

**BROOD YEAR REPORT  
DWORSHAK NATIONAL FISH HATCHERY  
SPRING CHINOOK SALMON  
BROOD YEAR 1997  
LIFE CYCLE COMPLETED IN 2002**

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Table of Contents

**BROOD YEAR 1997 OVERVIEW** ..... iii

**DISCLAIMER**..... iii

**INTRODUCTION**.....1

**Program Goal** .....1

**Site Description** .....1

**1997 ADULT SPRING CHINOOK SALMON RETURN TO DWORSHAK NFH**.....3

**Pre-Season Assessment**.....3

**Total Rack Return** .....3

**Run Timing**.....4

**Age Composition of Return**.....5

**Adult Tagging**.....6

**Adult Holding and Mortality** .....6

*Pre-Spawning Mortality*.....6

*Mortality During Spawning* .....7

**Spawning**.....7

**Adult Outplanting**.....7

**EGG PRODUCTION** .....8

**Green Eggs Taken**.....8

**Early Incubation (Dworshak NFH)**.....8

**Eggs Culled for BKD** .....8

**Eye-Up**.....8

**NURSERY REARING** .....9

**Tanking** .....9

**Growth and Mortality** .....9

**JUVENILE REARING** .....10

**Ponding** .....10

**Growth and Mortality** .....10

**Marking and Tagging**.....11

*Coded-Wire Tags* .....11

*PIT tags*.....11

**SMOLT RELEASES** .....12

**FISH HEALTH**.....13

**Adult Injections with Erythromycin** .....13

**Formalin as a Fungicide: INAD 9013**.....13

**LHRHa (ReproBoost): INAD 9709** .....14

**Adult Disease Testing** .....14

Monthly Disease Sampling .....	14
Erythromycin treatments.....	14
Smolt Assessments .....	14
<b>SMOLT EMIGRATION .....</b>	<b>15</b>
Travel Time .....	15
River Flow.....	15
Estimated Smolt Survival.....	16
<b>ADULT RETURNS .....</b>	<b>19</b>
Rack Return to Dworshak NFH .....	19
Harvest.....	19
<i>Idaho Tribal Fisheries</i> .....	19
<i>Idaho Sport Fisheries</i> .....	20
Estimated Minimum Total Adult Return Above Lower Granite Dam .....	20
Other Adult Recoveries .....	20
<b>SPECIAL STUDIES .....</b>	<b>21</b>
Comparative Survival Study.....	21
<b>REFERENCES.....</b>	<b>23</b>
<b>APPENDIX I.....</b>	<b>24</b>
<b>APPENDIX II.....</b>	<b>39</b>



## BROOD YEAR 1997 OVERVIEW

Life Stage	Number	% Survival
<b>1997 Rack Return</b>	<b>3,150</b>	-
<b>Number of Females Spawned</b>	<b>542</b>	-
<b>Green Eggs Taken</b>	<b>2,018,408</b>	-
<b>Average Eggs per Female</b>	<b>3,724</b>	-
<b>Eyed Eggs</b>	<b>1,569,237</b>	<b>90.9</b>
<b>Smolts Released<sup>1</sup></b>	<b>1,044,511</b>	<b>66.6</b>
<b>In-River Smolt Survival<sup>2</sup></b>	-	<b>62.9</b>
<b>Adult Returns to the Hatchery<sup>3</sup></b>	<b>4,071</b>	<b>0.3898<sup>4</sup></b>
<b>Adults Harvested in Idaho<sup>5</sup></b>	<b>8,648</b>	-
<b>Known Adult Return to Clearwater River</b>	<b>12,719</b>	<b>1.22<sup>6</sup></b>
<b>Adults Collected at Other Locations<sup>7</sup></b>	<b>257</b>	-

<sup>1</sup> From eye-egg to release.

<sup>2</sup> Minimum survival to Lower Granite Dam based on PIT tag interrogations.

<sup>3</sup> I-Ocean, II-Ocean, and III-Ocean returns in 1999, 2000, and 2001 to the hatchery rack.

<sup>4</sup> Percent survival from smolt to adult.

<sup>5</sup> Tribal and Sport fisheries combined (minimum estimate based on incomplete data).

<sup>6</sup> Percent survival from smolt to adult.

<sup>7</sup> Coded-wire tagged fish recovered at various other hatchery racks, dams, fish traps, etc. down river of Lower Granite Dam.

### DISCLAIMER

Data in this report is as complete and accurate as possible at the time of printing. However, because of the life history complexity of spring chinook salmon and the mixed stock fisheries in the Clearwater River, data is provisional and subject to future revision and corrections, especially in regards to the adult returns to the rack and harvest. All questions about the validity or precision of information in this report should be directed to the Idaho Fishery Resource Office, Dworshak Fisheries Complex, U.S. Fish and Wildlife Service, (208)-476-7242.

## INTRODUCTION

This report provides data for Brood Year 1997 spring chinook salmon at Dworshak National Fish Hatchery (NFH) which completed its life cycle in 2002. Data on the adults that were spawned to create the brood year, egg production, nursery rearing, juvenile rearing, smolt releases, fish health, smolt out migration, adult contribution to fisheries, and adult returns to the hatchery are summarized. Evaluation projects and other research studies involving this brood year are only briefly described in this report and the reader is referred to the specific project reports for details. This Brood Year Report is one of several products called for in the Region One, U.S. Fish and Wildlife Service, Fisheries Vision Action Plan and is intended to provide a broad overview of stock performance and is a compilation of data from various other reports generated by the Dworshak Fishery Complex.

The reporting of production data for Brood Year 1997 spring chinook salmon for Dworshak NFH is complicated because of the adult holding, spawning, incubation, and nursery rearing of the spring chinook salmon from Kooskia NFH. Although the two programs were kept separate as much as possible, these data were not always reported separately for the two stocks and summaries provided in various production and activity reports for brood Year 1997 were combined. In those sections where data for the two stocks are combined, it will be pointed out. Otherwise, data is for Dworshak NFH stock and production data for BY97 Kooskia NFH spring Chinook salmon will be found in the Brood Year Report for that hatchery.

### **Program Goal**

The spring chinook salmon production program at Dworshak NFH was started in 1982 as part of the Lower Snake River Compensation Plan (LSRCP) and was originally designed to rear 1.4 million smolts to a size of 20 fish per pound (FPP) for direct release from the hatchery into the Clearwater River (U.S. Army Corps of Engineers 1981). This level of production was designed to meet the mitigation goal of 9,135 adults returning to Lower Granite Dam from the ocean (Herrig 1990). Over the years, several changes have been made to the facility and the production program. For Brood Year 1997, the smolt release target was 1,135,000 smolts reared to a size of between 18 to 20 FPP. The reduction in the number of smolts to be released was based on a change in rearing density as a result of an evaluation by Jones and Miller (1996).

### **Site Description**

Dworshak NFH is located at the confluence of the North Fork and the main stem of the Clearwater River near Ahsahka, Idaho (**Figure 1**). Adults enter the hatchery by a ladder located in the North Fork Clearwater. Adults pass an electronic counter and enter a preliminary adult holding pond until they can be inventoried. Fish are mechanically crowded out of this pond, into a transfer channel and into the spawning room where they can be measured and sorted. From the spawning room, adults can be transferred to one of three long term adult holding ponds until they are spawned. The adult holding ponds are about 8,400 cubic feet in volume and can accommodate about 600 adult fish each. Fertilized eggs are incubated in Heath incubation trays. Dworshak NFH has 870 trays. Protocol calls for one female's eggs per tray giving the hatchery the capacity

to incubate nearly 3.0 million spring chinook salmon eggs. After hatching, fry are transferred to inside nursery tanks. Dworshak NFH has 64 cement tanks and 64 fiberglass tanks that hold about 667 and 643 gallons of water, respectively. The source of water for both the incubation and nursery rooms is Dworshak reservoir. Final rearing occurs in outside raceways. Dworshak NFH has 30 8' X 80' concrete raceways in two separate "banks" (A and B) for juvenile chinook rearing. Each bank has 15 raceways. All the raceways are supplied with single pass ambient river water from the North Fork Clearwater River.

**Figure 1.** Location of Dworshak National Fish Hatchery (NFH) at the confluence of the North Fork and mainstem Clearwater River, Idaho.

### 1997 ADULT SPRING CHINOOK SALMON RETURN TO DWORSHAK NFH

#### Pre-Season Assessment

The Idaho FRO uses a regression equation based on the I-Ocean (Jack) returns in the previous year to forecast or predict the return of II-Ocean adults the following year. In 1996, the I-Ocean return to Dworshak NFH was 275 fish. The prediction for adult returns to Dworshak NFH for the 1997 season was  $2,831 \pm 300$  total. The breakdown by age class for the predicted return is given below in **Table 1** (Idaho FRO 1996).

**Table 1.** Pre-season prediction of adult returns to Dworshak NFH by ocean age (Idaho FRO 1996).

Ocean Age	1997 Prediction
I - Ocean	6
II - Ocean	$2,725 \pm 300$
III - Ocean	100
<b>Total</b>	<b><math>2,831 \pm 300</math></b>

#### Total Rack Return

The 1997 adult spring chinook salmon return to Dworshak NFH was 3,150 adults (**Table 2**), slightly higher than the pre-season prediction of 2,831 made in 1996 and the best rack return on

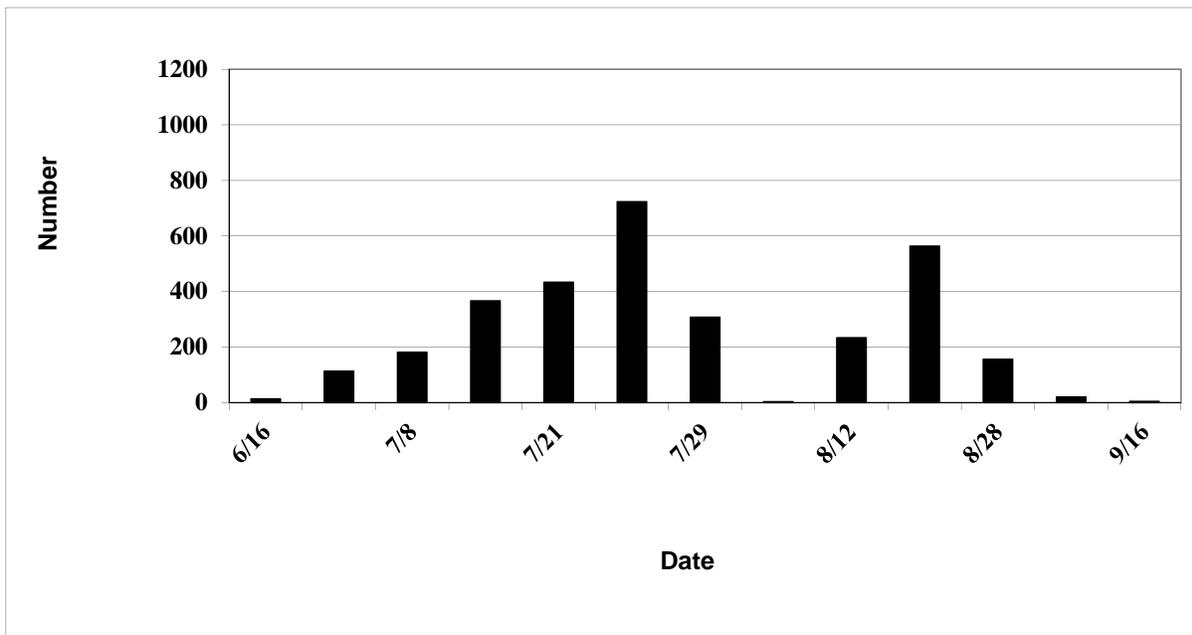
record at that time. The III-ocean returns were considerably higher than predicted, accounting for the higher than expected total return.

**Table 2.** Actual rack return of adult returns to Dworshak NFH by ocean age (Idaho FRO 1997).

Ocean Age	Smolts Released	1997 Rack Return
I - Ocean	102,903 (1996)	12
II - Ocean	1,311,445 (1995)	2,380
III - Ocean	1,278,273 (1994)	740
Unmeasured		18
<b>Total</b>		<b>3,150</b>

### Run Timing

The hatchery ladder was opened on May 19 and was closed on September 16, 1997 (Dworshak NFH. 1997). Records are not available to document the day the first and last fish entered the hatchery. The first inventory was taken on June 16. Inventories were taken periodically thereafter until the end of the season. Between June 30 and August 13, 2,935 adult fish or over 94% of the run entered the hatchery. The number of spring chinook salmon entering the hatchery on various dates is depicted in **Figure 2** and listed in **Table 3**.



**Figure 2.** Numbers of adult spring chinook salmon entering the adult holding pond at Dworshak NFH in 1997.

**Table 3.** Number of spring Chinook salmon entering the hatchery ladder from May 19 through September 16, 1997, by ocean-age class (IFRO database files). Numbers do not include trap mortalities or unmeasured fish.

Date	I-Ocean	II-Ocean	III-Ocean	Total
June 16	0	12	1	13
June 30	2	94	17	113
July 8	1	159	21	181
July 14	1	291	74	366
July 21	2	307	124	433
July 22	0	500	233	723
July 29	2	249	56	307
August 1	0	3	0	3
August 12	1	197	35	233
August 13	2	419	142	563
August 28	1	117	38	156
September 8	0	15	5	20

September 16	0	3	1	4
<b>Total</b>	<b>12</b>	<b>2,366</b>	<b>737</b>	<b>3,115</b>

### Age Composition of Return

Age composition of spring chinook salmon returning to the hatchery was based on fork length categories. These length categories were derived from known age/length/sex data from CWT recovery databases. Ocean age categories are listed below:

- I - Ocean (Jacks)  $\leq$  56 cm
- II - Ocean = 57 to 81 cm
- III - Ocean  $>$  81 cm.

Adult spring chinook salmon that return to Dworshak NFH are predominately II-Ocean fish, those that spend two years in salt water before returning to freshwater to spawn. The mean percent returns in the rack for I-Ocean, II-Ocean, and III-Ocean are 7.7%, 68%, and 23.7%, respectively, for all years from 1984 to 1996 (**Table 4**). The return in 1997 was somewhat atypical, 0.4% I-Ocean, 75.9% II-Ocean, and 23.6% III-Ocean (**Table 3**), in that the percentage of I-Ocean adults was considerably lower than average while the II-Ocean adults were higher than average.

**Table 4.** Number and percent of adult spring chinook salmon that returned to Dworshak NFH since 1984, by ocean age (Idaho FRO 1997).

Return Year	I-Ocean		II-Ocean		III-Ocean		Total Return	Age Not Known <sup>1</sup>
1984	14	17.07%	52	63.41%	16	19.51%	82	0
1985	13	3.89%	281	84.13%	35	10.48%	334	5
1986	78	15.15%	346	67.18%	91	17.67%	515	0
1987	25	1.24%	1604	79.52%	376	18.64%	2017	12
1988	163	8.27%	569	28.85%	1240	62.88%	1972	0
1989	156	9.18%	1322	77.76%	221	13.00%	1700	1
1990	7	0.34%	1892	93.02%	135	6.64%	2034	8
1991	16	9.70%	77	46.67%	72	43.64%	165	0
1992	22	5.96%	286	77.51%	40	10.84%	369	21
1993	9	1.09%	452	54.92%	359	43.62%	823	3
1994	3	4.05%	30	40.54%	41	55.41%	74	0
1995	83	66.4%	36	28.80%	6	4.80%	125	0
1996	275	28.56%	663	68.85%	25	2.6%	963	0
Mean	66	7.67%	585	68.02%	204	23.72%	860	4
<b>1997</b>	<b>12</b>	<b>0.38%</b>	<b>2,380</b>	<b>75.98%</b>	<b>740</b>	<b>23.62%</b>	<b>3,132</b>	<b>18</b>

<sup>1</sup> Unmeasured fish are those that escaped out of the preliminary adult holding pond without being inventoried prior to

spawning.

### Adult Tagging

Because of space and water temperature limitations at Kooksia NFH, all the spring chinook salmon collected for broodstock at that hatchery are transferred to Dworshak NFH for holding and spawning. To insure separation of stocks, all the Dworshak NFH adult spring Chinook salmon were marked with a left opercle punch and the adults from Kooskia NFH were marked on the right side.

### Adult Holding and Mortality

Adult females were injected with Erythromycin to protect eggs from vertical transmission of *R. salmoninarum*. All adults were treated with formalin prior to spawning to reduce parasites and fungus (see **FISH HEALTH** section for details). Adult mortality is reported for two separate periods: pre-spawning (holding mortality) and mortality during spawning.

*Pre-Spawning Mortality* - From May 19 to August 25, a total of 100 adult spring chinook salmon (3.2 % of total return) died: 83 females and 17 males (0 Jacks).

*Mortality During Spawning* - From August 26 through September 16, an additional 134 adults died (9.9 % of total return), 88 males and 218 females. Of the 88 males, 2 were jacks.

### Spawning

Spawning was started on August 26. Five takes were made with the last ripe females for the Dworshak NFH program taken on September 11. Four hundred and thirty-five males and 542 females were spawned. Every female was sampled to determine the level of infection by *Renibacterium salmoninarum* (see **FISH HEALTH** section for details). A summary of spawning is presented in **Table 5**. From Take 4, a surplus of 370,000 eggs were transferred to the Nez Perce Tribe. An additional 108 females were spawned with 33 males during the 5<sup>th</sup> spawning take to provide the Nez Perce Tribe with eggs for their program. On September 16, the remaining broodstock on hand was inventoried. A total of 29 males and 130 females were deposited in the local landfill because all existing programs were full and no other potential uses could be found for the remaining broodstock.

**Table 5.** Number of male and female spring chinook salmon spawned during each egg take for Brood Year 1997 at Dworshak NFH (Trock 1997).

Take Date	Males Spawned	Females Spawned
8/27/97	139	140
8/28/97	108	108

9/03/97	85	118
9/04/97	97	170
9/11/97	6	6
<b>Total</b>	<b>435</b>	<b>542</b>

### **Adult Outplanting**

Adult spring chinook salmon that were excess to broodstock needs at Dworshak NFH or for other programs were outplanted into Lolo Creek or the upper Selway River to hopefully spawn and increase natural production. A total of 474 adults (154 males and 320 females) were taken to Lolo Creek and 120 adults (27 males and 93 females) were taken to the Selway River.

## **EGG PRODUCTION**

Data on early incubation, eye-up, and final incubation and hatching is found in Dworshak NFH annual reports for 1997 and 1998, the hatchery monthly production narratives, as well as the spawning report for BY97 (Trock 1997). Although eggs for Kooskia NFH spring Chinook salmon were incubated at Dworshak NFH, the data is not reported here and the reader is referred to the BY97 Brood year Report for Kooksia NFH.

### **Green Eggs Taken**

Green eggs were not counted at the time of spawning. Eggs are not enumerated until after eye-up. The average number of eggs taken per female came out to be 3,724. The total number of green eggs taken was estimated to be 2,018,408.

### **Early Incubation (Dworshak NFH)**

All eggs were incubated in Heath trays. Eggs from each female (approximately 3,724 per female) were incubated separately to segregate and track offspring by the Bacterial Kidney Disease (BKD) status (low/medium/high) of the female parent based on Enzyme-Linked Immunosorbant Assay (ELISA) tests (see **FISH HEALTH** section for detail). Water flow through the incubators was maintained at about 5 gal./min. Water temperatures averaged 46°F using the water chillers (Dworshak NFH 1997).

### **Eggs Culled for BKD**

Generally, eggs from females that test high ( $\geq 1.0$  ODU) for BKD are culled from production. However, the level was reduced to 0.4 ODU (medium level of infection) because the number of eggs on hand after spawning exceeded production needs. The eggs from 77 females (13.3%) were removed from production (Dworshak NFH 1997).

## **Eye-Up**

At 46°F, eye-up occurred about 39 days after fertilization. The last takes reached the eye-up stage by the last week of October 1997. Eggs were shocked, dead eggs were removed and eggs were enumerated by a mechanized egg picker. The total number of eyed eggs enumerated was 1,569, 237, which included a surplus of 370,000 eggs from Take 4 that were transferred to the Nez Perce Tribe (**Table 6**).

**Table 6.** Summary of egg take and eye-up for Dworshak NFH BY97 spring chinook salmon (Trock 1997).

Take	No. of Females	No. of Females Culled	Eggs per Female	Eyed Eggs	Percent Enumerated Eye-up	Percent Total Eye-up
1	140	12	3,935	468,500	93.0	85.0
2	108	6	3,697	333,700	88.5	83.6
3	118	18	3,586	335,139	93.5	79.2
4	170	38	3,607	423,179	88.9	69.0
5	6	3	4,400	8,719	66.1	33.0
<b>Total /Ave</b>	<b>542</b>	<b>77</b>	<b>3,724</b>	<b>1,569,237</b>	<b>90.9</b>	<b>78.9</b>

### NURSERY REARING

The following data and information were summarized from the 1997 and 1998 Annual Reports and monthly production narratives for Dworshak NFH. Due to space and water constraints at Kooskia NFH, about 63,000 fry of Kooskia NFH stock were kept at Dworshak NFH for nursery rearing. These numbers are not reported here and the reader is referred to the BY97 Spring Chinook Salmon Brood year Report for Kooskia NFH.

#### Tanking

Incubation and hatching was completed in December 1997. A total of 1,120,000 fry were transferred from the incubators to the nursery. Fry were stocked at a density of about 20,000 fish per tank. Survival from eyed egg to tanked fry was 98.2% (Dworshak NFH 1998). Fish from all takes were in the nursery and on feed by the end of January 1998.

#### Growth and Mortality

Growth and mortality for fry during nursery rearing at Dworshak NFH is summarized in **Table 7**.

**Table 7.** Summary of monthly growth and mortality of Brood Year 1997 spring chinook salmon during nursery rearing at Dworshak NFH. Compiled from monthly Dworshak NFH production narratives.

Date (End of Month)	Number	Weight (lbs)	FPP	Mean Length (in.)	Mean Growth (in.)	Mortality (%)	Mean Water Temp (°F)
12/97	1,113,659	1,017	1,095	1.4	n/a	0.9	44.3
1/98	1,095,625	1,338	819	1.6	0.2	1.6	42.1
2/98	1,089,115	2,022	539	1.8	0.2	0.6	41.9
3/98	1,087,334	3,210	339	2.1	0.3	0.2	42.0

### JUVENILE REARING

The following data and information was summarized from the 1997 and 1998 Annual Reports for Dworshak NFH and Dworshak NFH monthly production narratives. Due to space and water constraints at Kooskia NFH, about 60,000 juveniles of Kooskia NFH stock were kept at Dworshak NFH for raceway rearing. These numbers are not reported here and the reader is referred to the BY97 Spring Chinook Salmon Brood year Report for Kooskia NFH.

#### Ponding

During the week of April 6, 1998, all the Dworshak NFH BY97 spring chinook salmon were transferred from the nursery to the outside raceways. The fish were loaded into 12 raceways, at densities between 100,000 and 120,000 fish per raceway.

#### Growth and Mortality

At the time of transfer from the nursery to the raceways, the fry were averaging about 250 fish per pound and were less than 2.5 inches in length. A record of daily growth and mortality is listed in **Table 8** from the end of April 1998 until the time of release in April 1999.

A period of fasting and feeding was implemented from May 30 to June 6 and from June 13 to 24, 1998 to reduce the growth rate and the width of the length frequency distribution. In June, the fish reached a size that made it necessary to split them into adjacent raceways. In September, 11 raceways were split to reduce densities. At that time, average density was 36,500 fish per raceway. In December, all the Kooskia NFH stock were transferred to Kooskia NFH for final rearing and release. All Dworshak NFH smolts were released the first week in April.

## Marking and Tagging

*Coded-Wire Tags* - Starting August 5, 1998, all the fish were adipose fin clipped and inventoried. At the same time, 142,000 fish were marked with coded-wire for contribution studies. All marking and tagging was completed by August 26, 1998. The inventory resulted in a 5% increase in numbers. **Table 9** lists the numbers of fish marked and their size, by tag code, and the final numbers and size at release. On February 26 and March 12, 1999, coded-wire tag retention was checked by the Idaho FRO and was estimated to be 99.3 % (Dworshak NFH 1999)

*PIT tags* - A total of 47,844 Brood Year 1997 spring chinook salmon were PIT tagged during February and March 1999 to monitor travel time and estimate survival to Lower Granite Dam after release. These fish were part of the Comparative Survival Study (see **SPECIAL STUDIES** section for details).

**Table 8.** Summary of monthly growth and mortality of Brood Year 1997 spring chinook salmon during outside raceway rearing at Dworshak NFH . Compiled from monthly production narratives and monthly inventory summaries.

Date (End of Month)	Number	Weight (lbs)	FPP	Mean Length (in.)	Mean Growth (in.)	Mortality (%)	Mean Water Temp (°F)
4/98	1,084,179	4,935	220	2.5	0.4	0.30	43.9
5/98	1,082,776	7,7252	140	2.9	0.4	0.13	46.2
6/98	995,410 <sup>1</sup>	7,241	137	2.9	0.1	0.09	51.9
7/98	994,735	11,118	89	3.4	0.3	0.07	50.2
8/98	1,048,083 <sup>2</sup>	14,741	71	3.6	0.1	0.10	50.9
9/98	1,047,524	19,536	54	4.0	0.4	0.05	47.1
10/98	1,047,016	25,768	41	4.3	0.3	0.05	47.3
11/98	1,046,511	31,372	33	4.6	0.3	0.05	50.1
12/98	1,046,118	36,803	28	4.9	0.3	0.04	45.5
1/99	1,045,728	39,631	26	5.0	0.1	0.04	41.5
2/99	1,045,323	42,568	25	5.1	0.1	0.04	40.3
3/99	1,008,827 <sup>3</sup>	46,645	21	5.4	0.1	0.11	42.7

<sup>1</sup> Fish were inventoried and split out of 12 raceways into 27 to reduce density.

<sup>2</sup> There was a five percent increase in numbers from the previous month due to marking inventory.

<sup>3</sup> Fish were released on April 7 and 8.

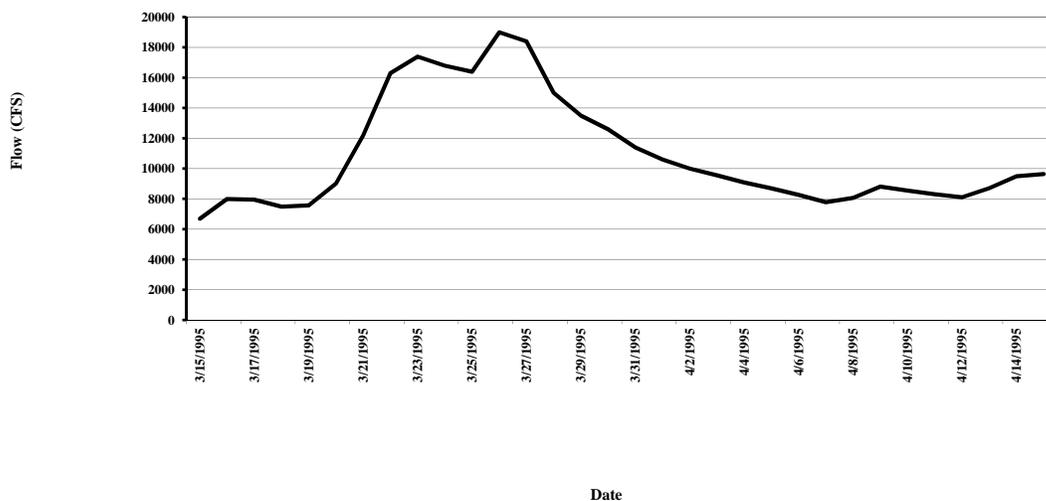
**Table 9.** Numbers of BY96 Dworshak spring chinook salmon that were adipose fin clipped and

coded-wire tagged and the final numbers released, by tag code (IFRO data base records).

Tag Code	Marked		Released	
	Number	Size (#/lb)	Number	Size (#/lb)
05-42-11	70,356	85	69,660	20.8
05-42-12	71,653	85	70,716	21.2
05-42-10	70,963	67	69,010	17.1
05-39-14	34,489	67	33,540	17.1
Total	247,461		242,926	

### SMOLT RELEASES

Idaho FRO began monitoring streamflows in the Clearwater River at the beginning of March, 1999 to coordinate spring smolt releases with increases in the hydrograph. Mean daily flows increased sharply starting March 21 and continued through March 28 (**Figure 3**). On March 29, 1999, Dworshak NFH conducted an early release of 35,843 smolts from raceway 11 to make room for 223,000 BY98 SCS fry that had to be transferred from Kooskia NFH to Dworshak NFH. The general production release for Brood Year 1997 spring chinook smolts at Dworshak NFH occurred on April 7-8, 1999. The total release from Dworshak NFH into the North Fork Clearwater River was 1,044,511 smolts (Dworshak NFH 1999). Releases were made in the late afternoon and early evening to minimize avian predation. Total weight was about 49,787 lbs, average number per pound was 21, and average length was 138mm.



**Figure 3.** Mean daily stream discharge of the Clearwater River at the Orofino bridge, 1999. Vertical line indicates the date smolts were released.

## FISH HEALTH

### Adult Injections with Erythromycin

The 1995 season was the last year that the University of Idaho did any work on INAD 6430: Injectable Erythromycin. A veterinary prescription for extra label use was obtained for using erythromycin in 1997. Adult females were inoculated with Gallimycin about 3 weeks prior to the start of spawning. Fish were injected in the intra-peritoneal cavity with 20 mg/kg of body weight. (Dworshak FHC 1997).

During spawning, all the adult females were sampled to test for infection with *Renibacterium salmoninarum* (*Rs*), the causative agent of BKD using ELISA. Eggs from females were segregated based on the level of infection (**Table 10.**). Results of these tests indicated that 55 females had high levels of *Rs* antigen, 200 females had moderate levels, 206 females had low levels, and 39 females were negative. Because numbers of returning females were plentiful, a 0.40 Optical Density level was used for culling. This resulted in 12.3% of the spawned eggs being culled.

**Table 10.** Categories of infection with *R. salmoninarum* for spring chinook salmon as determined by ELISA.

Level of Infection	Optical Density Units (ELISA)
Negative	0.000 - 0.099
Low	0.100 - 0.199
Medium	0.200 - 0.999
High	1.000 and above

### **Formalin as a Fungicide: INAD 9013**

Adult spring chinook salmon were treated with formalin during holding at Dworshak NFH prior to spawning to keep fungus infections at a minimum. Because formalin has not been approved for treatment of salmonids for fungus after the egg stage, administration was done under a veterinary prescription. Adult spring Chinook salmon were administered formalin using a charge and flow-through treatment regimen. The treatment volume was estimated by subtracting the volume of water displaced by fish from the total pond volume. To begin a treatment, water flow to the pond was reduced to about 1900 L/m and then 38.0 L formalin was added to the pond to achieve a concentration of 167  $\mu\text{L/L}$ . The treatment level was maintained for 1 h by adding formalin at a rate of 316 mL/m. A total of 57 L (15 gal) of formalin was required for each treatment at this dosage until treatments were completed.

Formalin appeared to be efficacious in the control of fungus on the 1997 spring Chinook salmon brood during the pre-spawn holding period. This was evident by the fact that there was little or no fungus on any of the dead fish removed from the pond or the live fish remaining. In previous years, Dworshak NFH had discontinued formalin treatments once the spawning process had started, because of the money and time involved in treating. Upon the recommendation of the Fish Health Center, formalin treatments for BY 97 were continued regularly until spawning was complete.

### **LHRHa (ReproBoost): INAD 9709**

Dworshak NFH usually has a few females that are not ripe and will die in the holding pond prior to spawning. This year, in order to maximize the egg take, Luteinizing Hormone-Release Hormone (LHRH) was used to facilitate ripening these few females. AquaPharm Technologies Corp. currently has INAD #8061 for LHRH, injectable and implants. Implants were chosen for use through this INAD. On September 9, 6 females were injected with one RB250 implant each. On September 16, only one fish survived to spawn and was ripe and successfully spawned (Dworshak FHC 1997). The implants were not implicated in the deaths of the other 5 fish. The deteriorated state of the fish was the most likely cause.

### **Adult Disease Testing**

Viral assays for 1997 spring Chinook salmon adults resulted in 2 out of 150 fish testing positive for IHNV. Intestine samples from 1997 adult spring Chinook salmon were examined for *Ceratomyxa shasta*. Spores of the parasites were found in 58.5% of the fish examined. In 1996, the prevalence of *C. shasta* was 31.3%. Although spores are commonly detected in adult fish returning to Dworshak NFH, there has never been an episode of ceratomyxosis in juvenile or yearling fish.

### **Monthly Disease Sampling**

There was nothing remarkable found during the monthly disease monitoring for this brood year. BKD monitoring in the fall indicated a very slight increase in clinical BKD in December. This trend continued until release.

### **Erythromycin treatments**

No Erythromycin treatments were administered to juveniles..

### **Smolt Assessments**

A total of 60 fish were sampled for pre-release assessment. Samples were split between four raceways, targeting the general population, not moribund fish. Exams included checking for *Myxobolus cerebralis*. ELISA values resulted in the following: Not detected - 59, low - 1, medium - 0, and high - 0. No other pathogens (bacterial, viral, or parasitic) were isolated prior to release.

## SMOLT EMIGRATION

The performance of spring chinook salmon smolts is monitored and evaluated using PIT tags after they are released from the hatchery. The tags are interrogated at Lower Granite, Little Goose, and Lower Monumental dams on the Lower Snake River and at McNary Dam on the lower Columbia River (**Figure 4**). PIT tags provide information on travel time and survival during emigration. PIT-tagged fish from 12 separate raceways were released in 1999 as part of a study to evaluate the effects of transportation on survival. The goal of the project is to evaluate adult returns and determine whether transportation affords a survival advantage during spring emigration to the ocean. (See **SPECIAL STUDIES** section for details)

### Travel Time

Mean raceway travel time from Dworshak NFH to Lower Granite Dam ranged from 24.4 to 37.7 days (**Table 11**). The number of days for 25, 50, and 90 percent of the run to reach Lower Granite Dam were 22, 28, and 43 days, respectively. After being released on April 7, 90% had reached Lower Granite Dam by May 20. The shortest and longest travel times to Lower Granite Dam were 4.6 and 99 days, respectively.

**Table 11.** Summary of travel time, and associated statistics, to Lower Granite Dam for PIT-tagged BY97 spring chinook salmon released from Dworshak NFH in 1999.

Raceway	N	Minimum	Maximum	Mean	SD
A03	335	10.0	72.5	33.3	11.7
A04	718	9.6	91.3	37.7	15.7
A05	598	6.8	88.8	30.1	9.8
A06	518	8.7	72.6	28.9	9.5
A07	553	5.4	70.8	28.2	8.8
A08	631	9.6	65.0	26.8	8.4
A18	552	4.6	71.1	24.4	9.1
B19	522	5.6	63.4	26.9	8.5
B20	503	11.0	74.4	29.0	10.4
B21	516	8.4	69.7	26.9	8.2
B22	518	9.8	99.0	29.6	9.5
B23	525	8.1	73.5	29.3	9.7

### River Flow

Flows in the Lower Snake River were higher than the 10-year average during most of the smolt emigration period of April and May (**Figure 5**). Inflow into Lower Granite Reservoir was greater

than 100,000 cubic feet per second (cfs) the last of March prior to smolt releases from Dworshak NFH. The flows decreased to below 80,000 cfs at the time of release and then increased to above 100,000 cfs before the end of April. Before 90% of the smolts had reached Lower Granite Dam on May 20, flows had again dropped off to nearly 80,000 cfs.

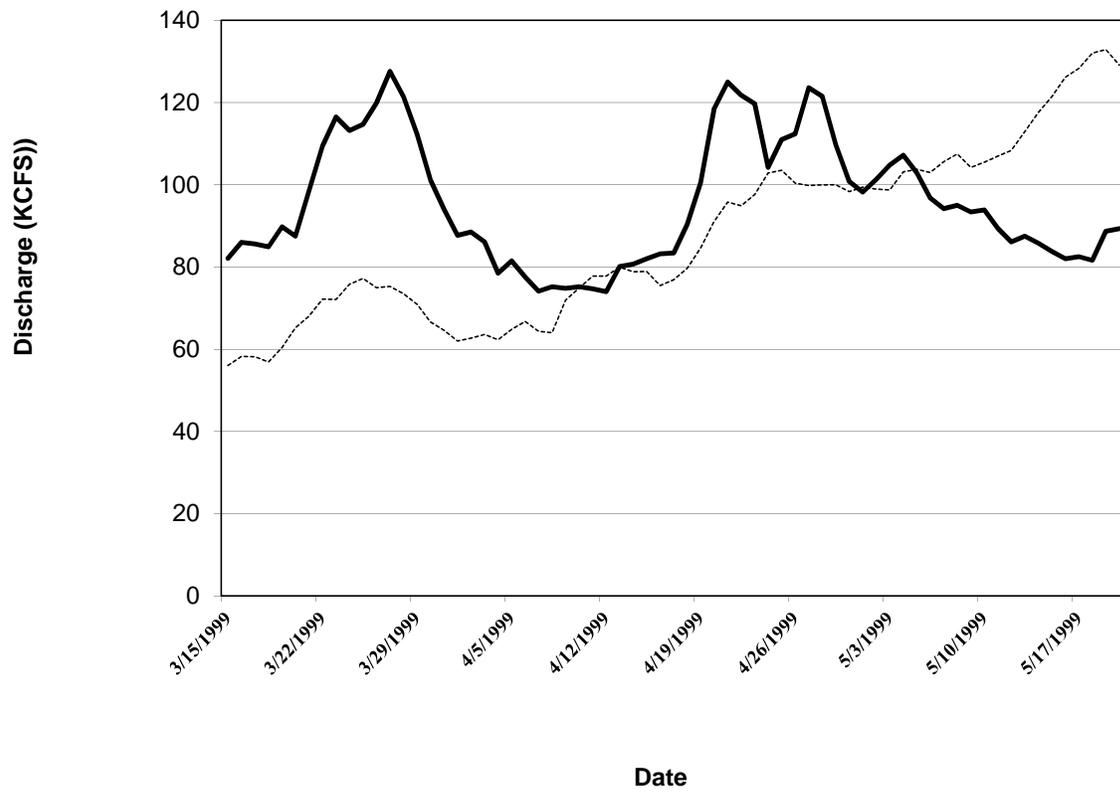
### Estimated Smolt Survival

A minimum estimate of smolt survival to Lower Granite Dam is calculated by summing the cumulative number of unique PIT-tag interrogations at Lower Granite, Little Goose, Lower Monumental, and McNary dams. The rate of estimated survival for PIT-tagged Brood Year 1997 spring Chinook salmon was 62.9 %. (**Table 12**).

**Table 12.** Number of unique interrogations of PIT-tagged spring chinook salmon released from Dworshak NFH as part of the transportation study and interrogated at downstream dams in 1999 (BY97).

Raceway	Number of Tags Released	Number of Unique Interrogations				Total	Percent
		Lower Granite Dam	Little Goose Dam	Lower Monumental Dam	McNary Dam		
A03	2,797	355	823	324	187	1,690	60.4
A04	5,256	718	1,364	568	307	2,958	56.3
A05	4,181	598	1,244	534	257	2,633	63.0
A06	4,096	518	1,295	505	296	2,614	63.8
A07	4,024	553	1,240	492	236	2,522	62.7
A08	4,156	631	1,389	543	206	2,769	66.6
B18	4,121	552	1,413	481	233	2,680	65.0
B19	4,108	522	1,343	473	272	2,610	63.5
B20	3,920	503	1,224	506	223	2,458	62.7
B21	4,046	516	1,282	540	294	2,632	65.1
B22	3,699	518	1,085	440	245	2,288	61.9
B23	3,440	525	1,080	427	188	2,221	64.6

**Figure 4.** Dams on the lower Snake and Columbia rivers where PIT-tag interrogation facilities are located for monitoring smolt emigration.



**Figure 5.** Mean daily inflow to Lower Granite Reservoir from March 15 through May 20, 1999 during spring chinook salmon emigration after release from Dworshak NFH (solid line). The 10 year average (dashed line) from 1993 through 2002 is shown for perspective.

## ADULT RETURNS

### Rack Return to Dworshak NFH

Brood Year 1997 spring chinook salmon smolts released in 1999 returned as adults in 2000 (I-Ocean), 2001 (II-Ocean), and 2002 (III-Ocean). The total adult return to the hatchery rack was 4,071 fish and is summarized in **Table 12**. The smolt to adult return rate was 0.39 %.

**Table 12.** Summary of adult returns to Dworshak NFH for Brood Year 1997 spring chinook salmon (IFRO 2002). A total of 1,044,511 smolts were released from Dworshak NFH in 1999.

Return Year	Ocean Age	Number of Returns	Smolt to Adult Return Rate (%)
2000	I	221	0.0212
2001	II	3,235	0.3097
2002	III	615	0.0589
	<b>Total Return</b>	<b>4,071</b>	<b>0.3898</b>

### Harvest

The spring chinook salmon production program at Dworshak NFH is designed to provide opportunities for harvest that were lost after the construction of four dams on the lower Snake River downstream from Lewiston, Idaho. Harvest of BY97 spring chinook salmon occurred in 2000 (I-Ocean fish), in 2001 (II-Ocean fish) and in 2002 (III-Ocean fish). Harvest in tribal and sport fisheries for those three return years is reported below.

*Idaho Tribal Fisheries* - The Tribal fishery in the North Fork Clearwater River occurs almost exclusively near the Dworshak NFH fish ladder. Data on the age composition of the harvest is generally not available. For that reason, it is assumed that the age composition of the harvest is similar to the age composition of the rack return to Dworshak NFH. A summary of the number of spring chinook salmon harvested by Ocean Age Class is provided in **Table 13** below.

**Table 13.** Estimated number of adult spring chinook salmon harvested by the Nez Perce Tribe, reported by Ocean Age from 2000-2002 (Idaho FRO data files).

Harvest Year	Ocean Age	Number Harvested
2000	I	81
2001	II	660
2002	III	226
<b>Total</b>		<b>967</b>

*Idaho Sport Fisheries* - Because of the mixed stock fishery in the Clearwater River, it is difficult to estimate the number of Dworshak NFH origin spring chinook salmon harvested. Discrimination and determination of origin is based on coded-wire tag recovery data which is generally not available before this report is completed. Therefore, the data reported here is provisional and subject to future revision based on more complete information. Sport fishing occurred in 2000, 2001, and 2002. A summary of the number harvested by Ocean Age Class is provided in **Table 14** below.

**Table 14.** Estimated number of adult spring chinook salmon harvested by sports fishermen, reported by Ocean Age from 2000-2002 (Idaho FRO data files).

Harvest Year	Ocean Age	Number Harvested
2000	I	194
2001	II	6,727
2002	III	1,010
<b>Total</b>		<b>7,931</b>

The Idaho Department of Fish and Game reported a total estimated harvest of 3,908 adult salmon in 2000, 194 of which was estimated to be I-Ocean fish. In 2001, the total estimated sport harvest was 8,355 (revised from 8,267 in the BY96 report) of which 6,727 were estimated to be II-Ocean

fish. In 2002, the total estimated sport harvest was 3,542 of which 1,010 were estimated to be III-Ocean fish.

### **Estimated Minimum Total Adult Return Above Lower Granite Dam**

The estimated minimum total number of adults returning above Lower Granite Dam is calculated by combining the number of adults returning to the hatchery rack with the estimated numbers harvested in Tribal and sport fisheries. For BY97, the estimated minimum total is 12,719 (4,071 rack return and 8,648 harvested) giving a smolt to adult return rate of 1.22 %.

### **Other Adult Recoveries**

Spring chinook salmon from Dworshak NFH have been recovered from a number of locations throughout the Columbia and Snake rivers. The only way to positively identify these fish is by recovering coded-wire tags. In some cases, coded-wire tag recoveries are expanded to estimate totals, but only actual recoveries are reported here. The data was obtained from the Pacific States Marine Fisheries Commission's (PSMFC) Regional Mark Information System. Thus, data reported here is up to date as of August 2003. For Brood Year 1997, a total of 257 coded-wire tags were recovered outside the Clearwater River basin. One hundred and six were collected in Tribal subsistence and ceremonial fisheries in Zone 6 (Bonneville Pool upstream to McNary Pool). Seventy-five were collected in Columbia River sport fisheries. The remainder were collected as strays to various hatcheries or other collection facilities throughout the Columbia River basin and in commercial fisheries below Bonneville Dam. **Table 15** provides a summary of recoveries by location and recovery year. Data on recoveries for individual tag codes is available from the IFRO office upon request.

## **SPECIAL STUDIES**

### **Comparative Survival Study**

The Dworshak Fishery Complex has been cooperating with the Fish Passage Center in a Comparative Survival Rate Study of hatchery PIT-tagged spring chinook salmon since 1997. This study examines the migration time and survival of hatchery spring chinook salmon emigrating through the Lower Snake River compared to those that are transported. A pilot study was started in 1997. Dworshak NFH released 47,844 BY97 spring Chinook salmon smolts in 1999. With PIT tags as part of the Service's contribution to the project. The goal of the project is to evaluate adult returns and determine whether transportation affords a survival advantage during spring emigration to the ocean.

**Table 15 .** Number of coded-wire tagged Brood year 1997 Dworshak NFH spring chinook salmon that were recovered as adults from various locations in the Columbia and Snake rivers.

Fishery/Location of Recovery	Recovering Agency	Recovery Year		
		2000	2001	2002
Blind Slough (Lwr Col. R)	ODFW <sup>1</sup>	-	1	-
Bonneville Pool Ceremonial	ODFW	1	-	-
Bonneville Pool Umatilla Tribe	ODFW	-	28	-
Bonneville Pool Warm Springs Tribe	ODFW	-	8	-
Bonneville Pool Net	ODFW	-	39	-
Columbia R. Sport Fishery Oregon	ODFW	-	35	-
Columbia R. Sport Fish Wash.	ODFW	-	40	-
Dalles Pool Net	ODFW	-	27	-
Columbia R. Net Zones 1-5	ODFW	-	19	-
John Day Pool Net	ODFW	-	42	-
Round Butte Trap	ODFW	-	2	-
Pelton Dam (Deschutes R.)	ODFW	-	3	-
Little White Salmon NFH	WDFW <sup>2</sup>	1	1	-
Leavenworth NFH	FWS <sup>3</sup>	1	-	-
Warm Springs NFH	FWS	-	2	-
Nason Creek	WDFW	-	2	-
Newport Troll 4	ODFW	-	2	-
Wind River	WDFW	-	2	-
Lower Snake River	WDFW	-	2	-
Lyons Ferry Hatchery	WDFW	-	1	-
<b>Totals</b>		<b>3</b>	<b>254</b>	<b>0</b>

<sup>1</sup> Oregon Department of Fish and Wildlife

<sup>2</sup> Washington Department of Fish and Wildlife

<sup>3</sup> U.S. Fish and Wildlife Service

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**APPENDIX I**

**Adult Spring Chinook Salmon Returns  
to Dworshak-Kooskia NFH Complex in 1997  
and Prognosis for 1998**

**Idaho Fishery Resource Office**

## **APPENDIX A**

# **ADULT SPRING CHINOOK SALMON RETURNS TO DWORSHAK-KOOSKIA NFH COMPLEX IN 1997 AND PROGNOSIS FOR 1998**

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## Introduction

Dworshak National Fish Hatchery (NFH) is located at the confluence of the North Fork and the main-stem of the Clearwater River near Ahsahka, Idaho. Construction of the hatchery was included in the authorization for Dworshak Dam and Reservoir (Public Law 87-847, October 23, 1962) to mitigate for losses of steelhead (*Oncorhynchus mykiss*) caused by the dam and reservoir.

The hatchery was designed and constructed by the U.S. Army Corps of Engineers and has been administered and operated by the U.S. Fish and Wildlife Service since the first phase of construction was completed in 1969. At that time, the hatchery had 25 Burrows ponds on a reuse system and 59 ponds on single-pass for rearing steelhead. In 1972, a second phase of construction placed all ponds on three reuse systems with the option of operating on either reuse or single pass. We began using only single pass water in the oldest reuse system (25 ponds) in 1986. Additional construction was completed in 1982 under the Lower Snake River Compensation Plan to provide rearing facilities for spring chinook salmon (*O. tshawytscha*). A total of 30 8-ft by 80-ft raceways were constructed. In 1986, 12 8-ft by 75-ft raceways were converted from rainbow trout rearing to chinook salmon rearing. In 1993, two of these raceways were converted to an adult holding pond. Presently spring chinook salmon are only reared in the 30 raceways built specifically for them.

Kooskia NFH is located about 1.5 miles southeast of Kooskia, Idaho, near the confluence of Clear Creek and Middle Fork of the Clearwater River. Because of production constraints, disease considerations, and other factors, Dworshak NFH holds and spawns spring chinook salmon adults returning to Kooskia NFH. Kooskia NFH eggs and juveniles are often held at Dworshak NFH as well. In 1995, Kooskia NFH was included as part of the Dworshak Fishery Complex.

This report includes a summary of the 1997 adult returns of spring chinook salmon to Dworshak and Kooskia NFHs. Our predictions for the 1997 returns are reviewed and predictions for the 1998 adult returns are presented.

## Stock description

The Dworshak NFH spring chinook salmon program was initially started using chinook salmon stock from the Leavenworth and Little White Salmon NFH programs. Eggs were transferred from these facilities and made up the smolt releases from 1983 to 1986 (Table 1). Since these stocks were very strongly influenced by transfers to their programs from Carson NFH, the early Dworshak chinook stock was considered a Lower Columbia River Carson derivative. The chinook programs for brood years 1985 and 1986 consisted entirely of eggs that had been transferred from Rapid River State Fish Hatchery (SFH), which used chinook returning to the Snake River at Hells Canyon Dam. Thus, smolts released in 1987 and 1988 were entirely Rapid River Stock, shifting the program away from using the Lower Columbia River Carson chinook stock. Since that time, Dworshak NFH has maintained its program from returns to its own rack. In some years when returns are too low to meet broodstock needs, Dworshak NFH has backfilled its program using excess eggs from Kooskia NFH or Rapid River SFH. The recent returns to Dworshak NFH (1989 and later) are referred to as Dworshak stock, since they are progeny of returns to Dworshak NFH, rather than direct products

of transfers of Rapid River stock.

The Kooskia NFH spring chinook salmon program was started using a wide variety of stocks from the Lower Columbia River and Rapid River SFH. However, from 1973 through 1980, smolt releases had a very strong Carson stock influence. Egg transfers from Dworshak NFH in 1985 and 1986 resulted in smolt releases in 1987 and 1988 that were a mixed stock, referred to as Clearwater stock (Table 2). Since the Kooskia NFH program already had stock made up primarily of Carson derivatives, the resultant program (1989 and later) is still considered a Carson type stock, and is referred to as Kooskia stock. Length frequency data, ocean age class at return time information, and allele frequencies (Elliot and Pascho 1994) all support a distinction between Dworshak and Kooskia stocks.

### **1997 Run Size**

The 1997 spring chinook salmon return to Dworshak NFH rack was 3,150 the best rack return in the program history (Table 3). There was a sport harvest (IDFG estimate of 741) of Dworshak NFH fish in the North Fork Clearwater River in 1997. This was the first significant sport harvest since 1990. The Nez Perce tribe estimated their harvest in the North Fork to be 835 fish. The spring chinook salmon return to Kooskia NFH was 1,657. This was the third best return ever recorded and by far the best in recent times (Table 4). The Nez Perce tribe estimated a tribal harvest of 12 in Clear Creek.

### **Age Composition**

Age composition of the run is presently based on fork length categories. The length categories were derived from known age/length data from CWT recovery databases. I-salts are 56 cm or less, II-salts are 57 through 81 cm, and III-salts are larger than 81 cm. The majority of spring chinook salmon returning to both Dworshak and Kooskia NFHs are II-salts with fewer III-salts (Table 5). The 740 III-salt fish that returned to Dworshak was a surprise and by far the best since the switch to Rapid River stock.

### **Survival**

The III-salt returns in 1997 complete the returns from the 1,278,273 smolts released at Dworshak NFH and the 305,813 smolts released at Kooskia NFH in 1994. Total returns to the Dworshak NFH from the 1994 release were 83 I-salts, 663 II-salts, and 1110 III-salts for a hatchery return survival rate of 0.1452 percent (Table 6). Total returns to Kooskia NFH from the 1994 release were 21 I-salts, 113 II-salts, and 127 III-salts for a hatchery return survival rate of 0.0853 percent (Table 7).

### **Coded-Wire Tag (CWT) Recoveries**

We have significantly increased spring chinook salmon marking from the contribution-only level (1987 release year, at Dworshak NFH, one CWT group) to the several-studies level (1988-1994 release years, 9 to 24 CWT groups). At Kooskia NFH, we released CWT groups less often (1984, 1990, 1992-1997). Since 1993 all hatchery spring chinook were fin clipped to allow discrimination between hatchery and natural or wild stocks. The increased marking in recent years has enlarged the spring chinook salmon CWT recovery database to a point where it is much more useful for hatchery evaluation. It also dramatically increased the workload for CWT sampling, recovery, and data processing.

CWT recoveries from spring chinook salmon in the Dworshak NFH rack shows seven 1996 recoveries were from salmon released from facilities other than Dworshak or Kooskia NFHs (Table 8). Rack recoveries in previous years have included strays from several other hatcheries and also National Marine Fisheries Service transportation study marks. Since we took four times as many snouts as any previous year, processing is not completed at this time.

### **1997 Run Predictions**

#### **Dworshak NFH-1997**

The 1997 spring chinook salmon return to Dworshak NFH surpassed expectations and broke the previous record high. The Dworshak NFH rack return alone was 3,150 fish. IDFG estimated the sport harvest was 741 fish. The Nez Perce tribal harvest biologist estimated that the tribe harvested 835 fish. Therefore, the total return to the North Fork Clearwater was in excess of 4,726. The record 275 jacks taken in the 1996 rack indicated that 1997 would be a humdinger of a return, but our prediction was conservative (Table 9). We were not prepared for quite this much success at one time.

#### **Kooskia NFH-1997**

The 1997 spring chinook salmon return to Kooskia NFH exceeded predictions (Table 10). It was the third best return ever and by far the best return since the 1970's.

### **1998 Run Predictions**

Our forecast for the 1998 spring chinook salmon returns to Dworshak and Kooskia NFHs is given in Table 11. The combined forecast for 1998 is for 1,300 spring chinook salmon to return to the Dworshak Fishery Complex. We predict broodstock requirements (1,700) will not be met, but the shortfall will be small. The predictions are conservative. Our equation method works well for II-salt returns but not for III-salt returns. If our three ocean estimate is low (as it was in 1993) we could exceed broodstock needs, especially at Kookia.

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Table 1. Genetic background of Dworshak NFH spring chinook salmon smolts directly released from the hatchery, 1983-1997. (RR = Rapid River, KK = Kooskia, DW = Dworshak, LE = Leavenworth, LW = Little White Salmon)

Release Year	Genetic Background
1983	75% LW, 12% RR, 13% LE
1984	100% LE
1985	68% LW, 32% LE
1986	100% LE
1987	100% RR
1988	100% RR
1989	100% DW
1990	100% DW
1991	100% DW
1992	100% DW
1993	100% DW
1994	100% DW
1995	66% DW, 34% KK
1996	100% DW
1997	100% DW

Table 2. Genetic background of Kooskia NFH spring chinook salmon smolts directly released from the hatchery, 1971-1997. (RR = Rapid River, KK = Kooskia, LE = Leavenworth, SS = South Santiam, CL = Clearwater, LW = Little White Salmon, CA = Carson, WR = Wind River.)

Release Year	Genetic Background
1971	86% RR, 14% WR
1972	100% RR
1973	100% CA
1974	100% CA
1975	58% RR, 42% CA
1976	100% SS
1977	84% CA, 11% KK, 5% LW
1978	75% RR, 25% CA
1979	69% KK, 31% CA
1980	31% KK, 69% CA
1981	64% CA, 19% KK, 17% RR
1982	100% CA
1983	65% KK, 35% LE
1984	89% KK, 11% RR
1985	100% KK
1986	100% KK
1987	100% CL
1988	100% CL
1989	100% KK
1990	100% KK
1991	100% KK
1992	100% KK
1993	100% KK
1994	100% KK
1995	100% KK

1996

100% KK

1997

100% KK

Table 3. Hatchery rack returns and age composition of spring chinook salmon for Dworshak NFH, 1984-1997.

Year	I-Salt	II-Salt	III-Salt	Unmeasured	Total Return
1984	14	52	16	0	82
1985	13	281	35	5	334
1986	78	346	91	0	516
1987	25	1,604	376	12	2,017
1988	163	569	1,240	0	1,972
1989	156	1,322	221	1	1,700
1990	7	1,892	135	8	2,042
1991	16	77	72	0	165
1992	23	286	40	21	370
1993	9	452	359	3	823
1994	3	30	41	0	74
1995	83	36	6	0	125
1996	275	663	25	0	963
1997	12	2,380	740	18	3,150

Table 4. Hatchery rack returns and age composition of spring chinook salmon for Kooskia NFH, 1972-1997.

Year	I-Salt	II-Salt	III-Salt	Unmeasured	Total Return
1972	5	0	0	0	5
1973	5	45	0	0	50
1974	16	35	2	0	53
1975	15	284	27	0	326
1976	409	286	106	0	801
1977	333	2,539	154	0	3,026
1978	23	1,676	336	0	2,035
1979	11	100	264	0	375
1980	9	55	3	0	67
1981	1	168	78	0	247
1982	3	116	139	0	258
1983	1	231	141	0	373
1984	55	80	206	0	341
1985	26	449	54	0	529
1986	21	159	103	0	283
1987	16	607	64	0	687
1988	39	363	193	0	595
1989	107	717	142	7	973
1990	11	921	209	0	1,141
1991	10	98	350	9	467
1992	14	239	38	21	312
1993	11	749	409	11	1,180
1994	1	96	135	0	232
1995	83	36	6	0	125
1996	86	113	3	0	202
1997	7	1,523	127	0	1,657

Table 5. Age composition of spring chinook salmon returning to Dworshak Fishery Complex, 1997.

Ocean Age	Dworshak NFH		Kooskia NFH	
	Number	Percent	Number	Percent
I - Salt	12	0.4	7	0.4
II - Salt	2,380	76.0	1,523	91.9
III - Salt	740	23.6	127	7.7
Total	3,132	100.0	1,657	100.0
Unmeasured				

Table 6. Return vs. release numbers for adult spring chinook salmon returns to Dworshak NFH, 1988-1996. Includes sport and tribal harvest estimates when there were monitored fisheries (1990 and 1997).

Release Year	Smolts Released <sup>1</sup>	I-Salt (% Return)	II-Salt (% Return)	III-Salt (% Return)	Total (% Return)
1988	1,547,219	156 (0.0101%)	2,709 (0.1751%)	72 (0.0047%)	2,937 (0.1898%)
1989	1,651,472	10 (0.0006%)	77 (0.0047%)	40 (0.0024%)	127 (0.0077%)
1990	1,251,247	16 (0.0013%)	286 (0.0229%)	359 (0.0287%)	661 (0.0528%)
1991	1,094,884	23 (0.0021%)	452 (0.0413%)	41 (0.0037%)	516 (0.0471%)
1992	959,369	9 (0.0009%)	30 (0.0031%)	6 (0.0007%)	45 (0.0047%)
1993	467,222	3 (0.0006%)	36 (0.0077%)	25 (0.0054%)	64 (0.0137%)
1994	1,278,273	83 (0.0065%)	663 (0.0517%)	1,110 (0.0868%)	1,856 (0.1452%)
1995	1,311,445	275 (0.0210%)	3,571 (0.2723)		
1996	102,903	18 (.0175%)			

<sup>1</sup> Releases at hatchery only and does not include off-site releases or fry/fingerling

Table 7. Return vs. release numbers for adult spring chinook salmon returns to Kooskia NFH, 1988-1996.

Release Year	Smolts Released <sup>1</sup>	I-Salt (% Return)	II-Salt (% Return)	III-Salt (% Return)	Total (% Return)
1988	778,407	107 (0.0137%)	921 (0.1183%)	350 (0.0450%)	1,378 (0.1770%)
1989	384,235	11 (0.0029%)	98 (0.0225%)	38 (0.0096%)	147 (0.0077%)
1990	403,701	10 (0.0025%)	239 (0.0590%)	409 (0.1013%)	658 (0.1630%)
1991	396,619	14 (0.0038%)	749 (0.2026%)	135 (0.0365%)	898 (0.2430%)
1992	727,251	11 (0.0015%)	96 (0.0132%)	12 (0.0017%)	119 (0.0164%)
1993	343,437	13 (0.0003%)	7 (0.0020%)	3 (0.0009%)	11 (0.0032%)
1994	305,813	21 (0.0069%)	113 (0.0360%)	127 (0.0415%)	261 (0.0853%)
1995	722,906	86 (0.0119%)	1,523 (0.2107%)		
1996	333,794	7 (.0021%)			

<sup>1</sup> Releases at hatchery only and does not include off-site releases or fry/fingerling releases.

Table 8. Summary of CWT recoveries for adult spring chinook salmon in the Dworshak NFH rack, 1987-1997.

Rack Year	Hatchery Tags Recovered <sup>1</sup>	Total Tags Recovered
1987	19	25
1988	49	55
1989	47	77
1990	302	306
1991	10	30
1992 <sup>2</sup>	177	183
1994 <sup>2</sup>	449	449
1995 <sup>2</sup>	95	95
1996 <sup>2</sup>	508	515
1997	Not Completed	1,937

<sup>1</sup> Includes both Dworshak and Kooskia NFHs.

<sup>2</sup> Recoveries include fish tagged at Kooskia NFH.

Table 9. Predicted and actual rack returns of spring chinook salmon to Dworshak NFH by ocean age class, 1997.

Ocean Age Class	Prediction	Rack Return
I - Salt	6	12
II - Salt	2,725 $\pm$ 300	2,380
III - Salt	100	740
Unmeasured	0	18
Total	2,831 $\pm$ 300	3,150

Table 10. Predicted and actual rack returns of spring chinook salmon to Kooskia NFH by ocean age class, 1997.

Ocean Age Class	Prediction	Rack Return
I - Salt	20	7
II - Salt	720 $\pm$ 100	1,523
III - Salt	20	127
Total	760 $\pm$ 100	1657

Table 11. Predicted returns of spring chinook salmon to the Dworshak Fishery Complex by ocean age class, 1998.

Ocean Age Class	Dworshak NFH	Kooskia NFH
I - Salt	3	1
II - Salt	311	225
III - Salt	496	265
Total	810	491

**APPENDIX II**

**SPAWNING REPORT  
Spring Chinook Salmon  
Brood Year 1997**

**U.S. Fish and Wildlife Service  
Dworshak-Kooskia National Fish Hatchery Complex  
Ahsahka, Idaho**

SPAWNING REPORT

BROOD YEAR 1997  
Spring Chinook Salmon

November 26, 1997

Prepared by:

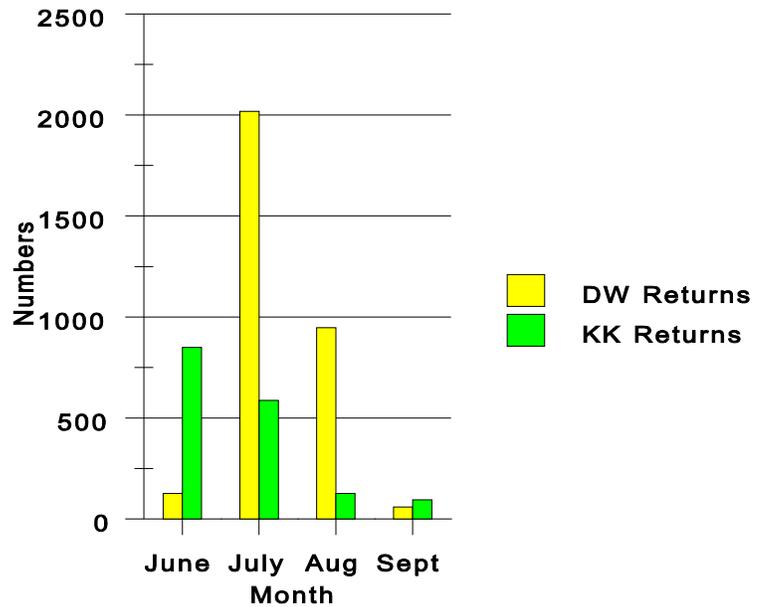
Thomas Trock  
Staff Biologist

U.S. Fish & Wildlife Service  
Dworshak-Kooskia National Fish Hatchery Complex  
Ahsahka, Idaho

**Brood Year 1997 Spring Chinook Salmon  
Dworshak National Fish Hatchery**

Adult Collection

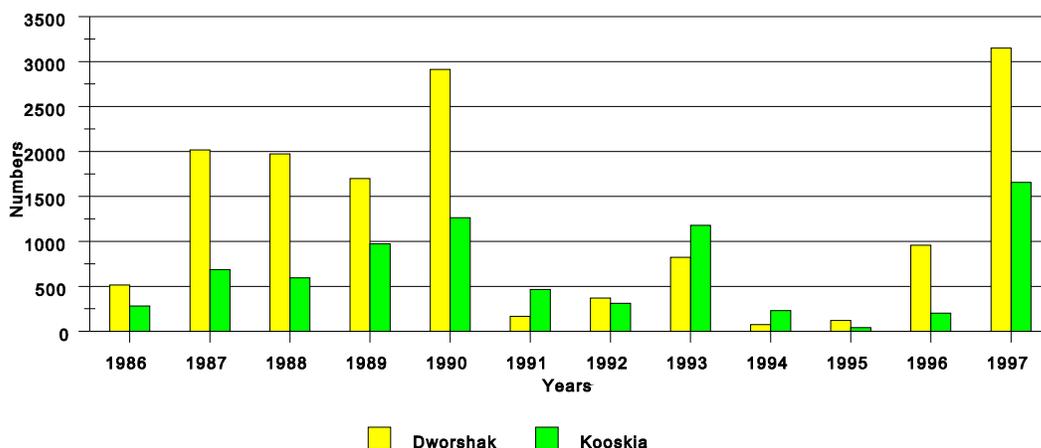
The Dworshak fish ladder was opened May 19, 1997 and closed September 16 for collection of spring chinook salmon (SCS). No salmon were collected in May. Chinook returning in 1997 to Dworshak and Kooskia totaled 3150 and 1657 fish, respectively. The returns from June-September are illustrated in Figure 1. There was a total of 12 jacks returned to Dworshak and 7 jacks to Kooskia. Kooskia transported 1313 fish to Dworshak for spawning and passed 127 fish over the weir.



**Figure 1. SCS returns to Dwsk/Kooskia 1997**

Source: IFRO-Dworshak/Kooskia SCS News-1997

Adult returns for brood year (BY97) SCS were the largest in recent years (Figure 2). A sport season (741 fish) along with a tribal harvest (835 fish) took place along the Clearwater River in the spring and summer of 1997. The Tribe also harvested 12 fish in Clear Creek.



**Figure 2. SCS returns to Dworshak/Kooskia 1986-97**

Source: IFRO SCS rack returns

### Spawning Season

The BY97 Dworshak/Kooskia SCS spawning season began August 26, 1997, and ended September 16. Dworshak adults were held in holding ponds (HP) 1 and 2, Kooskia's stock held in HP3. Fish from each HP were sorted and spawned once/week. Altogether there were 966 females and 775 males spawned (1:1.3 ratio) with approximately 3.5 million green eggs being taken (3,667 eggs/female). Dworshak took 542 females of Dworshak stock, retained 1.2 million eyed eggs for it's program and provided the Nez Perce Tribe (NPT) with 370,000 surplus eyed eggs. There were 316 females spawned of Kooskia stock, providing 732,000 eyed eggs for the Kooskia program. The NPT also took green eggs from 108 females of Dworshak stock for it's program (approximately 400,000 green eggs). These green eggs for the NPT were transferred to Kooskia for initial incubation. All available incubator trays in Dworshak were used for Dworshak and Kooskia initial incubation.

### Spawning Procedure

The spawning procedure was similar to past years: adults were crowded from

the holding ponds into a crowding channel, moved into a channel basket, and placed into an anesthetic bin. Each anesthetic bin was prepared with 130 grams/bin of Tricaine methanesulfonate (MS-222). Pro-Polyaqua was added (250 ml per bin) to reduce stress and susceptibility to infection. Oxygen was provided at a rate of one L/minute. Spinal columns of ripe females were severed using a pneumatic knife. The females were then placed on a table for 3-20 minutes for blood drainage. The ventral side was then cut open using a spawning knife and eggs were collected in disinfected colanders. After ovarian fluid was drained, the eggs were poured into a clean bucket. Milt from ripe males was stripped into Styrofoam cups and a one-percent saline solution was added to assist in milt motility. The milt solution was poured onto the eggs and swirled for more complete fertilization. After sufficient time had elapsed for fertilization to take place (one to two minutes), the eggs were rinsed of sperm, blood, and other organic matter.

After fertilization, eggs were placed in Heath incubator trays at approximately 3,667 eggs per tray (1 female). In the tray was a 75 mg/l iodophor solution buffered with sodium bicarbonate. Eggs were maintained in this solution for approximately 30 minutes. This was done as a precaution against disease transmission. The egg trays were then pushed into the incubator. Water flow rate was approximately five gallons/minute and temperature averaged 46.0°F.

#### Dworshak Fish Health Center (DFHC)

Kidneys were sampled for BKD from all females spawned and from a representative sample of males. The DFHC also took ovarian fluid from all females spawned for viral inspection. The adult females tested 5.4 percent high BKD (ELISA >1.0) for Dworshak and 10.1 percent for Kooskia. Final culling was at 0.40 ELISA and above for Dworshak (13.3 percent of the females spawned) and 0.50 ELISA and above for Kooskia (23.4 percent).

#### Nez Perce Tribe (NPT)

As mentioned earlier, the NPT spawned eggs from 108 Dworshak females (approximately 400,000 green eggs) to be incubated at Kooskia. In addition, the NPT also took 370,000 low and medium BKD eyed eggs from Take 4 of Dworshak stock which were surplus to Dworshak's needs. These eyed eggs were either planted into Meadow Creek (a tributary to the Selway River), or transferred to Sweetwater Hatchery for further rearing.

#### Cryopreservation Study/University of Idaho

Dworshak coordinated with researchers from the University of Idaho in cryopreservation of salmonid gametes. Joe Cloud is the primary investigator in studying the effects of short-term storage of milt prior to cryopreservation. Rolf Ingermann and David Bencic are studying the

relationship between ATP content regarding the motility and viability of the sperm. Dworshak provided chinook milt from 22 males and eggs from 12 females from excess spawning requirements.

#### Idaho Supplementation Study (ISS)

There were 21 females and 22 males collected from the Kooskia trap which were spawned for the ISS program. These fish yielded 72,610 green eggs which had a 86 percent survival for a total of 62,244 eyed eggs. These eggs were isolated from other eggs during initial incubation at Dworshak and were transferred to Kooskia in October, 1997, for final incubation and rearing.

#### Incubation

Upon eye-up (approximately 39 days after fertilization at 46.0°F), the eggs were shocked. The next day the eggs were enumerated and sorted using an electronic egg picker and counter (Van Gaalen Model N-100). Eggs were then disinfected for 10 minutes in a 100 mg/l iodophor solution buffered with sodium bicarbonate. Eyed eggs were then returned to Heath trays at 5000 per tray. The water flow was about 5 gpm in the trays. There were 670,000 eggs from Kooskia stock transported to Kooskia a few days after enumeration. Included in this number is 62,244 eggs from the Idaho Supplementation Study. Due to space/water constraints at Kooskia, Dworshak held another 63,990 Kooskia eggs for initial rearing. These will be transferred to Kooskia in August, 1998.

Water temperature in the incubation room averaged 46.0°F. Temperatures were kept the same for all Takes to facilitate eye-up and hatching to be approximately one week apart. The cold water line from Dworshak Reservoir was used as the sole water source. In an effort to further delay egg development, a small chiller which provided about 80 gpm of 42.0°F water was connected to the overhead supply tank in the incubation room.

Use of 46°F chilled water allows for a reduction in egg development so that smolts will be a target size of 15-20 fpp at release in the Spring of 1999. This delay in egg development is being undertaken to reduce the length of the chinook feeding program from 17 months to 15 and a half months. With this shortened feeding program, chinook will fast for a shorter period of time than if the water were not chilled. It is believed the fish will be in better condition for smoltification under this hatching and rearing plan. Tables 1 and 2 summarize the egg take and survival for both Dworshak and Kooskia BY97 SCS. Dworshak fry should be transferred from the incubator trays to the Dworshak nursery in December of 1997.

Table 1. Dworshak BY97 SCS egg take and survival.

Take	No of Female	Females culled BKD>0.4	Females culled eyed eggs	Eggs/Female	Eyed Eggs	Percent Enum Eye-up	Percent Total Eye-up
1	140	11	1	3,935	468,500	93.0	85.0
2	108	6	0	3,697	333,700	88.5	83.6
3	118	17	1	3,586	335,139	93.5	79.2
4	170	37	1	3,607	423,179	88.9	69.0
5	6	3	0	4,400	8,719	66.1	33.0
Tot/Ave	542	74	3	3,724	1,569,237	90.9	78.9
DW Production					1,199,237		
Extra/NPT					370,000		

Source: Egg Enumeration and Disposition Summary BY97 SCS  
 FHC BKD ELISA testing results BY97 SCS

Table 2. Kooskia BY97 SCS egg take and survival.

Take	No of Female	Females culled BKD>0.5	Females culled eyed eggs	Eggs/Female	Eyed Eggs	Percent Enum Eye-up	Percent Total Eye-up
1	45	5	1	3,719	131,816	90.9	78.8
2	154	32	3	3,470	397,699	96.3	74.4
3	115	39	1	3,550	195,941	73.6	48.0
4	2		0	4,315	7,419	86.0	86.0
Tot/Ave	316	316	5	3,545	732,875	89.2	68.3
Shipped to Kooskia					668,885		
Kept at Dworshak					63,990		
DW & KK combined average				3,667		90.3	75.5

Source: Egg Enumeration and Disposition Summary BY97 SCS  
 FHC BKD ELISA testing results BY97 SCS

Dworshak Nursery Loading

Due to Dworshak's space constraints in the nursery regarding the steelhead program, the following rearing regime is planned for BY97 SCS. After

culling all eggs of appropriate BKD levels, Dworshak will put approximately 1.12 million fry of Dworshak stock into 56 tanks in its nursery. Dworshak will also initially rear 64,000 fish of Kooskia stock in three tanks in the nursery. These 1,180,000 fish will be reared in C and D banks with initial loadings at about 20,000 fish/tank. There will be about 45 lbs fish/tank in April. This will equate to density indices of less than 0.3, eliminating any need to split tanks of fish (Table 3). Outside ponding will occur in April, 1998, when the fish are about 300-500 fpp.

Table 3. Nursery loading of 1,180,000 SCS into 59 concrete tanks/92ft<sup>3</sup> each.

Date	Number/tank	Weight/tank	Length (in)	FPP	DI
Jan 1	20,000	13	1.3	1500	0.11
Feb 1	19,800	17	1.4	1200	0.13
Mar 1	19,602	23	1.6	850	0.16
Apr 1	19,406	35	1.8	550	0.21
May 1	19,212	60	2.2	320	0.30

Assume 1% loss/month.

Source: Nursery Rearing Unit Records, DW Production BY96 SCS.

#### Initial Pond Loading

Historically during full rearing capacity years, 40-42,000 SCS would be loaded per raceway. Due to fish health concerns and low adult returns, loadings of 10-25,000 have been more common the past five years. With Dworshak being at full capacity again with BY97 SCS, approximately 37,000 fish per raceway will be the final loading rate. All BY97 SCS will be moved to outside raceways in April, 1998, to make room for BY98 steelhead. The chinook fingerlings will be first inventoried during their move from nursery tanks to outside ponds. This inventory will be checked against fish marking inventory values obtained from coded wire tag and ad-clip marking crews in June or July 1998. With the 670,000 eyed eggs shipped to Kooskia, both Dworshak and Kooskia will be at full rearing capacity for BY97 SCS.

#### Diet

Spring chinook salmon fry are brought on feed at 1,800 fpp and begin feeding on BioDiet No. 2. Over the 15 month program at Dworshak, the fish are fed seven sizes of feed, as outlined in Table 4 below. The hatchery currently uses feed exclusively from Bioproducts, Inc. During the rearing program the chinook receive a 28-day prophylactic treatment of medicated feed containing erythromycin. This medicated feeding will be given to BY97 SCS in the Spring 1999.

Table 4. Feed changeover, SCS BY97.

Feed No.	Feed Type	Feed Name	Abbrev.	Start fpp	End fpp
1	Biodiet Starter	BDS 2	BDS2	1800	750
2	Biodiet Starter	BDS3	BDS3	750	400
3	Bimoist Grower	BMG 1.0 mm	BG10	400	300
4	Bimoist Grower	BMG 1.3 mm	BG13	300	200
5	Bimoist Grower	BMG 1.5 mm	BG15	200	100
6	Bimoist Grower	BMG 2.5 mm	BF25	100	50
7	Bimoist Grower	BMG 3.0 mm	BF30	50	18

Source: FCTBSCDW.wk1 - 05/17/94

#### Growth Projection

The expected monthly growth rates and general target lengths for the BY97 chinook program are presented in Table 5. This growth regime allows for producing smolts the targeted size of 15-20 fpp.

Table 5. Growth projection for SCS BY97, Dworshak NFH.

Date	Temperature °F	FPP	Length (in)	Growth this month (in)
Jan 1	40.2	1500	1.30	0.10
Feb 1	39.1	1223	1.40	0.18
Mar 1	39.8	849	1.58	0.20
Apr 1	40.9	593	1.78	0.27
May 1	44.3	390	2.04	0.23
Jun 1	45.0	285	2.27	0.37
Jul 1	52.8	182	2.64	0.42
Aug 1	53.3	117	3.05	0.49
Sep 1	53.1	75	3.54	0.51
Oct 1	53.3	50	4.05	0.43
Nov 1	48.8	37	4.48	0.27
Dec 1	43.2	31	4.76	0.22
Jan 1	40.2	27	4.98	0.20
Feb 1	39.1	24	5.18	0.15
Mar 1	39.8	22	5.33	0.17
Apr 1	40.9	20	5.50	
Apr 16	42.0	18	5.70	

Source: GROWTJMS.WK1

### Smolt Disposition

All smolts produced from the Dworshak stock will be released from Dworshak hatchery into the North Fork of the Clearwater River in the spring of 1999. At Kooskia, smolts from the pond containing ISS fish will be released upstream in Clear Creek (approximately 100,000 fish). All other smolts produced from Kooskia stock will be released from Kooskia hatchery on Clear Creek. This creek is a tributary to the Middle Fork of the Clearwater River.

### Program Objectives

Projected release numbers for BY97 spring chinook salmon program are summarized in Table 6.

Table 6. Program objectives for BY97 SCS, Dworshak Complex.

Rearing location	Fish stock	Number at Release	Release Site	Type of release	FPP at release	Date of release
Dworshak	Dworshak	1,050,000	Dworshak	Smolt	15-20	Apr 99
DW/KK	Kooskia	50,000	Kooskia	Smolt	15-20	Apr 99
Kooskia	Kooskia	600,000	Kooskia	Smolt	15-20	Apr 99
Total smolts		1,700,000			15-20	

\*Projected release number is based on a green egg to eyed egg survival of 90%. Historical eyed egg to smolt survival has been 88% (1995 SCS Spawning Report)

### Adult Disposition

There were a total of 482 adults from Kooskia stock and 594 Dworshak stock which were outplanted from July to September, 1997 (IFRO-Adult SCS Outplants). Twenty one days before the first spawning date, erythromycin injections were given to the females. Due to these injections and the deteriorated condition of the adults after spawning, carcasses were unfit for human consumption and were subsequently transferred to the landfill.