Chinook Salmon Productivity and Escapement Monitoring in the John Day River Basin

Annual Technical Report

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Objectives

1. Estimate number and distribution of Chinook salmon redds and spawners for the John Day River subbasin populations.

2. Estimate age composition and hatchery stray fraction of the John Day River subbasin spring Chinook salmon populations.

3. Estimate productivity metrics including smolts/spawner for the John Day River spring Chinook populations.

Accomplishments and Findings

Spawning ground surveys for spring (stream-type) Chinook salmon *Oncorhynchus tshawytscha* were conducted in four main spawning areas (Mainstem, Middle Fork, North Fork, and Granite Creek System) and seven minor spawning areas (South Fork, Camas Creek, Desolation Creek, Trail Creek, Deardorff Creek, Clear Creek, and Big Creek) in the John Day River basin during August and September of 2007. Census surveys included 288 river kilometers (88.2 rkm within index and 199.8 rkm additional within census) of spawning habitat. We observed 853 redds and 380 carcasses including 357 redds in the Mainstem, 85 redds in the Middle Fork, 358 redds in the North Fork, 30 redds in the Granite Creek System, and 23 redds in Desolation Creek. Age composition of carcasses sampled for the entire basin was 0% age 2 (precocious), 5.2% age 3, 85.3% age 4, and 9.5% age 5. The sex ratio was 56% female and 44% male. During 2007, 88% of female carcasses sampled had released all of their eggs. Pre-spawn mortality was significant in the Middle Fork subbasin due to warm temperatures in July when 118 adult carcasses were recovered. Of the 380 carcasses recovered during spawning ground surveys, 17 (4.5%) were of hatchery origin. For the 2005 brood year, we estimate freshwater productivity at 45 smolts/redd for spring Chinook throughout the John Day River basin, 118 smolts/redd for the Upper Mainstem, and 42 smolts/redd for the Middle Fork watersheds.

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 property. Additionally, we would also like to thank Tim Unterwegner and Jeff Neal for providing guidance and advice. This project was funded by the Oregon Watershed Enhancement Board, Contract Number 207-906.

INTRODUCTION

The John Day River subbasin supports one of the last remaining intact wild populations of spring Chinook salmon in the Columbia River Basin. These populations remain depressed relative to historic levels. Numerous habitat protection and rehabilitation projects have been implemented in the basin to improve salmonid freshwater production and survival. Often, these projects lack effectiveness monitoring (but see Bayley and Li 2008). While our monitoring efforts outlined here will not specifically measure the effectiveness of any individual project, they will provide much needed programmatic or watershed-scale (status and trend) information to help evaluate project-specific effectiveness monitoring efforts as well as meet some of the data needs as index stocks. Our continued monitoring efforts to estimate salmonid abundance, age structure, smolts/redd, freshwater habitat use, and distribution of critical life stages will allow managers to assess the long-term effectiveness of habitat projects.

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 have 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 north, the Blue Mountains to the east, and the Ochoco Mountains to the west.

Spring Chinook salmon primarily spawn in the upper Mainstem John Day River (hereafter called Mainstem; Figure 2) above the mouth of Indian Creek, in the Middle Fork John Day River (hereafter called Middle Fork; Figure 2) above Armstrong Creek, and the North Fork John Day River (hereafter called North Fork; Figure 3) 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 and Trail creeks, and the Mainstem tributary Deardorff Creek. Fall Chinook are thought to spawn in the Lower Mainstem downstream of Kimberly, OR (rkm 298) but recent surveys have shown their distribution to be primarily between Cottonwood Bridge (rkm 64) and Tumwater Falls (rkm 16). Additional maps of the distribution of Chinook in the John Day River basin can be viewed at: http://www.streamnet.org/online-data/map_catalog.html.

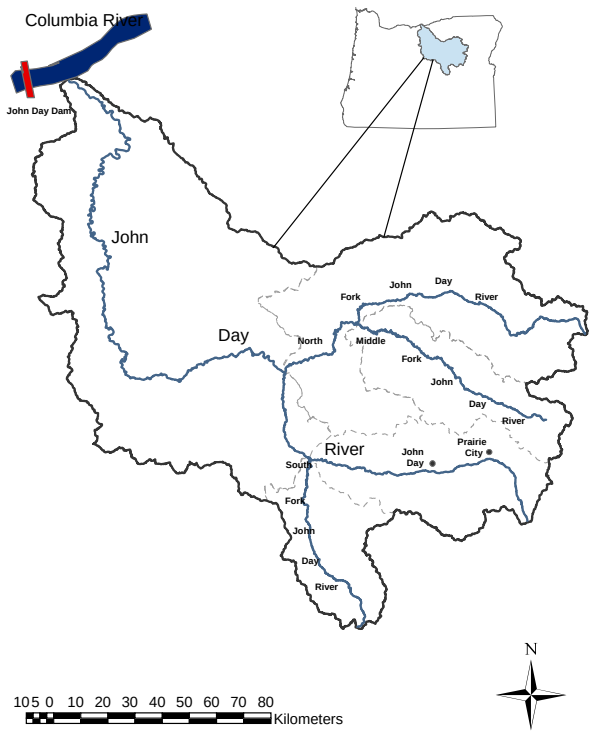

Figure 1. Map of John Day River basin.

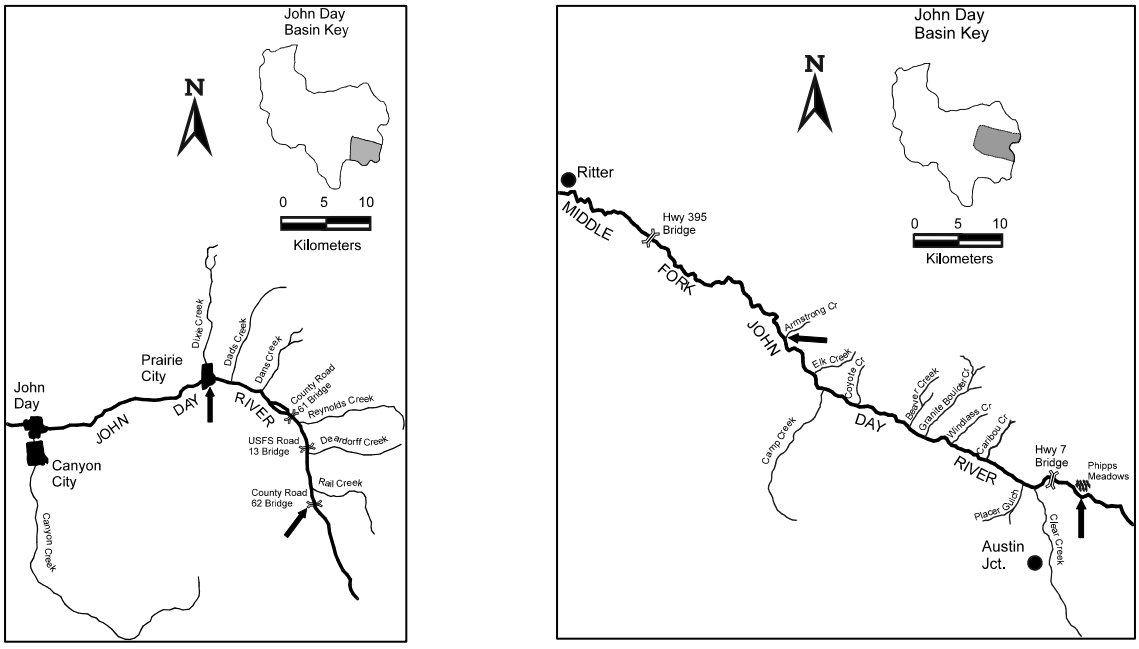

Figure 2. Map of the upper mainstem (left) and Middle Fork (right) John Day River. Arrows indicate upstream and downstream limits of census spawning ground surveys.

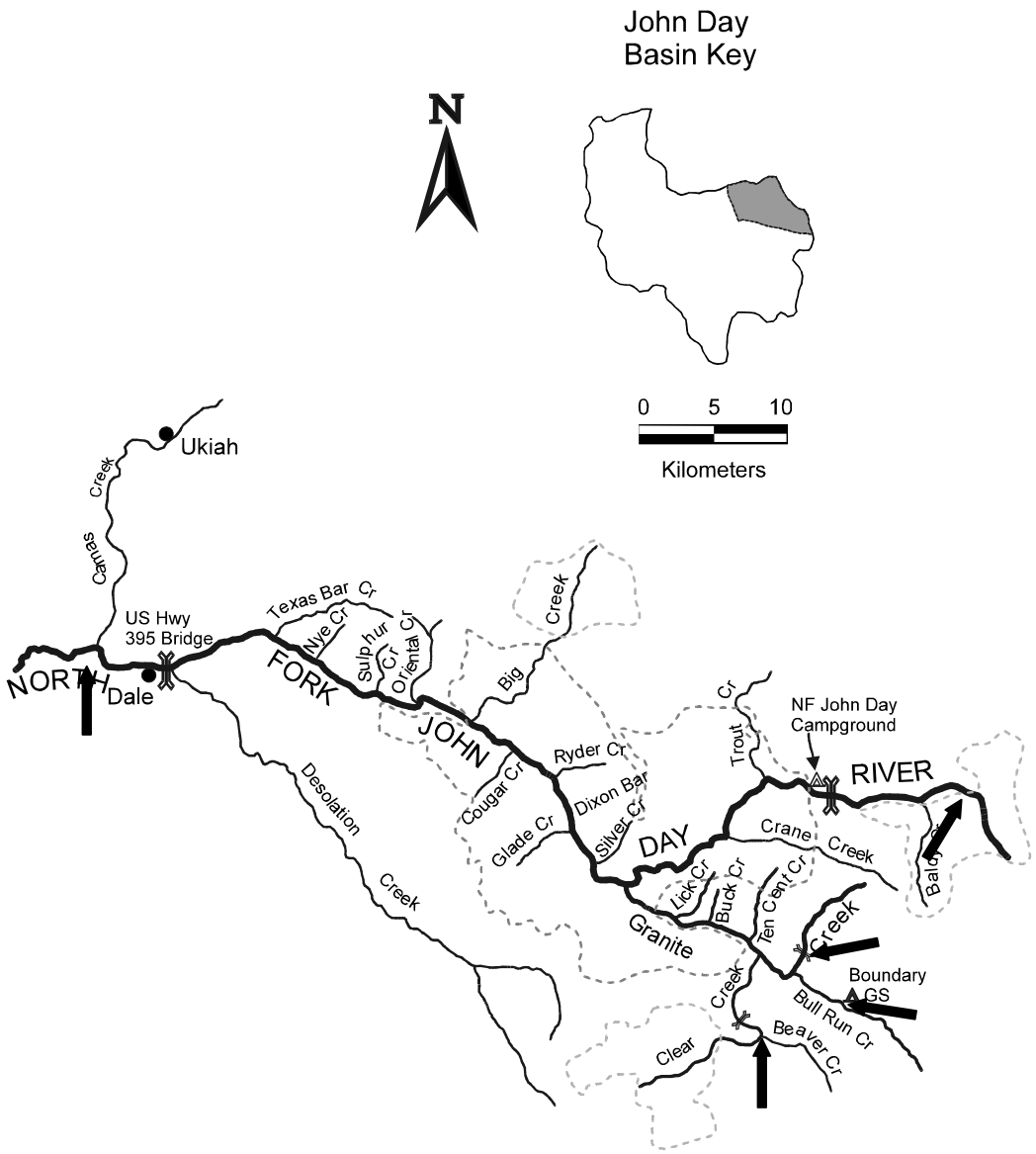

Figure 3. Map of the North Fork John Day River. Survey areas begin at the confluence with Desolation Creek and extend upstream to the confluence with Baldy Creek. Granite Creek survey areas extend from the mouth to approximately two kilometers above the confluence with Bull Run Creek, Clear Creek to the confluence with Beaver Creek, and Bull Run Creek upstream to the USFS Boundary guard station. Arrows show limits of census survey area. Not all reaches of stream between arrows were surveyed. Dashed lines denote boundaries of North Fork John Day wilderness.

METHODS

Spring Chinook Spawning Surveys

Spring Chinook salmon spawning surveys including historic index and census surveys were conducted during the months of August and September to encompass the spatial and temporal distribution of Chinook spawning in the John Day River basin (Table 1). Index sections were surveyed to provide relative abundance comparisons with historic redd count data collected since 1959. Index counts only encompass redds counted within index reaches, at the index time. New redds observed during post-index surveys are not included in the index count unless spawning is exceptionally late and more live fish than redds are observed during the index. Census survey sections are areas where redds have been previously documented, outside of the index area. Random surveys are conducted outside of the known spawning area to account for range expansion. Collectively, these surveys provide an annual census of spawning spring Chinook salmon and their redds.

Index surveys were scheduled to take place near the peak of spawning in each of the four primary spawning areas (Mainstem, Middle Fork, North Fork, and Granite Creek System). Pre-index surveys, one week prior to the index survey, were conducted in the North Fork. Post-index surveys, one week after the index surveys, were conducted in index sections in the Mainstem and Granite Creek System (GCS) to account for temporal variation in spawning. Post-index surveys were not conducted in the Middle Fork and North Fork because spawning was completed and few live fish were left at the time of the index survey.

Census surveys were conducted the same day or within one day of the index and post-index surveys in all four main spawning areas as well as in the South Fork and various tributaries of the North Fork to ensure that all spawning habitat was observed. If many live fish were observed during the initial surveys, we would return one week later to re-survey and make certain that all spawning was complete. Census surveys were conducted twice in the Mainstem and Desolation Creek, once in the middle Fork, and thrice in the North Fork. A pre-census survey was conducted during early August in the upper North Fork (between Trail Crossing and Trout Creek) due to early spawning activity.

Spawning surveys were conducted by walking in an upstream direction on the Mainstem, Middle Fork, South Fork, Big Creek, Trail Creek, and Clear Creek, and in a downstream direction on the North Fork, Camas Creek, Desolation Creek, Granite Creek, and Bull Run Creek. Where we were denied access to one side of the river on the Mainstem, the crew only walked on the permissible side. Survey sections ranged in length between 0.2 and 9.7 rkm depending on accessibility and difficulty (Appendix B). Typically teams of two would walk the stream for safety reasons and to ensure accuracy when distinguishing redds. In each section, surveyors recorded the number of new redds, number of live adult fish (on/near and off dig), and number of carcasses. On reaches surveyed more than once (i.e. index and census), the first team of surveyors marked redds with numbered colored flagging placed near each redd or group of redds. During subsequent surveys, surveyors re-identified flagged redds and recorded any new redds. During the last survey of each reach, surveyors marked redds with a GPS receiver and topographic map. Flagging was removed during the final surveys.

Table 1. Description, length, date of index, census, and random spawning survey sections in the John Day Basin for 2007. Sections are listed in upstream order for Mainstem and Middle Fork subbasins, and downstream order for South Fork and North Fork subbasins.

Stream	Survey type	Survey boundaries	Distance Km	Distance Mile	Survey dates
Mainstem	Census	Indian Creek to PWP Lower Boundary	7.1	4.4	Access Denied
	Census	PWP Lower Boundary to Dad's Creek	5.0	3.1	Sep 11, 18
	Index	Dad's Creek to Emmel Upper Fence	1.8	1.1	Access Denied
	Index	Emmel Upper Fence to Field Lower Fence	1.6	1.0	Sep 11, 18
	Index	Field Lower Fence to Jacobs Upper Fence[a]	8.8	5.5	Sep 11, 18
	Index	Jacobs Upper Fence to Road 13 Bridge	1.9	1.2	Access Denied
	Census	Mouth of Deardorff Creek to 2.3 km upstream	2.3	1.4	Sep 11
	Index	Road 13 Bridge to Reynolds Upper Fence[b]	2.3	1.4	Sep 11 ,18
	Index	Reynolds Upper Fence to Ricco Upper Fence	4.5	2.8	Access Denied
	Census	Ricco Upper Fence to Call Creek	3.2	2.0	Sep 11
South Fork	Census	Izee Falls to Cougar Gulch	5.2	3.2	Sep 27
	Census	Cougar Gulch to Rock Pile Ranch Bridge	4.5	2.8	Sep 27
	Census	Rock Pile Ranch Bridge to Murderer's Creek	5.5	3.4	Sep 27
Middle Fork	Census	Armstrong Creek to Beaver Creek	23.5	14.6	Sep 25
	Index	Beaver Creek to Highway 7 Culvert	21.4	13.3	Sep 24
	Census	Highway 7 Culvert to Phipps Meadow	7.1	4.4	Sep 24
Clear Creek[c]	Census	Mouth to Highway 26 Bridge	2.1	1.3	Sep 24
	Census	Highway 26 Bridge to 1.6 km upstream	1.6	1.0	Sep 24
North Fork	Census	North Fork Trail Crossing to Cunningham Creek	3.5	2.2	Aug, 28, Sep 12
	Census	Cunningham Creek to Trout Creek	18.2	11.3	Aug 28, Sep 12, 19
	Census	Trout Creek to Granite Creek	20.5	12.7	Sep 19,
	Index	Granite Creek to Cougar Creek	13.4	8.3	Sep 12, 13, 20, 21
	Census	Cougar Creek to Big Creek	3.9	2.4	Sep 21
	Index	Big Creek to Nye Creek	15.1	9.4	Sep 14, 21
	Census	Nye Creek to Camas Creek	16.6	10.3	Sep 21
Big Creek	Census	Mouth to Winom Creek	2.6	1.6	Sep 14
Trail Creek	Census	Mouth to confluence of North and South Forks	3.1	1.9	Aug 28
Granite Creek	Index	Road 73 Culvert to Buck Creek	9.5	5.9	Sep 13, 20
	Census	Buck Creek to mouth	7.9	4.9	Sep 20
Clear Creek[d]	Random	Lightening Creek to Ruby Creek Trailhead	1.4	0.9	Sep 13
	Census	Ruby Creek Trailhead to Alamo Road	1.8	1.4	Sep 13
	Census	Alamo Road to Smith Lower Boundary	1.3	0.8	Access Denied
	Census	Smith Lower Boundary to Beaver Creek	1.4	0.9	Sep 13
	Census	Beaver Creek to Old Road Crossing	1.6	1.0	Sep 13
	Index	Old Road Crossing to Mouth	4.8	3.0	Sep 13, 20
Bull Run Creek	Census	Deep Creek to Guard Station	2.4	1.5	Sep 13
	Index	Guard Station to Mouth	5.0	3.1	Sep 13, 20
Camas Creek	Census	0.4 km upstream to 0.4 km downstream of Fivemile Creek	0.8	0.5	Sep 26
Desolation Creek	Census	Impassable Waterfalls on South Fork to Mouth	46.0	28.5	Sep 7, 17

[a] Includes mileage of North Channel and South Channel

[b] Reynolds Upper Fence was previously listed as Klondike Lower Fence

[c] Tributary of the Middle Fork

[d] Tributary of Granite Creek in the North Fork subbasin

Each observed carcass was examined and sampled in each subbasin (except the North Fork below Trout Creek) due to typically smaller numbers of fish and the need for disease surveillance. Sampled carcasses were measured for fork length (FL, mm) and medial eye to posterior scale length (MEPS, mm), and dissected to verify sex. Females were checked for egg retention, to the nearest 25%. Trained surveyors recorded gill lesion presence or absence on fresh carcasses. The location of each lesioned fish was marked using a hand-held GPS receiver. Genetic samples (consisting of a small piece of rayed fin or skeletal muscle tissue on fresh carcasses) were collected and placed in vials containing 100% denatured ethanol at the request of the National Oceanic and Atmospheric Administration (NOAA) Fisheries Department.

Kidney samples were collected from fresh spring Chinook carcasses in each of the main spawning areas to determine concentration and prevalence of *Renibacterium salmoninarum* (Rs) antigen, the causative agent of bacterial kidney disease (BKD), in the spawning population. Trained surveyors selected carcasses with intact organs and membranes and non-glazed eyes, indicative of recent mortality. Wooden craft sticks and plastic spoons were used to scrape a 1–2 gram sample of kidney from each carcass. Samples were placed in sterile 1-ounce whirl-pack bags and stored in a cooler with ice until transported to a freezer. The enzyme-linked immunosorbent assay (ELISA) was used to obtain optical density (OD) values according to methodology adapted from Pascho and Mulcahy (1987). The Rs antigen level is an indication of bacterial infection load of *R. salmoninarum*. Table 2 summarizes the optical density value ranges and standard infection level categories used for BKD. Some samples were also examined for the presence of infectious hematopoietic necrosis virus (IHNV) by standard cell culture techniques using a portion of the collected kidney tissue. Viral samples were plated on *Epithelioma papillosum cyprini* and Chinook salmon embryo cell lines and incubated 10 to 14 days, respectively.

Surveyors collected scale samples from wild and hatchery carcasses encountered with a MEPS length of ≤ 550 mm (likely age-3 adults) and ≥ 650 mm (likely age-5 adults). Carcasses from 551 to 649 mm were assumed to be 4-year old fish, based on the size-at-age distribution of carcasses examined during previous years. Scales were mounted on gummed cards, impressions were made in acetate and viewed using a microfiche reader, and annuli were counted by two different readers to determine age. We calculated age structure for spawning populations separately for the Mainstem, Middle Fork, North Fork, GCS, and Desolation Creek. Tails were removed from all carcasses to prevent re-sampling. Carcasses were then returned near their original position in the stream.

Carcasses of hatchery fish were identified by an adipose fin clip and subsequently had their snout removed to detect the presence of a coded wire tag (CWT). Snouts were bagged with a numbered identification card and frozen. Later in the lab, snouts were halved and scanned for a CWT using a v-box tag detector. Any CWTs found were cleaned and examined for a tag code (binary or numerical) using a microscope. Tag codes were entered into the CWT database for ODFW and hatchery of origin was queried using the PSMFC database.

All spring Chinook redds in the basin were visually counted with the exception of areas in the Mainstem where landowners denied access. Where we were denied access, we multiplied the number of index kilometers not surveyed (8.2) by the redds/kilometer ratio of index sections that were surveyed. Where we were denied access to a Mainstem census survey section, we multiplied the number of denied census kilometers (7.1) by the ratio of known redds/kilometer of those census sections surveyed. A lack of weir counts in the basin prevents basin-specific fish/redd estimates. We therefore estimated spawner escapement conservatively by multiplying

the number of redds counted by the standard ratio of three fish/redd. We also estimated spawner escapement by multiplying the number of redds by 2.79, the fish/redd estimate from above the Catherine Creek weir in the Grande Ronde Basin during 2007.

While establishing habitat photo points during 6 July 2007 on the Dunstan Preserve (The Nature Conservancy property) located on the Middle Fork John Day River, we observed 29 adult spring Chinook salmon carcasses between Coyote Creek and Big Boulder Creek. Knowing that in the days immediately prior to that day, air temperatures consistently above 90° F were recorded in the John Day area, the decomposition state of the carcasses, and experience from previous years, we concluded that the fish had died earlier that week. Subsequently, we coordinated surveys of the John Day River basin with available staff to better understand the extent of adult salmon loss. During 6–12 July 2007, we conducted carcass surveys on approximately 35 river kilometers (RKM) of the Middle Fork John Day River (Dunstan Preserve to Phipps Meadows). We also conducted surveys on approximately 30 RKM of the North Fork John Day River (Granite Creek to Silver Creek, Ryder Creek to Cougar Creek, Big Creek to Horse Canyon) from 11–16 July 2007. In addition, Brent Smith, CTWSRO biologist, surveyed approximately 3 RKM of the Mainstem John Day River (Mainstem Forrest Ranch property downstream of Dad's Creek during 17 July 2007. Carcasses were examined for sex, age, fork length, MEPS length, fin clips, and for the presence of gill lesions. GPS coordinates were taken for locations of live adults and carcasses observed during surveys conducted after 9 July. Observations of other fish species were also noted.

During 2007, 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 274–296) to estimate smolt abundance and freshwater productivity (smolts/redd). The Mainstem seining operation was located just downstream of the confluence of the Mainstem and North Fork (Figure 1). The RSTs and Mainstem seining operation are all located downstream of all known spring Chinook spawning habitat. 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 a 1.52 or 2.44 m diameter RST depending on water conditions to optimize trap efficiency. A 1.52 m RST was fished at the Middle Fork (rkm 24) trap site. Traps were either removed or stopped during times of ice-up, high discharges, and during warm summer months after fish ceased migrating. Trapping efficiency 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). A complete description of smolt collection methods is described by Wilson et al. (2008).

RESULTS

During the 2007 census spawning survey, we observed 853 spring Chinook salmon redds while surveying 299.1 rkm of the John Day River basin (88.2 rkm within index areas, 198.6 rkm within census survey areas, and 12.3 rkm within random survey areas; Table 3, Appendix Tables A-1 to A-3). The Mainstem composed 41.8% of all redds observed (357 of 853 including estimated redds), while 42% were observed in the North Fork, 10% in the Middle Fork, 3.5% (in the GCS, and 2.7% in Desolation Creek (Tables 3 and 4, Appendix Table A-1). The overall basin redd count was the lowest observed since census surveys were reinstated in 2000 (Figure 4). Spawning densities within census survey reaches (combined index and census sites)

Table 2. Summary of ELISA optical density value ranges, designated Rs antigen category, and significance of result with respect to adult Chinook salmon.

Optical density value (OD_{405}) range	Rs antigen category	Significance to adult Chinook[b]
≤ 0.100	Negative or Very Low	Infection not detected by ELISA.
0.100–0.299	Low Positive	Low level of Rs antigen detected, not a factor in death, did not have BKD.
0.300–0.699	Moderate Positive	Moderate level of Rs antigen detected, beginning of significant infection with Rs in this range, signs of disease absent, rarely factor in death.
0.700–0.999	High Positive	Infection with Rs at high level, gross signs rare, could be factor in death.
≥ 1.000	Clinical[a]	Grossly infected with Rs, signs of disease usually, death probable, fish had BKD.

[a] By the ELISA, an optical density (OD) equal to or greater than 1.000 is considered to be clinical BKD
[b] Generally the significance to the maternal progeny is that there is a greater probability of vertical transmission (female parent to progeny) of Rs (BKD) from females with higher ELISA values

Table 3. Kilometers surveyed, total number of redds observed, and number of new redds observed during spring Chinook salmon spawning surveys in the John Day Basin, 2007.

	Kilometers surveyed			New redds observed			
Stream	Index	Census	Total redds	Pre-index	Index	Post-index	Census
Mainstem and Tributary							
Mainstem	19.0[a]	15.2[b]	355	--	140	135[a]	80[b]
Deardorff Creek	--	2.3	2	--	--	--	2
South Fork	--	15.1	0	--	--	--	0
Middle Fork	21.4	34.3	85[c]	--	73	--	12
North Fork and Tributaries							
North Fork	28.5	62.6	358	158	38	--	162
Desolation Cr.	--	46.0	23	--	--	--	23
Trail Creek	--	3.1	0	--	--	--	0
Big Creek	--	2.6	0	--	--	--	0
Camas Creek	--	0.8	0	--	--	--	0
Granite Creek System							
Granite Creek	9.5	7.9	19	--	11	2	6
Clear Creek	4.8	7.6	9[d]	--	8	0	1[d]
Bull Run Creek	5.0	2.4	2	--	2	0	0
Entire Basin	88.2	199.9	853	158	272	137	286

[a] Only 10.8 index kilometers were surveyed. We counted 140 index redds and added an estimate of the redds in the survey sections that we did not have landowner permission to survey. We estimated 107 redds for 8.2 index kilometers that were not surveyed (8.2 index kilometers · 13.0 redds/index kilometer). Twenty-eight redds were observed during the post-index surveys
[b] Landowner denied access to 7.1 kilometers of the lower census survey sections. We counted 30 redds within 5.0 kilometers and estimated 43 redds for 7.1 kilometers that were not surveyed (7.1 · 6 redds/census kilometer). This was added to 7 redds seen in upper census reaches
[c] Includes 1 redd found in Clear Creek
[d] Landowner denied access to 1.3 kilometers of census survey. Only one redd was observed in census areas above and below the property so no estimate was made for the denied reach.

were 3.0 redds/km for the John Day River basin, 9.8 redds/km in the Mainstem (including Deardorff Creek), 3.7 redds/km in the North Fork, 1.5 redds/km in the Middle Fork (Appendix Table A-3). We did not observe any redds in the South Fork in 2007.

We estimate that approximately 2,500 spring Chinook adults escaped to the John Day Basin this year (Table 4). This escapement estimate was based on our observation of 853 redds and two independent fish per redd ratios calculated in 2007: 2.79 fish/redd observed above the Catherine Creek weir in the Grande Ronde River basin (Fred Monzyk, ODFW, unpublished data) and three fish/redd as the standard conservative estimate.

We observed 372 carcasses during spawning surveys, representing about 15% of the estimated escapement (Table 5). We were able to sex 309 carcasses with a 56% female and 44% male composition observed throughout the John Day River basin (Tables 6 and 7). We determined the MEPS length, age, and gender of 304 carcasses. Age-4 adults composed 85.2% of the carcasses aged with age-5 adults accounting for 9.5%, and age-3 adults 5.2% (Tables 8 and 9).

Table 4. Estimated number of spring Chinook salmon redds and spawners and percentage of redds in each survey area compared to all survey areas in the John Day River basin, 2007. To estimate the number of spawners, we multiplied the number of redds counted in each spawning area by 2.79 fish/redd (from above Catherine Creek weir in the Grande Ronde Basin; Fred Monzyk, ODFW, unpublished data), and by the standard conservative estimate of 3.0 fish/redd.

Stream	Number of redds	Number of spawners estimated		Percentage of total basin
		2.79 fish/redd	3.0 fish/redd	
Mainstem	357	996	1,071	41.9
South Fork	0	0	0	0
Middle Fork	85	237	255	10.0
North Fork	358	999	1,074	42.0
Desolation Creek	23	64	69	2.7
Granite Creek	19	53	57	2.2
Clear Creek	9	25	27	1.0
Bull Run Creek	2	6	6	0.2
Entire basin	853	2,380	2,559	

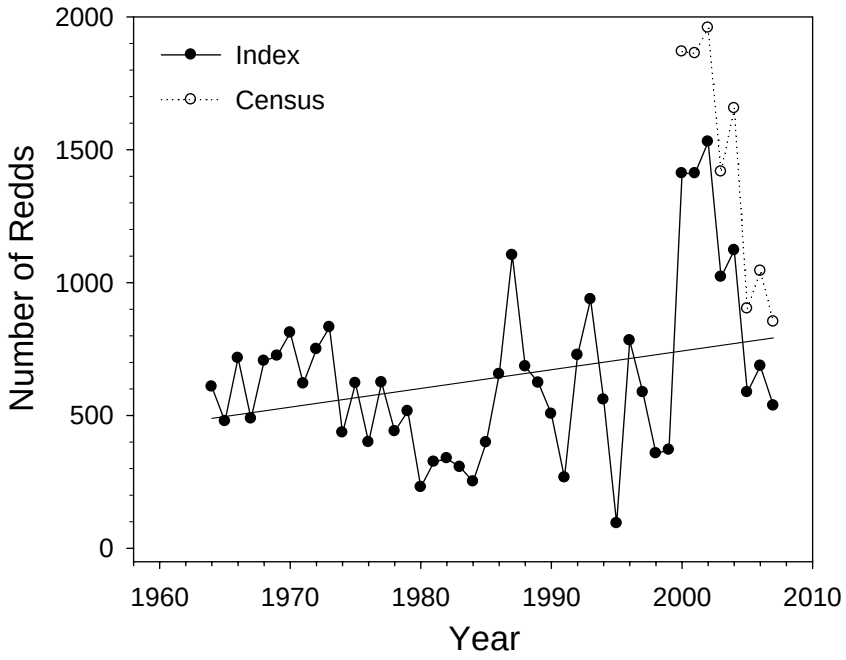

Figure 4. Index and census spawning ground survey counts of spring Chinook salmon redds in the John Day River basin. A linear regression fit to the index redd counts (P = 0.06) is also shown. Index counts from 1959-63 are excluded because the North Fork was not adequately surveyed during those years.

Table 5. Number of carcasses sampled during all spring Chinook salmon spawning surveys in the John Day River basin during 2007. Totals include carcasses of unknown sex.

Stream	Number of carcasses				
	Total	Pre-index	Index	Post-index	Census
Mainstem	102	--	50	36	16
South Fork	0	--	--	--	0
Middle Fork	73	--	61	--	12
North Fork and tributaries	205	35	51	5	114
North Fork	154	35	41	--	78
Big Creek	0	--	--	--	0
Trail Creek	0	--	--	--	0
Desolation Creek	30	--	--	--	30
Camas Creek	0	--	--	--	0
Granite Creek System	21	--	10	5	6
Basin total	380	35	162	41	142

Table 6. Number of female, male, and unknown carcasses (n) sampled during all spring Chinook salmon spawning surveys in the John Day River basin during 2007.

Stream	Number of carcasses			
	n	Female	Male	Unknown
Mainstem	88	49	38	1
South Fork	0	--	--	--
Middle Fork	66	41	24	1
North Fork	110	55	55	0
Desolation Creek	28	16	12	0
Granite Creek System	19	12	7	0
Basin total	311	173	136	2

Table 7. Sex ratio of carcasses sampled during all surveys in the John Day River basin, 2007. Number of carcasses (n) in which sex could be determined is also shown.

Survey type	n	% Female	% Male
Pre-index	28	50.0	50.0
Index	130	63.1	36.9
Post-index	32	65.6	34.4
Census	119	47.1	52.9
All surveys	309	56.0	44.0

Table 8. Percent age (y) and sex composition of male (M) and female (F) spring Chinook salmon carcasses sampled in the survey areas of the John Day River basin during 2007. Number of carcasses (n) where both age and sex could be determined is also shown.

Stream	n	Age (y)					
		3		4		5	
		F	M	F	M	F	M
Mainstem	87	1.1	11.5	54.0	31.0	1.1	1.1
Middle Fork	65	0.0	3.1	55.4	30.8	7.7	3.1
North Fork	106	0.0	2.8	44.3	42.5	6.6	3.8
Desolation Creek	28	0.0	0.0	35.7	39.4	21.4	3.6
Granite Creek System	18	0.0	0.0	50.0	38.9	11.1	0.0
Basin total	304	0.3	4.9	49.0	36.2	6.9	2.6

We estimated the percentage of eggs retained by 167 individual female carcasses sampled during spawning surveys (Table 10). Of those sampled, 88% (147) spawned completely, 7% (11) were incompletely spawned, and 5% (9) were pre-spawn mortalities at the time of spawning ground surveys (i.e. 100% egg retention). Of 243 carcasses examined for gill lesions during spawning ground surveys, 2.5% (6) were positive for the presence of lesions (Table 11). Gill lesion frequency differed among spawning areas. Proportion of gill lesions in Granite Creek was significantly greater (4 of 13 or 31%, $P < 0.001$) than that of the entire basin (Table 12). Hatchery carcasses composed 4.6% (17 of 372) of all carcasses examined for adipose fin clips. Only one of seventeen snouts (6%) collected contained a CWT (Table 13).

Pre-spawn mortality before spawning ground surveys were initiated was significant in the Middle Fork subbasin due to warm temperatures in July when numerous adult carcasses were recovered. In the Middle Fork John Day River we observed 118 carcasses and 37 live adult spring Chinook salmon during July. In the North Fork John Day River between Granite Creek and Silver Creek we observed ≤56 live fish and no carcasses. In the North Fork John Day River between Ryder Creek and Desolation Creek we observed 14 live fish and 16 carcasses. In the Granite Creek system we observed 14 live fish and no carcasses. In the Mainstem John Day River Forrest Ranch property Brent Smith observed three live fish and two carcasses. Besides adult spring Chinook salmon, carcasses of mountain whitefish *Prosopium williamsoni*, resident redband trout *Oncorhynchus mykiss*, and sculpin *Cottus spp.* were observed in the lower Middle Fork and North Fork survey sections.

Freshwater productivity of spring Chinook was apparently low during 2006-2007 at 45 smolts/redd for the 2005 brood year across the entire John Day River basin (Table 14; Figure 5). Based on upper Mainstem redd counts and abundance estimates from our Mainstem trap we estimated freshwater survival to be 118 smolts/redd for the Upper Mainstem, 2005 brood year. Using similar methods for the Middle Fork, we estimated freshwater production as 42 smolts/redd for the 2005 brood year.

DISCUSSION

While all four main spawning areas of the John Day Basin experienced pre-spawn mortalities of adult spring Chinook salmon, the Middle Fork John Day River appeared to be the most affected. During the week of the fourth of July, daily maximum air temperatures up to 42° C were recorded in the town of John Day (NOAA, unpublished data). Water levels during this time period were also extremely low throughout the John Day Basin—approximately one-third of average (USGS, unpublished data).

It is clear that these fish died as a result of water temperatures exceeding published lethal temperatures. During the immediate days prior to the observed carcasses on the Middle Fork, temperature loggers deployed by CTWSRO biologists on the Oxbow and Forrest Conservation properties indicated that maximum daily water temperatures ranged from 25–29° C. Published literature suggests that lethal temperatures for adult salmon are 21–22° C for one week of exposure (Poole et al. 2001). While daily average temperatures were lower than maxima, temperatures as high as 29° C are lethal to adult salmon already stressed by low water levels. Low water levels also likely contributed to salmon mortalities by limiting access for adults to the already limited reaches of coldwater refugia. Diseases can also be exacerbated by high water

Table 9. Number examined (n), mean, standard error (SE), and range of middle of eye to posterior scale (MEPS) length (mm) by age (y) and sex (male, M; female, F) of spring Chinook salmon carcasses sampled during spawning ground surveys in the John Day River basin during 2007.

				MEPS length		
Survey area	Age	Sex	n	Mean	SE	Range
Mainstem	3	M	10	428.5	17.6	380–520
	3	F	1	350.0	—	—
	4	M	27	607.9	12.6	485–780
	4	F	47	624.6	7.1	530–750
	5	M	1	660.0	—	—
	5	F	1	670.0	—	—
Middle Fork	3	M	2	405.0	15.0	390–420
	4	M	20	565.6	11.7	450–645
	4	F	36	592.1	8.0	515–710
	5	M	2	762.5	37.5	725–800
	5	F	5	707.0	14.3	680–760
North Fork	3	M	3	431.7	24.6	390–475
	4	M	45	624.1	7.8	530–790
	4	F	47	643.0	7.4	530–755
	5	M	4	763.8	26.0	695–815
	5	F	7	740.3	15.7	680–820
Granite Creek System	4	M	7	615.3	21.4	555–735
	4	F	9	632.1	17.0	565–730
	5	F	2	727.5	32.5	695–760
Desolation Creek	4	M	11	602.7	14.4	525–695
	4	F	10	657.8	25.8	570–789
	5	M	1	805.0	—	—
	5	F	6	704.2	7.9	685–735
Entire basin	3	M	15	426.0	12.5	380–520
	3	F	1	350.0	—	—
	4	M	110	606.8	5.6	450–790
	4	F	149	625.2	4.5	515–789
	5	M	8	755.6	20.2	660–815
	5	F	21	717.5	7.9	670–820

Table 10. Number of female spring Chinook salmon assigned to one of five categories based on the percentage of total eggs observed in carcasses during spawning ground surveys of the John Day River basin, 2007. Each carcass was placed into one of five categories shown. Number of female carcasses examined in each survey section (n) is also shown.

Survey Area	n	0%	25%	50%	75%	100%
Mainstem	45	43	0	1	0	1
Middle Fork	41	35	3	2	0	1
North Fork	54	52	2	0	0	0
Desolation Creek	16	12	1	2	0	1
Granite Creek	9	4	0	0	0	5
Clear Creek	1	1	0	0	0	0
Bull Run Creek	1	0	0	0	0	1
Granite Creek System	11	5	0	0	0	6
Entire basin	167	147	6	5	0	9

Table 11. Number of adult spring Chinook salmon observed for gill lesions as determined by carcass gill observations in four subbasins (five spawning areas) during spawning ground surveys in the John Day River basin, 2007. Each carcass was examined separately and placed into one of two categories shown. Number of carcasses examined for lesions in each survey section (n) is also shown.

Survey Area	n	Gill lesions	No gill lesions
Mainstem	58	0	58
Middle Fork	63	1	62
North Fork	85	1	84
Desolation Creek	24	0	24
Granite Creek System	13	4	9
Entire basin	**243**	**6**	**237**

Table 12. Percent pre-spawning mortality (PSM; 100% egg retention) of female carcasses and percent gill lesion incidence (GL) of all examined carcasses in the Granite Creek System, including significant difference, between 2000–2007 in the John Day Basin. Significance (P-value) of z-tests to determine differences in PSM and GL incidence between the GCS and the remainder of the basin are also shown. Carcasses were not examined for gill lesions until 2003.

	John Day Basin[a]		GCS		P-value	
Year	% PSM	% GL	% PSM	% GL	PSM	GL
2007	1.9[b]	0.9	54.5	30.8	$P < 0.001$	$P < 0.001$
2006	2.0	2.5	0.0	28.8	$P = 0.789$	$P < 0.001$
2005	2.6	1.6	36.4	18.2	$P < 0.001$	$P < 0.001$
2004	1.4	2.6	0.0	19.6	$P = 0.969$	$P < 0.001$
2003	5.0	20.5	0.0	59.0	$P = 0.254$	$P < 0.001$
2002	1.7	--	6.0	--	$P = 0.049$	--
2001	4.4	--	16.7	--	$P < 0.001$	--
2000	0.5	--	0.9	--	$P = 0.867$	--

[a] Values may differ from previous annual reports due to data revisions and error corrections

[b] Does not include 62 female pre-spawn mortalities found July 2007 in the Middle Fork and North Fork

temperatures however, the short timeframe and wide distribution of the observed carcasses suggest that disease was not the primary cause of the mortalities during July.

It will take several years before we will be able to measure the extent of these mortalities on the John Day Chinook population viability. Spawning ground surveys conducted during September indicated that only 85 redds were present or 10% of what was observed for the entire John Day River basin. During the two previous years, when basin-wide redd totals were similar to 2007, redds in the Middle Fork accounted for 19–20% of the total count. Further evidence of the long-term effect of this mortality will be measured when smolts are counted during the spring of 2009. At that time we will be able to estimate what impact it had on juvenile fish production. Even without these smolt estimates, the observed mortalities provide additional evidence that temperature is a primary factor limiting salmon production especially in the Middle Fork John Day River.

Table 13. Sample date, sample identification, stream location, fin clip, sex, medial eye to posterior scale length (MEPS, mm), and hatchery (H) origin and release location as determined by coded wire tag (CWT) information for all fin-clipped spring Chinook salmon sampled during spawning ground surveys of the John Day Basin, 2007. Fin clips were adipose (Ad).

Date	Sample tag #	Stream	Fin clip	Sex	MEPS (mm)	CWT record of hatchery origin and release
9/12/07	07G 4632	North Fork	Ad	M	560	No CWT
9/12/07	07G 4613	North Fork	Ad	M	390	No CWT
9/12/07	07G 4630	North Fork	Ad	F	570	No CWT
9/12/07	07G 4636	North Fork	Ad	F	625	No CWT
9/12/07	07G 4631	North Fork	Ad	F	625	No CWT
9/11/07	07G 4611	Mainstem	Ad	M	425	No CWT
9/11/07	07G 4612	Mainstem	Ad	F	560	No CWT
9/11/07	07G 4649	Mainstem	Ad	M	380	No CWT
9/11/07	07G 4638	Mainstem	Ad	M	380	No CWT
9/11/07	07G 4637	Mainstem	Ad	F	610	No CWT
9/18/07	07G 4670	Mainstem	Ad	M	380	No CWT
9/18/07	07G 4671	Mainstem	Ad	F	570	No CWT
9/10/07	07G 4663	Desolation Cr.	Ad	M	630	No CWT
9/10/07	07G 4664	Desolation Cr.	Ad	F	680	No CWT
9/10/07	07G 7410	Desolation Cr.	Ad	F	590	No CWT
9/10/07	07G 4639	Desolation Cr.	Ad	M	600	Rapid River H., ID
9/20/07	07G 4679	Granite Cr. (GCS)	Ad	F	695	No CWT

Table 14. 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 from the 1978-1982 brood years are from Lindsay et al. (1986).

Brood Year	Number of redds[a]	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

[a] includes all redds counted from spawning surveys in the John Day Basin for individual brood years.

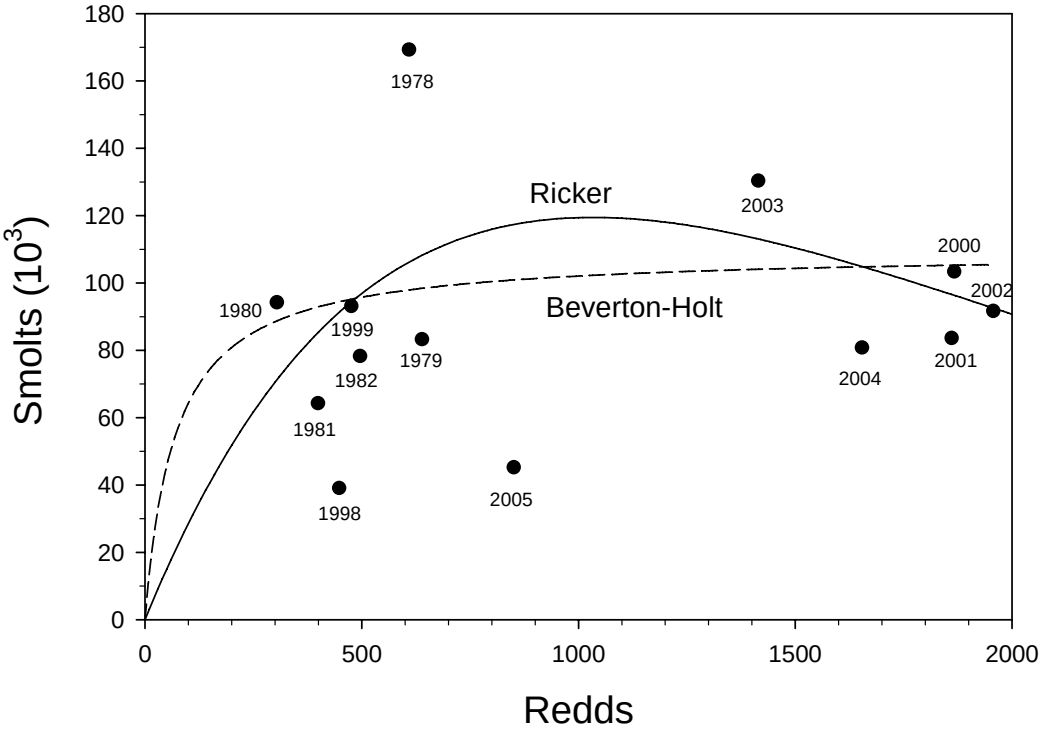

Figure 5. The number of spring Chinook smolts produced as a function of redd counts in the John Day River basin. Points indicate brood years. Beverton-Holt and Ricker stock-recruitment curves are fit to the data.

Despite significant efforts and improvements in spring Chinook habitat, our smolt/redd evidence suggests that additional habitat improvements are needed to ameliorate sub-optimal summer temperatures that decrease freshwater survival and limit achievement of recovery goals and opportunities for a sport fishery. The summer mortality of adult Chinook in the Middle Fork indicates that temperatures are sub-optimal for this species. But also, a review of Figure 5 suggests that even during high adult escapements, the number of smolts produced remains fairly constant. Despite significant improvements in Chinook rearing habitat and the region being heralded as a restoration success story, smolt-per-redd ratios indicate that juvenile rearing areas are fully seeded at recent escapement levels and that rearing habitat is limiting freshwater production. This relationship illustrates the need for further restoration efforts targeting temperature and coincident freshwater production.

For five consecutive years (2003–2007), carcasses in the GCS showed a significantly higher incidence of gill lesions compared to the remainder of the John Day Basin (Table 12). Furthermore, lesion occurrence in 2007 was the second highest recorded since 2003. The cause of gill lesions continues to elude us, but some evidence suggests water quality in the Granite Creek system contributes to the high incidence there. No definite pattern exists regarding locations of lesioned carcasses except that they appear to be concentrated in Granite Creek.

Index surveys continue to represent the majority of redds observed (mean 2000–2006 = 71.0%; 63% in 2007) in the John Day River basin. However, census surveys account for a greater proportion of redds most years as spring Chinook expand into new areas to spawn.

Census surveys from 2000–2006 accounted for a mean of 429 more redds than index surveys alone. Percentage of total redds found outside of index reaches in 2007 include 31%, 45%, 14%, and 30% in the Mainstem, North Fork, Middle Fork, and GCS, respectively (Table 3). Index surveys are useful for observing population trends but are inadequate for estimating escapement for a sport fishery. A census of redds is also needed to provide an accurate smolt per redd estimate. Index surveys when coupled with census surveys produce a complete picture of spring Chinook spawning distribution and redd count in the John Day Basin.

Insufficient numbers of spring Chinook have returned to the John Day River basin to meet the management goal of an average annual escapement of 5,950 adults for natural production (Columbia-Blue Mountain Resource Conservation and Development Area 2005). An average annual return of 5,950 spring Chinook would also trigger a limited sport fishery on the Mainstem that was discontinued in 1976. Conservative estimates of spawner escapement based on the ratio of three fish per redd indicate basin-wide escapements for 2000, 2001, 2002, 2003, 2004, 2005, 2006, and 2007 were 5,637, 5,658, 5,877, 4,251, 4,968, 2,706, 3,132, and 2,559, respectively. The mean escapement for all eight years is 4,348 adults, less than the number required to initiate a local fishery. There is currently a limited spring Chinook fishery in the summer for the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) on the North Fork and Granite Creek.

The estimated number of redds observed during 2007 was the lowest number censused since we began census counts in 2000. It was also the lowest estimate for index areas since 1999. From 2006 to 2007, redd numbers declined in all subbasins but the North Fork, and dramatically in the Middle Fork. The basin index redd count for 2007 (537) was slightly below the 48-year mean (1959–2006) of 601 redds and well below the 2000–2006 mean of 1,105 redds. Despite the last few years of relatively low redd counts, there remains an overall increasing trend since 1959, when spawning surveys first began in the John Day Basin. An increasing trend is evident in all subbasins except Granite Creek. It is still unclear as to what variables are contributing to the redd decline in Granite Creek. Recent declines in redd numbers and spawning adults throughout the John Day River basin exemplifies the continued need for spawner and redd monitoring, especially in the light of the dramatic die-off of pre-spawn adults in the Middle Fork during this past summer.

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APPENDIX

Appendix A. Historic Index and Census Redd Counts

Appendix Table A-1. Census (index, post-index, and census) redd counts for spring Chinook salmon in the John Day Basin, 2000–2007.

				North Fork and North Fork Tributaries					
					Granite Creek System				
Year	Mainstem	South Fork	Middle Fork	North Fork[c]	Granite Creek	Clear Creek	Bull Run Creek	Desolation Creek	Basin total
2000	380	3	563	612	198	96	12	5	1,879[d]
2001	432	0	354	803	126	80	45	23	1,886[d]
2002	549	0	389	707	163	64	31	56	1,959
2003	323[a]	0	236	668	118	32	1	39	1,417
2004	368[a,b]	0	319	805	72	38	8	46	1,656
2005	227[a]	0	178	420	43	15	4	15	902
2006	451[a,b]	0	199	262	55	30[a]	14	33	1,044
2007	357[a,b]	0	85	358	19	9	2	23	853

[a] Includes estimated redds in denied areas
[b] Includes Deardorff Creek tributary
[c] Includes Camas Creek, Trail Creek, and Big Creek tributaries
[d] Includes redd expansions; 10 redds and 23 redds were added in 2000 and 2001, respectively

Appendix Table A-2. Census (census plus index) survey kilometers for spring Chinook salmon spawning surveys in the John Day Basin, 2000–2007. Index and census survey areas are defined in Tables 1 and 3.

				North Fork and North Fork Tributaries					
					Granite Creek System				
Year	Mainstem	South Fork	Middle Fork	North Fork	Granite Creek	Clear Creek	Bull Run Creek	Desolation Creek	Basin total
2000	34.4	10.6	55.2	85.0	17.4	6.4	5.8	25.3	240.1
2001	34.4	10.6	55.2	85.0	17.4	6.4	5.8	33.8	248.5
2002	34.4	10.6	53.6	88.4	17.4	8.0	5.8	40.4	258.5
2003	34.4	10.6	55.2	88.4	17.4	10.9	5.8	40.4	263.0
2004	41.6[a]	17.6	60.9	102.4[b]	17.4	8.2	7.4	46.0[f]	301.5
2005	40.9[a]	17.3	60.1	104.2[c]	17.4	10.9	7.4	46.0[f]	304.2
2006	38.4[a]	17.1	59.5	102.4[d]	17.4	10.9	7.4	46.0[f]	299.1
2007	36.5[a]	15.1	55.7	97.6[e]	17.4	12.4	7.4	46.0[f]	288.1

[a] Includes 2.3 km on Deardorff Creek tributary
[b] Includes 3.2 km on Camas Creek, 3.1km on Trail Creek, and 2.6 km on Big Creek tributaries
[c] Includes 3.1 km on Camas Creek, 5.2 km on Trail Creek, and 2.6 km on Big Creek tributaries
[d] Includes 2.7 km on Camas Creek, 3.1 km on Trail Creek, and 2.6 km on Big Creek tributaries
[e] Includes 0.8 km on Camas Creek, 3.1 km on Trail Creek, and 2.6 km on Big Creek tributaries
[f] Previous mileage calculation errors were recently discovered and corrected for this report

Appendix Table A-3. Census spawning density (redds/km) for the combined index and census survey areas of the John Day Basin, 2000–2007. Index and census survey areas are defined in Tables 1 and 3.

Year	Mainstem	South Fork	Middle Fork	North Fork and North Fork Tributaries					Basin total
				North Fork	Granite Creek System			Desolation Creek	
					Granite Creek	Clear Creek	Bull Run Creek		
2000	11.0	0.3	10.2	7.2	11.4	15.0	2.1	0.2	7.8
2001	12.6	0.0	6.4	9.4	7.2	12.5	7.8	0.7	7.5
2002	16.0	0.0	7.3	8.0	9.4	8.0	5.3	1.4	7.6
2003	8.8	0.0	4.0	7.6	6.8	3.2	0.1	0.9	5.4[a]
2004	8.8	0.0	5.2	7.9	4.1	4.6	1.1	1.2	5.6[a]
2005	5.6	0.0	3.0	4.0	2.5	1.4	0.5	0.4	3.0[a]
2006	11.7	0.0	3.3	2.6	3.2	2.8	1.9	0.7	3.5[a]
2007	9.8	0.0	1.5	3.7	1.1	0.7	0.3	0.5	3.0

[a] Includes random survey sections which began in 2003

Appendix Table A-4. Index redd counts for spring Chinook salmon in the John Day Basin for each primary spawning area, 1959–2007. Index counts from 2000 to present include new redds observed during pre-index surveys, and if applicable, post-index surveys.

Year	Mainstem[a]	Middle Fork[b]	North Fork[c]	Granite Creek System[d]	Basin total
1959	4	0	--	50	54
1960	9	32	--	120	161
1961	39	11	--	42	92
1962	159	28	--	447	634
1963	10	4	--	280	294
1964	17	36	140	415	608
1965	75	37	146	220	478
1966	121	65	185	345	716
1967	96	17	99	276	488
1968	9	4	158	534	705
1969	121	48	369	186	724
1970	108	76	302	326	812
1971	91	41	212	276	620
1972	51	51	189	458	749
1973	116	43	349	324	832
1974	33	81	130	191	435
1975	92	89	211	229	621
1976	60	66	111	162	399
1977	64	58	295	207	624
1978	59	107	109	165	440
1979	68	118	200	130	516
1980	16	58	78	78	230
1981	51	26	138	110	325
1982	49	62	105	122	338
1983	133	51	76	46	306
1984	73	67	63	48	251
1985	116	40	110	132	398
1986	159	76	257	163	655
1987	247	340	375	141	1,103
1988	82	241	245	116	684
1989	165	113	196	149	623
1990	124	47	257	78	506
1991	61	35	115	55	266
1992	142	108	339	138	727
1993	135	155	379	268	937
1994	169	93	201	96	559
1995	29	15	27	23	94
1996	227	136	291	128	782
1997	125	163	197	102	587
1998	108	79	109	61	357
1999	58	105	120	87	370
2000	337	356	477	241	1,411
2001	383	199	607	222	1,411
2002	480	309	513	198	1,500
2003	273[e]	184	483	81	1,021
2004	263[e]	176	602	81	1,122
2005	161[e]	114	271	41[f]	587
2006	310[e]	153	160	63	686
2007	247[e]	73	196	21	537

[a] Index survey is 19.0 km

[b] Index survey was 15.3 km during 1959–85, 21.0 km during 1986–03, and 21.4 km in 2004–07

[c] Index survey is 28.5 km

[d] Index survey is 19.3 km. In 1993, 20.1 km were surveyed

[e] Landowners denied access to some index reaches; number includes estimated redds

[f] Seventeen redds from the post-index were added to twenty-four redds observed during the index, per management's request

Appendix Table A-5. Spawning density (redds/km) in index areas of the John Day River basin 1959–2007. Index counts from 2000 to present include new redds observed during pre-index surveys, and if applicable, post-index surveys.

Year	Mainstem[a]	Middle Fork[b]	North Fork[c]	Granite Creek System[d]	Basin
1959	0.2	0.0	--	2.6	0.7
1960	0.5	2.1	--	6.2	2.0
1961	2.1	0.7	--	2.2	1.1
1962	8.4	1.8	--	23.2	7.7
1963	0.5	0.3	--	14.5	3.6
1964	0.9	2.4	4.9	21.5	7.4
1965	4.0	2.4	5.1	11.4	5.8
1966	6.4	4.2	6.5	17.9	8.7
1967	5.1	1.1	3.5	14.3	5.9
1968	0.5	0.3	5.5	27.7	8.6
1969	6.4	3.1	12.9	9.6	8.8
1970	5.7	5.0	10.6	16.9	9.9
1971	4.8	2.7	7.4	14.3	7.6
1972	2.7	3.3	6.6	23.7	9.1
1973	6.1	2.8	12.2	16.8	10.1
1974	1.7	5.3	4.6	9.9	5.3
1975	4.9	5.8	7.4	11.9	7.6
1976	3.2	4.3	3.9	8.4	4.9
1977	3.4	3.8	10.4	10.7	7.6
1978	3.1	7.0	3.8	8.5	5.4
1979	3.6	7.7	7.0	6.7	6.3
1980	0.8	3.8	2.7	4.0	2.8
1981	2.7	1.7	4.8	5.7	4.0
1982	2.6	4.1	3.7	6.3	4.1
1983	7.0	3.3	2.7	2.4	3.7
1984	3.9	4.4	2.2	2.5	3.1
1985	6.1	2.6	3.9	6.8	4.8
1986	8.4	3.6	9.0	8.4	7.5
1987	13.1	16.3	13.2	7.3	12.6
1988	4.3	11.5	8.6	6.0	7.8
1989	8.7	5.4	6.9	7.7	7.1
1990	6.6	2.2	9.0	4.0	5.8
1991	3.2	1.7	4.0	2.8	3.0
1992	7.5	5.2	11.9	7.2	8.3
1993	7.1	7.4	13.3	13.3	10.7
1994	8.9	4.4	7.1	5.0	6.4
1995	1.5	0.7	0.9	1.2	1.1
1996	12.0	6.5	10.2	6.6	8.9
1997	6.6	7.8	6.9	5.3	6.7
1998	5.7	3.8	3.8	3.2	4.1
1999	3.1	5.0	4.2	4.5	4.2
2000	17.8	17.0	16.7	12.5	16.1
2001	20.3	9.5	21.3	11.5	16.1
2002	25.4	14.8	18.0	10.3	17.3
2003	14.4	9.5	17.7	5.2	12.3
2004	13.8	8.2	21.1	4.2	12.7
2005	8.5	5.3	9.5	2.1	6.7
2006	16.3	7.1	5.6	3.3	7.8
2007	13.0	3.4	6.9	1.1	6.1

[a] Index survey is 19.0 km

[b] Index survey was 15.3 km during 1959–85, 21.0 km during 1986–03, and 21.4 km in 2004–07

[c] Index survey is 28.5 km

[d] Index survey is 19.3 km. In 1993, 20.1 km were surveyed

Appendix Table A-6. Percentage of redds counted in survey sections of the main spawning areas within the John Day River basin, 2000–2007.

Stream	Survey section	Survey type	Km	2000	2001	2002	2003	2004	2005	2006	2007
Mainstem	Indian Creek to Main Street Bridge (Prairie City)	Census	8.5	2.1	4.2	4.4	9.6[c]	12.0[c]	16.7[c]	16.3[c]	14.6[c]
	Prairie City to Dad's Creek	Census	3.5	0.8	2.1	4.9	4.6	3.8	6.6	8.2	5.9
	Dad's Creek to French Lane	Index	8.7	53.2	53.0	66.7	38.7	35.6[c]	37.5[c]	36.5[c]	39.5[c]
	French Lane to Road 13 bridge below Deardorff Creek	Index	3.5	16.8	13.2	8.0	9.9[c]	10.6[c]	10.6[c]	11.5[c]	11.8[c]
	Road 13 Bridge below Deardorff Creek to Ricco's Upper Fence[a]	Index	6.8	26.1	27.1	14.4	35.9[c]	26.6[c]	27.3[c]	26.5[c]	25.8[c]
	Deardorff Creek to 2.3 km upstream	Census	2.3	0.0[b]	--	--	--	4.9	0.0	0.2	0.6
	Ricco's Upper Fence to Call Creek	Census	3.2	1.1	0.5	1.6	1.2	6.5	1.3	0.9	2.0
	Mainstem Subbasin Redd Count			***380***	***432***	***549***	***323***	***368***	***227***	***451***	***357***
Middle Fork	Armstrong Creek to Beaver Creek	Census	23.5	23.8	16.7	2.3	10.2	37.0	16.8	10.6	7.0
	Beaver Creek to Windlass Creek	Index	5.5	16.3	10.2	13.9	13.6	12.8	12.4	10.1	20.0
	Windlass Creek to Caribou Creek	Index	6.0	10.5	14.1	11.6	7.2	10.0	6.7	16.6	11.8
	Caribou Creek to Placer Gulch	Index	5.7	28.8	29.9	36.2	43.2	22.6	34.8	44.2	48.2
	Placer Gulch to Hwy 7	Index	4.2	9.6	6.2	17.7	20.3	9.7	10.1	6.0	5.9
	Hwy 7 to Phipps Meadow	Census	7.1	6.9	17.8	17.2	4.7	5.0	13.5	11.1	5.9
	Clear Creek (Mouth to Hwy 26 Bridge)	Census	2.1	1.8	5.1	1.0	0.8	1.3	5.1	0.5	1.2
	Clear Crk (Hwy 26 upstream 1.6 km)	Census	1.6	2.3	0.0	--	--	1.6	0.6	1.0	0.0
	Middle Fork Subbasin Redd Count			***563***	***354***	***389***	***236***	***319***	***178***	***199***	***85***
North Fork	Cunningham Creek to Road 73 Bridge	Census	13.4	0.7	2.5	2.4	3.3	1.7	6.9	11.8	5.6[d]
	Road 73 Bridge to Granite Creek	Census	25.2	7.6	12.2	6.8	18.0	9.2	11.7	24.0	38.0
	Road 73 Bridge to McCarty Gulch		14.4	--	4.5	2.6	7.8	4.1	6.0	13.3	20.1
	McCarty Gulch to Granite Cr.		10.8	--	7.7	13.1	10.2	5.1	5.7	10.7	17.9
	Granite Creek to Silver Creek	Index	3.2	5.9	10.6	17.7	10.5	5.5	6.2	9.2	14.0
	Silver Creek to Dixson Bar	Index	2.7	10.5	16.6	41.3	11.7	12.2	5.2	7.3	9.8
	Dixson Bar to Ryder Creek	Index	4.0	14.9	16.3	37.8	24.1	20.8	10.2	17.2	17.3
	Ryder Creek to Cougar Creek	Index	3.4	6.6	8.1	24.8	7.6	7.7	6.2	4.6	3.9
	Cougar Creek to Big Creek	Census	3.9	2.5	3.7	4.7	2.7	3.9	2.6	3.0	1.4
	Big Creek to Oriental Creek	Index	5.5	15.8	17.8	13.5	10.5	10.6	23.1	16.8	7.3
	Oriental Creek to Sulphur Creek	Index	3.2	10.0	6.2	5.0	5.5	8.3	10.2	2.7	0.3
	Sulphur Creek to Nye Creek	Index	6.4	15.9	4.5	2.6	5.5	14.9	12.6	3.4	2.2
	Nye Creek to Desolation Creek	Census	11.0	8.4	0.9	0.6	0.5	4.4	4.4	0.0	0.0
	Desolation Creek to Camas Creek	Census	5.6	1.3	0.6	0.0	0.0	0.6	0.7	0.0	0.0
	North Fork Redd Count			***609***	***803***	***704***	***668***	***803***	***420***	***262***	***358***
Granite Cr.	Rd. 73 Culvert to 1.6 km above Clear Cr.	Index	2.4	7.8	6.4	10.9	0.7	0.8	0.0	4.0	3.3
	1.6 km above Clear Creek to Ten Cent Creek	Index	3.1	20.6	20.3	33.8	14.7	12.7	33.9	19.2	13.3
	Ten Cent Creek to Buck Creek	Index	4.0	21.9	15.5	11.4	30.7	30.5	16.1	19.2	26.7
	Buck Creek to Indian Creek	Census	4.5	10.1	6.0	4.2	17.3	12.7	14.5	11.1	13.3
	Indian Creek to Mouth	Census	3.4	4.2	2.0	5.3	15.3	4.2	4.8	2.0	6.7
Clear Cr.	Ruby Creek Trailhead to Alamo Road	Census	1.8	--	--	0.8	0.0	0.0	0.0	2.0	3.3
	Alamo Road to Beaver Creek	Census	2.7	--	--	--	0.0	--	0.0	2.0	0.0
	Beaver Creek to Old Road Crossing	Census	1.6	5.2	0.0	3.1	1.3	6.8	0.0	4.0	0.0
	Old Road Crossing to Mouth	Index	4.8	26.1	31.9	20.9	19.3	25.4	24.2	22.2	26.7

Appendix Table A-6. Continued.

Stream	Survey section	Survey Type	Km	2000	2001	2002	2003	2004	2005	2006	2007
Bull Run Cr.	Deep Creek to Boundary Guard Station	Census	2.4	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0
	Boundary Guard Station to Mouth	Index	5.0	3.9	17.5	6.2	0.7	6.8	6.5	14.1	6.7
	Granite Creek System Redd Count			***306***	***251***	***258***	***150***[e]	***118***	***62***	***99***[c]	***30***
Desolation Cr.	South Fork (culvert downstream to forks)	Census	1.6	--	--	0.0	0.0	0.0	0.0	0.0	0.0
	N. & S. forks of Desolation Creek to Howard Creek	Census	4.2	--	0.0	7.1	2.6	0.0	0.0	0.0	0.0
	Howard Creek to Battle Creek	Census	4.8	--	4.3	5.4	15.4	2.2	0.0	6.1	0.0
	Battle Creek to Bruin Creek	Census	7.7	--	26.1	51.8	51.3	23.9	26.7	69.7	39.1
	Bruin Creek to Peep Creek	Census	9.0	80.0	17.4	33.9	10.2	52.1	40.0	18.2	39.1
	Peep Creek to Road 1003 Bridge	Census	8.9	20.0	52.2	1.8	20.5	19.6	26.7	6.1	21.7
	Road 1003 Bridge to Mouth	Census	6.8	--	0.0	0.0	0.0	2.2	6.6	0.0	0.0
	Desolation Creek Redd Count			***5***	***23***	***56***	***39***	***46***	***15***	***33***	***23***
	Total North Fork Subbasin Redd Count			***920***	***1,077***	***1,018***	***857***	***967***	***497***	***394***	***411***

[a] Ricco's Upper Fence = Road 62 Culvert in previous reports

[b] Creek was surveyed from mouth to 0.8 kilometers upstream

[c] Includes estimated redds for stream sections where landowners denied access

[d] Includes one redd found above Cunningham Creek

[e] Does not include one estimated redd in Clear Creek

Appendix B. Location Information for Major Spring Chinook Spawning Survey Sections

Appendix Table B-1. List of major spring Chinook spawning survey section start/stop locations and GPS coordinates for the Mainstem John Day River. Sites are listed in upstream order. Coordinates are in UTM format, NAD 27 conus datum and were obtained by using Maptech Terrain Navigator software (Maptech 2004).

Survey section start/stop location name	Latitude	Longitude
Indian Creek	11T 03 56 820 E	UTM 49 22 423 N
Shaw Gulch	11T 03 60 863 E	UTM 49 22 568 N
Prairie Wood Products Lower Fence	11T 03 63 062 E	UTM 49 23 488 N
Dixie Creek	11T 03 63 673 E	UTM 49 23 887 N
Main Street Bridge (Prairie City)	11T 03 64 199 E	UTM 49 24 075 N
West (downstream) Forrest Conservation Area Boundary	11T 03 64 753 E	UTM 49 24 088 N
Dad's Creek	11T 03 67 016 E	UTM 49 23 400 N
Emmel Upper Fence	11T 03 68 387 E	UTM 49 22 931 N
Field Lower Fence	11T 03 69 330 E	UTM 49 22 230 N
South Channel/North Channel Lower Split	11T 03 70 652 E	UTM 49 21 264 N
South Channel/North Channel Upper Split	11T 03 72 474 E	UTM 49 19 658 N
French Lane (N. River Rd)	11T 03 72 668 E	UTM 49 19 490 N
Jacobs Upper Fence	11T 03 73 625 E	UTM 49 18 491 N
Road 13 Bridge	11T 03 74 466 E	UTM 49 16 822 N
Deardorff Creek (mouth)	11T 03 74 526 E	UTM 49 16 726 N
Deardorff Creek (2.3 km above mouth)	11T 03 76 375 E	UTM 49 16 906 N
Reynolds Upper Fence	11T 03 74 283 E	UTM 49 14 852 N
Ricco Upper Fence	11T 03 74 608 E	UTM 49 10 638 N
Call Creek	11T 03 75 895 E	UTM 49 08 403 N

Appendix Table B-2. List of major spring Chinook spawning survey section start/stop locations and GPS coordinates for the South Fork John Day River. Sites are listed in downstream order. Coordinates are in UTM format, NAD 27 conus datum and were obtained by using Maptech Terrain Navigator software (Maptech 2004).

Survey section start/stop location name	Latitude	Longitude
Izee Falls	11T 02 98 285 E	UTM 48 95 328 N
Cougar Gulch	11T 02 97 720 E	UTM 49 00 290 N
Rock Pile Ranch Bridge	11T 02 96 496 E	UTM 49 04 561 N
Murderer's Creek	11T 02 97 550 E	UTM 49 09 743 N

Appendix Table B-3. List of major spring Chinook spawning survey section start/stop locations and GPS coordinates for the Middle Fork John Day River. Sites are listed in upstream order. Coordinates are in UTM format, NAD 27 conus datum and were obtained by using Maptech Terrain Navigator software (Maptech 2004).

Survey section start/stop location name	Latitude	Longitude
Armstrong Creek	11T 03 53 515 E	UTM 49 55 891 N
Deep Creek	11T 03 55 776 E	UTM 49 52 906 N
Road 36 Bridge	11T 03 57 926 E	UTM 49 50 162 N
Nature Conservancy Boundary Lower Fence	11T 03 59 938 E	UTM 49 48 957 N
Coyote Creek	11T 03 61 356 E	UTM 49 48 080 N
Nature Conservancy Boundary Upper Fence	11T 03 64 249 E	UTM 49 47 123 N
Oxbow Ranch Boundary Lower Fence	11T 03 65 724 E	UTM 49 46 205 N
Beaver Creek	11T 03 67 033 E	UTM 49 45 504 N
Oxbow Ranch Boundary Upper Fence	11T 03 70 110 E	UTM 49 44 171 N
Windlass Creek	11T 03 71 018 E	UTM 49 43 928 N
Caribou Creek	11T 03 75 284 E	UTM 49 41 961 N
Dead Cow Bridge	11T 03 77 050 E	UTM 49 40 322 N
Placer Gulch	11T 03 79 236 E	UTM 49 38 955 N
Forrest Conservation Area Upper Boundary	11T 03 79 509 E	UTM 49 38 866 N
Highway 7 Culvert	11T 03 82 375 E	UTM 49 39 822 N
Upstream End of Phipps Meadow	11T 03 86 564 E	UTM 49 37 585 N
Clear Creek (mouth)	11T 03 80 482 E	UTM 49 38 721 N
Clear Creek (Highway 26 Bridge)	11T 03 81 655 E	UTM 49 36 708 N
Clear Creek (1.6 km upstream of Highway 26 Bridge)	11T 03 81 842 E	UTM 49 35 221 N

Appendix Table B-4. List of major spring Chinook spawning survey section start/stop locations and GPS coordinates for the North Fork John Day River. Sites are listed in downstream order. Coordinates are in UTM format, NAD 27 conus datum and were obtained by using Maptech Terrain Navigator software (Maptech 2004).

Survey section start/stop location name	Latitude	Longitude
Upper North Fork Trail Crossing	11T 04 00 981 E	UTM 49 70 745 N
Cunningham Creek	11T 04 00 092 E	UTM 49 73 615 N
Baldy Creek	11T 03 96 054 E	UTM 49 73 552 N
Road 73 Bridge (North Fork Campground)	11T 03 89 554 E	UTM 49 74 024 N
Trail Creek (mouth)	11T 03 89 079 E	UTM 49 74 327 N
Trail Creek (north and south fork confluence)	11T 03 90 427 E	UTM 49 76 661 N
Trout Creek	11T 03 86 079 E	UTM 49 75 615 N
Thornburg Placer Mine	11T 03 83 943 E	UTM 49 73 737 N
McCarty Gulch	11T 03 81 557 E	UTM 49 71 314 N
Trail Crossing (near Bear Gulch)	11T 03 79 962 E	UTM 49 69 937 N
Granite Creek	11T 03 76 660 E	UTM 49 69 005 N
Silver Creek	11T 03 74 611 E	UTM 49 70 469 N
Dixson Bar (Glade Creek)	11T 03 73 181 E	UTM 49 72 776 N
Ryder Creek	11T 03 72 364 E	UTM 49 76 196 N
Cougar Creek	11T 03 70 099 E	UTM 49 77 858 N
Big Creek (mouth)	11T 03 67 352 E	UTM 49 79 702 N
Big Creek (Winom Creek)	11T 03 68 296 E	UTM 49 81 446 N
Oriental Creek	11T 03 63 922 E	UTM 49 81 285 N
Sulphur Creek	11T 03 61 178 E	UTM 49 82 083 N
Nye Creek	11T 03 56 286 E	UTM 49 85 064 N
Horse Canyon	11T 03 53 100 E	UTM 49 86 258 N
Desolation Creek	11T 03 47 419 E	UTM 49 84 331 N
Camas Creek	11T 03 42 798 E	UTM 49 85 817 N

Appendix Table B-5. List of major spring Chinook spawning survey section start/stop locations and GPS coordinates for Granite Creek (tributary to North Fork John Day River, also part of the Granite Creek System). Sites are listed in downstream order. Coordinates are in UTM format, NAD 27 conus datum and were obtained by using Maptech Terrain Navigator software (Maptech 2004).

Survey section start/stop location name	Latitude	Longitude
Road 73 Culvert	11T 03 87 762 E	UTM 49 63 304 N
1.6 km upstream of Clear Creek	11T 03 86 072 E	UTM 49 62 744 N
Clear Creek	11T 03 85 422 E	UTM 49 63 939 N
Ten Cent Creek	11T 03 84 828 E	UTM 49 65 015 N
Buck Creek	11T 03 81 960 E	UTM 49 66 212 N
Indian Creek	11T 03 78 601 E	UTM 49 67 278 N
Mouth	11T 03 76 660 E	UTM 49 69 005 N

Appendix Table B-6. List of major spring Chinook spawning survey section start/stop locations and GPS coordinates for Clear Creek (tributary to the North Fork John Day River, part of the Granite Creek System). Sites are listed in downstream order.

Survey section start/stop location name	Latitude	Longitude
Lightening Creek	11T 03 81 650 E	UTM 49 57 667 N
Ruby Creek Trailhead	11T 03 82 303 E	UTM 49 58 602 N
Alamo Road	11T 03 83 498 E	UTM 49 58 208 N
Smith Upper Boundary	11T 03 84 216 E	UTM 49 58 178 N
Smith Lower Boundary	11T 03 84 716 E	UTM 49 58 227 N
Beaver Creek	11T 03 84 805 E	UTM 49 59 311 N
Old Road Crossing	11T 03 83 579 E	UTM 49 59 984 N
Mouth	11T 03 85 422 E	UTM 49 63 939 N

Appendix Table B-7. List of major spring Chinook spawning survey section start/stop locations and GPS coordinates for Bull Run Creek (tributary to the North Fork John Day River, part of the Granite Creek System). Sites are listed in downstream order.

Survey section start/stop location name	Latitude	Longitude
Deep Creek	11T 03 93 382 E	UTM 49 59 183 N
Boundary Guard Station	11T 03 91 372 E	UTM 49 60 024 N
Mouth	11T 03 87 382 E	UTM 49 62 402 N

Appendix Table B-8. List of major spring Chinook spawning survey section start/stop locations and GPS coordinates for Desolation Creek (tributary to the North Fork John Day River). Sites are listed in downstream order. Coordinates are in UTM format, NAD 27 conus datum.

Survey section start/stop location name	Latitude	Longitude
South Fork Desolation Creek Falls	11T 03 67 754 E	UTM 49 60 903 N
South Fork Desolation Creek Culvert	11T 03 66 970 E	UTM 49 62 979 N
N. and S. Forks Desolation Creek	11T 03 66 514 E	UTM 49 64 183 N
Howard Creek	11T 03 63 819 E	UTM 49 66 197 N
Battle Creek	11T 03 60 919 E	UTM 49 68 357 N
Bruin Creek	11T 03 58 262 E	UTM 49 72 870 N
Road 1010 Bridge	11T 03 55 710 E	UTM 49 75 623 N
Peep Creek	11T 03 54 935 E	UTM 49 77 740 N
Road 1003 Bridge	11T 03 51 610 E	UTM 49 81 337 N
Mouth	11T 03 47 503 E	UTM 49 84 337 N

Appendix Table B-9. List of major spring Chinook spawning survey section start/stop locations and GPS coordinates for Camas Creek (tributary to the North Fork John Day River). Sites are listed in downstream order. Coordinates are in UTM format, NAD 27 conus datum.

Survey section start/stop location name	Latitude	Longitude
0.4 km upstream of Five Mile Creek	11T 03 43 639 E	UTM 49 93 524 N
0.4 km downstream of Five Mile Creek	11T 03 44 039 E	UTM 49 92 254 N
Mouth of Camas Creek	11T 03 42 802 E	UTM 49 85 790 N