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Productivity of Spring Chinook Salmon and Summer Steelhead in the John Day River Basin

Annual Technical Report

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EXECUTIVE SUMMARY

Objective

Estimate smolt-to-adult survival rates (SAR) and out-migrant abundance for spring Chinook *Oncorhynchus tshawytscha* and summer steelhead *O. mykiss* and life history characteristics of summer steelhead for the John Day River subbasin.

Accomplishments and Findings

To estimate spring (stream-type) Chinook *Oncorhynchus tshawytscha* and summer steelhead *O. mykiss* smolt-to-adult return (SAR), we PIT tagged 4,005 juvenile spring Chinook and 4,001 juvenile steelhead during the spring of 2009. We estimate 129,565 (95% CL's 89,301–190,356) juvenile spring Chinook emigrated from the upper John Day subbasin past our seining area (river kilometers 274–296) between 1 February and 19 May 2009. We also estimate 81,850 (95% CL's 66,803 and 105,138) juvenile spring Chinook and 50,198 (95% CL's 39,541 and 64,436) juvenile steelhead migrated past our Mainstem rotary screw trap (RST) at river kilometer (rkm) 326 between 30 September 2008 and 14 July 2009. In addition, we estimate 38,519 (95% CL's 34,191 and 43,658) juvenile spring Chinook and 14,522 (95% CL's 9,464 and 23,223) steelhead migrated past our Middle Fork RST (rkm 24) between 29 September 2008 and 18 June 2009. For the 2007 brood year, we estimate 151 smolts/redd for spring Chinook throughout the John Day River basin, 229 smolts/redd for the Upper Mainstem, and 453 smolts/redd for the Middle Fork watersheds. The age structure of steelhead emigrants was 72.2% age 2, 21.2% age 1, 6.6% age 3, and 0.04% age 4. Spring Chinook SAR for the 2004 brood year was 1.4% (48 returns of 3,418 PIT tagged smolts). Summer steelhead SAR for the 2007 migration year was 6.12% (248 returns of 4,053 PIT-tagged migrants). Over 50% of PIT tagged adult summer steelhead that returned during 2008 wintered outside of the John Day basin through April of 2009 in the Columbia River between Bonneville Dam (rkm 235) and Rock Island Dam (rkm 669), and the Snake River from it's mouth to Lower Granite Dam. Steelhead transported as smolts from Lower Granite Dam to below Bonneville Dam composed 86% (39 of 45) of stray adult steelhead PIT tag detections in the John Day River basin.

Acknowledgements

We would like to acknowledge the assistance and cooperation of private landowners throughout the John Day River basin who allowed us to survey on their private property. Additionally, we would like to thank Jeff Neal for providing guidance and advice. This project was funded by the U.S. Department of Energy, Bonneville Power Administration, Environment, Fish, and Wildlife-Project number 1998-016-00; Contract 40876.

INTRODUCTION

The John Day River subbasin supports one of the last remaining intact wild populations of spring Chinook salmon and summer steelhead in the Columbia River Basin. These populations remain depressed relative to historic levels and limited information is available for steelhead life history. Numerous habitat protection and rehabilitation projects have been implemented in the basin to improve salmonid freshwater production and survival. However, these projects often lack effectiveness monitoring. While our monitoring efforts outlined here will not specifically measure the effectiveness of any particular project, they will provide much needed programmatic or watershed (status and trend) information to help evaluate project-specific effectiveness monitoring efforts as well as meet some data needs as index stocks. Our continued monitoring efforts to estimate salmonid smolt abundance, age structure, SAR, smolts/redd, freshwater habitat use, and distribution of critical life states will enable managers to assess the long-term effectiveness of habitat projects and to differentiate freshwater and ocean survival.

Because Columbia Basin managers have identified the John Day subbasin spring Chinook population as an index population for assessing the effects of alternative future management actions on salmon stocks in the Columbia Basin (Schaller et al. 1999) we continue our ongoing studies. This project is high priority based on the level of emphasis by the NWPPC Fish and Wildlife Program, Independent Scientific Advisory Board (ISAB), Independent Scientific Review Panel (ISRP), NOAA National Marine Fisheries Service (NMFS), and the Oregon Plan for Salmon and Watersheds (OWEB). Each of these groups has placed priority on monitoring and evaluation to provide the real-time data to guide restoration and adaptive management in the region.

STUDY AREA

The John Day River drains 20,300 km^2 of east central Oregon, the third largest drainage area in the state (Figure 1). From its source in the Strawberry Mountains at an elevation near 1,800 m, the John Day River flows 457 km, to an elevation near 90 m, to the Columbia River. It enters the Columbia River at river kilometer (rkm) 351. The basin is bounded by the Columbia River to the south and the Ochoco Mountains to the west.

Spring Chinook salmon primarily spawn in the upper Mainstem John Day River (hereafter called Mainstem) above the mouth of Indian Creek, in the Middle Fork John Day River (hereafter called Middle Fork) above Armstrong Creek, and the North Fork John Day River (hereafter called North Fork) above the mouth of Camas Creek. Important spawning tributaries of the North Fork include Granite Creek and its tributaries (Clear Creek and Bull Run Creek; hereafter called Granite Creek System) and Desolation Creek. Spawning has also occurred in the South Fork John Day River (hereafter called South Fork), the North Fork Tributaries Camas Creek, Trail Creek, and the Mainstem tributary Deardorff Creek. Fall Chinook are thought to spawn in the Lower Mainstem downstream of Kimberly, OR (rkm 298) but primarily between Cottonwood Bridge (rkm 64) and Tumwater Falls (rkm 16).

Summer steelhead sampled during this study have a spawning and rearing distribution in the Mainstem, South Fork, Middle Fork, and North Fork channels and tributaries of the John Day River upstream of rkm 298 where the North Fork and Mainstem merge. Summer Steelhead also spawn and rear in the lower Mainstem tributaries downstream of rkm 298. When juvenile steelhead are referenced in this document, we acknowledge the presence of alternative life-history forms and that some juveniles of all sizes may be resident (redband trout) or anadromous (steelhead) life-history forms. These alternate life-history forms are typically morphologically indistinguishable when examined as immature parr. We therefore refer to all juvenile *O. mykiss* as juvenile steelhead. Maps of the distribution of both Chinook and steelhead in the John Day River basin can be viewed at: http://www.streamnet.org/online-data/map_catalog.html.

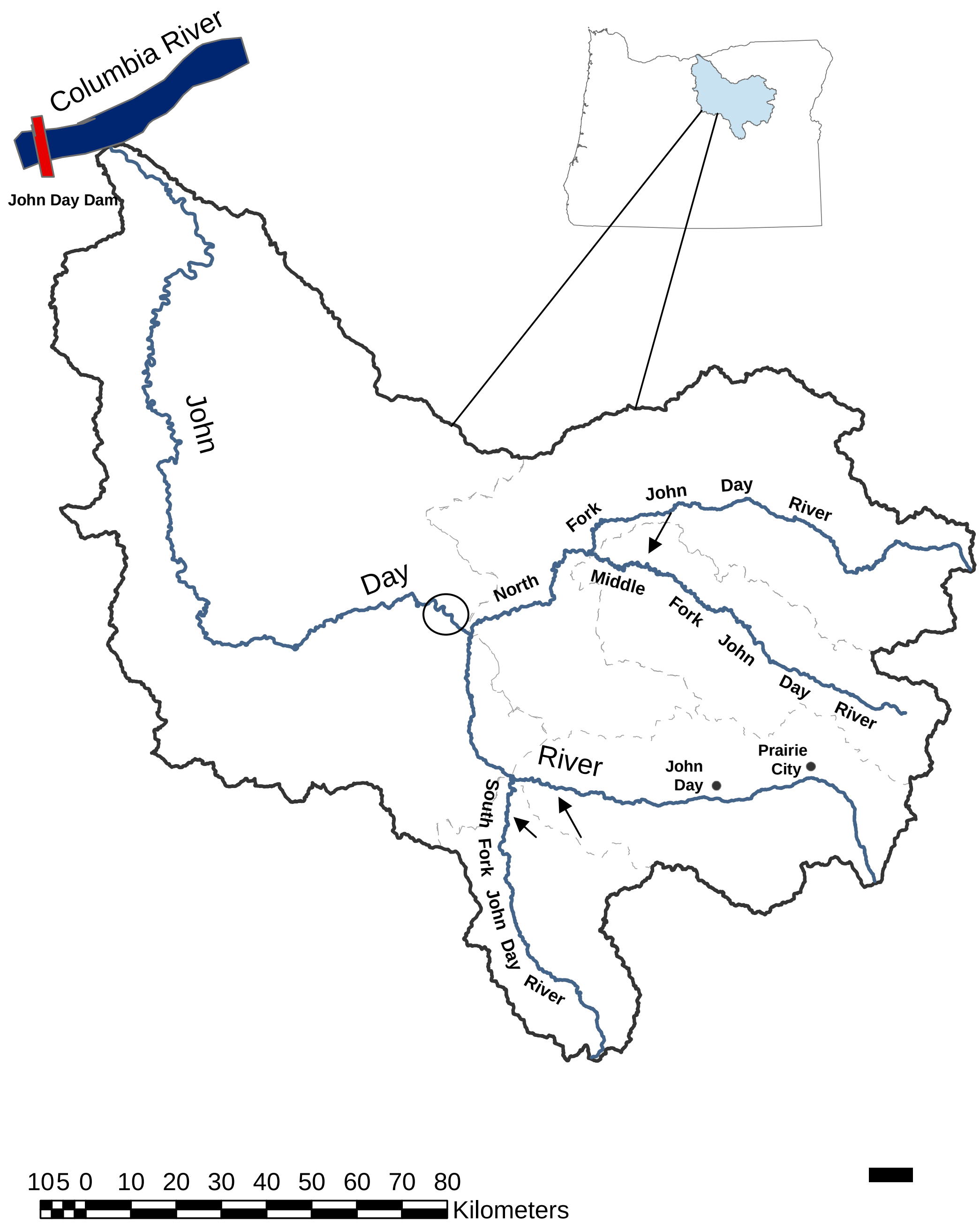

Figure 1. Map of John Day River basin. Dashed line denotes watershed boundary. Arrows indicate approximate locations of rotary screw traps and the circle indicates our Mainstem seining reach between Kimberly and Spray, OR.

METHODS

During 2009, juvenile spring Chinook and steelhead migrants were captured at three rotary screw trap (RST) sites and while seining in the Mainstem John Day River [river kilometers (rkm) 274–296] in order to estimate abundance, smolt-to-adult return (SAR), and to study life history characteristics of summer steelhead in the John Day River subbasin.

Two RSTs were located in the Upper Mainstem fourth level HUC and are hereafter referred to as the Mainstem trap at rkm 352 (just upstream of Dayville) and South Fork trap located at rkm 10 of the South Fork John Day River. The Mainstem trap was relocated from its previous site at rkm 326 to the current site near the Flat Creek access road of the Phillip Schneider Wildlife Area upstream of the confluence with the South Fork John Day River. A third RST was located in the Middle Fork John Day River at rkm 24 near Ritter and is hereafter referred to as the Middle Fork trap. The Mainstem seining operation was located just downstream of the confluence of the Mainstem and North Fork (Figure 1).

The Mainstem trap, South Fork trap, Middle Fork Trap, and Mainstem seining operation are all located downstream of all known spring Chinook spawning habitat. Some summer rearing does occur in Bridge Creek (Ian Tattam, personal communication) and likely occurs in other tributaries downstream of our collection sites. The Middle Fork trap site is upstream of four fish bearing tributaries entering the Middle Fork including Six-mile Creek, Three-mile Creek, Long Creek, and Eight-mile Creek. All RSTs are equipped with live boxes, which safely hold juvenile fish for 24–72 h time intervals. At the Mainstem and South Fork trap sites we fished either a 1.52 or 2.44 meter diameter RST depending on water conditions to optimize trap efficiency. Both sizes of RSTs were fished at the Mainstem and South Fork trap sites when water levels allowed. A 1.52 m diameter RST was fished at the Middle Fork (rkm 24) trap site. Traps were either removed or stopped during times of ice, high discharge, and during warm summer months after fish ceased migrating.

All RSTs were fished four days each by lowering cones on Mondays and raising cones on Fridays. Traps were checked daily during the weekly fishing periods. We assumed that all fish captured were migrants. Non-target fish species were identified, enumerated, and returned to the stream. Captured juvenile spring Chinook and steelhead migrants were anesthetized with tricane methane sulfonate (MS-222), interrogated for passive integrated transponder tags (PIT tags) or external marks, enumerated, weighed to the nearest 0.1 g, and measured (fork length, FL; mm). We followed PTAGIS marking procedures when handling, PIT tagging, and marking juvenile migrants (PTAGIS 1999, Keefe et al. 1998, Hart and Pitcher 1969).

Juvenile spring Chinook and steelhead were captured by beach and boat seining in the Mainstem John Day River between rkm 274 and 296 from 5 February to 19 May 2009 in order to supplement trapping efforts when traps were not operational due to high water discharge. Eddies, riffles, and river margins were sampled with a seine constructed of 12.7 mm mesh netting that measured 30.5 m long by 2.4 m deep with a 1.2 x 1.2 m bag constructed of 9.5 mm mesh netting in the middle. Locations for sampling within our study reach varied on a daily basis depending on discharge and success experienced during previous sampling days (see Appendix Table A-1 for a list of sample sites). Captured spring Chinook and steelhead emigrants were handled similar as at RST sites except all newly PIT-tagged or marked emigrants were released at rkm 298, two kilometers upstream of our most upstream seining site. Recaptured smolts were released seven kilometers downstream of Spray, OR at rkm 267. Mean weekly catch-per-seine estimates were determined to assess smolt migration timing through the lower Mainstem (rkm 268–296) during the months of February–May. All PIT-tag information was submitted to the PIT tag Information System (PTAGIS).

Day and night release trapping efficiency (TE) estimate strategy was evaluated for the Mainstem and Middle Fork trap sites. Day release and night release TE was estimated separately for each fish species at each RST site by releasing previously marked fish upstream of the trap and then counting the number of marked fish recaptured (Thedinga et al. 1994). Fish were marked with a pan jet paint mark below the surface of the fish's skin at the cranial (night release) or caudal (day release) insertion of the anal fin (Hart and Pitcher 1969, Keefe et al, 1998) or by PIT tagging. We alternated marking fish for day and night release as they were processed. Up to 30 fish were marked for day release and 30 for night release at the Mainstem and South Fork trap sites. At the Middle Fork trap, we marked half of all spring Chinook and summer steelhead captured for night release and half for day release.

Day release TE fish were released 4.8 rkm upstream of the South Fork trap, 4 rkm upstream of the Mainstem trap, and 2.5 rkm upstream of the Middle Fork trap immediately after they were marked. Night release TE fish were marked, held in the tubs of a modified timed release device (Miller et al, 2000), and released after dark 1.8 rkm upstream of the South Fork trap, 1.1 rkm upstream of the Middle Fork trap, and 1.3 rkm upstream of the Mainstem trap. Trap efficiency intervals varied depending on the number of recaptured fish of each species (Keefe et al, 1998). Trap efficiency was estimated from the equation:

$$TE = R/M \qquad (1)$$

where TE is the estimated trap efficiency, M is the number of marked fish released upstream and R is the number of marked fish recaptured. A stratified trap efficiency method, utilizing the Bailey estimator, was used to estimate migrant abundance (Steinhorst et al. 2004) for each species. A bootstrapping procedure was then used to estimate 95% confidence intervals for migrants during both the fall/winter and spring time periods. A similar mark-recapture and bootstrapping method was used to estimate capture efficiency for our seining efforts. Abundances estimated within mark/recapture strata were expanded for days when the traps were not operated.

Additional life history, parasite, and mark information was also collected from captured fish. The presence of trematode cysts (black spot disease; *Neascus sp.*) on captured smolts was noted. We identified fin clips on adult steelhead and spring Chinook captured to determine if they were of hatchery origin. Sex, MEPS length, FL, and scale samples were taken when adult steelhead carcasses were observed. Snouts of carcasses and captured steelhead with adipose and left ventral fin clips were collected for coded wire tag identification.

Mean, SE, and range of fork length (L; mm), weight (W; g), and coefficient of condition (K) were reported for both fall/winter 30 September 2008 to 31 January 2009) and spring (1 February to 14 June 2009) migrating juvenile spring Chinook and steelhead. Coefficient of condition was calculated as:

$$K = 100\ W/L_F^{\,b} \qquad (2)$$

Where $b = 3$—the ratio of specific growth rates for length (L_F) and weight (W) (Saltzman 1977).

Travel times for fall/winter and spring tagged emigrants to reach John Day and Bonneville Dams from the release sites were summarized for each tagging location. In addition, first and last detection dates and mean, SE, and range of travel time to John Day Dam, Bonneville Dam, and the Columbia Estuary were estimated. Detection rates for each seasonal tag group were calculated by dividing the number of first time detections at dams by the number PIT tagged and released at collection sites. Detection rates represent a minimum survival rate because they are not adjusted to account for fish that pass undetected through the hydrosystem.

Smolt-to-adult return (SAR; marine survival) was estimated as the ratio of smolts PIT tagged in our trapping and seining efforts to the number of returning PIT-tagged adults detected at dams as they ascended the Columbia River using DART and PTAGIS databases (DART, PTAGIS). Spring Chinook adults return at three ages (ages 3–5) so return rate of any cohort requires three years of adult data detection. Summer steelhead typically rear 1-2 years in the ocean requiring two years of adult data detection for a single smolt cohort. We also report adult detection histories of returning John Day origin spring Chinook and summer steelhead and the detection histories of known stray PIT tagged fish detected at McDonald's Ford on the John Day River (rkm 33). Detection histories included all known adult detections in the Columbia Basin. Freshwater survival (smolt-per-redd estimates) for the 2007 brood year of spring Chinook was estimated using the number of smolts estimated to pass individual trap sites (Mainstem, Middle Fork) and the seining reach (representing the entire basin) during 2009 divided by the number of redds estimated during 2007 (Ruzycki et al, 2008).

We explored three new methods of estimating the number of returning PIT-tagged adult spring Chinook and summer steelhead to the John Day basin: (1) Confirmed John Day PIT tag detections in the John Day Basin compared to the number of all PIT tagged John Day adults observed at Bonneville Dam. (2) Ratio of John Day origin fish PIT tag recoveries in carcasses examined during spawning surveys. (3) Calculated from a McDonald Ford detection probability estimate calculated as:

$$\check{N} = C/DP_{LP} \quad (3)$$

Where $\check{N}$ is the estimated number of returning PIT-tagged fish, C is the number of PIT-tagged fish detected at the McDonald Ford array, and DP_{LP} is the detection probability from a two occasion Lincoln Peterson Model.

We assumed that fish would return to the tributary at which they were PIT tagged. Therefore, only returning fish from tributaries with PIT tag detector arrays, the South Fork, Middle Fork and Bridge Creek, were used in our McDonald Ford detection probability estimate calculated as:

$$DP_{LP} = [n_1 / (n_1 \cdot n_2) / m_2] \cdot 100 \quad (4)$$

Where the first occasion (n_1) was the number detected at the McDonald Ford array, the second occasion (n_2) was the pooled PIT tag observations at three upstream tributary arrays in the Middle Fork, South Fork and Bridge Creek, and m_2 is the number of PIT tagged fish observed at both McDonald Ford and at the three upstream arrays.

RESULTS

Juvenile Chinook Smolt Capture and Tagging

Collectively, we PIT tagged 4,005 juvenile spring Chinook at our three trap sites and in the Mainstem seining operation during the spring migration from 1 February to 14 July 2009 (Table 1). Peak movements were recorded during the month of April at all trap sites (Figure 2). Mean FL at capture for spring migrants from all trapping sites was 103.8 mm (range 64–165 mm; Table 2). Also see Table 2 for mass and body condition values of all smolts captured. Of the 7,559 juvenile spring Chinook examined for *Neascus sp.* infestation, 46 (0.6%) showed visible signs of black spot. Based on adult spring Chinook redd counts and juvenile abundance estimates from our seining operation in the Mainstem we estimated freshwater production to be 151 smolts per redd (95% CL's, 104–223) for the 2007 brood year (Table 3, Ruzycki et al, 2008).

Trapping efficiency varied among trap sites and release strategies. Appendix Tables C-1, and C-5 show weekly trapping efficiency (TE) estimates for day and night released spring Chinook at the Mainstem and Middle Fork traps, respectively. Only night release fish were used to estimate TE for spring Chinook at the South Fork trap site (Appendix C-3). The Middle Fork night release device was not deployed until the end of February because of ice. Trap efficiency estimates for the Mainstem and Middle Fork trap sites were usually higher for night release Chinook than fish released during the day with the exception of the month of October (Appendix Table C-1) when mink predation in the night release device compromised estimates. We subsequently eliminated mink predation by redesigning the lid of our release device.

At our Mainstem trap (rkm 352) we captured 2,898 juvenile spring Chinook during the fall and winter (29 September 2008–31 January 2009). During the Spring of 2009, we captured 1,781 and PIT tagged 742 juvenile migrants (1 February to 15 July 2009, Tables 1 and 2). We estimate that 81,850 (95% CL's, 66,803–105,138) juvenile Chinook migrated past the Mainstem trap site during our trapping period (Table 1). The observed age structure of 135 fish examined during May was 6.7% age 0 (parr) and 93.3% age 1 (smolt). The estimated age structure of 427 fish examined during May was 99.5% age 0 and 0.5% age 1. Mean FL during the fall migration was 99.2 mm (range 74–127 mm; Table 2). Mean FL during the spring migration was 100.7 mm (range 64–164 mm; Table 2). Of 2,908 juvenile spring Chinook examined for *Neascus sp.* infestation, 24 (0.8%) showed visible signs of black spot. Based on adult spring Chinook upper Mainstem redd counts and abundance estimates from our Mainstem trap we estimate a freshwater production of 229 smolts per redd (95% CL's, 187–294) for the 2007 brood year of the Upper Mainstem population (Table 4, Ruzycki et al, 2008).

At our South Fork trap we captured only 48, and PIT tagged 24, juvenile spring Chinook between 30 September 2008 and 25 June 2009. Mean FL of spring migrants was 101.9 mm (range = 69–118 mm, Table 2).

At our Middle Fork trap we captured 1,434 juvenile spring Chinook during the fall and winter (29 September 2008–31 January 2009). During the 2009 spring migration, we captured 2,212 and PIT tagged 1,317 juvenile spring Chinook from 1 February to 14 July (Tables 1 & 2). We estimate that 38,519 (95% CL's, 34,191–43,658) juvenile Chinook migrated past the Middle Fork trap site during our trapping period (Table 1). Mean FL during the fall migration was 90.2 mm (range 69–112 mm; Table 2). Mean FL during the spring migration was 98.2 mm (range 67–149 mm, Table 2). Of 1,826 juvenile spring Chinook examined for *Neascus sp.* infestation, three

(0.2%) showed visible signs of black spot. Based on adult spring Chinook redd counts and abundance estimates from our Middle Fork trap, we estimate freshwater production of the Middle Fork to be 453 smolts per redd (95% CL's 402–513) for the 2007 brood year (Table 5, Ruzycki et al, 2008).

We PIT tagged 1,922 of the 2,866 juvenile spring Chinook captured in 543 seine hauls in the Mainstem John Day River (rkm 274–296) from 5 February to 19 May 2009 (Table 1). Of 2,746 fish released upstream of the seining reach, 142 juveniles were recaptured during our mark-recapture efforts indicating a capture efficiency of 5.2% which peaked during the first week of May (Figure 3). We estimate that 129,565 (± 95% CL's 89,301–190,356) juveniles migrated past the seining area during our seining period (Table 3). Mean fork length was 108.6 mm (range = 80–160mm; Table 2). Of 2,788 smolts examined for *Neascus sp*. infestation in our Mainstem seining operation, 19 (0.7%) showed visible signs of black spots.

Table 1. Collection period, number captured (n), number PIT tagged (during 2009), and abundance estimates (± 95% confidence limits) for juvenile spring Chinook migrants captured at three rotary screw trap sites and while seining in the John Day River (rkm 274–296) from 29 September 2008 to 14 July 2009.

Trap Location	Collection Period	n	PIT Tagged	Abundance	95% CI
South Fork	9/30/08–6/25/09	48	24		
Mainstem	9/30/08–7/14/09	4,679	742	81,850	66,803–105,138
Middle Fork	9/29/08–6/18/09	3,646	1,317	38,519	34,191–43,658
Mainstem Seining	2/5/09–5/19/09	2,866	1,922	129,565	89,301–190,356

Table 2. Number (N), mean, and range of fork length (mm), mass (g), and coefficient of condition for spring Chinook migrants captured in three rotary screw traps and while seining on the John Day River during two periods (Fall/Winter, 29 September 2008 to 31 January 2009; and Spring, 1 February to 15 July 2009).

		Fork Length (mm)			Mass (g)			Coefficient of condition		
Location	Period	N	Mean	Range	N	Mean	Range	N	Mean	Range
South Fork Trap	Fall/Winter	12	100.2	95–105	6	12.5	9.6–14.0	6	1.19	1.05–1.35
Mainstem Trap	Fall/Winter	1,393	99.2	74–127	1,105	11.7	4.2–26.3	1,105	1.18	0.46–1.85
Middle Fork	Fall/Winter	242	90.2	69–112	204	8.8	3.5–16.4	204	1.17	0.73–1.76
All sites	Fall/Winter	1,647	97.8	69–127	1,315	11.3	3.5–26.3	1,315	1.18	0.46–1.85
South Fork Trap	Spring	25	101.9	69–118	25	11.8	3.8–18.7	25	1.08	0.92–1.17
Mainstem Trap	Spring	1,515	100.7	64–165	913	13.7	4.0–46.4	913	1.26	0.59–1.89
Middle Fork Trap	Spring	1,586	98.2	67–149	1,355	10.9	3.2–24.7	1,355	1.13	0.55–1.84
Mainstem Seining	Spring	2,787	108.6	80–160	2,548	15.4	5.1–42.6	2,548	1.17	0.67–1.70
All sites	Spring	5,913	103.8	64–165	4,841	13.8	3.2–46.4	4,841	1.18	0.55–1.89

Table 3. Smolt/redd ratios based on recent and historic estimates of smolt abundance and census redd counts for spring Chinook salmon for the entire John Day River basin. Historic estimates prior to the 1999 brood year are from Lindsay et al. (1986).

Brood year	Number of redds	Smolt migration year	Smolt abundance	95% CI	Smolts/redd	95% CI
1978	611	1980	169,000	80,000–257,000	277	131–421
1979	641	1981	83,000	52,000–113,000	129	81–176
1980	306	1982	94,000	1,000–211,000	307	3–690
1981	401	1983	64,000	40,000–89,000	160	100–222
1982	498	1984	78,000	64,000–93,000	157	129–187
1999	478	2001	92,922	79,258–111,228	194	166–233
2000	1,869	2002	103,097	90,280–119,774	55	48–64
2001	1,863	2003	83,394	76,739–91,734	45	41–49
2002	1,959	2004	91,372	76,507–113,027	47	39–58
2003	1,417	2005	130,144	97,133–168,409	92	69–119
2004	1,656	2006	101,262	59,688–179,494	61	36–108
2005	902	2007	40,615	32,117–51,385	45	36–57
2006	1,044	2008	70,319	60,597–83,201	67	58–79
2007	853	2009	129,565	89,301–190,356	151	104–223

Table 4. Upper Mainstem John Day River smolt/redd ratios based on estimates of smolt abundance and census redd counts for spring Chinook salmon, 2002–2007 brood years.

Brood year	Number of redds	Migration year	Trapping period	Smolt abundance	95% CI	Smolt/redd	95% CI
2002	549	2004	10/23/03–6/24/04	23,589	18,310–30,833	43	33–56
2003	323	2005	10/4/04–7/6/05	32,601	29,651–36,264	101	92–112
2004	368	2006	2/10/06–6/26/06	58,490	22,089–90,428	159	60–246
2005	227	2007 [a]	10/12/06–6/22/07	26,903[a]	22,184–32,716[a]	118	98–144
2006	451	2008	10/10/07–6/20/08	22,913	20,310–25,872	51	45–57
2007	357	2009	9/30/08–7/14/09	81,850	66,803–105,138	229	187–294

[a] Mainstem trap was moved upstream of the confluence with the South Fork. Estimated abundance from Mainstem and South Fork traps were henceforth combined.

Table 5. Middle Fork John Day River smolt/redd ratios based on estimates of smolt abundance and census redd counts for spring Chinook salmon, 2002–2007 brood years.

Brood Year	Number of redds	Migration Year	Trapping period	Smolt abundance	95% CI	Smolt/redd	95% CI
2002	389	2004	10/29/03–6/23/04	9,744	7,918–12,257	25	20–32
2003	236	2005	10/6/04–6/17/05	20,193	17,699–22,983	85	75–97
2004	319	2006	3/6/06–6/22/06	20,720	14,401–30,870	65	45–97
2005	178	2007	10/31/06–6/14/07	7,524	6,285–9,112	42	35–51
2006	199	2008	2/12/08–6/20/08	2,986	2,476–3,643	15	12–18
2007	85	2009	9/29/08–6/18/09	38,519	34,191–43,658	453	402–513

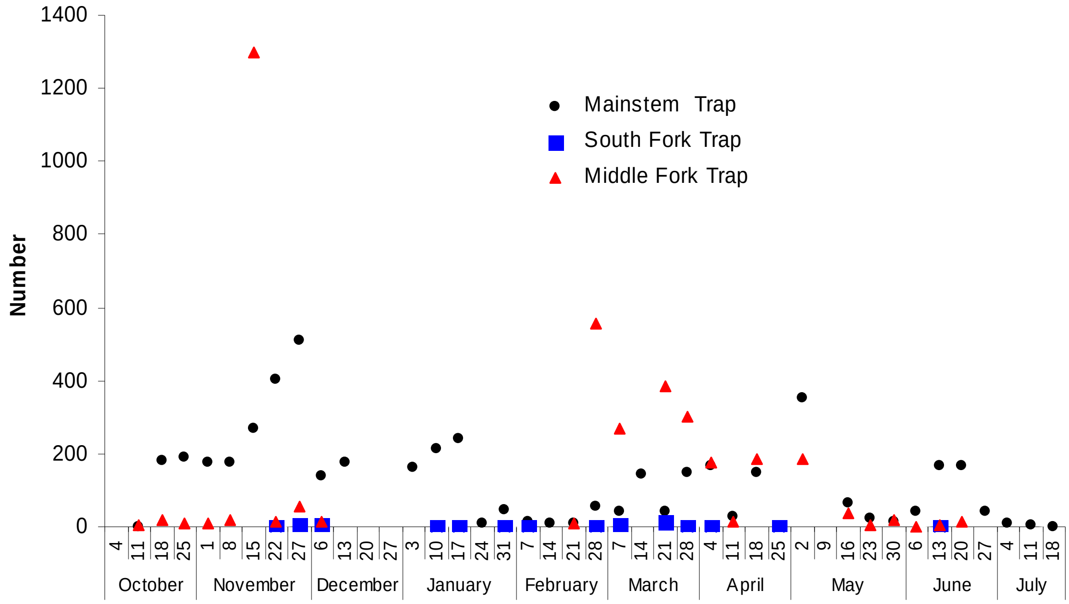

Figure 2. Weekly number of juvenile spring Chinook captured at three rotary screw traps operated in the John Day River basin during autumn 2008 and spring 2009.

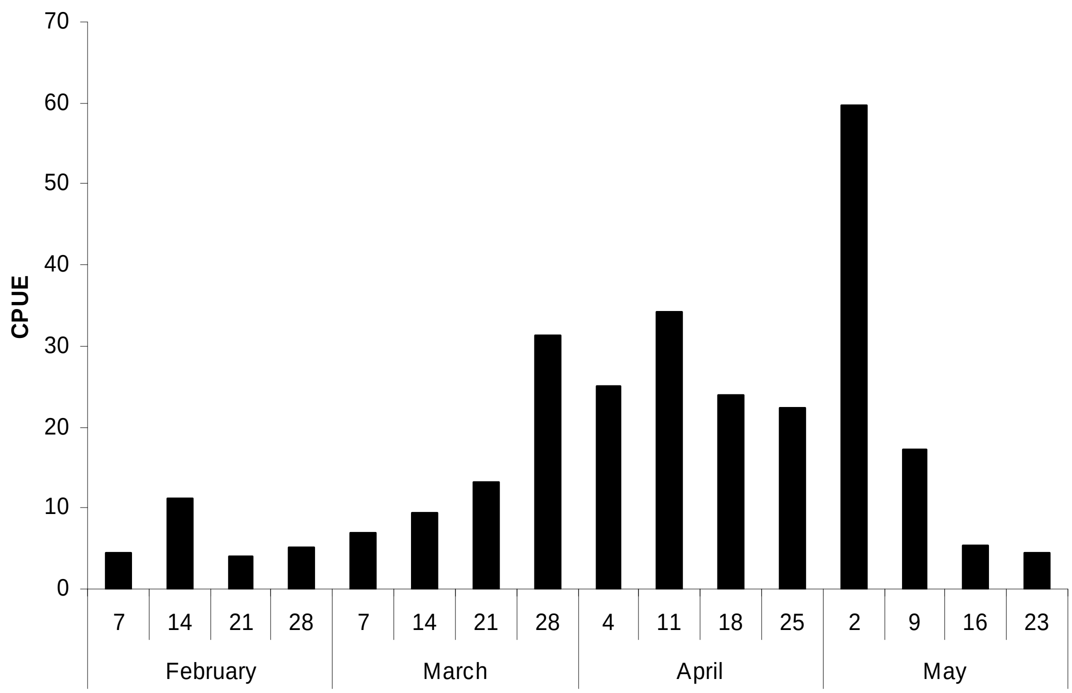

Figure 3. Weekly catch per unit effort (CPUE, number/seine haul) of spring Chinook smolts captured while seining the John Day River between river kilometers 274 and 296 from 5 February to 19 May 2009.

Juvenile Steelhead Smolt Capture and Tagging

Collectively, we PIT tagged 4,001 juvenile summer steelhead at our three trap sites and in the Mainstem seining operation during the spring migration from 1 February to 14 July 2009 (Tables 6, 7). Migration timing peaked during the month of May at all three trapping sites (Figure 4). Mean fork length of migrants captured during the spring period was 157.9 mm (range 63–301 mm). We estimated age structure of all 5,709 steelhead migrants as 21.2% age 1, 72.2% age 2, 6.5% age 3, and 0.04% age 4 (Tables 9 and 10). Of 5,704 juvenile steelhead examined for *Neascus sp.* infestation, 9 (0.1%) showed visible signs of black spot.

Trapping efficiency varied among trap sites and release strategies. Appendix Tables C-2, C-3, and C-6 list weekly trapping efficiency (TE) estimates for day and night released summer steelhead at the Mainstem, South Fork, and Middle Fork traps, respectively. Only night release fish were used to estimate TE for summer steelhead at the South Fork trap site (Appendix C-3). The Middle Fork night release device was not deployed until the end of February because of ice. Trap efficiency estimates for the Mainstem and Middle Fork trap sites were usually higher for night release compared to fish released during the day with the exception of the month of October (Appendix Table C-2). October results were compromised because of predation by a mink getting into the night release device. We subsequently modified the lid of our release device to prevent further predation.

At our Mainstem trap, we captured 413 summer steelhead during the fall/winter time period (30 September 2008–31 January 2009). We captured 1,425 and PIT tagged 836 juvenile steelhead during the spring period (Table 7). We estimate that 50,198 (95% CL's 39,541 and 64,436) juvenile steelhead migrated past the Mainstem trap site during our trapping period. Mean FL of spring migrants was 165.8 mm (range 68–264 mm). The estimated age structure of 1,123 steelhead migrants measured for fork length was 24.9% age 1, 73.2% age 2, and 1.9% age 3 (Tables 9 and 10). Of 1,403 juvenile steelhead examined for *Neascus sp.* infestation at the Mainstem trap, 5 (0.4%) showed visible signs of black spot.

At our South Fork trap, we captured 4,984 and PIT tagged 2,731 juvenile steelhead during the 2009 migration from 29 September 2008 to 14 July 2009 (Table 7). We estimate 43,575 (95% CL's 38,670 and 49,181) juveniles migrated past the trap site during our trapping period. Mean FL of fall/winter migrants was 134.2 mm (range 58–277 mm; Table 8). Mean FL of spring migrants was 153.8 mm (range 63–301 mm). The estimated age structure of 3,128 steelhead migrants during the spring was 27.6% age 1, 64.2% age 2, 7.8% age 3 and 0.06% age-4 (Table 9). Of 3,785 juvenile steelhead examined for *Neascus sp.* infestation at the South Fork trap, 2 (0.05%) showed visible signs of black spot.

At our Middle Fork trap we captured 465 and PIT tagged 376 juvenile steelhead from 16 February to 18 June 2009. High spring runoff and debris between April 7 and May 20 made it impossible to operate the Middle Fork trap during the usual May peak movement. We estimate 14,522 (95% CL's 9,646 and 23,223) juvenile steelhead migrated past the Middle Fork trap site during our spring trapping period. Mean FL for spring migrants was 166.3 mm (range 79–277 mm; Table 8). The estimated age structure of 436 steelhead migrants examined during the spring was 2.1% age 1, 80.9% age 2, and 17.1% age 3 (Table 9). Of 447 juvenile steelhead examined for *Neascus sp.* infestation, two (0.4%) showed visible signs of black spot.

We captured 73 and PIT tagged 58 juvenile steelhead seined in the Mainstem John Day River between rkm 274–296 from 5 February to 19 May 2009. We were unable to estimate an abundance for steelhead past our seining reach because of the small sample. Mean FL was 164.3

mm (range 121–213 mm; Table 8). None of the 69 emigrants examined for *Neascus sp.* infestation showed visible signs of black spot.

Table 6. Season, collection period, number captured (N), number PIT tagged, percent capture efficiency, and abundance estimates (95% confidence limits) for juvenile steelhead migrants captured at three rotary screw trap sites and while seining in the John Day River from 29 September 2008 to 14 July 2009.

Trap Location	Collection Period	N	Number tagged	Abundance	95% CI
South Fork	9/30/08–6/25/09	4,984	2,731	43,575	38,670–49,181
Mainstem	9/30/08–7/14/09	1,838	836	50,198	39,541–64,436
Middle Fork	9/29/09–6/18/09	477	376	14,522	9,646–23,223
Seining	2/05/09–5/19/09	73	58	--	

Table 7. Number (N), mean, and range of fork length (mm), mass (g), and coefficient of condition for steelhead migrants captured in four rotary screw traps and while seining on the Mainstem John Day River during two periods (Fall/Winter, 29 September 2008 to 31 January 2009; Spring, 1 February to 15 July 2009).

		Fork Length (mm)			Weight (g)			Coefficient of condition		
Location	Period	N	Mean	Range	N	Mean	Range	N	Mean	Range
South Fork Trap	Fall/Winter	659	134.2	58–277	543	30.2	2.2–274.5	543	1.04	0.45–2.37
Mainstem Trap	Fall/Winter	282	141.2	65–236	251	35.8	2.7–137.6	251	1.08	0.51–2.73
Middle Fork	Fall/Winter	12	189.6	134–233	11	71.2	26.7–132	11	1.03	0.90–1.13
All sites	Fall/Winter	953	136.9	58–277	805	32.5	2.2–274.5	805	1.05	0.45–2.73
South Fork Trap	Spring	3,128	153.8	63–301	2,423	39.6	2.7–318.2	2,423	1.03	0.38–2.66
Mainstem Trap	Spring	1,123	165.8	68–264	741	51.8	3.4–188.8	741	1.06	0.85–1.50
Middle Fork Trap	Spring	436	166.3	79–277	410	50.0	5.5–119.0	410	1.04	0.87–1.49
Mainstem Seining	Spring	69	164.3	121–213	59	46.3	18.9–89.5	59	1.02	0.80–1.13
All sites	Spring	4,756	157.9	63–301	3,633	43.4	2.7–318.2	3,633	1.04	0.38–2.66

Table 8. Trap location, season, number of scale samples taken (n), and percent age composition of four size categories (fork length, FL) of juvenile summer steelhead sampled at three rotary screw trap sites and in the Mainstem seining reach during the Fall/winter and spring seasons of the 2009 migration.

Location	Season	FL (mm)	n	Age 1	Age 2	Age 3	Age 4
Mainstem Trap	Fall/Winter	65–90	12	100			
		90–120	25	36	64		
		121–200	31		97	3	
		≥ 201	20		75	25	
	Spring	65–90	23	100			
		90–120	11	55	45		
		121–200	51	24	74	2	
		≥ 201	24	4	92	4	
South Fork Trap	Fall/Winter	65–90	25	68	32		
		90–120	25		100		
		121–200	27		100		
		≥ 201	26		88	12	
	Spring	65–90	54	100			
		90–120	57	70	30		
		121–200	46	22	69	9	
		≥ 201	59	2	79	17	2
Middle Fork Trap	Fall/Winter	65 – 90	0				
		90 – 120	0				
		121 – 200	7		14	86	
		≥ 201	5		100		
	Spring	65–90	5	60	40		
		90–120	4	75	25		
		121–200	50		82	18	
		≥ 201	20		90	10	
Mainstem Seine	Spring	65–90	0				
		90–120	0				
		121–200	45	5	82	13	
		≥ 201	2		100		

Table 9. Number captured and measured for fork length (n) and estimated age structure by brood year of juvenile steelhead captured at rotary screw trap and seine sites in the John Day River during two periods (Fall/Winter, October to 31 January; Spring, 1 February to 15 July) from 2005 to 2009.

	Migration			Brood Year (%)							
Trap Site	Season	Year	n	2001	2002	2003	2004	2005	2006	2007	2008
South Fork	Fall/Winter	2005	243		2.9	82.3	14.8				
	Fall/Winter	2007	205			0.5	4.2	90.0	5.4		
	Fall/Winter	2008	480					0.2	83.0	16.8	
	Fall/Winter	2009	659						0.5	96.5	3.0
	Spring	2005	1,925	0.2	5.8	78.0	16.1				
	Spring	2006	656			36.0	63.9	0.1			
	Spring	2007	1,581				13.7	63.7	22.7		
	Spring	2008	2,881					7.2	73.0	19.8	
	Spring	2009	3,128					0.1	7.9	64.4	27.6
Mainstem (rkm 326)	Fall/Winter	2005	244		6.1	61.9	32.0				
	Spring	2005	1,408	0.1	11.2	76.7	12.0				
	Spring	2006	425			23.9	58.2	17.9			
Mainstem (rkm 352)	Fall/Winter	2008	144						81.5	18.5	
	Fall/Winter	2009	282						3.5	82.7	13.8
	Spring	2007	1,444				5.7	86.0	8.3		
	Spring	2008	1,051					2.0	71.6	26.4	
	Spring	2009	1,123						2.0	73.2	24.8
Middle Fork	Spring	2005	1,327	0.8	27.7	62.1	8.7				
	Spring	2006	779		0.2	26.9	68.7	4.1			
	Spring	2007	1,295				9.1	84.6	5.6		
	Spring	2008	226					5.9	86.6	7.5	
	Spring	2009	436						17.1	80.8	2.1
All Sites (Including Seining)		2005	4,660	0.3	13.8	73.1	12.8				
		2006	2,167		0.1	30.0	63.2	6.7			
		2007	4562			0.2	9.3	77.9	12.6		
		2008	4,867					5.1	74.8	20.1	
		2009	5,709					0.1	6.5	72.2	21.2

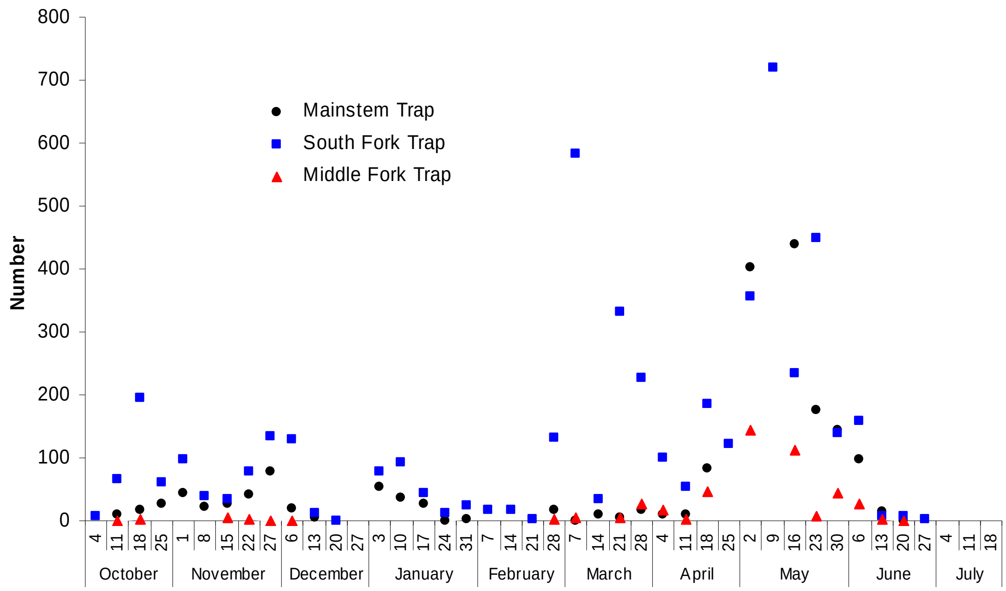

Figure 4. Weekly number of summer steelhead captured at three rotary screw traps operated in the John Day River basin during autumn 2008 and spring 2009.

Incidental Catch and Observations

We captured 16 non-target species of fish in our seining and trapping efforts during the 2009 migration (Table 10). A total of 32 adult summer steelhead were captured during our trapping and seining efforts including five (15.6%) of hatchery origin (adipose fin clip). Three bull trout were captured this season, one at the Middle Fork trap site (3/5/09, 204 mm FL) and two in the Mainstem seining reach (4/20/09, 273 mm FL and 4/27/09, 300 m FL). Two *O. nerka* smolts were also captured during April (4/7/09, 94 mm FL and 4/27/2009, 110 mm FL) in our seining effort. The first one captured was mistakenly PIT tagged (3D9.1C2CF150A4). We captured a total of 914 juvenile pacific lamprey of two morphological types (visible eyes, and brown with eye spots) at all three rotary screw trap sites combined. The brown with eye spots morph composed the majority of juvenile pacific lamprey observed (Table 10). Other notable species captured included bluegill *Lepomis macrochirus*, largemouth bass *Micropterus salmoides*, and rusty crayfish *Orconectes rusticus*. From 23 June to 14 July we counted the number of ringed crayfish captured at each trap. At the South Fork trap we captured 2–15/day and at the Mainstem trap we captured 12–43 per day.

PIT-tag Detections of Juveniles at FCRPS Facilities

Of 4,005 juvenile spring Chinook migrants captured, PIT tagged, and released at our trapping and seining sites between 1 February and 21 April 2009, 0.4% (19) were detected at McDonald Ford, 26.7% (1,072) were detected at John Day Dam, 10.7% (431) were detected at Bonneville Dam, and 1.5% (62) were detected in the Columbia River estuary. Detections at John Day Dam occurred between 21 April and 23 May 2009 and 50% of these were recorded by 7 May (Table 11). Mean travel time from all release sites to John Day Dam was 42days (± 0.6

days SE, range 4–100 days). Detections at Bonneville Dam occurred between 27 April and 25 May 2009 and 50% of these occurred by 11 May (Table 11). Mean travel time to Bonneville Dam was 46 days (± 0.8 days SE, range 7–106 days). Detections in the Columbia River estuary occurred between 27 April and 27 May 2009 and mean travel time was 55 days (± 2.4 days SE, range 17–90 days).

Of 4,001 juvenile steelhead migrants captured, PIT tagged, and released at our trapping and seining sites between 1 February and 15 May 2009, only 33 (0.8%) were detected at McDonald Ford, 17.8% (712) were detected at John Day Dam, 9.3% (372) at Bonneville Dam, and 1.8% (75) were detected in the Columbia River Estuary (Table 11). Detections at John Day Dam occurred between 14 April and 12 June 2009 with 50% occurring by 12 May 2009 (Table 11). Mean travel time from all release sites to John Day Dam was 26 days (± 0.8 days SE, range 3–102 days). Detections at Bonneville Dam occurred between 14 April and 14 June 2009 and 50% occurred by 15 May 2009. Mean travel time to Bonneville Dam was 28 days (± 1.1 days SE, range 5–99 days). Detections in the Columbia River estuary occurred between 27 April and 8 June 2009 and mean travel time was 35 days (± 2.9 days SE, range 7–97 days).

Table 10. Number of each fish species captured incidentally at the South Fork (SF), Mainstem (MS), and Middle Fork (MF) trap sites, and in the Mainstem seining operation (rkms 274–296, 29 September 2008 to 15 July 2009.

	Trap sites			
Species	SF	MS	MF	Seining
Hatchery adult Summer Steelhead		1		4
Wild adult Summer Steelhead	8	1		18
Spring Chinook fry	1	13	2	
Summer Steelhead fry	64	6	2	
Mountain Whitefish (*Prosopium williamsoni*)	32	1	3	
Brown Bullhead (*Ameiurus nebulosus*)		1	6	26
Bull Trout			1	2
Chiselmouth (*Acrocheilus alutaceus*)	30		24	26
Bluegill (*Lepomis macrochirus*)		50		1
Common Carp (*Cyprinus carpio*)				4
Dace (*Rhinichthys sp.)*	1,114	440	445	0
Kokanee (*O. nerka*)				2
Northern Pike Minnow (*Ptychocheilus oregonensis*)	497	209	88	129
Sucker Sp. (*Catostomus macrocheilus or C. columbianus*)	2,763	1,468	1,491	230
Smallmouth Bass (*Micropterus dolomieui*)		6	43	20
Largemouth Bass (*Micropterus salmoides*)		3		
Red Side Shiner (*Richardsonius balteatus*)	1,383	1,361	1,102	
Sculpin sp. (*Cottus sp.*)	215	2	1	
West Slope Cutthroat (*O. clarki lewisi*)	1			
Juvenile Pacific Lamprey (*L. tridentata*)				
Developed Eyes	28	72	16	
Brown with Eye Spots	155	296	347	

Table 11. . Number detected (N), first and last detection dates, and mean, standard error (SE) and range of travel time (days) to detection at McDonald Ford, John Day Dam, Bonneville Dam, and the Columbia River Estuary during 2009 for spring Chinook and summer steelhead smolts PIT tagged in the John Day Basin from 5 February to 14 May 2009.

Species	Detection Location	N	Detection Dates	Travel Time Mean	SE	Range
Spring Chinook	McDonald Ford	19	4/23–5/19	35	5.2	2–79
	John Day Dam	1,072	4/21–5/23	42	0.6	4–100
	Bonneville Dam	431	4/27–5/25	46	0.8	7–106
	Estuary	62	4/27–5/27	55	2.4	17–90
Summer steelhead	McDonald Ford	25	4/23–6/6	33	5.5	4–97
	John Day Dam	712	4/14–6/12	26	0.8	3–102
	Bonneville Dam	372	4/14–6/14	28	1.1	5–99
	Estuary	75	4/27–6/8	35	2.9	7–97

PIT Tag Detection of Adults at FCRPS Facilities

Of the 155 adult, John Day River Spring Chinook detected passing Bonneville Dam, 150 were PIT tagged as smolts for our John Day basin (SAR) estimate and five were PIT tagged by other research projects. SAR for spring Chinook to Bonneville Dam for the 2004 brood year was 1.4% (Table 12). Return data for subsequent cohorts is not yet complete, but the preliminary SAR for our 2005 brood is 3.4% without the return of age-5 adults. Eighteen (11.6%) of the detections at Bonneville Dam occurred during April with 84% (130 fish) detected during May and 4.5% (7 fish) detected during June. Seventeen percent (27 fish) of the 155 were age 3, 116 (74.8%) were age 4 and 12 (7.7%) were age 5. Sixteen adult spring Chinook also migrated past McNary Dam (Table 14). Of these, four were later observed in John Day basin, three were last observed at Ice Harbor Dam, one was last observed at Lower Granite Dam, one was last observed in the South Fork Salmon River of Idaho, and one was last observed in the Lower Entiat River of Washington (Table 14, Figure 5).

We confirmed that 44% (68 of 155) of the adult PIT tagged spring Chinook observed at Bonneville Dam were subsequently observed in the John Day basin during the summer and fall of 2009 (Table 14, Figure 6). Spawning survey crews detected four PIT tags from 265 scanned carcasses. Based on the 2009 adult spring Chinook escapement estimate (4,125 fish) and ratio of PIT tags recovered to carcasses scanned we estimated that 40% of our PIT tagged spring Chinook returned (Josh McCormick, personal communication). Based on the detection of 44 John Day River adult spring Chinook at McDonald Ford and the McDonald Ford array detection probability of 36.3%, we estimated that 78% (121 of the 155) of the adult PIT tagged spring Chinook observed at Bonneville Dam successfully returned to the John Day basin (Appendix Table E).

A total of 344 adult summer steelhead PIT tagged as smolts in the John Day Basin were detected at Bonneville Dam from 22 June to 25 October 2009. Of these, 1.7% (6) were detected in June, 43.6% (150) in July, 49.7% (171) in August, 4.4% (15) in September, and two (0.6%) were observed in October. Of these 344 returning adults, 284 were part of our effort to estimate summer steelhead SAR and 60 were from other projects tagging efforts. Estimated SAR for summer steelhead from the 2007 juvenile migration year was 3.41% for the Fall/winter tag group and 6.12% for the spring tag group (Table 13). Preliminary summer steelhead SAR for the 2008 juvenile migration was estimated at 5.27% for spring migrants. Of the 255 adult summer steelhead that returned during 2008 and 2009 from PIT tagging in 2007, 73% (186 fish) returned as one-ocean fish and 27% (69 fish) returned as two-ocean fish (Table 13).

Complete detection histories of the 247 PIT tagged adult John Day steelhead that returned during the summer of 2008 are summarized in Table 14 and individually in Appendix D. Fifty percent of the PIT tagged summer steelhead observed at Bonneville Dam were also observed in the John Day River basin. Based on the detection of 106 adult steelhead at McDonald Ford, and the McDonald Ford array detection probability of 66%, we estimated that 65% (161 of the 247) of adult, John Day River steelhead observed at Bonneville Dam also returned to the John Day River basin.

Table 12. Brood year, migration year, number of smolts PIT tagged, adult PIT tag return years, number and age of PIT tagged adults detected at Bonneville Dam and in the John Day Basin during the return years, and estimated smolt-to-adult survival (SAR) of John Day spring Chinook salmon PIT tagged from 2000–2009.

Brood Year	Migration Year	# Smolts Tagged	Bonneville Dam PIT Tag Detection						SAR
				Adult Detections					
			Return Years	Age 3	Age 4	Age 5	Age 6	Total	
1998	2000	1,852	2001–2003	4	112	28		144	7.8%
1999	2001	3,893	2002–2005	7	80	15	1	103	2.7%
2000	2002	4,000	2003–2005	5	86	9		100	2.5%
2001	2003	6,147	2004–2006	5	110	13		128	2.1%
2002	2004	4,435	2005–2007	5	68	20		93	2.1%
2003	2005	5,794	2006–2008	8	61	10		76	1.4%
2004	2006	3,418	2007–2009	2	34	12		48	1.4%
2005	2007	4,055	2008–2010	20	116			136	
2006	2008	3,998	2009–2011	22					
2007	2009	4,005	2010–2012						

Table 13. Juvenile tag year, number PIT tagged as juveniles, adult return years, number returning by ocean residence, and number of delayed migrants that were detected at Bonneville Dam, and estimated smolt-to-adult return (SAR) of John Day summer steelhead from 2000–2009.

Tag Year		Number Tagged	Bonneville Dam PIT Tag Detection					SAR
			Return Years	Age at return by Ocean year				
				One-Ocean	Two-Ocean	Delayed migrants	Total	
2001		435	2002–2004	1	5	1	7	1.6%
2002		0						
2003		144	2004–2005	1	1		2	1.4%
2004	Fall/Winter[a]	898	2005–2006	6	1		7	0.8%
	Spring[b]	3,732		60	46[c]	3	109	2.9%
2005	Fall/Winter	573	2006–2007	8	5		13	2.3%
	Spring	4,913		49	30		79	1.6%
2006	Fall/Winter	1,048	2007–2008	8	1		9	0.9%
	Spring	2,167		35	22		57	2.6%
2007	Fall/winter	205	2008–2009	6	1		7	3.4%
	Spring	4,053		180	68		248	6.1%
2008		4,076	2009–2010	215				
2009		4,001	2010–2011					

[a] captured and PIT tagged between September and January 31.
[b] captured and PIT tagged between February 1 and July.
[c] two adults detected at McNary Dam were not detected at Bonneville Dam.

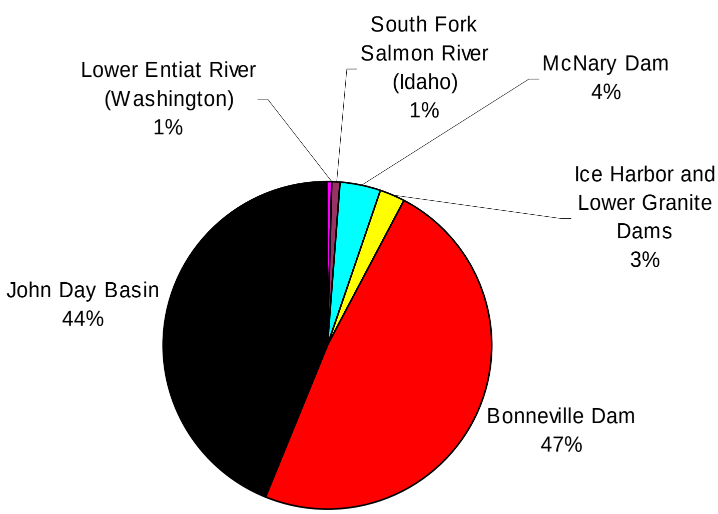

Figure 5. Last known PIT tag observation sites of 155 spring Chinook that returned during the spring of 2009.

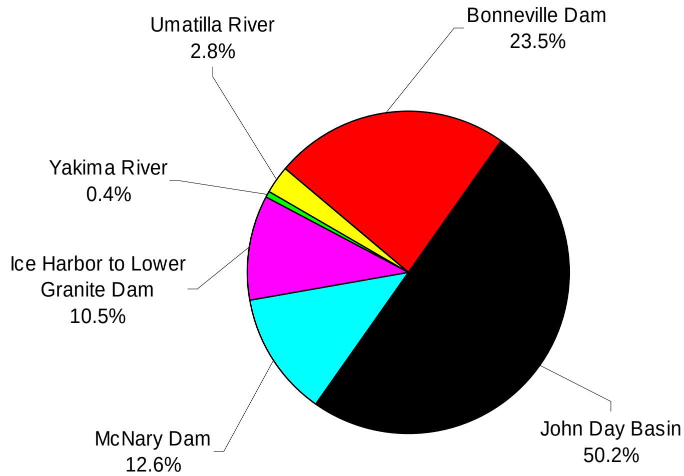

Figure 6. Last known PIT tag observation sites of 247 adult summer steelhead that returned during the summer of 2008.

Table 14. Detection histories of 247 adult summer steelhead that returned during the summer of 2008 and 155 adult spring Chinook that returned during the spring of 2009 that were PIT tagged as juveniles in the John Day basin.

Detection History	Summer Steelhead	Spring Chinook
Bonneville Only	58	75
Bonneville → John Day Basin	75	64
Bonneville → McNary → John Day Basin	35	4
Bonneville → McNary Dam	30	6
Bonneville → McNary → Ice Harbor Dam	10	3
Bonneville → McNary → Ice Harbor → John Day Basin	13	
Bonneville → McNary → Umatilla River	2	
Bonneville → McNary → Ice Harbor → Lower Granite → Little Gooose Dam	1	
Bonneville → McNary → Ice Harbor → Lower Granite → Little Goose Dam → Umatilla River	1	
Bonneville → McNary → Ice Harbor → Lower Granite Dam	10	1
Bonneville → McNary → Ice Harbor → Umatilla River	3	
Bonneville → McNary → Ice Harbor → Little Goose → Lower Granite Dam	1	
Bonneville → McNary → Ice Harbor→ Lower Granite → Tucannon R .→ Prosser Dam	1	
Bonneville → McNary → Ice Harbor → Lower Granite → Lower Monumental Dam	2	
Bonneville → McNary → Ice Harbor → Lower Granite → Umatilla River	1	
Bonneville → McNary → Ice Harbor → Lower Monumental	1	
Bonneville → McNary → Ice Harbor → Lower Monumental Dam → John Day Basin	1	
Bonneville → McNary → Ice Harbor → Prosser (Yakima R.) → Lower Granite Dam	1	
Bonneville → McNary → John Day Dam	1	
Bonneville → McNary → Ice Harbor → Lower Granite→SF Salmon River @ Krassel Cr		1
Bonneville → McNary → Priest Rapids → Rock Island → Rocky Reach → Lower Entiat River (WA)		1
Summary		
Total detected at Bonneville Dam	247	155
Total detected at McNary Dam	114	16
Number detected at McNary Dam known to have returned to the John Day River	49	3
Number detected at Bonneville Dam and later detected at the John Day river McDonald Ford array	106	44
Number detected at Bonneville Dam and later detected in the John Day basin (all detections)	124	64

DISCUSSION

Spring Chinook juvenile migrant abundance and smolt per redd estimates for the Mainstem and Middle Fork John Day River sites were the highest we have recorded. These high smolt/redd estimates were the result of both relatively low redd densities and record smolt abundance for the 2007 brood year. The 2007 drought, and subsequent adult spring Chinook die off in the Middle Fork therefore, did not reduce juvenile production for the 2007 brood as it did for the 2006 brood (Ruzycki et al. 2008). Several factors likely contributed to the overall increase in Chinook production. Reduced intraspecific competition for food and rearing habitat likely contributed to increased growth potential for juveniles during the summer of 2008. In addition, the John Day basin had a good snow pack resulting in above average summer flows and potentially cooler water during the summer of 2008. Higher flows allow for an increase in rearing habitat in the main channels and also increase access to tributary habitats. The contrast of productivity for the Middle Fork population between the 2006 and 2007 brood years is remarkable, and demonstrates the potential for this population to respond to improvements of their rearing habitat.

Juvenile steelhead abundance estimate for the Middle Fork population were within the range previously reported however, the Mainstem and South Fork abundance estimates were nearly double our previously highest estimates reported in the last six years (Appendix B). It is possible that the Middle Fork steelhead population has not recovered from the 2007 drought year since steelhead have a longer rearing time in freshwater compared to Chinook juveniles.

Our estimated spring Chinook SAR for the 2004 brood year (1.4%) was among the lowest we have reported for the John Day basin (Table 12). In contrast, the preliminary 2005 brood SAR (3.35%) is the second highest we have reported in the last eight years and reflects improving ocean conditions. This survival estimate will increase as age-5 adults return during 2010. Our summer steelhead SAR from the 2007 migration (6.12%) is the highest we have recorded for the John Day River basin populations and preliminary data suggests that our 2008 SAR will be even greater (Table 13).

The success of steelhead recovery efforts in the John Day basin may be compromised by both high rates of out-of-basin hatchery fish straying into the basin and high stray rates of John Day River fish to non-natal habitat outside of the John Day River basin. Combined, the John Day River PIT tag antenna arrays at McDonald Ford, Bridge Creek, Middle Fork, and South Fork John Day River detected only half of the 247 PIT tagged adults that were detected at Bonneville Dam John during 2008 (PTAGIS, Ian Tattam, personal communication). Adult PIT tag observations also indicate that at least 50% of adult John Day summer steelhead reside in freshwater during the fall and winter outside of the John Day basin in the Columbia River basin between Bonneville Dam (rkm 235) and Rock Island Dam (rkm 669), and to a lesser extent in the Snake River from it's mouth to Lower Granite Dam (Table 15, Appendix D). Over wintering behavior outside of the John Day basin may subject John Day steelhead to increased passage mortality at Columbia and Snake River Dams and to greater mortality from fisheries. Snake River steelhead transported as juveniles from Lower Granite Dam to below Bonneville Dam composed 86% (25 of 29) of PIT tagged hatchery strays and 87% (14 of 16) of wild stray adult steelhead detected at the John Day River McDonald Ford array between September of 2008 and April of 2009. Similar detections were not observed for non-transported tag groups.

CONCLUSIONS

Our PIT tagging efforts from trap and seine operations provide the only measure of freshwater production of Chinook and steelhead in the upper Mainstem, South Fork, Middle Fork, and North Fork John Day Rivers. This tagging also enables us to estimate SAR that allows for an out-of-basin survival estimate for the John Day populations. Abundance estimates and the ratio of smolts per redd should continue to be monitored to detect a fish production response to new and maturing riparian habitat restoration projects implemented in the John Day River basin. Real-time data from long term monitoring activities such as ours will help guide restoration and adaptive management in the region, and aid in evaluating the success of alternative management practices on other salmon and steelhead stocks in the Columbia Basin. Continued monitoring of straying by wild adult John Day summer steelhead and Chinook will aid in the evaluation of Mainstem Columbia River operations.

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APPENDIX

Appendix Table A-1. Geographic location, % of overall smolt captures, number of seines pulled at each site, and catch-per-unit-effort (CPUE: #smolt/seine haul) at sites sampled during the 2009 seining effort on the Mainstem John Day River between Kimberly and Spray, OR.

Site Name	Latitude and Longitude (DMS)	Percent of total catch		Number of Seines	CPUE Chinook	CPUE Steelhead
		Chinook	Steelhead			
Backwater	N 44° 48' 20.73" W 119° 43' 42.79"	6	0	29	6	0
Bass	N 44° 49' 07.4" W 119° 45' 21.3"	2	1	17	3	<1
Bologna	N 44° 46' 41.1" W 119° 40' 46.3"	2	0	10	5	0
Bullhead	N 44° 49' 24.3" W 119° 44' 12.9"	17	1	62	8	<1
Bull Trout	N 44˚ 50' 19.3" W 119˚ 48' 10.2"	2	25	28	2	<1
Car	N 44˚ 50' 20.97" W 119˚ 48' 7.2"	3	0	6	15	0
Chucker	N 44˚ 48' 34.68" W 119˚ 44' 13.50"	8	0	50	5	0
Dam	N 44° 48' 21.7" W 119° 43' 57.7"	7	0	30	7	0
Dead Fish	N 44° 48' 26.9" W 119° 43' 28.4"	9	0	36	7	0
Juniper	N 44° 47' 42.67" W 119° 42' 19.16"	2	0	14	4	0
Log	N 44° 49' 11.6" W 119° 46' 58.4"	6	18	52	3	<1
Lower House Boat	N 44° 48' 57.12" W 119° 47' 19.40"	4	0	14	8	0
Slippery Shelf	N 44° 46' 9.03" W 119° 40' 16.62"	5	0	10	16	0
Spider Cove	N 44° 48' 18.74" W 119° 43' 42.10"	7	0	24	8	0
Spider	N 44° 48' 18.74" W 119° 43' 42.10"	5	0	32	4	0
Spray Boat Ramp	N 44° 49' 34.9" W 119° 47' 34.9"	12	53	59	6	<1
Ten Dollar	N 44˚ 47' 45.7" W 119˚ 41' 37.6"	2	0	10	5	0
Other Sites	---	3	2	43	2	<1

Appendix Table B-1. Trap site, smolt migration year, trapping period, summer steelhead abundance estimate, and 95% confidence intervals of estimates.

Trap site	MigrationYear	Period	Abundance	95% CI
South Fork (rkm 10)	2004	10/10/03–6/18/04	12,506	10,640–14,700
	2005	9/2/04–6/17/05	25,364	21,952–27,919
	2006	10/8/05–6/23/06	13,185	9,778–16,942
	2007	10/12/06–6/15/07	10,590	9,276–12,311
	2008	10/4/07–6/20/08	11,732	10,906–12,577
	2009	9/30/08–6/25/09	43,575	38,670–49,181
Mainstem (rkm 326)	2004	10/23/03–6/24/04	22,539	15,659–32,914
	2005	10/4/04–7/6/05	47,921	35,025–67,366
	2006	2/10–6/26/06	58,490	22,089–90,428
Mainstem (rkm 352)	2007	10/12/06–6/22/07	23,264	18,450–29,507
	2008	10/10/07–6/20/08	12,861	10,328–15,787
	2009	9/30/08–7/14/09	50,198	39,541–64,436
Middle Fork (rkm 24)	2004	3/2/04–6/23/04	12,365	10,015–15,643
	2005	10/6/04–6/17/05	28,980	19,914–43,705
	2006	3/6/06–6/22/06	20,720	14,401–30,870
	2007	10/31/06–6/14/07	14,784	11,947–18,004
	2008[a]	2/12/08–6/20/08	2,913	1,710–4,964
	2009	9/29/09–6/18/09	14,522	9,646–23,223

[a] The Middle Fork trap was inoperable during most of the usual peak movement of summer steelhead because of high water and debris.

Appendix Table C-1. Trap operation week, trap size (m) & number, night release distance to trap, and number of new captures, marked, recaptured, and weekly estimated trap efficiency (%) for the Mainstem trap sampling of Spring Chinook, 30 September 2008 to 15 July 2009.

Trap Week	Trap size (m)	Release distance (m)	New	Marked		Recaptured		Trap Efficiency (%)	
				Night	Day	Night	Day	Night	Day
9/30–10/3	1.5	85	0	0	0	0	0		
10/6–10/10	1.5	85	2	0	0	0	0		
10/13–10/17	1.5	85	179	48	48	9	13	18.8	27.1
10/20–10/24	1.5	1,300	188	61	60	9	16	14.8	26.7
10/27–10/31	1.5	1,300	178	72	71	16	19	22.2	26.8
11/4–11/7	1.5	1,300	174	14	43	7	18	50.0	41.9
11/12–11/14	1.5	1,300	269	30	30	4	4	13.3	13.3
11/17–11/21	2.4	1,300	405	89	89	38	26	42.7	29.2
11/24–11/26	2.4	1,300	512	30	30	5	11	16.7	36.7
12/1–12/5	2.4	1,300	141	18	50	0	19	0.0	38.0
12/8 –12/12	2.4	1,300	175	0	62	0	23		37.1
12/30–12/31	2.4	1,300	164	0	0	0	0		
1/5–1/9	2.4	1,300	212	0	73	0	22		30.1
1/12–1/16	2.4	1,300	242	50	48	12	5	24.0	10.4
1/20–1/23	2.4	1,300	9	9	0	0	0	0.0	
1/28–1/30	2.4	1,300	48	10	10	1	2	10.0	20.0
2/2–2/6	2.4	1,300	16	7	8	0	0	0.0	0.0
2/9–2/13	2.4	1,300	10	1	1	0	0	0.0	0.0
2/17–2/20	2.4	1,300	9	2	2	0	0	0.0	0.0
2/23–2/27	2.4	1,300	54	22	18	6	3	27.3	16.7
3/4–3/6	2.4	1,300	40	0	0	0	0		
3/9–3/13	2.4	1,300	145	48	48	11	5	22.9	10.4
3/16–3/20	1.5	1,300	44	8	8	2	0	25.0	0.0
3/23–3/27	1.5	1,300	147	52	46	2	1	3.8	2.2
3/30–4/3	1.5	1,300	165	57	57	7	0	12.3	0.0
4/6–4/9	2(1.5)	1,300	27	0	0	0	0		
4/13–4/17	2(1.5)	1,300	209	66	45	0	1	0.0	2.2
4/27–5/1	2(1.5)	1,300	351	89	109	8	3	9.0	2.8
5/11–5/15	2(1.5) + 2.4	1,300	98	43	42	6	8	14.0	19.0
5/18–5/22	2(1.5) + 2.4	1,300	21	1	1	1	0	100.0	0.0
5/26–5/29	2(1.5) + 2.4	1,300	12	2	2	2	1	100.0	50.0
6/1–6/5	1.5 + 2.4	1,300	44	15	11	2	2	13.3	18.2
6/8–6/10	1.5 + 2.4	1,300	167	30	30	9	2	30.0	6.7
6/17–6/19	1.5	1,300	166	0	65	0	7		10.8
6/23–6/26	1.5	1,300	42	0	42	0	2		4.8
6/29–7/1	1.5	1,300	10	0	4	0	1		25.0
7/6 - 7/9	1.5	1,300	3	0	2	0	0		0.0
7/14 - 7/15	1.5	1,300	1	0	0	0	0		
Totals			**4,679**	**874**	**1,155**	**157**	**214**	**18.0**	**18.5**

Appendix Table C-2. Trap operation week, trap size (m) & number, night release distance to trap, and number of new captures, marked, recaptured, and weekly estimated trap efficiency (%) for the Mainstem trap sampling of steelhead, 30 September 2008 to 15 July 2009.

Trap Week	Trap size (m)	Release distance (m)	New	Marked		Recaptured		Trap Efficiency (%)	
				Night	Day	Night	Day	Night	Day
9/30–10/3	1.5	85	0	0	0	0	0		
10/6–10/10	1.5	85	9	0	0	0	0		
10/13–10/17	1.5	85	17	7	6	1	1	14.3	16.7
10/20–10/24	1.5	1,300	26	9	10	0	2	0.0	20.0
10/27–10/31	1.5	1,300	44	16	16	1	0	6.3	0.0
11/4–11/7	1.5	1,300	22	4	6	2	1	50.0	16.7
11/12–11/14	1.5	1,300	28	8	7	0	2	0.0	28.6
11/17–11/21	2.4	1,300	42	13	12	2	3	15.4	25.0
11/24–11/26	2.4	1,300	78	29	29	0	5	0.0	17.2
12/1–12/5	2.4	1,300	21	1	9	0	1	0.0	11.1
12/8 –12/12	2.4	1,300	6	0	2	0	0		0.0
12/30–12/31	2.4	1,300	54	0	0	0	0		
1/5–1/9	2.4	1,300	36	0	31	0	4		12.9
1/12–1/16	2.4	1,300	27	6	6	0	0	0.0	0.0
1/20–1/23	2.4	1,300	1	0	0	0	0		
1/28–1/30	2.4	1,300	2	0	1	0	0		0.0
2/2–2/6	2.4	1,300	0	0	0	0	0		
2/9–2/13	2.4	1,300	0	0	0	0	0		
2/17–2/20	2.4	1,300	0	0	0	0	0		
2/23–2/27	2.4	1,300	17	7	6	2	1	28.6	16.7
3/4–3/6	2.4	1,300	1	0	0	0	0		
3/9–3/13	2.4	1,300	9	4	3	1	1	25.0	33.3
3/16–3/20	1.5	1,300	4	2	0	0	0	0.0	
3/23–3/27	1.5	1,300	18	13	1	1	0	7.7	0.0
3/30–4/3	1.5	1,300	9	2	1	0	0	0.0	0.0
4/6–4/9	2(1.5)	1,300	9	0	0	0	0		
4/13–4/17	2(1.5)	1,300	82	39	33	0	2	0.0	6.1
4/27–5/1	2(1.5)	1,300	402	90	89	10	2	11.1	2.2
5/11–5/15	2(1.5) + 2.4	1,300	440	90	90	8	6	8.9	6.7
5/18–5/22	2(1.5) + 2.4	1,300	176	16	15	4	0	25.0	0.0
5/26–5/29	2(1.5) + 2.4	1,300	145	45	45	7	3	15.6	6.7
6/1–6/5	1.5 + 2.4	1,300	98	49	26	7	3	14.3	11.5
6/8–6/10	1.5 + 2.4	1,300	14	6	0	0	0	0.0	
6/17–6/19	1.5	1,300	1	0	1	0	0		0.0
6/23–6/26	1.5	1,300	0	0	0	0	0		
6/29–7/1	1.5	1,300	0	0	0	0	0		
7/6 - 7/9	1.5	1,300	0	0	0	0	0		
7/14 - 7/15	1.5	1,300	0	0	0	0	0		
Totals			**1,838**	**456**	**445**	**46**	**37**	**10.1**	**8.3**

Appendix Table C-3. Trap operation week, trap size (m) & number, number of new captures, marked, recaptured, and weekly estimated trap efficiency (%) for the South Fork trap sampling of Spring Chinook and steelhead, 30 September 2008–1 July 2009.

		Summer Steelhead				Spring Chinook			
Trap Week	Trap Size (m)	New	Marked	Recaptured	Percent trap efficiency	New	Marked	Recaptured	Percent trap efficiency
9/30–10/3	1.5	7	4	0	0	0	0	0	
10/6–10/10	1.5	66	31	10	32	0	0	0	
10/13–10/17	1.5	194	60	10	17	0	0	0	
10/20–10/24	1.5	60	0	0		0	0	0	
10/27–10–31	1.5	97	45	3	7	0	0	0	
11/4–11/7	1.5	40	28	6	21	0	0	0	
11/12–11/14	1.5	35	0	1		0	0	0	
11/17–11/21	1.5	79	44	14	32	1	0	0	
11/24–11/26	1.5	135	25	9	36	5	1	1	100
12/1–12/5	1.5	130	70	23	33	3	2	2	100
12/8–12/12	1.5	11	9	2	22	0	0	0	
12/5–12/16	1.5	1	0	0		0	0	0	
12/30–12/31	1.5	77	0	0		0	0	0	
1/5–1/8	1.5	93	75	23	31	2	2	0	0
1/12–1/16	1.5	45	36	9	25	1	1	1	100
1/20–1/23	1.5	12	11	0	0	0	0	0	
1/26–1/30	1.5	24	19	9	47	2	1	0	0
2/2–2/6	1.5	18	14	7	50	1	1	1	100
2/9–2/13	1.5	16	13	5	38	0	0	0	
2/17–2/20	1.5	3	3	0	0	0	0	0	
2/23–2/27	1.5	132	30	16	53	2	2	2	100
3/2–3/6	1.5	584	60	39	65	6	6	5	83
3/9–3/13	2.4	35	34	9	27	0	0	0	
3/16–3/20	2.4	331	90	20	22	15	9	8	89
3/23–3/27	1.5 + 2.4	226	90	26	29	2	2	2	100
3/30–4/3	1.5 + 2.4	101	54	17	31	1	1	1	100
4/6–4/9	2.4	53	36	1	3	0	0	0	
4/13–4/17	2.4	185	87	14	16	5	5	0	0
4/20–4/24	2.4	122	52	3	6	1	0	0	
4/27–5/1	2.4	357	90	16	18	0	0	0	
5/4–5/8	2.4	719	99	20	20	0	0	0	
5/11–5/12	2.4	233	30	10	33	0	0	0	
5/18–5/22	2.4	448	90	18	20	0	0	0	
5/26–5/29	2.4	138	66	13	20	0	0	0	
6/1–6/5	2.4	159	100	18	18	0	0	0	
6/8–6/9	2.4	8	5	0	0	1	1	0	0
6/17–6/19	2.4	7	5	0	0	0	0	0	
6/23–6/26	2.4	3	3	0	0	0	0	0	
6/29–7/1	2.4	0	0	0		0	0	0	
Totals		**4,984**	**1,508**	**371**	**25**	**48**	**34**	**23**	**68**

Appendix Table C-5. Trap operation week, number of new captures, marked, recaptured, and weekly estimated trap efficiency (%) for the Middle Fork trap sampling of Spring Chinook, 29 September 2008 to 19 June 2009.

		Marked		Recaptured		Percent Trap Efficiency	
Trap week	New	Night	Day	Night	Day	Night	Day
9/29-10/3	0	0	0	0	0		
10/6-10/10	3	0	0	0	0		
10/13-10/17	17	0	11	0	3		27
10/20-10/24	7	0	5	0	2		40
10/27-10/31	7	0	5	0	2		40
11/4-11/7	18	0	11	0	7		64
11/12-11/14	1,298	0	20	0	4		20
11/17-11/21	14	0	12	0	7		58
11/24-11/26	55	0	13	0	3		23
12/1-12/5	15	0	15	0	8		53
2/17-2/19	10	0	9	0	0		0
2/23-2/27	557	198	197	42	55	21	28
3/2-3/6	267	92	91	25	16	27	18
3/16-3/20	385	115	117	27	32	24	27
3/23-3/27	300	109	106	24	14	22	13
3/30-4/3	180	78	78	8	8	10	10
4/6-4/7	12	0	0	0	0		
4/15-4/17	186	0	116	0	10		9
4/27-5/1	185	72	72	11	16	15	22
5/11-5/15	88	10	13	2	1	20	8
5/21-5/22	4	0	0	0	0		
5/26-5/29	17	12	0	3	0	25	
6/2-6/5	2	0	0	0	0		
6//-6/10	6	2	0	0	0	0	
6/17-6/19	13	0	3	0	0		0
Totals	**3,646**	**688**	**894**	**191**	**188**	**28**	**21**

Appendix Table C-6. Trap operation week, number of new captures, marked, recaptured, and weekly estimated trap efficiency (%) for the Middle Fork trap sampling of steelhead, 29 September 2008 to 19 June 2009.

		Marked		Recaptured		Percent Trap Efficiency	
Trap week	New	Night	Day	Night	Day	Night	Day
9/29-10/3	0	0	0	0	0		
10/6-10/10	1	0	0	0	0		
10/13-10/17	2	0	1	0	0		0
10/20-10/24	0	0	0	0	0		
10/27-10/31	0	0	0	0	0		
11/4-11/7	0	0	0	0	0		
11/12-11/14	6	0	1	0	0		0
11/17-11/21	2	0	2	0	1		50
11/24-11/26	0	0	0	0	0		
12/1-12/5	1	0	1	0	0		0
2/17-2/19	0	0	0	0	0		
2/23-2/27	3	1	0	0	0	0	
3/2-3/6	6	2	2	0	1	0	50
3/16-3/20	6	1	0	0	0	0	
3/23-3/27	27	10	9	1	1	10	11
3/30-4/3	17	9	4	0	0	0	0
4/6-4/7	3	0	0	0	0		
4/15-4/17	46	35	0	1	0	3	
4/27-5/1	145	57	57	4	3	7	5
5/11-5/15	132	87	19	20	0	23	0
5/21-5/22	7	0	0	0	0		
5/26-5/29	43	24	0	2	0	8	
6/2-6/5	28	26	0	3	0	12	
6//-6/10	2	1	0	0	0	0	
6/17-6/19	1	0	1	0	1		100
Totals	**478**	**253**	**97**	**31**	**7**	**12**	**7**