

Spawning Distribution of Fall Chinook Salmon in the Snake River

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**SPAWNING DISTRIBUTION OF FALL CHINOOK SALMON IN THE
SNAKE RIVER**

ANNUAL REPORT 1998

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CHAPTER ONE

Progress toward determining the spawning distribution of supplemented fall chinook salmon in the Snake River basin upriver of Lower Granite Dam in 1998

by

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Abstract

In 1998, we collected data on the spawning distribution of the first adult fall chinook salmon to return from releases of yearling hatchery fish upriver of Lower Granite Dam. Yearling fish were released at three locations with the intent of distributing spawning throughout the existing habitat. Our project was designed to use radio-telemetry to determine if the use of multiple release sites resulted in widespread spawning. Returning fish were radio-tagged at the Lower Granite Dam fish trap, their origin identified by an external mark (elastomer). We plan to tag about 50 returning adult females from each release site over a five-year period, 1998–2002. Female fish are targeted so that we can determine spawning locations by observing redds, although we will tag some male fish (adults and jacks) so that we have information on the movements of both sexes and all age groups. In addition, we will tag returns from subyearling hatchery fish released, and natural fish PIT tagged, upriver of Lower Granite Dam for comparison with the other groups. In 1998, we tagged 64 fall chinook salmon. Of these, 30 were adult fish from the first release in the Snake River (Pittsburg Landing in 1996), 15 were jacks from the first release in the Clearwater River in 1997, 8 were from a release of subyearling fish at Pittsburg Landing in 1995, and 7 were from a subyearling release in the Snake River at Billy Creek. Four of the fish tagged in 1998 were natural fish (3 from the Snake River, and 1 from the Clearwater River). Tracking data collected in 1998 is being processed. Information on the movements of radio-tagged fish will be included in the next annual report. The project is progressing as planned.

Introduction

In 1996, yearling fall chinook salmon (*Oncorhynchus tshawytscha*) from Lyons Ferry Hatchery were released upriver of Lower Granite Dam. This release marked the beginning of a program to increase natural production in the free-flowing Snake River and tributaries using supplementation. The supplementation program called for hatchery fish to be released at three locations phased in over a three year period, 1996–1998. The first release location was in the Snake River at Pittsburg Landing, about 109 miles upriver of Lower Granite Dam. The second release location was in the Clearwater River near Big Canyon Creek, roughly 67 miles upriver of the dam. The final release site was in the Snake River near Captain Johns Rapids, about 57 miles upriver of Lower Granite Dam. Multiple release locations were used with the intent of distributing spawning throughout the existing spawning habitat.

The fall chinook salmon supplementation program is being evaluated (WDFW et al. 1996). Our part in this evaluation is to determine where returning adult fish spawn and whether or not a widespread spawning distribution is achieved using multiple release sites. Since subyearling fall chinook salmon are also released, and natural fish are PIT-tagged, upriver of Lower Granite Dam, we are monitoring the movements of these fish for comparative purposes. Our project is scheduled for completion in 2002. In 1998, we collected the data on the first adult fish to return from the first release group (Pittsburg Landing in 1996). In this report, we present a summary of the work conducted, and data collected, in 1998.

Description of Project Area

The study area includes the Snake River from Ice Harbor Dam to Hells Canyon Dam, portions of the Grande Ronde, Imnaha, and Salmon rivers, all of the Clearwater River, and some tributaries of the Salmon and Clearwater rivers (Figure 1). River locations are referred to by river miles (RM). Our work was routinely conducted along 178 miles of the Snake River from Little Goose to Hells Canyon dams, 41 miles of the Clearwater River from the mouth to Dworshak Fish Hatchery, 53 miles of the Grande Ronde River from the mouth to Wildcat Creek, and 4 miles of the Imnaha River from the mouth to Cow Creek Bridge. Work was conducted in other areas, though less frequently.

Methods and Materials

This project has three main field components: (1) radio-tag fish at Lower Granite Dam; (2) track fish throughout the Snake River and tributaries; and (3) conduct redd searches (covered in Chapter 2). Radio-tagged fish are tracked using fixed receivers and air and ground tracking methods conducted by the U.S. Fish and Wildlife Service (USFWS), Nez Perce Tribe (NPT), and WDFW. Redd searches are used to confirm spawning locations of radio-tagged fish. Data analysis is also divided into three components: (1) determine the spawning location of individual fish; (2) group spawning locations by release location/origin; and (3) determine if spawning distribution varies between groups.

All yearling fall chinook salmon released upriver of Lower Granite Dam were injected with a colored elastomer tag that was used to identify where each fish was released. Fish released at Pittsburg Landing were injected with a blue-colored elastomer near their right eye (Appendix 1). Most fish released at Big Canyon Creek were injected with a green-colored elastomer near their left eye. However, in 1997 about 25% of the fish released at Big Canyon Creek had the same mark as the fish released at Captain Johns Rapids in 1998 (a blue-colored elastomer near the left eye). Subyearling hatchery fish and natural fish were identified using PIT tags.

We plan to tag 50 adult female fall chinook salmon returning from each release site over the course of the study. Female fish are needed to improve our ability to determine spawning location (Scott and Crossman 1973, Schroder 1981). We also plan to tag some male fish (adults and jacks) from each release group to obtain information on the movements of all age groups.

Fish were tagged by NMFS personnel at the Lower Granite Dam fish trap. Two sizes of coded radio transmitters were used depending on the fork-length of the fish. A 16-g (3V) transmitter (Lotek¹ MCFT-3) was used for fish less than 60 cm, and a 29-g (7V) transmitter (Lotek MCFT-7A) was used for fish 60-cm and larger. Radio transmitters were coated with glycerine and inserted into the esophagus. The radio transmitters used in this project were obtained from the University of Idaho.

¹ The use of trade names does not imply endorsement by the U. S. Government.

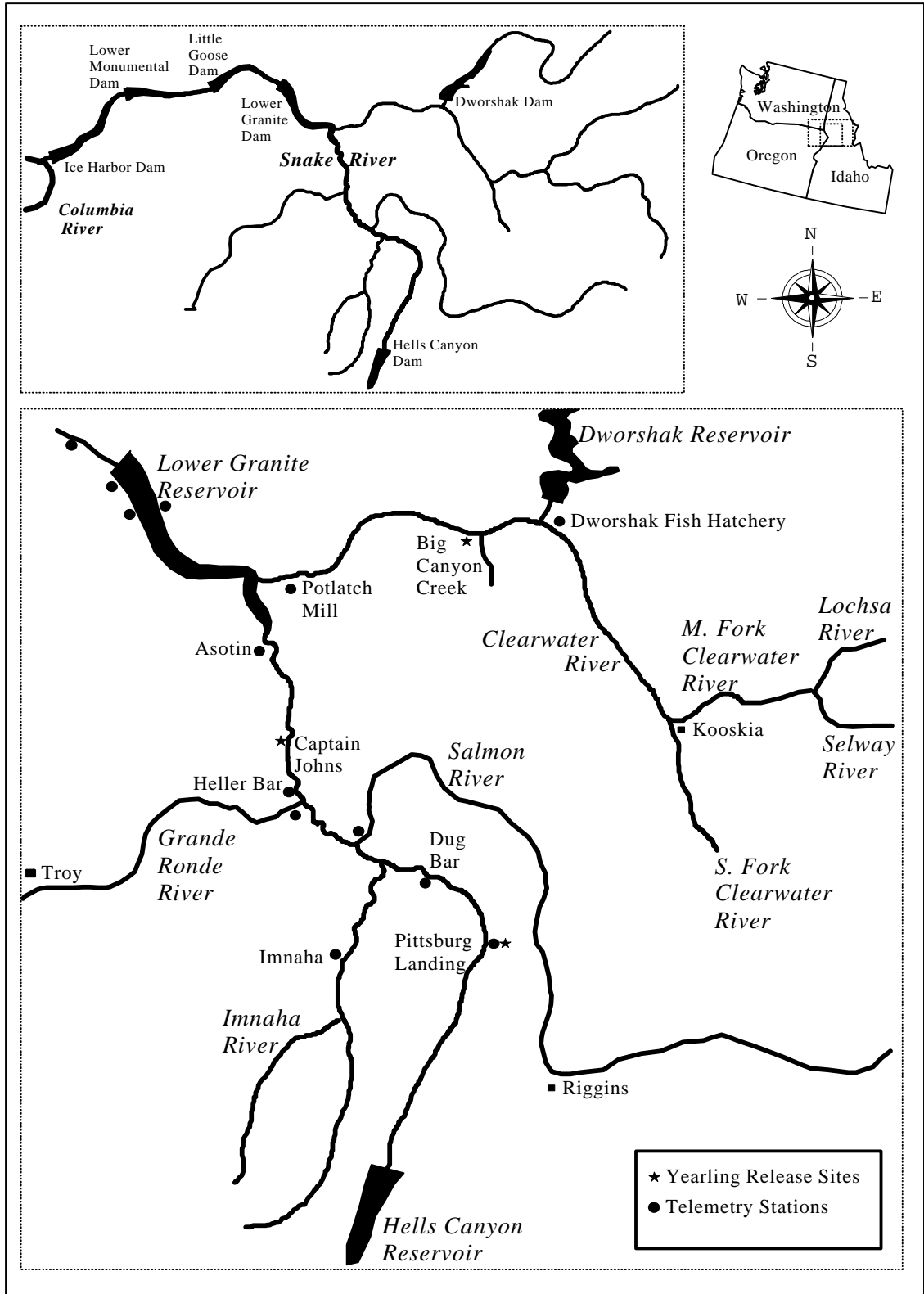


Figure 1. Map of the Snake River drainage in Oregon, Washington, and parts of Idaho.

Fixed-telemetry receivers were maintained and operated by the USFWS and the University of Idaho. In the Snake River, fixed receivers were positioned at or near the four lower Snake River dams, Heller Bar (RM 168), Dug Bar (RM 197), and Pittsburg Landing (RM 215). In the Clearwater River, fixed telemetry stations were located near Potlatch Mill (RM 5), and at Dworshak Fish Hatchery (RM 41). In the Grande Ronde and Salmon rivers, telemetry stations were located within the first river mile. Tracking data were downloaded from these receivers periodically. Data files provided information on when an individual radio tag (fish) arrived and departed, and which direction (upriver or downriver) the fish was traveling.

Mobile tracking surveys were conducted by the USFWS, NPT, and WDFW. Portions of the Snake River reservoirs were surveyed weekly using fixed-wing aircraft. The roaded sections of the Snake, Clearwater, and lower Grande Ronde rivers were surveyed weekly via automobile. Portions of the un-roaded section of the Snake River were surveyed weekly by boat (in the course of downloading fixed receivers) and helicopter (while conducting redd searches).

Results and Discussion

In 1998, we tagged 64 fall chinook salmon (Appendix 1). Of these fish, 30 were adult hatchery fish from the 1996 release at Pittsburg Landing, 15 were jacks from the first release in the Clearwater River, 8 were from a release of subyearling fish at Pittsburg Landing in 1995, and 7 were from a subyearling release in the Snake River at RM 165 near Billy Creek. Four were natural fish (3 from the Snake River, and 1 from the Clearwater River).

A total of 56 separate mobile tracking missions were conducted throughout the spawning and migration period resulting in 905 observations. Of the 56 searches, 14 were conducted by the NPT using fixed-wing aircraft, 13 by the WDFW via automobile, and 29 by the USFWS via boat, automobile, or helicopter. Fixed receivers operated by the USFWS were downloaded about once a week, and the data were converted to text files. Tracking data collected during the 1998 season is being compiled. Information on the movements fish radio-tagged in 1998 will be included in upcoming reports.

Tagging progressed as planned in 1998, although we tagged more of the primary target group (1996 Pittsburg Landing release) than we expected to. Large numbers of returning adult fall chinook salmon at Lower Granite Dam created some difficulties in coordinating tagging operations. Increased returns are anticipated in upcoming years which may require increased personnel to handle and tag fish at Lower Granite Dam (Jerry Harmon, NMFS, personal communication). If future returns maintain the pace of the 1996 Pittsburg release, we will be able to meet our tagging goals.

Tracking also progressed as planned in 1998, although we had difficulty maintaining our solar-powered remote receivers (two on the Snake River and the Salmon River receiver) due to frequent cloud cover. To prevent further problems we will install additional solar panels, and possibly upgrade the batteries, at these sites next season.

Summary and Conclusions

The project is proceeding as scheduled. We tagged more fish than anticipated in 1998, which puts us ahead of schedule for the Pittsburg Landing release group. At this time, we expect to reach our tagging goals for the upcoming year. Coordination with all cooperating groups is going as planned, although we may need to provide more assistance to the NMFS tagging crew at Lower Granite Dam if fall chinook returns continue to increase. Compilation of the 1998 data set should be completed prior to the next field season.

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CHAPTER TWO

Fall chinook salmon spawning ground surveys in the Snake River basin
upriver of Lower Granite Dam, 1998

by

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Abstract

In 1998, aerial searches for fall chinook salmon redds were conducted upriver of Lower Granite Dam in portions of the Snake, Grande Ronde, Imnaha, and Salmon rivers, all of the Clearwater River, and some tributaries of the Salmon and Clearwater rivers. In addition, underwater searches were conducted in the Snake River using submersible cameras. A total of 303 fall chinook salmon redds were counted. Of these, 185 were in the Snake River (135 counted during aerial searches, and 50 using submersible cameras), 78 in the Clearwater River, 24 in the Grande Ronde River, 13 in the Imnaha River, and three in the Salmon River. The total redd count in 1998 was the highest recorded in recent years, and was paralleled by an increase in the number of adult fall chinook salmon counted at Lower Granite Dam.

Introduction

Redd searches were conducted in 1998 to monitor fall chinook salmon (*Oncorhynchus tshawytscha*) spawning in the Snake River basin upriver of Lower Granite Dam. Redd counts in this area were first reported infrequently between 1959 and 1978 (Irving and Bjornn 1981, Witty 1988; Groves and Chandler 1996)(Appendix 2), and were limited to the Snake River. From 1986 to 1990, the Washington Department of Fish and Wildlife (WDFW) began reporting redd counts for the Snake, Grande Ronde, and Imnaha rivers (Seidel and Bugert 1987, Seidel et al. 1988, Bugert et al. 1989-1991, and Mendel et al. 1992). In 1991, the U. S. Fish and Wildlife Service (USFWS) and Idaho Power Company (IPC) joined in conducting redd searches in these rivers and began reporting search results (Connor et al. 1993; Garcia et al. 1994a, 1994b, 1996, 1997; Groves 1993; Groves and Chandler 1996). The Nez Perce Tribe (NPT) started redd searches in the Clearwater River basin in 1988 (Arnsberg et. al 1992), and in the Salmon river basin in 1992. For the most part, results from redd searches in the Snake, Grande Ronde, and Imnaha rivers have been reported independently from those of the Clearwater and Salmon river basins.

The objective of this report is to present the results of redd searches conducted upriver of Lower Granite Dam. We present detailed information on redd counts from 1998, and summary information on data collected previously. Work conducted in 1998 was funded by Bonneville Power Administration (Projects: 9403400, 9801003), Idaho Power Company, U.S. Bureau of Land Management – Cottonwood Resource Area, and U.S. Forest Service – Wallowa Whitman National Forest.

Description of Project Area

The study area includes the free-flowing Snake River, and portions of the major tributaries that enter the Snake River, between Lower Granite and Hells Canyon dams (Figure 1). We refer to redd locations using river miles (RM), and nearby landmarks. In 1998, the following eight river sections encompassed the primary study area: (a) The free-flowing Snake River from the head of Lower Granite Reservoir (RM 147) to Hells Canyon Dam (RM 248); (b) the Clearwater River to terminus at the Lochsa and Selway rivers (RM 98); (c) the Selway River to Meadow Creek (RM 19); (d) the lower mile of the North Fork Clearwater River; (e) the South Fork Clearwater River

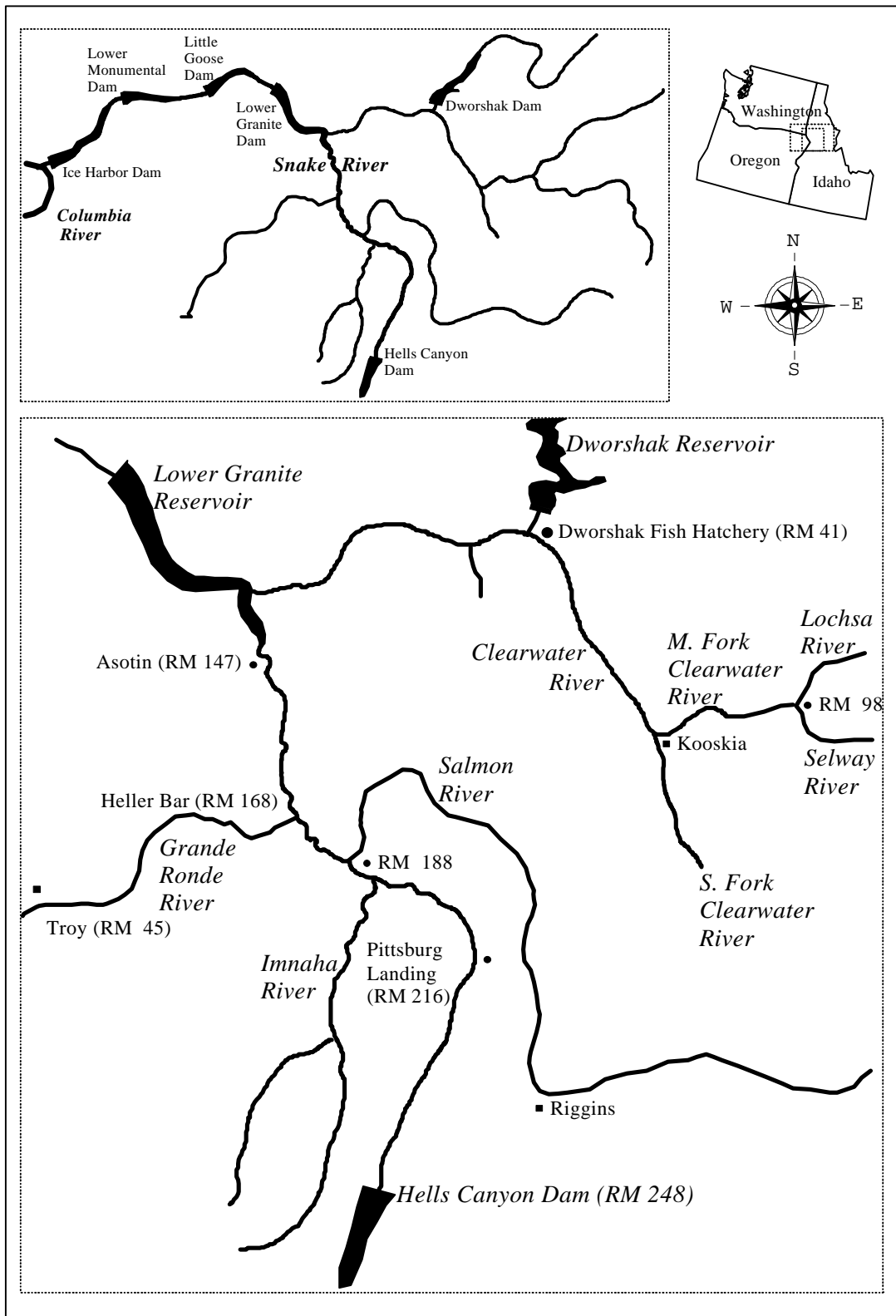


Figure 1. Map of the Snake River drainage in Oregon, Washington, and parts of Idaho.

to Butcher Creek (RM 12); (f) the Grande Ronde River to Wildcat Creek (RM 53); (g) the Salmon River to French Creek (RM 105); and (h) the Imnaha River to Cow Creek Bridge (RM 4). Additional portions of some of these tributaries were searched occasionally, as well as portions of the Lochsa, Selway, and South Fork Salmon rivers.

Methods and Materials

Redd searches were conducted using a helicopter. A pilot and one or two observers searched the river bottom as the helicopter was flown at an altitude of about 700 ft. Since 1991, weekly searches were scheduled from mid-October to mid-December in the Snake, Clearwater, Grande Ronde, and Imnaha rivers. Prior to 1991, and in the other rivers, searches were conducted less frequently. In most years, some of the scheduled searches were canceled or shortened due to poor visibility or inclement weather. Beginning in 1991, suspected redds in the Snake River that could not clearly be identified as redds from the air were observed from the ground to confirm their origin. This practice was performed in the other rivers, though less consistently. The number of new redds observed on each search are reported in this document.

Starting in 1991, redd searches in the Snake River were also conducted beneath the water surface to locate redds in areas too deep to allow detection from the air. In 1991 and 1992, underwater observations were made by the USFWS using methods developed by Swan (1989) that involved direct observation of the river bottom by scuba divers (Connor et al. 1993; Garcia et al. 1994). From 1993-1998, the USFWS and IPC conducted underwater searches using a video system consisting of a DC-powered video recorder, submersible camera, 110° lens, 65-ft camera cable, and at least one monitor. The submersible camera was either enclosed in an aluminum sheath mounted on a 90-lb lead weight, or attached to an aluminum frame mounted between two 30-lb lead weights, and could be adjusted 45° to 90° down from horizontal (Groves and Garcia, *In press*). The camera was suspended from a boat using a wire rope passed through a roller on the bow, and attached to a sounding-reel/depth-indicator mounted in the boat cabin.

Searches using underwater video were conducted by passing the camera over the river bottom in a zigzag pattern, with each pass ending about 30-ft upriver of the previous pass. From 1993 to 1995, natural features along the shore were used to judge the distance between passes. Beginning in 1996, we determined this distance by placing a rope constructed of different-colored 30-ft sections along the shoreline. The distance between the camera and river bottom, and the angle of the camera, was adjusted to maximize the amount of viewable area without losing our ability to observe details of the bottom substrates. If a redd was observed, the distance between passes in the search pattern was reduced by half (15 ft), and the entire area was searched at least one more time.

Observations of redds were recorded on video tape, and when large groups of redds were found, redd coordinates were recorded using electronic surveying equipment. Coordinates were used to plot the position of redds observed on each search so that redd positions could be reviewed along with the video to determine the total number of redds at each spawning location. In areas where

redds overlapped and could not be identified individually, the perimeter of the redd group was surveyed and the overall area divided by 183 ft², the average size of fall chinook salmon redds observed in the Columbia River (Chapman et al. 1986). This produced an estimate of the total number of redds in the group.

Underwater searches were limited to areas greater than about 10-ft deep with a dominant bottom substrate particle size (Bovee 1982) ranging from 1 to 6-in. diameter (Raleigh et al. 1986). In 1991 and 1992, a few pilot searches were conducted to develop search techniques. Then, from 1993 to 1998, we attempted to annually search about 90 deepwater areas known to fit the criteria, although not all these sites were searched each year.

Results and Discussion

Snake River.— A total of 185 redds were observed in the Snake River in 1998, the highest number recorded since 1986 (Table 1). Of these, 135 redds were observed during eight aerial searches (Table 2), and 50 were observed at five of 48 sites searched using submersible cameras (Table 3 and 4). Overall, the number of searches (search effort) was comparable to recent years (Table 5). Aerial search conditions were good throughout the Snake River during the first five searches, but varied during the last three searches due to high turbidity and wind. Underwater search conditions were good all season upriver of the Imnaha River. Downriver of the Imnaha River, however, search effort was limited due to high water turbidity. Redds were observed at River discharge ranging from 9,535 cfs to 9,633 cfs at Hells Canyon Dam (RM 248), and 15,375 cfs to 18,626 cfs about a mile downriver from the Grande Ronde River (RM 168).

Table 1. Number of fall chinook salmon redds counted upstream of Lower Granite Dam, 1986-1998. An empty cell indicates no searches were conducted in the corresponding river or method, and year.

River	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Snake (aerial) ^a	7	66	64	58	37	41	47	60	53	41	71	49	135
Snake (camera) ^b						5	0	67	14	30	42	9	50
Clearwater			21	10	4	4	26	36	30	20	66	58	78
N. F. Clearwater							0	0	7	0	2	14	0
S. F. Clearwater							0	0	0	0	1	0	0
Grande Ronde	0	7	1	0	1	0	5	49	15	18	20	55	24
Imnaha		0	1	1	3	4	3	4	0	4	3	3	13
Salmon							1	3	1	2	1	1	3
Totals	7	73	87	69	45	54	82	219	120	115	206	189	303

^a The targeted search area was the entire reach from the head of Lower Granite Reservoir to Hells Canyon Dam.

^b The targeted search areas were discrete sites composed mainly of 1-6 in. bottom substrates. The number of sites searched varied each year.

Table 2. New fall chinook salmon redds counted during aerial searches of the Snake River in 1998. Counts are presented by river mile (RM), landmark, and date. Counts were adjusted based on ground-truthing observations, and an empty cell indicates no survey was conducted over the corresponding river mile.

RM	Landmark	New redds counted by flight date								Site totals
		19-Oct	26-Oct	02-Nov	09-Nov	17-Nov	23-Nov	30-Nov	07-Dec	
149.1	Three Mile Island	0	0	1	1	0	0		0	2
152.4	Big Bench Point	0	0	2	0	1	0		0	3
157.6	Couse Creek Mouth	0	2	1	0	0	0		0	3
161.0	Upper Buffalo Rapids	0	6	1	2	0	0		0	9
165.3	Perkins Gulch (center)	0	1	0	0	0	0		0	1
165.9	Match Line	0	1	1	0	0	0		0	2
172.5	Deer Head Rapids	0	1	2	1	0	0		0	4
178.9	Upper Cochran Range	0	0	0	1	1	0		0	2
190.8	Eureka Bar	0	0	1	3	0	0	0	0	4
193.4	Divide Creek	0	0	2	0	0	0	2	0	4
193.7	Divide-to-Zig Zag	0	0	3	0	0	0	0	0	3
194.0	Big Canyon Range	0	1	6	6	0	0	1	0	14
196.0	Rapid No. 97	0	0	0	1	0	0	0	0	1
198.2	Camp 71	0	0	1	0	0	0	0	0	1
198.8	Robinson Gulch	0	0	2	1	1	0	0	0	4
205.3	Copper Creek	0	0	0	0	3	0	0	0	3
206.4	High Range No. 1	0	2	0	0	0	0	0	0	2
208.0	Forest Boundary	0	7	3	2	1	0	0	0	13
211.9	McCarty Creek	0	1	6	1	1	1	1	0	11
213.7	Lower Pleasant Rapid 128	0	2	1	1	0	0	0	0	4
215.4	Mid. Pittsburg Range	0	0	0	0	1	0	0	0	1
216.1	Klopton Creek	0	0	0	0	2	0	1	0	3
217.3	Corral Creek Reef	0	1	1	2	0	0	0	0	4
218.7	Kirby Range No. 2	0	0	0	3	1	0	0	0	4
219.0	Middle Kirby Rapids 137	0	0	1	2	1	0	0	0	4
219.3	Kirby Range No. 5	0	0	2	3	1	0	0	0	6
224.7	Rapid No. 148	0	0	0	0	0	3	0	0	3
235.1	Bernard Creek	0	0	0	1	0	0	0		1
235.7	Hat Creek	0	0	0	1	3	0	0		4
237.0	Lower Dry Gulch	0	1	2	2	3	0	0		8
240.5	Granite Creek to Rocky Bar	0	0	2	0	0	0	0		2
240.7	Rocky Bar Camp	0	2	2	0	0	0	0		4
243.5	Chimney Bar	0	0	0	1	0	0	0		1
Totals		0	28	43	35	20	4	5	0	135
River mile start		147	147	147	147	147	147	183	147	
River mile end		248	248	248	248	248	248	246	230	

Table 3. Record of fall chinook salmon redds counted in the Snake River using underwater video, 1998.

RM	Landmark	Number of redds	Search Dates		Redd Depth Range
			1	2	(feet)
166.5	Lower Lewis Rapids	6	13-Nov	16-Nov	13-17
179.6	Cougar bar	16	16-Nov		N.D.
203.1	Wolf Creek	10	30-Nov	01-Dec	8 -13
212.2	Davis Creek	17	19-Nov	04-Dec	13-16
242.8	Barton Cabin	1	03-Dec		N.D.
		50			

Table 4. List of sites searched for fall chinook salmon redds in the Snake River, 1998, by river mile (RM) and date.

RM	Date	RM	Date	RM	Date	RM	Date
153.2	12-Nov	183.1	7-Dec	203.1	30-Nov	217.8	1-Dec
154.3	12-Nov	188.6	7-Dec	203.9	4-Dec	218.2	19-Nov
155.6	17-Nov	190.8	4-Dec	204.9	8-Dec	218.7	20-Nov
158.0	17-Nov	193.5	25-Nov	208.0	19-Nov	222.3	2-Dec
162.4	10-Nov	193.7	25-Nov	208.1	1-Dec	223.7	3-Dec
165.7	10-Nov	193.8	18-Nov	208.3	8-Dec	227.9	3-Dec
166.2	16-Nov	194.1	20-Nov	209.3	2-Dec	228.0	3-Dec
166.6	13-Nov	194.6	30-Nov	209.9	2-Dec	235.0	8-Dec
171.4	23-Nov	198.2	18-Nov	212.2	19-Nov	235.7	19-Nov
171.9	24-Nov	198.8	25-Nov	212.3	18-Nov	237.0	19-Nov
177.6	20-Nov	199.4	18-Nov	213.3	1-Dec	237.9	8-Dec
179.6	16-Nov	202.2	4-Dec	215.3	2-Dec	242.8	3-Dec

Table 5. Number of redd searches conducted in the Snake River and tributaries upriver of Lower Granite Dam, 1986-1998. Data for underwater searches indicates the number of discrete patches of gravels searched, whereas all other data indicates the number of helicopter flights over the corresponding river.

River	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Snake (aerial)	1	2	2	2	3	9	8	8	8	7	7	8	8
Snake (camera)						1	3	50	73	42	32	63	59
Clearwater			1	2	2	2	2	5	5	3	4	9	5
N. F. Clearwater							2	4	5	3	5	9	5
S. F. Clearwater							2	4	4	1	3	7	5
Grande Ronde	1	3	2	1	1	3	6	8	7	3	4	8	6
Imnaha		1	2	2	1	9	6	8	8	6	5	7	6
Salmon							2	3	3	1	4	3	3
Totals	2	6	7	7	7	24	31	90	113	66	64	114	97

Clearwater River basin.— A total of 78 redds were observed on five searches of the Clearwater River in 1998 (Tables 5 and 6). This was the highest number of redds recorded since searches began in the Clearwater River in 1988 (Table 1). During the searches, river discharge ranged from 2,982 cfs to 3,528 cfs near Spalding (RM 11), and observation conditions were good on all searches. More searches were scheduled, but search conditions deteriorated after the fifth search.

Table 6. New fall chinook salmon redds counted in 1998 during aerial surveys of the mainstem/Middle Fork Clearwater River. Counts are presented by river mile (RM) landmark, and date.

RM	Landmark	New redds counted by flight date					Site totals
		12-Oct	21-Oct	27-Oct	02-Nov	10-Nov	
8.7	Hog Island	0	0	0	1	0	1
17.1	Isl. above Gibbs Eddy	0	0	0	1	0	1
17.4	Isl. above Gibbs Eddy	0	0	1	0	0	1
18.0	Lower Myrtle	1	1	0	0	0	2
19.1	Lower Cottonwood Isl.	0	3	0	1	0	4
22.0	Fir Island (Cherry Lane)	9	5	4	6	1	25
26.8	Below Big Eddy	0	0	1	0	0	1
27.6	Big Eddy	0	0	0	2	0	2
28.3	Below Lenore Bridge	0	0	1	0	0	1
32.1	Forest Service tree farm	0	0	2	0	4	6
34.0	Leaning Pine Hole	0	1	1	1	1	4
35.7	Above Old Peck Bridge	2	1	2	1	4	10
36.2	Above Old Peck Bridge	1	0	0	0	0	1
39.6	Above Pink House Hole	1	5	3	0	0	9
40.3	Ahsahka Islands	0	2	7	0	1	10
Totals		14	18	22	13	11	78
River mile start		0	0	0	0	0	
River mile end		98	98	98	98	98	

Grande Ronde.— A total of 24 redds were observed on six searches of the Grande Ronde River in 1998 (Table 7). River discharge in the Grande Ronde River near Troy, Oregon (RM 45), ranged from 828 cfs to 1,018 cfs during searches, and search conditions were good on all searches. The last two scheduled weekly searches were canceled due to high water turbidity.

Salmon River.— A total of three redds were observed on three searches of the Salmon River in 1998 (Table 8). River discharge in the Salmon River ranged from 4,771 cfs to 5,035 cfs near White Bird, Idaho (RM 54), and search conditions were good on each search. This river was not scheduled to be searched on a weekly basis.

Imnaha River.— A total of 12 redds were observed during six searches of the Imnaha River in 1998 (Table 9). During searches, river discharge ranged from 186 cfs to 315 cfs near the town of Imnaha, Oregon (RM 19). Search conditions were good on the first five searches and poor on sixth. The fourth and sixth searches were extended past the primary four-mile search area (Table 9). Ground searches were conducted on November 23 by NPT and Oregon Department of Fish and Wildlife crews to locate redds and carcasses. During these searches, one redd was located at RM 3.4 that was not observed from the air (Jim Harbeck, NPT, personal communication).

Table 7. New fall chinook salmon redds counted during aerial searches of the Grande Ronde River, 1998. Counts are presented by river mile (RM), landmark, and date.

RM	Landmark	New redds counted by flight date						Site totals
		12-Oct	19-Oct	26-Oct	02-Nov	09-Nov	17-Nov	
3.0	Bridge Site	0	0	0	1	0	0	1
3.2	Below Bond Horse Ranch	0	0	0	1	0	0	1
4.4	Joseph Creek	0	0	0	1	2	0	3
10.5	Second Bend Below Hackberry Gulch	0	0	1	1	0	0	2
12.6	Above Phillip Johnson Place	0	0	3	1	1	0	5
19.5	Half-mile Mark	0	0	1	0	1	0	2
20.0	Spring Creek	0	0	1	2	2	0	5
33.3	McNeil Island	0	0	3	0	0	0	3
37.6	Horseshoe Bend	0	0	2	0	0	0	2
Totals		0	0	11	7	6	0	24
River mile start		0	0	0	0	0	0	
River mile end		53	53	53	53	53	53	

Table 8. New fall chinook salmon redds counted during aerial searches of the Salmon River, 1998. Counts are presented by river mile (RM), landmark, and date.

RM	Landmark	New redds counted by flight date			Site totals
		21-Oct	02-Nov	16-Nov	
15.5	Above Cottonwood Creek	1	0	0	1
31.0	Bingman Ridge	0	0	1	1
65.4	Slate Creek Boat Ramp	1	0	0	1
Totals		2	0	1	3
River mile start		105	105	105	
River mile end		0	0	0	

Table 9. New fall chinook salmon redds counted in 1998 during air and ground surveys of the Imnaha River. Counts are presented by river mile (RM), landmark, and date. The redd observed at RM 3.4 on 23-Nov was located from the ground and not observed from the air (Jim Harbeck, NPT, personal communication).

RM	Landmark	New redds counted by flight date						Site totals
		19-Oct	26-Oct	02-Nov	09-Nov	16-Nov	23-Nov	
0.5	Pool 1	0	0	1	0	0	0	1
0.6	Pool 2	0	0	1	1	0	0	2
1.0	Rock pillar	0	0	1	0	0	0	1
1.2	Creek mouth	0	0	1	0	0	0	1
1.4	Bonnie Doone Mine	0	0	1	0	0	0	1
2.4	Under power line	0	2	0	0	0	0	2
3.4	Vicinity of BM 1139	0	0	0	0	0	1	1
10.0	Below Horse Creek Bridge				1		1	2
12.0	Near Buck Creek				1		0	1
13.0	Near Packsaddle Creek				1		0	1
Totals		0	2	5	4	0	1	13
River mile start		0	0	0	35	0	0	
River mile end		4	4	4	0	4	15	

Summary and Conclusions

The number of fall chinook salmon redds observed upriver of Lower Granite Dam in 1998 was the highest recorded since 1986. Correspondingly, the count of adult fall chinook salmon passing Lower Granite Dam was the highest recorded with 1,908 fish counted in 1998 (Glen Mendel, WDFW, personal communication) compared to 1,007 fish in 1997. From 1986 to 1996 the average number of fall chinook salmon counted at Lower Granite Dam was 703 fish (range, 335–952)(USACE 1986–1997). Search effort in 1998 was comparable to that of recent years.

Redd searches were limited in all rivers due to high turbidity or winds. To improve our chances of covering the lower Snake River (downriver from the Grande Ronde River) in 1999, we plan to begin underwater searches a week earlier. In addition, we plan to conduct an early aerial search in the Clearwater and Grande Ronde rivers to make sure we are detecting the beginning of spawning.

In the course of our work in 1998 we found some new areas that should be searched using submersible cameras. It appears that flood events have shifted gravel deposits in portions of the Snake River, creating new spawning areas. We plan to search the Snake River for new spawning areas in 1999.

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Appendix 1

Appendix 1. Fall chinook salmon tagging records for 1998 at Lower Granite Dam.

Seq.	Radio Tag		Elastomer	Tag	Fl	CWT			Initial Release	Age at	Release		
No.	Chan	Code	Tag	Pit Tag Code	Date	(Cm)	Sex	Clips	Nose	Location	Release	Year	Notes
1	24	80		221C757272	03-sep-98	90	F	Adipose	Yes	Pittsburg Landing	Subyearling	1995	
2	24	134	Right Blue		12-sep-98	62	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
3	24	55	Left Green	7F7A0F745A	13-sep-98	50	M	Adipose	Yes	Big Canyon Creek	Yearling	1997	
4	10	17		7F7D453B7F	12-sep-98	84	M	None	No	Snake River (RM 157)	Subyearling	1994	
5	10	18		221D706B15	12-sep-98	88	F	Adipose	Yes	Pittsburg Landing	Subyearling	1995	
6	10	19		7F7D510C7D	12-sep-98	94	M	None	No	Clearwater R. (RM 35.5)	Subyearling	1994	
7	10	20		221D2D1315	12-sep-98	93	M	Adipose	Yes	Billy Creek	Subyearling	1995	
8	10	39		221D4E507E	13-sep-98	91	F	Adipose	Yes	Pittsburg Landing	Subyearling	1995	
9	24	15	Left Green		14-sep-98	57	M	Adipose	Yes	Big Canyon Creek	Yearling	1997	
10	24	71	Left Green		14-sep-98	60	M	Adipose	Yes	Big Canyon Creek	Yearling	1997	
11	24	130		22162D0372	15-sep-98	78	F	Adipose	Yes	Billy Creek	Subyearling	1995	Open sores on fish
12	24	99	Right Blue		15-sep-98	80	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
13	24	113	Left Green		16-sep-98	60	M	Adipose	Yes	Big Canyon Creek	Yearling	1997	
14	24	107	Right Blue		17-sep-98	66	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
15	24	58	Left Green		18-sep-98	55	M	Adipose	Yes	Big Canyon Creek	Yearling	1997	
16	24	51	Left Green		18-sep-98	53	M	Adipose	Yes	Big Canyon Creek	Yearling	1997	
17	24	132		22163D0530	19-sep-98	76	F	Adipose	Yes	Billy Creek	Subyearling	1995	
18	24	75	Right Blue		19-sep-98	73	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
19	24	110	Right Blue		19-sep-98	60	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	Spit Tag in Trap
20	25	117	Right Blue		19-sep-98	60	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
21	25	152	Right Blue		20-sep-98	74	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
22	24	50	Left Green		20-sep-98	55	M	Adipose	Yes	Big Canyon Creek	Yearling	1997	
23	25	143	Left Green		20-sep-98	64	M	Adipose	Yes	Big Canyon Creek	Yearling	1997	
24	24	39	Left Green		20-sep-98	55	M	Adipose	Yes	Big Canyon Creek	Yearling	1997	
25	25	134		221D1D2B55	20-sep-98	84	F	Adipose	Yes	Billy Creek	Subyearling	1995	
26	25	90	Right Blue		20-sep-98	67	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
27	25	137	Right Blue		21-sep-98	63	U	Adipose	Yes	Pittsburg Landing	Yearling	1996	
28	25	18	Left Green		21-sep-98	54	M	Adipose	Yes	Big Canyon Creek	Yearling	1997	
29	25	154	Right Blue		21-sep-98	71	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
30	25	36	Left Green		21-sep-98	56	M	Adipose	Yes	Big Canyon Creek	Yearling	1997	
31	25	161		7F7D506031	21-sep-98	80	F	None	No	Snake River (RM 159)	Subyearling	1994	Open sores on fish
32	25	3	Left Green		21-sep-98	50	M	Adipose	Yes	Big Canyon Creek	Yearling	1997	Open sores on fish

Appendix 1 (continued)

Seq. No.	Radio Tag		Elastomer Tag	Pit Tag Code	Tag Date	Fl (Cm)	Sex	CWT Clips	CWT Nose	Initial Release Location	Age at Release	Migration Year	Notes
33	25	82		221D543C04	21-sep-98	72	F	Adipose	Yes	Pittsburg Landing	Subyearling	1995	
34	25	108		221C35681F	21-sep-98	74	F	Adipose	Yes	Pittsburg Landing	Subyearling	1995	
35	25	17	Left Blue		22-sep-98	55	M	Adipose	Yes	Big Canyon Creek	Yearling	1997	
36	25	22	Left Blue		23-sep-98	57	M	Adipose	Yes	Big Canyon Creek	Yearling	1997	
37	25	4	Left Green		23-sep-98	58	M	Adipose	Yes	Big Canyon Creek	Yearling	1997	
38	25	91	Right Blue		23-sep-98	74	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
39	25	121	Right Blue		25-sep-98	68	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
40	23	59	Right Blue		25-sep-98	74	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
41	23	66	Right Blue		26-sep-98	70	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	Tag Pulled 10/24 at Hells Canyon Dam
42	23	80	Right Blue		27-sep-98	74	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	Spit Tag in Trap
43	23	129	Right Blue		27-sep-98	70	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
44	23	135		200F165A61	27-sep-98	83	F	None	No	Snake River (RM 147)	Subyearling	1994	
45	23	151	Right Blue		27-sep-98	73	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
46	23	164	Right Blue		27-sep-98	67	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
47	23	166	Right Blue		30-sep-98	74	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
48	10	43	Right Blue		30-sep-98	69	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	Open sores on fish
49	10	44		22360A4B56	30-sep-98	77	F	Adipose	Yes	Pittsburg Landing	Subyearling	1995	Open sores on fish
50	10	45	Right Blue		30-sep-98	74	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
51	10	46	Right Blue		30-sep-98	72	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
52	10	47	Right Blue		30-sep-98	67	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
53	10	48	Right Blue		30-sep-98	73	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
54	10	49	Right Blue		01-oct-98	72	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
55	10	50	Right Blue		01-oct-98	83	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
56	10	51	Right Blue		01-oct-98	73	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
57	10	150		221D305E30	04-oct-98	82	F	Adipose	Yes	Billy Creek	Subyearling	1995	
58	10	148		22360E246B	04-oct-98	70	F	Adipose	Yes	Pittsburg Landing	Subyearling	1995	
59	10	154		2216211040	07-oct-98	75	F	Adipose	Yes	Billy Creek	Subyearling	1995	
60	10	157		2216396F34	10-oct-98	74	F	Adipose	Yes	Billy Creek	Subyearling	1995	
61	10	22	Right Blue		14-oct-98	79	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
62	10	25	Right Blue		16-oct-98	73	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
63	10	26	Right Blue		19-oct-98	76	F	Adipose	Yes	Pittsburg Landing	Yearling	1996	
64	10	28		221B235E04	22-oct-98	81	F	Adipose	Yes	Billy Creek	Subyearling	1995	

Appendix 2

Appendix 2. Redd counts recorded from 1959 to 1978 in the Snake River between Lewiston, Idaho, and the Hells Canyon Dam site.

River section	Citation	Year											
		1959	1960	-	1967	-	1969	-	1974	1975	1976	-	1978
Hells Canyon Dam to Pleasant Valley Dam Site	Irving and Bjornn 1980	19	2	-	144	-	294	-					
Pleasant Valley Dam Site to Imnaha River		7	2	-	11	-	94	-					
Imnaha River to Lewiston, ID		<u>2</u>	<u>0</u>	-	<u>33</u>	-	<u>180</u>	-					
		28	4	-	188	-	568	-					
Hells Canyon Dam to Johnson Bar	Witty 1988			-		-	170	-	1	N.D.	8		
Johnson Bar to Pleasant Valley				-		-	124	-	10	N.D.	1		
Pleasant Valley to Appaloosa				-		-	61	-	3	N.D.	0		
Appaloosa to Mountain Sheep				-		-	33	-	2	N.D.	4		
Mountain Sheep to State Line				-		-	<u>0</u>	-	<u>0</u>	<u>N.D.</u>	<u>0</u>		
				-		-	388	-	16	10	13		
Hells Canyon Dam to Asotin, Washington	Groves and Chandler 1996			-		-		-					132
Maximum annual count		28	4	-	188	-	568	-	16	10	13		132