |
| 2011        | 3,513 (18, 613.0)  | 3,061 (30, 615.1) | 4,709 (27, 755.2)   | 3,954 (11, 731.3)  |
| 2012        | 2,998 (40, 618.1)  | 2,539 (45, 462.5) | 4,371 (5, 478.0)    | 3,105 (2, 356.4)   |
| 2013        | 3,479 (34, 574.8)  | 3,145 (28, 592.9) | 4,702 (12, 931.5)   | 3,746 (2, 185.3)   |
| <b>Mean</b> | <b>3,445</b>       | <b>3,058</b>      | <b>4,479</b>        | <b>3,706</b>       |
| <b>SD</b>   | <b>642.6</b>       | <b>652.4</b>      | <b>859.9</b>        | <b>747.0</b>       |

## Coded-Wire Tag Sampling

Broodstock collection, pre-spawn mortalities, and carcasses recovered during spawning ground surveys provide representatives of the annual run that can be sampled for CWT study groups (Table 8). In 2013, based on the estimated escapement of fish to the river, we sampled approximately 17% of the run (Table 9).

**Table 8. Coded-wire tag codes of hatchery salmon sampled at LFH and the Tucannon River, 2013.**

| CWT Code                                   | Broodstock Collected <sup>a</sup> |                 |           | Recovered in Tucannon River |                     |          | Totals    |
|--|-----------------------------------|-----------------|-----------|-----------------------------|---------------------|----------|-----------|
|  | Died in Pond                      | Killed Outright | Spawned   | Dead in Trap                | Pre-spawn Mortality | Spawned  |           |
| 63-60-75                                   |                                   |                 |           |                             |                     | 1        | 1         |
| 63-60-76                                   |                                   |                 |           |                             |                     | 1        | 1         |
| 63-55-65                                   |                                   |                 | 16        |                             |                     | 3        | 19        |
| 63-55-66                                   |                                   | 2 <sup>a</sup>  | 37        |                             |                     | 4        | 43        |
| 63-51-74                                   |                                   |                 |           |                             | 1                   |          | 1         |
| 63-51-75                                   | 2                                 |                 | 3         |                             |                     |          | 5         |
| <b>-Strays-<br/>AD/No Wire<sup>b</sup></b> |                                   |                 |           | 2                           |                     |          | 2         |
| <b>Total</b>                               | <b>2</b>                          | <b>2</b>        | <b>56</b> | <b>2</b>                    | <b>1</b>            | <b>9</b> | <b>72</b> |

<sup>a</sup> Two green females were killed by mistake during spawning.

<sup>b</sup> Adipose clipped strays are killed outright at the trap.

**Table 9. Spring Chinook salmon (natural and hatchery) sampled from the Tucannon River, 2013.**

|   | 2013    |          |       |
|---|---------|----------|-------|
|   | Natural | Hatchery | Total |
| <b><i>Total escapement to river</i></b> | 752     | 365      | 1,117 |
| Broodstock collected                    | 98      | 60       | 158   |
| Fish dead in adult trap                 | 0       | 2        | 2     |
| Total hatchery sample                   | 98      | 62       | 160   |
| <b><i>Total fish left in river</i></b>  | 654     | 303      | 957   |
| In-river pre-spawn mortalities observed | 1       | 1        | 2     |
| Spawned carcasses recovered             | 22      | 9        | 31    |
| Total river sample                      | 23      | 10       | 33    |
| <b>Carcasses sampled</b>                | 121     | 72       | 193   |

## Arrival and Spawn Timing Trends

We monitor peak arrival and spawn timing to determine whether the hatchery program has caused a shift (Table 10). Peak arrival dates were based on the greatest number of fish trapped on a single day. Peak spawn in the hatchery was determined by the day when the most females were spawned. Peak spawning in the river was determined by the highest weekly redd count.

Peak arrival to the adult trap during 2013 was within the range found in previous years for both natural and hatchery origin fish, with peak arrival on 6 June for both groups (Table 10). Peak spawning in the hatchery was 10 September for both natural and hatchery origin fish which was similar to the range found from previous years. The duration of spawning in the hatchery was similar to the historical mean. Spawning in the river peaked during 11 September which was also the same week for the peak number of fish spawned in the hatchery. The duration of active spawning in the Tucannon River was within the range found from previous years.

**Table 10. Peak dates of arrival of natural and hatchery salmon to the TFH adult trap and peak (date) and duration (number of days) for spawning in the hatchery and river, 1986-2013.**

| Year              | Peak Arrival at Trap |             | Spawning in Hatchery |             |                 | Spawning in River |                  |
|-------------------|----------------------|-------------|----------------------|-------------|-----------------|-------------------|------------------|
|                   | Natural              | Hatchery    | Natural              | Hatchery    | Duration        | Combined          | Duration         |
| 1986              | 5/27                 | –           | 9/17                 | –           | 31              | 9/16              | 36               |
| 1987              | 5/15                 | –           | 9/15                 | –           | 29              | 9/23              | 35               |
| 1988              | 5/24                 | –           | 9/07                 | –           | 22              | 9/17              | 35               |
| 1989              | 6/06                 | 6/12        | 9/15                 | 9/12        | 29              | 9/13              | 36               |
| 1990              | 5/22                 | 5/23        | 9/04                 | 9/11        | 36              | 9/12              | 42               |
| 1991              | 6/11                 | 6/04        | 9/10                 | 9/10        | 29              | 9/18              | 35               |
| 1992              | 5/18                 | 5/21        | 9/15                 | 9/08        | 28              | 9/09              | 44               |
| 1993              | 5/31                 | 5/27        | 9/13                 | 9/07        | 30              | 9/08              | 52               |
| 1994              | 5/25                 | 5/27        | 9/13                 | 9/13        | 22              | 9/15              | 29               |
| 1995 <sup>a</sup> | –                    | 6/08        | 9/13                 | 9/13        | 30              | 9/12              | 21               |
| 1996              | 6/06                 | 6/20        | 9/17                 | 9/10        | 21              | 9/18              | 35               |
| 1997              | 6/15                 | 6/17        | 9/09                 | 9/16        | 30              | 9/17              | 50               |
| 1998              | 6/03                 | 6/16        | 9/08                 | 9/16        | 36              | 9/17              | 16               |
| 1999 <sup>a</sup> | –                    | 6/16        | 9/07                 | 9/14        | 22              | 9/16              | 23               |
| 2000              | 6/06                 | 5/22        | –                    | 9/05        | 22              | 9/13              | 30               |
| 2001              | 5/23                 | 5/23        | 9/11                 | 9/04        | 20              | 9/12              | 35               |
| 2002              | 5/29                 | 5/29        | 9/10                 | 9/03        | 22              | 9/11              | 42               |
| 2003              | 5/25                 | 5/25        | 9/09                 | 9/02        | 36              | 9/12              | 37               |
| 2004              | 6/04                 | 6/02        | 9/14                 | 9/07        | 29              | 9/08              | 30               |
| 2005              | 6/01                 | 5/31        | 9/06                 | 9/06        | 28              | 9/14              | 28               |
| 2006              | 6/12                 | 6/09        | 9/12                 | 9/12        | 28              | 9/8               | --- <sup>b</sup> |
| 2007              | 6/04                 | 6/04        | 9/18                 | 9/04        | 22              | 9/12              | 30               |
| 2008              | 6/16                 | 6/20        | 9/09                 | 9/16        | 21              | 9/11              | 34               |
| 2009              | 6/01                 | 6/15        | 9/15                 | 9/08        | 29              | 9/10              | 37               |
| 2010              | 6/04                 | 6/03        | 9/14                 | 9/08        | 14 <sup>c</sup> | 9/10              | 33               |
| 2011              | 6/08                 | 6/23        | 9/6                  | 9/06        | 22              | 9/16              | 33               |
| 2012              | 5/30                 | 6/02        | 9/11                 | 9/18        | 22              | 9/12              | 36               |
| <b>Mean</b>       | <b>6/01</b>          | <b>6/05</b> | <b>9/12</b>          | <b>9/10</b> | <b>26</b>       | <b>9/14</b>       | <b>34</b>        |
| 2013              | 6/06                 | 6/06        | 9/10                 | 9/10        | 29              | 9/11              | 42               |

<sup>a</sup> Too few natural salmon were trapped in 1995 and 1999 to determine peak arrival.

<sup>b</sup> Access restrictions during the Columbia Complex Forest Fire prohibited spawning ground surveys during the beginning of spawning.

<sup>c</sup> Unspawned females determined to be excess of eggtake goals were returned to the river for natural spawning which truncated duration of spawning in the hatchery.

Half of the total run for both natural and hatchery-origin fish arrive at the adult trap by 12 June (Figure 5). After this date, the hatchery fish tend to arrive at the adult trap at a slightly faster rate than natural origin fish.

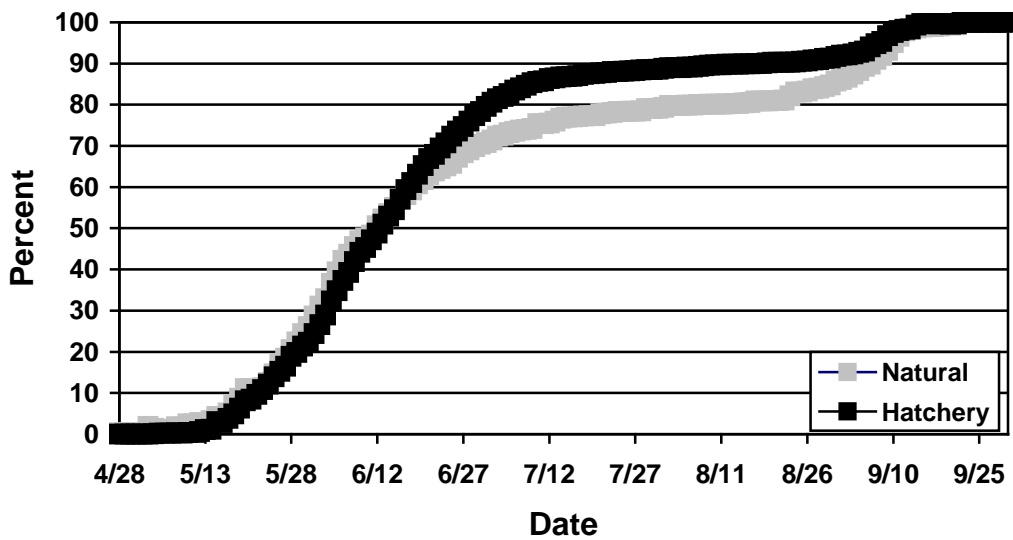


Figure 5. Mean percent of total run captured by date at the Tucannon Fish Hatchery adult trap on the Tucannon River for both natural and hatchery origin Tucannon River spring Chinook salmon, 1993-2013.

## Total Run-Size

Redd counts have a strong direct relationship to total run-size entering the Tucannon River and passage of adult salmon at the TFH adult trap (Bugert et al. 1991). However, fish have been able to bypass the Tucannon River adult trap in past years (Gallinat and Ross 2009). In order to more accurately estimate escapement above the trap, a hanging plastic curtain was installed at the adult trap by hatchery staff during the winter of 2008 to inhibit salmon and steelhead from bypassing the adult trap during high flows. While the plastic curtain might have reduced the bypass rate, some fish are still able to travel upstream without going through the adult trap. We calculated separate bypass rates for both jacks and adults since their ability to bypass the trap was different.

Using fish recovered during spawning ground surveys we calculated the number of jacks and adults that bypassed the adult trap by solving for the following equation:

$$\text{Number of fish}^3 \text{ that bypassed adult trap} = \frac{\text{Number of carcasses without operculum punches} \times \text{Fish passed above trap}}{\text{Number of carcasses with operculum punches}}$$

Based on 2013 spawning ground carcass operculum punch recoveries, no spring Chinook were able to bypass the adult trap. We added the calculated number of fish that bypassed the trap (0 jacks, 0 adults) to the number of fish that were passed upstream by hatchery staff (157 jacks, 222 adults) for a total of 379 fish above the trap. Five fish (0 jacks, 5 adults) fell back below the

<sup>3</sup> This formula was used to separately calculate for jacks and adults bypassing the adult trap. The word “fish” is used as a generic term referring to either adults or jacks.

adult trap and there were no observed pre-spawn mortalities leaving 374 fish above the trap. The number of fish above the trap divided by the number of redds above the trap (25) calculated out to 14.96 fish per redd. Using the fish per redd estimate for above the trap we multiplied that estimate by the number of redds below the trap (39) to estimate the number of fish below the trap (583). There were two pre-spawn mortalities below the trap leaving 581 fish available for spawning.

The run-size estimate for 2013 was calculated by adding the estimated number of fish upstream of the TFH adult trap (374), the estimated fish below the weir (581), the number of observed pre-spawn mortalities above (0) and below the weir (2), the number of trap mortalities (0) and stray fish killed at the trap (2), and the number of broodstock collected (158) (Table 11). Run-size for 2013 was estimated to be 1,117 fish (661 natural adults, 91 natural jacks, and 297 hatchery adults, 68 hatchery-origin jacks). Historical breakdowns are provided in Appendix D.

**Table 11. Estimated spring Chinook salmon run to the Tucannon River, 1985-2013.**

| <b>Year<sup>a</sup></b> | <b>Total Redds</b> | <b>Fish/Redd Ratio<sup>b</sup></b> | <b>Potential Spawners</b> | <b>Broodstock Collected</b> | <b>Pre-spawning Mortalities<sup>c</sup></b> | <b>Total Run-Size</b> | <b>Percent Natural</b> |
|-------------------------|--------------------|------------------------------------|---------------------------|-----------------------------|---|-----------------------|------------------------|
| 1985                    | 219                | 2.60                               | 569                       | 22                          | 0   | 591                   | 100                    |
| 1986                    | 200                | 2.60                               | 520                       | 116                         | 0   | 636                   | 100                    |
| 1987                    | 185                | 2.60                               | 481                       | 101                         | 0   | 582                   | 100                    |
| 1988                    | 117                | 2.60                               | 304                       | 125                         | 0   | 429                   | 96                     |
| 1989                    | 106                | 2.60                               | 276                       | 169                         | 0   | 445                   | 76                     |
| 1990                    | 180                | 3.39                               | 611                       | 135                         | 8   | 754                   | 66                     |
| 1991                    | 90                 | 4.33                               | 390                       | 130                         | 8   | 528                   | 49                     |
| 1992                    | 200                | 2.82                               | 564                       | 97                          | 92  | 753                   | 56                     |
| 1993                    | 192                | 2.27                               | 436                       | 97                          | 56  | 589                   | 54                     |
| 1994                    | 44                 | 1.59                               | 70                        | 70                          | 0   | 140                   | 70                     |
| 1995                    | 5                  | 2.20                               | 11                        | 43                          | 0   | 54                    | 39                     |
| 1996                    | 68                 | 2.00                               | 136                       | 80                          | 34  | 250                   | 66                     |
| 1997                    | 73                 | 2.00                               | 146                       | 97                          | 108   | 351                   | 46                     |
| 1998                    | 26                 | 1.94                               | 51                        | 89                          | 4   | 144                   | 59                     |
| 1999                    | 41                 | 2.60                               | 107                       | 136                         | 2   | 245                   | 1                      |
| 2000                    | 92                 | 2.60                               | 239                       | 81                          | 19  | 339                   | 24                     |
| 2001                    | 298                | 3.00                               | 894                       | 106                         | 12  | 1,012                 | 71                     |
| 2002                    | 299                | 3.00                               | 897                       | 107                         | 1   | 1,005                 | 35                     |
| 2003                    | 118                | 3.10                               | 366                       | 77                          | 1   | 444                   | 56                     |
| 2004                    | 160                | 3.00                               | 480                       | 92                          | 1   | 573                   | 70                     |
| 2005                    | 102                | 3.10                               | 317                       | 100                         | 3   | 420                   | 69                     |
| 2006                    | 101                | 1.60                               | 161                       | 89                          | 3   | 253                   | 55                     |
| 2007                    | 81                 | 3.10                               | 250                       | 88                          | 6   | 344                   | 58                     |
| 2008                    | 199                | 4.10                               | 1,056                     | 134                         | 1   | 1,191                 | 45                     |
| 2009                    | 451                | 3.70                               | 1,676                     | 177                         | 9   | 1,862                 | 40                     |
| 2010                    | 481                | 4.87                               | 2,341                     | 173                         | 11  | 2,525                 | 57                     |
| 2011                    | 297                | 3.79                               | 1,128                     | 166                         | 6   | 1,300                 | 58                     |
| 2012                    | 169                | 6.30                               | 1,059                     | 170                         | 10  | 1,239                 | 66                     |
| 2013                    | 64                 | 14.96                              | 955                       | 158                         | 4   | 1,117                 | 67                     |

<sup>a</sup> In 1994, 1995, 1998 and 1999, fish were not passed upstream, and in 1996 and 1997, high pre-spawning mortality occurred in fish passed above the trap, therefore; fish/redd ratio was based on the sex ratio of broodstock collected.

<sup>b</sup> From 1985-1989 the TFH trap was temporary, thereby underestimating total fish passed upstream of the trap. The 1985-1989 fish/redd ratios were calculated from the 1990-1993 average, excluding 1991 because of a large jack run.

<sup>c</sup> Effort in looking for pre-spawn mortalities has varied from year to year with more effort expended during years with poor conditions or large runs. This total also includes stray fish that are killed at the trap.

## Spawning Escapement

To calculate spawning escapement, we assume one redd per female (Murdoch et al. 2009) and multiply the number of redds by the sex ratio of the pre-spawning population that was collected at the adult trap (i.e., no carcass collection bias issues). This should provide a more accurate expansion method than simply applying a constant value based on assumptions, or data from other studies, since it incorporates the natural variability that occurs in most populations (Murdoch et al. 2010). Because spawner distribution of hatchery and natural origin fish may be different, we expanded redds by reach and estimate natural and hatchery fish by reach based on carcass recoveries. The total for all reaches equals the spawning escapement.

Sex ratio from the adult trap was only available from 2000 to present. For 1985 to 1999, we used corrected carcass data based on the methodology of Murdoch et al. (2010). For years when the corrected carcass data produced clear outliers, or produced spawning escapements greater than the run escapement we used data cited by Meekin (1967) that cited an average of 2.20 adults/redd and proportionately adjusted that figure up during years with high jack returns. The estimated spawning escapement for 1985 to 2013 is found in Table 12.



**Table 12. Estimated spawning escapement and the calculation methodology used for the 1985 to 2013 run years.**

| <b>Run Year</b> | <b>Number of Redds</b> | <b>Spawning Escapement</b> | <b>Natural:Hatchery Ratio</b> | <b>Fish/Redd</b> | <b>Methodology</b>      |
|-----------------|------------------------|----------------------------|-------------------------------|------------------|-------------------------|
| 1985            | 189                    | 416                        | 1.000:0.000                   | 2.20             | Meekin (1967)           |
| 1986            | 200                    | 440                        | 1.000:0.000                   | 2.20             | Meekin (1967)           |
| 1987            | 185                    | 407                        | 1.000:0.000                   | 2.20             | Meekin (1967)           |
| 1988            | 117                    | 257                        | 1.000:0.000                   | 2.20             | Meekin (1967)           |
| 1989            | 106                    | 276                        | 0.988:0.012                   | 2.60             | Meekin (1967)           |
| 1990            | 180                    | 572                        | 0.785:0.215                   | 3.18             | Corrected Carcasses     |
| 1991            | 90                     | 291                        | 0.677:0.323                   | 3.23             | Corrected Carcasses     |
| 1992            | 200                    | 476                        | 0.641:0.359                   | 2.38             | Corrected Carcasses     |
| 1993            | 192                    | 397                        | 0.617:0.383                   | 2.07             | Corrected Carcasses     |
| 1994            | 44                     | 97                         | 1.000:0.000                   | 2.20             | Meekin (1967)           |
| 1995            | 5                      | 27                         | 1.000:0.000                   | 5.30             | Corrected Carcasses     |
| 1996            | 69                     | 152                        | 0.767:0.233                   | 2.20             | Meekin (1967)           |
| 1997            | 73                     | 105                        | 0.644:0.356                   | 1.44             | Corrected Carcasses     |
| 1998            | 26                     | 60                         | 0.739:0.261                   | 2.30             | Meekin (1967)           |
| 1999            | 41                     | 160                        | 0.023:0.977                   | 3.91             | Corrected Carcasses     |
| 2000            | 92                     | 201                        | 0.307:0.693                   | 2.18             | Sex ratio at Adult Trap |
| 2001            | 298                    | 769                        | 0.801:0.199                   | 2.58             | Sex ratio at Adult Trap |
| 2002            | 299                    | 568                        | 0.395:0.605                   | 1.90             | Sex ratio at Adult Trap |
| 2003            | 118                    | 329                        | 0.742:0.258                   | 2.79             | Sex ratio at Adult Trap |
| 2004            | 160                    | 346                        | 0.826:0.174                   | 2.16             | Sex ratio at Adult Trap |
| 2005            | 102                    | 252                        | 0.804:0.196                   | 2.47             | Sex ratio at Adult Trap |
| 2006            | 109                    | 202                        | 0.759:0.241                   | 1.85             | Sex ratio at Adult Trap |
| 2007            | 81                     | 211                        | 0.776:0.224                   | 2.60             | Sex ratio at Adult Trap |
| 2008            | 199                    | 796                        | 0.610:0.390                   | 4.00             | Sex ratio at Adult Trap |
| 2009            | 451                    | 1191                       | 0.507:0.493                   | 2.64             | Sex ratio at Adult Trap |
| 2010            | 481                    | 938                        | 0.578:0.422                   | 1.95             | Sex ratio at Adult Trap |
| 2011            | 297                    | 849                        | 0.703:0.297                   | 2.86             | Sex ratio at Adult Trap |
| 2012            | 169                    | 335                        | 0.697:0.303                   | 1.98             | Sex ratio at Adult Trap |
| 2013            | 64                     | 170                        | 0.688:0.312                   | 2.66             | Sex ratio at Adult Trap |

## Stray Salmon into the Tucannon River

Spring Chinook from other river systems (strays) are periodically recovered in the Tucannon River, though generally at a low proportion of the total run (Bumgarner et al. 2000). However, Umatilla River hatchery strays accounted for 8 and 12% of the total Tucannon River run in 1999 and 2000, respectively (Gallinat et al. 2001). Increased strays, particularly from the Umatilla River, was a concern since it exceeded the 5% stray proportion of hatchery fish deemed acceptable by NOAA Fisheries, and was contrary to WDFW's management intent for the Tucannon River. In addition, the Oregon Department of Fish and Wildlife (ODFW) and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) did not mark a portion of Umatilla River origin spring Chinook with an RV or LV fin clip (65-70% of releases), or CWT for the 1997-1999 brood years. Because of that action, some stray fish that returned from those brood years were physically indistinguishable from natural origin Tucannon River spring Chinook. Scale samples were collected from adults in those brood years to determine hatchery-origin fish based on scale pattern analysis. However, we are unable to differentiate between unmarked Tucannon fish and unmarked strays based on scale patterns. Beginning with the 2000 BY, Umatilla River hatchery-origin spring Chinook were 100% marked (adipose clipped). This will help reduce the effect of Umatilla fish by allowing their selective removal from the hatchery broodstock. However, strays will still have access to spawning areas below the hatchery trap. The addition of Carson stock spring Chinook releases into the Walla Walla River may also increase the number of strays into the Tucannon River, similar to the Umatilla strays (Glen Mendel, WDFW, personal communication). WDFW will continue to monitor the Tucannon River and emphasize the need for external marks and CWTs for Walla Walla River releases.

Two strays were recovered from the Tucannon River during 2013. Both of the recovered strays were AD only/no wire hatchery fish of unknown origin that were killed outright at the adult trap. After expansions, strays accounted for an estimated 0.2% of the total 2013 run (Appendix E).

While no stray fish of known origin were recovered, the increased use of PIT tags by fish and wildlife agencies and the utilization of in-stream PIT tag arrays in the Tucannon River have permitted us to identify the origin of stray PIT tagged spring Chinook during 2013. A total of six fish originally PIT tagged at locations other than the Tucannon River had their last known detections in the Tucannon River (Table 13). These strays were natural origin fish of unknown origin that were tagged as adults at Lower Granite Dam and eventually returned back downstream and entered the Tucannon River (Table 13).

**Table 13. Final Tucannon River PIT tag array detections of spring Chinook originally tagged at locations other than the Tucannon River (strays) during 2013.**

| PIT Tag        | Detection |         | Tucannon          | Tag Release Location              |
|----------------|-----------|---------|-------------------|-----------------------------------|
|                | Origin    | Date    | Site <sup>a</sup> |                                   |
| 3D9.1C2DAE86CD | N         | 6/27/13 | TFH               | Returning adult tagged at LGR Dam |
| 3D9.1C2DAE8791 | N         | 6/07/13 | UTR               | Returning adult tagged at LGR Dam |
| 3D9.1C2DAE99DB | N         | 6/17/13 | UTR               | Returning adult tagged at LGR Dam |
| 3D9.1C2DAEA74E | N         | 6/09/13 | TFH               | Returning adult tagged at LGR Dam |
| 3D9.1C2DAEC78B | N         | 7/02/13 | UTR               | Returning adult tagged at LGR Dam |
| 3D9.1C2DB1F51A | N         | 5/31/13 | TFH               | Returning adult tagged at LGR Dam |

<sup>a</sup> PIT tag array locations are as follows: LTR – Lower Tucannon River (rkm 2.2), MTR – Middle Tucannon River (rkm 17.8), UTR – Upper Tucannon River (rkm 44.4), TFH – Tucannon Fish Hatchery (rkm 59.2).

## Tucannon River Spring Chinook in Asotin Creek

The Major Population Group (MPG) for the lower Snake River includes only the Tucannon River and Asotin Creek populations; both must be viable for ESA recovery of this MPG (or the Tucannon population must be highly viable). The Asotin Creek population is considered to be functionally extirpated (SRSRB 2011). Based on genetic analysis of spring Chinook sampled from Asotin Creek (Blankenship and Mendel 2010), Tucannon River spring Chinook salmon are known to stray to Asotin Creek and contribute to population genetics. To assess the extent of this behavior, we conduct annual spring Chinook spawning ground surveys on Asotin Creek.

Asotin Creek Field Office staff captured no adult spring Chinook at the Asotin Creek weir before the weir was removed on 31 May, 2013 (Ethan Crawford, WDFW, personal communication). Two known origin PIT tagged spring Chinook salmon were detected at PIT tag arrays in Asotin Creek during 2013. One was a Tucannon River spring Chinook (natural origin) and the other was a hatchery origin spring Chinook salmon from the Lookingglass Hatchery (Imnaha River). Snake River Lab and Asotin Creek Field Office staff walked known spring Chinook spawning areas in Asotin Creek (rkm 14.6-41.3) on 10, 12, 19, and 21 September, 2013. Two redds were counted and one natural origin female carcass was recovered (Table 14). Historical redd numbers are found in Table 15.

**Table 14. Numbers and general locations of spring Chinook salmon redds, live fish observed, and carcasses recovered from Asotin Creek, 2013.**

| Rkm <sup>a</sup> | Number of Redds | Live Fish Observed | Carcasses Recovered |          |          |          |
|------------------|-----------------|--------------------|---------------------|----------|----------|----------|
|                  |                 |                    | Natural             |          | Hatchery |          |
|                  |                 |                    | Male                | Female   | Male     | Female   |
| 36.5-41.3        | 0               | 0                  | 0                   | 0        | 0        | 0        |
| 28.6-36.5        | 0               | 0                  | 0                   | 0        | 0        | 0        |
| 27.0-28.6        | 0               | 0                  | 0                   | 0        | 0        | 0        |
| 22.0-27.0        | 2               | 0                  | 0                   | 1        | 0        | 0        |
| 14.6-22.0        | 0               | 0                  | 0                   | 0        | 0        | 0        |
| <b>Totals</b>    | <b>2</b>        | <b>0</b>           | <b>0</b>            | <b>1</b> | <b>0</b> | <b>0</b> |

<sup>a</sup> River kilometers used here are from the mouth of Asotin Creek and continue up the north fork of Asotin Creek.

**Table 15. Historical redd counts in Asotin Creek from 1972-73 and 1984-2013 (data from WDFW SASI website).**

| <b>Year</b> | <b>Number of Redds</b> | <b>Year</b> | <b>Number of Redds</b> |
|-------------|------------------------|-------------|------------------------|
| 1972        | 12                     | 1998        | 0                      |
| 1973        | 13                     | 1999        | 0                      |
| 1984        | 8                      | 2000        | 1                      |
| 1985        | 1                      | 2001        | 4                      |
| 1986        | 1                      | 2002        | 4                      |
| 1987        | 3                      | 2003        | 1                      |
| 1988        | 1                      | 2004        | 13                     |
| 1989        | 0                      | 2005        | 2                      |
| 1990        | 2                      | 2006        | 11                     |
| 1991        | 0                      | 2007        | 3                      |
| 1992        | 0                      | 2008        | 6                      |
| 1993        | 2                      | 2009        | 6                      |
| 1994        | 0                      | 2010        | 5                      |
| 1995        | 0                      | 2011        | 16                     |
| 1996        | 0                      | 2012        | 8                      |
| 1997        | 1                      | 2013        | 2                      |

## Adult PIT Tag Returns

Three hundred fifty-eight Tucannon River spring Chinook adults originally PIT tagged as juveniles have been detected returning to the Columbia River System (Table 16).

**Table 16. Number of Tucannon River spring Chinook juvenile fish PIT tagged by origin and year and adult returns detected (%) in the Columbia River System by origin.**

| Tag Year      | PIT Tagged Hatchery | PIT Tagged Natural | PIT Tagged Captive Brood | Detected H Adult Returns | Detected N Adult Returns | Detected CB Adult Returns |
|---------------|---------------------|--------------------|--------------------------|--------------------------|--------------------------|---------------------------|
| 1995          | 1,292               | ---                | ---                      | 1 (0.08%)                | ---                      | ---                       |
| 1996          | 1,923               | ---                | ---                      | 0                        | ---                      | ---                       |
| 1997          | 1,984               | ---                | ---                      | 2 (0.10%)                | ---                      | ---                       |
| 1998          | 1,999               | ---                | ---                      | 0                        | ---                      | ---                       |
| 1999          | 335                 | 374                | ---                      | 2 (0.60%)                | 5 (1.34%)                | ---                       |
| 2000          | ---                 | ---                | ---                      | ---                      | ---                      | ---                       |
| 2001          | 301                 | 158                | ---                      | 0                        | 0                        | ---                       |
| 2002          | 318                 | 321                | ---                      | 1 (0.31%)                | 3 (0.94%)                | ---                       |
| 2003          | 1,010               | ---                | 1,007                    | 3 (0.30%)                | ---                      | 0                         |
| 2004          | 1,012               | ---                | 1,029                    | 0                        | ---                      | 0                         |
| 2005          | 993                 | 93                 | 993                      | 0                        | 1 (1.08%)                | 0                         |
| 2006          | 1,001               | 70                 | 1,002                    | 1 (0.10%)                | 1 (1.43%)                | 0                         |
| 2007          | 1,308               | 504                | 1,000                    | 3 (0.23%)                | 11 (2.18%)               | 4 (0.40%)                 |
| 2008          | 4,989               | 1,588              | 997                      | 47 (0.94%)               | 48 (3.02%)               | 6 (0.60%)                 |
| 2009          | 4,987               | 1,346              | ---                      | 14 (0.28%)               | 17 (1.26%)               | ---                       |
| 2010          | 15,000              | 2,565              | ---                      | 88 (0.59%)               | 20 (0.78%)               | ---                       |
| 2011          | 24,976              | 5,407              | ---                      | 46 (0.18%)               | 22 (0.41%)               | ---                       |
| 2012          | 22,982              | 3,830              | ---                      | 12 (0.05%)               | 0                        | ---                       |
| <b>Totals</b> | <b>86,410</b>       | <b>16,256</b>      | <b>6,028</b>             | <b>220 (0.25%)</b>       | <b>128 (0.79%)</b>       | <b>10 (0.17%)</b>         |

From the detected returns, 51 (14%) of the returning PIT tagged adults were detected upstream of the Tucannon River (Table 17; Appendix F). Thirty-one of these fish (9%) had their last detections at or above Lower Granite Dam (Table 17; Appendix F). The bypass rate has decreased over time and it is unknown whether this is related to changes in smolt release methods (from direct release to acclimation ponds with volitional release), changes in hydropower operations and river flows, changes in the proportion barged downstream, or increases in tagging numbers/sample size (Table 17). This does not appear to be a hatchery effect as both natural and hatchery origin fish bypass the Tucannon River (Table 17). Non-direct homing behavior has been documented for adult Chinook in the Columbia River System (Keefer et al. 2008), and similar percentages of natural origin spring Chinook from the John Day River have been documented bypassing that river (Jim Ruzycki, ODFW, personal communication). However, more research into these events should be conducted to examine whether they are natural straying occurrences, or if it is related to hydropower operations. The installation of PIT

tag arrays in the Tucannon River during the past few years [Lower Tucannon River (LTR) at rkm 2.2 - 2005, Middle Tucannon River (MTR) at rkm 17.8 and Upper Tucannon River (UTR) at rkm 44.4 - 2011, and Tucannon Fish Hatchery (TFH) at rkm 59.2 – 2012] should enable us to document whether Tucannon spring Chinook are able to make it back to the Tucannon River. Returning adults bypassing the Tucannon River is a concern, especially if they are unable to return to the Tucannon River, and may partially explain why this population has been slow to respond to recovery and supplementation actions.

**Table 17. Number and origin of PIT tagged Tucannon River spring Chinook adult returns that bypassed the Tucannon River (includes fish that were last detected returning back downstream towards the Tucannon River) and also adults detected at Lower Granite Dam (LGR) that stayed above LGR Dam.**

| Tag Years     | # Adult Detections |                            |                 |                  | # Adults  |                 |                  | Percent Bypass |
|---------------|--------------------|----------------------------|-----------------|------------------|-----------|-----------------|------------------|----------------|
|               |                    | # Adults Above Tucannon R. | Percent Natural | Percent Hatchery | Above LGR | Percent Natural | Percent Hatchery |                |
| 1995-1999     | 10                 | 8                          | 37.5            | 62.5             | 8         | 37.5            | 62.5             | 80.0           |
| 2000-2004     | 7                  | 2                          | 50.0            | 50.0             | 2         | 50.0            | 50.0             | 28.6           |
| 2005-2009     | 153                | 20                         | 35.0            | 65.0             | 14        | 42.9            | 57.1             | 9.2            |
| 2010-2012     | 188                | 21                         | 19.0            | 81.0             | 7         | 28.6            | 71.4             | 3.7            |
| <b>Totals</b> | <b>358</b>         | <b>51</b>                  | <b>29.4%</b>    | <b>70.6%</b>     | <b>31</b> | <b>38.7%</b>    | <b>61.3%</b>     | <b>8.7%</b>    |

# Juvenile Salmon Evaluation

## Hatchery Rearing, Marking, and Release

The majority of conventional supplementation juveniles (2012 BY) were reared at LFH with a small test group (~30,000) reared at TFH to evaluate the potential for full time rearing at that facility. On 15 November, 2012, 30,012 eyed eggs were transferred from LFH to TFH for hatching and rearing. The LFH reared fish (228,615) were tagged with CWT (63/65/85) from 31 July to 6 August, 2013. The TFH reared fish (28,792) were tagged with CWT (63/65/86) on 3 October, 2013. Lyons Ferry Hatchery fish were transported to TFH during 8-9 October, 2013. The target release size was increased from 30 g fish (15 fpp) to 38 g fish (12 fpp) beginning with the 2011 BY based on higher survival estimates through the hydropower system for larger fish from the size at release study.

Brood year 2012 fish were sampled twice during the rearing cycle (Table 18). During January, fish were sampled for length, weight, precocity and mark quality, and were PIT tagged for outmigration and adult return comparisons (target 7,500 per group) before transfer to Curl Lake AP. The 2012 BY fish were transported to Curl Lake from 4-12 February, 2014 for acclimation and volitional release. Length, weight, and precocity samples were repeated in April at Curl Lake AP prior to release (Table 18).

**Table 18. Sample size (N), mean length (mm), coefficient of variation (CV), condition factor (K), mean weight (g), and precocity of 2012 BY juveniles sampled at TFH, and Curl Lake AP.**

| <b>Brood/<br/>Date</b> | <b>Rearing<br/>Type</b> | <b>Sample<br/>Location</b> | <b>N</b> | <b>Mean<br/>Length (mm)</b> | <b>CV</b> | <b>K</b> | <b>Mean<br/>Wt. (g)</b> | <b>%<br/>Precocity</b> |
|------------------------|-------------------------|----------------------------|----------|-----------------------------|-----------|----------|-------------------------|------------------------|
| <b>2012</b>            |                         |                            |          |                             |           |          |                         |                        |
| 1/14/14                | LFH                     | TFH                        | 259      | 122.8                       | 13.0      | 1.20     | 23.2                    | 0.1                    |
| 1/14/14                | TFH                     | TFH                        | 259      | 117.5                       | 8.5       | 1.28     | 21.2                    | 0.0                    |
| 4/09/14                | Combined                | Curl Lake                  | 263      | 136.4                       | 15.2      | 1.19     | 32.3                    | 0.0                    |

After reports by hatchery staff of increased numbers of predators (primarily river otters) at Curl Lake AP, a PIT tag array was installed at the outlet of Curl Lake on 10 April, 2014 in order to obtain a more accurate release number. Volitional release began 11 April and continued until 23 April when the remaining fish were forced out. Based on tag detections at the array, predation mortality in the lake was higher than originally suspected, however, PIT tag “collisions” were a problem at the array so estimated release numbers should be considered minimal estimates. The release number may be adjusted in the future as more information becomes available. Estimated



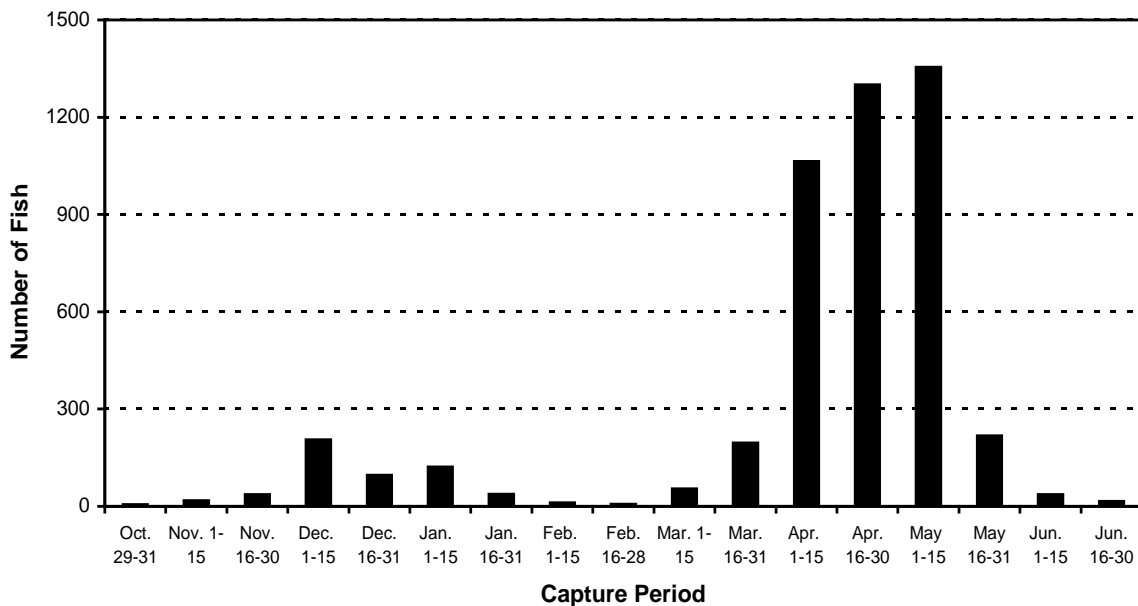
numbers of fish released are provided in Table 19. Historical hatchery releases are summarized in Appendix G.

**Table 19. Spring Chinook salmon releases into the Tucannon River, 2014 release year.**

| Rearing Location | Release Date | CWT Code | Total Released | Number CWT | VIE Mark | Size       |          |
|------------------|--------------|----------|----------------|------------|----------|------------|----------|
|                  |              |          |                |            |          | Total (kg) | Mean (g) |
| LFH              | 4/11-4/23    | 63/65/85 | 129,952        | 129,165    | None     | 4,214      | 32       |
| TFH              | 4/11-4/23    | 63/65/86 | 16,609         | 15,227     | None     | 538        | 32       |

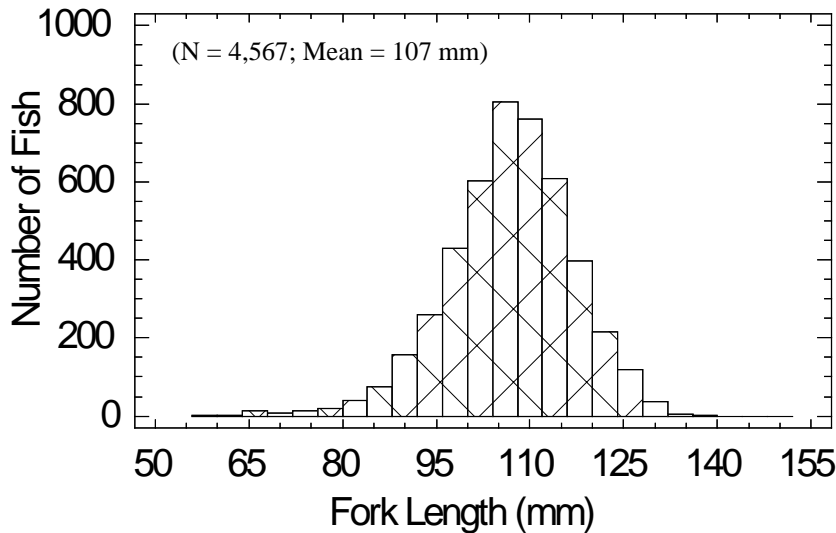
## Smolt Trapping

Evaluation staff operated a 1.5 m rotary screw trap at rkm 3 on the Tucannon River from 29 October 2012 through 10 July 2013 to estimate numbers of migrating juvenile natural and hatchery spring Chinook. Numbers of each fish species captured by month during the 2013 outmigration can be found in Appendix H. The main outmigration of natural origin spring Chinook occurred during the spring, but outmigration also occurred in the fall and winter (Figure 6).



**Figure 6. Emigration timing of natural spring Chinook salmon captured during smolt trap operations (rkm 3) on the Tucannon River for the 2012-13 migration year.**

Natural spring Chinook emigrating from the Tucannon River (BY 2011) averaged 107 mm (Figure 7). This is in comparison to a mean length of 137 mm for hatchery-origin fish (BY 2011) released from Curl Lake Acclimation Pond (Gallinat and Ross 2013).



**Figure 7. Length frequency distribution of sampled natural spring Chinook salmon captured in the Tucannon River smolt trap, 2012/2013 season.**

Each week we attempted to determine trap efficiency by clipping a portion of the caudal fin on a representative subsample of captured migrants and releasing them approximately one kilometer upstream. The percent of marked fish recaptured was used as an estimate of weekly trapping efficiency.

To estimate potential juvenile migrants passing when the trap was not operated for short intervals, such as periods when freshets washed out large amounts of debris from the river, we calculated the mean number of fish trapped for three days before and three days after non-trapping periods. The mean number of fish trapped daily was then divided by the estimated trap efficiency to calculate fish passage. The estimated number of fish passing each day was then applied to each day the trap was not operated.

In previous reports we attempted to relate trap efficiency to abiotic factors such as stream flow or staff gauge level based on similar juvenile outmigration studies (Groot and Margolis 1991; Seiler et al. 1999; Cheng and Gallinat 2004). We found no significant relationships.

We estimated outmigration based on the approach of Steinhorst et al. (2004). This involved using a Bailey-modified Lincoln-Peterson estimation with 95% bootstrap confidence intervals by running the Gauss Run-Time computer program (version 7.0). Bootstrap iterations numbered 1,000. The program allows for the division of the out-migration trapping season into strata with similar capture efficiencies as long as at least seven marked recaptures occurred. Strata with less than seven recaptures were grouped with either the preceding or following strata, depending upon similarity in trapping/flow conditions. Where river conditions were similar, we used our best judgment to group the strata.

A number of assumptions are required to attain unbiased estimates of smolt production. How well the assumptions are met will determine the accuracy and precision of the estimates. Some of these assumptions are:

- Survival from release to the trap was 100%.
- All marked fish are identified and correctly enumerated.
- Fish do not lose their marks.
- All fish in the tag release group emigrate (i.e., do not residualize in the area of release).
- Marked fish are caught at the same rate as unmarked fish.

Accurate outmigration estimates are critical for describing survival trends and to measure population response to management actions such as hatchery supplementation and habitat restoration. It has been strongly suggested that researchers test the assumptions of population estimators being used (Peterson et al. 2004; Rosenberger and Dunham 2005). Other WDFW researchers have identified bias in smolt trap efficiency estimates that were conducted similarly to Tucannon River trap efficiency tests. While the evidence of estimator bias and error seem consistent in the literature, our methods differ from those, and must be tested to estimate the level of error, and confirm compliance of the methods with underlying assumptions. If bias in our methods has been consistent over the term of the data, data could be adjusted as appropriate once bias is measured.

In past years, we attempted to measure bias in our efficiency estimates through the use of PIT tags and the PIT tag array that has been deployed in the lower Tucannon River below the smolt trap. Representative groups of fish were fin clipped and PIT tagged to determine smolt trap efficiency based on either recaptures in the smolt trap or detections by the PIT tag array in the Tucannon River. However, the PIT tag array proved unreliable in its detection of juvenile salmonids. If PIT tag technology in the future allows for greater detections of juvenile salmonids, then we will attempt to measure trapping bias again. We estimate that 23,376 (S.E. 1,525; 95% C.I. 20,848-27,056) migrant natural-origin spring Chinook (2011 BY) passed the smolt trap during 2012-2013.

## Juvenile Migration Studies

In 2013, we used passive integrated transponder (PIT) tags to study the emigration timing and relative success of our hatchery supplementation and natural origin smolts. A total of 14,987 hatchery supplementation fish were PIT tagged (7,494 of the TFH reared fish and 7,493 of the LFH reared fish) during January before transferring them to Curl Lake AP for acclimation and volitional release (Table 20). We also tagged natural origin smolts at the smolt trap throughout the outmigration year (Oct.-June). Cumulative PIT tag detections at hydroelectric projects downstream of the Tucannon River were 34% for the TFH reared fish, 34% for the LFH reared fish, and 50% for the natural origin smolts (Table 20).

**Table 20. Cumulative detection (one unique detection per tag code) and mean travel time in days (TD) of PIT tagged conventional hatchery supplementation (TFH and LFH reared) smolts released<sup>a</sup> from Curl Lake AP (rkm 65.6) on the Tucannon River at downstream Snake and Columbia River dams and natural origin smolts tagged and released at the Tucannon River smolt trap (rkm 3) during 2013.**

| Origin  | Release Data |             |      |             | Recapture Data |      |     |      |     |      |     |      |      |      | Total <sup>b</sup> |      |
|---------|--------------|-------------|------|-------------|----------------|------|-----|------|-----|------|-----|------|------|------|--------------------|------|
|         | N            | Mean Length | S.D. | Mean Length | LMJ            |      | ICH |      | MCJ |      | JDJ |      | BONN |      | N                  | %    |
| TFH     | 7,494        | 116.8       | 12.7 | 117.2       | 519            | 25.6 | 303 | 27.9 | 748 | 29.9 | 293 | 33.3 | 99   | 34.4 | 2,523              | 33.7 |
| LFH     | 7,493        | 111.9       | 13.1 | 113.0       | 549            | 24.4 | 239 | 27.1 | 686 | 28.1 | 230 | 32.3 | 62   | 33.2 | 2,581              | 34.4 |
| Natural | 4,241        | 107.7       | 10.0 | 108.7       | 679            | 9.8  | 233 | 12.7 | 606 | 23.2 | 256 | 25.9 | 53   | 28.3 | 2,123              | 50.1 |

<sup>a</sup> Fish were volitionally released from 4/03/13 – 4/22/13.

<sup>b</sup> Includes fish detected at the lower Tucannon River PIT tag array (LTR) and trawl detections below Bonneville Dam (TWX). Note: Mean travel times listed are from the total number of fish detected at each dam, not just unique recoveries for a tag code. Abbreviations are as follows: LMJ-Lower Monumental Dam, ICH- Ice Harbor Dam, MCJ-McNary Dam, JDJ-John Day Dam, BONN-Bonneville Dam, TD- Mean Travel Days.

Survival probabilities were estimated by the Cormack-Jolly-Seber methodology using the Survival Under Proportional Hazards (SURPH) 2.2 computer model. The data files were created using the PitPro version 4.19.7 computer program to translate raw PIT Tag Information System (PTAGIS) data of the Pacific States Marine Fisheries Commission into usable capture histories for the SURPH program. Estimated survival probabilities from Curl Lake to Lower Monumental Dam were 0.56 (S.E. = 0.03) for LFH reared fish and 0.56 (S.E. = 0.03) for TFH reared fish. Estimated survival probabilities for natural origin fish tagged at the smolt trap to Lower Monumental Dam were 0.80 (S.E. = 0.03).

## Survival Rates

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Point estimates of population sizes have been calculated for various life stages (Tables 21 and 22) of natural and hatchery-origin spring Chinook from spawning ground and juvenile mid-summer population surveys, smolt trapping, and fecundity estimates. Survivals between life stages have been calculated for both natural and hatchery salmon to assist in the evaluation of the hatchery program. These survival estimates provide insight as to where efforts should be directed to improve not only the survival of fish produced within the hatchery, but fish in the river as well.

As expected, juvenile (egg-parr-smolt) survival rates for hatchery fish are considerably higher than for naturally reared salmon (Table 23) because they have been protected in the hatchery. However, smolt-to-adult return rates (SAR) to the Tucannon River of natural salmon were over five times higher (based on geometric means) than for hatchery-reared salmon (Tables 24 and 25). With the exception of the 2006 brood year, hatchery SARs (mean 0.27%; geometric mean 0.17%) documented from the 1985-2008 broods were well below the LSRCP survival goal of 0.87%. Hatchery SARs for Tucannon River salmon need to substantially improve to meet the mitigation goal of 1,152 hatchery adult salmon. For the 2005 brood year, size at release was arbitrarily increased in an attempt to improve smolt-to-adult return survival rates. For the 2006-2010 brood years we experimented with size at release (30 g/fish vs. 50 g/fish) to improve hatchery SARs. Improvements in hatchery SARs were seen beginning with the 2005 BY (Table 25), however, more time will be needed to ascertain whether observed improvements in SARs were release size related or due to improved environmental conditions.

**Table 21. Estimates of natural in-river produced Tucannon spring Chinook salmon (both hatchery and natural origin parents) abundance by life stage for 1985-2013 broods.**

| Brood Year | Females in River |          | Mean Fecundity <sup>a</sup> |          | Number of Eggs | Number <sup>b</sup> of Parr | Number of Smolts | Progeny <sup>c</sup> (returning adults) |
|------------|------------------|----------|-----------------------------|----------|----------------|-----------------------------|------------------|---|
|            | Natural          | Hatchery | Natural                     | Hatchery |                |                             |                  |   |
| 1985       | 219              | -        | 3,883                       | -        | 850,377        | 90,200                      | 42,000           | 392                                     |
| 1986       | 200              | -        | 3,916                       | -        | 783,200        | 102,600                     | 58,200           | 468                                     |
| 1987       | 185              | -        | 4,096                       | -        | 757,760        | 79,100                      | 44,000           | 238                                     |
| 1988       | 117              | -        | 3,882                       | -        | 454,194        | 69,100                      | 37,500           | 527                                     |
| 1989       | 103              | 3        | 3,883                       | 2,606    | 407,767        | 58,600                      | 30,000           | 158                                     |
| 1990       | 128              | 52       | 3,993                       | 2,697    | 651,348        | 86,259                      | 49,500           | 94                                      |
| 1991       | 51               | 39       | 3,741                       | 2,517    | 288,954        | 54,800                      | 30,000           | 7                                       |
| 1992       | 119              | 81       | 3,854                       | 3,295    | 725,521        | 103,292                     | 50,800           | 196                                     |
| 1993       | 112              | 80       | 3,701                       | 3,237    | 673,472        | 86,755                      | 49,560           | 204                                     |
| 1994       | 39               | 5        | 4,187                       | 3,314    | 179,863        | 12,720                      | 7,000            | 12                                      |
| 1995       | 5                | 0        | 5,224                       | 0        | 26,120         | 0                           | 75               | 6                                       |
| 1996       | 53               | 16       | 3,516                       | 2,843    | 231,836        | 2,845                       | 1,612            | 69                                      |
| 1997       | 39               | 33       | 3,609                       | 3,315    | 250,146        | 32,913                      | 21,057           | 799                                     |
| 1998       | 19               | 7        | 4,023                       | 3,035    | 97,682         | 8,453                       | 5,508            | 389                                     |
| 1999       | 1                | 40       | 3,965                       | 3,142    | 129,645        | 15,944                      | 8,157            | 141                                     |
| 2000       | 26               | 66       | 3,969                       | 3,345    | 323,964        | 44,618                      | 20,045           | 446                                     |
| 2001       | 219              | 79       | 3,612                       | 3,252    | 1,047,936      | 63,412                      | 38,079           | 244                                     |
| 2002       | 104              | 195      | 3,981                       | 3,368    | 1,070,784      | 72,197                      | 60,530           | 202                                     |
| 2003       | 67               | 51       | 3,789                       | 3,812    | 448,275        | 40,900                      | 23,003           | 173                                     |
| 2004       | 117              | 43       | 3,444                       | 2,601    | 514,791        | 30,809                      | 21,057           | 399                                     |
| 2005       | 77               | 25       | 3,773                       | 2,903    | 363,096        | 21,162                      | 17,579           | 739                                     |
| 2006       | 65               | 36       | 2,887                       | 2,654    | 283,199        | ---                         | 30,228           | 1,721                                   |
| 2007       | 49               | 32       | 3,847                       | 2,869    | 280,311        | ---                         | 8,529            | 612                                     |
| 2008       | 95               | 104      | 3,732                       | 3,020    | 668,620        | ---                         | 14,778           | 885                                     |
| 2009       | 179              | 272      | 3,639                       | 3,267    | 1,540,005      | ---                         | 45,538           | 561                                     |
| 2010       | 278              | 203      | 3,579                       | 3,195    | 1,643,547      | ---                         | 35,080           | 91                                      |
| 2011       | 175              | 122      | 4,230                       | 3,301    | 1,142,972      | ---                         | 23,376           |   |
| 2012       | 115              | 54       | 3,151                       | 2,563    | 500,767        | ---                         |                  |   |
| 2013       | 44               | 20       | 3,798                       | 3,185    | 230,812        |                             |                  |   |

<sup>a</sup> 1985 and 1989 mean fecundity of natural females is the average of 1986-88 and 1990-93 brood years.

<sup>b</sup> Number of parr estimated from electrofishing (1985-1989), Line transect snorkel surveys (1990-1992), and Total Count snorkel surveys (1993-2005).

<sup>c</sup> Numbers do not include down river harvest or other out-of-basin recoveries.

**Table 22. Estimates of Tucannon spring Chinook salmon abundance (*spawned and reared in the hatchery*) by life stage for 1985-2013 broods.**

| Brood Year | Females Spawned |          | Mean Fecundity <sup>a</sup> |          | Number of Eggs | Number of Parr | Number of Smolts     | Progeny <sup>b</sup> (returning adults) |
|------------|-----------------|----------|-----------------------------|----------|----------------|----------------|----------------------|---|
|            | Natural         | Hatchery | Natural                     | Hatchery |                |                |                      |   |
| 1985       | 4               | -        | 3,883                       | -        | 14,843         | 13,401         | 12,922               | 45                                      |
| 1986       | 57              | -        | 3,916                       | -        | 187,958        | 177,277        | 152,725              | 327                                     |
| 1987       | 48              | -        | 4,096                       | -        | 196,573        | 164,630        | 152,165              | 188                                     |
| 1988       | 49              | -        | 3,882                       | -        | 182,438        | 150,677        | 145,146              | 445                                     |
| 1989       | 28              | 9        | 3,883                       | 2,606    | 133,521        | 103,420        | 99,057               | 243                                     |
| 1990       | 21              | 23       | 3,993                       | 2,697    | 126,334        | 89,519         | 85,737               | 28                                      |
| 1991       | 17              | 11       | 3,741                       | 2,517    | 91,275         | 77,232         | 74,064               | 25                                      |
| 1992       | 28              | 18       | 3,854                       | 3,295    | 156,359        | 151,727        | 87,752 <sup>c</sup>  | 82                                      |
| 1993       | 21              | 28       | 3,701                       | 3,237    | 168,366        | 145,303        | 138,848              | 207                                     |
| 1994       | 22              | 21       | 4,187                       | 3,314    | 161,707        | 132,870        | 130,069              | 34                                      |
| 1995       | 6               | 15       | 5,224                       | 0        | 85,772         | 63,935         | 62,144               | 178                                     |
| 1996       | 18              | 19       | 3,516                       | 2,843    | 117,287        | 80,325         | 76,219               | 267                                     |
| 1997       | 17              | 25       | 3,609                       | 3,315    | 144,237        | 29,650         | 24,186               | 181                                     |
| 1998       | 30              | 14       | 4,023                       | 3,035    | 161,019        | 136,027        | 127,939              | 796                                     |
| 1999       | 1               | 36       | 3,965                       | 3,142    | 113,544        | 106,880        | 97,600               | 33                                      |
| 2000       | 3               | 35       | 3,969                       | 3,345    | 128,980        | 123,313        | 102,099              | 157                                     |
| 2001       | 29              | 27       | 3,612                       | 3,252    | 184,127        | 174,934        | 146,922              | 125                                     |
| 2002       | 22              | 25       | 3,981                       | 3,368    | 169,364        | 151,531        | 123,586              | 120                                     |
| 2003       | 17              | 20       | 3,789                       | 3,812    | 140,658        | 126,400        | 71,154               | 71                                      |
| 2004       | 28              | 18       | 3,444                       | 2,601    | 140,459        | 128,877        | 67,542               | 120                                     |
| 2005       | 25              | 24       | 3,773                       | 2,903    | 161,345        | 151,466        | 149,466              | 692                                     |
| 2006       | 18              | 27       | 2,887                       | 2,654    | 123,629        | 112,350        | 106,530              | 1,123                                   |
| 2007       | 27              | 9        | 3,847                       | 2,869    | 124,543        | 117,182        | 114,681              | 270                                     |
| 2008       | 17              | 43       | 3,732                       | 3,020    | 193,324        | 183,925        | 172,897              | 666                                     |
| 2009       | 42              | 54       | 3,639                       | 3,267    | 323,341        | 292,291        | 231,437 <sup>d</sup> | 299                                     |
| 2010       | 39              | 44       | 3,579                       | 3,195    | 279,969        | 237,861        | 201,585              | 68                                      |
| 2011       | 45              | 41       | 4,230                       | 3,301    | 325,701        | 305,215        | 259,964              |   |
| 2012       | 48              | 47       | 3,151                       | 2,563    | 269,514        | 246,033        | 146,561              |   |
| 2013       | 48              | 30       | 3,798                       | 3,185    | 275,188        | 263,630        |                      |   |

<sup>a</sup> 1985 and 1989 mean fecundity of natural females is the average of 1986-88 and 1990-93 brood years; 1999 mean fecundity of natural fish is based on the mean of 1986-1998 brood years.

<sup>b</sup> Numbers do not include down river harvest or other out-of-basin recoveries.

<sup>c</sup> Number of smolts is less than actual release number. 57,316 parr were released in October 1993, with an estimated 7% survival. Total number of hatchery fish released from the 1992 brood year was 140,725. We therefore use the listed number of 87,752 as the number of smolts released.

<sup>d</sup> Parr determined to be in excess of program goals were released at Russell Springs and are not included in number of parr and smolts.

**Table 23. Percent survival by brood year for juvenile salmon and the multiplicative advantage of hatchery-reared salmon over naturally-reared salmon in the Tucannon River.**

| Brood Year        | Natural     |               |              | Hatchery    |                   |                   | Hatchery Advantage |               |              |
|-------------------|-------------|---------------|--------------|-------------|-------------------|-------------------|--------------------|---------------|--------------|
|                   | Egg to Parr | Parr to Smolt | Egg to Smolt | Egg to Parr | Parr to Smolt     | Egg to Smolt      | Egg to Parr        | Parr to Smolt | Egg to Smolt |
| 1985              | 10.6        | 46.6          | 4.9          | 90.3        | 96.4              | 87.1              | 8.5                | 2.1           | 17.6         |
| 1986              | 13.1        | 56.7          | 7.4          | 94.3        | 86.2              | 81.3              | 7.2                | 1.5           | 10.9         |
| 1987              | 10.4        | 55.6          | 5.8          | 83.8        | 92.4              | 77.4              | 8.0                | 1.7           | 13.3         |
| 1988              | 15.2        | 54.3          | 8.3          | 82.6        | 96.3              | 79.6              | 5.4                | 1.8           | 9.6          |
| 1989              | 14.4        | 51.2          | 7.4          | 77.5        | 95.8              | 74.2              | 5.4                | 1.9           | 10.1         |
| 1990              | 13.2        | 57.4          | 7.6          | 70.9        | 95.8              | 67.9              | 5.4                | 1.7           | 8.9          |
| 1991              | 19.0        | 54.7          | 10.4         | 84.6        | 95.9              | 81.1              | 4.5                | 1.8           | 7.8          |
| 1992              | 14.2        | 49.2          | 7.0          | 97.0        | 57.8              | 56.1              | 6.8                | 1.2           | 8.0          |
| 1993              | 12.9        | 57.1          | 7.4          | 86.3        | 95.6              | 82.5              | 6.7                | 1.7           | 11.2         |
| 1994              | 7.1         | 55.0          | 3.9          | 82.2        | 97.9              | 80.4              | 11.6               | 1.8           | 20.7         |
| 1995              | 0.0         | 0.0           | 0.3          | 74.5        | 97.2              | 72.5              | --                 | --            | --           |
| 1996              | 1.2         | 56.7          | 0.7          | 68.5        | 94.9              | 65.0              | 55.8               | 1.7           | --           |
| 1997              | 13.2        | 64.0          | 8.4          | 20.6        | 81.6              | 16.8              | 1.6                | 1.3           | 2.0          |
| 1998              | 8.7         | 65.2          | 5.6          | 84.5        | 94.1              | 79.5              | 9.8                | 1.4           | 14.1         |
| 1999              | 12.3        | 51.2          | 6.3          | 94.1        | 91.3              | 86.0              | 7.7                | 1.8           | 13.7         |
| 2000              | 13.8        | 44.9          | 6.2          | 95.6        | 82.8              | 79.2              | 6.9                | 1.8           | 12.8         |
| 2001              | 6.1         | 60.1          | 3.6          | 95.0        | 84.0              | 79.8              | 15.7               | 1.4           | 22.0         |
| 2002              | 6.7         | 83.8          | 5.7          | 89.5        | 81.6              | 73.0              | 13.3               | 1.0           | 12.9         |
| 2003              | 9.1         | 56.2          | 5.1          | 89.9        | 56.3              | 50.6              | 9.8                | 1.0           | 9.9          |
| 2004              | 6.0         | 68.3          | 4.1          | 91.8        | 52.4              | 48.1              | 15.3               | 0.8           | 11.8         |
| 2005              | 5.8         | 83.1          | 4.8          | 93.9        | 98.7              | 92.6              | 16.1               | 1.2           | 19.1         |
| 2006              | ---         | ---           | 10.7         | 90.9        | 94.8              | 86.2              | ---                | ---           | 8.1          |
| 2007              | ---         | ---           | 3.0          | 94.1        | 97.9              | 92.1              | ---                | ---           | 30.3         |
| 2008              | ---         | ---           | 2.2          | 95.1        | 94.0              | 89.4              | ---                | ---           | 40.5         |
| 2009              | ---         | ---           | 3.0          | 90.4        | 79.2              | 71.6              | ---                | ---           | 24.2         |
| 2010              | ---         | ---           | 2.1          | 85.0        | 84.7              | 72.0              | ---                | ---           | 33.7         |
| 2011              | ---         | ---           | 2.0          | 93.7        | 85.2              | 79.8              | ---                | ---           | 39.0         |
| 2012 <sup>a</sup> |             |               |              | 91.3        | 59.6 <sup>a</sup> | 54.4 <sup>a</sup> |                    |               |              |
| 2013              |             |               |              | 95.8        |                   |                   |                    |               |              |
| <b>Mean</b>       | 10.1        | 55.8          | 5.3          | 85.6        | 86.4              | 73.4              | 11.1               | 1.5           | 16.5         |
| <b>SD</b>         | 4.7         | 16.2          | 2.7          | 14.6        | 13.8              | 16.2              | 11.2               | 0.3           | 10.1         |

<sup>a</sup> Smolt release numbers were estimated with a PIT tag array at the outlet of Curl Lake AP.



**Table 24. Adult returns and SARs of natural salmon to the Tucannon River for brood years 1985-2010. (2009 and 2010 are incomplete brood years included for comparison.)**

| Brood Year            | Estimated Number of Smolts | Number of Adult Returns, observed (obs) and expanded (exp) <sup>a</sup> |     |       |       |       |     | SAR (%)           |                   |
|-----------------------|----------------------------|---|-----|-------|-------|-------|-----|-------------------|-------------------|
|                       |                            | Age 3   |     | Age 4 |       | Age 5 |     | w/                | No                |
|                       |                            | Obs   | Exp | Obs   | Exp   | Obs   | Exp | Jacks             | Jacks             |
| 1985                  | 42,000                     | 8   | 19  | 110   | 255   | 36    | 118 | 0.93              | 0.89              |
| 1986 <sup>b</sup>     | 58,200                     | 1   | 2   | 115   | 376   | 28    | 90  | 0.80              | 0.80              |
| 1987                  | 44,000                     | 0   | 0   | 52    | 167   | 29    | 71  | 0.54              | 0.54              |
| 1988                  | 37,500                     | 1   | 3   | 136   | 335   | 74    | 189 | 1.41              | 1.40              |
| 1989                  | 30,000                     | 5   | 12  | 47    | 120   | 23    | 26  | 0.53              | 0.49              |
| 1990                  | 49,500                     | 3   | 8   | 63    | 72    | 12    | 14  | 0.19              | 0.17              |
| 1991                  | 30,000                     | 0   | 0   | 4     | 5     | 1     | 2   | 0.02              | 0.02              |
| 1992                  | 50,800                     | 2   | 2   | 84    | 161   | 16    | 33  | 0.39              | 0.38              |
| 1993                  | 49,560                     | 1   | 2   | 62    | 127   | 58    | 75  | 0.41              | 0.41              |
| 1994                  | 7,000                      | 0   | 0   | 8     | 10    | 1     | 2   | 0.17              | 0.17              |
| 1995                  | 75                         | 0   | 0   | 1     | 1     | 2     | 5   | 8.00              | 8.00              |
| 1996                  | 1,612                      | 0   | 0   | 27    | 63    | 2     | 6   | 4.28              | 4.28              |
| 1997                  | 21,057                     | 6   | 14  | 234   | 703   | 29    | 82  | 3.79              | 3.73              |
| 1998                  | 5,508                      | 3   | 9   | 91    | 259   | 43    | 121 | 7.06              | 6.90              |
| 1999                  | 8,157                      | 3   | 9   | 44    | 124   | 3     | 8   | 1.73              | 1.62              |
| 2000                  | 20,045                     | 1   | 3   | 148   | 392   | 16    | 51  | 2.22              | 2.21              |
| 2001                  | 38,079                     | 0   | 0   | 73    | 235   | 5     | 9   | 0.64              | 0.64              |
| 2002                  | 60,530                     | 1   | 3   | 68    | 124   | 36    | 75  | 0.33              | 0.33              |
| 2003                  | 23,003                     | 4   | 7   | 55    | 115   | 21    | 51  | 0.75              | 0.72              |
| 2004                  | 21,057                     | 4   | 8   | 147   | 352   | 19    | 39  | 1.89              | 1.86              |
| 2005                  | 17,579                     | 23  | 131 | 260   | 595   | 2     | 13  | 4.20              | 3.46              |
| 2006                  | 30,228                     | 32  | 116 | 298   | 1,390 | 73    | 215 | 5.69              | 5.31              |
| 2007                  | 8,529                      | 4   | 41  | 133   | 456   | 22    | 115 | 7.18              | 6.69              |
| 2008                  | 14,778                     | 10  | 85  | 150   | 693   | 23    | 107 | 5.99              | 5.41              |
| 2009                  | 45,538                     | 1   | 7   | 94    | 554   | ---   | --- | 1.23              | 1.22              |
| 2010                  | 35,080                     | 3   | 91  | ---   | ---   | ---   | --- | 0.26              | ---               |
| <b>Mean</b>           |                            |   |     |       |       |       |     | 2.22 <sup>c</sup> | 2.11 <sup>c</sup> |
| <b>Geometric Mean</b> |                            |   |     |       |       |       |     | 1.07 <sup>c</sup> | 1.03 <sup>c</sup> |

<sup>a</sup> Expanded numbers are calculated from the proportion of each known age salmon recovered in the river and from broodstock collections in relation to the total estimated return to the Tucannon River. Expansions do not include down river harvest or Tucannon River fish straying to other systems.

<sup>b</sup> One known (expanded to two) Age 6 salmon was recovered.

<sup>c</sup> 1995, 2009, and 2010 SAR's are not included in the mean.

**Table 25. Adult returns and SARs of hatchery salmon to the Tucannon River for brood years 1985-2010. (2009 and 2010 are incomplete brood years included for comparison.)**

| Brood Year            | Estimated Number of Smolts | Number of Adult Returns, known and expanded (exp.) <sup>a</sup> |      |       |      |       |      | SAR (%)           |                   |
|-----------------------|----------------------------|---|------|-------|------|-------|------|-------------------|-------------------|
|                       |                            | Age 3   |      | Age 4 |      | Age 5 |      | w/                | No                |
|                       |                            | Known   | Exp. | Known | Exp. | Known | Exp. | Jacks             | Jacks             |
| 1985                  | 12,922                     | 9   | 19   | 25    | 26   | 0     | 0    | 0.35              | 0.20              |
| 1986                  | 152,725                    | 79  | 83   | 99    | 226  | 8     | 18   | 0.21              | 0.16              |
| 1987                  | 152,165                    | 9   | 20   | 70    | 151  | 8     | 17   | 0.12              | 0.11              |
| 1988                  | 145,146                    | 46  | 99   | 140   | 293  | 26    | 53   | 0.31              | 0.24              |
| 1989                  | 99,057                     | 7   | 15   | 100   | 211  | 14    | 17   | 0.25              | 0.23              |
| 1990                  | 85,737                     | 3   | 6    | 16    | 20   | 2     | 2    | 0.03              | 0.03              |
| 1991                  | 74,064                     | 4   | 5    | 20    | 20   | 0     | 0    | 0.03              | 0.03              |
| 1992                  | 87,752                     | 11  | 11   | 50    | 67   | 2     | 4    | 0.09              | 0.08              |
| 1993                  | 138,848                    | 11  | 15   | 93    | 174  | 15    | 18   | 0.15              | 0.14              |
| 1994                  | 130,069                    | 2   | 4    | 21    | 25   | 4     | 5    | 0.03              | 0.02              |
| 1995                  | 62,144                     | 13  | 16   | 117   | 158  | 2     | 4    | 0.29              | 0.26              |
| 1996                  | 76,219                     | 44  | 59   | 100   | 194  | 5     | 14   | 0.35              | 0.27              |
| 1997                  | 24,186                     | 7   | 13   | 59    | 168  | 0     | 0    | 0.75              | 0.69              |
| 1998                  | 127,939                    | 36  | 99   | 174   | 547  | 39    | 150  | 0.62              | 0.54              |
| 1999                  | 97,600                     | 3   | 11   | 5     | 19   | 1     | 3    | 0.03              | 0.02              |
| 2000                  | 102,099                    | 7   | 26   | 47    | 131  | 0     | 0    | 0.15              | 0.13              |
| 2001                  | 146,922                    | 7   | 19   | 51    | 105  | 1     | 1    | 0.09              | 0.07              |
| 2002                  | 123,586                    | 3   | 6    | 60    | 98   | 6     | 16   | 0.10              | 0.09              |
| 2003                  | 71,154                     | 1   | 2    | 23    | 65   | 2     | 4    | 0.10              | 0.10              |
| 2004                  | 67,542                     | 7   | 18   | 59    | 98   | 2     | 4    | 0.18              | 0.15              |
| 2005                  | 149,466                    | 50  | 291  | 180   | 401  | 0     | 0    | 0.46              | 0.27              |
| 2006                  | 106,530                    | 60  | 402  | 180   | 680  | 19    | 41   | 1.05              | 0.68              |
| 2007                  | 114,681                    | 7   | 74   | 76    | 171  | 6     | 25   | 0.24              | 0.17              |
| 2008                  | 172,897                    | 27  | 269  | 112   | 391  | 6     | 6    | 0.39              | 0.23              |
| 2009                  | 231,437                    | 1   | 8    | 62    | 291  | ---   | ---  | 0.13              | 0.13              |
| 2010                  | 201,585                    | 4   | 68   | ---   | ---  | ---   | ---  | 0.03              | ---               |
| <b>Mean</b>           |                            |   |      |       |      |       |      | 0.27 <sup>b</sup> | 0.20 <sup>b</sup> |
| <b>Geometric Mean</b> |                            |   |      |       |      |       |      | 0.17 <sup>b</sup> | 0.14 <sup>b</sup> |

<sup>a</sup> Expanded numbers are calculated from the proportion of each known age salmon recovered in the river and from broodstock collections in relation to the total estimated return to the Tucannon River. Expansions do not include down river harvest or Tucannon River fish straying to other systems.

<sup>b</sup> 2009 and 2010 brood years are not included in the mean.

As previously stated, overall survival of hatchery salmon to return as adults was higher than for naturally reared fish because of the early-life survival advantage (Table 23). With the exception of ten brood years, naturally produced fish have been below the replacement level (Figure 8; Table 26). Based on adult returns from the 1985-2009 broods, naturally reared salmon produced only 0.78 adults for every spawner, while hatchery reared fish produced 2.05 adults (based on geometric means).

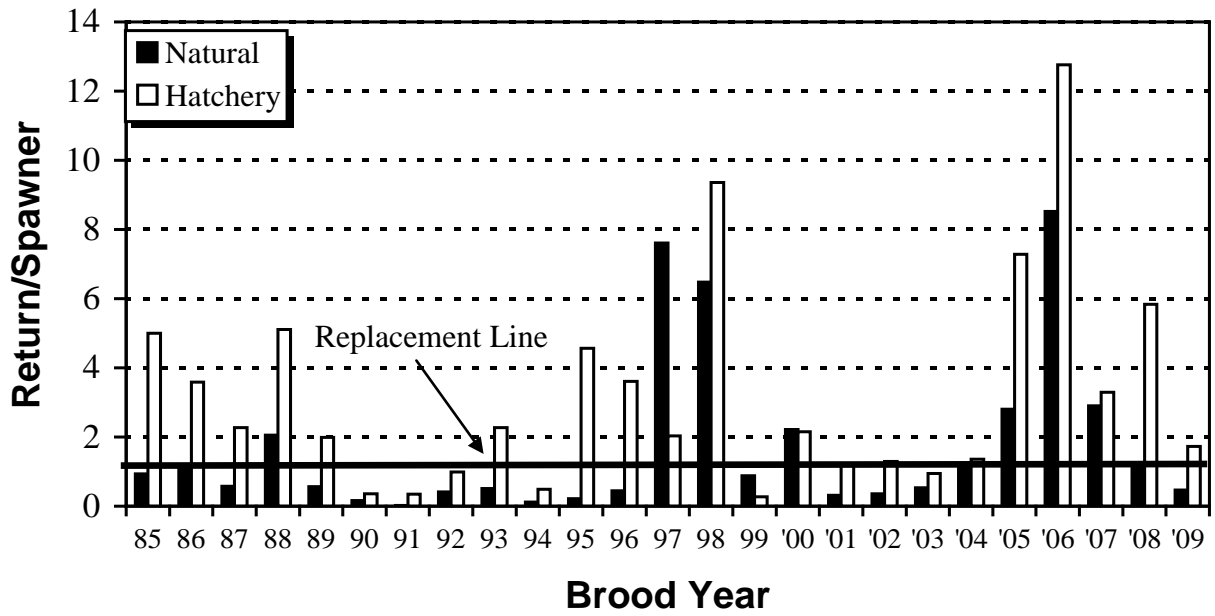


Figure 8. Return per spawner (with replacement line) for the 1985-2009 brood years (2009 incomplete brood year).

**Table 26. Progeny-to-parent survival estimates of Tucannon River spring Chinook salmon from 1985 through 2009 brood years (2009 brood year incomplete).**

| Brood Year            | Natural Salmon     |                   |                 | Hatchery Salmon    |                   |                 | Hatchery to Natural Advantage |
|-----------------------|--------------------|-------------------|-----------------|--------------------|-------------------|-----------------|-------------------------------|
|                       | Potential Spawners | Number of Returns | Return/ Spawner | Number of Spawners | Number of Returns | Return/ Spawner |                               |
| 1985                  | 416                | 392               | 0.94            | 9                  | 45                | 5.00            | 5.3                           |
| 1986                  | 440                | 468               | 1.06            | 91                 | 327               | 3.59            | 3.4                           |
| 1987                  | 407                | 238               | 0.58            | 83                 | 188               | 2.27            | 3.9                           |
| 1988                  | 257                | 527               | 2.05            | 87                 | 445               | 5.11            | 2.5                           |
| 1989                  | 276                | 158               | 0.57            | 122                | 243               | 1.99            | 3.5                           |
| 1990                  | 572                | 94                | 0.16            | 78                 | 28                | 0.36            | 2.2                           |
| 1991                  | 291                | 7                 | 0.02            | 72                 | 25                | 0.35            | 14.4                          |
| 1992                  | 476                | 196               | 0.41            | 83                 | 82                | 0.99            | 2.4                           |
| 1993                  | 397                | 204               | 0.51            | 91                 | 207               | 2.27            | 4.4                           |
| 1994                  | 97                 | 12                | 0.12            | 69                 | 34                | 0.49            | 4.0                           |
| 1995                  | 27                 | 6                 | 0.22            | 39                 | 178               | 4.56            | 20.5                          |
| 1996                  | 152                | 69                | 0.45            | 74                 | 267               | 3.61            | 7.9                           |
| 1997                  | 105                | 799               | 7.61            | 89                 | 181               | 2.03            | 0.3                           |
| 1998                  | 60                 | 389               | 6.48            | 85                 | 796               | 9.36            | 1.4                           |
| 1999                  | 160                | 141               | 0.88            | 122                | 33                | 0.27            | 0.3                           |
| 2000                  | 201                | 446               | 2.22            | 73                 | 157               | 2.15            | 1.0                           |
| 2001                  | 766                | 244               | 0.32            | 104                | 125               | 1.20            | 3.8                           |
| 2002                  | 568                | 202               | 0.36            | 93                 | 120               | 1.29            | 3.6                           |
| 2003                  | 329                | 173               | 0.53            | 75                 | 71                | 0.95            | 1.8                           |
| 2004                  | 346                | 399               | 1.15            | 88                 | 120               | 1.36            | 1.2                           |
| 2005                  | 264                | 739               | 2.80            | 95                 | 692               | 7.28            | 2.6                           |
| 2006                  | 202                | 1,721             | 8.52            | 88                 | 1,123             | 12.76           | 1.5                           |
| 2007                  | 211                | 612               | 2.90            | 82                 | 270               | 3.29            | 1.1                           |
| 2008                  | 796                | 885               | 1.11            | 114                | 666               | 5.84            | 5.3                           |
| 2009                  | 1191               | 561               | 0.47            | 173                | 299               | 1.73            | 3.7                           |
| <b>Mean</b>           |                    |                   | <b>1.70</b>     |                    |                   | <b>3.21</b>     | <b>4.1</b>                    |
| <b>Geometric Mean</b> |                    |                   | <b>0.78</b>     |                    |                   | <b>2.05</b>     | <b>2.6</b>                    |

Beginning with the 2006 brood year, the annual smolt goal was increased from 132,000 to 225,000 to help offset for the higher mortality of hatchery-origin fish after they leave the hatchery. This should increase adult salmon returns back to the Tucannon River. However, based on current hatchery SARs the increase in production would still not produce enough adult returns to reach the LSRCP mitigation goal. As mentioned previously, in conjunction with increased smolt production, we are conducting an experiment to examine size at release as a possible means to improve SAR of hatchery fish. These changes in the hatchery production program may result in a Proportionate Natural Influence (PNI) of less than 0.5. This level is

generally not considered acceptable for supplementation programs. Historically the PNI for the Tucannon Spring Chinook Program has generally been above 0.5 (Appendix I).

## **Fishery Contribution and Out-of-Basin Straying**

An original goal of the LSRCP supplementation program was to enhance returns of salmon to the Tucannon River by providing 1,152 adult hatchery origin fish (the number estimated to have been lost to the project area due to the construction and operation of the Lower Snake River hydropower system) to the river from hatchery-reared smolt releases. Such an increase would allow for limited harvest and increased spawning. However, hatchery adult returns have always been below the mitigation goal (Figure 9). Based on CWT recoveries reported to the RMIS database (Appendix J), sport, commercial, and treaty ceremonial harvest combined accounted for an average of less than 6% of the adult hatchery fish recovered for the 1985-1996 brood years. Increased fishery impacts occurred for the 1997 through 1999 broods when the states implemented mark-selective fisheries in the lower Columbia River (fishery harvest comprised an average of 19% for recoveries). We subsequently stopped adipose fin clipping of hatchery production (Gallinat et al. 2001) to lessen non-tribal fishery impacts. Returning conventional supplementation adults are now marked with either a CWT and a VIE tag behind the left eye or just CWT. This has resulted in lower sport fishery impacts. Based on CWT recoveries for the 2000-2008 brood years, harvest (primarily commercial) has accounted for only 8% of the hatchery adult CWT recoveries (Appendix J).

Out-of-basin stray rates of Tucannon River spring Chinook have generally been low (Appendix J), with an average of 1.4% of the adult hatchery fish straying to other river systems/hatcheries for brood years 1985-2009 (range 0-20%).

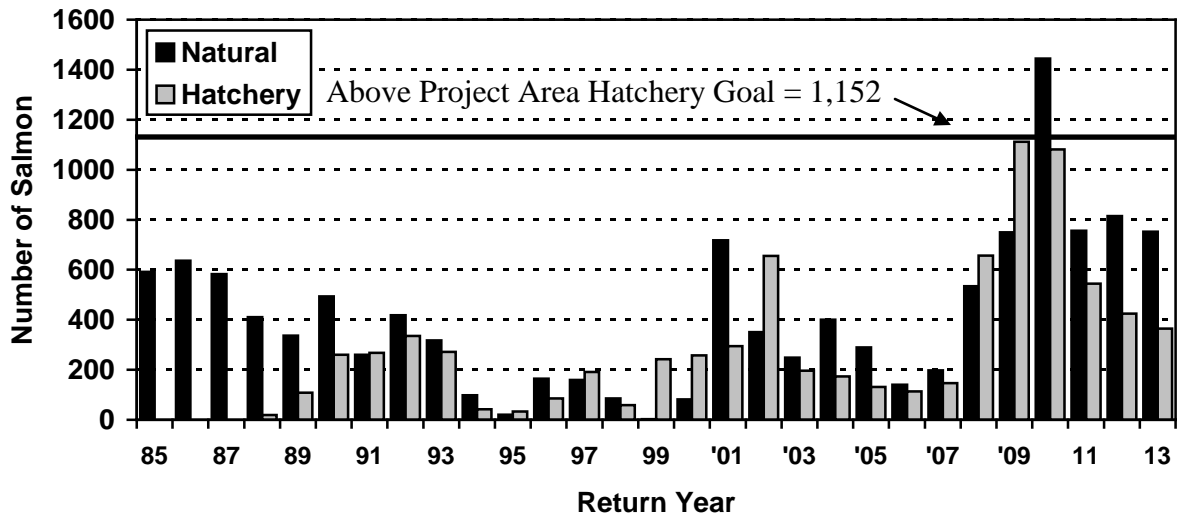


Figure 9. Total escapement for Tucannon River spring Chinook salmon for the 1985-2013 run years.

## Adjusted Hatchery SAS

Using CWT recoveries from the RMIS database, we adjusted Tucannon River spring Chinook hatchery smolt-to-adult survival (SAS) to include all known recoveries both from within and outside the Tucannon River. With minor exceptions (1997 and 2006 brood years), even after adjustment, hatchery SAS were still well below the LSRCF survival goal of 0.87% (Table 27). Increased fishing mortality resulted in higher adjusted SAS for the 1997, 1998, and 2006 brood years.

**Table 27. Hatchery SAS adjusted for recoveries from outside the Tucannon River subbasin as reported in the RMIS database, 1985-2008 brood years. (Data downloaded from RMIS database on 2/03/14).**

| Brood Year            | Estimated Number of Smolts | Expanded Return to Tucannon | Expanded Other Returns <sup>a</sup> | Grand Total of CWT Hatchery Origin Recoveries | Original Hatchery SAR (%) | Adjusted Hatchery SAS (%) |
|-----------------------|----------------------------|-----------------------------|-------------------------------------|---|---------------------------|---------------------------|
| 1985                  | 12,922                     | 45                          | 1                                   | 46  | 0.35                      | 0.36                      |
| 1986                  | 152,725                    | 327                         | 15                                  | 342   | 0.21                      | 0.22                      |
| 1987                  | 152,165                    | 188                         | 2                                   | 190   | 0.12                      | 0.12                      |
| 1988                  | 145,146                    | 445                         | 26                                  | 471   | 0.31                      | 0.32                      |
| 1989                  | 99,057                     | 243                         | 12                                  | 255   | 0.25                      | 0.26                      |
| 1990                  | 85,737                     | 28                          | 0                                   | 28  | 0.03                      | 0.03                      |
| 1991                  | 74,064                     | 25                          | 4                                   | 29  | 0.03                      | 0.04                      |
| 1992                  | 87,752                     | 82                          | 17                                  | 99  | 0.09                      | 0.11                      |
| 1993                  | 138,848                    | 207                         | 11                                  | 218   | 0.15                      | 0.16                      |
| 1994                  | 130,069                    | 34                          | 0                                   | 34  | 0.03                      | 0.03                      |
| 1995                  | 62,144                     | 178                         | 2                                   | 180   | 0.29                      | 0.29                      |
| 1996                  | 76,219                     | 267                         | 5                                   | 272   | 0.35                      | 0.36                      |
| 1997                  | 24,186                     | 181                         | 41                                  | 222   | 0.75                      | 0.92                      |
| 1998                  | 127,939                    | 796                         | 216                                 | 1,012   | 0.62                      | 0.79                      |
| 1999                  | 97,600                     | 33                          | 3                                   | 36  | 0.03                      | 0.04                      |
| 2000                  | 102,099                    | 157                         | 1                                   | 158   | 0.15                      | 0.15                      |
| 2001                  | 146,922                    | 125                         | 6                                   | 131   | 0.09                      | 0.09                      |
| 2002                  | 123,586                    | 120                         | 0                                   | 120   | 0.10                      | 0.10                      |
| 2003                  | 71,154                     | 71                          | 0                                   | 71  | 0.10                      | 0.10                      |
| 2004                  | 67,542                     | 120                         | 1                                   | 121   | 0.18                      | 0.18                      |
| 2005                  | 149,466                    | 692                         | 2                                   | 694   | 0.46                      | 0.46                      |
| 2006                  | 106,530                    | 1,123                       | 36                                  | 1,159   | 1.05                      | 1.09                      |
| 2007                  | 114,681                    | 270                         | 5                                   | 275   | 0.24                      | 0.24                      |
| 2008                  | 172,897                    | 666                         | 4                                   | 670   | 0.39                      | 0.39                      |
| <b>Mean</b>           |                            |                             |                                     |   | <b>0.27</b>               | <b>0.29</b>               |
| <b>Geometric Mean</b> |                            |                             |                                     |   | <b>0.17</b>               | <b>0.18</b>               |

<sup>a</sup> Includes expanded RMIS CWT recoveries from sources outside the Tucannon River subbasin (i.e., sport and commercial fisheries, Tucannon strays in other river systems, etc.).

# Tucannon River Natural Productivity

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Carrying capacity is one of the main factors in determining whether hatchery supplementation is a viable technique of increasing natural production (Pearsons 2002). The current carrying capacity of spring Chinook salmon in the Tucannon River has been of great interest for informed fisheries management. Two expert fishery panels have identified watershed capacity and density corrected productivity as key metrics for evaluating hatchery supplementation (ISRP and ISAB 2005). For example, productivity of a control population may be very high because it is below carrying capacity, but the productivity of a hatchery supplemented population may be low because it is at carrying capacity. Without knowledge of the carrying capacity in this example, one might erroneously conclude that hatchery supplementation was decreasing natural productivity.

We define carrying capacity two ways. The first,  $K_{sp}$ , is the minimum number of adults that produce the asymptotic maximum number of progeny (typically the most important measure for management purposes). The second,  $K_r$ , is the maximum number of recruits that the environment can support. To estimate  $K_{sp}$  and  $K_r$  for Tucannon River spring Chinook we used Ricker, Beverton-Holt, and hockey stick stock-recruit models (Beverton and Holt 1957, Ricker 1975, Barrowman and Myers 2000).

The Ricker model is defined as:  $R = \alpha \cdot P \exp^{-\beta(P)}$  and the Beverton-Holt model is:  $R = P / (\alpha P + \beta)$ ; where R is recruitment and P is parental stock size. The  $\alpha$  coefficient for both models represents density independent recruitment (productivity coefficient) and represents the slope of the stock-recruitment curve at the origin (rate of recruitment in the absence of any environmental constraints). The  $\beta$  coefficient in both models represents density-dependent processes. At relatively high spawning stock levels, various ecological processes (e.g., rate of predation, habitat, or food limitations) will result in compensation in the survival of recruits, and recruitment rate will decline with an increase in spawner abundance (Maceina and Pereira 2007).

The Ricker model was developed to describe stocks in which recruitment declines as population size tends toward infinity. Proposed mechanisms of this density dependence include predation, cannibalism, redd superimposition, and disease (Maceina and Pereira 2007). The Beverton-Holt recruitment curve assumes that competition among early life stages for a limited resource (e.g., food or space) will cause recruits to increase initially, then to decline to an asymptotic value as spawner abundance increases (Maceina and Pereira 2007).

In the hockey stick model, the sharp bend represents a change from completely density-independent mortality to completely density-dependent mortality (Barrowman and Myers 2000).



Carrying capacity was determined as the break-point at which the addition of parental stock does not produce additional recruits.

Variance in the numbers of males relative to females can confound true relationships between the number of spawners and progeny, therefore we used redd counts, with the assumption that only one female produces one redd, to reduce the potential variance between parents and progeny. Redd counts are conducted throughout the spawning area over the length of the spawning period during optimum river conditions in the fall (i.e., low water, high visibility) and are thought to be very reliable. Recruitment estimates are based on natural origin smolt estimates from juvenile trapping in the lower river (below the production area) for the 1985-2011 brood years (the 1991 brood year data was excluded due to the lack of a Section 10 Permit).

We used the computer software program FISHPARM (Prager et al. 1989) to fit the Ricker and Beverton-Holt models. The output from the non-linear least squares fitting procedure provided by FISHPARM provided estimates of the model parameters as well as estimates of the model fits to the data. The parameter estimates were used in a spreadsheet to compute predicted recruitment based on the models and to graphically plot the model fits to the data. For the Ricker model, carrying capacity was assumed to be the asymptote, or the point on the curve where the slope of the model is zero. For the Beverton-Holt model, the asymptote was far outside the range of data observed, or even thought to have occurred, so points were selected that were within 95% and 99% of the asymptote.

The computer program SegReg was used to provide parameter estimates for the hockey stick (segmented regression) model. The program uses variance minimization techniques to estimate the function. All modeled stock-recruit relationships represent average conditions.

#### Ricker Model

The parameter estimates calculated by FISHPARM for the Ricker model were  $\alpha = 3.36E^{-1}$  and  $\beta = 2.76E^{-3}$  ( $R^2 = 0.602$ ; adjusted  $R^2 = 0.567$ ). Estimated  $K_{sp}$  was 362 redds (females) and estimated  $K_r$  was 44,700 smolts (Figure 10).

#### Beverton-Holt Model

The parameter estimates calculated by FISHPARM for the Beverton-Holt model were  $\alpha = 1.49 E^{-2}$  and  $\beta = 2.49$  ( $R^2 = 0.560$ ; Adjusted  $R^2 = 0.521$ ). The Beverton-Holt model provided a  $K_{sp}$  estimate of 578 redds (females) and a  $K_r$  estimate of 52,000 smolts at 95% of capacity (Figure 10). The model also predicted a  $K_{sp}$  of 1,499 redds (females) and  $K_r$  of 60,281 smolts at 99% of capacity (Figure 10).

## Hockey Stick Model

For the hockey stick model, when the numbers of redds (females) was less than 181 the function formula was  $R = 0.244 \cdot P + -1.98$ . When the numbers of redds (females) was greater than 181 the function formula was  $R = 0 \cdot P + 42.1$ . Estimated  $K_{sp}$  was 181 redds (females) and estimated  $K_r$  was 42,184 smolts (Figure 10).

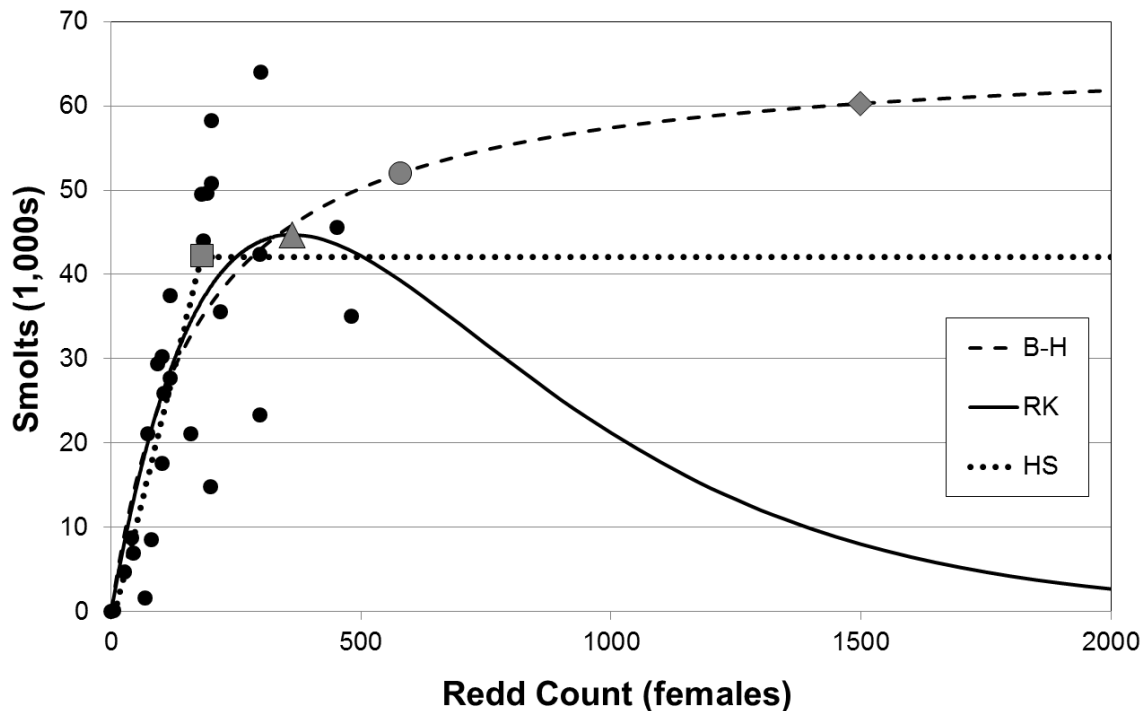
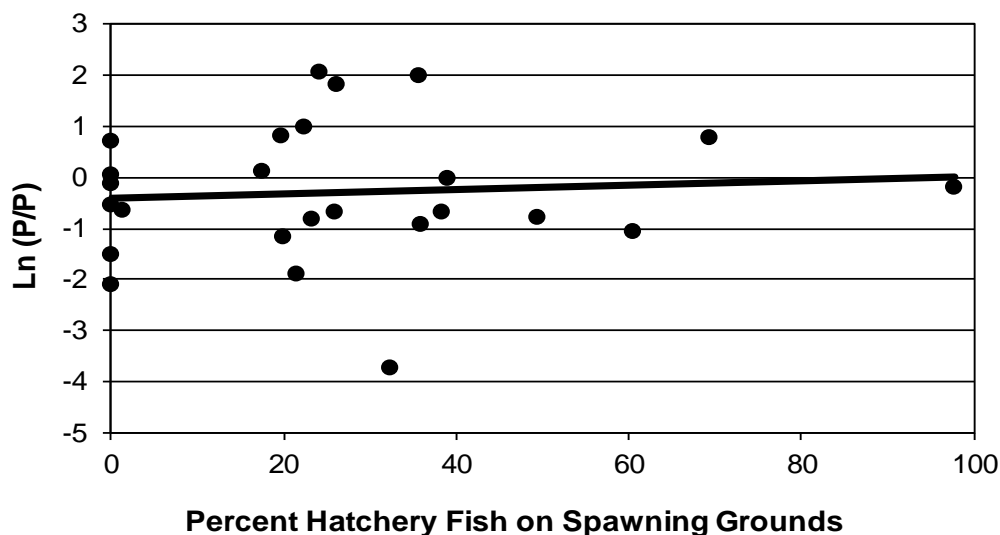


Figure 10. Beverton-Holt (B-H), Ricker (RK), and hockey stick (HS) stock-recruitment functions relating Tucannon spring Chinook salmon smolts (emigrants) against number of redds (females) for the 1985-2011 brood years (excludes 1991). Current carrying capacity is denoted by the gray square for the hockey stick function and gray triangle for the Ricker function. For the Beverton-Holt function, the gray circle represents carrying capacity at 95% of the asymptote and the gray diamond represents carrying capacity at 99% of the asymptote.

Historical abundance was not well documented, but it has been estimated that there were approximately 30,000 adult spawners in the Tucannon prior to 1916 (Columbia Conservation District 2004). By the 1950s the run had declined to around 5,000 (Columbia Conservation District 2004). Based on our analysis using three different stock-recruitment models,  $K_{sp}$  ranged from 181 to 1,499 redds (females) under current conditions. Estimates for  $K_r$  ranged from 42,184 to 60,281 smolts. However, the reader is cautioned that carrying capacity estimates can change and ongoing habitat restoration efforts have the potential to increase carrying capacity and decrease density-dependent mortality.

## Adult Progeny-per-Parent Ratios and Density Dependence

Another metric we used to examine natural productivity of spring Chinook in the Tucannon River was progeny-per-parent ratios (adults). Chilcote et al. (2011) found a negative relationship between the reproductive performance of natural, anadromous salmonid populations and the proportion of hatchery fish in the spawning population. However, when we plotted progeny-per-parent ratios against the proportion of hatchery fish on the spawning grounds we found a slightly increasing trend in natural productivity rather than a decrease (Figure 11).



**Figure 11. Tucannon River spring Chinook in-river natural-log transformed progeny-per-parent ratio (adult) against percent hatchery fish on the spawning grounds for the 1985 to 2009 brood years.**

A large amount of effort/focus has been spent in recent years examining the effects (either adverse or beneficial) of hatchery origin fish on natural populations. Although this evaluation is important, it may not be focused on the primary limitations for expanding ESA-listed populations to meet ESA/recovery goals. This hatchery evaluation process has provided many years of detailed evaluations of both the hatchery and natural components of the population and helped identify other limiting factors that may be depressing population abundance and productivity.

Density-dependent mortality is often assumed to be negligible for populations below historical capacity. However, we have documented that that is not the case for Tucannon River spring Chinook (Gallinat and Ross 2012). More recently, Walters et al. (2013) found that density

dependence was ubiquitous among nine ESA listed Idaho spring/summer Snake River Chinook salmon populations. They identified overwinter mortality, spatial clustering of redds, and limited resource availability as potentially important limiting factors contributing to density dependence. Walters et al. (2013) concluded from their study that density dependence at the population level is common in anadromous salmonids with substantial freshwater residence time, even if the population has experienced serious declines, and must be considered in demographic analysis and management.

Our data shows that years with large escapement back to the Tucannon River did not produce large returns suggesting density-dependent effects were affecting productivity. Comparing mean lengths of outmigrating spring Chinook at the Tucannon smolt trap with year class strength showed a significant relationship ( $P < 0.01$ ), with smaller year class strength producing larger smolts on average (Figure 12). These larger smolts survived at a greater rate and tended to be the brood years that were above replacement (Figure 13). Sampling conducted by Howell et al. (1985) before the Tucannon Hatchery Program was in place noted that pre-smolts collected in the Tucannon River averaged 78 mm and this was generally smaller than juveniles of the same age collected from other spring Chinook populations. Could this small size help explain why the Tucannon spring Chinook population has struggled to recover? Will the higher survival of larger smolts result in an evolutionary shift to a Tucannon population with greater size of smolts at outmigration? Or will habitat improvements in the Tucannon River Basin lead to increases in carrying capacity, smolt length/size, and higher survival? These are questions that should be examined as part of this hatchery evaluation in the future.

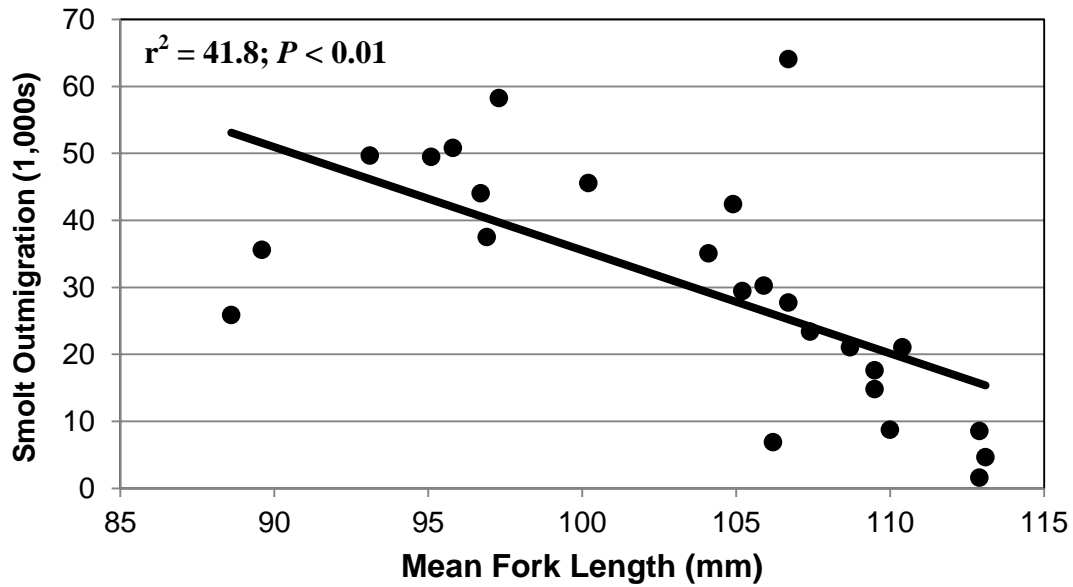


Figure 12. Linear regression of mean fork length (mm) of outmigrating Tucannon River spring Chinook smolts versus year class strength for the 1985 to 2011 brood years (excludes 1991 brood year).

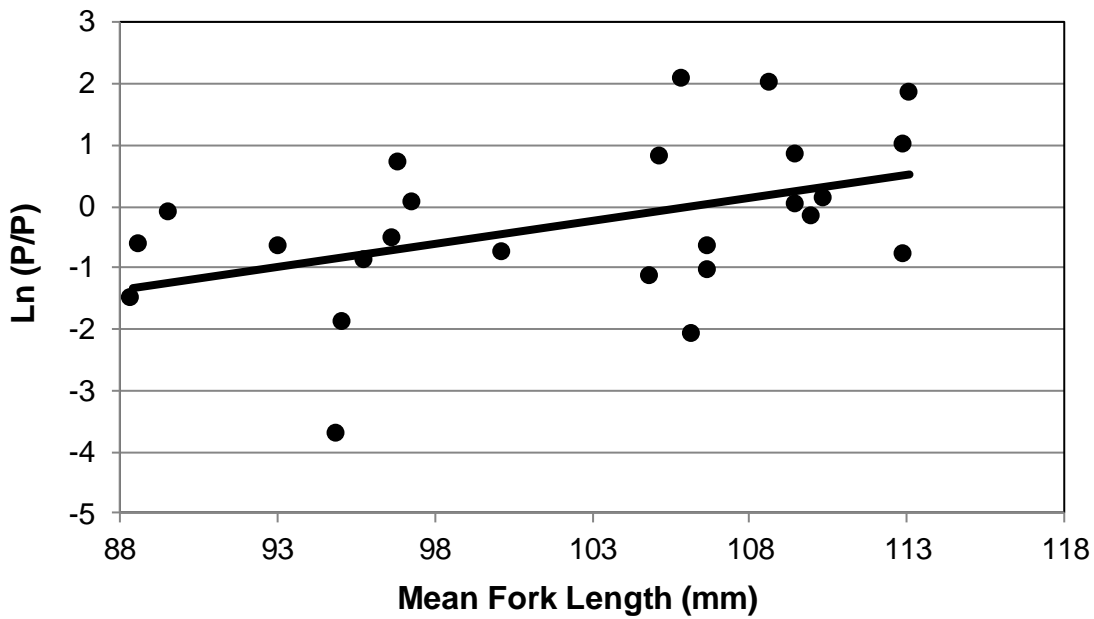


Figure 13. Tucannon River spring Chinook in-river natural-log transformed progeny-per-parent ratio (adult) against mean fork length (mm) of natural-origin emigrating smolts for the 1985 to 2009 brood years.

The long-term mitigation goal is to provide a total annual return of between 2,400-3,400 hatchery and natural origin fish back to the Tucannon River (SRSRB 2006) that should include at least 750 natural origin fish over a 10-year geometric mean (population viability threshold) (ICTRT 2008). Based on the density-dependent effects we have observed, this goal may be higher than the habitat can support under current conditions. Natural origin returns have been increasing in recent years (Figure 14). However, we are still well below the 10-year moving geometric mean of 750 natural origin fish.

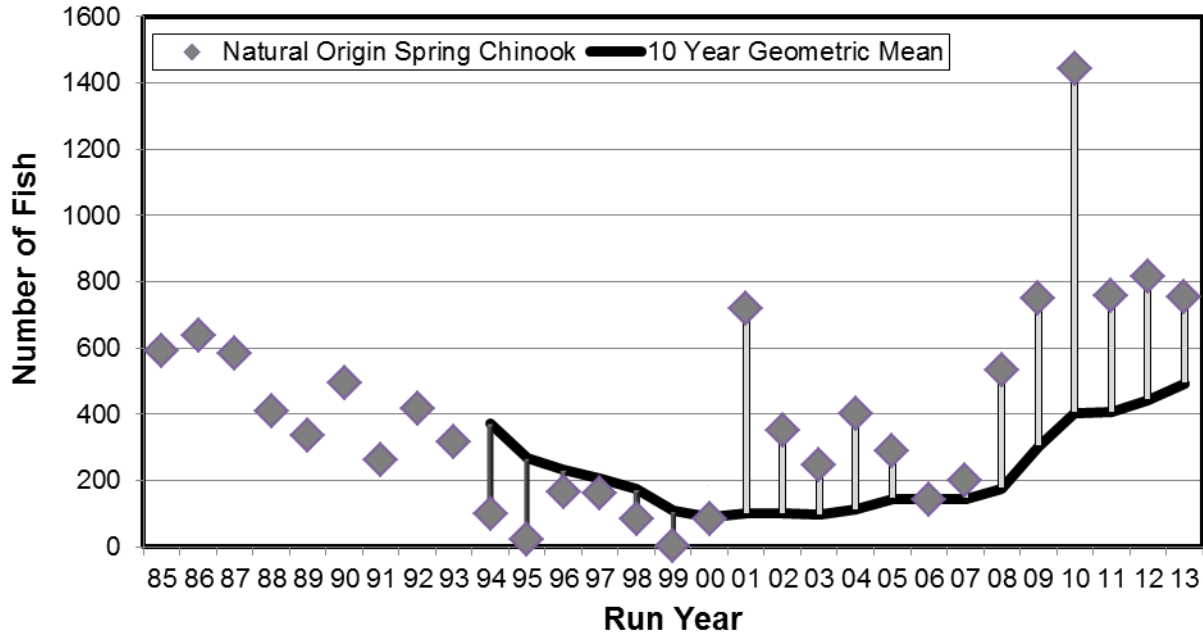


Figure 14. Tucannon River spring Chinook natural origin returns with the moving ten year geometric mean (black line) for the 1985-2013 run years.

## Size at Release Evaluation

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In order to release Tucannon River spring Chinook at 30 g/fish hatchery staff must retard fish growth in the hatchery. While a target goal of 30 g/fish more closely mimics the migrating size of natural origin spring Chinook smolts (approximately 18 g/fish), the hatchery fish are not surviving as well as the natural fish based on smolt-to-adult returns (Gallinat and Ross 2009). Hatchery fish, due to their protection in the hatchery environment may lack the necessary survival skills learned by natural origin fish living in the wild. Hatchery fish may also have difficulty adjusting to and locating food upon release into the wild, resulting in post-release mortality (Rondorf et al. 1985). Releasing fish at a larger size would likely increase smolt survival (Tipping 1997), but this may also increase the number of precocious males and possibly change the age structure of the returning adult population. Although precocious maturation of males is associated with spring Chinook populations in headwater tributaries, many precocious males mature outside the normal spawning time of sea-run fish (Groot and Margolis 1991). If this occurs, then contribution by precocial males to the next generation may be small overall. Therefore, the amount of production from hatchery fish released at a larger size may be equal to, or even greater than, fish released at a smaller size if survival is greater for larger fish.

In order to fully examine the effects of size at release, we initiated a plan to compare the differences in survival and size and age at return between smolts reared to 30 g/fish and 50 g/fish from the 2006-2010 brood years. Methods were previously described in Gallinat and Ross (2010).

Estimated survival probabilities from Curl Lake to Lower Monumental Dam were similar for the first two years of the study (Table 28). However, there was a large overlap in size between the two groups at release (Gallinat and Ross 2010). Beginning with the 2008 brood year we PIT tagged fish based on length to better separate the two groups of fish. With that change in protocol we were able to detect significantly greater outmigration survival of the larger fish for the 2008 through 2010 brood years (Table 28). Although, with the exception of the fish reared to 50 g from the 2008 BY, the survival advantage of the larger hatchery smolts through the outmigration corridor did not equal survival of the natural origin fish. However, the hatchery fish were tagged before planting into Curl Lake AP and the natural origin fish were tagged at the smolt trap which likely explains differences in survival rates.

We are now gathering adult return data (Table 29). However, with only three complete brood year returns, it is still too early in the study to come to any definite conclusions. We will continue to examine smolt-to-adult survival rates and compare age composition for the two groups. Results will be reported annually.

**Table 28. Summary of SURPH juvenile survival estimates based on PIT tags detections from Curl Lake to Lower Monumental Dam and survival based on CWT recoveries obtained from the RMIS website for the Tucannon River spring Chinook size at release experiment.**

| <b>Brood Year</b> | <b>CWT</b> | <b>VIE</b> | <b>Target Size (g)</b> | <b>Release Size (g)</b> | <b>Tagging Target</b> | <b>SURPH Surv. Est.</b> | <b>S.E.</b> | <b>RMIS CWT Survival</b> |
|-------------------|------------|------------|------------------------|-------------------------|-----------------------|-------------------------|-------------|--------------------------|
| 2006              | 63/40/94   | L. Purple  | 30                     | 39                      | 2,500                 | 0.26                    | 0.02        | 1.07                     |
| 2006              | 63/40/93   | L. Blue    | 50                     | 54                      | 2,500                 | 0.30                    | 0.02        | 0.96                     |
| 2007              | 63/46/87   | L. Purple  | 30                     | 37                      | 2,500                 | 0.28                    | 0.03        | 0.13                     |
| 2007              | 63/46/88   | L. Blue    | 50                     | 57                      | 2,500                 | 0.33                    | 0.04        | 0.26                     |
| 2008              | 63/51/74   | L. Purple  | 30                     | 40                      | 7,500                 | 0.48                    | 0.07        | 0.22                     |
| 2008              | 63/51/75   | L. Blue    | 50                     | 66                      | 7,500                 | 0.75                    | 0.36        | 0.37                     |
| 2009              | 63/55/65   | L. Purple  | 30                     | 35                      | 12,500                | 0.52                    | 0.02        | 0.00                     |
| 2009              | 63/55/66   | L. Blue    | 50                     | 51                      | 12,500                | 0.74                    | 0.03        | 0.01                     |
| 2010              | 63/60/75   | L. Purple  | 30                     | 32                      | 11,500                | 0.21                    | 0.01        | ---                      |
| 2010              | 63/60/76   | L. Blue    | 50                     | 66                      | 11,500                | 0.28                    | 0.02        | ---                      |

**Table 29. Adult returns and smolt-to-adult return (SAR) rates from the Tucannon River spring Chinook size at release experiment.**

| <b>50g Target Smolt Size</b> |                                   |              |              |              |                |  |
|------------------------------|-----------------------------------|--------------|--------------|--------------|----------------|--|
| <b>Brood Year</b>            | <b>Estimated Number Of Smolts</b> | <b>Age 3</b> | <b>Age 4</b> | <b>Age 5</b> | <b>SAR (%)</b> |  |
| 2006                         | 52,735                            | 207          | 313          | 21           | 1.03           |  |
| 2007                         | 55,480                            | 35           | 108          | 17           | 0.29           |  |
| 2008                         | 86,203                            | 141          | 233          | 5            | 0.44           |  |
| 2009                         | 113,049                           | 8            | 174          | ---          | 0.16           |  |
| 2010                         | 97,259                            | 33           | ---          | ---          | 0.03           |  |

| <b>30 g Target Smolt Size</b> |                                   |              |              |              |                |  |
|-------------------------------|-----------------------------------|--------------|--------------|--------------|----------------|--|
| <b>Brood Year</b>             | <b>Estimated Number Of Smolts</b> | <b>Age 3</b> | <b>Age 4</b> | <b>Age 5</b> | <b>SAR (%)</b> |  |
| 2006                          | 53,795                            | 195          | 367          | 20           | 1.08           |  |
| 2007                          | 59,201                            | 39           | 63           | 0            | 0.17           |  |
| 2008                          | 86,694                            | 128          | 136          | 1            | 0.31           |  |
| 2009                          | 118,388                           | 0            | 117          | ---          | 0.10           |  |
| 2010                          | 104,326                           | 33           | ---          | ---          | 0.03           |  |



## Conclusions and Recommendations

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Washington's LSRCP hatchery spring Chinook salmon program has failed to return adequate numbers of adults to meet the mitigation goal. This has occurred because SARs of hatchery origin fish have been consistently lower than what was originally assumed under the LSRCP program development, even though hatchery returns (recruits/spawner) have generally been at 2-3 times the replacement level. Further, the natural spring Chinook population in the river has declined and remains below the replacement level for most years, with the majority (95%) of the mortality occurring between the green egg and smolt stages. However, because of the advantage in survival during early life history stages for fish in the hatchery, the progeny-to-parent ratio for hatchery produced fish has generally been above replacement and therefore may have sustained the population during years when the population was at critically low levels. We have seen a significant rebound of natural origin fish in recent years and we came close to reaching the LSRCP within river hatchery goal of 1,152 fish in 2009 and 2010. System survivals (in-river, migration corridor, and ocean) must increase in the near future for the hatchery program to succeed, the natural run to persist over the short-term, and the natural population to increase to a level where it can be sustainable over the long-term.

Until that time, the evaluation program will continue to document and study life history survivals, straying, carrying capacity, genotypic and phenotypic traits, and examine procedures within the hatchery that can be changed to improve the hatchery program and the natural population. Based on our previous studies and current data involving survival and physical characteristics we recommend the following:

1. We continue to see annual differences in phenotypic characteristics of returning salmon (i.e., hatchery fish are generally younger and less fecund than natural origin fish), yet other traits such as run and spawn time are little changed over the program's history. Further, genetic analysis to date has detected little change in the natural population that may have resulted from hatchery actions.

Recommendation: Continue to collect as many carcasses as possible for the most accurate age composition data. Collect biological data (length, run timing, spawn timing, fecundity estimates, DNA samples, smolt trapping, and life stage survival) to document the effects (positive or negative) that the hatchery program may have on the natural population.

2. Based on annual redd densities and historical spring Chinook radio tag data, the Tucannon Fish Hatchery weir/trap has been an impediment to upstream passage of spring Chinook to the better spawning and rearing habitat upstream of the trap.

Recommendation: Seek funding and engineering expertise to modify the design and/or operation of the weir/trap structure.

3. Subbasin and recovery planning for ESA listed species in the Tucannon River have identified factors limiting the spring Chinook population and strategies to recover the population.

Recommendation: Assist population conservation efforts by updating recent carrying capacity/density and straying effects, and productivity estimates of the Tucannon River so that hatchery stocking is appropriate, and hatchery and natural performance is measured against future basin capacity after habitat improvements. Determine impacts to other species of concern (e.g., steelhead, bull trout). Compare the Tucannon population with unsupplemented control populations in the Columbia Basin to examine if hatchery supplementation is benefiting the natural population in the Tucannon River.

4. We have documented that hatchery juvenile (egg-parr-smolt) survival rates are considerably higher than naturally reared salmon, and hatchery smolt-to-adult return rates are much lower. We need to identify and address the factors that limit hatchery SARs in order to meet mitigation goals and for natural production to meet recovery goals. Beginning with the 2006 brood year, the annual hatchery smolt goal was increased from 132,000 to 225,000 to help offset the higher mortality of hatchery-origin fish after they leave the hatchery. This should increase adult salmon returns back to the river, however, based on current mean hatchery SARs this would still not produce enough adult returns to consistently reach the LSRCP mitigation goal.

Recommendation: Continue to evaluate survival rates from other reference watersheds to see if the LSRCP goal of 0.87% is a realistic goal under existing conditions. Continue to evaluate the size at release experiment to see if we can use larger smolt size to increase survival of hatchery fish. PIT tag natural origin fish in the river to ascertain where or at what life stage mortality is occurring. Encourage fish and wildlife enforcement patrols and additional public education efforts during periods when spring Chinook adults are most vulnerable (pre-spawn and spawning).

5. Adult Tucannon River spring Chinook appear to be “overshooting” or bypassing the Tucannon River based on PIT tag returns. This is occurring for both hatchery and natural origin fish, and thus does not appear to be a hatchery effect; although genetic analysis of fish that bypass may be informative regarding hatchery effects and relatedness.

Recommendation: Utilize detectors at the dams and on the Tucannon and Asotin Creek to determine if this “overshooting” is due to natural straying, a life history variant (fish rearing in the Snake River), or is due to hydropower operations (fish may not be able to detect the

flow of the Tucannon River in the artificially dammed Snake River). Support the operation and maintenance of PIT tag arrays on the Tucannon River. Seek funding for a collaborative radio telemetry project to examine migratory behavior of Tucannon River spring Chinook. The magnitude of this bypass behavior, and its causes, must be understood and addressed in order to meet Tucannon spring Chinook population conservation needs and mitigation goals.

6. Very few carcasses were recovered both upstream and downstream of the adult trap in 2013 and robust live fish that were observed during spawning ground surveys disappeared quickly. Some surveyors noted an unusually high number of small ‘test digs’ that were not developed into complete redds. It was unknown whether fish were preyed upon by predators, poached, died of disease or stress, or fell back over the adult trap dam. Disease was not noted in fish collected for broodstock and water temperatures in the river were not thought to be at a level to cause undue stress based on temperature monitors.

Recommendation: Implant radio tags in a representative group of Tucannon River spring Chinook salmon in 2014 to determine the potential cause for the high pre-spawn mortality. Report findings to district fish management, tribal co-managers, and other interested parties.

## Literature Cited

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- Barrowman, N. J., and R. Myers. 2000. Still more spawner-recruitment curves: the hockey stick and its generalizations. *Canadian Journal of Fisheries and Aquatic Sciences* 57: 665-676.
- Beverton, R. J. H., and S. J. Holt. 1957. *On the dynamics of exploited fish populations*. Chapman and Hall, London.
- Blankenship, S., and G. Mendel. 2010. Genetic characterization of adult Chinook trapped in lower Asotin Creek. WDFW report. 12 pp.
- Bugert, R., P. LaRiviere, D. Marbach, S. Martin, L. Ross, and D. Geist. 1990. Lower Snake River Compensation Plan Salmon Hatchery Evaluation Program 1989 Annual Report to U.S. Fish and Wildlife Service, AFF 1/LSR-90-08, Cooperative Agreement 14-16-0001-89525. Washington Department of Fisheries, Olympia, Washington.
- Bugert, R., C. Busack, G. Mendel, L. Ross, K. Petersen, D. Marbach, and J. Dedloff. 1991. Lower Snake River Compensation Plan Tucannon River Spring Chinook Salmon Hatchery Evaluation Program 1990 Annual Report to U.S. Fish and Wildlife Service, AFF 1/LSR-91-14, Cooperative Agreement 14-16-0001-90524. Washington Department of Fisheries, Olympia, Washington.
- Bumgarner, J., L. Ross, and M. Varney. 2000. Lower Snake River Compensation Plan Tucannon River Spring Chinook Salmon Hatchery Evaluation Program 1998 and 1999 Annual Reports to U.S. Fish and Wildlife Service, Cooperative Agreements 1448-14110-98-J057 and CA-14110-9-J070. Washington Department of Fish and Wildlife, Olympia, Washington. Report # FPA00-17.
- Busack, C., and C. M. Knudsen. 2007. Using factorial mating designs to increase the effective number of breeders in fish hatcheries. *Aquaculture* 273: 24-32.
- Cheng, Y. W., and M. P. Gallinat. 2004. Statistical analysis of the relationship among environmental variables, inter-annual variability and smolt trap efficiency of salmonids in the Tucannon River. *Fisheries Research* 70: 229-238.
- Chilcote, M. W., K. W. Goodson, and M. R. Faley. 2011. Reduced recruitment performance in natural populations of anadromous salmonids associated with hatchery-reared fish. *Canadian Journal of Fisheries and Aquatic Science* 68: 511-522.
- Columbia Conservation District. 2004. Tucannon subbasin plan. Available: <http://www.nwcouncil.org/fw/subbasinplanning/tucannon/plan>. (May 2014).
- Gallinat, M. P. and W-Y Chang. 2013. Phenotypic comparisons among natural-origin, hatchery-origin, and captive-reared female spring Chinook salmon from the Tucannon River, Washington. *North American Journal of Aquaculture* 75 (4): 572-581.

- Gallinat, M. P., J. D. Bumgarner, L. Ross, and M. Varney. 2001. Tucannon River Spring Chinook Salmon Hatchery Evaluation Program 2000 Annual Report to U.S. Fish and Wildlife Service, Cooperative Agreement 1411-09-J070. Washington Department of Fish and Wildlife, Olympia, Washington. Report # FPA01-05.
- Gallinat, M. P., and L. A. Ross. 2009. Tucannon River Spring Chinook Salmon Hatchery Evaluation Program 2008 Annual Report to U.S. Fish and Wildlife Service, Cooperative Agreement 1411-08-J011. Washington Department of Fish and Wildlife, Olympia, Washington. Report # FPA10-01. 75 p.
- Gallinat, M. P., and L. A. Ross. 2010. Tucannon River Spring Chinook Salmon Hatchery Evaluation Program 2009 Annual Report to U.S. Fish and Wildlife Service, Cooperative Agreement 1411-09-J012. Washington Department of Fish and Wildlife, Olympia, Washington. Report # FPA09-08. 73 p.
- Gallinat, M. P., and L. A. Ross. 2012. Tucannon River Spring Chinook Salmon Hatchery Evaluation Program 2011 Annual Report to U.S. Fish and Wildlife Service, Cooperative Agreement 14110-B-J012. Washington Department of Fish and Wildlife, Olympia, Washington. Report # FPA12-02. 94 p.
- Gallinat, M. P., and L. A. Ross. 2013. Tucannon River Spring Chinook Salmon Hatchery Evaluation Program 2012 Annual Report to U.S. Fish and Wildlife Service, Cooperative Agreement F12AC00091. Washington Department of Fish and Wildlife, Olympia, Washington. Report #FPA13-03. 102 p.
- Groot, C., and L. Margolis. 1991. Pacific salmon life histories. UBC Press. Vancouver, B.C. 564 p.
- Howell, P., K. Jones, D. Scarnecchia, L. LaVoy, W. Kendra, and D. Ortmann. 1985. Final Report: Stock Assessment of Columbia River Anadromous Salmonids. Volume 1: Chinook, coho, chum and sockeye salmon stock summaries. Report to U.S.D.O.E., Bonneville Power Administration. Contract No. DE-A179-84BP12737. Project No. 83-335.
- ICTRT (Interior Columbia Technical Recovery Team). 2008. Current status assessments. U.S. Dept. Commer., NOAA, National Marine Fisheries Service, Northwest Region, Portland, Ore.
- ISRP and ISAB. 2005. Monitoring and evaluation of supplementation projects. Available: [http://www.nwcouncil.org/media/33467/isrpisab2005\\_15.pdf](http://www.nwcouncil.org/media/33467/isrpisab2005_15.pdf). (May 2014).
- Keefer, M. L., C. C. Caudill, C. A. Peery, and C. T. Boggs. 2008. Non-direct homing behaviours by adult Chinook salmon in a large, multi-stock river system. *Journal of Fish Biology* 72: 27-44.
- Maceina, M. J., and D. L. Pereira. 2007. Recruitment. Pages 121-185 in C. S. Guy and M. L. Brown, editors. Analysis and interpretation of freshwater fisheries data. American Fisheries Society, Bethesda, Maryland.

- Meekin, T. K., 1967. Report on the 1966 Wells Dam Chinook tagging study. Report to Douglas County PUD, Contract 001-01-022-4201. Washington Department of Fisheries, Olympia, WA. 41 p. (Available from Douglas County PUD, 1151 Valley Mall Parkway, East Wenatchee, WA 98801.)
- Murdoch, A. R., T. N. Pearsons, and T. W. Maitland. 2009. The number of redds constructed per female spring Chinook salmon in the Wenatchee River basin. *North American Journal of Fisheries Management* 29: 441-446.
- Murdoch, A. R., T. N. Pearsons, T. W. Maitland. 2010. Estimating the spawning escapement of hatchery- and natural-origin spring Chinook salmon using redd and carcass data. *North American Journal of Fisheries Management* 30: 361-375.
- Pearsons, T. N. 2002. Chronology of ecological interactions associated with the life-span of salmon supplementation programs. *Fisheries* 27(12): 10-15.
- Peterson, J. T., R. F. Thurow, and J. W. Guzevich. 2004. An evaluation of multipass electrofishing for estimating the abundance of stream-dwelling salmonids. *Transactions of the American Fisheries Society* 113: 462-475.
- Prager, M. H., S. B. Saila, and C. W. Reckseik. 1989. FISHPARM: a microcomputer program for parameter estimation of nonlinear models in fishery science, 2<sup>nd</sup> edition. Old Dominion University Oceanography Technical Report 87-10, Norfolk, Virginia.
- Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. *Bull. Fish. Res. Can.* 191: 382 p.
- Rondorf, D. W., M. S. Dutchuk, A. S. Kolok, and M. L. Gross. 1985. Bioenergetics of juvenile salmon during the spring outmigration – Annual Report 1983. U.S. Fish and Wildlife Service. BPA Project No. 82-11. 78 p.
- Rosenberger, A. E., and J. B. Dunham. 2005. Validation of abundance estimates from mark-recapture and removal techniques for rainbow trout captured by electrofishing in small streams. *North American Journal of Fisheries Management* 25: 1395-1410.
- Seiler, D., L. Kishimoto, and S. Neuhauser. 1999. 1998 Skagit River wild 0+ Chinook production evaluation. Washington Department of Fish and Wildlife. Olympia, Washington. 73 pp.
- Snake River Salmon Recovery Board (SRSRB). 2006. Technical Document Snake River Salmon Recovery Plan for S.E. Washington. Prepared for the Washington Governor's Salmon Recovery Office. 408 pages, plus appendices.
- Snake River Salmon Recovery Board (SRSRB). 2011. Technical Document Snake River Salmon Recovery Plan for S.E. Washington. Prepared for the Washington Governor's Salmon Recovery Office. 272 pages, plus appendices.

- Steinhorst, K., Y. Wu, B. Dennis, and P. Kline. 2004. Confidence intervals for fish outmigration estimates using stratified trap efficiency methods. *Journal of Agricultural, Biological, and Environmental Statistics* 9 (3): 284-299.
- Tipping, J. M. 1997. Effect of smolt length at release on adult returns of hatchery-reared winter steelhead. *Prog. Fish. Cult.* 59 (4): 310-311.
- Tucannon Subbasin Summary. 2001. L. Gephart and D. Nordheim, editors. Prepared for the Northwest Power Planning Council. Dayton, Washington.
- USACE (U.S. Army Corps of Engineers), 1975. Special Reports: Lower Snake River Fish and Wildlife Compensation Plan. Walla Walla, Washington.
- Walters, A. W., T. Copeland, and D. A. Venditti. 2013. The density dilemma: limitations on juvenile production in threatened salmon populations. *Ecology of Freshwater Fish* 22: 509-519.

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## Appendix A: Annual Takes for 2013

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**Appendix A. Table 1. Summary of maximum annual (calendar year) takes allowed and 2013 takes (in parenthesis) of listed Snake River spring Chinook salmon (Tucannon River Stock).**

| <b>TYPE OF TAKE</b>                                 | <b>Wild Spring Adults</b> | <b>Wild Spring Juvenile</b> | <b>Hatchery Spring Juvenile</b> |
|---|---------------------------|-----------------------------|---------------------------------|
| Collect for Transport                               |                           |                             |                                 |
| Observe/Harass <sup>a</sup>                         | 300 (0)                   | 4,000 (0)                   | 4,000 (0)                       |
| Capture, Handle and Release                         |                           | 25,000 (457)                | 100,000 (16,026)                |
| Capture, Handle, Tag/Mark, and Release <sup>b</sup> | 30 (0)                    | 5,000 (2,385)               | 20,000 (3,863)                  |
| Lethal Take <sup>c</sup>                            |                           | 125 (0)                     | 200 (0)                         |
| Spawning, Dead, or Dying                            | 1,500 (23)                |                             |                                 |
| Other Take (specify) <sup>d</sup>                   |                           | 10,000 (4,026)              | 50,000 (14,987)                 |
| Indirect Mortality                                  |                           | 375 (30)                    | 1,500 (18)                      |
| Incidental Take <sup>e</sup>                        |                           | 0                           |                                 |
| Incidental Mortality <sup>e</sup>                   |                           | 0                           |                                 |

<sup>a</sup> Refers to the number of fish observed during snorkel surveys (summer and fall precocial surveys).

<sup>b</sup> Refers to the number of fish marked at the smolt trap.

<sup>c</sup> Refers to the number of fish collected for organosomatic index samples.

<sup>d</sup> Refers to the number of fish PIT tagged at the hatchery or smolt trap.

<sup>e</sup> Refers to the number of fish collected or killed during electrofishing surveys.

**Appendix A. Table 2. Summary of maximum annual (calendar year) takes allowed and 2013 takes (in parenthesis) of listed Snake River spring Chinook salmon (Tucannon River Stock).**

| <b>TYPE OF TAKE</b>                        | <b>Wild Adults</b> | <b>Wild Jacks</b> | <b>Hatchery Adults</b> | <b>Hatchery Jacks</b> | <b>Wild Juvenile</b> | <b>Hatchery Juvenile</b> |
|--|--------------------|-------------------|------------------------|-----------------------|----------------------|--------------------------|
| Collect for Transport <sup>a</sup>         | 300 (98)           | N/A (0)           | 300 (60)               | N/A (0)               |                      |                          |
| Observe/Harass (Total of all fish trapped) | 2,500 (226)        | N/A (45)          | 2,500 (154)            | NA (114)              |                      |                          |
| Capture, Handle and Release <sup>b</sup>   | 2,500 (128)        | N/A (45)          | 2,500 (94)             | NA (112)              |                      |                          |
| Capture, Handle, Tag/Mark, and Release     |                    |                   |                        |                       |                      | 247,500 (259,964 BY11)   |
| Lethal Take (Broodstock) <sup>c</sup>      | 300 (98)           | N/A (0)           | 300 (60)               | NA (0)                |                      |                          |
| Spawning, Dead, or Dying <sup>d</sup>      | 25 (0)             | N/A (0)           | 25 (0)                 | NA (2)                |                      |                          |
| Other Take (specify)                       |                    |                   |                        |                       |                      |                          |
| Indirect Mortality <sup>e</sup>            | 10 (5)             | N/A (0)           | 10 (2)                 | NA (0)                |                      |                          |
| Incidental Take                            |                    |                   |                        |                       |                      |                          |
| Incidental Mortality                       |                    |                   |                        |                       |                      |                          |

<sup>a</sup> Refers to the number fish collected for the hatchery broodstock.

<sup>b</sup> Refers to the number of fish released upstream or downstream of the trap following capture.

<sup>c</sup> Excludes excess broodstock females returned to the river for natural spawning.

<sup>d</sup> Refers to the number of fish that may die in the trap before release or taken for broodstock

<sup>e</sup> Refers to the number of fish (collected for broodstock) that may die in transport or during broodstock holding.

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**Appendix B: Spring Chinook Captured, Collected, or  
Passed Upstream at the Tucannon Hatchery Trap in  
2013**

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**Appendix B. Spring Chinook salmon captured, collected, or passed upstream at the Tucannon Hatchery trap in 2013. (Trapping began in February; last day of trapping was September 30).**

| Date | Captured in Trap |          | Collected for Broodstock |          | Passed Upstream |          | Killed Outright <sup>a</sup> |          | Trap Mortality |          |
|------|------------------|----------|--------------------------|----------|-----------------|----------|------------------------------|----------|----------------|----------|
|      | Natural          | Hatchery | Natural                  | Hatchery | Natural         | Hatchery | Natural                      | Hatchery | Natural        | Hatchery |
| 5/13 |                  | 1        |                          |          |                 |          |                              |          |                |          |
| 5/14 |                  | 1        |                          |          |                 |          |                              |          |                |          |
| 5/15 |                  | 2        |                          |          |                 |          |                              |          |                |          |
| 5/17 | 2                | 3        | 1                        | 3        | 1               |          |                              |          |                |          |
| 5/18 | 9                | 5        |                          |          | 9               | 5        |                              |          |                |          |
| 5/19 | 4                | 4        |                          |          | 4               | 4        |                              |          |                |          |
| 5/20 | 6                | 3        | 6                        | 3        |                 |          |                              |          |                |          |
| 5/21 | 13               | 11       | 8                        | 5        | 5               | 6        |                              |          |                |          |
| 5/22 | 1                | 6        | 1                        | 4        |                 | 2        |                              |          |                |          |
| 5/23 |                  | 3        |                          |          |                 | 3        |                              |          |                |          |
| 5/24 | 2                | 6        | 2                        | 5        |                 | 1        |                              |          |                |          |
| 5/25 | 1                |          |                          |          | 1               |          |                              |          |                |          |
| 5/26 | 7                | 4        |                          |          | 7               | 4        |                              |          |                |          |
| 5/27 | 4                | 8        |                          |          | 4               | 8        |                              |          |                |          |
| 5/28 | 7                | 10       | 6                        | 5        | 1               | 5        |                              |          |                |          |
| 5/29 | 9                | 6        | 6                        | 3        | 3               | 3        |                              |          |                |          |
| 5/30 | 6                | 5        | 5                        | 3        | 1               | 2        |                              |          |                |          |
| 5/31 | 8                | 7        | 5                        | 3        | 3               | 4        |                              |          |                |          |
| 6/01 | 10               | 8        |                          |          | 10              | 8        |                              |          |                |          |
| 6/02 | 3                | 7        |                          |          | 3               | 6        |                              | 1        |                |          |
| 6/03 | 8                | 1        | 8                        | 1        |                 |          |                              |          |                |          |
| 6/04 | 13               | 12       | 10                       | 2        | 3               | 10       |                              |          |                |          |
| 6/05 | 8                | 9        | 5                        | 3        | 3               | 6        |                              |          |                |          |
| 6/06 | 13               | 16       | 10                       | 4        | 3               | 12       |                              |          |                |          |
| 6/07 | 11               | 14       |                          |          | 11              | 14       |                              |          |                |          |
| 6/08 | 9                | 14       |                          |          | 9               | 14       |                              |          |                |          |
| 6/09 | 8                | 9        |                          |          | 8               | 9        |                              |          |                |          |
| 6/10 | 6                | 7        | 5                        | 2        | 1               | 5        |                              |          |                |          |
| 6/11 | 2                | 3        |                          |          | 2               | 3        |                              |          |                |          |
| 6/12 | 2                | 1        | 2                        |          |                 | 1        |                              |          |                |          |
| 6/13 | 1                | 7        |                          | 4        | 1               | 3        |                              |          |                |          |
| 6/14 | 1                | 3        |                          |          | 1               | 3        |                              |          |                |          |
| 6/15 |                  | 1        |                          |          |                 | 1        |                              |          |                |          |
| 6/17 | 7                | 6        | 4                        | 2        | 3               | 4        |                              |          |                |          |
| 6/18 | 3                | 8        |                          |          | 3               | 8        |                              |          |                |          |
| 6/19 | 2                | 3        |                          |          | 2               | 3        |                              |          |                |          |
| 6/20 | 1                | 3        |                          |          | 1               | 3        |                              |          |                |          |
| 6/21 | 1                | 4        |                          |          | 1               | 4        |                              |          |                |          |
| 6/22 |                  | 2        |                          |          |                 | 2        |                              |          |                |          |
| 6/23 |                  | 1        |                          |          |                 | 1        |                              |          |                |          |
| 6/25 |                  | 1        |                          |          |                 | 1        |                              |          |                |          |
| 6/26 |                  | 5        |                          | 1        |                 | 4        |                              |          |                |          |
| 6/27 | 4                |          |                          |          | 4               |          |                              |          |                |          |
| 6/30 | 7                | 4        |                          |          | 7               | 4        |                              |          |                |          |
| 7/01 | 2                | 2        |                          | 2        | 2               |          |                              |          |                |          |
| 7/02 | 3                | 4        |                          |          | 3               | 4        |                              |          |                |          |
| 7/03 | 2                |          |                          |          | 2               |          |                              |          |                |          |
| 7/04 | 1                | 1        |                          |          | 1               | 1        |                              |          |                |          |
| 7/05 | 7                | 1        |                          |          | 7               | 1        |                              |          |                |          |
| 7/06 | 1                |          |                          |          | 1               |          |                              |          |                |          |
| 7/07 |                  | 2        |                          |          |                 | 2        |                              |          |                |          |
| 7/08 | 1                | 1        |                          |          | 1               | 1        |                              |          |                |          |
| 7/09 |                  | 1        |                          |          |                 | 1        |                              |          |                |          |
| 7/10 |                  | 1        |                          | 1        |                 |          |                              |          |                |          |
| 7/12 | 1                |          |                          |          | 1               |          |                              |          |                |          |

<sup>a</sup> Fin clipped strays are killed outright at the trap.

Appendix B (continued). Spring Chinook salmon captured, collected, or passed upstream at the Tucannon Hatchery trap in 2013. (Trapping began in February; last day of trapping was September 30).

| Date                           | Captured in Trap |            | Collected for Broodstock |           | Passed Upstream |            | Killed Outright <sup>a</sup> |          | Trap Mortality |          |
|--------------------------------|------------------|------------|--------------------------|-----------|-----------------|------------|------------------------------|----------|----------------|----------|
|                                | Natural          | Hatchery   | Natural                  | Hatchery  | Natural         | Hatchery   | Natural                      | Hatchery | Natural        | Hatchery |
| 7/23                           |                  | 1          |                          |           |                 |            |                              |          |                | 1        |
| 7/26                           |                  | 1          |                          | 1         |                 |            |                              |          |                |          |
| 7/30                           | 1                |            | 1                        |           |                 |            |                              |          |                |          |
| 8/05                           | 2                | 1          | 2                        | 1         |                 |            |                              |          |                |          |
| 8/07                           | 1                |            | 1                        |           |                 |            |                              |          |                |          |
| 8/13                           | 2                | 1          | 2                        |           |                 |            |                              |          | 1              |          |
| 8/16                           | 3                |            | 3                        |           |                 |            |                              |          |                |          |
| 8/19                           | 1                |            | 1                        |           |                 |            |                              |          |                |          |
| 8/26                           | 2                |            | 2                        |           |                 |            |                              |          |                |          |
| 8/28                           | 3                |            |                          |           |                 | 3          |                              |          |                |          |
| 8/30                           | 2                |            |                          |           |                 | 2          |                              |          |                |          |
| 9/03                           | 4                | 2          |                          | 2         |                 | 4          |                              |          |                |          |
| 9/05                           | 1                |            |                          |           |                 | 1          |                              |          |                |          |
| 9/06                           | 3                | 7          |                          | 2         |                 | 3          |                              | 5        |                |          |
| 9/07                           | 2                |            |                          |           |                 | 2          |                              |          |                |          |
| 9/08                           | 3                | 2          |                          |           |                 | 3          |                              | 2        |                |          |
| 9/09                           | 1                | 4          |                          | 1         |                 | 1          |                              | 3        |                |          |
| 9/10                           | 1                |            |                          |           |                 | 1          |                              |          |                |          |
| 9/11                           | 4                | 3          |                          |           |                 | 4          |                              | 3        |                |          |
| 9/12                           | 8                |            |                          |           |                 | 8          |                              |          |                |          |
| 9/13                           | 3                | 1          |                          |           |                 | 3          |                              |          | 1              |          |
| 9/15                           | 1                |            |                          |           |                 | 1          |                              |          |                |          |
| 9/19                           | 3                |            |                          |           |                 | 3          |                              |          |                |          |
| 9/21                           | 1                |            |                          |           |                 | 1          |                              |          |                |          |
| <b>Total</b>                   | <b>269</b>       | <b>270</b> | <b>96</b>                | <b>62</b> | <b>173</b>      | <b>206</b> | <b>0</b>                     | <b>2</b> | <b>0</b>       | <b>0</b> |
| <b>Final Total<sup>b</sup></b> | <b>271</b>       | <b>268</b> | <b>98</b>                | <b>60</b> | <b>173</b>      | <b>206</b> | <b>0</b>                     | <b>2</b> | <b>0</b>       | <b>0</b> |

<sup>a</sup> Fin clipped strays are killed outright at the trap.

<sup>b</sup> Corrected numbers after spawning.

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**Appendix C: Age Composition by Brood Year for  
Tucannon River Spring Chinook Salmon  
(1985-2008 BYs)**

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**Appendix C. Age composition by brood year for natural and hatchery origin Tucannon River spring Chinook salmon (1985-2008 BYs). (Number at age is found in Tables 22 and 23).**

| <b>Brood<br/>Year</b> | <b>Natural origin</b> |                |                | <b>Hatchery origin</b> |                |                |
|-----------------------|-----------------------|----------------|----------------|------------------------|----------------|----------------|
|                       | <b>% Age 3</b>        | <b>% Age 4</b> | <b>% Age 5</b> | <b>% Age 3</b>         | <b>% Age 4</b> | <b>% Age 5</b> |
| 1985                  | 4.85                  | 65.05          | 30.10          | 42.22                  | 57.78          | 0.00           |
| 1986                  | 0.43                  | 80.34          | 19.23          | 25.38                  | 69.11          | 5.50           |
| 1987                  | 0.00                  | 70.17          | 29.83          | 10.64                  | 80.32          | 9.04           |
| 1988                  | 0.57                  | 63.57          | 35.86          | 22.25                  | 65.84          | 11.91          |
| 1989                  | 7.59                  | 75.95          | 16.46          | 6.17                   | 86.83          | 7.00           |
| 1990                  | 8.51                  | 76.60          | 14.89          | 21.43                  | 71.43          | 7.14           |
| 1991                  | 0.00                  | 71.43          | 28.57          | 20.00                  | 80.00          | 0.00           |
| 1992                  | 1.02                  | 82.14          | 16.84          | 13.41                  | 81.71          | 4.88           |
| 1993                  | 0.98                  | 62.25          | 36.76          | 7.25                   | 84.06          | 8.70           |
| 1994                  | 0.00                  | 83.33          | 16.67          | 11.76                  | 73.53          | 14.71          |
| 1995                  | 0.00                  | 16.67          | 83.33          | 8.99                   | 88.76          | 2.25           |
| 1996                  | 0.00                  | 91.30          | 8.70           | 22.10                  | 72.66          | 5.24           |
| 1997                  | 1.75                  | 87.98          | 10.26          | 7.18                   | 92.82          | 0.00           |
| 1998                  | 2.31                  | 66.58          | 31.11          | 12.44                  | 68.72          | 18.84          |
| 1999                  | 6.38                  | 87.94          | 5.67           | 33.33                  | 57.58          | 9.09           |
| 2000                  | 0.67                  | 87.89          | 11.43          | 16.56                  | 83.44          | 0.00           |
| 2001                  | 0.00                  | 96.31          | 3.69           | 15.20                  | 84.00          | 0.80           |
| 2002                  | 1.49                  | 61.39          | 37.13          | 5.00                   | 81.67          | 13.33          |
| 2003                  | 4.05                  | 66.47          | 29.48          | 2.82                   | 91.55          | 5.63           |
| 2004                  | 2.01                  | 88.22          | 9.77           | 15.00                  | 81.67          | 3.33           |
| 2005                  | 17.73                 | 80.51          | 1.76           | 42.05                  | 57.95          | 0.00           |
| 2006                  | 6.74                  | 80.77          | 12.49          | 35.80                  | 60.55          | 3.65           |
| 2007                  | 6.70                  | 74.51          | 18.79          | 27.41                  | 63.33          | 9.26           |
| 2008                  | 9.60                  | 78.31          | 12.09          | 40.39                  | 58.71          | 0.90           |
| <b>Means</b>          | <b>5.20</b>           | <b>78.17</b>   | <b>16.63</b>   | <b>24.63</b>           | <b>69.11</b>   | <b>6.26</b>    |

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**Appendix D: Total Estimated Run-Size of Tucannon  
River Spring Chinook Salmon (1985-2013)**

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**Appendix D. Total estimated run-size of spring Chinook salmon to the Tucannon River, 1985-2013. (Includes breakdown of conventional hatchery supplementation, captive brood progeny and stray hatchery components).**

| Year | Natural<br>Jacks | Natural<br>Adults | Hatchery<br>Jacks | Hatchery<br>Adults | C.B.<br>Jacks | C.B.<br>Adults | Stray<br>Jacks | Stray<br>Adults | Total<br>Natural | Total<br>Hatchery | Total<br>Run |
|------|------------------|-------------------|-------------------|--------------------|---------------|----------------|----------------|-----------------|------------------|-------------------|--------------|
| 1985 | ---              | ---               | ---               | ---                | ---           | ---            | ---            | ---             | 591              | 0                 | 591          |
| 1986 | ---              | ---               | ---               | ---                | ---           | ---            | ---            | ---             | 636              | 0                 | 636          |
| 1987 | ---              | ---               | ---               | ---                | ---           | ---            | ---            | ---             | 582              | 0                 | 582          |
| 1988 | 19               | 391               | 19                | ---                | ---           | ---            | ---            | ---             | 410              | 19                | 429          |
| 1989 | 2                | 334               | 83                | 26                 | ---           | ---            | ---            | ---             | 336              | 109               | 445          |
| 1990 | 0                | 494               | 20                | 226                | ---           | ---            | 0              | 14              | 494              | 260               | 754          |
| 1991 | 3                | 257               | 99                | 169                | ---           | ---            | 0              | 0               | 260              | 268               | 528          |
| 1992 | 12               | 406               | 15                | 310                | ---           | ---            | 0              | 10              | 418              | 335               | 753          |
| 1993 | 8                | 309               | 6                 | 264                | ---           | ---            | 0              | 2               | 317              | 272               | 589          |
| 1994 | 0                | 98                | 5                 | 37                 | ---           | ---            | 0              | 0               | 98               | 42                | 140          |
| 1995 | 2                | 19                | 11                | 22                 | ---           | ---            | 0              | 0               | 21               | 33                | 54           |
| 1996 | 2                | 163               | 15                | 67                 | ---           | ---            | 0              | 3               | 165              | 85                | 250          |
| 1997 | 0                | 160               | 4                 | 178                | ---           | ---            | 0              | 9               | 160              | 191               | 351          |
| 1998 | 0                | 85                | 16                | 43                 | ---           | ---            | 0              | 0               | 85               | 59                | 144          |
| 1999 | 0                | 3                 | 59                | 163                | ---           | ---            | 5              | 15              | 3                | 242               | 245          |
| 2000 | 14               | 68                | 13                | 198                | ---           | ---            | 5              | 41              | 82               | 257               | 339          |
| 2001 | 9                | 709               | 99                | 182                | ---           | ---            | 13             | 0               | 718              | 294               | 1,012        |
| 2002 | 9                | 341               | 11                | 547                | ---           | ---            | 0              | 97              | 350              | 655               | 1,005        |
| 2003 | 3                | 245               | 26                | 169                | ---           | ---            | 1              | 0               | 248              | 196               | 444          |
| 2004 | 0                | 400               | 19                | 134                | 3             | 0              | 0              | 17              | 400              | 173               | 573          |
| 2005 | 3                | 286               | 6                 | 105                | 0             | 14             | 2              | 4               | 289              | 131               | 420          |
| 2006 | 7                | 133               | 2                 | 99                 | 2             | 2              | 0              | 8               | 140              | 113               | 253          |
| 2007 | 8                | 190               | 18                | 81                 | 0             | 19             | 15             | 13              | 198              | 146               | 344          |
| 2008 | 131              | 403               | 291               | 102                | 158           | 82             | 23             | 1               | 534              | 657               | 1,191        |
| 2009 | 116              | 634               | 402               | 405                | 92            | 196            | 13             | 4               | 750              | 1,112             | 1,862        |
| 2010 | 41               | 1,403             | 74                | 680                | 0             | 306            | 4              | 17              | 1,444            | 1,081             | 2,525        |
| 2011 | 85               | 671               | 269               | 212                | 0             | 27             | 12             | 24              | 756              | 544               | 1,300        |
| 2012 | 7                | 808               | 8                 | 387                | ---           | ---            | 0              | 29              | 815              | 424               | 1,239        |
| 2013 | 91               | 661               | 66                | 297                | ---           | ---            | 2              | 0               | 752              | 365               | 1,117        |



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**Appendix E: Stray Hatchery-Origin Spring Chinook  
Salmon in the Tucannon River (1990-2013)**

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**Appendix E. Summary of identified stray hatchery origin spring Chinook salmon that escaped into the Tucannon River (1990-2013).**

| Year                | CWT Code or Fin clip | Agency | Origin (stock)      | Release Location / Release River | Number Observed/ Expanded <sup>a</sup> | % of Tuc. Run |
|---------------------|----------------------|--------|---------------------|----------------------------------|--|---------------|
| 1990                | 074327               | ODFW   | Carson (Wash.)      | Meacham Cr./Umatilla River       | 2 / 5                                  | <b>1.9</b>    |
|                     | 074020               | ODFW   | Rapid River         | Lookingglass Cr./Grande Ronde    | 1 / 2                                  |               |
|                     | 232227               | NMFS   | Mixed Col.          | Columbia River/McNary Dam        | 2 / 5                                  |               |
|                     | 232228               | NMFS   | Mixed Col.          | Columbia River/McNary Dam        | 1 / 2                                  |               |
| <b>Total Strays</b> |                      |        |                     |                                  | <b>14</b>                              |               |
| 1992                | 075107               | ODFW   | Lookingglass Cr.    | Bonifer Pond/Umatilla River      | 2 / 6                                  | <b>1.3</b>    |
|                     | 075111               | ODFW   | Lookingglass Cr.    | Meacham Cr./Umatilla River       | 1 / 2                                  |               |
|                     | 075063               | ODFW   | Lookingglass Cr.    | Meacham Cr./Umatilla River       | 1 / 2                                  |               |
| <b>Total Strays</b> |                      |        |                     |                                  | <b>10</b>                              |               |
| 1993                | 075110               | ODFW   | Lookingglass Cr.    | Meacham Cr./Umatilla River       | 1 / 2                                  | <b>0.3</b>    |
|                     | <b>Total Strays</b>  |        |                     |                                  |  |               |
| 1996                | 070251               | ODFW   | Carson (Wash.)      | Imeqes AP/Umatilla River         | 1 / 1                                  | <b>1.3</b>    |
|                     | LV clip              | ODFW   | Carson (Wash.)      | Imeqes AP/Umatilla River         | 1 / 2                                  |               |
| <b>Total Strays</b> |                      |        |                     |                                  | <b>3</b>                               |               |
| 1997                | 103042               | IDFG   | South Fork Salmon   | Knox Bridge/South Fork Salmon    | 1 / 2                                  | <b>2.6</b>    |
|                     | 103518               | IDFG   | Powell              | Powell Rearing Ponds/Lochsa R.   | 1 / 2                                  |               |
|                     | RV clip              | ODFW   | Carson (Wash.)      | Imeqes AP/Umatilla River         | 3 / 5                                  |               |
| <b>Total Strays</b> |                      |        |                     |                                  | <b>9</b>                               |               |
| 1999                | 091751               | ODFW   | Carson (Wash.)      | Imeqes AP/Umatilla River         | 2 / 3                                  | <b>8.2</b>    |
|                     | 092258               | ODFW   | Carson (Wash.)      | Imeqes AP/Umatilla River         | 1 / 1                                  |               |
|                     | 104626               | UI     | Eagle Creek NFH     | Eagle Creek NFH/Clackamas R.     | 1 / 1                                  |               |
|                     | LV clip              | ODFW   | Carson (Wash.)      | Imeqes AP/Umatilla River         | 2 / 2                                  |               |
|                     | RV clip              | ODFW   | Carson (Wash.)      | Imeqes AP/Umatilla River         | 8 / 13                                 |               |
| <b>Total Strays</b> |                      |        |                     |                                  | <b>20</b>                              |               |
| 2000                | 092259               | ODFW   | Carson (Wash.)      | Imeqes AP/Umatilla River         | 4 / 4                                  | <b>13.6</b>   |
|                     | 092260               | ODFW   | Carson (Wash.)      | Imeqes AP/Umatilla River         | 1 / 1                                  |               |
|                     | 092262               | ODFW   | Carson (Wash.)      | Imeqes AP/Umatilla River         | 1 / 3                                  |               |
|                     | 105137               | IDFG   | Powell              | Walton Creek/Lochsa R.           | 1 / 3                                  |               |
|                     | 636330               | WDFW   | Klickitat (Wash.)   | Klickitat Hatchery               | 1 / 1                                  |               |
|                     | 636321               | WDFW   | Lyons Ferry (Wash.) | Lyons Ferry/Snake River          | 1 / 1                                  |               |
|                     | LV clip              | ODFW   | Carson (Wash.)      | Imeqes AP/Umatilla River         | 18 / 31                                |               |
|                     | Ad clip              | ODFW   | Carson (Wash.)      | Imeqes AP/Umatilla River         | 2 / 2                                  |               |
| <b>Total Strays</b> |                      |        |                     |                                  | <b>46</b>                              |               |
| 2001                | 076040               | ODFW   | Umatilla R.         | Umatilla Hatch./Umatilla River   | 1/7                                    | <b>1.3</b>    |
|                     | 092828               | ODFW   | Imnaha R. & Tribs.  | Lookingglass/Imnaha River        | 1/3                                    |               |
|                     | 092829               | ODFW   | Imnaha R. & Tribs.  | Lookingglass/Imnaha River        | 1/3                                    |               |
| <b>Total Strays</b> |                      |        |                     |                                  | <b>13</b>                              |               |

<sup>a</sup> The expansion is based on subsample rates of the proportion of stray carcasses to Tucannon River origin carcasses from the river. Actual counts are not expanded.

**Appendix E (continued). Summary of identified stray hatchery origin spring Chinook salmon that escaped into the Tucannon River (1990-2013).**

| Year | CWT Code or Fin clip | Agency  | Origin (stock)       | Release Location / Release River | Number Observed/Expanded <sup>a</sup> | % of Tuc. Run |
|------|----------------------|---------|----------------------|----------------------------------|---------------------------------------|---------------|
| 2002 | 054208               | USFWS   | Dworshak             | Dworshak NFH/Clearwater R.       | 1/29                                  |               |
|      | 076039               | ODFW    | Umatilla R.          | Umatilla Hatch./Umatilla River   | 1/8                                   |               |
|      | 076040               | ODFW    | Umatilla R.          | Umatilla Hatch./Umatilla River   | 2/16                                  |               |
|      | 076041               | ODFW    | Umatilla R.          | Umatilla Hatch./Umatilla River   | 2/16                                  |               |
|      | 076049               | ODFW    | Umatilla R.          | Umatilla Hatch./Umatilla River   | 1/8                                   |               |
|      | 076051               | ODFW    | Umatilla R.          | Umatilla Hatch./Umatilla River   | 1/8                                   |               |
|      | 076138               | ODFW    | Umatilla R.          | Umatilla Hatch./Umatilla River   | 1/8                                   |               |
|      | 105412               | IDFG    | Powell               | Clearwater Hatch./Powell Ponds   | 1/4                                   |               |
|      |                      |         | <b>Total Strays</b>  | <b>97</b>                        | <b>9.7</b>                            |               |
| 2003 | 100472               | IDFG    | Salmon R.            | Sawtooth Hatch./Nature's Rear.   | 1/1                                   |               |
|      |                      |         |                      | <b>Total Strays</b>              | <b>1</b>                              | <b>0.2</b>    |
| 2004 | Ad clip              | Unknown | Unknown              | Unknown                          | 6/17                                  |               |
|      |                      |         |                      | <b>Total Strays</b>              | <b>17</b>                             | <b>3.0</b>    |
| 2005 | Ad clip              | Unknown | Unknown              | Unknown                          | 3/6                                   |               |
|      |                      |         |                      | <b>Total Strays</b>              | <b>6</b>                              | <b>1.4</b>    |
| 2006 | 109771               | IDFG    | Sum. Ch. - S Fk Sal. | McCall Hatch./S. Fk. Salmon R.   | 1/1                                   |               |
|      | 093859               | ODFW    | Umatilla R.          | Umatilla Hatch./Umatilla River   | 1/1                                   |               |
|      | Ad clip              | Unknown | Unknown              | Unknown                          | 3/6                                   |               |
|      |                      |         |                      | <b>Total Strays</b>              | <b>8</b>                              | <b>3.2</b>    |
| 2007 | 092043               | ODFW    | Rogue R. – Cole H.   | Cole Rivers Hatchery/Rogue R.    | 1/1                                   |               |
|      | Ad clip              | Unknown | Unknown              | Unknown                          | 9/27                                  |               |
|      |                      |         |                      | <b>Total Strays</b>              | <b>28</b>                             | <b>8.1</b>    |
| 2008 | 092045               | ODFW    | Rogue R. – Cole H.   | Cole Rivers Hatchery/Rogue R.    | 1/1                                   |               |
|      | 094358               | ODFW    | Grande Ronde R.      | Lookingglass/Grande Ronde R.     | 1/11                                  |               |
|      | 094460               | ODFW    | Umatilla R.          | Umatilla Hatch./Umatilla River   | 1/11                                  |               |
|      | Ad clip              | Unknown | Unknown              | Unknown                          | 1/1                                   |               |
|      |                      |         |                      | <b>Total Strays</b>              | <b>24</b>                             | <b>2.0</b>    |
| 2009 | 092043               | ODFW    | Rogue R.             | Cole Rivers Hatch./Rogue R.      | 1/3                                   |               |
|      | 094532               | ODFW    | Imnaha R.            | Lookingglass Hatch./Imnaha R.    | 1/3                                   |               |
|      | 094538               | ODFW    | Lostine R.           | Lookingglass/Lostine R.          | 2/4                                   |               |
|      | 100181               | IDFG    | Salmon R. Sum. Ck.   | Knox Bridge/S. Fork Salmon       | 1/1                                   |               |
|      | Ad clip              | Unknown | Unknown              | Unknown                          | 6/6                                   |               |
|      |                      |         |                      | <b>Total Strays</b>              | <b>17</b>                             | <b>0.9</b>    |
| 2010 | 092737               | ODFW    | Umatilla R.          | Umatilla Hatch./Umatilla River   | 1/6                                   |               |
|      | 094351               | ODFW    | Lostine R.           | Lookingglass/Lostine R.          | 1/6                                   |               |
|      | Ad clip              | Unknown | Unknown              | Unknown                          | 9/9                                   |               |
|      |                      |         |                      | <b>Total Strays</b>              | <b>21</b>                             | <b>0.8</b>    |
| 2011 | 054685               | USFWS   | Dworshak             | Dworshak Hatchery                | 1/1                                   |               |
|      | 094591               | ODFW    | Catherine Ck.        | Lookingglass Hatchery            | 2/2                                   |               |
|      | 094593               | ODFW    | Lookingglass Ck.     | Lookingglass Hatchery            | 1/1                                   |               |
|      | 094665               | ODFW    | Lostine R.           | Lookingglass Hatchery            | 1/6                                   |               |
|      | 101381               | IDFG    | Clear Ck.            | Clearwater Hatchery/Powell       | 1/6                                   |               |
|      | 102380               | IDFG    | S.F. Clearwater      | Clearwater Hatchery              | 1/6                                   |               |
|      | 105081               | IDFG    | Selway R.            | Clearwater Hatchery/Powell       | 1/6                                   |               |
|      | Ad clip              | Unknown | Unknown              | Unknown                          | 3/8                                   |               |
|      |                      |         |                      | <b>Total Strays</b>              | <b>36</b>                             | <b>2.8</b>    |

<sup>a</sup> The expansion is based on subsample rates of the proportion of stray carcasses to Tucannon River origin carcasses from the river. Actual counts are not expanded.

**Appendix E (continued). Summary of identified stray hatchery origin spring Chinook salmon that escaped into the Tucannon River (1990-2013).**

| <b>Year</b> | <b>CWT Code or Fin clip</b> | <b>Agency</b> | <b>Origin (stock)</b> | <b>Release Location / Release River</b> | <b>Number Observed/ Expanded<sup>a</sup></b> | <b>% of Tuc. Run</b> |
|-------------|-----------------------------|---------------|-----------------------|---|--|----------------------|
| 2012        | Ad clip                     | Unknown       | Unknown               | Unknown                                 | 9/29   |                      |
|             |                             |               |                       | <b>Total Strays</b>                     | <b>29</b>                                    | <b>2.3</b>           |
| 2013        | Ad clip                     | Unknown       | Unknown               | Unknown                                 | 2/2  |                      |
|             |                             |               |                       | <b>Total Strays</b>                     | <b>2</b>                                     | <b>0.2</b>           |

<sup>a</sup> The expansion is based on subsample rates of the proportion of stray carcasses to Tucannon River origin carcasses from the river. Actual counts are not expanded.

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## **Appendix F: Final PIT Tag Detections of Returning Tucannon River Spring Chinook**

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**Appendix F. Final PIT tag detections of returning Tucannon River spring Chinook from fish originally tagged as juveniles from the Tucannon River.**

| PIT Tag ID     | Release Data |             |              | Adult Return Final Detection Data <sup>a</sup> |          |             |          |
|----------------|--------------|-------------|--------------|--|----------|-------------|----------|
|                | Origin       | Length (mm) | Release Date | OBS  | OBS Date | Travel Time | Est. Age |
| 1F4E71071B     | H            | 169         | 3/20/95      | LGR  | 8/03/95  | 136.0       | 2        |
| 5042423B61     | H            | 139         | 3/25/97      | LGR  | 5/29/99  | 795.1       | 4        |
| 50470F3608     | H            | 142         | 3/25/97      | LGR  | 6/17/99  | 813.7       | 4        |
| 517D1E0552     | W            | 112         | 4/22/99      | BON  | 4/17/01  | 726.2       | 4        |
| 5202622F42     | W            | 110         | 4/22/99      | BON  | 4/19/01  | 728.1       | 4        |
| 517D1A197C     | W            | 118         | 4/22/99      | LGR  | 4/21/01  | 730.0       | 4        |
| 5176172874     | W            | 108         | 4/29/99      | LGR  | 4/29/01  | 730.8       | 4        |
| 5200712827     | W            | 103         | 4/29/99      | LGR  | 5/12/02  | 1109.2      | 5        |
| 5177201601     | H            | 151         | 5/6/99       | LGR  | 5/31/01  | 755.9       | 4        |
| 517D22216B     | H            | 137         | 5/12/99      | LGR  | 5/15/01  | 734.3       | 4        |
| 3D9.1BF1693290 | H            | 130         | 5/07/02      | LGR  | 5/23/04  | 747         | 4        |
| 3D9.1BF1677795 | W            | 117         | 4/29/02      | LGR  | 5/19/04  | 750.7       | 4        |
| 3D9.1BF16876C6 | W            | 105         | 4/30/02      | ICH  | 5/04/05  | 1100.4      | 5        |
| 3D9.1BF167698F | W            | 96          | 5/02/02      | ICH  | 5/03/05  | 1097.1      | 5        |
| 3D9.1BF12F6891 | H            | 136         | 4/21/03      | ICH  | 5/09/04  | 392.0       | 3        |
| 3D9.1BF12F7182 | H            | 115         | 4/21/03      | ICH  | 5/19/04  | 396.1       | 3        |
| 3D9.1BF149E5EA | H            | 126         | 4/21/03      | MCN  | 5/05/05  | 751.2       | 4        |
| 3D9.1BF1A2EF4B | W            | 104         | 12/07/05     | LGR  | 6/16/08  | 921.9       | 5        |
| 3D9.257C5B558A | H            | 125         | 4/26/06      | ICH  | 6/16/08  | 782.2       | 4        |
| 3D9.257C5A0975 | W            | 113         | 11/20/06     | MCN  | 5/29/09  | 920.7       | 5        |
| 3D9.1BF26E119D | H            | 170         | 4/12/07      | LTR  | 5/22/08  | 405.8       | 3        |
| 3D9.257C6C4BAD | CB           | 142         | 4/12/07      | ICH  | 5/15/08  | 398.9       | 3        |
| 3D9.257C6C1B20 | CB           | 148         | 4/12/07      | LTR  | 5/31/08  | 414.7       | 3        |
| 3D9.257C6C57DF | CB           | 125         | 4/12/07      | ICH  | 5/31/08  | 415.3       | 3        |
| 3D9.1BF26D36B8 | W            | 114         | 4/24/07      | LTR  | 5/09/08  | 381.5       | 3        |
| 3D9.1BF26D389C | W            | 114         | 4/24/07      | LTR  | 5/27/08  | 400.1       | 3        |
| 3D9.1BF26DB184 | W            | 106         | 4/24/07      | BON  | 5/02/09  | 738.9       | 4        |
| 3D9.1BF26DB741 | W            | 118         | 4/24/07      | ICH  | 5/10/09  | 747.3       | 4        |
| 3D9.1BF26DA2CB | W            | 103         | 4/23/07      | ICH  | 5/10/09  | 748.4       | 4        |
| 3D9.1BF26D340D | W            | 102         | 4/16/07      | ICH  | 5/06/09  | 751.3       | 4        |
| 3D9.1BF26D39F9 | W            | 110         | 4/24/07      | ICH  | 5/15/09  | 752.1       | 4        |
| 3D9.1BF26D693A | H            | 144         | 4/12/07      | ICH  | 5/08/09  | 757.0       | 4        |
| 3D9.1BF26DFD75 | H            | 112         | 4/12/07      | MCN  | 5/11/09  | 760.0       | 4        |
| 3D9/257C6C514A | CB           | 125         | 4/12/07      | ICH  | 5/17/09  | 766.2       | 4        |
| 3D9.1BF26DF8E5 | W            | 118         | 4/02/07      | ICH  | 5/09/09  | 768.3       | 4        |
| 3D9.1BF26DEE22 | W            | 115         | 4/15/07      | MCN  | 5/24/09  | 769.3       | 4        |

Abbreviations are as follows: BON – Bonneville Dam, TDA – The Dalles Dam, MCN – McNary Dam, ICH – Ice Harbor Dam, LTR – Lower Tucannon River, MTR – Middle Tucannon River, UTR – Upper Tucannon River, LGO – Little Goose Dam, LGR – Lower Granite Dam, AFC – Asotin Creek.

<sup>a</sup> PIT tag adult detection systems were in operation beginning in 1988 for LGR, 1998 for BON, 2002 for MCN, 2005 for both ICH and LTR, 2011 for MTR and UTR, and 2012 for TFH.

**Appendix F (continued). Final PIT tag detections of returning Tucannon River spring Chinook from fish originally tagged as juveniles from the Tucannon River.**

| PIT Tag ID     | Release Data |             |              | Adult Return Final Detection Data <sup>a</sup> |          |             |          |
|----------------|--------------|-------------|--------------|--|----------|-------------|----------|
|                | Origin       | Length (mm) | Release Date | OBS  | OBS Date | Travel Time | Est. Age |
| 3D9.257C59FC64 | W            | 116         | 3/22/07      | ICH  | 5/17/09  | 786.9       | 4        |
| 3D9.257C5BF3CB | W            | 95          | 1/16/07      | BON  | 4/11/09  | 816.0       | 4        |
| 3D9.1BF27DF007 | H            | ---         | 4/15/08      | LTR <sup>b</sup>                               | 7/08/08  | 84.2        | 2        |
| 3D9.1BF27E6923 | H            | ---         | 4/15/08      | MCN  | 5/11/09  | 390.7       | 3        |
| 3D9.1BF27E6615 | H            | ---         | 4/15/08      | ICH  | 5/12/09  | 392.0       | 3        |
| 3D9.1BF27E396B | H            | 144         | 4/15/08      | ICH  | 5/14/09  | 394.0       | 3        |
| 3D9.1BF27E5152 | H            | ---         | 4/15/08      | MCN  | 5/14/09  | 394.0       | 3        |
| 3D9.1BF27DFA43 | H            | 136         | 4/15/08      | ICH  | 5/14/09  | 394.2       | 3        |
| 3D9.1BF27E45D5 | H            | ---         | 4/15/08      | BON  | 5/14/09  | 394.3       | 3        |
| 3D9.1BF27E5420 | H            | ---         | 4/15/08      | ICH  | 5/15/09  | 395.2       | 3        |
| 3D9.1BF27DC33A | H            | ---         | 4/15/08      | MCN  | 5/16/09  | 395.3       | 3        |
| 3D9.1C2C4A2C09 | CB           | ---         | 4/15/08      | ICH  | 5/16/09  | 396.2       | 3        |
| 3D9.1BF27E0BF9 | H            | 174         | 4/15/08      | ICH  | 5/20/09  | 400.0       | 3        |
| 3D9.1BF27E4A9A | H            | ---         | 4/15/08      | BON  | 5/21/09  | 401.0       | 3        |
| 3D9.1BF27DDDE3 | H            | 125         | 4/15/08      | ICH  | 5/21/09  | 401.1       | 3        |
| 3D9.1BF27E5F9D | H            | ---         | 4/15/08      | MCN  | 5/23/09  | 403.0       | 3        |
| 3D9.1C2C4A17EF | CB           | ---         | 4/15/08      | ICH  | 5/29/09  | 409.0       | 3        |
| 3D9.1C2C4AC01A | CB           | ---         | 4/15/08      | ICH  | 5/13/09  | 393.1       | 3        |
| 3D9.1BF27E6750 | H            | ---         | 4/15/08      | LGR  | 6/07/09  | 417.8       | 3        |
| 3D9.1BF27E0B48 | H            | ---         | 4/15/08      | LGR  | 6/19/09  | 429.8       | 3        |
| 3D9.1BF27E335D | H            | 112         | 4/15/08      | LGR  | 6/21/09  | 431.9       | 3        |
| 3D9.1BF27DEBAF | H            | ---         | 4/15/08      | ICH  | 5/30/09  | 409.8       | 3        |
| 3D9.1BF27DE680 | H            | 209         | 4/15/08      | ICH  | 5/13/09  | 393.3       | 3        |
| 3D9.1BF27C49AC | W            | 120         | 4/02/08      | ICH  | 6/10/09  | 434.0       | 3        |
| 3D9.1BF27C15D9 | W            | 103         | 4/07/08      | BON  | 4/29/10  | 751.5       | 4        |
| 3D9.1BF27C3C06 | W            | 112         | 3/31/08      | MCN  | 4/26/10  | 755.8       | 4        |
| 3D9.1BF27C3C7F | W            | 108         | 4/11/08      | ICH  | 5/13/10  | 762.2       | 4        |
| 3D9.1BF27C4002 | W            | 121         | 3/31/08      | ICH  | 6/15/10  | 806.2       | 4        |
| 3D9.1BF27C43BD | W            | 104         | 3/31/08      | LTR  | 5/06/10  | 766.0       | 4        |
| 3D9.1BF27C47C9 | W            | 120         | 4/30/08      | LTR  | 4/11/10  | 711.6       | 4        |
| 3D9.1BF27C4C13 | W            | 113         | 4/08/08      | LTR  | 4/27/10  | 746.8       | 4        |
| 3D9.1BF27C5838 | W            | 120         | 4/04/08      | ICH  | 5/06/10  | 762.2       | 4        |
| 3D9.1BF27C6137 | W            | 105         | 4/20/08      | LTR  | 5/01/10  | 740.7       | 4        |
| 3D9.1BF27C67B1 | W            | 105         | 4/26/08      | ICH  | 5/12/10  | 746.1       | 4        |
| 3D9.1BF27C681F | W            | 105         | 3/31/08      | ICH  | 4/30/10  | 760.1       | 4        |
| 3D9.1BF27CEC4F | W            | 106         | 4/14/08      | LGR  | 5/14/10  | 760.0       | 4        |

Abbreviations are as follows: BON – Bonneville Dam, TDA – The Dalles Dam, MCN – McNary Dam, ICH – Ice Harbor Dam, LTR – Lower Tucannon River, MTR – Middle Tucannon River, UTR – Upper Tucannon River, LGO – Little Goose Dam, LGR – Lower Granite Dam, AFC – Asotin Creek.

<sup>a</sup> PIT tag adult detection systems were in operation beginning in 1988 for LGR, 1998 for BON, 2002 for MCN, 2005 for both ICH and LTR, 2011 for MTR and UTR, and 2012 for TFH.

<sup>b</sup> This fish was detected bypassing the Tucannon River (LGO or LGR detection) before heading back downstream.

**Appendix F (continued). Final PIT tag detections of returning Tucannon River spring Chinook from fish originally tagged as juveniles from the Tucannon River.**

| PIT Tag ID     | Release Data |             |              | Adult Return Final Detection Data <sup>a</sup> |          |             |          |
|----------------|--------------|-------------|--------------|--|----------|-------------|----------|
|                | Origin       | Length (mm) | Release Date | OBS  | OBS Date | Travel Time | Est. Age |
| 3D9.1BF27CF786 | W            | 109         | 4/26/08      | ICH  | 5/22/10  | 756.0       | 4        |
| 3D9.1BF27DD7AC | W            | 101         | 5/04/08      | ICH  | 5/23/10  | 736.4       | 4        |
| 3D9.1BF27DE7AE | W            | 121         | 5/28/08      | LTR  | 5/02/10  | 704.8       | 4        |
| 3D9.1BF27E114D | W            | 98          | 4/30/08      | ICH  | 5/07/10  | 736.7       | 4        |
| 3D9.1BF27E3670 | W            | 120         | 5/12/08      | ICH  | 5/05/10  | 723.1       | 4        |
| 3D9.1BF27E3A3B | W            | 105         | 5/01/08      | BON  | 4/30/10  | 728.9       | 4        |
| 3D9.1BF27E4969 | W            | 111         | 5/02/08      | ICH  | 5/18/10  | 745.7       | 4        |
| 3D9.1BF27E5ADF | W            | 108         | 4/30/08      | ICH  | 5/15/10  | 745.2       | 4        |
| 3D9.1BF27E6A2A | W            | 103         | 5/15/08      | LTR  | 5/09/10  | 724.6       | 4        |
| 3D9.1BF27E806F | W            | 119         | 5/27/08      | ICH  | 5/07/10  | 710.4       | 4        |
| 3D9.1BF27EA280 | W            | 102         | 5/04/08      | LTR  | 5/06/10  | 732.1       | 4        |
| 3D9.1BF27EC355 | W            | 111         | 5/03/08      | ICH  | 5/16/10  | 743.6       | 4        |
| 3D9.1C2C87304F | W            | 96          | 4/20/08      | BON  | 4/28/10  | 738.2       | 4        |
| 3D9.1C2C875C89 | W            | 115         | 4/18/08      | MCN  | 5/08/10  | 750.2       | 4        |
| 3D9.1C2C87D02B | W            | 110         | 4/18/08      | ICH  | 5/09/10  | 746.2       | 4        |
| 3D9.1C2C87D789 | W            | 99          | 4/20/08      | MCN  | 5/01/10  | 741.6       | 4        |
| 3D9.1C2C9CA1D0 | W            | 115         | 4/22/08      | BON  | 4/25/10  | 733.8       | 4        |
| 3D9.1C2CA9921E | W            | 109         | 4/22/08      | LGR  | 5/23/10  | 760.8       | 4        |
| 3D9.1C2CA9B076 | W            | 118         | 4/21/08      | BON  | 4/25/10  | 734.3       | 4        |
| 3D9.1BF27DBF36 | H            | ---         | 4/15/08      | LTR  | 5/09/10  | 754.0       | 4        |
| 3D9.1BF27DE0CD | H            | ---         | 4/15/08      | BON  | 4/29/10  | 744.2       | 4        |
| 3D9.1BF27E0336 | H            | ---         | 4/15/08      | ICH  | 5/15/10  | 760.3       | 4        |
| 3D9.1BF27E196E | H            | ---         | 4/15/08      | ICH  | 5/01/10  | 746.0       | 4        |
| 3D9.1BF27E3B75 | H            | ---         | 4/15/08      | ICH  | 4/22/10  | 737.2       | 4        |
| 3D9.1BF27E55A0 | H            | 135         | 4/15/08      | ICH  | 5/24/10  | 769.2       | 4        |
| 3D9.1BF27E8ADF | H            | ---         | 4/15/08      | BON  | 4/25/10  | 739.8       | 4        |
| 3D9.1BF27EBB28 | H            | 113         | 4/15/08      | LTR  | 5/26/10  | 770.6       | 4        |
| 3D9.1BF27ECB41 | H            | 124         | 4/15/08      | ICH  | 5/14/10  | 759.2       | 4        |
| 3D9.1BF27ED02D | H            | ---         | 4/15/08      | BON  | 5/09/10  | 754.2       | 4        |
| 3D9.1BF27E53AA | H            | 123         | 4/15/08      | LTR  | 6/05/10  | 781.1       | 4        |
| 3D9.1BF27E5A15 | H            | ---         | 4/15/08      | ICH  | 5/19/10  | 764.1       | 4        |
| 3D9.1BF27E9E98 | H            | ---         | 4/15/08      | MCN  | 4/23/10  | 737.8       | 4        |
| 3D9.1BF27EAC50 | H            | ---         | 4/15/08      | LTR  | 5/05/10  | 749.8       | 4        |
| 3D9.1BF27EAD0A | H            | 153         | 4/15/08      | ICH  | 5/10/10  | 755.3       | 4        |
| 3D9.1BF27E4C02 | H            | ---         | 4/15/08      | ICH  | 5/12/10  | 757.1       | 4        |
| 3D9.1BF27E172D | H            | ---         | 4/15/08      | BON  | 4/21/10  | 736.3       | 4        |

Abbreviations are as follows: BON – Bonneville Dam, TDA – The Dalles Dam, MCN – McNary Dam, ICH – Ice Harbor Dam, LTR – Lower Tucannon River, MTR – Middle Tucannon River, UTR – Upper Tucannon River, LGO – Little Goose Dam, LGR – Lower Granite Dam, AFC – Asotin Creek.

<sup>a</sup> PIT tag adult detection systems were in operation beginning in 1988 for LGR, 1998 for BON, 2002 for MCN, 2005 for both ICH and LTR, 2011 for MTR and UTR, and 2012 for TFH.



**Appendix F (continued). Final PIT tag detections of returning Tucannon River spring Chinook from fish originally tagged as juveniles from the Tucannon River.**

| PIT Tag ID     | Release Data |             |              | Adult Return Final Detection Data <sup>a</sup> |          |             |          |
|----------------|--------------|-------------|--------------|--|----------|-------------|----------|
|                | Origin       | Length (mm) | Release Date | OBS  | OBS Date | Travel Time | Est. Age |
| 3D9.1BF27E066A | H            | ---         | 4/15/08      | LGR  | 5/24/10  | 768.3       | 4        |
| 3D9.1BF27E0720 | H            | 131         | 4/15/08      | LGR  | 5/17/10  | 744.0       | 4        |
| 3D9.1BF27E0425 | H            | ---         | 4/15/08      | BON  | 4/28/10  | 743.3       | 4        |
| 3D9.1BF27E050F | H            | ---         | 4/15/08      | MCN  | 4/26/10  | 740.9       | 4        |
| 3D9.1BF27DF85C | H            | ---         | 4/15/08      | LTR  | 6/07/10  | 783.1       | 4        |
| 3D9.1BF27DEFC8 | H            | 124         | 4/15/08      | BON  | 4/23/10  | 738.1       | 4        |
| 3D9.1BF27CF491 | H            | ---         | 4/15/08      | LGR  | 5/19/10  | 764.1       | 4        |
| 3D9.1BF27DB43A | H            | 131         | 4/15/08      | ICH  | 5/05/10  | 749.8       | 4        |
| 3D9.1BF27DC0B5 | H            | 138         | 4/15/08      | LTR  | 4/30/10  | 745.3       | 4        |
| 3D9.1BF27DC33F | H            | ---         | 4/15/08      | LTR <sup>b</sup>                               | 5/08/10  | 752.8       | 4        |
| 3D9.1BF27DEB6D | H            | ---         | 4/15/08      | LTR  | 5/26/10  | 770.5       | 4        |
| 3D9.1C2C455F7C | CB           | ---         | 4/15/08      | MCN  | 5/15/10  | 759.9       | 4        |
| 3D9.1C2C48AA85 | CB           | ---         | 4/15/08      | ICH  | 5/08/10  | 752.9       | 4        |
| 3D9.1C2C4AF06C | CB           | ---         | 4/15/08      | LTR  | 5/05/10  | 750.3       | 4        |
| 3D9.1BF27C301A | W            | 98          | 4/24/08      | LTR <sup>b</sup>                               | 5/17/11  | 1118.4      | 5        |
| 3D9.1BF27C38CD | W            | 106         | 4/25/08      | LTR  | 5/14/11  | 1113.9      | 5        |
| 3D9.1BF27C3DD3 | W            | 103         | 4/17/08      | LTR  | 5/11/11  | 1119.0      | 5        |
| 3D9.1BF27C524B | W            | 110         | 4/29/08      | BON  | 4/26/11  | 1092.3      | 5        |
| 3D9.1BF27C65EB | W            | 103         | 4/27/08      | ICH  | 6/16/11  | 1145.1      | 5        |
| 3D9.1BF27CDCC9 | W            | 103         | 4/26/08      | ICH  | 5/07/11  | 1105.8      | 5        |
| 3D9.1BF27CF043 | W            | 98          | 4/01/08      | LTR  | 5/12/11  | 1135.8      | 5        |
| 3D9.1BF27E02B6 | W            | 101         | 5/03/08      | BON  | 4/30/11  | 1091.7      | 5        |
| 3D9.1C2C97ECE2 | W            | 103         | 4/23/08      | MCN  | 5/09/11  | 1111.7      | 5        |
| 3D9.1BF27E0E0D | W            | 112         | 11/17/08     | ICH  | 5/15/11  | 909.1       | 5        |
| 3D9.1BF27E4192 | W            | 113         | 12/31/08     | ICH  | 5/08/11  | 858.1       | 5        |
| 3D9.1BF27E502E | W            | 102         | 12/29/08     | AFC  | 6/20/11  | 903.3       | 5        |
| 3D9.1BF27E54F2 | W            | 111         | 11/26/08     | MCN  | 6/30/11  | 946.1       | 5        |
| 3D9.1BF27E8A96 | W            | 125         | 12/31/08     | MCN  | 6/24/11  | 905.1       | 5        |
| 3D9.1BF27EB33D | W            | 111         | 12/11/08     | ICH  | 5/24/11  | 893.2       | 5        |
| 3D9.1BF27EC294 | H            | 130         | 4/15/08      | MCN  | 5/07/11  | 1116.2      | 5        |
| 3D9.1BF27C382A | W            | 110         | 4/17/08      | LTR  | 3/27/12  | 1440.0      | 6        |
| 3D9.1C2CFD0260 | H            | ---         | 4/17/09      | LTR  | 6/20/10  | 429.4       | 3        |
| 3D9.1C2D044E4D | H            | ---         | 4/17/09      | LTR <sup>b</sup>                               | 5/30/10  | 408.5       | 3        |
| 3D9.1C2D03EA21 | H            | ---         | 4/17/09      | ICH  | 5/18/10  | 396.1       | 3        |
| 3D9.1C2CFCCEAF | H            | ---         | 4/17/09      | LTR  | 6/29/10  | 438.3       | 3        |
| 3D9.1C2CF467AE | H            | ---         | 4/17/09      | ICH  | 5/12/10  | 390.1       | 3        |

Abbreviations are as follows: BON – Bonneville Dam, TDA – The Dalles Dam, MCN – McNary Dam, ICH – Ice Harbor Dam, LTR – Lower Tucannon River, MTR – Middle Tucannon River, UTR – Upper Tucannon River, LGO – Little Goose Dam, LGR – Lower Granite Dam, AFC – Asotin Creek.

<sup>a</sup> PIT tag adult detection systems were in operation beginning in 1988 for LGR, 1998 for BON, 2002 for MCN, 2005 for both ICH and LTR, 2011 for MTR and UTR, and 2012 for TFH.

<sup>b</sup> This fish was detected bypassing the Tucannon River (LGO or LGR detection) before heading back downstream.

**Appendix F (continued). Final PIT tag detections of returning Tucannon River spring Chinook from fish originally tagged as juveniles from the Tucannon River.**

| PIT Tag ID     | Release Data |             |              | Adult Return Final Detection Data <sup>a</sup> |          |             |          |
|----------------|--------------|-------------|--------------|--|----------|-------------|----------|
|                | Origin       | Length (mm) | Release Date | OBS  | OBS Date | Travel Time | Est. Age |
| 3D9.1C2CFBAFCC | H            | ---         | 4/17/09      | LTR <sup>b</sup>                               | 5/24/11  | 767.4       | 4        |
| 3D9.1C2CFCD300 | H            | ---         | 4/17/09      | BON  | 5/17/11  | 760.1       | 4        |
| 3D9.1C2CFD176B | H            | ---         | 4/17/09      | LGR  | 6/06/11  | 773.2       | 4        |
| 3D9.1C2D02834D | H            | ---         | 4/17/09      | LTR  | 5/20/11  | 762.9       | 4        |
| 3D9.1C2D02ACF7 | H            | 158         | 4/17/09      | LGO <sup>b</sup>                               | 5/17/11  | 759.5       | 4        |
| 3D9.1C2D034513 | H            | ---         | 4/17/09      | LTR  | 5/16/11  | 759.0       | 4        |
| 3D9.1C2D0357E4 | H            | 194         | 4/17/09      | LGR  | 6/21/11  | 780.8       | 4        |
| 3D9.1C2D040E6F | H            | ---         | 4/17/09      | ICH  | 6/02/11  | 771.2       | 4        |
| 3D9.1BF27C2A80 | W            | 110         | 5/02/09      | ICH  | 5/11/11  | 739.1       | 4        |
| 3D9.1BF27C32F1 | W            | 116         | 4/30/09      | ICH  | 6/06/11  | 767.4       | 4        |
| 3D9.1BF27C34E2 | W            | 131         | 5/01/09      | ICH  | 5/17/11  | 746.1       | 4        |
| 3D9.1BF27C3AEE | W            | 114         | 4/27/09      | LTR  | 5/10/11  | 743.0       | 4        |
| 3D9.1BF27C3EE4 | W            | 117         | 5/10/09      | ICH  | 5/20/11  | 740.4       | 4        |
| 3D9.1BF27C51C3 | W            | 117         | 5/03/09      | MCN  | 5/13/11  | 739.5       | 4        |
| 3D9.1BF27C610A | W            | 125         | 4/27/09      | ICH  | 5/06/11  | 739.3       | 4        |
| 3D9.1BF27C652F | W            | 122         | 4/28/09      | LTR  | 5/14/11  | 746.1       | 4        |
| 3D9.1BF27C6784 | W            | 105         | 5/09/09      | LTR  | 5/18/11  | 739.0       | 4        |
| 3D9.1BF27CE9F8 | W            | 105         | 4/29/09      | LTR  | 5/19/11  | 749.9       | 4        |
| 3D9.1BF27DB642 | W            | 109         | 1/20/09      | AFC  | 9/09/11  | 927.6       | 4        |
| 3D9.1BF27E20BB | W            | 99          | 1/27/09      | MCN  | 5/15/11  | 837.9       | 4        |
| 3D9.1BF27E2615 | W            | 128         | 4/19/09      | ICH  | 6/22/11  | 793.5       | 4        |
| 3D9.1BF27EBF86 | W            | 113         | 1/26/09      | BON  | 5/14/11  | 838.1       | 4        |
| 3D9.1C2D031FC6 | W            | 105         | 11/16/09     | LGR  | 6/21/11  | 581.8       | 4        |
| 3D9.1C2CF44596 | H            | ---         | 4/17/09      | MTR  | 4/02/12  | 1080.7      | 5        |
| 3D9.1C2CF45F43 | W            | 116         | 5/19/09      | BON  | 4/24/12  | 1071.4      | 5        |
| 3D9.1C2CFCEF10 | W            | 93          | 12/15/09     | MTR  | 5/28/12  | 895.4       | 5        |
| 3D9.1C2CB17349 | H            | ---         | 4/07/10      | LTR  | 5/10/11  | 398.4       | 3        |
| 3D9.1C2CFBE7D3 | H            | ---         | 4/07/10      | ICH  | 5/16/11  | 403.9       | 3        |
| 3D9.1C2CFCA747 | H            | ---         | 4/07/10      | ICH  | 5/23/11  | 411.2       | 3        |
| 3D9.1C2CFCB6E1 | H            | ---         | 4/07/10      | ICH  | 5/24/11  | 412.1       | 3        |
| 3D9.1C2D0A57A9 | H            | ---         | 4/07/10      | LGR  | 5/11/11  | 399.1       | 3        |
| 3D9.1C2D0C6B10 | H            | ---         | 4/07/10      | ICH  | 5/20/11  | 407.9       | 3        |
| 3D9.1C2D0C6EC3 | H            | ---         | 4/07/10      | ICH  | 6/02/11  | 421.0       | 3        |
| 3D9.1C2D10D73B | H            | ---         | 4/07/10      | LTR  | 7/04/11  | 452.6       | 3        |
| 3D9.1C2D116974 | H            | ---         | 4/07/10      | MCN  | 5/18/11  | 405.9       | 3        |
| 3D9.1C2D11BDED | H            | ---         | 4/07/10      | ICH  | 5/22/11  | 410.2       | 3        |

Abbreviations are as follows: BON – Bonneville Dam, TDA – The Dalles Dam, MCN – McNary Dam, ICH – Ice Harbor Dam, LTR – Lower Tucannon River, MTR – Middle Tucannon River, UTR – Upper Tucannon River, LGO – Little Goose Dam, LGR – Lower Granite Dam, AFC – Asotin Creek.

<sup>a</sup> PIT tag adult detection systems were in operation beginning in 1988 for LGR, 1998 for BON, 2002 for MCN, 2005 for both ICH and LTR, 2011 for MTR and UTR, and 2012 for TFH.

<sup>b</sup> This fish was detected bypassing the Tucannon River (LGO or LGR detection) before heading back downstream.

**Appendix F (continued). Final PIT tag detections of returning Tucannon River spring Chinook from fish originally tagged as juveniles from the Tucannon River.**

| PIT Tag ID     | Release Data |             |              | Adult Return Final Detection Data <sup>a</sup> |          |             |          |
|----------------|--------------|-------------|--------------|--|----------|-------------|----------|
|                | Origin       | Length (mm) | Release Date | OBS  | OBS Date | Travel Time | Est. Age |
| 3D9.1C2D1227AC | H            | ---         | 4/07/10      | ICH  | 5/21/11  | 408.9       | 3        |
| 3D9.1C2D74B711 | H            | ---         | 4/07/10      | MCN  | 6/05/11  | 423.9       | 3        |
| 3D9.1C2D750B0B | H            | ---         | 4/07/10      | LTR <sup>b</sup>                               | 7/05/11  | 454.5       | 3        |
| 3D9.1C2D752277 | H            | ---         | 4/07/10      | ICH  | 6/06/11  | 425.0       | 3        |
| 3D9.1C2D754D65 | H            | ---         | 4/07/10      | LTR  | 6/04/11  | 422.8       | 3        |
| 3D9.1C2D755233 | H            | ---         | 4/07/10      | LGR  | 6/17/11  | 436.1       | 3        |
| 3D9.1C2D7555EA | H            | ---         | 4/07/10      | ICH  | 5/30/11  | 417.9       | 3        |
| 3D9.1C2D755E10 | H            | ---         | 4/07/10      | ICH  | 6/07/11  | 426.2       | 3        |
| 3D9.1C2D756572 | H            | ---         | 4/07/10      | LTR  | 6/07/11  | 425.6       | 3        |
| 3D9.1C2D7565B1 | H            | ---         | 4/07/10      | LTR  | 6/15/11  | 433.7       | 3        |
| 3D9.1C2D756D09 | H            | ---         | 4/07/10      | ICH  | 6/06/11  | 424.8       | 3        |
| 3D9.1C2D75B9F9 | H            | ---         | 4/07/10      | ICH  | 6/04/11  | 423.0       | 3        |
| 3D9.1C2D75BAC1 | H            | ---         | 4/07/10      | BON  | 5/23/11  | 411.3       | 3        |
| 3D9.1C2D75C3CB | H            | ---         | 4/07/10      | LGO <sup>b</sup>                               | 7/02/11  | 450.6       | 3        |
| 3D9.1C2D75CA67 | H            | ---         | 4/07/10      | LTR  | 6/05/11  | 424.5       | 3        |
| 3D9.1C2D7A9C66 | H            | ---         | 4/07/10      | MCN  | 6/08/11  | 427.1       | 3        |
| 3D9.1C2D7AB0CD | H            | ---         | 4/07/10      | ICH  | 6/06/11  | 425.2       | 3        |
| 3D9.1C2D7AB2FB | H            | ---         | 4/07/10      | MCN  | 5/14/11  | 402.0       | 3        |
| 3D9.1C2D7ABE87 | H            | ---         | 4/07/10      | LTR  | 5/11/11  | 398.9       | 3        |
| 3D9.1C2D7ABEE8 | H            | ---         | 4/07/10      | LTR  | 5/20/11  | 408.0       | 3        |
| 3D9.1C2D7ABF15 | H            | ---         | 4/07/10      | BON  | 5/20/11  | 408.2       | 3        |
| 3D9.1C2D7AD6C0 | H            | ---         | 4/07/10      | ICH  | 6/16/11  | 435.1       | 3        |
| 3D9.1C2D7AF0D6 | H            | ---         | 4/07/10      | ICH  | 5/31/11  | 419.2       | 3        |
| 3D9.1C2D7AF13B | H            | ---         | 4/07/10      | BON  | 5/16/11  | 404.1       | 3        |
| 3D9.1C2D7B4C96 | H            | ---         | 4/07/10      | BON  | 5/09/11  | 397.3       | 3        |
| 3D9.1C2D7B723E | H            | ---         | 4/07/10      | ICH  | 5/29/11  | 417.0       | 3        |
| 3D9.1C2D7C5759 | H            | ---         | 4/07/10      | ICH  | 5/29/11  | 417.0       | 3        |
| 3D9.1C2D80F436 | H            | ---         | 4/07/10      | MCN  | 5/27/11  | 414.9       | 3        |
| 3D9.1C2D80FE10 | H            | ---         | 4/07/10      | BON  | 5/19/11  | 406.3       | 3        |
| 3D9.1C2D8102EE | H            | ---         | 4/07/10      | BON  | 5/16/11  | 404.0       | 3        |
| 3D9.1C2D8142B7 | H            | ---         | 4/07/10      | MCN  | 6/05/11  | 423.7       | 3        |
| 3D9.1C2D8158FB | H            | ---         | 4/07/10      | BON  | 5/23/11  | 411.1       | 3        |
| 3D9.1C2D824F31 | H            | ---         | 4/07/10      | LTR  | 5/18/11  | 405.9       | 3        |
| 3D9.1C2CF45F7D | W            | 116         | 4/11/10      | LTR  | 4/02/11  | 355.7       | 3        |
| 3D9.1C2CF468D0 | W            | 123         | 4/17/10      | LTR  | 6/09/11  | 418.1       | 3        |
| 3D9.1C2CFC3BD4 | W            | 109         | 5/07/10      | LTR  | 4/01/11  | 329.6       | 3        |

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<sup>a</sup> PIT tag adult detection systems were in operation beginning in 1988 for LGR, 1998 for BON, 2002 for MCN, 2005 for both ICH and LTR, 2011 for MTR and UTR, and 2012 for TFH.

<sup>b</sup> This fish was detected bypassing the Tucannon River (LGO or LGR detection) before heading back downstream.

**Appendix F (continued). Final PIT tag detections of returning Tucannon River spring Chinook from fish originally tagged as juveniles from the Tucannon River.**

| PIT Tag ID     | Release Data |             |              | Adult Return Final Detection Data <sup>a</sup> |          |             |          |
|----------------|--------------|-------------|--------------|--|----------|-------------|----------|
|                | Origin       | Length (mm) | Release Date | OBS  | OBS Date | Travel Time | Est. Age |
| 3D9.1C2D030778 | W            | 120         | 4/15/10      | LTR  | 1/17/11  | 276.8       | 3        |
| 3D9.1C2D030B45 | W            | 130         | 4/26/10      | MCN  | 6/07/11  | 407.1       | 3        |
| 3D9.1C2D03E72B | W            | 97          | 4/19/10      | LTR  | 5/30/11  | 406.4       | 3        |
| 3D9.1C2D03EF5F | W            | 116         | 2/01/10      | LTR  | 5/31/11  | 483.6       | 3        |
| 3D9.1C2CB10281 | H            | ---         | 4/07/10      | MTR  | 6/28/12  | 813.0       | 4        |
| 3D9.1C2CFB857B | H            | ---         | 4/07/10      | TFH  | 9/07/12  | 884.3       | 4        |
| 3D9.1C2D07E9D1 | H            | ---         | 4/07/10      | MTR <sup>b</sup>                               | 6/02/12  | 786.8       | 4        |
| 3D9.1C2D0C2DA7 | H            | ---         | 4/07/10      | MTR  | 5/24/12  | 777.8       | 4        |
| 3D9.1C2D0C5BED | H            | ---         | 4/07/10      | MTR  | 5/19/12  | 773.4       | 4        |
| 3D9.1C2D0D1C3C | H            | ---         | 4/07/10      | UTR  | 5/26/12  | 778.3       | 4        |
| 3D9.1C2D0D4DF0 | H            | ---         | 4/07/10      | MTR  | 5/22/12  | 776.2       | 4        |
| 3D9.1C2D10D771 | H            | ---         | 4/07/10      | UTR  | 6/13/12  | 797.7       | 4        |
| 3D9.1C2D10D97F | H            | ---         | 4/07/10      | MTR <sup>b</sup>                               | 6/3/12   | 788.2       | 4        |
| 3D9.1C2D1187CD | H            | ---         | 4/07/10      | MTR  | 5/22/12  | 776.0       | 4        |
| 3D9.1C2D74B7DA | H            | ---         | 4/07/10      | LGR  | 5/15/12  | 768.8       | 4        |
| 3D9.1C2D74B82A | H            | ---         | 4/07/10      | UTR  | 5/26/12  | 780.1       | 4        |
| 3D9.1C2D74BF68 | H            | ---         | 4/07/10      | UTR  | 5/28/12  | 782.4       | 4        |
| 3D9.1C2D74C77F | H            | ---         | 4/07/10      | MTR  | 5/24/12  | 778.0       | 4        |
| 3D9.1C2D754D26 | H            | ---         | 4/07/10      | BON  | 4/24/12  | 748.0       | 4        |
| 3D9.1C2D759A04 | H            | ---         | 4/07/10      | UTR  | 5/24/12  | 778.3       | 4        |
| 3D9.1C2D7A9292 | H            | ---         | 4/07/10      | MTR  | 5/19/12  | 773.0       | 4        |
| 3D9.1C2D7A941E | H            | ---         | 4/07/10      | UTR <sup>b</sup>                               | 6/14/12  | 799.2       | 4        |
| 3D9.1C2D7AB43F | H            | ---         | 4/07/10      | MTR  | 4/3/12   | 726.6       | 4        |
| 3D9.1C2D7AB4B3 | H            | ---         | 4/07/10      | BON  | 5/9/12   | 763.0       | 4        |
| 3D9.1C2D7AB60D | H            | ---         | 4/07/10      | LTR  | 5/9/12   | 762.8       | 4        |
| 3D9.1C2D7ACCC9 | H            | ---         | 4/07/10      | BON  | 4/22/12  | 745.8       | 4        |
| 3D9.1C2D7AE415 | H            | ---         | 4/07/10      | MTR  | 5/20/12  | 774.1       | 4        |
| 3D9.1C2D7AE70C | H            | ---         | 4/07/10      | LTR  | 4/24/12  | 747.3       | 4        |
| 3D9.1C2D7AFC8E | H            | ---         | 4/07/10      | MTR  | 3/31/12  | 724.0       | 4        |
| 3D9.1C2D7B0029 | H            | ---         | 4/07/10      | TFH  | 8/29/12  | 875.0       | 4        |
| 3D9.1C2D7B39BD | H            | ---         | 4/07/10      | TFH  | 4/26/12  | 750.0       | 4        |
| 3D9.1C2D7B4B24 | H            | ---         | 4/07/10      | BON  | 5/08/12  | 761.9       | 4        |
| 3D9.1C2D7B5A59 | H            | ---         | 4/07/10      | BON  | 5/15/12  | 769.1       | 4        |
| 3D9.1C2D7B86D6 | H            | ---         | 4/07/10      | MTR  | 5/21/12  | 775.3       | 4        |
| 3D9.1C2D7BB359 | H            | ---         | 4/07/10      | AFC  | 7/01/12  | 815.8       | 4        |
| 3D9.1C2D7C0465 | H            | ---         | 4/07/10      | LTR  | 5/12/12  | 765.7       | 4        |

Abbreviations are as follows: BON – Bonneville Dam, TDA – The Dalles Dam, MCN – McNary Dam, ICH – Ice Harbor Dam, LTR – Lower Tucannon River, MTR – Middle Tucannon River, UTR – Upper Tucannon River, LGO – Little Goose Dam, LGR – Lower Granite Dam, AFC – Asotin Creek.

<sup>a</sup> PIT tag adult detection systems were in operation beginning in 1988 for LGR, 1998 for BON, 2002 for MCN, 2005 for both ICH and LTR, 2011 for MTR and UTR, and 2012 for TFH.

<sup>b</sup> This fish was detected bypassing the Tucannon River (LGO or LGR detection) before heading back downstream.

**Appendix F (continued). Final PIT tag detections of returning Tucannon River spring Chinook from fish originally tagged as juveniles from the Tucannon River.**

| PIT Tag ID     | Release Data |             |              | Adult Return Final Detection Data <sup>a</sup> |          |             |          |
|----------------|--------------|-------------|--------------|--|----------|-------------|----------|
|                | Origin       | Length (mm) | Release Date | OBS  | OBS Date | Travel Time | Est. Age |
| 3D9.1C2D7C4237 | H            | ---         | 4/07/10      | MTR  | 6/14/12  | 799.1       | 4        |
| 3D9.1C2D7C4BBC | H            | ---         | 4/07/10      | MTR  | 3/31/12  | 723.5       | 4        |
| 3D9.1C2D80D818 | H            | ---         | 4/07/10      | MTR  | 5/29/12  | 782.7       | 4        |
| 3D9.1C2D812B48 | H            | ---         | 4/07/10      | UTR  | 5/26/12  | 780.1       | 4        |
| 3D9.1C2D815183 | H            | ---         | 4/07/10      | MTR  | 5/21/12  | 775.4       | 4        |
| 3D9.1C2D8243D7 | H            | ---         | 4/07/10      | MTR  | 5/19/12  | 772.9       | 4        |
| 3D9.1C2D825C9D | H            | ---         | 4/07/10      | MTR  | 5/26/12  | 780.2       | 4        |
| 3D9.1C2D826D4F | H            | ---         | 4/07/10      | MTR  | 5/19/12  | 773.3       | 4        |
| 3D9.1C2D826F4D | H            | ---         | 4/07/10      | LTR  | 5/21/12  | 774.8       | 4        |
| 3D9.1C2D828612 | H            | ---         | 4/07/10      | MTR  | 5/19/12  | 772.8       | 4        |
| 3D9.1C2D829474 | H            | ---         | 4/07/10      | LTR  | 5/24/12  | 778.3       | 4        |
| 3D9.1C2D829B73 | H            | ---         | 4/07/10      | LGR  | 5/23/12  | 777.0       | 4        |
| 3D9.1C2D0C6405 | H            | ---         | 4/07/10      | UTR  | 5/12/13  | 1131        | 5        |
| 3D9.1C2CFB5F1B | W            | 105         | 5/02/10      | LTR  | 4/07/12  | 705.6       | 4        |
| 3D9.1C2CFD12B3 | W            | 120         | 4/29/10      | MTR  | 5/21/12  | 752.9       | 4        |
| 3D9.1C2CFF248D | W            | 116         | 5/10/10      | BON  | 5/02/12  | 767.5       | 4        |
| 3D9.1C2D02D770 | W            | 119         | 5/06/10      | MTR  | 6/11/12  | 767.5       | 4        |
| 3D9.1C2D02EB49 | W            | 104         | 5/07/10      | AFC  | 9/27/12  | 874.0       | 4        |
| 3D9.1C2D03599C | W            | 101         | 4/05/10      | LTR  | 4/18/12  | 742.6       | 4        |
| 3D9.1C2D03A283 | W            | 112         | 5/13/10      | LTR  | 6/14/12  | 762.8       | 4        |
| 3D9.1C2CF44450 | W            | 93          | 12/20/10     | LTR  | 4/25/12  | 491.8       | 4        |
| 3D9.1C2D03EECD | W            | 125         | 3/26/10      | TFH  | 6/17/13  | 1179        | 5        |
| 3D9.1C2D031A03 | W            | 97          | 4/29/10      | TFH  | 6/15/13  | 1143        | 5        |
| 3D9.1C2CFC3DD5 | W            | 115         | 5/14/10      | TDA  | 5/05/13  | 1087        | 5        |
| 3D9.1C2CF52775 | W            | 83          | 11/15/10     | UTR  | 5/18/13  | 915         | 5        |
| 3D9.1C2CF52CD5 | W            | 80          | 12/09/10     | AFC  | 9/20/13  | 915         | 5        |
| 3D9.1C2D9FAD7C | H            | 110         | 4/16/11      | MTR  | 3/28/12  | 347.4       | 3        |
| 3D9.1C2D9FAFB1 | H            | 107         | 4/16/11      | LTR  | 4/22/12  | 372.5       | 3        |
| 3D9.1C2DA0DB23 | H            | 105         | 4/16/11      | LTR  | 3/26/12  | 344.5       | 3        |
| 3D9.1C2DA2D949 | H            | 98          | 4/16/11      | TFH  | 4/24/12  | 374.4       | 3        |
| 3D9.1C2DC02030 | H            | 121         | 4/16/11      | UTR  | 4/01/12  | 351.0       | 3        |
| 3D9.1C2DC03995 | H            | 147         | 4/16/11      | MTR  | 4/01/12  | 351.2       | 3        |
| 3D9.1C2DC172E2 | H            | 164         | 4/16/11      | LTR  | 4/02/12  | 351.0       | 3        |
| 3D9.1C2DC19AEF | H            | 155         | 4/16/11      | UTR  | 7/02/12  | 443.3       | 3        |
| 3D9.1C2DC19B8B | H            | 142         | 4/16/11      | UTR  | 6/02/12  | 413.1       | 3        |
| 3D9.1C2DC31A5A | H            | 154         | 4/16/11      | LTR  | 5/22/12  | 402.4       | 3        |

Abbreviations are as follows: BON – Bonneville Dam, TDA – The Dalles Dam, MCN – McNary Dam, ICH – Ice Harbor Dam, LTR – Lower Tucannon River, MTR – Middle Tucannon River, UTR – Upper Tucannon River, LGO – Little Goose Dam, LGR – Lower Granite Dam, AFC – Asotin Creek.

<sup>a</sup> PIT tag adult detection systems were in operation beginning in 1988 for LGR, 1998 for BON, 2002 for MCN, 2005 for both ICH and LTR, 2011 for MTR and UTR, and 2012 for TFH.

**Appendix F (continued). Final PIT tag detections of returning Tucannon River spring Chinook from fish originally tagged as juveniles from the Tucannon River.**

| PIT Tag ID     | Release Data |             |              | Adult Return Final Detection Data <sup>a</sup> |          |             |          |
|----------------|--------------|-------------|--------------|--|----------|-------------|----------|
|                | Origin       | Length (mm) | Release Date | OBS  | OBS Date | Travel Time | Est. Age |
| 3D9.1C2DC34F18 | H            | 128         | 4/16/11      | MTR  | 12/03/12 | 596.7       | 3        |
| 3D9.1C2DC3FB56 | H            | 124         | 4/16/11      | MTR  | 6/07/12  | 418.4       | 3        |
| 3D9.1C2DC4BAA0 | H            | 122         | 4/16/11      | MTR  | 3/18/12  | 337.1       | 3        |
| 3D9.1C2DC4C76D | H            | 149         | 4/16/11      | BON  | 5/08/12  | 388.1       | 3        |
| 3D9.1C2DCA0C73 | H            | 148         | 4/16/11      | UTR <sup>b</sup>                               | 7/02/12  | 443.3       | 3        |
| 3D9.1C2D817ABD | H            | 119         | 4/16/11      | TFH  | 6/09/13  | 780         | 4        |
| 3D9.1C2D81924A | H            | 115         | 4/16/11      | UTR  | 5/29/13  | 765         | 4        |
| 3D9.1C2D8444A7 | H            | 105         | 4/16/11      | TFH  | 6/08/13  | 784         | 4        |
| 3D9.1C2D846942 | H            | 108         | 4/16/11      | BON  | 5/03/13  | 748         | 4        |
| 3D9.1C2D9FC789 | H            | 110         | 4/16/11      | UTR  | 5/24/13  | 769         | 4        |
| 3D9.1C2DA03139 | H            | 107         | 4/16/11      | TFH  | 6/07/13  | 773         | 4        |
| 3D9.1C2DA04F21 | H            | 117         | 4/16/11      | UTR  | 5/18/13  | 763         | 4        |
| 3D9.1C2DA2F58B | H            | ---         | 4/16/11      | TFH  | 6/23/13  | 799         | 4        |
| 3D9.1C2DBF6BA9 | H            | 141         | 4/16/11      | TFH  | 6/11/13  | 773         | 4        |
| 3D9.1C2DBF6BBC | H            | 157         | 4/16/11      | TFH  | 6/10/13  | 786         | 4        |
| 3D9.1C2DC00CEF | H            | 169         | 4/16/11      | TFH  | 6/07/13  | 783         | 4        |
| 3D9.1C2DC0450F | H            | 152         | 4/16/11      | TFH  | 5/30/13  | 775         | 4        |
| 3D9.1C2DC070AB | H            | 157         | 4/16/11      | UTR  | 6/21/13  | 771         | 4        |
| 3D9.1C2DC182B7 | H            | 176         | 4/16/11      | TDA  | 4/29/13  | 744         | 4        |
| 3D9.1C2DC19B5C | H            | 156         | 4/16/11      | BON  | 5/05/13  | 750         | 4        |
| 3D9.1C2DC19E38 | H            | 170         | 4/16/11      | TDA  | 5/21/13  | 766         | 4        |
| 3D9.1C2DC1A8B3 | H            | 148         | 4/16/11      | TFH  | 5/27/13  | 767         | 4        |
| 3D9.1C2DC29D7D | H            | 148         | 4/16/11      | TFH  | 5/22/13  | 767         | 4        |
| 3D9.1C2DC361C7 | H            | 134         | 4/16/11      | UTR <sup>b</sup>                               | 5/28/13  | 773         | 4        |
| 3D9.1C2DC3D35F | H            | 127         | 4/16/11      | UTR  | 5/22/13  | 767         | 4        |
| 3D9.1C2DC43449 | H            | 164         | 4/16/11      | TFH  | 6/25/13  | 772         | 4        |
| 3D9.1C2DC45465 | H            | 130         | 4/16/11      | TFH  | 7/07/13  | 772         | 4        |
| 3D9.1C2DC4673F | H            | 158         | 4/16/11      | TFH  | 6/30/13  | 806         | 4        |
| 3D9.1C2DC4ADF3 | H            | 165         | 4/16/11      | TFH  | 6/04/13  | 780         | 4        |
| 3D9.1C2DC5085D | H            | 142         | 4/16/11      | MTR  | 5/06/13  | 751         | 4        |
| 3D9.1C2DC52B1C | H            | 143         | 4/16/11      | TFH  | 6/08/13  | 773         | 4        |
| 3D9.1C2DC91C7A | H            | 121         | 4/16/11      | TFH  | 6/30/13  | 806         | 4        |
| 3D9.1C2DC9248E | H            | 131         | 4/16/11      | UTR  | 5/30/13  | 762         | 4        |
| 3D9.1C2DC9A9FC | H            | 150         | 4/16/11      | TFH  | 6/12/13  | 769         | 4        |
| 3D9.1C2DC9B125 | H            | 134         | 4/16/11      | UTR  | 6/04/13  | 761         | 4        |
| 3D9.1C2DC9EA81 | H            | 173         | 4/16/11      | TFH  | 6/08/13  | 784         | 4        |

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<sup>a</sup> PIT tag adult detection systems were in operation beginning in 1988 for LGR, 1998 for BON, 2002 for MCN, 2005 for both ICH and LTR, 2011 for MTR and UTR, and 2012 for TFH.

<sup>b</sup> This fish was detected bypassing the Tucannon River (LGO or LGR detection) before heading back downstream.

**Appendix F (continued). Final PIT tag detections of returning Tucannon River spring Chinook from fish originally tagged as juveniles from the Tucannon River.**

| PIT Tag ID     | Release Data |             |              | Adult Return Final Detection Data <sup>a</sup> |          |             |          |
|----------------|--------------|-------------|--------------|--|----------|-------------|----------|
|                | Origin       | Length (mm) | Release Date | OBS  | OBS Date | Travel Time | Est. Age |
| 3D9.1C2D751A48 | W            | 114         | 4/05/11      | BON  | 5/22/12  | 412.5       | 3        |
| 3D9.1C2D752AEA | W            | 86          | 2/02/11      | LTR  | 4/25/12  | 448.5       | 3        |
| 3D9.1C2D80E283 | W            | 101         | 5/15/11      | LTR  | 4/01/12  | 321.9       | 3        |
| 3D9.1C2D810EC1 | W            | 110         | 5/13/11      | LTR  | 4/21/12  | 343.7       | 3        |
| 3D9.1C2DCA49A5 | W            | 126         | 4/17/11      | BON  | 9/26/12  | 528.0       | 3        |
| 3D9.1C2DCA78FE | W            | 110         | 4/21/11      | LTR  | 4/01/12  | 345.8       | 3        |
| 3D9.1C2DCAD4E4 | W            | 104         | 4/24/11      | LTR  | 4/26/12  | 367.6       | 3        |
| 3D9.1C2DCB037F | W            | 106         | 4/15/11      | UTR  | 6/18/12  | 429.7       | 3        |
| 3D9.1C2DCB1BF3 | W            | 104         | 4/29/11      | LTR  | 3/31/12  | 336.4       | 3        |
| 3D9.1C2DCB9A41 | W            | 98          | 5/08/11      | LTR  | 4/26/12  | 351.8       | 3        |
| 3D9.1C2DCC07AE | W            | 95          | 4/29/11      | LTR  | 5/03/12  | 370.2       | 3        |
| 3D9.1C2DCC4647 | W            | 112         | 4/24/11      | LTR  | 4/23/12  | 363.4       | 3        |
| 3D9.1C2D74F991 | W            | 91          | 3/15/11      | TFH  | 6/04/13  | 812         | 4        |
| 3D9.1C2DCAB790 | W            | 110         | 4/17/11      | TFH  | 6/17/13  | 787         | 4        |
| 3D9.1C2DCA9CB6 | W            | 115         | 4/18/11      | UTR  | 5/10/13  | 753         | 4        |
| 3D9.1C2DCADF0D | W            | 107         | 4/21/11      | TFH  | 6/20/13  | 791         | 4        |
| 3D9.1C2D6F5121 | W            | 108         | 4/25/11      | LTR  | 5/21/13  | 757         | 4        |
| 3D9.1C2DCAEA83 | W            | 115         | 4/26/11      | TFH  | 5/28/13  | 757         | 4        |
| 3D9.1C2DCBB53A | W            | 104         | 4/27/11      | UTR <sup>b</sup>                               | 6/11/13  | 776         | 4        |
| 3D9.1C2DCBEA6D | W            | 106         | 4/27/11      | UTR <sup>b</sup>                               | 5/13/13  | 747         | 4        |
| 3D9.1C2D7B5F96 | W            | 105         | 5/02/11      | UTR  | 5/20/13  | 749         | 4        |
| 3D9.1C2D7A9160 | W            | 101         | 5/14/11      | TFH  | 6/07/13  | 755         | 4        |
| 3D9.1C2DC809DB | H            | 154         | 4/16/12      | TFH  | 7/15/13  | 415         | 3        |
| 3D9.1C2DC852D4 | H            | 111         | 4/16/12      | UTR  | 6/26/13  | 436         | 3        |
| 3D9.1C2DC853A6 | H            | 134         | 4/16/12      | UTR <sup>b</sup>                               | 6/17/13  | 427         | 3        |
| 3D9.1C2DCB165D | H            | 116         | 4/16/12      | UTR  | 5/29/13  | 408         | 3        |
| 3D9.1C2DCE4C77 | H            | ---         | 4/16/12      | UTR <sup>b</sup>                               | 6/15/13  | 425         | 3        |
| 3D9.1C2DCE4C9F | H            | 115         | 4/16/12      | LTR  | 5/17/13  | 396         | 3        |
| 3D9.1C2DCF2BC0 | H            | 168         | 4/16/12      | MTR <sup>b</sup>                               | 5/31/13  | 410         | 3        |
| 3D9.1C2DCF3297 | H            | 129         | 4/16/12      | TFH <sup>b</sup>                               | 7/12/13  | 427         | 3        |
| 3D9.1C2DCF6319 | H            | 138         | 4/16/12      | UTR <sup>b</sup>                               | 6/10/13  | 420         | 3        |
| 3D9.1C2DCF6E41 | H            | 178         | 4/16/12      | TFH  | 6/07/13  | 417         | 3        |
| 3D9.1C2DCF99B4 | H            | 159         | 4/16/12      | UTR  | 7/01/13  | 441         | 3        |
| 3D9.1C2DCA2AE  | H            | 151         | 4/16/12      | UTR  | 5/31/13  | 410         | 3        |

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<sup>a</sup> PIT tag adult detection systems were in operation beginning in 1988 for LGR, 1998 for BON, 2002 for MCN, 2005 for both ICH and LTR, 2011 for MTR and UTR, and 2012 for TFH.

<sup>b</sup> This fish was detected bypassing the Tucannon River (LGO or LGR detection) before heading back downstream.

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## **Appendix G: Historical Hatchery Releases (1987-2014 Release Years)**

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**Appendix G. Historical hatchery spring Chinook releases from the Tucannon River, 1987-2014 release years.  
(Totals are summation by brood year and release year.)**

| Release Year | Brood | Release           |           | CWT Code <sup>b</sup> | Number CWT     | Ad-only marked | Additional Tag/location/cross <sup>c</sup> | Kg    | Mean Wt. (g) |
|--------------|-------|-------------------|-----------|-----------------------|----------------|----------------|--|-------|--------------|
|              |       | Type <sup>a</sup> | Date      |                       |                |                |  |       |              |
| 1987         | 1985  | H-Acc             | 4/6-10    | 34/42                 | 12,922         |                |  | 986   | 76           |
| <b>Total</b> |       |                   |           |                       | <b>12,922</b>  |                |  |       |              |
| 1988         | 1986  | H-Acc             | 3/7       | 33/25                 | 12,328         | 512            |  | 628   | 45           |
|              |       | "                 | "         | 41/46                 | 12,095         | 465            |  | 570   | 45           |
|              |       | "                 | "         | 41/48                 | 13,097         | 503            |  | 617   | 45           |
|              |       | "                 | 4/13      | 33/25                 | 37,893         | 1,456          |  | 1,696 | 45           |
|              |       | "                 | "         | 41/46                 | 34,389         | 1,321          |  | 1,621 | 45           |
|              |       | "                 | "         | 41/48                 | 37,235         | 1,431          |  | 1,756 | 45           |
| <b>Total</b> |       |                   |           |                       | <b>147,037</b> | <b>5,688</b>   |  |       |              |
| 1989         | 1987  | H-Acc             | 4/11-13   | 49/50                 | 151,100        | 1,065          |  | 7,676 | 50           |
| <b>Total</b> |       |                   |           |                       | <b>151,100</b> | <b>1,065</b>   |  |       |              |
| 1990         | 1988  | H-Acc             | 3/30-4/10 | 55/01                 | 68,591         | 3,007          |  | 2,955 | 41           |
|              |       | "                 | "         | 01/42                 | 70,459         | 3,089          |  | 3,035 | 41           |
| <b>Total</b> |       |                   |           |                       | <b>139,050</b> | <b>6,096</b>   |  |       |              |
| 1991         | 1989  | H-Acc             | 4/1-12    | 14/61                 | 75,661         | 989            |  | 3,867 | 50           |
|              |       | "                 | "         | 01/31                 | 22,118         | 289            |  | 1,130 | 50           |
| <b>Total</b> |       |                   |           |                       | <b>97,779</b>  | <b>1,278</b>   |  |       |              |
| 1992         | 1990  | H-Acc             | 3/30-4/10 | 40/21                 | 51,149         |                | BWT, RC, WxW                               | 2,111 | 41           |
|              |       | "                 | "         | 43/11                 | 21,108         |                | BWT, LC, HxH                               | 873   | 41           |
|              |       | "                 | "         | 37/25                 | 13,480         |                | Mixed                                      | 556   | 41           |
| <b>Total</b> |       |                   |           |                       | <b>85,737</b>  |                |  |       |              |
| 1993         | 1991  | H-Acc             | 4/6-12    | 46/25                 | 55,716         | 796            | VI, LR, WxW                                | 1,686 | 30           |
|              |       | "                 | "         | 46/47                 | 16,745         | 807            | VI, RR, HxH                                | 507   | 30           |
| <b>Total</b> |       |                   |           |                       | <b>72,461</b>  | <b>1,603</b>   |  |       |              |
| 1993         | 1992  | Direct            | 10/22-25  | 48/23                 | 24,883         | 251            | VI, LR, WxW                                | 317   | 13           |
|              |       | "                 | "         | 48/24                 | 24,685         | 300            | VI, RR, HxH                                | 315   | 13           |
|              |       | "                 | "         | 48/56                 | 7,111          | 86             | Mixed                                      | 91    | 13           |
| <b>Total</b> |       |                   |           |                       | <b>56,679</b>  | <b>637</b>     |  |       |              |
| 1994         | 1992  | H-Acc             | 4/11-18   | 48/10                 | 35,405         | 871            | VI, LY, WxW                                | 1,176 | 32           |
|              |       | "                 | "         | 49/05                 | 35,469         | 2,588          | VI, RY, HxH                                | 1,234 | 32           |
|              |       | "                 | "         | 48/55                 | 8,277          | 799            | Mixed                                      | 294   | 32           |
| <b>Total</b> |       |                   |           |                       | <b>79,151</b>  | <b>4,258</b>   |  |       |              |
| 1995         | 1993  | H-Acc             | 3/15-4/15 | 53/43                 | 45,007         | 140            | VI, RG, HxH                                | 1,437 | 32           |
|              |       | "                 | "         | 53/44                 | 42,936         | 2,212          | VI, LG, WxW                                | 1,437 | 32           |
|              |       | P-Acc             | 3/20-4/3  | 56/15                 | 11,661         | 72             | VI, RR, HxH                                | 355   | 30           |
|              |       | "                 | "         | 56/17                 | 10,704         | 290            | VI, LR, WxW                                | 333   | 30           |
|              |       | "                 | "         | 56/18                 | 13,705         | 47             | Mixed                                      | 416   | 30           |
|              |       | Direct            | 3/20-4/3  | 56/15                 | 3,860          | 24             | VI, RR, HxH                                | 118   | 30           |
|              |       | "                 | "         | 56/17                 | 3,542          | 96             | VI, LR, WxW                                | 110   | 30           |
|              |       | "                 | "         | 56/18                 | 4,537          | 15             | Mixed                                      | 138   | 30           |
| <b>Total</b> |       |                   |           |                       | <b>135,952</b> | <b>2,896</b>   |  |       |              |
| 1996         | 1994  | H-Acc             | 3/16-4/22 | 56/29                 | 89,437         |                | VI, RR, Mixed                              | 2,326 | 26           |
|              |       | P-Acc             | 3/27-4/19 | 57/29                 | 35,334         | 35             | VI, RG, Mixed                              | 1,193 | 30           |
|              |       | Direct            | 3/27      | 43/23                 | 5,263          |                | VI, LG, Mixed                              | 168   | 34           |
| <b>Total</b> |       |                   |           |                       | <b>130,034</b> | <b>35</b>      |  |       |              |

**Appendix G (continued). Historical hatchery spring Chinook releases from the Tucannon River, 1987-2014 release years. (Totals are summation by brood year and release year.)**

| Release Year | Brood  | Release           |           | CWT Code <sup>b</sup> | Number CWT     | Ad-only marked           | Additional Tag/location/cross <sup>c</sup> | Kg    | Mean Wt. (g) |    |
|--------------|--------|-------------------|-----------|-----------------------|----------------|--------------------------|--|-------|--------------|----|
|              |        | Type <sup>a</sup> | Date      |                       |                |                          |  |       |              |    |
| 1997         | 1995   | H-Acc             | 3/07-4/18 | 59/36                 | 42,160         | 40                       | VI, RR, Mixed                              | 1,095 | 26           |    |
|              |        | P-Acc             | 3/24-3/25 | 61/41                 | 10,045         | 50                       | VI, RB, Mixed                              | 244   | 24           |    |
|              |        | Direct            | 3/24      | 61/40                 | 9,811          | 38                       | VI, LB, Mixed                              | 269   | 27           |    |
| <b>Total</b> |        |                   |           |                       | <b>62,016</b>  | <b>128</b>               |  |       |              |    |
| 1998         | 1996   | H-Acc             | 3/11-4/17 | 03/60                 | 14,308         | 27                       | Mixed                                      | 410   | 29           |    |
|              |        | C-Acc             | 3/11-4/18 | 61/25                 | 23,065         | 62                       | “  | 680   | 29           |    |
|              |        | “                 | “         | 61/24                 | 24,554         | 50                       | “  | 707   | 29           |    |
|              |        | Direct            | 4/03      | 03/59                 | 14,101         | 52                       | “  | 392   | 28           |    |
| <b>Total</b> |        |                   |           | <b>76,028</b>         | <b>191</b>     |                          |  |       |              |    |
| 1999         | 1997   | C-Acc             | 3/11-4/20 | 61/32                 | 23,664         | 522                      | Mixed                                      | 704   | 29           |    |
| <b>Total</b> |        |                   |           |                       | <b>23,664</b>  | <b>522</b>               |  |       |              |    |
| <b>Total</b> | 2000   | 1998              | C-Acc     | 3/20-4/26             | 12/11          | 125,192                  | 2,747                                      | Mixed | 4,647        | 36 |
| <b>Total</b> |        |                   |           |                       | <b>125,192</b> | <b>2,747</b>             |  |       |              |    |
| 2001         | 1999   | C-Acc             | 3/19-4/25 | 02/75                 | 96,736         | 864                      | Mixed                                      | 4,180 | 43           |    |
| <b>Total</b> |        |                   |           |                       | <b>96,736</b>  | <b>864</b>               |  |       |              |    |
| 2002         | 2000   | C-Acc             | 3/15-4/23 | 08/87                 | 99,566         | 2,533 <sup>e</sup>       | VI, RR, Mixed                              | 2,990 | 29           |    |
| <b>Total</b> |        |                   |           |                       | <b>99,566</b>  | <b>2,533<sup>e</sup></b> |  |       |              |    |
| 2002         | 2000CB | C-Acc             | 3/15/4/23 | 63                    | 3,031          | 24 <sup>f</sup>          | CB, Mixed                                  | 156   | 51           |    |
| <b>Total</b> |        |                   |           |                       | <b>3,031</b>   | <b>24<sup>f</sup></b>    |  |       |              |    |
| 2002         | 2001   | Direct            | 5/06      | 14/29                 | 19,948         | 1,095                    | Mixed                                      | 77    | 4            |    |
| <b>Total</b> |        |                   |           |                       | <b>19,948</b>  | <b>1,095</b>             |  |       |              |    |
| 2002         | 2001CB | Direct            | 5/06      | 14/30                 | 20,435         | 157                      | CB, Mixed                                  | 57    | 3            |    |
| <b>Total</b> |        |                   |           |                       | <b>20,435</b>  | <b>157</b>               |  |       |              |    |
| 2003         | 2001   | C-Acc             | 4/01-4/21 | 06/81                 | 144,013        | 2,909 <sup>e</sup>       | VI, RR, Mixed                              | 5,171 | 35           |    |
| <b>Total</b> |        |                   |           |                       | <b>144,013</b> | <b>2,909<sup>e</sup></b> |  |       |              |    |
| 2003         | 2001CB | C-Acc             | 4/01-4/21 | 63                    | 134,401        | 5,995 <sup>f</sup>       | CB, Mixed                                  | 4,585 | 33           |    |
| <b>Total</b> |        |                   |           |                       | <b>134,401</b> | <b>5,995<sup>f</sup></b> |  |       |              |    |
| 2004         | 2002   | C-Acc             | 4/01-4/20 | 17/91                 | 121,774        | 1,812 <sup>e</sup>       | VI, RR, Mixed                              | 4,796 | 39           |    |
| <b>Total</b> |        |                   |           |                       | <b>121,774</b> | <b>1,812<sup>e</sup></b> |  |       |              |    |
| 2004         | 2002CB | C-Acc             | 4/01-4/20 | 63                    | 42,875         | 1,909 <sup>f</sup>       | CB, Mixed                                  | 1,540 | 34           |    |
| <b>Total</b> |        |                   |           |                       | <b>42,875</b>  | <b>1,909<sup>f</sup></b> |  |       |              |    |
| 2005         | 2003   | C-Acc             | 3/28-4/15 | 24/82                 | 69,831         | 1,323 <sup>e</sup>       | VI, RR, Mixed                              | 2,544 | 36           |    |
| <b>Total</b> |        |                   |           |                       | <b>69,831</b>  | <b>1,323<sup>e</sup></b> |  |       |              |    |
| 2005         | 2003CB | C-Acc             | 3/28-4/15 | 27/78                 | 125,304        | 4,760 <sup>f</sup>       | CB, Mixed                                  | 4,407 | 34           |    |
| <b>Total</b> |        |                   |           |                       | <b>125,304</b> | <b>4,760<sup>f</sup></b> |  |       |              |    |
| 2006         | 2004   | C-Acc             | 4/03-4/26 | 28/87                 | 67,272         | 270 <sup>e</sup>         | VI, RR, Mixed                              | 2,288 | 34           |    |
| <b>Total</b> |        |                   |           |                       | <b>67,272</b>  | <b>270<sup>e</sup></b>   |  |       |              |    |
| 2006         | 2004CB | C-Acc             | 4/03-4/26 | 28/65                 | 127,162        | 5,150 <sup>f</sup>       | CB, Mixed                                  | 3,926 | 30           |    |
| <b>Total</b> |        |                   |           |                       | <b>127,162</b> | <b>5,150<sup>f</sup></b> |  |       |              |    |
| 2007         | 2005   | C-Acc             | 4/02-4/23 | 35/99                 | 144,833        | 4,633 <sup>e</sup>       | VI, RR, Mixed                              | 8,482 | 57           |    |
| <b>Total</b> |        |                   |           |                       | <b>144,833</b> | <b>4,633<sup>e</sup></b> |  |       |              |    |
| 2007         | 2005CB | C-Acc             | 4/02-4/23 | 34/77                 | 88,885         | 1,171 <sup>f</sup>       | CB, Mixed                                  | 5,525 | 61           |    |
| <b>Total</b> |        |                   |           |                       | <b>88,885</b>  | <b>1,171<sup>f</sup></b> |  |       |              |    |

**Appendix G (continued). Historical hatchery spring Chinook releases from the Tucannon River, 1987-2014 release years. (Totals are summation by brood year and release year.)**

| Release Year | Brood  | Release           |           | CWT Code <sup>b</sup> | Number CWT     | Ad-only marked            | Additional Tag/location/cross <sup>c</sup> | Kg    | Mean Wt. (g) |
|--------------|--------|-------------------|-----------|-----------------------|----------------|---------------------------|--|-------|--------------|
|              |        | Type <sup>a</sup> | Date      |                       |                |                           |  |       |              |
| 2008         | 2006   | C-Acc             | 4/08-4/22 | 40/93                 | 50,309         | 2,426 <sup>e</sup>        | VI, LB, Mixed                              | 2,850 | 54           |
| 2008         | 2006   | C-Acc             | 4/08-4/22 | 40/94                 | 51,858         | 1,937 <sup>e</sup>        | VI, LP, Mixed                              | 2,106 | 39           |
| <b>Total</b> |        |                   |           |                       | <b>102,167</b> | <b>4,363<sup>e</sup></b>  |  |       |              |
| 2008         | 2006CB | C-Acc             | 4/08-4/22 | 41/94                 | 75,283         | 2,893 <sup>f</sup>        | CB, Mixed                                  | 4,493 | 57           |
| <b>Total</b> |        |                   |           |                       | <b>75,283</b>  | <b>2,893<sup>f</sup></b>  |  |       |              |
| 2009         | 2007   | C-Acc             | 4/13-4/22 | 46/88                 | 55,266         | 214 <sup>e</sup>          | VI, LB, Mixed                              | 3,188 | 57           |
| 2009         | 2007   | C-Acc             | 4/13-4/22 | 46/87                 | 58,044         | 1,157 <sup>e</sup>        | VI, LP, Mixed                              | 2,203 | 37           |
| <b>Total</b> |        |                   |           |                       | <b>113,310</b> | <b>1,371<sup>e</sup></b>  |  |       |              |
| 2010         | 2008   | C-Acc             | 4/2-4/12  | 51/75                 | 84,738         | 1,465 <sup>e</sup>        | VI, LB, Mixed                              | 5,672 | 66           |
| 2010         | 2008   | C-Acc             | 4/2-4/12  | 51/74                 | 84,613         | 2,081 <sup>e</sup>        | VI, LP, Mixed                              | 3,423 | 40           |
| <b>Total</b> |        |                   |           |                       | <b>169,351</b> | <b>3,546<sup>e</sup></b>  |  |       |              |
| 2010         | 2009   | Direct            | 4/22-4/23 | None                  | 0              | 52,253 <sup>f</sup>       | Oxytet., Mixed                             | 342   | 7            |
| <b>Total</b> |        |                   |           |                       | <b>0</b>       | <b>52,253<sup>f</sup></b> |  |       |              |
| 2011         | 2009   | C-Acc             | 4/7-4/25  | 55/66                 | 113,049        | 0 <sup>e</sup>            | VI, LB, Mixed                              | 5,767 | 51           |
| 2011         | 2009   | C-Acc             | 4/7-4/25  | 55/65                 | 117,824        | 564 <sup>e</sup>          | VI, LP, Mixed                              | 4,135 | 35           |
| <b>Total</b> |        |                   |           |                       | <b>230,873</b> | <b>564<sup>e</sup></b>    |  |       |              |
| 2012         | 2010   | C-Acc             | 4/11-4/23 | 60/76                 | 96,984         | 275 <sup>e</sup>          | VI, LB, Mixed                              | 6,400 | 66           |
| 2012         | 2010   | C-Acc             | 4/11-4/23 | 60/75                 | 102,169        | 2,157 <sup>e</sup>        | VI, LP, Mixed                              | 3,312 | 32           |
| <b>Total</b> |        |                   |           |                       | <b>199,153</b> | <b>2,432<sup>e</sup></b>  |  |       |              |
| 2012         | 2011   | Direct            | 5/01      | None                  | 0              | 39,460 <sup>f</sup>       | Oxytet., Mixed                             | 285   | 7            |
| <b>Total</b> |        |                   |           |                       | <b>0</b>       | <b>39,460<sup>f</sup></b> |  |       |              |
| 2013         | 2011   | C-Acc             | 4/3-4/22  | 64/42                 | 27,748         | 1,825 <sup>f</sup>        | TFH reared, Mixed                          | 987   | 33           |
| 2013         | 2011   | C-Acc             | 4/3-4/22  | 64/41                 | 227,703        | 2,688 <sup>f</sup>        | LFH reared, Mixed                          | 7,691 | 33           |
| <b>Total</b> |        |                   |           |                       | <b>255,451</b> | <b>4,513<sup>f</sup></b>  |  |       |              |
| 2014         | 2012   | C-Acc             | 4/11-4/23 | 65/86                 | 15,227         | 1,382 <sup>f</sup>        | TFH reared, Mixed                          | 538   | 32           |
| 2014         | 2012   | C-Acc             | 4/11-4/23 | 65/85                 | 129,165        | 787 <sup>f</sup>          | LFH reared, Mixed                          | 4,214 | 32           |
| <b>Total</b> |        |                   |           |                       | <b>144,392</b> | <b>2,169<sup>f</sup></b>  |  |       |              |

<sup>a</sup> Release types are: Tucannon Hatchery Acclimation Pond (H-Acc); Portable Acclimation Pond (P-Acc); Curl Lake Acclimation Pond (C-Acc); and Direct Stream Release (Direct).

<sup>b</sup> All tag codes start with agency code 63.

<sup>c</sup> Codes listed in column are as follows: BWT - Blank Wire Tag; CB - Captive Brood; VI-Visual Implant (elastomer); LR - Left Red, RR - Right Red, LG-Left Green, RG - Right Green, LY - Left Yellow, RY - Right Yellow, LB - Left Blue, RB - Right Blue, LP - Left Purple; Oxytet. - Oxytetracycline Mark; Crosses: WxW - wild x wild progeny, HxH - hatchery x hatchery progeny, Mixed - wild x hatchery progeny.

<sup>d</sup> No tag loss data due to presence of both CWT and BWT in fish.

<sup>e</sup> VI tag only.

<sup>f</sup> No wire.

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**Appendix H: Numbers of Fish Species Captured by  
Month in the Tucannon River Smolt Trap During the  
2013 Outmigration**

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**Appendix H. Numbers of fish species captured by month in the Tucannon River smolt trap during the 2013 outmigration sampling period (29 October, 2012 – 10 July, 2013).**

| <b>Species</b>                   | <b>Oct</b> | <b>Nov</b> | <b>Dec</b> | <b>Jan</b> | <b>Feb</b> | <b>Mar</b> | <b>Apr</b> | <b>May</b> | <b>Jun</b> | <b>Jul</b> | <b>Total</b> |
|----------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|--------------|
| Nat. spring Chinook              | 6          | 55         | 301        | 160        | 18         | 250        | 2364       | 1572       | 51         |            | 4,777        |
| Hatchery Spring Chinook          |            |            |            |            |            | 14         | 5761       | 14107      | 25         |            | 19,907       |
| Fall Chinook                     |            |            |            |            | 86         | 118        | 980        | 7654       | 7119       | 106        | 16,063       |
| Coho salmon                      |            | 1          | 3          | 5          | 2          | 4          | 82         | 252        | 80         | 1          | 430          |
| Bull trout                       |            | 3          | 21         | 3          |            |            | 1          | 1          |            |            | 29           |
| Steelhead < 80 mm                |            | 1          |            |            |            |            | 1          | 276        | 367        | 43         | 688          |
| Steelhead 80-124 mm              | 2          | 27         | 117        | 15         | 1          | 2          | 4          |            |            | 2          | 170          |
| Steelhead ≥ 125 mm               | 4          | 77         | 330        | 66         | 4          | 17         | 866        | 1615       | 36         |            | 3,015        |
| Hatch. endemic Steelhead         |            |            |            |            |            |            | 18         | 253        | 34         |            | 305          |
| Mountain whitefish               | 2          | 4          | 24         | 5          | 1          | 6          | 10         | 13         |            |            | 65           |
| Pacific lamprey - Ammocoetes     | 29         | 35         | 4          | 4          |            | 112        | 102        | 1          | 7          |            | 294          |
| Pacific lamprey - Macrophthalmia | 7          | 67         | 4          | 6          | 3          | 8          | 7          | 1          |            |            | 103          |
| Pacific lamprey - Adults         |            |            |            |            |            |            |            | 11         | 1          |            | 12           |
| American shad                    |            |            |            | 3          | 5          | 1          |            |            |            |            | 9            |
| Smallmouth bass                  | 5          | 4          | 17         | 3          | 5          | 9          | 71         | 207        | 19         |            | 340          |
| Bluegill                         |            |            | 2          |            |            | 1          |            |            |            |            | 3            |
| Pumpkinseed sunfish              |            | 1          | 1          |            |            |            | 2          | 1          | 1          | 1          | 7            |
| Chiselmouth                      | 12         | 46         | 82         | 43         | 3          | 8          | 112        | 793        | 326        | 12         | 1,437        |
| Peamouth                         |            |            |            |            |            |            |            | 3          |            |            | 3            |
| Banded killifish                 | 37         | 102        | 111        | 86         | 104        | 92         | 89         | 18         | 1          |            | 640          |
| Sand roller                      |            |            |            |            |            |            |            | 1          | 1          |            | 2            |
| Longnose dace                    | 29         | 112        | 3          | 19         | 6          | 34         | 74         | 1244       | 633        | 28         | 2,182        |
| Speckled dace                    | 1          | 1          |            |            |            |            | 1          | 2          |            |            | 5            |
| Redside shiner                   | 4          | 15         | 9          | 9          |            | 1          | 13         | 18         | 19         | 2          | 90           |
| Bridgelip sucker                 | 35         | 223        | 777        | 33         | 10         | 45         | 357        | 224        | 92         | 3          | 1799         |
| Northern pikeminnow              | 5          | 13         | 49         | 21         |            | 2          | 322        | 1770       | 349        | 2          | 2533         |
| Brown bullhead                   |            |            | 1          |            |            |            |            | 2          | 18         |            | 21           |
| Sculpin sp.                      |            | 1          |            |            |            |            | 3          | 5          | 7          | 7          | 23           |

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## **Appendix I: Proportionate Natural Influence (PNI) for the Tucannon Spring Chinook Population (1985-2013)**

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**Appendix I. Proportionate Natural Influence (PNI)<sup>a</sup> for the Tucannon River spring Chinook population (1985-2013). Note: Pre-spawn and trap mortalities are excluded from the analysis.**

| Year | Spawned Hatchery<br>Broodstock |                     | River Spawning Fish |                      | PNI  | PNI<br>< 0.50 |
|------|--------------------------------|---------------------|---------------------|----------------------|------|---------------|
|      | Total                          | % Natural<br>(PNOB) | Total               | % Hatchery<br>(PHOS) |      |               |
| 1985 | 8                              | 100.00              | 416                 | 0.00                 | 1.00 |               |
| 1986 | 91                             | 100.00              | 440                 | 0.00                 | 1.00 |               |
| 1987 | 83                             | 100.00              | 407                 | 0.00                 | 1.00 |               |
| 1988 | 90                             | 100.00              | 257                 | 0.00                 | 1.00 |               |
| 1989 | 122                            | 45.08               | 276                 | 1.45                 | 0.97 |               |
| 1990 | 62                             | 48.39               | 572                 | 21.50                | 0.69 |               |
| 1991 | 71                             | 56.34               | 291                 | 32.30                | 0.64 |               |
| 1992 | 82                             | 45.12               | 476                 | 35.92                | 0.56 |               |
| 1993 | 87                             | 51.72               | 397                 | 38.29                | 0.57 |               |
| 1994 | 69                             | 50.72               | 97                  | 0.00                 | 1.00 |               |
| 1995 | 39                             | 23.08               | 27                  | 0.00                 | 1.00 |               |
| 1996 | 75                             | 44.00               | 152                 | 23.68                | 0.65 |               |
| 1997 | 89                             | 42.70               | 105                 | 35.24                | 0.55 |               |
| 1998 | 86                             | 52.33               | 60                  | 26.67                | 0.66 |               |
| 1999 | 122                            | 0.82                | 161                 | 97.52                | 0.01 | *             |
| 2000 | 73                             | 10.96               | 201                 | 69.15                | 0.14 | *             |
| 2001 | 104                            | 50.00               | 766                 | 19.84                | 0.72 |               |
| 2002 | 93                             | 45.16               | 568                 | 60.56                | 0.43 | *             |
| 2003 | 75                             | 54.67               | 329                 | 25.84                | 0.68 |               |
| 2004 | 88                             | 54.55               | 346                 | 17.34                | 0.76 |               |
| 2005 | 95                             | 49.47               | 264                 | 19.70                | 0.72 |               |
| 2006 | 88                             | 40.91               | 202                 | 24.26                | 0.63 |               |
| 2007 | 82                             | 62.20               | 210                 | 22.38                | 0.74 |               |
| 2008 | 114                            | 35.09               | 796                 | 39.07                | 0.47 | *             |
| 2009 | 173                            | 50.87               | 1,190               | 49.24                | 0.51 |               |
| 2010 | 161                            | 50.31               | 938                 | 42.22                | 0.54 |               |
| 2011 | 166                            | 53.61               | 849                 | 29.68                | 0.64 |               |
| 2012 | 164                            | 56.10               | 334                 | 30.24                | 0.65 |               |
| 2013 | 149                            | 62.42               | 170                 | 31.18                | 0.67 |               |

<sup>a</sup> PNI = PNOB/(PNOB + PHOS).

PNOB = Percent natural origin fish in the hatchery broodstock.

PHOS = Percent hatchery origin fish among naturally spawning fish.

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**Appendix J: Recoveries of Coded-Wire Tagged  
Salmon Released Into the Tucannon River for the  
1985-2009 Brood Years**

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**Appendix J. Observed and estimated recoveries of coded-wire tagged salmon released into the Tucannon River with percent return to the Tucannon Basin, out-of-basin returns, and estimated survival and exploitation rates for the 1985-2009 brood years. (Data downloaded from RMIS database on 2/03/14.)**

| <b>Brood Year</b>   | 1985            |                  | 1986                |                  | 1987            |                  |
|---|-----------------|------------------|---------------------|------------------|-----------------|------------------|
| <b>Smolts Released</b>  | 12,922          |                  | 147,037             |                  | 151,100         |                  |
| <b>Fish Size (g)</b>  | 76              |                  | 45                  |                  | 50              |                  |
| <b>CWT Codes<sup>a</sup></b>  | 34/42           |                  | 33/25, 41/46, 41/48 |                  | 49/50           |                  |
| <b>Release Year</b>   | 1987            |                  | 1988                |                  | 1989            |                  |
| <b>Agency (fishery/location)</b>  | Observed Number | Estimated Number | Observed Number     | Estimated Number | Observed Number | Estimated Number |
| <b>WDFW</b>   |                 |                  |                     |                  |                 |                  |
| Tucannon River<br>Kalama R., Wind R.<br>Fish Trap - F.W.<br>Treaty Troll<br>Lyons Ferry Hatch. <sup>b</sup><br>F.W. Sport         |                 |                  | 30                  | 84               | 28              | 130              |
|   | 32              | 38               | 1                   | 2                | 53              | 71               |
|   |                 |                  | 136                 | 280              |                 |                  |
|   |                 |                  | 1                   | 4                |                 |                  |
| <b>ODFW</b>   |                 |                  |                     |                  |                 |                  |
| Test Net, Zone 4<br>Treaty Ceremonial<br>Three Mile, Umatilla R.<br>Spawning Ground<br>Fish Trap - F.W.<br>F.W. Sport<br>Hatchery | 1               | 1                | 1                   | 1                | 1               | 2                |
|   |                 |                  | 2                   | 4                |                 |                  |
| <b>CDFO</b>   |                 |                  |                     |                  |                 |                  |
| Non-treaty Ocean Troll<br>Mixed Net & Seine<br>Ocean Sport  |                 |                  | 1                   | 4                |                 |                  |
| <b>USFWS</b>  |                 |                  |                     |                  |                 |                  |
| Warm Springs Hatchery<br>Dworshak NFH   |                 |                  |                     |                  |                 |                  |
| <b>IDFG</b>   |                 |                  |                     |                  |                 |                  |
| Hatchery  |                 |                  |                     |                  |                 |                  |
| <b>Total Returns</b>  | 33              | 39               | 172                 | 379              | 82              | 203              |
| <b>Tucannon (%)</b>   | 97.4            |                  | 96.0                |                  | 99.0            |                  |
| <b>Out-of-Basin (%)</b>   | 0.0             |                  | 0.0                 |                  | 0.0             |                  |
| <b>Commercial Harvest (%)</b>   | 2.6             |                  | 1.8                 |                  | 0.0             |                  |
| <b>Sport Harvest (%)</b>  | 0.0             |                  | 1.1                 |                  | 0.0             |                  |
| <b>Treaty Ceremonial (%)</b>  | 0.0             |                  | 1.1                 |                  | 1.0             |                  |
| <b>Other (%)</b>  | 0.0             |                  | 0.0                 |                  | 0.0             |                  |
| <b>Survival</b>   | 0.30            |                  | 0.26                |                  | 0.13            |                  |

<sup>a</sup> WDFW agency code prefix is 63.

<sup>b</sup> Fish trapped at TFH and held at LFH for spawning.

**Appendix J (continued). Observed and estimated recoveries of coded-wire tagged salmon released into the Tucannon River with percent return to the Tucannon Basin, out-of-basin returns, and estimated survival and exploitation rates for the 1985-2009 brood years. (Data downloaded from RMIS database on 2/03/14.)**

| <b>Brood Year</b>                | 1988            |                  | 1989            |                  | 1990                |                  |
|----------------------------------|-----------------|------------------|-----------------|------------------|---------------------|------------------|
| <b>Smolts Released</b>           | 139,050         |                  | 97,779          |                  | 85,737              |                  |
| <b>Fish Size (g)</b>             | 41              |                  | 50              |                  | 41                  |                  |
| <b>CWT Codes<sup>a</sup></b>     | 01/42, 55/01    |                  | 01/31, 14/61    |                  | 37/25, 40/21, 43/11 |                  |
| <b>Release Year</b>              | 1990            |                  | 1991            |                  | 1992                |                  |
| <b>Agency (fishery/location)</b> | Observed Number | Estimated Number | Observed Number | Estimated Number | Observed Number     | Estimated Number |
| <b>WDFW</b>                      |                 |                  |                 |                  |                     |                  |
| Tucannon River                   | 107             | 370              | 61              | 191              | 2                   | 6                |
| Kalama R., Wind R.               |                 |                  |                 |                  |                     |                  |
| Fish Trap - F.W.                 | 1               | 1                |                 |                  |                     |                  |
| Treaty Troll                     |                 |                  | 2               | 2                |                     |                  |
| Lyons Ferry Hatch. <sup>b</sup>  | 83              | 86               | 55              | 55               | 19                  | 19               |
| F.W. Sport                       | 1               | 4                |                 |                  |                     |                  |
| <b>ODFW</b>                      |                 |                  |                 |                  |                     |                  |
| Test Net, Zone 4                 | 3               | 3                | 2               | 2                |                     |                  |
| Treaty Ceremonial                | 8               | 17               | 4               | 8                |                     |                  |
| Three Mile, Umatilla R.          |                 |                  |                 |                  |                     |                  |
| Spawning Ground                  |                 |                  |                 |                  |                     |                  |
| Fish Trap - F.W.                 |                 |                  |                 |                  |                     |                  |
| F.W. Sport                       |                 |                  |                 |                  |                     |                  |
| Hatchery                         |                 |                  |                 |                  |                     |                  |
| <b>CDFO</b>                      |                 |                  |                 |                  |                     |                  |
| Non-treaty Ocean Troll           |                 |                  |                 |                  |                     |                  |
| Mixed Net & Seine                |                 |                  |                 |                  |                     |                  |
| Ocean Sport                      |                 |                  |                 |                  |                     |                  |
| <b>USFWS</b>                     |                 |                  |                 |                  |                     |                  |
| Warm Springs Hatchery            |                 |                  |                 |                  |                     |                  |
| Dworshak NFH                     | 1               | 1                |                 |                  |                     |                  |
| <b>IDFG</b>                      |                 |                  |                 |                  |                     |                  |
| Hatchery                         |                 |                  |                 |                  |                     |                  |
| <b>Total Returns</b>             | 204             | 482              | 124             | 258              | 21                  | 25               |
| <b>Tucannon (%)</b>              |                 | 94.6             |                 | 95.3             |                     | 100.0            |
| <b>Out-of-Basin (%)</b>          |                 | 0.4              |                 | 0.0              |                     | 0.0              |
| <b>Commercial Harvest (%)</b>    |                 | 0.6              |                 | 1.6              |                     | 0.0              |
| <b>Sport Harvest (%)</b>         |                 | 0.8              |                 | 0.0              |                     | 0.0              |
| <b>Treaty Ceremonial (%)</b>     |                 | 3.5              |                 | 3.1              |                     | 0.0              |
| <b>Other (%)</b>                 |                 | 0.0              |                 | 0.0              |                     | 0.0              |
| <b>Survival</b>                  |                 | 0.35             |                 | 0.26             |                     | 0.03             |

<sup>a</sup>WDFW agency code prefix is 63.

<sup>b</sup> Fish trapped at TFH and held at LFH for spawning.

**Appendix J (continued). Observed and estimated recoveries of coded-wire tagged salmon released into the Tucannon River with percent return to the Tucannon Basin, out-of-basin returns, and estimated survival and exploitation rates for the 1985-2009 brood years. (Data downloaded from RMIS database on 2/03/14.)**

| <b>Brood Year</b>                | 1991            |                  | 1992                |                  | 1992                |                  |
|----------------------------------|-----------------|------------------|---------------------|------------------|---------------------|------------------|
| <b>Smolts Released</b>           | 72,461          |                  | 56,679              |                  | 79,151              |                  |
| <b>Fish Size (g)</b>             | 30              |                  | 13                  |                  | 32                  |                  |
| <b>CWT Codes<sup>a</sup></b>     | 46/25, 46/47    |                  | 48/23, 48/24, 48/56 |                  | 48/10, 48/55, 49/05 |                  |
| <b>Release Year</b>              | 1993            |                  | 1993                |                  | 1994                |                  |
| <b>Agency (fishery/location)</b> | Observed Number | Estimated Number | Observed Number     | Estimated Number | Observed Number     | Estimated Number |
| <b>WDFW</b>                      |                 |                  |                     |                  |                     |                  |
| Tucannon River                   |                 |                  |                     |                  | 11                  | 34               |
| Kalama R., Wind R.               |                 |                  |                     |                  |                     |                  |
| Fish Trap - F.W.                 |                 |                  |                     |                  |                     |                  |
| Treaty Troll                     |                 |                  |                     |                  |                     |                  |
| Lyons Ferry Hatch. <sup>b</sup>  | 24              | 24               | 2                   | 2                | 45                  | 47               |
| F.W. Sport                       |                 |                  |                     |                  |                     |                  |
| <b>ODFW</b>                      |                 |                  |                     |                  |                     |                  |
| Test Net, Zone 4                 |                 |                  |                     |                  |                     |                  |
| Treaty Ceremonial                | 1               | 3                |                     |                  | 1                   | 1                |
| Three Mile, Umatilla R.          |                 |                  |                     |                  |                     |                  |
| Spawning Ground                  | 1               | 1                |                     |                  | 2                   | 2                |
| Fish Trap - F.W.                 |                 |                  | 1                   | 1                | 5                   | 9                |
| F.W. Sport                       |                 |                  |                     |                  | 2                   | 2                |
| Hatchery                         |                 |                  |                     |                  |                     |                  |
| <b>CDFO</b>                      |                 |                  |                     |                  |                     |                  |
| Non-treaty Ocean Troll           |                 |                  |                     |                  |                     |                  |
| Mixed Net & Seine                |                 |                  | 1                   | 2                |                     |                  |
| Ocean Sport                      |                 |                  |                     |                  |                     |                  |
| <b>USFWS</b>                     |                 |                  |                     |                  |                     |                  |
| Warm Springs Hatchery            |                 |                  |                     |                  | 3                   | 3                |
| Dworshak NFH                     |                 |                  |                     |                  |                     |                  |
| <b>IDFG</b>                      |                 |                  |                     |                  |                     |                  |
| Hatchery                         |                 |                  |                     |                  |                     |                  |
| <b>Total Returns</b>             | 26              | 28               | 4                   | 5                | 69                  | 98               |
| <b>Tucannon (%)</b>              | 85.7            |                  | 40.0                |                  | 82.7                |                  |
| <b>Out-of-Basin (%)</b>          | 3.6             |                  | 20.0                |                  | 14.3                |                  |
| <b>Commercial Harvest (%)</b>    | 0.0             |                  | 40.0                |                  | 0.0                 |                  |
| <b>Sport Harvest (%)</b>         | 0.0             |                  | 0.0                 |                  | 2.0                 |                  |
| <b>Treaty Ceremonial (%)</b>     | 10.7            |                  | 0.0                 |                  | 1.0                 |                  |
| <b>Other (%)</b>                 | 0.0             |                  | 0.0                 |                  | 0.0                 |                  |
| <b>Survival</b>                  | 0.04            |                  | 0.01                |                  | 0.12                |                  |

<sup>a</sup> WDFW agency code prefix is 63.

<sup>b</sup> Fish trapped at TFH and held at LFH for spawning.

**Appendix J (continued). Observed and estimated recoveries of coded-wire tagged salmon released into the Tucannon River with percent return to the Tucannon Basin, out-of-basin returns, and estimated survival and exploitation rates for the 1985-2009 brood years. (Data downloaded from RMIS database on 2/03/14.)**

| <b>Brood Year</b>                | 1993                      |                  | 1994                |                  | 1995                |                  |
|----------------------------------|---------------------------|------------------|---------------------|------------------|---------------------|------------------|
| <b>Smolts Released</b>           | 135,952                   |                  | 130,034             |                  | 62,016              |                  |
| <b>Fish Size (g)</b>             | 30-32                     |                  | 25-35               |                  | 24-27               |                  |
| <b>CWT Codes<sup>a</sup></b>     | 56/15, 56/17-18, 53/43-44 |                  | 43/23, 56/29, 57/29 |                  | 59/36, 61/40, 61/41 |                  |
| <b>Release Year</b>              | 1995                      |                  | 1996                |                  | 1997                |                  |
| <b>Agency (fishery/location)</b> | Observed Number           | Estimated Number | Observed Number     | Estimated Number | Observed Number     | Estimated Number |
| <b>WDFW</b>                      |                           |                  |                     |                  |                     |                  |
| Tucannon River                   | 42                        | 138              | 3                   | 8                | 36                  | 92               |
| Kalama R., Wind R.               |                           |                  |                     |                  |                     |                  |
| Fish Trap - F.W.                 |                           |                  |                     |                  |                     |                  |
| Treaty Troll                     |                           |                  |                     |                  |                     |                  |
| Lyons Ferry Hatch. <sup>b</sup>  | 66                        | 66               | 21                  | 21               | 94                  | 94               |
| F.W. Sport                       |                           |                  |                     |                  |                     |                  |
| <b>ODFW</b>                      |                           |                  |                     |                  |                     |                  |
| Test Net, Zone 4                 |                           |                  |                     |                  |                     |                  |
| Treaty Ceremonial                | 3                         | 3                |                     |                  |                     |                  |
| Three Mile, Umatilla R.          |                           |                  |                     |                  |                     |                  |
| Spawning Ground                  | 3                         | 3                |                     |                  | 1                   | 1                |
| Fish Trap - F.W.                 | 1                         | 1                |                     |                  |                     |                  |
| F.W. Sport                       |                           |                  |                     |                  |                     |                  |
| Hatchery                         | 1                         | 1                |                     |                  | 1                   | 1                |
| <b>CDFO</b>                      |                           |                  |                     |                  |                     |                  |
| Non-treaty Ocean Troll           |                           |                  |                     |                  |                     |                  |
| Mixed Net & Seine                |                           |                  |                     |                  |                     |                  |
| Ocean Sport                      | 1                         | 3                |                     |                  |                     |                  |
| <b>USFWS</b>                     |                           |                  |                     |                  |                     |                  |
| Warm Springs Hatchery            |                           |                  |                     |                  |                     |                  |
| Dworshak NFH                     |                           |                  |                     |                  |                     |                  |
| <b>IDFG</b>                      |                           |                  |                     |                  |                     |                  |
| Hatchery                         |                           |                  |                     |                  |                     |                  |
| <b>Total Returns</b>             | 117                       | 215              | 24                  | 29               | 132                 | 188              |
| <b>Tucannon (%)</b>              | 94.9                      |                  | 100.0               |                  | 98.9                |                  |
| <b>Out-of-Basin (%)</b>          | 2.3                       |                  | 0.0                 |                  | 1.1                 |                  |
| <b>Commercial Harvest (%)</b>    | 0.0                       |                  | 0.0                 |                  | 0.0                 |                  |
| <b>Sport Harvest (%)</b>         | 1.4                       |                  | 0.0                 |                  | 0.0                 |                  |
| <b>Treaty Ceremonial (%)</b>     | 1.4                       |                  | 0.0                 |                  | 0.0                 |                  |
| <b>Other (%)</b>                 | 0.0                       |                  | 0.0                 |                  | 0.0                 |                  |
| <b>Survival</b>                  | 0.16                      |                  | 0.02                |                  | 0.30                |                  |

<sup>a</sup> WDFW agency code prefix is 63.

<sup>b</sup> Fish trapped at TFH and held at LFH for spawning.

**Appendix J (continued). Observed and estimated recoveries of coded-wire tagged salmon released into the Tucannon River with percent return to the Tucannon Basin, out-of-basin returns, and estimated survival and exploitation rates for the 1985-2009 brood years. (Data downloaded from RMIS database on 2/03/14.)**

| <b>Brood Year</b>                | 1996               |                  | 1997            |                  | 1998            |                  |
|----------------------------------|--------------------|------------------|-----------------|------------------|-----------------|------------------|
| <b>Smolts Released</b>           | 76,028             |                  | 23,509          |                  | 124,093         |                  |
| <b>Fish Size (g)</b>             | 28                 |                  | 28              |                  | 35              |                  |
| <b>CWT Codes<sup>a</sup></b>     | 03/59-60, 61/24-25 |                  | 61/32           |                  | 12/11           |                  |
| <b>Release Year</b>              | 1998               |                  | 1999            |                  | 2000            |                  |
| <b>Agency (fishery/location)</b> | Observed Number    | Estimated Number | Observed Number | Estimated Number | Observed Number | Estimated Number |
| <b>WDFW</b>                      |                    |                  |                 |                  |                 |                  |
| Tucannon River                   | 43                 | 139              | 17              | 85               | 147             | 680              |
| Kalama R., Wind R.               |                    |                  |                 |                  |                 |                  |
| Fish Trap - F.W.                 | 1                  | 1                |                 |                  |                 |                  |
| Treaty Troll                     |                    |                  |                 |                  |                 |                  |
| Lyons Ferry Hatch. <sup>b</sup>  | 96                 | 99               | 44              | 46               | 83              | 83               |
| F.W. Sport                       |                    |                  |                 |                  | 3               | 14               |
| Non-treaty Ocean Troll           |                    |                  |                 |                  | 1               | 2                |
| <b>ODFW</b>                      |                    |                  |                 |                  |                 |                  |
| Test Net, Zone 4                 |                    |                  |                 |                  | 1               | 1                |
| Treaty Ceremonial                |                    |                  |                 |                  | 5               | 5                |
| Three Mile, Umatilla R.          |                    |                  |                 |                  |                 |                  |
| Spawning Ground                  |                    |                  |                 |                  | 1               | 1                |
| Fish Trap - F.W.                 | 1                  | 1                | 2               | 2                | 8               | 10               |
| F.W. Sport                       |                    |                  |                 |                  | 2               | 4                |
| Hatchery                         | 2                  | 2                | 1               | 1                |                 |                  |
| Columbia R. Gillnet              |                    |                  | 7               | 22               | 32              | 85               |
| Columbia R. Sport                |                    |                  | 2               | 15               | 17              | 94               |
| <b>CDFO</b>                      |                    |                  |                 |                  |                 |                  |
| Non-treaty Ocean Troll           |                    |                  |                 |                  |                 |                  |
| Mixed Net & Seine                |                    |                  |                 |                  |                 |                  |
| Ocean Sport                      |                    |                  |                 |                  |                 |                  |
| <b>USFWS</b>                     |                    |                  |                 |                  |                 |                  |
| Warm Springs Hatchery            |                    |                  |                 |                  |                 |                  |
| Dworshak NFH                     |                    |                  |                 |                  |                 |                  |
| <b>IDFG</b>                      |                    |                  |                 |                  |                 |                  |
| Hatchery                         | 1                  | 1                | 1               | 1                |                 |                  |
| <b>Total Returns</b>             | 144                | 243              | 74              | 172              | 300             | 979              |
| <b>Tucannon (%)</b>              | 97.9               |                  | 76.2            |                  | 77.9            |                  |
| <b>Out-of-Basin (%)</b>          | 2.1                |                  | 2.3             |                  | 1.2             |                  |
| <b>Commercial Harvest (%)</b>    | 0.0                |                  | 12.8            |                  | 9.0             |                  |
| <b>Sport Harvest (%)</b>         | 0.0                |                  | 8.7             |                  | 11.4            |                  |
| <b>Treaty Ceremonial (%)</b>     | 0.0                |                  | 0.0             |                  | 0.5             |                  |
| <b>Other (%)</b>                 | 0.0                |                  | 0.0             |                  | 0.0             |                  |
| <b>Survival</b>                  | 0.32               |                  | 0.73            |                  | 0.79            |                  |

<sup>a</sup> WDFW agency code prefix is 63.

<sup>b</sup> Fish trapped at TFH and held at LFH for spawning.

**Appendix J (continued). Observed and estimated recoveries of coded-wire tagged salmon released into the Tucannon River with percent return to the Tucannon Basin, out-of-basin returns, and estimated survival and exploitation rates for the 1985-2009 brood years. (Data downloaded from RMIS database on 2/03/14.)**

| <b>Brood Year</b>                | 1999            |                  | 2000            |                  | 2001            |                  |
|----------------------------------|-----------------|------------------|-----------------|------------------|-----------------|------------------|
| <b>Smolts Released</b>           | 96,736          |                  | 99,566          |                  | 144,013         |                  |
| <b>Fish Size (g)</b>             | 43              |                  | 29              |                  | 35              |                  |
| <b>CWT Codes<sup>a</sup></b>     | 02/75           |                  | 08/87           |                  | 06/81           |                  |
| <b>Release Year</b>              | 2001            |                  | 2002            |                  | 2003            |                  |
| <b>Agency (fishery/location)</b> | Observed Number | Estimated Number | Observed Number | Estimated Number | Observed Number | Estimated Number |
| <b>WDFW</b>                      |                 |                  |                 |                  |                 |                  |
| Tucannon River                   | 2               | 12               | 13              | 37               | 6               | 26               |
| Kalama R., Wind R.               |                 |                  |                 |                  |                 |                  |
| Fish Trap - F.W.                 |                 |                  |                 |                  |                 |                  |
| Treaty Troll                     |                 |                  |                 |                  |                 |                  |
| Lyons Ferry Hatch. <sup>b</sup>  | 6               | 6                | 39              | 39               | 51              | 51               |
| F.W. Sport                       |                 |                  |                 |                  |                 |                  |
| Non-treaty Ocean Troll           |                 |                  |                 |                  |                 |                  |
| <b>ODFW</b>                      |                 |                  |                 |                  |                 |                  |
| Test Net, Zone 4                 |                 |                  |                 |                  |                 |                  |
| Treaty Ceremonial                |                 |                  |                 |                  |                 |                  |
| Three Mile, Umatilla R.          |                 |                  |                 |                  |                 |                  |
| Spawning Ground                  |                 |                  |                 |                  |                 |                  |
| Fish Trap - F.W.                 |                 |                  |                 |                  |                 |                  |
| F.W. Sport                       |                 |                  |                 |                  |                 |                  |
| Hatchery                         |                 |                  |                 |                  |                 |                  |
| Columbia R. Gillnet              | 1               | 3                | 1               | 1                |                 |                  |
| Columbia R. Sport                |                 |                  |                 |                  |                 |                  |
| <b>CDFO</b>                      |                 |                  |                 |                  |                 |                  |
| Non-treaty Ocean Troll           |                 |                  |                 |                  | 1               | 5                |
| Mixed Net & Seine                |                 |                  |                 |                  |                 |                  |
| Ocean Sport                      |                 |                  |                 |                  |                 |                  |
| <b>USFWS</b>                     |                 |                  |                 |                  |                 |                  |
| Warm Springs Hatchery            |                 |                  |                 |                  |                 |                  |
| Dworshak NFH                     |                 |                  |                 |                  |                 |                  |
| <b>IDFG</b>                      |                 |                  |                 |                  |                 |                  |
| Hatchery                         |                 |                  |                 |                  |                 |                  |
| <b>Total Returns</b>             | 9               | 21               | 53              | 77               | 58              | 82               |
| <b>Tucannon (%)</b>              | 86.0            |                  | 98.7            |                  | 93.9            |                  |
| <b>Out-of-Basin (%)</b>          | 0.0             |                  | 0.0             |                  | 0.0             |                  |
| <b>Commercial Harvest (%)</b>    | 14.0            |                  | 1.3             |                  | 6.1             |                  |
| <b>Sport Harvest (%)</b>         | 0.0             |                  | 0.0             |                  | 0.0             |                  |
| <b>Treaty Ceremonial (%)</b>     | 0.0             |                  | 0.0             |                  | 0.0             |                  |
| <b>Other (%)</b>                 | 0.0             |                  | 0.0             |                  | 0.0             |                  |
| <b>Survival</b>                  | 0.02            |                  | 0.08            |                  | 0.06            |                  |

<sup>a</sup> WDFW agency code prefix is 63.

<sup>b</sup> Fish trapped at TFH and held at LFH for spawning.

**Appendix J (continued). Observed and estimated recoveries of coded-wire tagged salmon released into the Tucannon River with percent return to the Tucannon Basin, out-of-basin returns, and estimated survival and exploitation rates for the 1985-2009 brood years. (Data downloaded from RMIS database on 2/03/14.)**

| <b>Brood Year</b>                | 2001            |                  | 2002            |                  | 2003            |                  |
|----------------------------------|-----------------|------------------|-----------------|------------------|-----------------|------------------|
| <b>Smolts Released</b>           | 19,948          |                  | 121,774         |                  | 69,831          |                  |
| <b>Fish Size (g)</b>             | 4               |                  | 39              |                  | 36              |                  |
| <b>CWT Codes<sup>a</sup></b>     | 14/29           |                  | 17/91           |                  | 24/82           |                  |
| <b>Release Year</b>              | 2002            |                  | 2004            |                  | 2005            |                  |
| <b>Agency (fishery/location)</b> | Observed Number | Estimated Number | Observed Number | Estimated Number | Observed Number | Estimated Number |
| <b>WDFW</b>                      |                 |                  |                 |                  |                 |                  |
| Tucannon River                   |                 |                  | 11              | 47               | 5               | 21               |
| Kalama R., Wind R.               |                 |                  |                 |                  |                 |                  |
| Fish Trap - F.W.                 |                 |                  |                 |                  |                 |                  |
| Treaty Troll                     |                 |                  |                 |                  |                 |                  |
| Lyons Ferry Hatch. <sup>b</sup>  |                 |                  | 58              | 58               | 21              | 21               |
| F.W. Sport                       |                 |                  |                 |                  |                 |                  |
| Non-treaty Ocean Troll           |                 |                  |                 |                  |                 |                  |
| <b>ODFW</b>                      |                 |                  |                 |                  |                 |                  |
| Test Net, Zone 4                 |                 |                  |                 |                  |                 |                  |
| Treaty Ceremonial                |                 |                  |                 |                  |                 |                  |
| Three Mile, Umatilla R.          |                 |                  |                 |                  |                 |                  |
| Spawning Ground                  |                 |                  |                 |                  |                 |                  |
| Fish Trap - F.W.                 |                 |                  |                 |                  |                 |                  |
| F.W. Sport                       |                 |                  |                 |                  |                 |                  |
| Hatchery                         |                 |                  |                 |                  |                 |                  |
| Columbia R. Gillnet              | 1               | 1                |                 |                  |                 |                  |
| Columbia R. Sport                |                 |                  |                 |                  |                 |                  |
| <b>CDFO</b>                      |                 |                  |                 |                  |                 |                  |
| Non-treaty Ocean Troll           |                 |                  |                 |                  |                 |                  |
| Mixed Net & Seine                |                 |                  |                 |                  |                 |                  |
| Ocean Sport                      |                 |                  |                 |                  |                 |                  |
| <b>USFWS</b>                     |                 |                  |                 |                  |                 |                  |
| Warm Springs Hatchery            |                 |                  |                 |                  |                 |                  |
| Dworshak NFH                     |                 |                  |                 |                  |                 |                  |
| <b>IDFG</b>                      |                 |                  |                 |                  |                 |                  |
| Hatchery                         |                 |                  |                 |                  |                 |                  |
| <b>Total Returns</b>             | 1               | 1                | 69              | 105              | 26              | 42               |
| <b>Tucannon (%)</b>              | 0.0             |                  | 100.0           |                  | 100.0           |                  |
| <b>Out-of-Basin (%)</b>          | 0.0             |                  | 0.0             |                  | 0.0             |                  |
| <b>Commercial Harvest (%)</b>    | 100.0           |                  | 0.0             |                  | 0.0             |                  |
| <b>Sport Harvest (%)</b>         | 0.0             |                  | 0.0             |                  | 0.0             |                  |
| <b>Treaty Ceremonial (%)</b>     | 0.0             |                  | 0.0             |                  | 0.0             |                  |
| <b>Other (%)</b>                 | 0.0             |                  | 0.0             |                  | 0.0             |                  |
| <b>Survival</b>                  | 0.01            |                  | 0.09            |                  | 0.06            |                  |

<sup>a</sup> WDFW agency code prefix is 63.

<sup>b</sup> Fish trapped at TFH and held at LFH for spawning.

**Appendix J (continued). Observed and estimated recoveries of coded-wire tagged salmon released into the Tucannon River with percent return to the Tucannon Basin, out-of-basin returns, and estimated survival and exploitation rates for the 1985-2009 brood years. (Data downloaded from RMIS database on 2/03/14.)**

| <b>Brood Year</b>                | 2003            |                  | 2004            |                  | 2004            |                  |
|----------------------------------|-----------------|------------------|-----------------|------------------|-----------------|------------------|
| <b>Smolts Released</b>           | 125,304         |                  | 67,272          |                  | 127,162         |                  |
| <b>Fish Size (g)</b>             | 34              |                  | 34              |                  | 30              |                  |
| <b>CWT Codes<sup>a</sup></b>     | 27/78 CB        |                  | 28/87           |                  | 28/65 CB        |                  |
| <b>Release Year</b>              | 2005            |                  | 2006            |                  | 2006            |                  |
| <b>Agency (fishery/location)</b> | Observed Number | Estimated Number | Observed Number | Estimated Number | Observed Number | Estimated Number |
| <b>WDFW</b>                      |                 |                  |                 |                  |                 |                  |
| Tucannon River                   | 5               | 21               | 24              | 102              | 17              | 73               |
| Kalama R., Wind R.               |                 |                  |                 |                  |                 |                  |
| Fish Trap - F.W.                 |                 |                  |                 |                  |                 |                  |
| Treaty Troll                     |                 |                  |                 |                  |                 |                  |
| Lyons Ferry Hatch. <sup>b</sup>  | 3               | 3                | 44              | 44               | 36              | 36               |
| F.W. Sport                       |                 |                  |                 |                  |                 |                  |
| Non-treaty Ocean Troll           |                 |                  |                 |                  |                 |                  |
| <b>ODFW</b>                      |                 |                  |                 |                  |                 |                  |
| Test Net, Zone 4                 |                 |                  |                 |                  |                 |                  |
| Treaty Ceremonial                |                 |                  |                 |                  |                 |                  |
| Three Mile, Umatilla R.          |                 |                  |                 |                  |                 |                  |
| Spawning Ground                  |                 |                  |                 |                  |                 |                  |
| Fish Trap - F.W.                 |                 |                  |                 |                  |                 |                  |
| F.W. Sport                       |                 |                  |                 |                  |                 |                  |
| Hatchery                         |                 |                  |                 |                  |                 |                  |
| Columbia R. Gillnet              |                 |                  |                 |                  | 3               | 14               |
| Columbia R. Sport                |                 |                  |                 |                  | 1               | 4                |
| <b>CDFO</b>                      |                 |                  |                 |                  |                 |                  |
| Non-treaty Ocean Troll           |                 |                  | 1               | 1                |                 |                  |
| Mixed Net & Seine                |                 |                  |                 |                  |                 |                  |
| Ocean Sport                      |                 |                  |                 |                  |                 |                  |
| <b>USFWS</b>                     |                 |                  |                 |                  |                 |                  |
| Warm Springs Hatchery            |                 |                  |                 |                  |                 |                  |
| Dworshak NFH                     |                 |                  |                 |                  |                 |                  |
| <b>IDFG</b>                      |                 |                  |                 |                  |                 |                  |
| Hatchery                         |                 |                  |                 |                  |                 |                  |
| <b>Total Returns</b>             | <b>8</b>        | <b>24</b>        | <b>69</b>       | <b>147</b>       | <b>57</b>       | <b>127</b>       |
| <b>Tucannon (%)</b>              |                 | 100.0            |                 | 99.3             |                 | 85.8             |
| <b>Out-of-Basin (%)</b>          |                 | 0.0              |                 | 0.0              |                 | 0.0              |
| <b>Commercial Harvest (%)</b>    |                 | 0.0              |                 | 0.7              |                 | 11.0             |
| <b>Sport Harvest (%)</b>         |                 | 0.0              |                 | 0.0              |                 | 3.2              |
| <b>Treaty Ceremonial (%)</b>     |                 | 0.0              |                 | 0.0              |                 | 0.0              |
| <b>Other (%)</b>                 |                 | 0.0              |                 | 0.0              |                 | 0.0              |
| <b>Survival</b>                  |                 | 0.02             |                 | 0.22             |                 | 0.10             |

<sup>a</sup> WDFW agency code prefix is 63.

<sup>b</sup> Fish trapped at TFH and held at LFH for spawning.



**Appendix J (continued). Observed and estimated recoveries of coded-wire tagged salmon released into the Tucannon River with percent return to the Tucannon Basin, out-of-basin returns, and estimated survival and exploitation rates for the 1985-2009 brood years. (Data downloaded from RMIS database on 2/03/14.)**

| <b>Brood Year</b>   | 2005            |                  | 2005            |                  | 2006            |                  |
|---|-----------------|------------------|-----------------|------------------|-----------------|------------------|
| <b>Smolts Released</b>  | 88,885          |                  | 144,833         |                  | 75,283          |                  |
| <b>Fish Size (g)</b>  | 61              |                  | 57              |                  | 57              |                  |
| <b>CWT Codes<sup>a</sup></b>  | 34/77 CB        |                  | 35/99           |                  | 41/94 CB        |                  |
| <b>Release Year</b>   | 2007            |                  | 2007            |                  | 2008            |                  |
| <b>Agency (fishery/location)</b>  | Observed Number | Estimated Number | Observed Number | Estimated Number | Observed Number | Estimated Number |
| <b>WDFW</b>   |                 |                  |                 |                  |                 |                  |
| Tucannon River<br>Kalama R., Wind R.<br>Fish Trap - F.W.<br>Treaty Troll  | 78              | 298              | 130             | 494              | 68              | 384              |
| Lyons Ferry Hatch. <sup>b</sup><br>F.W. Sport<br>Non-treaty Ocean Troll   | 3               | 3                | 96              | 97               | 4               | 5                |
| <b>ODFW</b>   |                 |                  |                 |                  |                 |                  |
| Test Net, Zone 4<br>Treaty Ceremonial<br>Three Mile, Umatilla R.<br>Spawning Ground<br>Fish Trap - F.W.<br>F.W. Sport<br>Hatchery |                 |                  | 2               | 2                |                 |                  |
| Columbia R. Gillnet<br>Columbia R. Sport<br>Juv. Marine Seine   | 1               | 1                |                 |                  | 8<br>3          | 26<br>3          |
| <b>CDFO</b>   |                 |                  |                 |                  |                 |                  |
| Non-treaty Ocean Troll<br>Mixed Net & Seine<br>Ocean Sport  |                 |                  |                 |                  |                 |                  |
| <b>USFWS</b>  |                 |                  |                 |                  |                 |                  |
| Warm Springs Hatchery<br>Dworshak NFH   |                 |                  |                 |                  |                 |                  |
| <b>IDFG</b>   |                 |                  |                 |                  |                 |                  |
| Hatchery  |                 |                  |                 |                  |                 |                  |
| <b>Total Returns</b>  | 82              | 302              | 228             | 593              | 83              | 418              |
| <b>Tucannon (%)</b>   | 99.7            |                  | 99.7            |                  | 93.1            |                  |
| <b>Out-of-Basin (%)</b>   | 0.0             |                  | 0.0             |                  | 0.0             |                  |
| <b>Commercial Harvest (%)</b>   | 0.0             |                  | 0.3             |                  | 6.2             |                  |
| <b>Sport Harvest (%)</b>  | 0.0             |                  | 0.0             |                  | 0.0             |                  |
| <b>Treaty Ceremonial (%)</b>  | 0.0             |                  | 0.0             |                  | 0.0             |                  |
| <b>Other (%)</b>  | 0.3             |                  | 0.0             |                  | 0.7             |                  |
| <b>Survival</b>   | 0.34            |                  | 0.41            |                  | 0.56            |                  |

<sup>a</sup> WDFW agency code prefix is 63.

<sup>b</sup> Fish trapped at TFH and held at LFH for spawning.

**Appendix J (continued). Observed and estimated recoveries of coded-wire tagged salmon released into the Tucannon River with percent return to the Tucannon Basin, out-of-basin returns, and estimated survival and exploitation rates for the 1985-2009 brood years. (Data downloaded from RMIS database on 2/03/14.)**

| <b>Brood Year</b>                | 2006            |                  | 2006            |                  | 2007            |                  |
|----------------------------------|-----------------|------------------|-----------------|------------------|-----------------|------------------|
| <b>Smolts Released</b>           | 50,309          |                  | 51,858          |                  | 58,044          |                  |
| <b>Fish Size (g)</b>             | 54              |                  | 39              |                  | 37              |                  |
| <b>CWT Codes<sup>a</sup></b>     | 40/93           |                  | 40/94           |                  | 46/87           |                  |
| <b>Release Year</b>              | 2008            |                  | 2008            |                  | 2009            |                  |
| <b>Agency (fishery/location)</b> | Observed Number | Estimated Number | Observed Number | Estimated Number | Observed Number | Estimated Number |
| <b>WDFW</b>                      |                 |                  |                 |                  |                 |                  |
| Tucannon River                   | 75              | 385              | 85              | 457              | 7               | 42               |
| Kalama R., Wind R.               |                 |                  |                 |                  |                 |                  |
| Fish Trap - F.W.                 |                 |                  |                 |                  |                 |                  |
| Treaty Troll                     |                 |                  |                 |                  |                 |                  |
| Lyons Ferry Hatch. <sup>b</sup>  | 42              | 75               | 48              | 87               | 31              | 31               |
| F.W. Sport                       |                 |                  |                 |                  |                 |                  |
| Non-treaty Ocean Troll           |                 |                  |                 |                  |                 |                  |
| <b>ODFW</b>                      |                 |                  |                 |                  |                 |                  |
| Test Net, Zone 4                 |                 |                  |                 |                  |                 |                  |
| Treaty Ceremonial                |                 |                  |                 |                  |                 |                  |
| Three Mile, Umatilla R.          |                 |                  |                 |                  |                 |                  |
| Spawning Ground                  |                 |                  |                 |                  |                 |                  |
| Fish Trap - F.W.                 |                 |                  |                 |                  |                 |                  |
| F.W. Sport                       |                 |                  |                 |                  |                 |                  |
| Hatchery                         |                 |                  |                 |                  |                 |                  |
| Columbia R. Gillnet              | 5               | 21               | 2               | 9                | 1               | 5                |
| Columbia R. Sport                |                 |                  |                 |                  |                 |                  |
| Juv. Marine Seine                | 3               | 3                | 2               | 2                |                 |                  |
| <b>CDFO</b>                      |                 |                  |                 |                  |                 |                  |
| Non-treaty Ocean Troll           |                 |                  |                 |                  |                 |                  |
| Mixed Net & Seine                |                 |                  |                 |                  |                 |                  |
| Ocean Sport                      |                 |                  |                 |                  |                 |                  |
| <b>USFWS</b>                     |                 |                  |                 |                  |                 |                  |
| Warm Springs Hatchery            |                 |                  |                 |                  |                 |                  |
| Dworshak NFH                     |                 |                  |                 |                  |                 |                  |
| <b>IDFG</b>                      |                 |                  |                 |                  |                 |                  |
| Hatchery                         |                 |                  | 1               | 1                |                 |                  |
| <b>Total Returns</b>             | 125             | 484              | 138             | 556              | 39              | 78               |
| <b>Tucannon (%)</b>              | 95.1            |                  | 97.8            |                  | 93.6            |                  |
| <b>Out-of-Basin (%)</b>          | 0.0             |                  | 0.2             |                  | 0.0             |                  |
| <b>Commercial Harvest (%)</b>    | 4.3             |                  | 1.6             |                  | 6.4             |                  |
| <b>Sport Harvest (%)</b>         | 0.0             |                  | 0.0             |                  | 0.0             |                  |
| <b>Treaty Ceremonial (%)</b>     | 0.0             |                  | 0.0             |                  | 0.0             |                  |
| <b>Other (%)</b>                 | 0.6             |                  | 0.4             |                  | 0.0             |                  |
| <b>Survival</b>                  | 0.96            |                  | 1.07            |                  | 0.13            |                  |

<sup>a</sup> WDFW agency code prefix is 63.

<sup>b</sup> Fish trapped at TFH and held at LFH for spawning.

**Appendix J (continued). Observed and estimated recoveries of coded-wire tagged salmon released into the Tucannon River with percent return to the Tucannon Basin, out-of-basin returns, and estimated survival and exploitation rates for the 1985-2009 brood years. (Data downloaded from RMIS database on 2/03/14.)**

| <b>Brood Year</b>                | 2007            |                  | 2008            |                  | 2008            |                  |
|----------------------------------|-----------------|------------------|-----------------|------------------|-----------------|------------------|
| <b>Smolts Released</b>           | 55,266          |                  | 84,613          |                  | 84,738          |                  |
| <b>Fish Size (g)</b>             | 57              |                  | 40              |                  | 66              |                  |
| <b>CWT Codes<sup>a</sup></b>     | 46/88           |                  | 51/74           |                  | 51/75           |                  |
| <b>Release Year</b>              | 2009            |                  | 2010            |                  | 2010            |                  |
| <b>Agency (fishery/location)</b> | Observed Number | Estimated Number | Observed Number | Estimated Number | Observed Number | Estimated Number |
| <b>WDFW</b>                      |                 |                  |                 |                  |                 |                  |
| Tucannon River                   | 18              | 113              | 21              | 150              | 35              | 270              |
| Kalama R., Wind R.               |                 |                  |                 |                  |                 |                  |
| Fish Trap - F.W.                 |                 |                  |                 |                  |                 |                  |
| Treaty Troll                     |                 |                  |                 |                  |                 |                  |
| Lyons Ferry Hatch. <sup>b</sup>  | 32              | 32               | 28              | 28               | 44              | 44               |
| F.W. Sport                       |                 |                  |                 |                  |                 |                  |
| Non-treaty Ocean Troll           |                 |                  |                 |                  |                 |                  |
| <b>ODFW</b>                      |                 |                  |                 |                  |                 |                  |
| Test Net, Zone 4                 |                 |                  |                 |                  |                 |                  |
| Treaty Ceremonial                |                 |                  |                 |                  |                 |                  |
| Three Mile, Umatilla R.          |                 |                  |                 |                  |                 |                  |
| Spawning Ground                  |                 |                  |                 |                  |                 |                  |
| Fish Trap - F.W.                 |                 |                  |                 |                  |                 |                  |
| F.W. Sport                       |                 |                  |                 |                  |                 |                  |
| Hatchery                         |                 |                  |                 |                  |                 |                  |
| Columbia R. Gillnet              |                 |                  | 1               | 4                |                 |                  |
| Columbia R. Sport                |                 |                  |                 |                  |                 |                  |
| Juv. Marine Seine                |                 |                  |                 |                  |                 |                  |
| <b>CDFO</b>                      |                 |                  |                 |                  |                 |                  |
| Non-treaty Ocean Troll           |                 |                  |                 |                  |                 |                  |
| Mixed Net & Seine                |                 |                  |                 |                  |                 |                  |
| Ocean Sport                      |                 |                  |                 |                  |                 |                  |
| <b>USFWS</b>                     |                 |                  |                 |                  |                 |                  |
| Warm Springs Hatchery            |                 |                  |                 |                  |                 |                  |
| Dworshak NFH                     |                 |                  |                 |                  |                 |                  |
| <b>IDFG</b>                      |                 |                  |                 |                  |                 |                  |
| Hatchery                         |                 |                  |                 |                  |                 |                  |
| <b>Total Returns</b>             | 50              | 145              | 50              | 182              | 79              | 314              |
| <b>Tucannon (%)</b>              | 100.0           |                  | 97.8            |                  | 100.0           |                  |
| <b>Out-of-Basin (%)</b>          | 0.0             |                  | 0.0             |                  | 0.0             |                  |
| <b>Commercial Harvest (%)</b>    | 0.0             |                  | 2.2             |                  | 0.0             |                  |
| <b>Sport Harvest (%)</b>         | 0.0             |                  | 0.0             |                  | 0.0             |                  |
| <b>Treaty Ceremonial (%)</b>     | 0.0             |                  | 0.0             |                  | 0.0             |                  |
| <b>Other (%)</b>                 | 0.0             |                  | 0.0             |                  | 0.0             |                  |
| <b>Survival</b>                  | 0.26            |                  | 0.22            |                  | 0.37            |                  |

<sup>a</sup> WDFW agency code prefix is 63.

<sup>b</sup> Fish trapped at TFH and held at LFH for spawning.

**Appendix J (continued). Observed and estimated recoveries of coded-wire tagged salmon released into the Tucannon River with percent return to the Tucannon Basin, out-of-basin returns, and estimated survival and exploitation rates for the 1985-2009 brood years. (Data downloaded from RMIS database on 2/03/14.)**

| <b>Brood Year</b>                | 2009 <sup>c</sup> |                  | 2009 <sup>c</sup> |                  |                 |                  |
|----------------------------------|-------------------|------------------|-------------------|------------------|-----------------|------------------|
| <b>Smolts Released</b>           | 117,824           |                  | 113,049           |                  |                 |                  |
| <b>Fish Size (g)</b>             | 35                |                  | 51                |                  |                 |                  |
| <b>CWT Codes<sup>a</sup></b>     | 55/65             |                  | 55/66             |                  |                 |                  |
| <b>Release Year</b>              | 2011              |                  | 2011              |                  |                 |                  |
| <b>Agency (fishery/location)</b> | Observed Number   | Estimated Number | Observed Number   | Estimated Number | Observed Number | Estimated Number |
| <b>WDFW</b>                      |                   |                  |                   |                  |                 |                  |
| Tucannon River                   |                   |                  | 1                 | 9                |                 |                  |
| Kalama R., Wind R.               |                   |                  |                   |                  |                 |                  |
| Fish Trap - F.W.                 |                   |                  |                   |                  |                 |                  |
| Treaty Troll                     |                   |                  |                   |                  |                 |                  |
| Lyons Ferry Hatch. <sup>b</sup>  |                   |                  |                   |                  |                 |                  |
| F.W. Sport                       |                   |                  |                   |                  |                 |                  |
| Non-treaty Ocean Troll           |                   |                  |                   |                  |                 |                  |
| <b>ODFW</b>                      |                   |                  |                   |                  |                 |                  |
| Test Net, Zone 4                 |                   |                  |                   |                  |                 |                  |
| Treaty Ceremonial                |                   |                  |                   |                  |                 |                  |
| Three Mile, Umatilla R.          |                   |                  |                   |                  |                 |                  |
| Spawning Ground                  |                   |                  |                   |                  |                 |                  |
| Fish Trap - F.W.                 |                   |                  |                   |                  |                 |                  |
| F.W. Sport                       |                   |                  |                   |                  |                 |                  |
| Hatchery                         |                   |                  |                   |                  |                 |                  |
| Columbia R. Gillnet              |                   |                  | 1                 | 1                |                 |                  |
| Columbia R. Sport                |                   |                  |                   |                  |                 |                  |
| Juv. Marine Seine                |                   |                  |                   |                  |                 |                  |
| <b>CDFO</b>                      |                   |                  |                   |                  |                 |                  |
| Non-treaty Ocean Troll           |                   |                  |                   |                  |                 |                  |
| Mixed Net & Seine                |                   |                  |                   |                  |                 |                  |
| Ocean Sport                      | 1                 | 4                |                   |                  |                 |                  |
| <b>USFWS</b>                     |                   |                  |                   |                  |                 |                  |
| Warm Springs Hatchery            |                   |                  |                   |                  |                 |                  |
| Dworshak NFH                     |                   |                  |                   |                  |                 |                  |
| <b>IDFG</b>                      |                   |                  |                   |                  |                 |                  |
| Hatchery                         |                   |                  |                   |                  |                 |                  |
| <b>Total Returns</b>             | 1                 | 4                | 2                 | 10               |                 |                  |
| <b>Tucannon (%)</b>              | 0.0               |                  | 90.0              |                  |                 |                  |
| <b>Out-of-Basin (%)</b>          | 0.0               |                  | 0.0               |                  |                 |                  |
| <b>Commercial Harvest (%)</b>    | 0.0               |                  | 10.0              |                  |                 |                  |
| <b>Sport Harvest (%)</b>         | 100.0             |                  | 0.0               |                  |                 |                  |
| <b>Treaty Ceremonial (%)</b>     | 0.0               |                  | 0.0               |                  |                 |                  |
| <b>Other (%)</b>                 | 0.0               |                  | 0.0               |                  |                 |                  |
| <b>Survival</b>                  | 0.00              |                  | 0.01              |                  |                 |                  |

<sup>a</sup> WDFW agency code prefix is 63.

<sup>b</sup> Fish trapped at TFH and held at LFH for spawning.

<sup>c</sup> Data for the 2009 brood year is incomplete.



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