JOHN DAY BASIN SPRING CHINOOK SALMON ESCAPEMENT AND PRODUCTIVITY MONITORING

FISH RESEARCH PROJECT OREGON

Project Period: July 17, 1998 Through June 30, 1999

Annual Report 1998

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FISH RESEARCH PROJECT
OREGON

JOHN DAY BASIN SPRING CHINOOK SALMON ESCAPEMENT AND PRODUCTIVITY MONITORING

ANNUAL PROGRESS REPORT

Project Period: July 17, 1998 to June 30, 1999

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EXECUTIVE SUMMARY

Objectives

1. Estimate the total number of adult spring chinook salmon redds and spawners in the John Day River basin in 1998.

2. Determine sex ratio, age composition, length-age relationship, and proportion of natural spawners that are hatchery origin strays.

3. Determine how adequately historic index surveys index spawner abundance and determine changes in spawner distribution.

Accomplishments and Findings

Spawning ground surveys were conducted during September 1998 in the four spawning areas (Mainstem, Middle Fork, North Fork, and Granite Creek system) of the John Day basin covering 108.3 river miles (55 miles index and 53.3 miles extensive areas) of spawning habitat. During our surveys in the basin, we observed 430 redds and we sampled 311 carcasses. We estimated 136 redds and 428 spawners in the Mainstem, 88 redds and 277 spawners in the Middle Fork, 127 redds and 400 spawners in the North Fork, and 81 redds and 255 spawners in the Granite Creek system. We determined that 90% of the redds in the John Day basin were within the index survey areas, and 91% of the spawning within the index areas was completed by the time we conducted the index surveys. The age composition of the carcasses sampled for the entire basin was 1.3% age-2 (precocious males), 1.6% age-3 (jacks), 81.6% age-4, and 15.5% age-5. The sex ratio of the carcasses recovered was 49% females and 51% males. We determined that one of 311 (0.3%) carcasses examined was of hatchery origin.

Management Recommendations

1. Surveys of the index and extensive areas in the John Day basin should be continued to provide the most accurate assessment of the size and composition of the spawning population. Surveying the index areas three times and the extensive areas once will allow us to estimate natural spawning escapement and assess age composition and progeny-to-parent production values in the John Day basin.

2. Continue managing John Day River spring chinook salmon for wild fish only. The ecological and scientific importance of maintaining a totally wild population to compare with supplemented populations outweighs the potential benefits of supplementing with hatchery fish.

INTRODUCTION

The John Day River basin supports one of the healthiest naturally-produced populations of spring chinook in the mid-Columbia River basin. The study of life history and natural escapement conducted from 1978 to 1985 (Lindsay et al. 1986) provided valuable information on production and productivity of the John Day River spring chinook. With the exception of two years since completion of the study in 1985 (1989 and 1995), spring chinook spawning surveys were conducted in index areas only and have not provided adequate information to assess age composition, progeny-to-parent production values, and estimate natural spawning escapement. The PATH project (Marmorek and Peters 1996) has identified the John Day basin spring chinook as an index population for assessing the effects of alternative future management actions on salmon stocks in the Columbia Basin. To meet the data needs as an index stock, sufficient annual estimates of spawner escapement, age composition, and smolt-to-adult survival are essential. There is need to determine the annual spawner escapement and age composition for the John Day basin spring chinook to provide us the ability to estimate progeny-to-parent production for each brood year. This need can be met by expanding the annual chinook spawning surveys, estimating the annual escapement, and determining age composition by scale pattern analyses.

This project provides information as directed under two measures of the Columbia Basin Fish and Wildlife Program (NPPC 1994). Measure 4.3C specifies that the key indicator populations should be monitored to provide detailed stock status information. In addition, measure 7.1C identifies the need for collection of population status, life history, and other data on wild and naturally spawning populations. This project was developed in direct response to recommendations and needs of the PATH project, the Fish and Wildlife Program, and the Columbia Basin Fish and Wildlife Authority Multi-Year Implementation Plan.

STUDY AREA

The John Day River drains 20,300 sq km in 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 its mouth at km 351 on the Columbia River at an elevation near 90 m. The basin is bounded by the Columbia River to the north, the Blue Mountains to the east, the Strawberry and Aldrich mountains to the south, and the Ochoco Mountains to the west.

Spring chinook salmon spawn in the main John Day River (hereafter called Mainstem) above Prairie City (Figure 2), in the Middle Fork John Day River (hereafter called the Middle Fork) above Armstrong Creek (Figure 3), and in the North Fork John Day River (hereafter called the North Fork, Figure 4) above Camas Creek including Granite Creek and its tributaries Clear and Bull Run creeks (hereafter called the Granite Creek system).

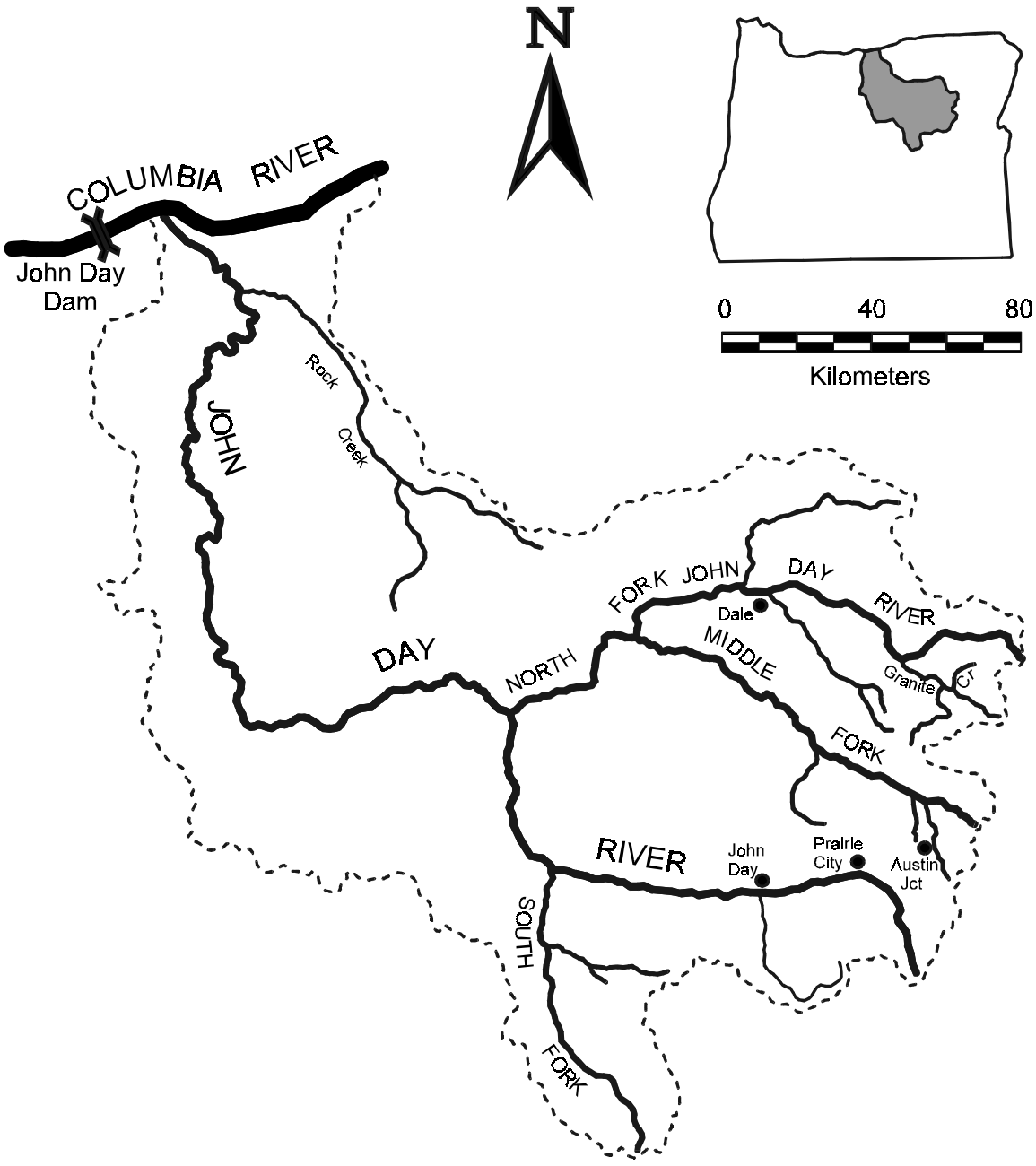

Figure 1. Map of John Day River basin. Dashed lines denote boundaries of the basin.

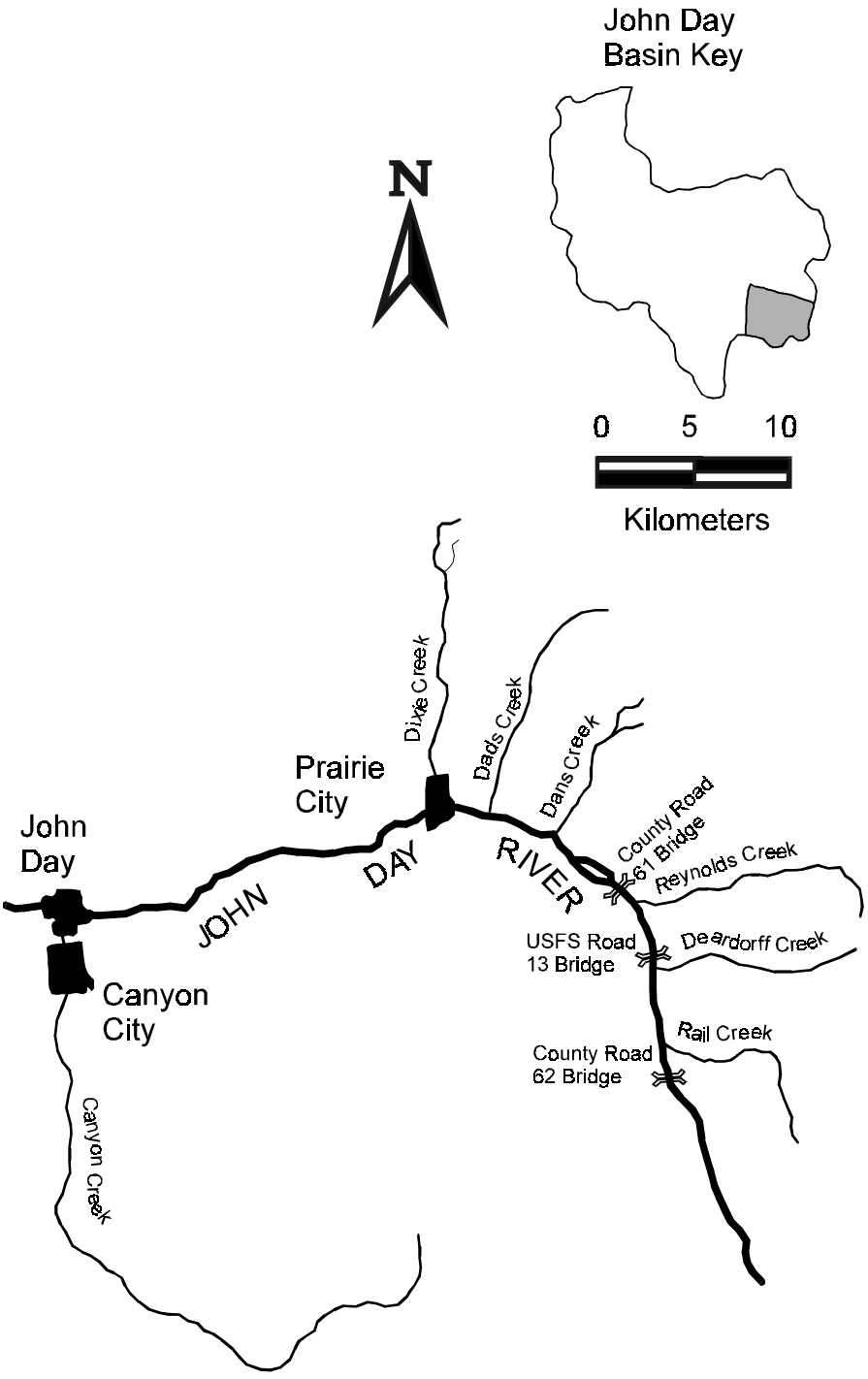

Figure 2. Map of the upper mainstem John Day River.

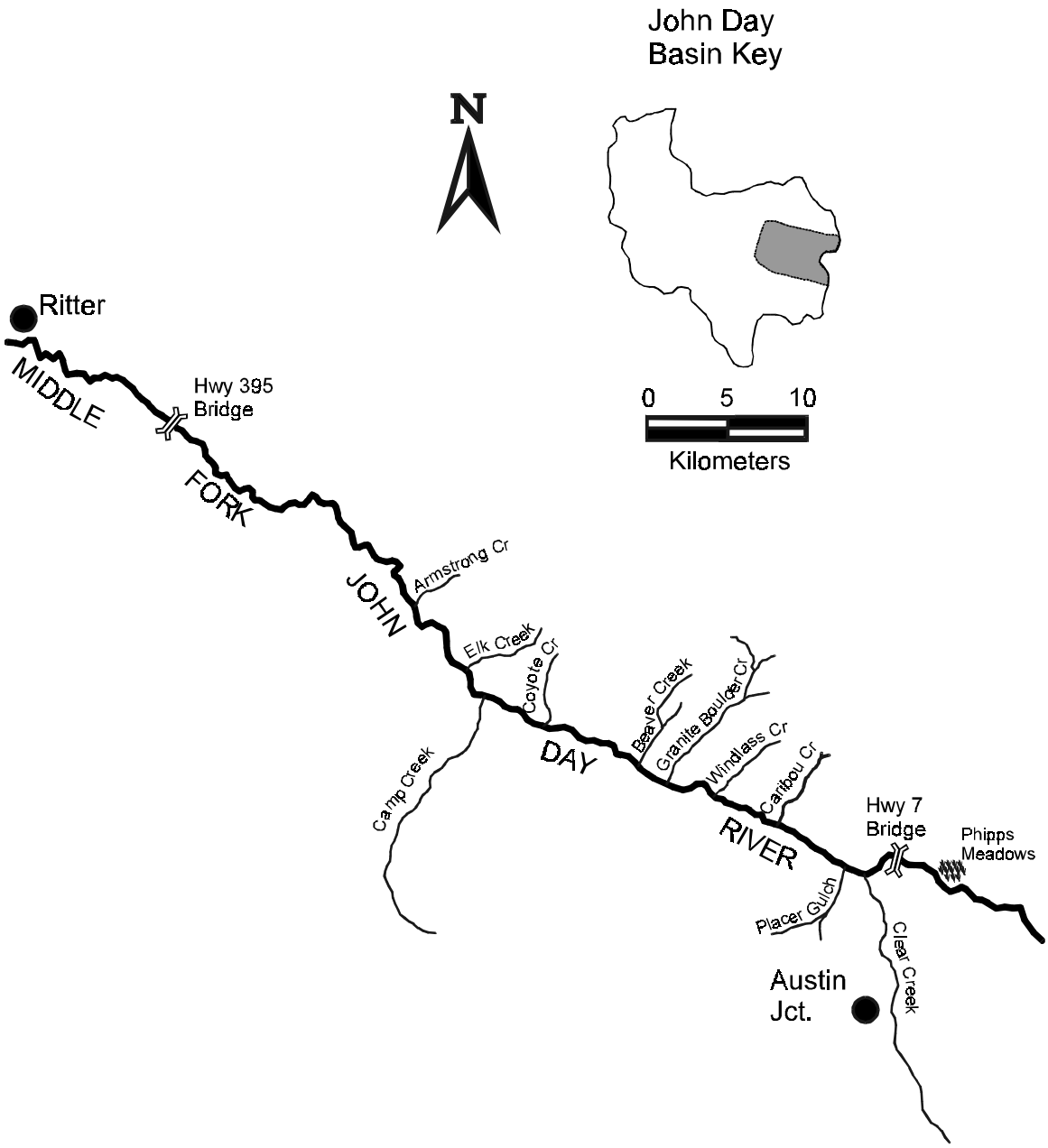

Figure 3. Map of the Middle Fork John Day River.

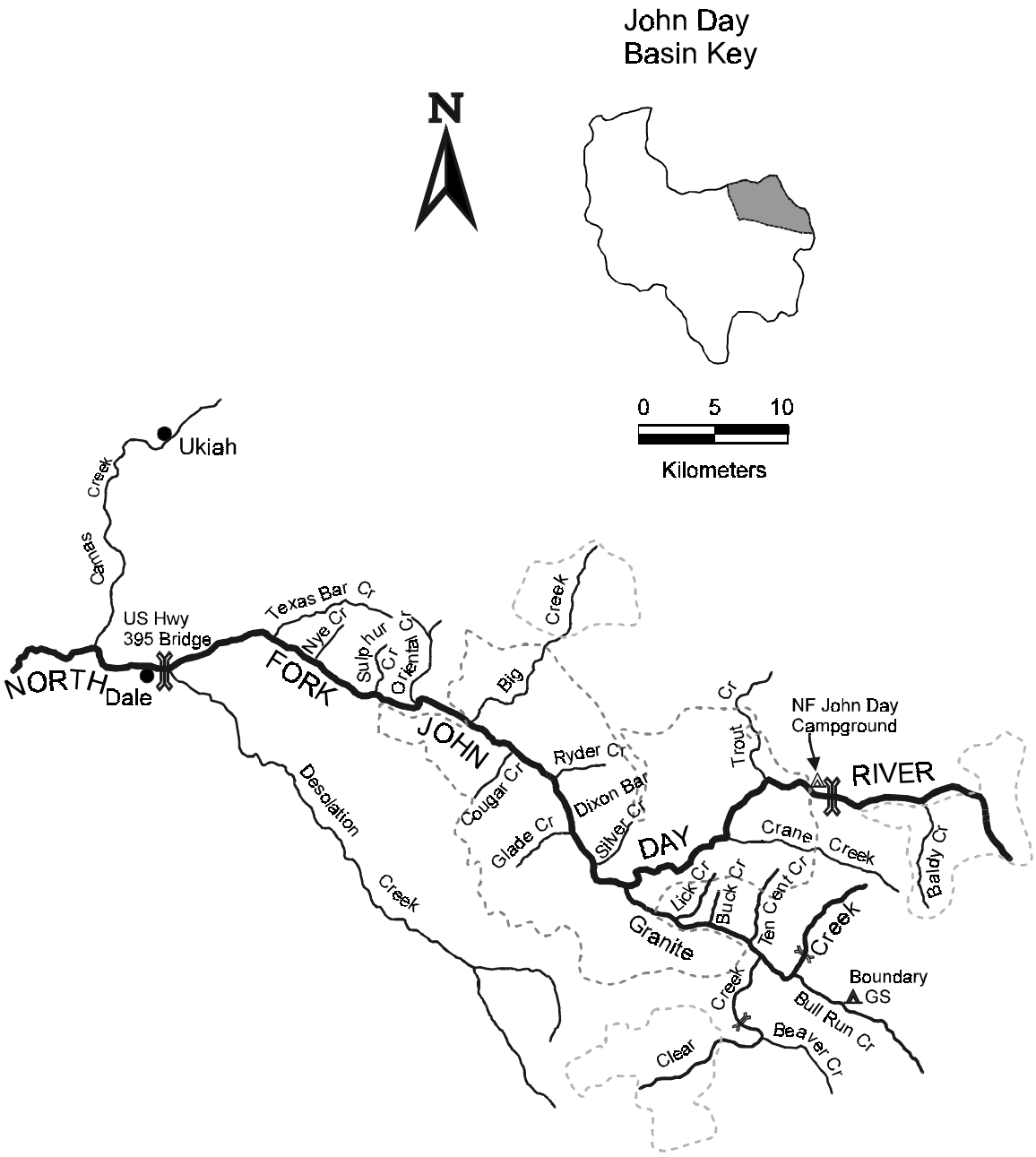

Figure 4. Map of the North Fork John Day River. Dashed lines denote boundaries of North Fork John Day wilderness.

METHODS

Chinook salmon spawning ground surveys are conducted each year during September in the John Day basin. Specific stream sections are surveyed at specific times (index surveys) to provide an index of the relative abundance of redds. The index surveys are scheduled to take place near the peak of spawning in each system. To get a nearly complete count of redds in the basin, we surveyed the index survey areas one week before the index survey (pre-index), at the time of the index survey (index), and one week after the index survey (post-index). We also surveyed areas outside of the index survey areas where spawning is believed to occur (extensive surveys) at the time of the index survey. The index and extensive survey sections and mean dates for the index surveys during 1989-97 are shown in Table 1. We completed the 1998 index surveys within four days of the mean index survey dates during 1989-97.

Surveys were conducted by walking in an upstream direction on Granite Creek system, Mainstem, and Middle Fork surveys, and in a downstream direction on North Fork surveys, following the recent protocol of the John Day Fish District. Survey sections ranged from 2 to 5 miles in length, depending on accessibility and difficulty. Surveyors recorded the number of occupied and unoccupied redds, the number of live fish observed (on redds and off redds), and the number, sex, and origin (hatchery or wild) of carcasses recovered in each survey section. In index survey areas the redds were numbered and marked with colored flagging, so that the number of new redds could be determined during each additional survey. Flagging was removed on the last survey. The carcasses found during the survey were measured (middle of eye to posterior scale, MEPS, mm), sex was confirmed, and percent of eggs spawned was estimated to the nearest 25% for females. Any identifying marks or tags were noted, and the tags were removed for identification and returned to the appropriate agency. Scale samples were removed from the key scale area (Nicholas and Van Dyke 1982) to determine age. If any fin marks were observed, the snout of the fish was removed to be examined for the presence of a coded-wire tag. The tail was removed from each carcass sampled to prevent repeated sampling on subsequent surveys and the carcass was placed back in the stream.

We assessed the timing of the index surveys relative to the timing of spawning in each primary spawning area (i.e. Mainstem, Middle Fork, North Fork, and Granite Creek system) by

$$P_t = \frac{R_1 + R_2}{R_1 + R_2 + R_3}, \tag{1}$$

where P_t is the proportion of redds in the index area that were completed at the time of the index survey, R_1 is the number of redds counted during the pre-index survey, R_2 is the number of new redds counted during the index survey, and R_3 is the number of new redds counted during the post-index survey. We also assessed the index survey areas relative to entire spawning areas by

$$P_a = \frac{R_1 + R_2}{R_1 + R_2 + R_4}, \quad (2)$$

where P_a is the proportion of redds in the spawning area that were within the index survey area and R_4 is the number of redds counted in the extensive survey area.

Because we surveyed the extensive survey area only at the time of the index survey, we estimated the total number of redds in each primary spawning area by

$$\hat{R}_{total} = \frac{R_1 + R_2 + R_3}{P_a}; \quad (3)$$

where $\hat{R}_{total}$ is the estimated number of redds in the entire primary spawning area. We estimated the number of spawners in each of the four primary spawning areas by multiplying the estimated number of redds by a fish per redd ratio of 3.15 estimated in the Imnaha River, Oregon above a weir in 1998 (Oregon Department of Fish and Wildlife, unpublished data).

We mounted the scales on gummed cards and made impressions in acetate. The scale impressions were viewed on a microfiche reader and we counted the freshwater and ocean annuli to determine age of the sampled carcasses. For carcasses which had unreadable scales, we assigned an age based on the length of the carcass, and the relationship between length and age of the carcasses from which we could determine age from scales. We also examined the freshwater portion of the scale to determine the origin (wild or hatchery) of spawners. We used the scale ages to estimate the age composition for spawning populations in the Mainstem, Middle Fork, North Fork, and the Granite Creek system.

Table 1. Description of index and extensive spawning survey sections in the John Day basin, and mean index survey dates during 1989-97.

Stream, survey type	Survey boundaries	Distance		Index survey dates
		Km	Miles	
Mainstem:				
Index	62 Road Culvert to Dad's Creek	20.9	13.0	12 Sep
Extensive	Dad's Creek to Depot Park Bridge in Prairie City	3.7	2.3	
Middle Fork:				
Index	Hwy 7 to Beaver Creek	19.3	12.0	23 Sep
Extensive	Phipps Meadows to Hwy 7, Beaver Creek to Armstrong Creek, and lower 1 mile of Clear Creek	29.0	18.0	
North Fork:				
Upper index	Granite Creek to Cougar Creek	12.9	8.0	20-21 Sep
Lower index	Big Creek to Nye Creek	16.1	10.0	22 Sep
Extensive	Baldy Creek to Granite Creek, Cougar Creek to Big Creek, and Nye Creek to Desolation Creek	44.1	27.5	
Granite Creek:				
Index	73 Road to Buck Creek	8.9	5.5	13 Sep
Extensive	Buck Creek to Mouth	7.2	4.5	
Clear Creek:[a]				
Index	13 Road Crossing to Mouth	6.4	4.0	13 Sep
Extensive	Beaver Creek to 13 Road Crossing	1.6	1.0	
Bull Run Creek:[a]				
Index	Boundary Guard Station to Mouth	4.0	2.5	13 Sep
Extensive	No additional area	0.0	0.0	

[a] *Tributary of Granite Creek.*

Results and Discussion

Redds and Escapement

We surveyed a total of 218.3 miles in the John Day basin (55 miles of index area surveyed three times and 53.3 miles of extensive area) and counted a total of 430 redds. The number of redds counted in each of the four primary spawning areas are shown in Table 2. We estimated 432 redds and 1,360 spawners in the John Day basin in 1998. The estimated number of redds and spawners in each of the four primary spawning areas are shown in Table 3. The redd and fish count data collected during the surveys are reported by spawning area in **Appendix A**.

We found eight female prespawning mortalities and no redds in the Middle Fork downstream of Granite Boulder Creek (RM 56.5). In the week prior to the pre-index survey, a debris torrent came down Granite Boulder Creek and deposited mud into the Middle Fork. Any redds that were constructed before this event were covered by mud, and the eggs would not be expected to survive.

The index redd counts for the four primary spawning areas in 1998 were 108 redds in the Mainstem, 79 redds in the Middle Fork, 109 Redds in the North Fork, and 61 redds in the Granite Creek system, for a basin total of 357 redds. The index counts for the basin in 1998 were lower than the average for the 1990's (557 redds), but were within the range of the annual redd counts. The average for the index redd counts during the earlier spring chinook salmon study in 1978-1985 was 401 redds. Historic index redd count data for the John Day basin is reported in **Appendix B**.

Table 2. Summary of redds observed during spring chinook salmon spawning surveys in the John Day basin, 1998.

	Miles surveyed		Total	New redds observed			
Stream	Index	Extensive	Redds	Pre-index	Index	Post-index	Extensive
Mainstem	13.0	2.3	135	49	59	24	3
Middle Fork	12.0	18.0	88	59	20	5	4
North Fork	18.0	27.5	127	95	14	0	18
Granite Creek System	12.0	5.5	80	43	18	6	13
Basin Total	**55.0**	**53.3**	**430**	**246**	**111**	**35**	**38**

Table 3. Estimated spring chinook salmon redds and spawners in the John Day basin, 1998.

	Estimated total	
Stream	Redds	Spawners
Mainstem	136	428
Middle Fork	88	277
North Fork	127	400
Granite Creek System	81	255
Basin Total	**432**	**1,360**

Adequacy Of Historic Index Surveys and Spawner Distribution

We determined that 90% of the redds in the John Day basin were within the index survey areas, and 91% of the spawning within the index areas was completed by the time we conducted the index surveys in 1998. The percentages of redds counted in the index areas and completed by the time of the index counts in each of the four primary spawning areas are shown in Table 4. The percentages of redds counted in the index areas in the Mainstem and Granite Creek system during 1978-85 (Lindsay et al. 1986) are similar to what we found in 1998, whereas the percentage of redds in the index area of the North Fork was slightly higher in 1998 than observed during 1978-85 (Table 5). The index survey area in the Middle Fork was expanded in 1986, and the data collected in 1998 is not directly comparable to the data collected during 1978-85.

The distribution of redds among the four primary spawning areas counted on index surveys within the John Day basin in 1998 are within the range seen during 1978-85 (Table 6). However, the trend over the last 20 years shows a shift in spawning from the Granite Creek system into the North Fork, and an increase in the Mainstem.

Table 4. Percentage of redds counted in the index survey areas and completed by the time of the index surveys in the John Day basin, 1998.

	Percentage of redds	
Stream	In index survey area	At time of index survey
Mainstem	97	82
Middle Fork	95	94
North Fork	86	100
Granite Creek system	82	91

Table 5. Percentage of redds counted during the index and extensive surveys that were in index survey areas in the John Day basin, 1978-85 and 1998. Data for 1978-85 is from Lindsay et al. (1986). The index area of the Middle Fork was expanded in 1986, and the data collected in 1998 is not directly comparable to 1978-85.

	Year								
Stream	1978	1979	1980	1981	1982	1983	1984	1985	1998
Mainstem	100.0	91.9	100.0	96.2	96.1	96.4	91.3	96.7	97.3
North Fork	64.9	80.0	75.0	77.1	60.7	66.7	76.8	70.5	85.8
Granite Creek system	81.6	89.0	87.6	90.2	85.3	82.1	76.2	82.5	82.4

Table 6. Percentage distribution of redds counted on index surveys among the primary spawning areas of the John Day basin, 1978-85 and 1998. Data for 1978-85 is from Lindsay et al. (1986).

	Year								
Stream	1978	1979	1980	1981	1982	1983	1984	1985	1998
Mainstem	13.4	13.2	7.0	15.7	14.5	43.5	29.1	29.1	30.3
Middle Fork	24.3	22.9	25.2	8.0	18.3	16.7	26.7	10.1	22.1
North Fork	24.8	38.8	33.9	42.5	31.1	24.8	25.1	27.6	30.5
Granite Creek system	37.5	25.2	33.9	33.8	36.1	15.0	19.1	33.2	17.1

Sex Ratio, Age Composition, Length-age Relationship and Proportion of Natural Spawners that are Hatchery Origin Strays

We recovered 311 carcasses from the surveys in the John Day basin (Table 7). The addition of the post-index and extensive surveys allowed us to recover 69 more carcasses than would have been recovered with only the index surveys. The pre-index survey probably also allowed us to recover more carcasses as many probably would have been too decomposed or consumed by scavengers by the time of the index surveys. More carcasses were sampled in 1998 than in 1996 and 1997 (215 and 103 carcasses, respectively) when only the index surveys were conducted, even though more redds were counted in those years (587 redds in 1996, 782 redds in 1997).

We were able to determine the sex of 310 carcasses, and determine age from the scales of 292 carcasses. The sex ratio of the carcasses recovered was 49% females to 51% males. The age composition of the carcasses recovered was 1.3% age-2 (precocious males), 1.6% age-3 (jacks), 81.6% age-4, and 15.5% age-5, which falls within the range of age compositions reported by Lindsay et al. (1986), with the exception that no age-2 chinook were reported during 1978-85. The age composition by sex of carcasses recovered in the four primary spawning areas are shown in Table 8. The length of carcasses by age and sex is shown in Table 9.

We determined that one of 311 (0.3%) carcasses examined was of hatchery origin. This fish had an adipose fin clip, no coded-wire tag, and we confirmed its origin by its freshwater scale pattern. This fish was a male collected on 2 September 1998 in Clear Creek of the Granite Creek system.

Table 7. Summary of carcasses sampled during spring chinook salmon spawning surveys in the John Day basin, 1998.

	Number of carcasses sampled				
Stream	Total	Pre-index	Index	Post-index	Extensive
Mainstem	51	2	32	17	0
Middle Fork	105	27	51	23	4
North Fork	61	41	15	3	2
Granite Creek System	94	15	59	12	8
Basin Total	**311**	**85**	**157**	**55**	**14**

Table 8. Percentage age and sex composition of spring chinook salmon carcasses sampled in the four primary spawning areas of the John Day basin, 1998.

		Age							
		2		3		4		5	
Stream	*N*	M	F	M	F	M	F	M	F
Mainstem	51	2.0	0.0	2.0	0.0	35.2	58.8	2.0	0.0
Middle Fork	105	1.0	0.0	1.9	0.0	32.4	46.6	10.5	7.6
North Fork	60	1.7	0.0	1.7	0.0	43.3	38.3	10.0	5.0
Granite Creek	94	1.1	0.0	1.1	0.0	42.5	35.1	14.9	5.3

Table 9. MEPS length (mm) by age and sex of spring chinook salmon sampled on spawning ground surveys in the four primary spawning areas of the John Day basin, 1998.

	Age							
	2		3		4		5	
Stream, item	M	F	M	F	M	F	M	F
Mainstem								
number	1	0	1	0	16	30	1	0
mean	150.0	--	360.0	--	598.9	585.3	655.0	--
standard error	--	--	--	--	11.24	6.65	--	--
Middle Fork								
number	1	0	2	0	29	47	11	8
mean	115.0	--	390.0	--	594.9	593.6	700.0	639.0
standard error	--	--	50.00	--	5.73	6.36	16.24	26.96
North Fork								
number	1	0	1	0	21	21	5	3
mean	97.0	--	380.0	--	592.0	614.0	728.0	718.3
standard error	--	--	--	--	7.70	10.44	10.20	13.64
Granite Creek								
number	1	0	1	0	39	32	14	5
mean	90.0	--	389.0	--	600.8	616.0	733.0	730.0
standard error	--	--	--	--	7.12	7.13	8.87	22.42

We recovered six radio tags from carcasses of spring chinook salmon tagged at Bonneville Dam by Idaho Cooperative Fish and Wildlife Research Unit . Tagging and recovery information is shown in Table 10. All of the tagged fish recovered in the John Day basin were tagged at Bonneville Dam between mid-April and mid-May. Lindsay et al. (1986) reported that John Day basin spring chinook salmon were caught in Columbia River fisheries below Bonneville Dam and in the Bonneville Pool between mid-April and mid-May.

Table 10. Tagging and recovery information for spring chinook salmon radio tagged at Bonneville Dam and recovered during spawning ground surveys in the John Day basin, 1998.

Recovery stream	Date tagged	Date recovered	MEPS length (mm)	Sex
Mainstem	05/11/98	09/08/98	655	M
Middle Fork	04/18/98	09/14/98	645	F
Middle Fork	04/27/98	09/21/98	570	M
Granite Creek	04/14/98	09/09/98	680	M
Granite Creek	04/16/98	09/09/98	730	M
Granite Creek	04/30/98	09/09/98	605	M

Conclusion

The index redd counts of the John Day River spring chinook salmon in 1998 were lower than the last several years, but are within the range of counts since 1978. The redd counts in the basin show an increasing trend over the last 20 years, although there is much annual variation. Since the John Day spring chinook is an index stock, expanding the annual survey will provide more information in assessing the effects of alternative future management actions on salmon stocks in the Columbia Basin.

The multiple surveys allowed us to collect more carcasses than are usually collected when only the index surveys are conducted. The John Day spring chinook stock continues to remain without significant influence of hatchery stocks as we determined that only one of 311 (0.3%) carcasses examined was of hatchery origin. The age composition for the basin was within the range of annual age compositions observed during 1978-85. The distribution of spawners within the basin was within the range observed during 1978-85.

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APPENDIX A

Survey Data

Appendix Table A-1. Spring chinook salmon spawning ground survey data from the John Day basin, 1998.

Stream, section	Survey type	Date	Miles	New redds		On dig		Off dig		Dead fish, unmarked				Dead fish, marked				Dead	Live	Unmarked	Marked
				Occ.	Unocc.	A	J	A	J	M	F	J	U	M	F	J	U	Fish	Fish	Dead	Dead
John Day River, mainstem																					
Dad's Creek to Dan's Creek	Pre-index	1-Sep	2.2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Dan's Creek to 61 Road bridge	Pre-index	1-Sep	4.2	5	3	14	0	6	0	0	0	0	0	0	0	0	0	0	20	0	0
61 Rd bridge to Deardorff Creek	Pre-index	1-Sep	2.2	17	4	31	2	5	0	1	0	0	0	0	0	0	0	1	38	1	0
Deardorff Cr. to 62 Road culvert	Pre-index	1-Sep	4.4	12	6	32	2	4	0	0	1	0	0	0	0	0	0	1	38	1	0
Prairie City to Dad's Creek	Extensive	8-Sep	2.3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dad's Creek to Dan's Creek	Index	8-Sep	2.2	6	1	8	0	2	1	1	0	1	1	0	0	0	0	3	11	3	0
Dan's Creek to 61 Road bridge	Index	8-Sep	4.2	16	12	27	2	2	1	8	6	0	0	0	0	0	0	14	32	14	0
61 Rd bridge to Deardorff Creek	Index	8-Sep	2.2	9	4	20	0	0	0	5	7	0	0	0	0	0	0	12	20	12	0
Deardorff Cr. to 62 Road culvert	Index	8-Sep	4.4	7	4	15	0	0	0	1	4	0	0	0	0	0	0	5	15	5	0
Dad's Creek to Dan's Creek	Post-index	17-Sep	2.2	1	3	2	0	0	0	1	2	1	0	0	0	0	0	4	2	4	0
Dan's Creek to 61 Road bridge	Post-index	15-Sep	4.2	6	9	6	0	1	0	2	3	0	1	0	0	0	0	6	7	6	0
61 Rd bridge to Deardorff Creek	Post-index	15-Sep	2.2	1	0	5	0	0	0	2	4	0	0	0	0	0	0	6	5	6	0
Deardorff Cr. to 62 Road culvert	Post-index	15-Sep	4.4	4	0	6	0	0	0	0	5	0	2	0	0	0	0	7	6	7	0
Mainstem Total			41.3	86	49	167	6	20	2	21	32	2	4	0	0	0	0	59	195	59	0
Middle Fork John Day River																					
Beaver Creek to Windlass Creek	Pre-index	14-Sep	3.0	8	6	10	0	1	0	4	9	1	0	0	0	0	0	14	11	14	0
Windlass Creek to Caribou Creek	Pre-index	14-Sep	3.5	10	2	14	0	1	0	1	3	0	0	0	0	0	0	4	15	4	0
Caribou Creek to Placer Gulch	Pre-index	14-Sep	3.5	14	4	53	1	14	1	4	3	0	2	0	0	0	0	9	69	9	0
Placer Gulch to Hwy 7	Pre-index	14-Sep	2.0	8	7	11	0	3	0	0	2	0	0	0	0	0	0	2	14	2	0
Armstrong Cr. to Beaver Creek	Extensive	22-Sep	14.0	0	0	0	0	1	0	1	2	0	0	0	0	0	0	3	1	3	0
Beaver Creek to Windlass Creek	Index	21-Sep	3.0	1	2	2	0	0	0	4	4	0	0	0	0	0	0	8	2	8	0
Windlass Creek to Caribou Creek	Index	21-Sep	3.5	2	0	3	0	0	0	5	6	2	0	0	0	0	0	13	3	13	0
Caribou Creek to Placer Gulch	Index	21-Sep	3.5	0	11	12	0	3	0	13	12	0	0	0	0	0	0	25	15	25	0
Placer Gulch to Hwy 7	Index	21-Sep	2.0	1	3	3	0	2	0	2	5	0	0	0	0	0	0	7	5	7	0
Hwy 7 to Phipps Meadows	Extensive	22-Sep	3.0	1	3	1	0	0	0	0	1	0	0	0	0	0	0	1	1	1	0
Lower mile of Clear Creek	Extensive	22-Sep	1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beaver Creek to Windlass Creek	Post-index	28-Sep	3.0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	4	0	4	0
Windlass Creek to Caribou Creek	Post-index	28-Sep	3.5	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caribou Creek to Placer Gulch	Post-index	28-Sep	3.5	1	0	2	0	0	0	4	6	0	1	0	0	0	0	11	2	11	0
Placer Gulch to Hwy 7	Post-index	28-Sep	2.0	0	2	0	0	0	0	0	4	7	0	0	0	0	0	11	0	11	0
Middle Fork Total			54.0	46	42	111	1	25	1	41	58	10	3	0	0	0	0	112	138	112	0

Appendix Table A-1. Continued.

Stream, section	Survey type	Date	Miles	New redds		On dig		Off dig		Dead fish, unmarked				Dead fish, marked				Dead	Live	Unmarked	Marked
				Occ.	Unocc.	A	J	A	J	M	F	J	U	M	F	J	U	Fish	Fish	Dead	Dead
North Fork John Day River																					
Granite Creek to Silver Creek	Pre-index	14-Sep	2.0	0	11	0	0	0	0	2	6	0	0	0	0	0	0	8	0	8	0
Silver Creek to Dixon Bar	Pre-index	14-Sep	2.0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dixon Bar to Ryder Creek	Pre-index	15-Sep	2.0	5	25	8	1	6	0	2	6	2	2	0	0	0	0	12	15	12	0
Ryder Creek to Cougar Creek	Pre-index	15-Sep	2.0	1	6	1	0	0	0	1	3	0	4	0	0	0	0	8	1	8	0
Big Creek to Oriental Creek	Pre-index	16-Sep	3.3	4	18	7	0	1	0	6	3	0	1	0	0	0	0	10	8	10	0
Oriental Creek to Sulphur Creek	Pre-index	16-Sep	2.3	0	4	2	0	0	0	4	4	0	1	0	0	0	0	9	2	9	0
Sulphur Creek to Nye Creek	Pre-index	16-Sep	4.4	1	3	1	0	0	0	4	2	0	0	0	0	0	0	6	1	6	0
Baldy Cr. to N. F. Campgrnd	Extensive	24-Sep	5.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N. F. Campgrnd to Granite Cr.	Extensive	21-22-Sep	12.7	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Granite Creek to Silver Creek	Index	23-Sep	2.0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silver Creek to Dixon Bar	Index	23-Sep	2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dixon Bar to Ryder Creek	Index	23-24-Sep	2.0	0	7	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0
Ryder Creek to Cougar Creek	Index	24-Sep	2.0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0
Cougar Creek to Big Creek	Extensive	24-Sep	2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Creek to Oriental Creek	Index	23-Sep	3.3	0	1	0	0	1	0	6	5	0	2	0	0	0	0	13	1	13	0
Oriental Creek to Sulphur Creek	Index	23-Sep	2.3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sulphur Creek to Nye Creek	Index	23-Sep	4.4	1	0	0	0	0	0	2	0	0	0	0	0	0	0	2	0	2	0
Nye Creek to Desolation Cr.	Extensive	23-Sep	6.6	0	1	0	0	0	0	1	1	0	0	0	0	0	0	2	0	2	0
Granite Creek to Silver Creek	Post-index	28-Sep	2.0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0
Silver Creek to Dixon Bar	Post-index	28-Sep	2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dixon Bar to Ryder Creek	Post-index	29-Sep	2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ryder Creek to Cougar Creek	Post-index	29-Sep	2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Creek to Oriental Creek	Post-index	30-Sep	3.3	0	0	0	0	0	0	2	2	0	2	0	0	0	0	6	0	6	0
Oriental Creek to Sulphur Creek	Post-index	30-Sep	2.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sulphur Creek to Nye Creek	Post-index	30-Sep	4.4	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0
North Fork Total			81.5	12	115	19	1	8	0	31	33	2	14	0	0	0	0	80	28	80	0

Appendix Table A-1. Continued.

Stream, section	Survey type	Date	Miles	New redds Occ.	New redds Unocc.	On dig A	On dig J	Off dig A	Off dig J	Dead fish, unmarked M	Dead fish, unmarked F	Dead fish, unmarked J	Dead fish, unmarked U	Dead fish, marked M	Dead fish, marked F	Dead fish, marked J	Dead fish, marked U	Dead Fish	Live Fish	Unmarked Dead	Marked Dead
Granite Creek System																					
Granite Creek																					
Buck Creek to Tencent Creek	Pre-index	2-Sep	2.0	5	4	24	1	10	0	1	3	0	0	0	0	0	0	4	35	4	0
Tencent Cr. to 1 m above Clear Cr.	Pre-index	2-Sep	2.0	10	8	22	1	13	1	1	6	0	0	0	0	0	0	7	37	7	0
1mile above Clear Cr. to 73 Rd	Pre-index	2-Sep	1.5	2	2	4	0	4	0	0	1	0	0	0	0	0	0	1	8	1	0
Mouth to Lick Creek	Extensive	9-Sep	3.2	0	2	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0
Lick Creek to Buck Creek	Extensive	9-Sep	1.3	4	5	5	0	1	0	4	1	0	0	0	0	0	0	5	6	5	0
Buck Creek to Tencent Creek	Index	9-Sep	2.0	1	9	4	0	0	0	11	6	0	0	0	0	0	0	17	4	17	0
Tencent Cr. to 1 m above Clear Cr.	Index	9-Sep	2.0	2	3	1	0	0	0	5	4	1	0	0	0	0	0	10	1	10	0
1m above Clear Cr. to 73 Rd	Index	9-Sep	1.5	1	1	1	0	0	0	6	4	1	0	0	0	0	0	11	1	11	0
Buck Creek to Tencent Creek	Post-index	16-Sep	2.0	0	2	0	0	1	0	3	3	0	0	0	0	0	0	6	1	6	0
Tencent Cr. to 1 m above Clear Cr.	Post-index	16-Sep	2.0	0	0	0	0	1	0	3	1	0	0	0	0	0	0	4	1	4	0
1m above Clear Cr to 73 Rd	Post-index	16-Sep	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Granite Creek Total			21.0	25	36	61	2	30	1	35	29	2	0	0	0	0	0	66	94	66	0
Clear Creek																					
Mouth to road crossing	Pre-index	2-Sep	4.0	5	6	6	0	6	0	0	1	0	1	1	0	0	0	3	12	2	1
Mouth to road crossing	Index	9-Sep	4.0	0	1	6	0	3	0	13	8	0	0	0	0	0	0	21	9	21	0
Road Crossing to Beaver Creek	Extensive	9-Sep	1.0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0
Mouth to road crossing	Post-index	16-Sep	4.0	1	3	1	0	0	0	1	1	0	0	0	0	0	0	2	1	2	0
Clear Creek Total			13.0	6	12	13	0	9	0	15	10	0	1	1	0	0	0	27	22	26	1
Bull Run Creek																					
Mouth to Guard Station	Pre-index	2-Sep	2.5	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0	3	0	0
Mouth to Guard Station	Index	9-Sep	2.5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0
Mouth to Guard Station	Post-index	16-Sep	2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bull Run Creek Total			7.5	1	0	2	1	0	0	0	1	0	0	0	0	0	0	1	3	1	0
Granite Creek System Total			41.5	32	48	76	3	39	1	50	40	2	1	1	0	0	0	94	119	93	1

Appendix Table A-2. Summary of data collected during spring chinook salmon spawning ground surveys in the John Day basin, 1998.

Stream	Miles index survey	Miles extensive survey	Total Redds	Pre-index			Index			Post-index			Extensive		
					Fish			Fish			Fish			Fish	
				New Redds	Live	Dead	New Redds	Live	Dead	New Redds	Live	Dead	New Redds	Live	Dead
John Day River, mainstem	13.0	2.3	135	49	97	2	59	78	34	24	20	23	3	0	0
Middle Fork John Day River	12.0	18.0	88	59	109	29	20	25	53	5	2	26	4	2	4
North Fork John Day River	18.0	27.5	127	95	27	53	14	1	17	0	0	8	18	0	2
Granite Creek System	12.0	5.5	80	43	95	15	18	15	60	6	3	12	13	6	7

APPENDIX B

Historic Index Redd Counts

Appendix Table B-1. Index redd counts for spring chinook salmon in the John Day basin, by primary spawning area, 1959-98.

Year	Mainstem[a]	Middle Fork[b]	North Fork[c]	Granite Creek[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

[a] *Index survey is 13 miles.*
[b] *Index survey was 10 miles during 1959-85 and 12 miles during 1986-99.*
[c] *Index survey is 18 miles.*
[d] *Index survey is 12 miles. In 1993, 12.5 miles were surveyed.*

Appendix Table B-1. Continued.

Year	Mainstem	Middle Fork	North Fork	Granite Creek	Basin total
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