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

Annual Technical Report

July 1, 2008–June 30, 2009

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OWEB Contract Number: 208-992-6478

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Objectives

1. Estimate number and distribution of Chinook salmon *Oncorhynchus tshawytscha* 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 Chinook salmon *Oncorhynchus tshawytscha* were conducted in four main spawning areas (Mainstem John Day River, Middle Fork John Day River, North Fork John Day River, and Granite Creek System) and seven minor spawning areas (South Fork John Day River, Camas Creek, Desolation Creek, Trail Creek, Deardorff Creek, Clear Creek, and Big Creek) in the John Day River basin during August and September of 2008. We observed 916 spring Chinook redds while surveying 261.5 km of Chinook spawning habitat within the John Day River basin in 2008 (250 km were in the census areas and 11.5 km were random surveys). We estimated a total of 166 redds in the 14.5 km of census area where we were denied access. We estimate that 1,082 spring Chinook redds were constructed in the John Day Basin at an overall density of 4.09 redds/km for the census area. This is an increase of 229 redds from 2007 but 368 redds below the mean observed from 2000-2007. Of the 1,082 estimated redds in the John Day basin, 620 were included in the 84.5 km of the historic index sections at a density of 7.34 redds/km. No redds were observed in the South Fork, Camas Creek, or any of the random sections. We determined the origin of 547 spring Chinook carcasses, 18 (3%) were of hatchery origin and 529 (97%) were wild. We observed a higher proportion of jack (age-3) Chinook carcasses in 2008 than any other census survey year, which may be a result of strong year class survival of the 2005 brood year. We estimate an escapement of 3,343 fish to the spawning grounds in 2008 using a 3.09 fish/ redd ratio. We also estimate that 67 smolts per redd were produced for the 2006 brood year.

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 like to thank Tim Unterwegner and Jeff Neal for providing guidance and advice. We would also like to thank Travis Bennet, Keith DeHart, Kevyn Groot, Chris James, Ben Willis and countless volunteers for helping conduct field surveys. This project was funded by the Oregon Watershed Enhancement Board, Contract Number 208-992-6478.

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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 (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 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 as an index 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 Northwest Power Planning Council (NWPPC) Fish and Wildlife Program, Independent Scientific Advisory Board (ISAB), Independent Scientific Review Panel (ISRP), National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), and the Oregon Watershed Enhancement Board (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 3) above Armstrong Creek, and the North Fork John Day River (hereafter called North Fork; Figure 4) 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 (Figure 4). Spawning has also occurred in the South Fork John Day River (hereafter called South Fork; Figure 5), 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).

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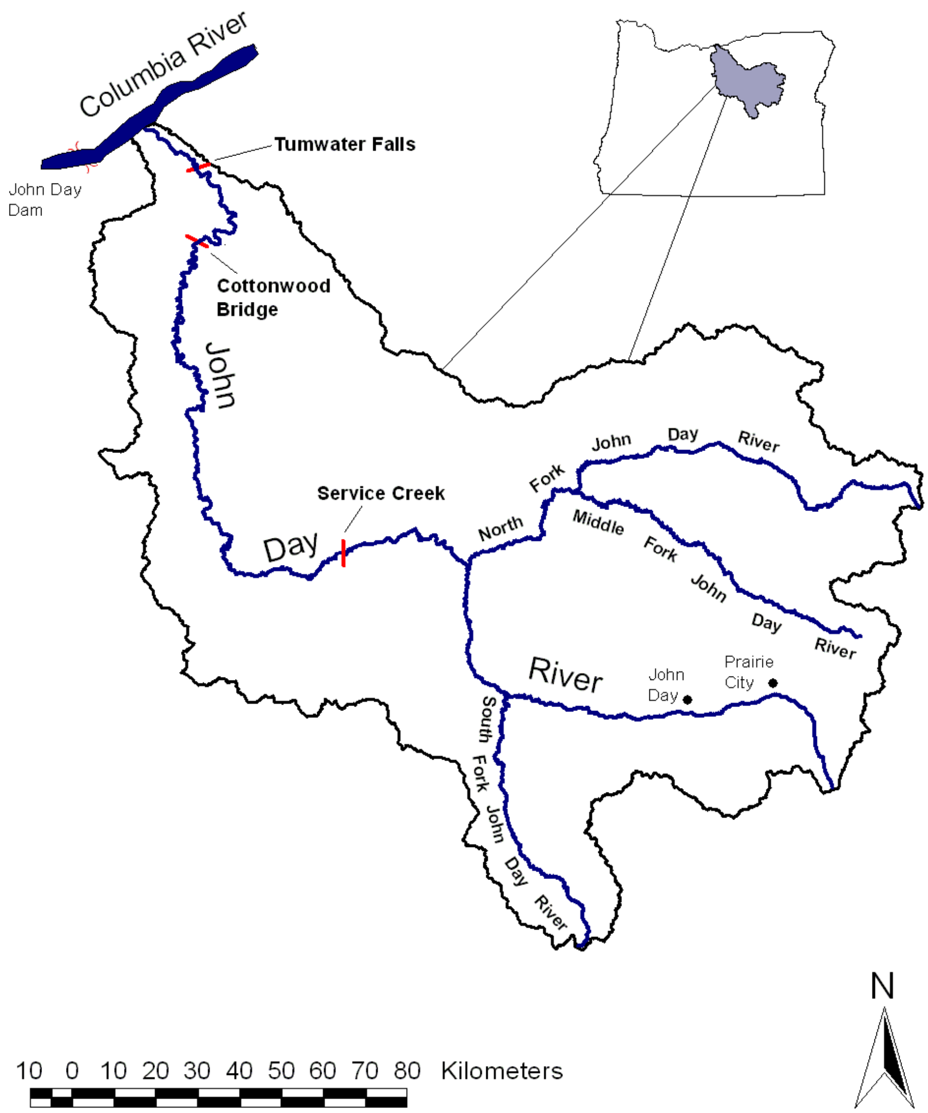

Figure 1. Map of John Day River basin.

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METHODS

Sampling Design

Spring Chinook salmon spawning 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). These surveys included historic index, census, and random surveys. Census survey sections were conducted in areas where redds have been previously documented, this includes index sections. Index sections were surveyed to provide relative abundance comparisons with historic redd count data collected since 1959. Collectively, these surveys provide an annual census of spawning spring Chinook salmon and their redds. Random surveys were conducted outside of the known spawning area to account for range expansion. Random survey sections, approximately 2 km in length, were drawn from a non-random sampling universe (Figures 2, 3, and 4). The sampling universe extends 20 km downstream from the downstream border of current survey sections from the most downstream redd observed in each Hydrologic Unit Code (HUC; 4th level HUC; North Fork, Middle Fork, Upper Mainstem). A second sampling universe extends 4 km upstream from the border of our current census reaches or 4 km upstream from the most upstream redd observed since 1959. Survey sections were selected with a random number generator based on river kilometer. For every one site selected above the census section, two sites were selected below if stream length allowed. If redds were observed in a random site, that survey section was added to the census survey the following year.

Index Surveys

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; Figures 2, 3, and 4, respectively). Pre-index surveys, were conducted one week prior to the index surveys. Post-index surveys, one week after the index surveys, were conducted in index sections in the Granite Creek System (GCS) to account for temporal variation in spawning. Post-index surveys were not conducted in the Mainstem, Middle Fork and North Fork because spawning was completed and few live fish were left at the time of the index survey. Post-index counts were not included in the overall index count. We surveyed a total of 78.2 km of spring Chinook spawning habitat within the historic index areas and were denied access to 6.3 km (Table 1).

Census Surveys

Census surveys were conducted the same or within one day of the index 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 surveyed (Figures 5 and 4, respectively). 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 multiple times in the North Fork (between Trail Crossing and Trout Creek) due to early spawning activity. Pre-index, index, and post-index counts were included in the census count. The census area includes 264.5 km of spring Chinook spawning habitat, 14.5 km of which we were denied access to (Table 1).

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Random surveys

We conducted random surveys on the Mainstem, Canyon Creek, Middle Fork, North Fork and Camas Creek on the same day or within one day of the index for their respective streams for a total length of 11.5 km of surveyed stream. (Table 1; Figures 2–4).

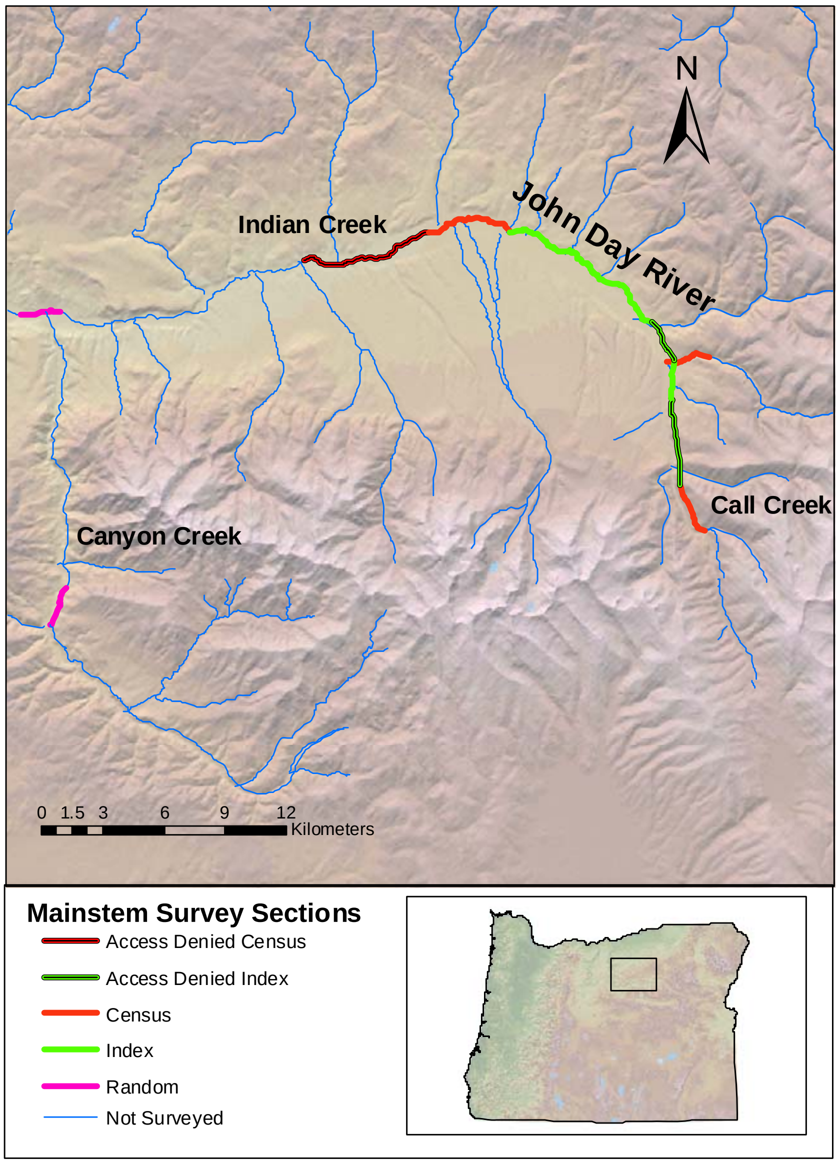

Figure 2. Map of the 2008 Mainstem John Day River, spring Chinook spawning ground survey sections.

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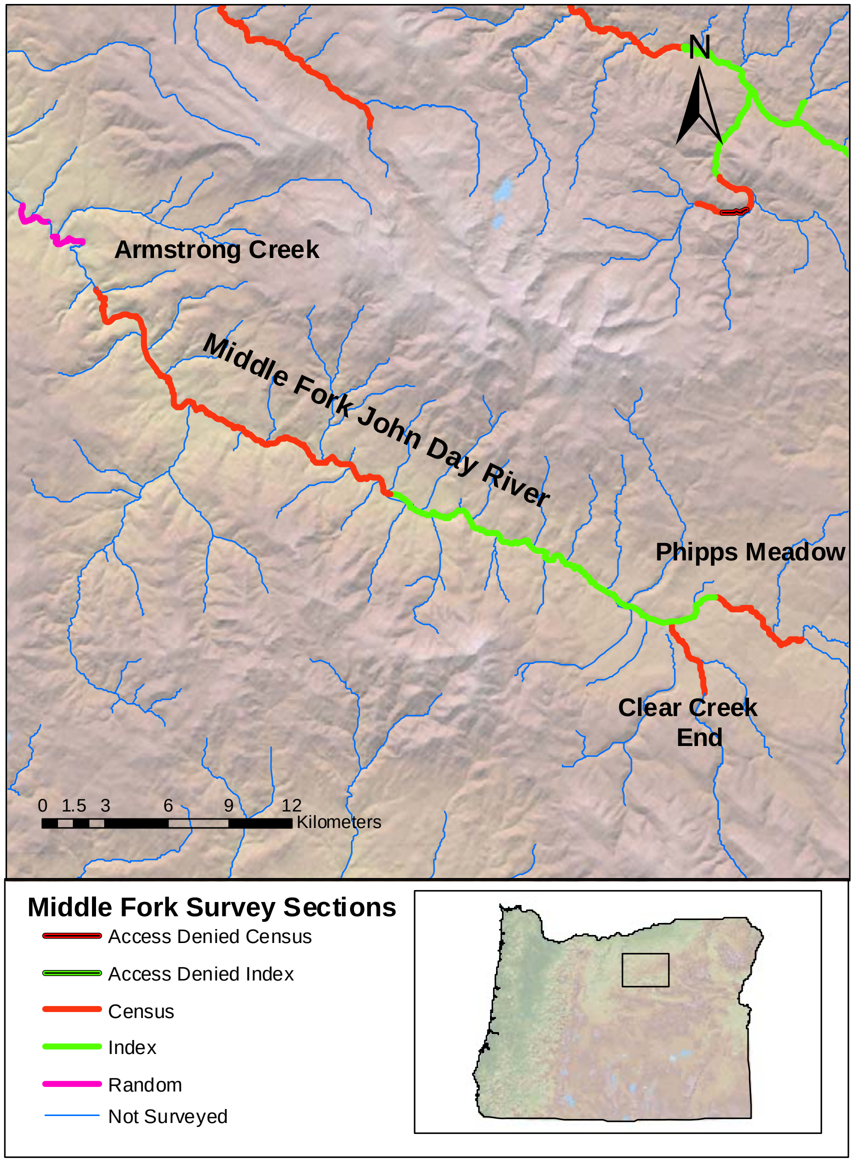

Figure 3. Map of the 2008 Middle Fork John Day River, spring Chinook spawning ground survey sections.

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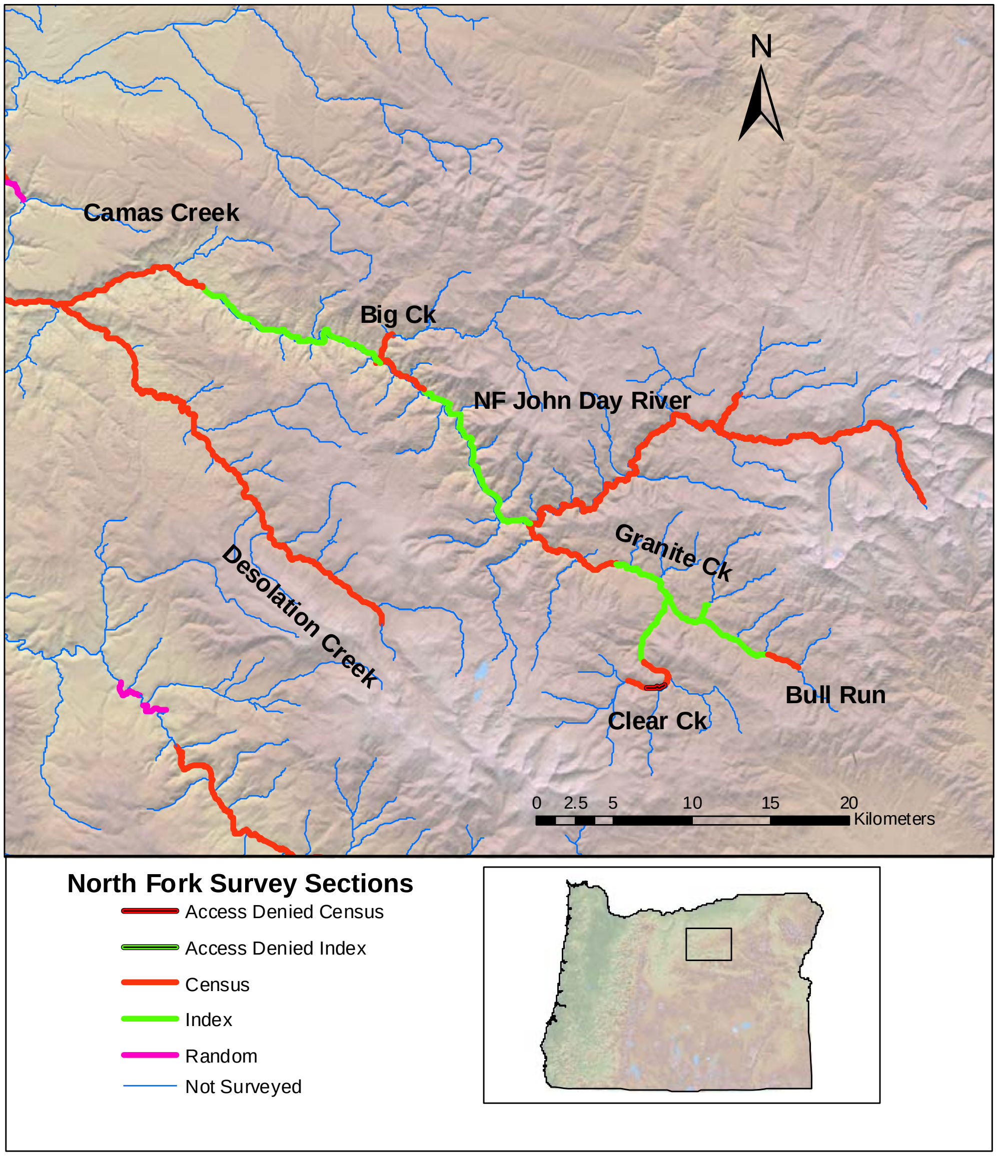

Figure 4. Map of the 2008 North Fork John Day River, spring Chinook spawning ground survey sections.

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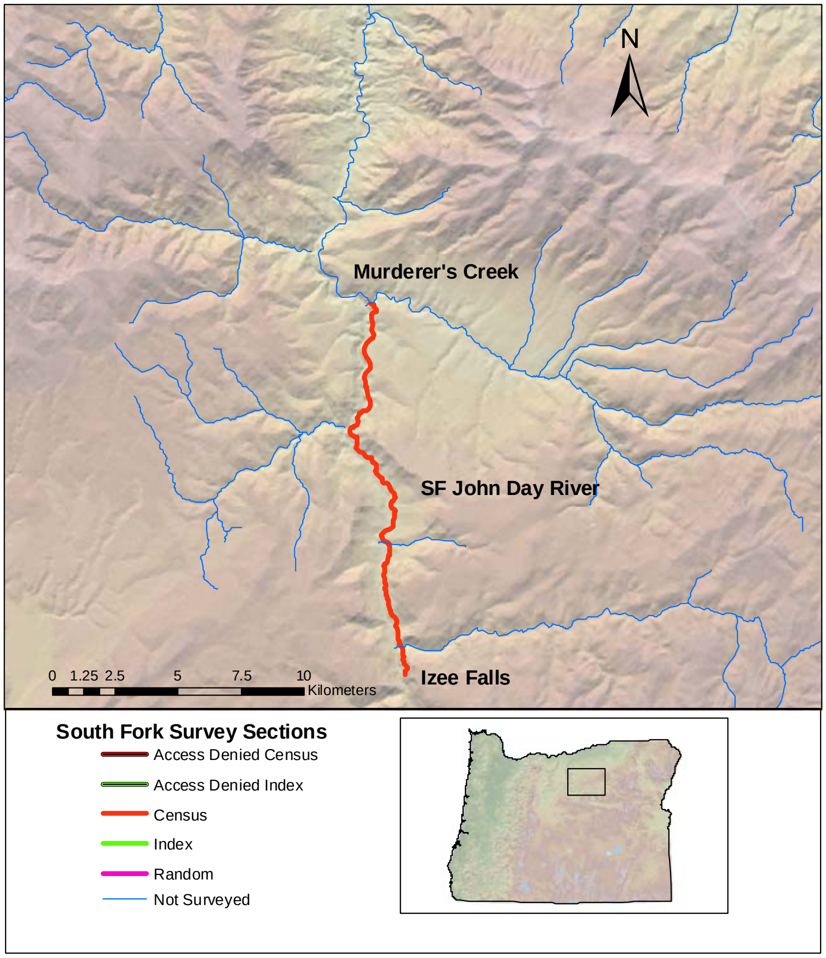

Figure 5. Map of the 2008 South Fork John Day River, spring Chinook spawning ground survey sections.

Spring Chinook Spawning Surveys

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, we surveyed on the permissible side only. Survey sections ranged in length from 0.2 to 9.7 km depending on accessibility and difficulty. Typically, teams of two walked the stream for safety reasons and to ensure accuracy when distinguishing redds. In each section, surveyors recorded the number of observed new redds, number of live adult fish (on/near and off dig), and number of carcasses. On reaches surveyed more than once, 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.

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Table 1. Survey type, access and reach length for spring Chinook salmon spawning survey reaches in the John Day Basin during 2008.

System	Survey Type	Access Granted	Reach Length (km)
Bull Run (GCS)	Census	Yes	2.3
	Index	Yes	4.9
Camas Creek	Census	Yes	0.8
	Random	Yes	1.5
Clear Creek (GCS)	**Census**	**No**	**1.2**
	Census	Yes	4.3
	Index	Yes	4.7
Desolation Creek	Census	Yes	35.3
Granite Creek (GCS)	Census	Yes	7.5
	Index	Yes	9.0
Mainstem John Day River	**Census**	**No**	**7.0**
	Census	Yes	9.6
	Index	**No**	**6.3**
	Index	Yes	11.4
	Random	Yes	4.0
Middle Fork John Day River	Census	Yes	31.8
	Index	Yes	19.8
	Random	Yes	4.0
North Fork John Day River	Census	Yes	62.9
	Index	Yes	28.5
	Random	Yes	2.0
South Fork John Day River	Census	Yes	17.3
Total:			**276.1**

Each observed carcass was examined and sampled in each subbasin. 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, which was estimated to the nearest 25%. Trained surveyors recorded gill lesion presence or absence on fresh carcasses. The location of each fish with gill lesions was marked using a hand-held GPS receiver. We used a Z-test to test the difference in proportion of fish with gill lesions between Granite Creek and the rest of the John Day basin. 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 NOAA Fisheries.

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

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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. An optical density (OD) equal to or greater than 1.000 is considered to be clinical 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.

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
≤ 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.

Surveyors collected scale samples from wild and hatchery carcasses 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, 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.

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 Oregon Department of Fish and Wildlife (ODFW) and hatchery of origin was queried using the Pacific State Marine Fisheries Commission (PSMFC) database. Tails were removed from all carcasses to prevent resampling. Carcasses were then returned near their original position in the stream.

All spring Chinook redds in the basin were visually counted with the exception of areas in the Mainstem and Clear Creek (GCS) where landowners denied access. In areas of the index

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where we were denied access, we expanded redd densities observed in the index section to the total length of stream that we were denied access. When we were denied access to a census survey section, we applied the same expansion but used the census redd density for the respective streams. A Geographic Information System (GIS) incorporating a 1:100,000 digital stream network was used to estimate stream reach and total reach lengths. A lack of weir counts in the basin prevents basin-specific fish/redd estimates. We estimated spawner escapement by multiplying the number of redds by 3.09, the fish/redd estimate from above the Catherine Creek weir in the Grande Ronde Basin during 2008. We established a linear regression relationship between index and census counts from 2000-2008. This relationship was used to estimate census redd numbers before the census count was established in 1998. The 1998 and 1999 datasets were not included in the model because we did not survey Desolation Creek until 2000.

In September 2007 a Passive Integrated Transponder (PIT) tag detection array became operational at McDonald's Ford at river km 32 in the John Day River. In 2008 for the first year we were able to monitor in and out of basin PIT tagged spring Chinook use in the John Day River with data provided from the McDonald's Ford PIT tag array (DART 2007).

Smolt Capture and Tagging

In the fall of 2007 and spring of 2008, juvenile spring Chinook and summer steelhead *O. mykiss* 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). This trapping and tagging effort was funded by the Bonneville Power Administration (BPA). The Mainstem seining operation was located just downstream of the confluence of the Mainstem and North Fork (Figure 6). The RSTs and Mainstem seining operation are all located downstream of all known spring Chinook spawning habitat (Figure 6). 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). In order to estimate smolt abundance and freshwater productivity for the entire John Day Basin we used data from the seining reach only. We used a combination of data collected from each of the RSTs and seining data to estimate freshwater productivity for the Mainstem, Middle Fork, and North Fork watersheds.

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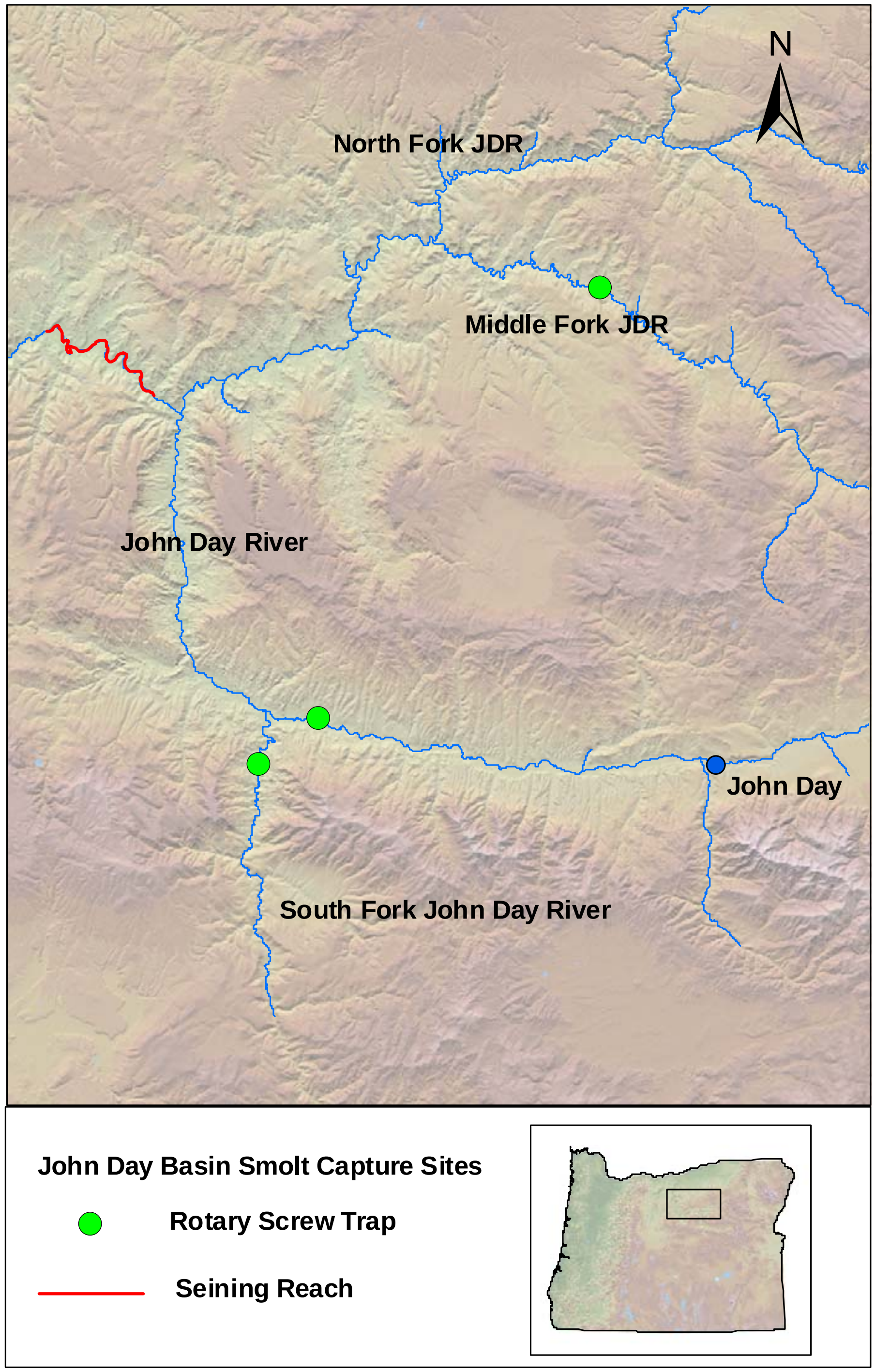

Figure 6. Map of rotary screw trap sites and seining reaches in the John Day River basin during 2008.

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RESULTS

We observed 916 spring Chinook redds while surveying 261.5 km of Chinook spawning habitat within the John Day River basin in 2008 (250 km were in the census areas and 11.5 km were random surveys). In the 14.5 km of census area where we were denied access we estimated a total of 166 redds. This results in an estimated 1,082 spring Chinook redds at an overall density of 4.09 redds/km for the census area (Table 3). Of these 1,082 estimated redds, 620 were included in the historic index count at a density of 7.34 redds/km (Table 3). One redd was observed outside of both the historic census area and the 2008 random reaches on the North Fork John Day River approximately 4 km downstream of the mouth of Camas Creek. No redds were observed in the South Fork, Camas Creek or any of the random sections. The North Fork accounted for 40% of the total redds observed in 2008 while 34% were observed in the Mainstem, 16% in the Middle Fork, 8% in GCS and 3% in Desolation Creek (Table 3). The Mainstem had the highest density of redds with 10.7 redds/km followed by the North Fork with 4.73 redds/km, the Middle Fork with 3.28 redds/km, GCS with 2.44 redds/km, and Desolation Creek with 0.88 redds/km (Figure 7, 8, and 9).

Using a 3.09 fish per redd ratio observed above the weir on Catherine Creek in the Grande Ronde River basin we estimate an escapement of 3,343 spring Chinook spawners in the John Day basin in 2008 (ODFW and CTUIR, unpublished data). These were apportioned as 1,332 spawners in the North Fork, 1,134 in the Mainstem, 522 in the Middle Fork, 176 in Granite Creek, 96 in Desolation Creek, 49 in Clear Creek (GCS), and 34 in Bull Run Creek (Figure 10).

Table 3. Total number of index and census redds and carcasses observed during spring Chinook salmon spawning surveys in the John Day Basin, 2008.

	Redds		Carcasses		
Stream	**Index**	**Census**	**Wild**	**Hatchery**	**Unknown**
Mainstem John Day River	270	367	81	0	6
Middle Fork John Day River	113	169	142	0	9
South Fork John Day River	--	0	0	0	0
North Fork John Day River	174	432	206	15	28
Bull Run Creek (GCS)	10	10	5	0	1
Clear Creek (GCS)	11	16	20	1	2
Granite Creek (GCS)	42	57	46	0	5
Desolation Creek	--	31	29	2	4
Camas Creek	--	0	0	0	0
Granite Creek System Total:	**63**	**83**	**71**	**1**	**8**
North Fork Subbasin Total:	**237**	**546**	**306**	**18**	**40**
Basin Wide Total:	**620**	**1082**	**529**	**18**	**55**

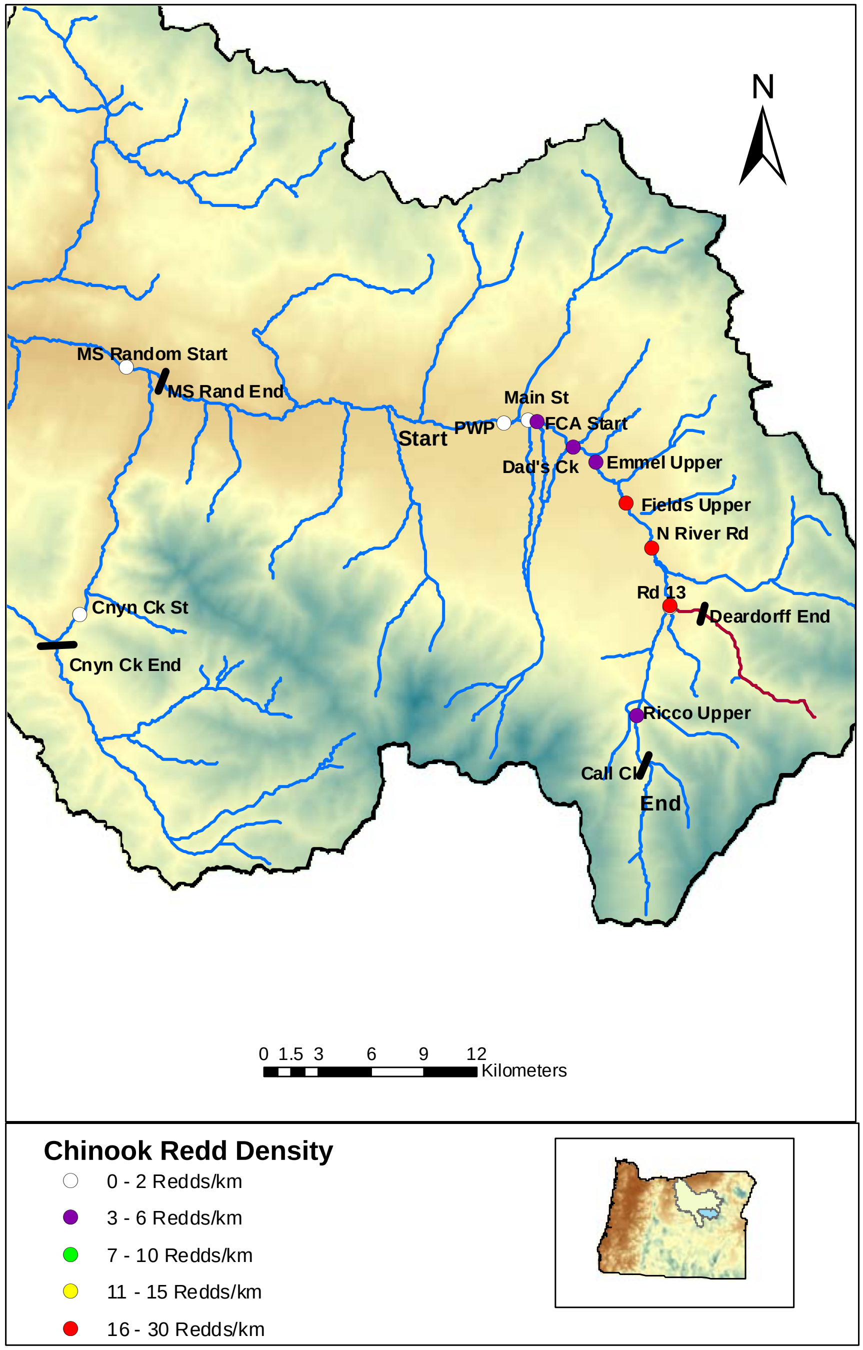

Figure 7. Map of spawning ground survey sections and associated Chinook redd densities in the Upper Mainstem John Day River subbasin, 2008.

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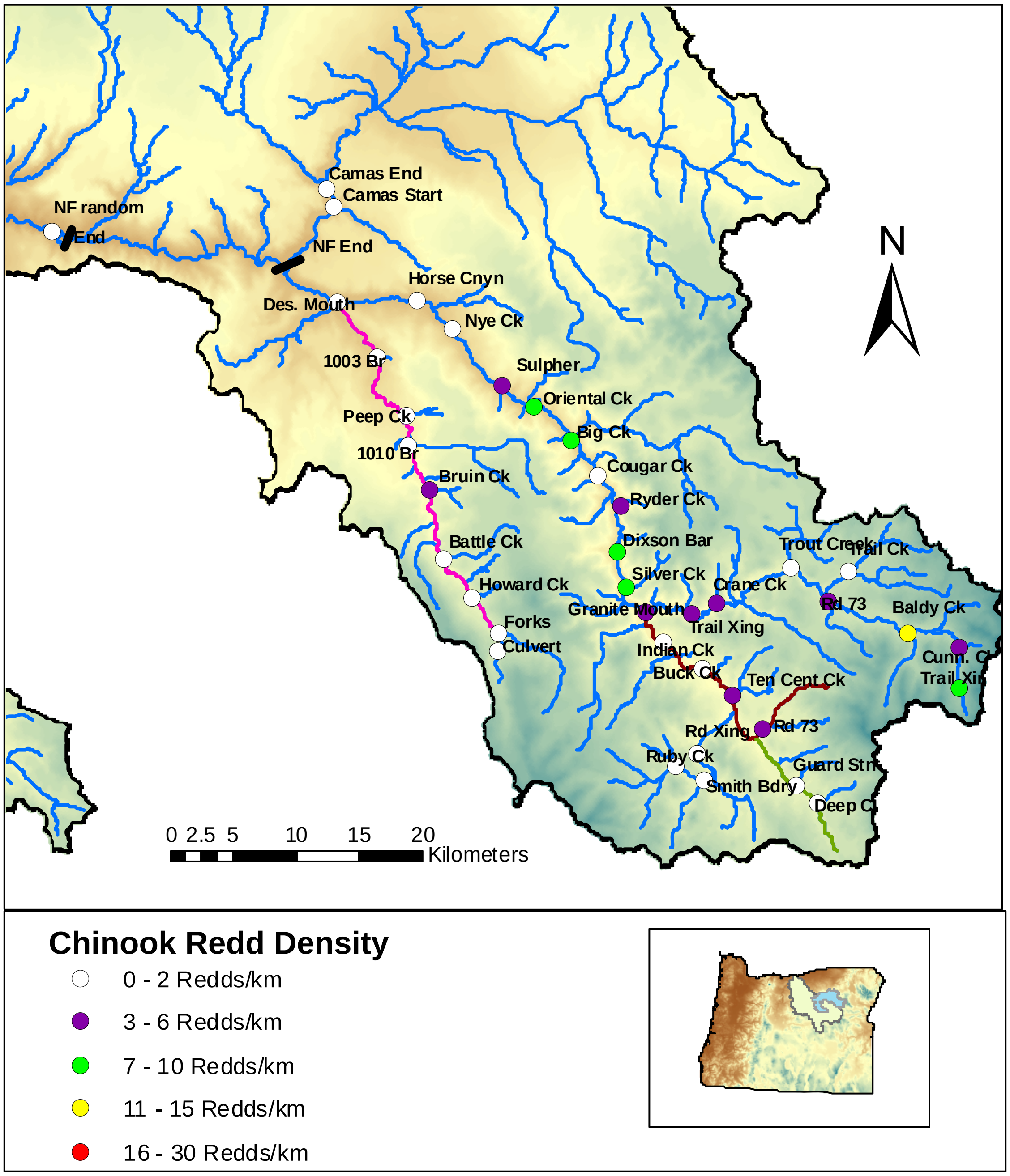

Figure 8. Map of spawning ground survey sections and associated Chinook redd densities in the North Fork John Day River subbasin, 2008.

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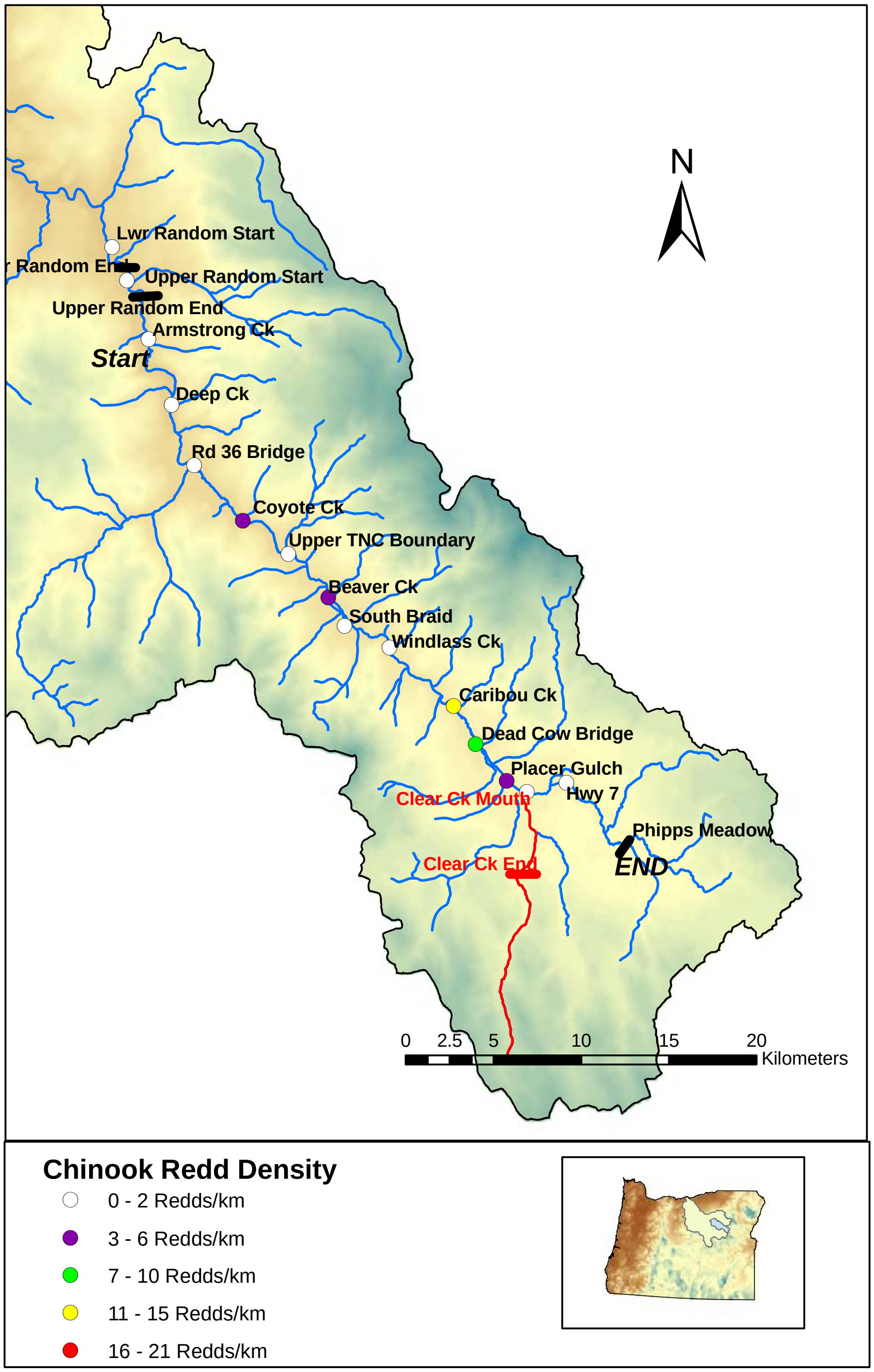

Figure 9. Map of spawning ground survey sections and associated Chinook redd densities in the Middle Fork John Day River subbasin, 2008.

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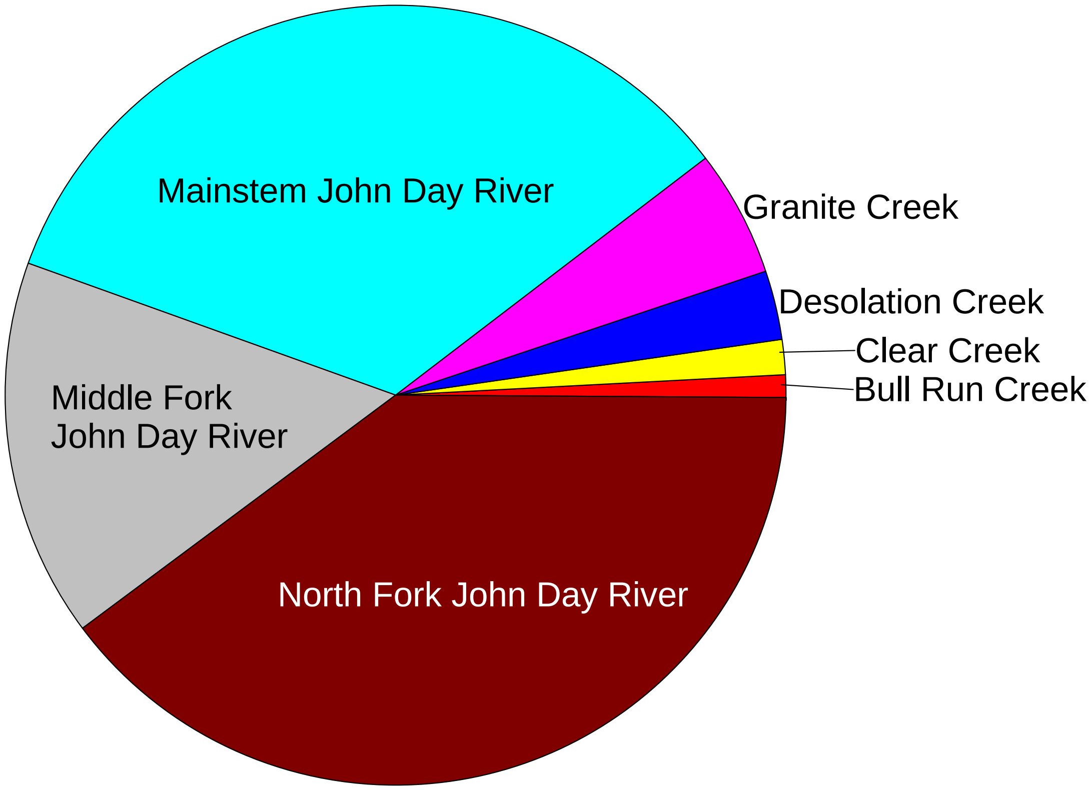

Figure 10. Spring Chinook spawner escapement estimates by stream for the John Day River basin, 2008.

In 2008 we sampled 602 carcasses representing 18% of the estimated spring Chinook spawner escapement (Table 3). We sampled approximately 19% of the estimated carcasses in the North Fork, 8% in the Mainstem, 29% in the Middle Fork, 29% in Granite Creek, 36% in Desolation Creek, 43% in Clear Creek, and 18% in Bull Run. We were able to determine origin of 547 carcasses, 18 (3%) of which lacked an adipose fin. Only two of the 18 snouts that we collected from hatchery fish contained coded wire tags, both fish were age-4 females that originated at the Lookinglass hatchery and were sampled in the North Fork John Day. One fish was released at Lookingglass hatchery and one was released at Catherine Creek in the Grand Ronde River basin. Both scale readers estimated the age of these fish at four years. All hatchery carcasses were observed in the North Fork John Day River subbasin with two in Desolation Creek (Figure 11).

We determined the sex of 524 carcasses, 278 (53%) were female and 246 (47%) were male. We estimated the age of 504 carcasses, 190 from scale pattern analysis and 316 were within the 550-650 MEPS length range which we assumed to be 4 year old fish. Three fish were age-2 (0.4 %), 35 (7%) were age-3, 426 (84%) were age-4, and 40 (8%) were age-5 (Figure 12; Table 4). All of the age-2 precocious Chinook carcasses recovered were males (n=3), and 33 (94%) jack

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Chinook (age-3) carcasses recovered were males with more than half coming from the Mainstem (Table 5). Of the 40 age-5 carcasses recovered, 27 (68%) were in the North Fork (Table 5).

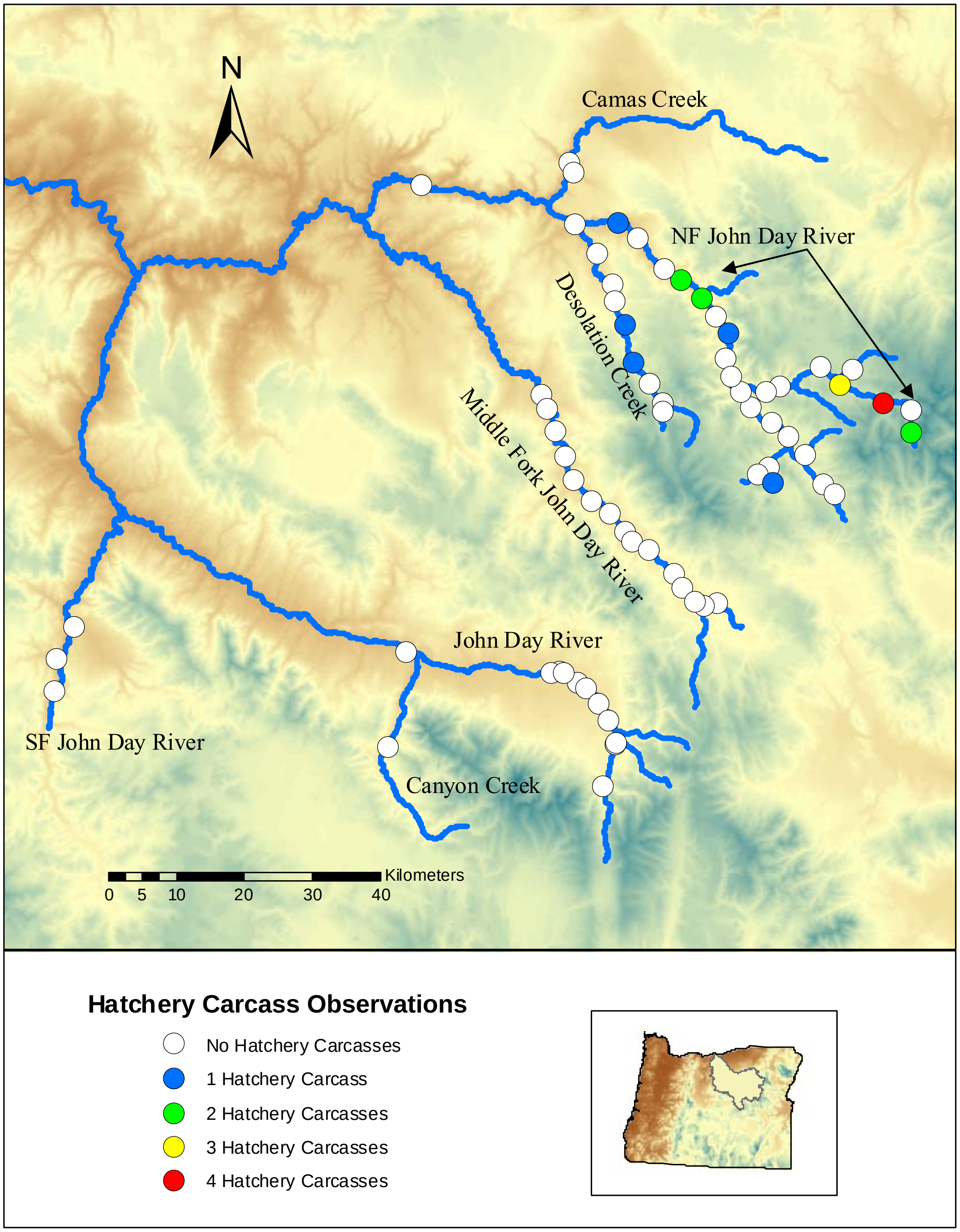

Figure 11. Distribution of spring Chinook hatchery carcasses in the John Day River basin by survey section in 2008.

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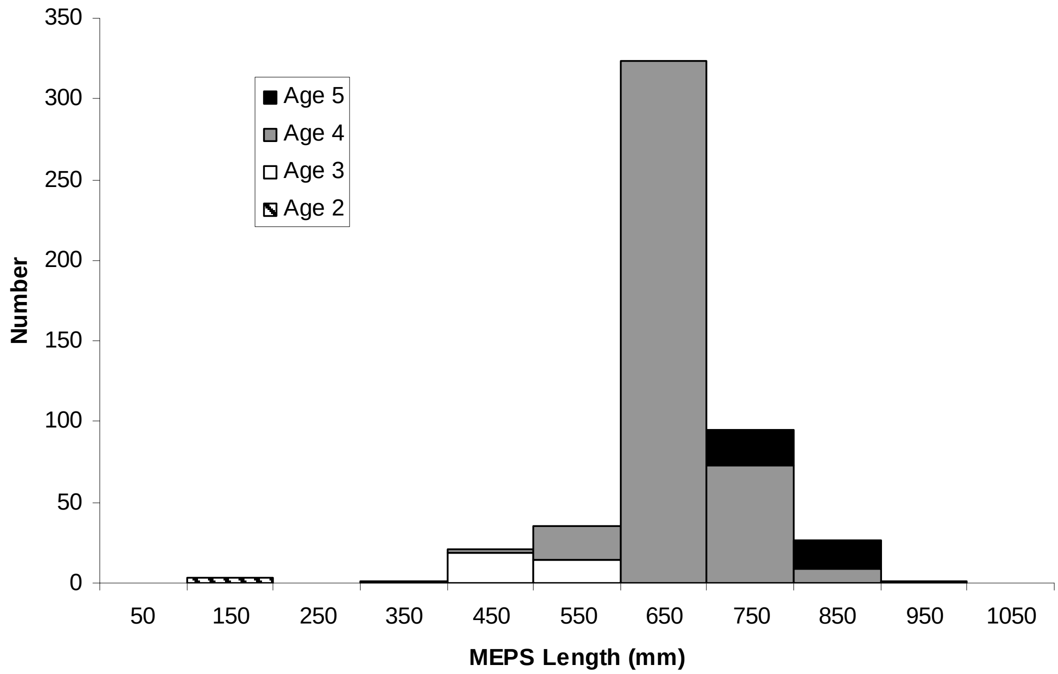

Figure 12. Length and age frequency distributions for spring Chinook carcasses recovered during 2008 (n = 504).

Table 4. Age, mean MEPS length (mm), standard error, sample size (n), range (mm), and % of total Chinook aged from all carcasses recovered during 2008.

	Male					Female				
Age	Length (mm)	SE	n	Range	%	Length (mm)	SE	n	Range	%
2	91.7	6.4	3	80–102	<1			0		
3	438.4	8.8	32	305–546	6	484	29.7	2	463–505	<1
4	624.5	4.6	183	400–820	36	611.8	2.8	243	517–780	48
5	781	14.1	14	695–850	3	724	8.4	26	660–805	5

Table 5. Sex, age proportion, and sample size (n) of aged Chinook carcasses by subbasin, 2008.

		Male				Female			
	n	2	3	4	5	2	3	4	5
Mainstem	73	0	23.3	29	0	0	1.4	44	2.7
Middle Fork	139	0.7	5.7	36	2.2	0	0	50	5
North Fork	191	0	2.1	41	5.8	0	0.5	42	8.4
Desolation Creek	22	0	0	36	0	0	0	64	0
Granite Creek System	66	3	4.5	29	0	0	0	62	1.5
Basin Total	491	0.6	6.5	36	3	0	0.4	48.3	5

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We determined the presence or absence of gill lesions in 464 carcasses, 20 (4.3%) of which were positive for the presence of gill lesions. Eleven (41%) fish in Granite Creek were positive for gill lesions, six (4%) fish were positive in the North Fork and one fish was positive in each the Mainstem (1%), Middle Fork (1%) and Desolation Creek (4%; Figure 13). The fish with gill lesions in Desolation Creek was a hatchery fish that was a pre-spawn mortality. All other females that tested positive for gill lesions had 0% egg retention. The proportion of carcasses with gill lesions in Granite Creek was significantly greater when compared to the remainder of the John Day basin ($p<0.001$).

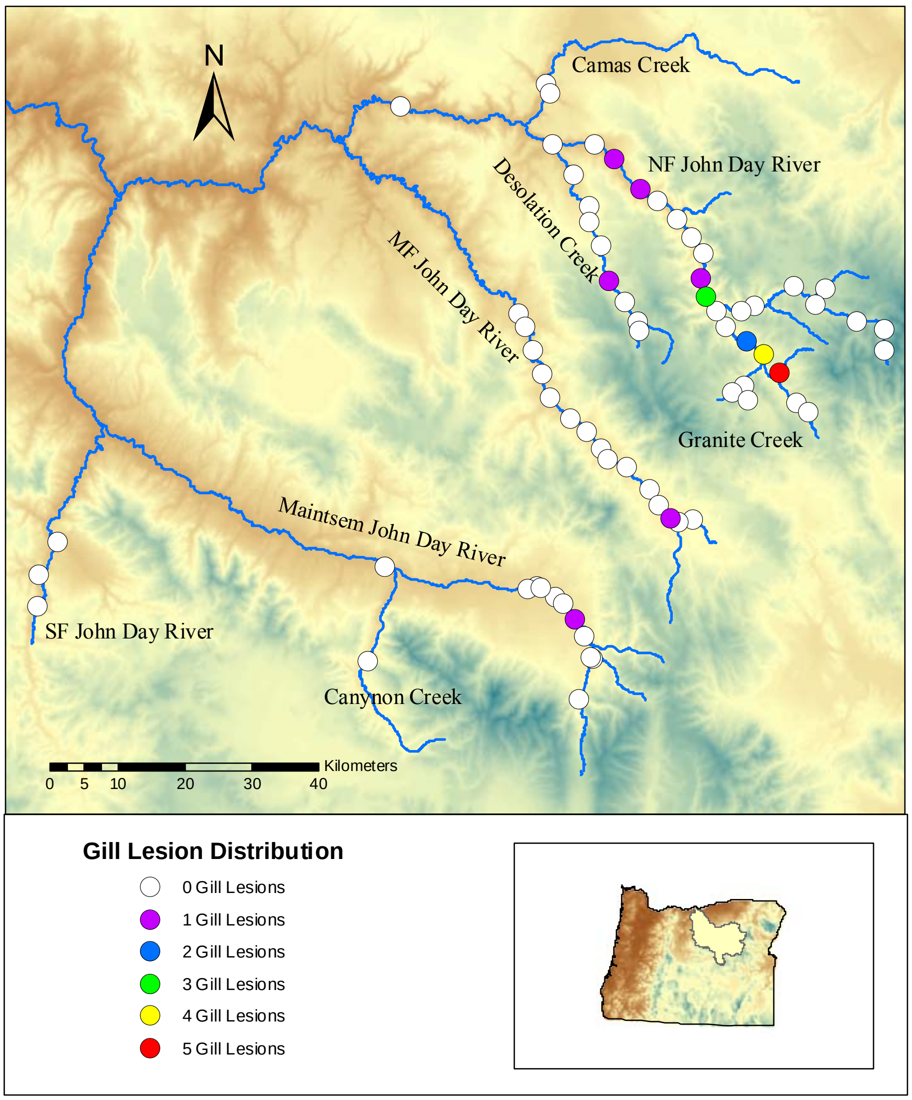

Figure 13. Distribution of recovered carcasses with gill lesions.

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Of the 265 female carcasses for which we estimated egg retention, 249 (94%) were completely spawned, 9 (3%) were incompletely spawned and 7 (3%) were pre-spawn mortalities at the time of the spawning ground surveys. Fourteen of the 16 (88%) fish that were incompletely spawned or pre-spawn mortalities were in the North Fork subbasin (Figure 14). We found no pre-spawn carcasses during our pre-spawn mortality survey of the Middle Fork. We did however find a fresh female pre-spawn carcass on the Lower Mainstem John Day River near the mouth of Service Creek on August 5, 2008. This pre-spawn carcass had gill lesions present but showed no other visible signs that would have caused it to expire.

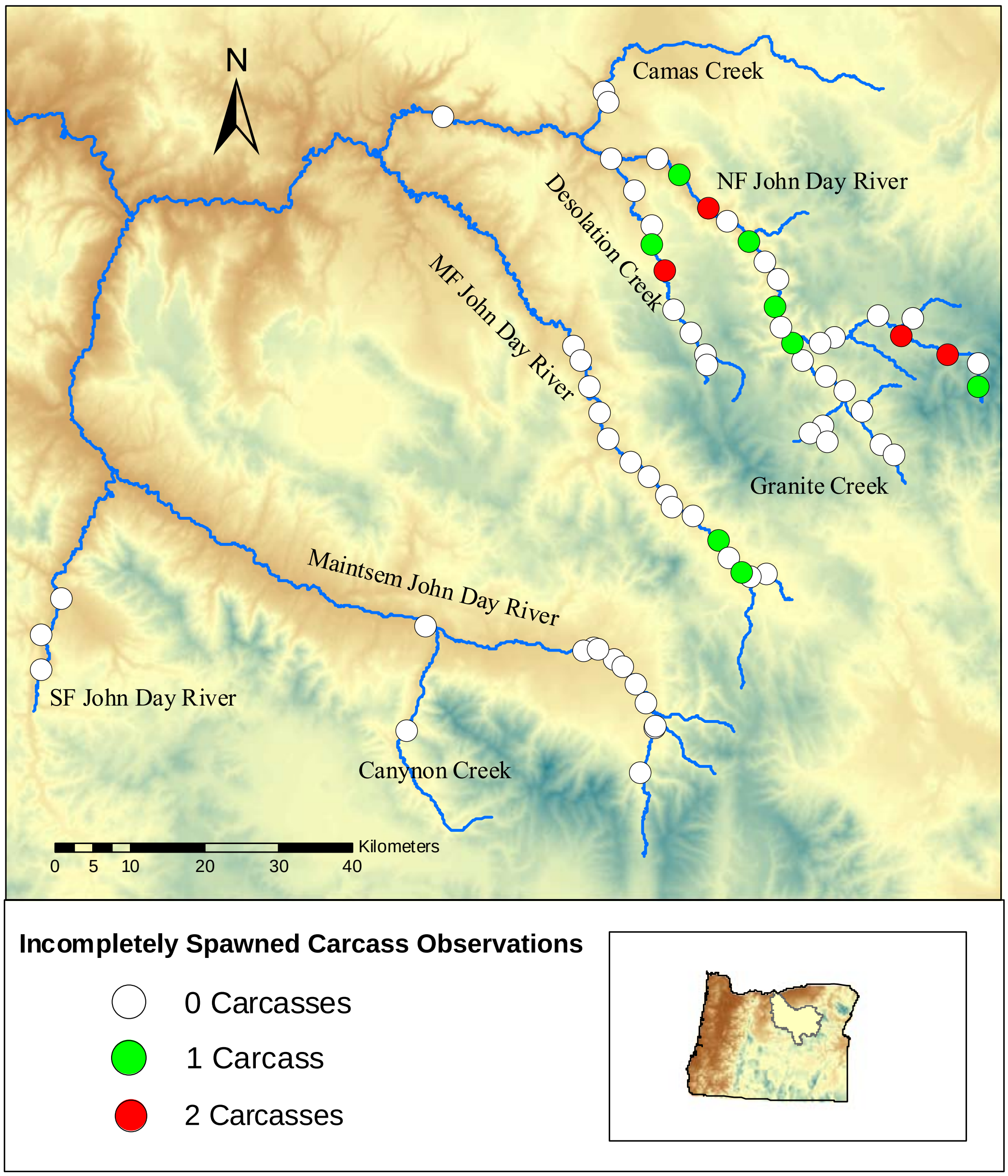

Figure 14. Distribution of incompletely spawned carcasses by site.

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A total of 14 adult spring Chinook PIT tagged as juveniles in the John Day River were detected at the McDonald Ford PIT tag array in 2008. In addition, two others were detected at Lower Granite Dam, but not the McDonald Ford array, one of which was also detected in the Tucannon River. Sixty-four were detected at Bonneville Dam including the 14 fish that were detected at McDonald Ford and the two fish that were detected at Lower Granite Dam. A total of 18 out of basin PIT tagged fish were detected at McDonald Ford including 10 wild and 8 hatchery fish (Table 7).

Table 6. Tagging location, release location, adult detection history, and source (wild/hatchery) of PIT tagged adult spring Chinook that returned to the John Day River in the spring of 2008, but originated outside of the John Day Basin.

Location PIT Tagged	**Release Location**	**Adult Detection History**	**Source**	
			Wild	**Hatchery**
Bonneville Dam	Bonneville Dam	Bonneville Dam **tagged as an adult**→John Day River	6	2
Bonneville Dam	Bonneville Dam	Bonneville Dam **tagged as an adult**→McNary Dam→John Day River	1	1
Lookingglass Hatchery	Catherine Creek Pond (trib. to Grande Ronde River)	Bonneville Dam →McNary Dam→Ice Harbor Dam→John Day River		1
McCall Hatchery	Knox Bridge (South Fork Salmon River)	Bonneville Dam (7/22/08)→John Day River (2/11/08 134mm)		1
		Bonneville Dam →John Day River →**McNary Dam**		1
		Bonneville Dam →John Day River →McNary Dam→Ice Harbor→**Lower Granite Dam**		1
		Bonneville Dam →McNary Dam→Ice Harbor Dam→John Day River		1
Lower Granite Dam	Trucked to below Bonneville Dam	Bonneville Dam →McNary Dam→John Day River	1	
Lower Granite Dam	Barged from Lower Granite Dam and released below Bonneville Dam	Bonneville Dam →John Day River →**McNary Dam**	1	
		Bonneville Dam →John Day River →McNary Dam→Ice Harbor→**Lower Granite Dam**	1	
		Totals	**10**	**8**

We estimate that freshwater spring Chinook productivity for the entire John Day Basin was 133 smolts per redd for the 2006 brood year (Table 8). Freshwater productivity specific to the upper Mainstem was 96 smolts per redd and 37 smolts per redd in the Middle Fork for the 2006 brood year. Since 1978, the relationship between smolt abundance and redd counts suggests the potential for an upper limit to freshwater productivity in the John day River (Figure 15).

Table 7. 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). Estimates for the 1999-2006 brood years are from Ruzycki et al. 2002, 2008; Carmichael et al. 2002; Wilson et al. 2002, 2005, 2007; Schultz et al. 2006, 2007.

Brood Year	Number of redds	Smolt migration year	Smolt abundance	95% CI	Smolts/redd
1978	611	1980	169,000	80,000–257,000	277
1979	641	1981	83,000	52,000–113,000	129
1980	306	1982	94,000	1,000–211,000	307
1981	401	1983	64,000	40,000–89,000	160
1982	498	1984	78,000	64,000–93,000	157
1998	450	2000	141,540	84,103–254,656	315
1999	478	2001	131,142	109,794–159,947	274
2000	1,869	2002	120,438	104,149–139,902	64
2001	1,863	2003	109,537	94,077–132,958	59
2002	1,959	2004	181,589	145,617–234,061	93
2003	1,417	2005	180,933	162,651–287,911	128
2004	1,656	2006	185,733	98,768–373,825	112
2005	902	2007	89,336	66,844–129,702	105
2006	1,044	2008	138,957	118,178–167,736	133

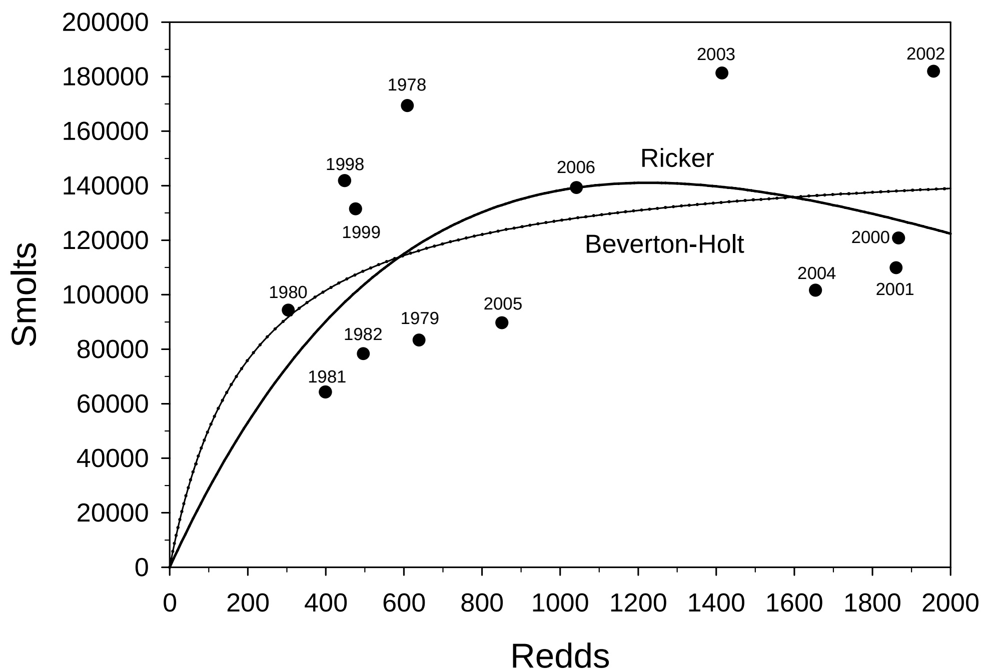

Figure 15. Smolt production as a function of redd count by brood year of John Day River basin spring Chinook salmon since 1978. Ricker (solid line) and Beverton-Holt (dashed line) stock-recruitment relationships are also fit to the data.

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DISCUSSION

We estimate that there were 1,082 spring Chinook redds constructed in the John Day River Basin in 2008 that resulted in an estimated escapement of 3,343 spawners. This is an increase of 229 redds from 2007, likely a result of a relatively large pre-spawn mortality event that took place in the Middle Fork and North Fork as a result of low flows and high water temperatures in 2007 (Ruzycki et al. 2008). We experienced relatively low pre-spawn mortality in 2008 because of low air temperatures, and greater than average snow pack and precipitation which provided sufficient stream flow and water temperatures to support adult spring Chinook in their summer holding habitat. The 2008 redd count is 368 redds below the mean of 1,450 from 2000, when census redd counts were implemented (Ruzycki et al. 2008). From 2000 to 2004, redd counts have been some of the highest on record since 1959, likely a result of improved oceanic and fresh water habitat conditions (Schultz et al. 2006). The 2008 redd count continues a weak but increasing trend in overall redd numbers observed since 1959.

We observed 620 redds during index surveys in 2008, an increase of 83 redds from 2007. Index counts during 2008 continued to represent a majority of redds observed in the basin (57%) but this was well below the mean of 70% in recent years, continuing a downward trend in index representation since 2000 (Ruzycki et al. 2008). We found a strong, statistically significant relationship between numbers of index redds and numbers of census redds from 2000 to 2008 ($r^2 = 0.98$, p-value <0.001, n = 9; Figure 16). It is likely that this strong relationship results from the index sampling universe spatially accounting for a large proportion of spring Chinook spawning habitat. Because of this relationship we were able to estimate previous census counts and continued to see the increasing trends in basin-wide redd estimates since 1959 (Figure 17).

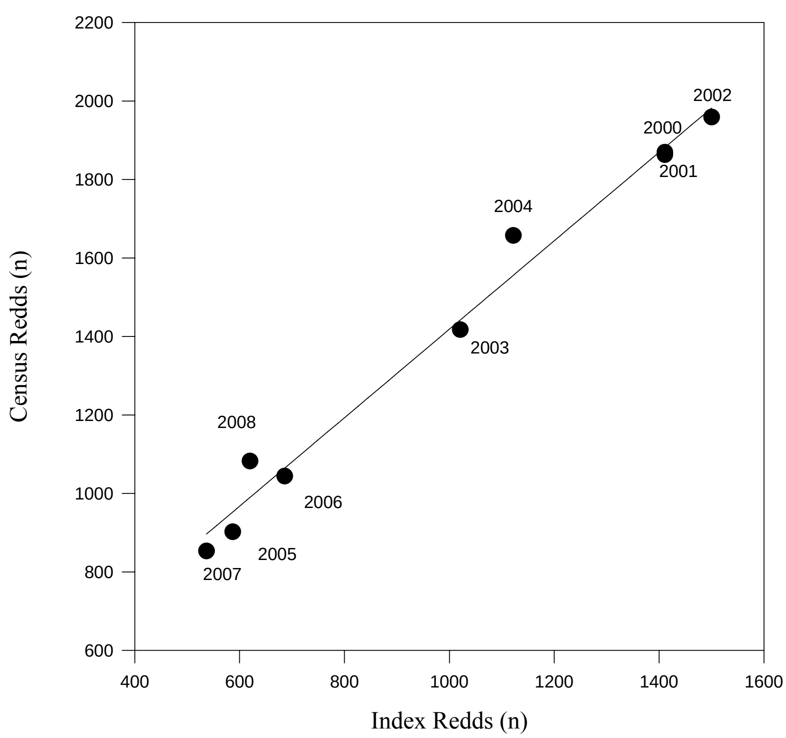

Figure 16. Relationship between index redd counts and census redd counts from 2000–2008.

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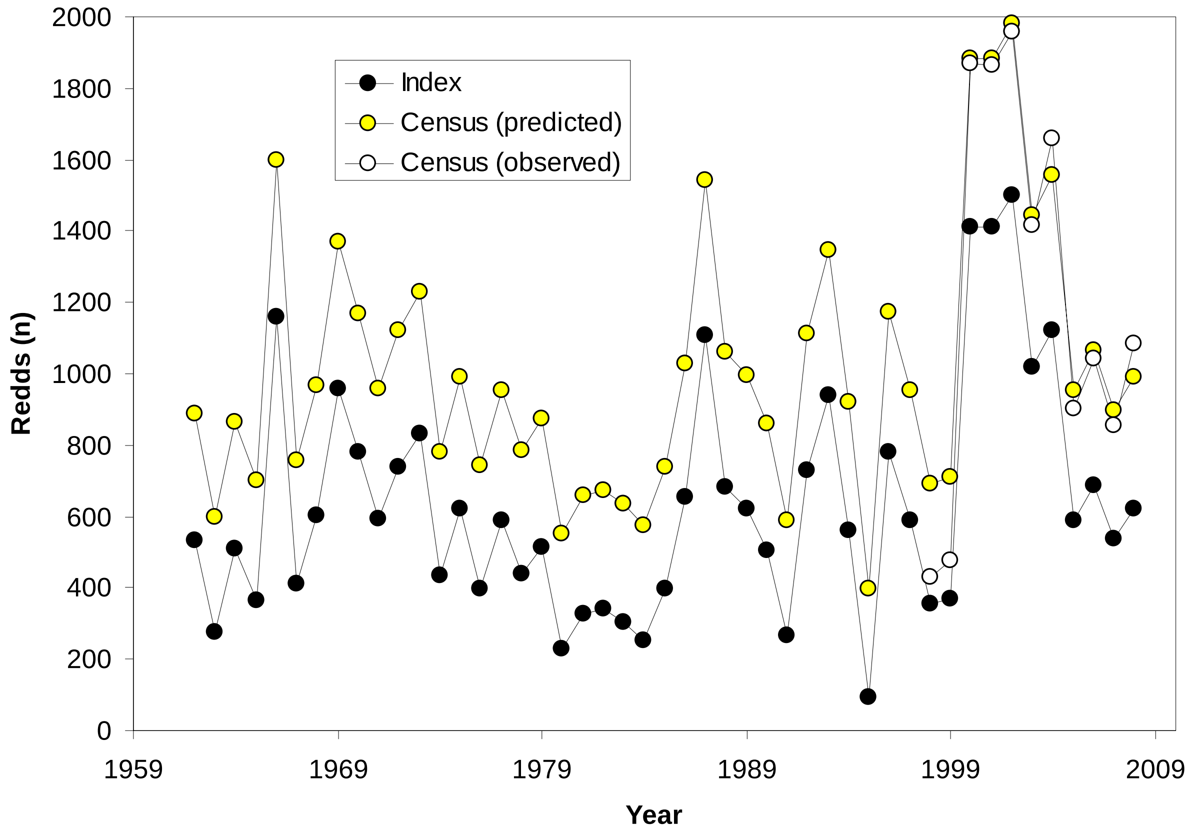

Figure 17. Index and census spawning ground survey counts and predicted historic census counts of spring Chinook salmon redds in the John Day River basin.

A majority of redds observed outside of the index areas in 2008 were in the upper North Fork. This is likely a result of higher than normal stream flows in the North Fork which allowed easier access to the upper portion and provided additional quality holding and spawning habitat (Schultz et al. 2006). In 2008 we were granted access to the Emmel property on the Mainstem for the first time since 2002. Because this section is in the index reach, in past years we would average the redd density found in the index reach on the Mainstem and expand that redd density to the section where we were denied access. In 2008 the mean redd density on the Mainstem index reach was 15.3 redds/ km, and only 3.76 redds/ km on the Emmel section. Because spawning habitat on the Emmel section may not be representative of the entire index reach on the Mainstem, it is likely that we have overestimated the number of redds that would have existed on this section in previous years when we were denied access. This shows the importance for ODFW biologists to continue to develop and maintain good relations with landowners in the basin to maintain the quality of data collected. This also suggests that adult abundance does not entirely account for the variability associated with index counts and with a relatively small amount of additional effort (census surveys) we can account for this variability. Census surveys also reduce variability in smolt/redd estimates which index surveys alone cannot account for.

Currently, a limited ceremonial tribal fishery is the only within-basin fishery for spring Chinook. Tribal members of the Confederated Tribe of the Umatilla Indian Reservation (CTUIR)

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reported harvesting only six of their allotted 150 adult spring Chinook from Granite Creek (Jeff Neal, ODFW, personal communication). 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). A three year average annual escapement to the mouth of the John Day River of 7,000 spring Chinook is the goal to implement a limited sport fishery on the Mainstem that was discontinued in 1976 (ODFW et al. 1990). The mean spawner escapement estimate since 2000 is 4,236 adults, fewer than the number needed to meet the minimum for a fishery. It is possible in years where we have sub-optimal holding and drought conditions that we have relatively high adult pre-spawn mortality, a variable that is difficult to quantify on the basin wide scale (Ruzycki et al. 2008). Given the recent smolt abundance estimates and smolt-per-redd estimates, it appears that adult abundance has a relatively small effect on smolt production at the escapement levels we have seen since census surveys were implemented in 2000. Managers may need to consider this when setting escapement goals for a fishery. However, in years where we have higher flows and cooler water temperatures, rearing habitat may be greatly increased and as a result smolt-per-redd ratios may exceed the levels we have seen since 2000.

We observed a greater proportion of jack (age-3) Chinook in the John Day Basin in 2008 than any year since the implementation of census surveys. This increase is likely a result of good year class survival from the 2005 brood year (Burton et al, 2002). Jack counts were also relatively high (44%) in the Grande Ronde Basin at the Catherine Creek weir and PIT tag detections indicate that the proportion of jacks was relatively high across the Columbia basin in 2008 (DART 2007). The 2005 brood year provided the lowest number of smolts ever observed in the John Day Basin (Table 8). Age structure data collection should be continued in 2009 to confirm the high smolt to adult survival of the 2005 year class. A much larger proportion of jacks were observed in the Mainstem than any other subbasin, with the North Fork having the lowest jack returns. Scheuerell (2005) suggested that juvenile growth rates may have some effect on age at maturity, where larger juveniles are more likely to mature at a younger age than slower growing individuals. The Mainstem is a much more productive system than the North Fork which may have resulted in the relatively high jack counts in the Mainstem and proportionally low counts in the North Fork. The North Fork also had the highest proportion of age-5 spawners which could be a result of slow growth rates delaying age at maturity.

The relatively high jack count at the Catherine Creek weir in 2008 compared to John Day jack counts indicate that we may have overestimated escapement due to high fish per redd estimates. Because a large proportion of jacks are males, this would result in a high fish per redd estimate because males do not contribute to redd construction. Studies have shown that there may be some bias when assessing age composition through carcass recovery based on size (Neilson and Banford 1983; Pahlke 1995; Roni and Quinn 1995 Zhou; 2002, Boe et al. 2007). The literature suggest that jacks tend to be under represented, if this is the case, we may have underestimated jack composition but corrected for it with our escapement estimate.

Even with the increase in proportion of male jacks in the carcass recoveries in 2008 we still saw a bias towards females in the sex ratio, a trend we have seen annually since the implementation of census surveys in 2000. Kissner and Hubartt (1986) suggest bias may exist towards female carcasses because they remain on the redd until they expire and settle on shallow riffles, runs or gravel bars, whereas males tend to drift downstream after spawning and are likely to scatter or settle in larger pools where they are not as easily recovered.

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For six consecutive years, carcasses in the GCS showed a significantly higher incidence of gill lesions than the remainder of the John Day Basin (Figure 13). Gill lesion occurrence in 2008 was the second highest recorded since 2003, in both the Granite Creek system and basin wide. Because we only sampled one carcass with gill lesions that was a pre-spawn mortality, it is apparent that given optimal holding conditions gill lesions may not be a significant source of adult mortality in the John Day Basin. We did not however account for mortalities that may have occurred during the heat of the summer, because carcasses would have been decomposed or scavenged by the time of spawning ground surveys in August and September. In the future when summer water temperatures reach near lethal levels it may be beneficial to conduct pre-spawn mortality surveys on Granite Creek to assess the confounding effects of water temperature and gill lesions on adult survival.

The proportion of hatchery carcasses observed was within the range reported since 2000 (Schultz et al 2007, Ruzycki et al 2008). We recovered CWTs from carcasses that originated at the Lookingglass Hatchery again in 2008, a trend that we have seen in surveys from previous years (Schultz et al 2007, Wilson et al 2007, Schultz at al 2006). The PIT tag array at McDonald Ford revealed additional strays both hatchery and wild from other sources. It may be beneficial to scan carcasses with hand held PIT tag detectors in the future to estimate a correction factor given the unknown efficiency of the McDonald Ford PIT tag array and to improve estimates of hatchery and wild strays on spawning grounds. All the carcasses of hatchery origin that we recovered were in the North Fork sub basin. Through genetic analysis on carcasses recovered from 2004 to 2006 Narum et al. (2008) found similar results in that the North Fork sub basin had a higher rate of out-of-basin strays, both marked (hatchery origin) and unmarked (wild origin) compared to the Mainstem and Middle Fork. Narum et al. (2008) also suggested that wild strays may be more prevalent than hatchery strays in the John Day River basin.

Smolt-per-redd ratios indicate that juvenile rearing areas are fully seeded at recent escapement levels and rearing habitat is limiting freshwater production (Figure 15). This relationship illustrates the need for further restoration efforts targeting rearing habitat and that adult escapement estimates may not be a suitable metric to assess the effectiveness of individual restoration projects on a short term scale (Lawson 1993). This also shows the importance of considering the entire life history when developing recovery plans. McHugh et al (2004) found that the potential for increasing egg-to-smolt survival rates of Chinook for most of the populations they assessed was relatively low or nonexistent, through freshwater habitat restoration in the Snake River Basin. However, for a few stocks, they predicted that improvements in egg-to-smolt survival rates could be greatly improved. They also found that in all populations, survival rates were potentially reduced when freshwater habitat quality is degraded. In 2008 Tim Unterwegner (ODFW District Fish Biologist) observed adult Chinook attempting unsuccessfully to enter Bridge Creek, a tributary to the Middle Fork, by way of a man made fish ladder. A spawning survey on Bridge Creek confirmed that no redds were present and it is believed that the ladder at the mouth is a barrier to upstream migration at low flows. An ODFW juvenile fish distribution survey in 2008 also revealed the absence of Chinook in Bridge Creek (Chris James, ODFW unpublished data). In the Middle Fork alone, there exist multiple tributaries that contain upstream migration barriers that block access to juvenile Chinook rearing and adult Chinook spawning habitat (Chris James, personal communication). Reducing barriers and allowing juvenile and adult Chinook access to additional spawning and rearing habitat is a valuable tool to increase smolt production through freshwater habitat restoration (Sharma and Hilborn 2001).

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New technology has allowed us to better asses the length of stream surveyed including census and index surveys. Using the 1:100,000 GIS layer allows greater consistency when determining survey distances. This new technology however has revealed some inconsistencies in our estimated survey lengths, which in turn has effected redd density estimates including estimates for reaches where we were denied access in previous years. Redd expansions for reaches where we were denied access from 1999 to 2003 have not been updated using the new survey lengths in Appendix A because of ambiguity of survey reaches during this period. However redd densities have been updated. Appendix Table A-5 only lists redd densities dating back to 1998 because of questions about the accuracy of the survey lengths in years previous. A review of historic ODFW district fish reports from 1959 to 1997 has revealed small inaccuracies in the numbers and densities of redds that have been reported in our previous annual reports. Updated redd numbers can be found in Appendix table A-4.

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APPENDIX

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Appendix A. Historic Index and Census Redd Counts

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Appendix Table A-1. Spring Chinook census redd counts in the John Day Basin, 1998-2008. Includes redds estimated where we were denied access (Schultz et al. 2007;Wilson et al. 2007; Schultz et al. 2006; Wilson et al. 2005, 2002; Carmichael et al. 2002; Ruzycki et al. 2002; Wilson et al. 1999, Jonasson et al. 1998).

				North Fork Subbasin					
					Granite Creek System				
Year	**Mainstem**	**South Fork**	**Middle Fork**	**North Fork**	**Granite Creek**	**Clear Creek**	**Bull Run Creek**	**Desolation Creek**	**Basin Total**
1998	135	-	88	127	61	18	1	-	430
1999	62	-	132	162	92	22	8	-	478
2000	380	3	563	612	198	96	12	5	1869
2001	432	0	354	803	126	80	45	23	1863
2002	549	0	389	707	163	64	31	56	1959
2003	323	0	236	668	118	32	1	39	1417
2004	368	0	319	806	72	38	8	46	1657
2005	227	0	178	420	43	15	4	15	902
2006	451	0	199	262	55	30	14	33	1044
2007	357	0	85	358	19	9	2	23	853
2008	367	0	169	432	57	16	10	31	1082

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Appendix Table A-2. Census survey length (km) for spring Chinook salmon spawning surveys in the John Day Basin, 1998–2008. Includes estimated redds in areas where we were denied access (Schultz et al. 2007;Wilson et al. 2007; Schultz et al. 2006; Wilson et al. 2005, 2002; Carmichael et al. 2002; Ruzycki et al. 2002; Wilson et al. 1999; Jonasson et al. 1998).

				North Fork Subbasin					
					Granite Creek System				
Year	**Mainstem**	**South Fork**	**Middle Fork**	**North Fork**	**Granite Creek**	**Clear Creek**	**Bull Run Creek**	**Desolation Creek**	**Basin Total**
1998	22.4	-	51.5	72.5	16.5	7.6	4.9	-	175.4
1999	22.4	-	51.5	72.5	16.5	7.6	5.7	-	176.2
2000	32.2	17.3	51.5	83.9	16.5	7.6	5.7	21.4	236.1
2001	32.2	17.3	51.5	83.9	16.5	7.6	5.7	28.5	243.2
2002	32.2	17.3	51.5	86.9	16.5	10.3	7.2	34.0	255.9
2003	32.2	0.16	51.5	86.9	16.5	10.3	7.2	38.2	243.0
2004	34.3	17.3	51.5	88.3	16.5	10.3	7.2	34.6	260.0
2005	34.3	17.3	51.5	92.2	16.5	10.3	7.2	38.2	267.5
2006	34.3	17.3	51.5	92.2	16.5	10.3	7.2	35.3	264.6
2007	34.3	17.3	51.5	92.2	16.5	10.3	7.2	38.2	267.5
2008	34.3	17.3	51.5	92.2	16.5	10.3	7.2	35.3	264.6

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Appendix Table A-3. Census spawning density (redds/km) in the John Day Basin, 1998–2008. Includes density estimates for areas where we were denied access (Schultz et al. 2007;Wilson et al. 2007; Schultz et al. 2006; Wilson et al. 2005, 2002; Carmichael et al. 2002; Ruzycki et al. 2002; Wilson et al. 1999; Jonasson et al. 1998).

					North Fork Subbasin Granite Creek System				
Year	**Mainstem**	**South Fork**	**Middle Fork**	**North Fork**	**Granite Creek**	**Clear Creek**	**Bull Run Creek**	**Desolation Creek**	**Basin Total**
1998	6.0	-	1.7	1.8	3.7	2.4	0.2	-	2.5
1999	2.8	-	2.6	2.2	5.6	2.9	1.4	-	2.7
2000	11.8	0.2	10.9	7.3	12.0	12.6	2.1	0.2	7.9
2001	13.4	0.0	6.9	9.6	7.6	10.5	7.9	0.8	7.7
2002	17.0	0.0	7.6	8.1	9.9	6.2	4.3	1.6	7.7
2003	10.0	0.0	4.6	7.7	7.2	3.1	0.1	1.0	5.8
2004	10.7	0.0	6.2	9.1	4.4	3.7	1.1	1.3	6.4
2005	6.6	0.0	3.5	4.6	2.6	1.5	0.6	0.4	3.4
2006	13.1	0.0	3.9	2.8	3.3	2.9	1.9	0.9	3.9
2007	10.4	0.0	1.7	3.9	1.2	0.9	0.3	0.6	3.2
2008	10.7	0.0	3.3	4.7	3.5	1.6	1.4	0.9	4.1

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Appendix Table A-4. Spring Chinook index redd counts in the John Day Basin, 1959–2008. Includes estimated redds in areas where we were denied access.

Year	Granite Creek System	Mainstem	Middle Fork	North Fork	Total
1959	40	1	0		41
1960	94	3	29		126
1961	34	12	8		53
1962	398	110	23		531
1963	256	11	7		274
1964	383	13	36	78	510
1965	204	58	37	65	364
1966	454	140	129	437	1160
1967	266	78	14	55	413
1968	509	8	4	80	601
1969	296	121	87	452	956
1970	309	108	76	286	779
1971	260	91	41	200	592
1972	458	51	51	178	738
1973	324	116	43	350	833
1974	191	33	81	130	435
1975	229	92	89	211	621
1976	162	60	66	111	399
1977	207	63	58	261	589
1978	165	58	107	108	438
1979	130	68	118	200	516
1980	78	16	58	78	230
1981	110	51	26	138	325
1982	122	49	62	107	340
1983	46	133	51	76	306
1984	48	73	67	63	251
1985	132	116	40	110	398
1986	163	159	76	257	655
1987	147	247	340	375	1109
1988	116	82	241	245	684
1989	149	165	113	196	623
1990	78	124	47	257	506
1991	55	61	35	115	266
1992	138	142	108	339	727
1993	268	135	155	379	937
1994	96	169	93	201	559
1995	23	29	15	27	94
1996	128	227	136	291	782
1997	102	125	163	197	587
1998	58	108	79	109	354
1999	87	58	105	120	370
2000	241	337	356	477	1411
2001	222	383	199	607	1411
2002	198	480	309	513	1500
2003	81	273	184	483	1021
2004	81	263	176	602	1122
2005	41	161	114	271	587
2006	63	310	153	160	686
2007	21	247	73	196	537
2008	63	270	113	174	620

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Appendix Table A-5. Index redd density (redds/km) in the John Day River basin 1998–2008. Includes redd densities that were estimated in areas where we were denied access (Schultz et al. 2007;Wilson et al. 2007; Schultz et al. 2006; Wilson et al. 2005, 2002; Carmichael et al. 2002; Ruzycki et al. 2002; Wilson et al. 1999; Jonasson et al. 1998).

Year	Granite Creek System	Mainstem	Middle Fork	North Fork	Total
1998	3.1	3.8	4.0	6.2	4.2
1999	4.7	2.0	5.3	6.8	4.4
2000	13.0	11.8	18.0	26.9	16.7
2001	11.9	13.4	10.1	34.3	16.7
2002	10.6	16.8	15.6	29.0	17.7
2003	4.4	9.6	9.3	27.3	12.1
2004	4.4	9.2	8.9	34.0	13.3
2005	2.2	5.6	5.8	15.3	6.9
2006	3.4	10.9	7.7	9.0	8.1
2007	1.1	8.7	3.7	11.1	6.3
2008	3.4	9.5	5.7	9.8	7.3

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

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Appendix Table B-1. List of major spring Chinook spawning survey section start/stop locations and coordinates for the Mainstem John Day River. Sites are listed in upstream order. Coordinates are in UTM format, NAD 27 conus datum.

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 coordinates for the South 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
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

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Appendix Table B-3. List of major spring Chinook spawning survey section start/stop locations and coordinates for the Middle Fork John Day River. Sites are listed in upstream order. Coordinates are in UTM format, NAD 27 conus datum.

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

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Appendix Table B-4. List of major spring Chinook spawning survey section start/stop locations and coordinates for 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
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 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.

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

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Appendix Table B-6. List of major spring Chinook spawning survey section start/stop locations and coordinates for Clear Creek (tributary to the North Fork John Day River, part of the Granite Creek System). Sites are listed in downstream order, coordinates are in UTM format, NAD 27 conus datum.

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 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 coordinates for Desolation Creek (tributary to the North Fork John Day River). Sites are listed in downstream order, coordinates are in UTM format.

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 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

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Appendix C. Kidney Sample Results

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Appendix Table C-1. Kidney sample anaylsis results, egg retention estimates, and gill lesion presence of kidney sampled adult spring Chinook in the John Day basin 2008.

Stream Name	% Egg retention	Gill Lesions	Kidney Sample #	ELISA OD Value
Granite Creek		Y	29	0.173
Granite Creek	0	Y	30	0.118
Granite Creek	0	Y	73	0.089
Granite Creek		Y	105	0.143
Granite Creek	0	N	108	0.285
Granite Creek	0	N	156	0.171
Granite Creek	0	N	177	0.136
Granite Creek		Y	179	0.157
Granite Creek		N	198	0.171
Granite Creek		N	220	0.171
Granite Creek	0	N	224	0.262
Granite Creek	0	N	225	0.173
Granite Creek	0	Y	229	0.151
Granite Creek		N	239	0.154
Granite Creek		Y	270	0.192
Granite Creek	0	Y	277	0.208
Granite Creek	0	Y	401	no sample
Bull Run Creek-Granite Creek	0	N	159	0.167
Bull Run Creek-Granite Creek	0	N	162	0.135
Clear Creek - Granite Creek Tributary	0	N	28	0.165
Clear Creek - Granite Creek Tributary	0	N	165	0.153
Clear Creek - Granite Creek Tributary		N	205	0.175
Clear Creek - Granite Creek Tributary		N	217	0.086
Clear Creek - Granite Creek Tributary	0	N	248	0.162
Desolation Creek		N	109	0.101
Desolation Creek		N	110	0.203
Desolation Creek		N	157	0.178
Desolation Creek	0		158	0.125
Desolation Creek		N	163	0.098
Desolation Creek	100	Y	167	0.114

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Table C-1 Continued.

Stream Name	% Egg retention	Gill Lesions	Kidney Sample #	ELISA OD Value
Desolation Creek		N	172	0.130
Desolation Creek	0	N	181	0.106
Desolation Creek		N	187	0.071
Desolation Creek		N	188	0.162
Desolation Creek	0	N	191	0.094
Desolation Creek		N	192	0.066
Desolation Creek	0		193	0.113
Desolation Creek	0	N	196	0.147
Desolation Creek	0	N	197	0.232
Desolation Creek	0	N	207	0.217
Desolation Creek	100	N	236	0.102
Desolation Creek	100	N	240	0.128
Mainstem John Day River		N	27	0.069
Mainstem John Day River		N	46	0.073
Mainstem John Day River		N	56	0.079
Mainstem John Day River		N	57	0.085
Mainstem John Day River	0	N	95	0.103
Mainstem John Day River		N	103	0.100
Mainstem John Day River		N	111	0.073
Mainstem John Day River		N	112	0.082
Mainstem John Day River		N	117	0.110
Mainstem John Day River		N	122	0.073
Mainstem John Day River	0	N	127	0.091
Mainstem John Day River	0	N	136	0.087
Mainstem John Day River		N	143	0.074
Mainstem John Day River	0	N	146	0.091
Mainstem John Day River	0	N	155	0.065
Mainstem John Day River			164	0.087
Mainstem John Day River		N	168	0.100
Mainstem John Day River	0	N	169	0.089
Mainstem John Day River		N	173	0.067
Mainstem John Day River		N	175	0.078

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Table C-1 Continued.

Stream Name	% Egg retention	Gill Lesions	Kidney Sample #	ELISA OD Value
Mainstem John Day River			178	0.078
Mainstem John Day River		N	180	0.078
Mainstem John Day River		N	182	0.078
Mainstem John Day River	0	N	201	0.073
Mainstem John Day River		N	206	0.087
Mainstem John Day River	0	N	210	0.085
Mainstem John Day River		N	212	0.122
Mainstem John Day River		N	213	0.114
Mainstem John Day River	0	N	226	0.080
Mainstem John Day River		N	228	0.179
Mainstem John Day River	0	N	230	0.096
Mainstem John Day River	0	N	231	0.102
Mainstem John Day River	0	N	232	0.133
Mainstem John Day River	0	N	234	0.073
Mainstem John Day River	0	N	235	0.089
Mainstem John Day River	0	Y	238	0.131
Mainstem John Day River	0	N	242	0.088
Mainstem John Day River	0	N	246	0.072
Mainstem John Day River	0	N	252	0.105
Middle Fork John Day River	0	N	91	0.094
Middle Fork John Day River	0	N	106	0.128
Middle Fork John Day River	0	N	116	0.123
Middle Fork John Day River		N	126	0.181
Middle Fork John Day River	0	N	152	0.243
Middle Fork John Day River	0	N	161	0.246
Middle Fork John Day River	0	U	170	0.143
Middle Fork John Day River		N	183	0.162
Middle Fork John Day River		N	190	0.118
Middle Fork John Day River		N	199	0.260
Middle Fork John Day River	0	N	215	0.087
Middle Fork John Day River	0	N	256	0.210
Middle Fork John Day River	0	N	257	0.141

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Table C-1 Continued.

Stream Name	% Egg retention	Gill Lesions	Kidney Sample #	ELISA OD Value
Middle Fork John Day River	0	Y	258	0.102
Middle Fork John Day River		N	259	0.360
Middle Fork John Day River		N	260	0.177
Middle Fork John Day River		N	262	0.276
Middle Fork John Day River		N	264	0.346
Middle Fork John Day River		N	267	0.208
Middle Fork John Day River		N	268	0.106
Middle Fork John Day River	0	N	271	0.178
Middle Fork John Day River	0	N	273	0.172
Middle Fork John Day River	0	N	275	0.167
Middle Fork John Day River	0	N	278	0.101
Middle Fork John Day River		N	279	0.123
Middle Fork John Day River	0	N	280	0.106
Middle Fork John Day River	0	N	282	0.136
Middle Fork John Day River		N	283	0.092
Middle Fork John Day River		N	284	0.149
Middle Fork John Day River	0	N	285	0.136
Middle Fork John Day River	0	N	286	0.218
Middle Fork John Day River		N	287	0.183
Middle Fork John Day River	0	N	289	0.195
Middle Fork John Day River		N	290	0.258
Middle Fork John Day River	0	N	291	0.132
Middle Fork John Day River	0	N	294	0.106
Middle Fork John Day River	0	N	295	0.101
Middle Fork John Day River	0	N	297	0.112
Middle Fork John Day River		N	300	0.223
North Fork John Day River		N	21	0.085
North Fork John Day River	0	N	34	0.112
North Fork John Day River	0	N	37	0.089
North Fork John Day River		N	39	0.076
North Fork John Day River	0	N	40	0.099
North Fork John Day River	0	N	43	0.097

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Table C-1 Continued.

Stream Name	% Egg retention	Gill Lesions	Kidney Sample #	ELISA OD Value
North Fork John Day River	0	N	44	0.184
North Fork John Day River		N	54	0.142
North Fork John Day River			55	0.157
North Fork John Day River		N	58	0.137
North Fork John Day River	25	N	64	0.158
North Fork John Day River	50	0	66	0.117
North Fork John Day River	0	N	71	0.170
North Fork John Day River			75	0.096
North Fork John Day River	50	N	78	0.087
North Fork John Day River		N	80	0.115
North Fork John Day River		N	85	0.121
North Fork John Day River	0	N	101	0.176
North Fork John Day River		N	104	0.100
North Fork John Day River	0	N	107	0.125
North Fork John Day River	0	N	113	0.205
North Fork John Day River	0	U	114	0.182
North Fork John Day River	0	N	118	0.174
North Fork John Day River	0	N	119	0.490
North Fork John Day River		N	124	0.091
North Fork John Day River	0	N	125	no sample
North Fork John Day River		N	128	0.073
North Fork John Day River	75	N	130	0.140
North Fork John Day River		N	131	0.099
North Fork John Day River	0	N	135	0.097
North Fork John Day River		N	138	0.151
North Fork John Day River	0	N	141	0.109
North Fork John Day River		N	142	0.131
North Fork John Day River	0	N	147	0.105
North Fork John Day River	0	N	153	0.102
North Fork John Day River	0	N	154	0.229
North Fork John Day River		N	160	0.093
North Fork John Day River	0	N	171	0.130

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Table C-1 Continued.

Stream Name	% Egg retention	Gill Lesions	Kidney Sample #	ELISA OD Value
North Fork John Day River	0	N	174	0.155
North Fork John Day River		N	176	0.107
North Fork John Day River	0	N	184	0.093
North Fork John Day River	0	N	185	0.185
North Fork John Day River		N	189	0.111
North Fork John Day River		N	194	0.109
North Fork John Day River	0	N	202	0.223
North Fork John Day River	75	N	203	0.105
North Fork John Day River		N	208	0.134
North Fork John Day River		N	209	0.135
North Fork John Day River		N	211	0.260
North Fork John Day River	0	N	214	0.096
North Fork John Day River	0	N	216	0.199
North Fork John Day River	100	N	218	0.094
North Fork John Day River	25	N	221	0.091
North Fork John Day River		N	222	0.074
North Fork John Day River		N	223	0.107
North Fork John Day River	0	N	233	0.121
North Fork John Day River	0	N	241	0.129
North Fork John Day River		N	243	0.114
North Fork John Day River			244	0.088
North Fork John Day River		N	250	0.116
North Fork John Day River	0	N	251	0.109
North Fork John Day River	0	U	254	0.084
North Fork John Day River		N	255	0.176
North Fork John Day River		N	261	0.100
North Fork John Day River	0	N	263	0.124
North Fork John Day River	0	N	265	0.104
North Fork John Day River	0	N	296	0.100

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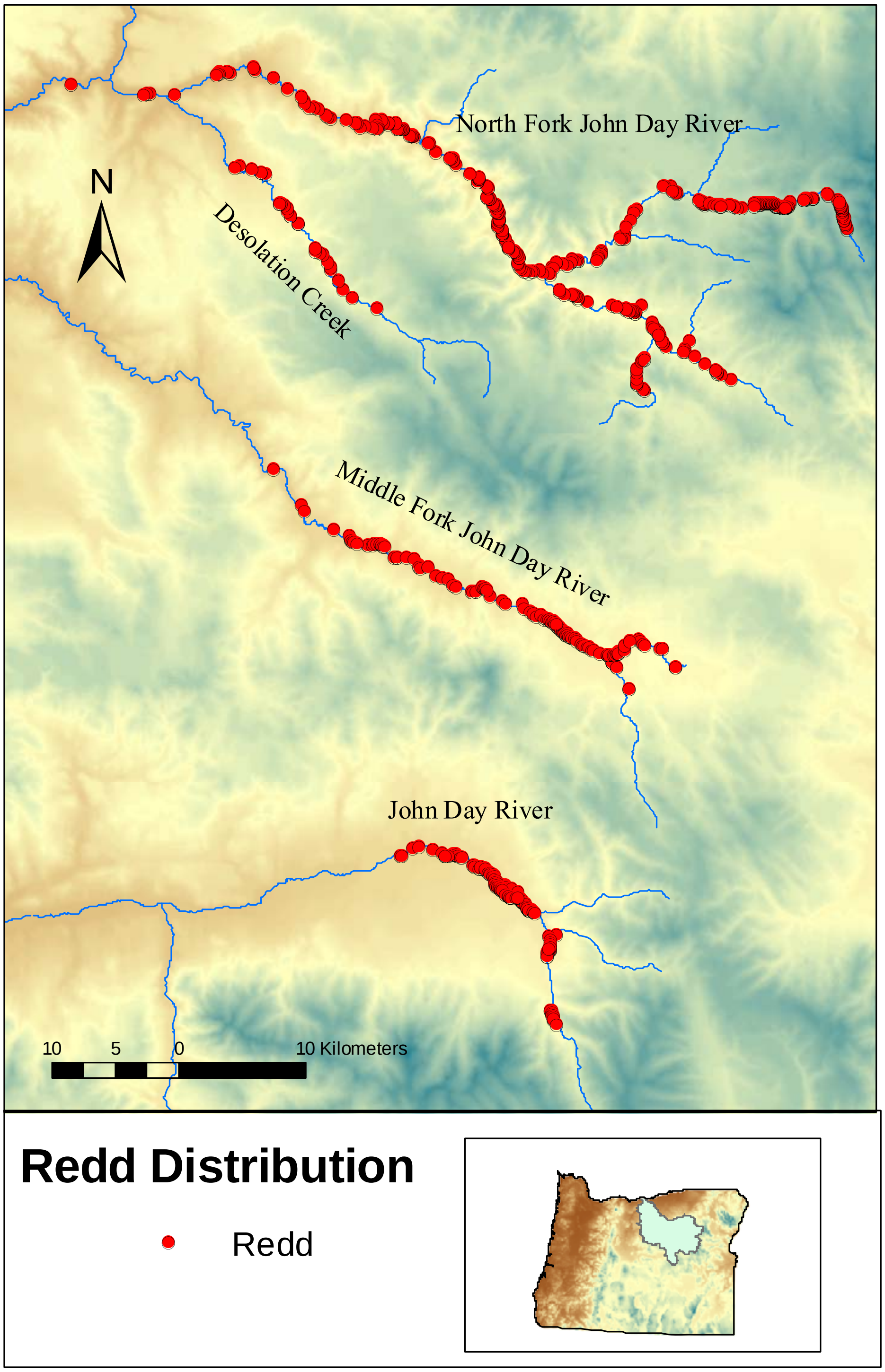

Appendix Figure D-1. Map of the locations of spring Chinook redds found in the John Day Basin during 2008.