

**BROOD YEAR REPORT
DWORSHAK NATIONAL FISH HATCHERY
SPRING CHINOOK SALMON
BROOD YEAR 2000
LIFE CYCLE COMPLETED IN 2005**

PREPARED BY

**Ray Jones and Carrie Bretz
Idaho Fishery Resource Office**

**Thomas Trock
Dworshak National Fish Hatchery**

**Marilyn Blair
Idaho Fish Health Center**

**Dworshak Fisheries Complex
U.S. Fish and Wildlife Service
276 Dworshak Complex Lane
Orofino, Idaho 84544**

PREPARED FOR

**Complex Manager
Dworshak Fisheries Complex
U.S. Fish and Wildlife Service
276 Dworshak Complex Drive
Orofino, Idaho 83544**

and

**The Lower Snake River Compensation Plan Office
U.S. Fish and Wildlife Service
1387 South Vinnell Way, Suite 343
Boise, Idaho 83709**

January 2011

BROOD YEAR 2000 OVERVIEW

Life Stage	Number
2000 Rack Return	3,202
Number of Females Spawned	439
Green Eggs Taken¹	1,536,500
Average Eggs per Female	3,782
Eyed Eggs	1,115,448
Smolts Released	1,000,561
In-River Smolt Survival²	0.815
Adult Returns to the Hatchery³	2,779
Adults Harvested in Idaho⁴	4,261
Known Adult Return to Clearwater River	7,074
Adults Collected at Other Locations⁵	1,194

¹ Number based on the number of eggs culled and enumerated eyed eggs.

² Minimum survival to Lower Granite Dam based on PIT tag interrogations.

³ 1-Ocean, 2-Ocean, and 3-Ocean returns in 2003, 2004, and 2005 to the hatchery rack.

⁴ Tribal and Sport fisheries combined (minimum estimate based on incomplete data).

⁵ Based on expanded coded-wire tagged fish recovered in various fishery programs below 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 Columbia, Snake, and Clearwater rivers, data is provisional and subject to future revision and corrections, especially in regards to the adult returns. 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.

Addendum: Since the original report for the BY2000 adult returns was written (Idaho Fishery Resource Office 2000), data on the rack return for Dworshak NFH and the sport harvest on Dworshak NFH stock in the Clearwater River reported by the Idaho Department of Fish and Game have been revised and updated. The changes have been made in the original Annual Report, the 2011 and subsequent Annual Reports, and this Brood Year Report.

Citation for this report

Jones, R.N., C. Bretz, T. Trock, and M. Blair. 2011. Brood year report, Dworshak National Fish Hatchery spring Chinook salmon brood year 2000, life cycle completed in 2005. Technical fisheries report by Dworshak Fisheries Complex, U.S. Fish and Wildlife Service, Ahsahka, ID. 27p.

Acknowledgments

The Complex would like to acknowledge and extend much appreciation to all the other Administrative, Production, Maintenance, and Fish Health staff members at Dworshak Fisheries Complex who accomplish all the fundamental work of producing spring Chinook salmon at Dworshak National Fish Hatchery on an annual basis. From the time that adults are collected and spawned until the smolts are released almost two years later, the Production staff logs an incredible number of hours feeding, cleaning, and monitoring over a million fish on a daily basis. During that time, the Maintenance staff keeps a very complicated infrastructure of rearing containers, pumps, piping, electrical systems, and other equipment operational. The Fish Health staff provides continual testing and monitoring of infectious diseases and parasites. The Administrative Staff works behind the scenes to insure efficient and timely processing of all the necessary paper work required to keep everything operational. Your names might not be on the cover, but you are the people that are really responsible for all that the Complex accomplishes.

INTRODUCTION

This report provides data for Brood Year (BY) 2000 spring Chinook salmon (SCS) at Dworshak National Fish Hatchery (NFH) which completed its life cycle in 2005. Data are summarized on the adults that were spawned to create the brood year, egg production, nursery rearing, juvenile rearing, smolt releases, fish health, smolt emigration to the ocean, adult contribution to fisheries, adult returns to the hatchery, and estimated total adult return to Lower Granite Dam. 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 Fisheries Complex.

The reporting of production data for Brood Year 2000 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 2000 were occasionally 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 BY2000 Kooskia NFH spring Chinook salmon will be found in the applicable reports 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 2000, the smolt release target was 1,050,000 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) and the criteria developed by Integrated Hatchery Operation Team (IHOT).

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 River. Adults pass an electronic counter and enter an adult trap 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 or out-planted. The adult holding ponds are about 8,400 cubic feet in volume and can accommodate about 600-800 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. In previous years, fry were transferred to inside nursery tanks after hatching. Dworshak NFH has 64 concrete tanks and 64 fiberglass nursery 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. However, starting with BY98, fry were transferred directly into the outside rearing raceways, eliminating nursery rearing, in order to lessen the impact on the summer steelhead rearing program. 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.

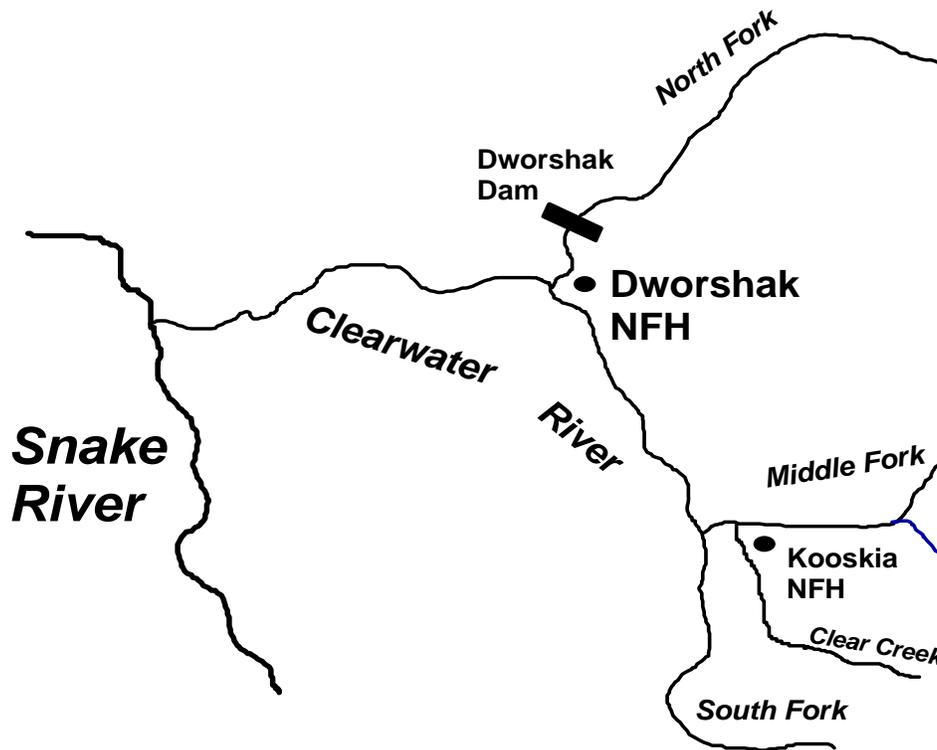


Figure 1. Location of Dworshak National Fish Hatchery (NFH) at the confluence of the North Fork and main stem Clearwater River, Idaho.

2000 ADULT SPRING CHINOOK SALMON RETURN TO DWORSHAK NFH

Pre-Season Assessment

The Idaho Fishery Resource Office (FRO) uses a regression equation based on the 2-Ocean (Jack) returns in the previous year to predict the number of returning 2-Ocean adults the following year. Predictions for the 1-Ocean and 3-Ocean age classes is based on average return rates, since the regression model does not work well for those age classes. In 1999, a prediction of 8,938 adult returns to the Clearwater River was made for the 2000 season. The breakdown by age class for the predicted return is given below in **Table 1** (Idaho Fishery Resource Office 1999).

Table 1. Pre-season prediction of adult returns to the Clearwater River, by ocean age (Idaho Fishery Resource Office 1999).

Ocean Age	Prediction for 2000
1 - Ocean	349
2 - Ocean	8,567
3 - Ocean	22
Total	8,938

At the time we made the prediction, we were not entirely confident, since the 1-Ocean return in 1999 was more than double the previous record for this age group, giving us a point in our regression that was way outside the normal range of data points. However, the prediction was only 468 fish greater than the actual return to the Clearwater River, the difference being primarily our over-estimate of the number of 2-Ocean adults that would return (Idaho Fishery Resource Office 2000).

Total Rack Return

The total rack return is the number of adults that return to the hatchery and is not an accounting of the total return to the river. The 2000 adult spring Chinook salmon return to Dworshak NFH was 3,202 adults (**Table 2**).

Table 2. Actual rack return of adult spring Chinook salmon to Dworshak NFH by ocean age (Idaho Fishery Resource Office 2000).

Ocean Age	Smolts Released	2000 Rack Return
1 - Ocean	1,044,511 (1999)	233
2 - Ocean	973,400 (1998)	2,866
3 - Ocean	53,078 (1997)	103
Unmeasured		0
Total		3,202

Ladder Operations and Adult Inventories

As large numbers of spring Chinook salmon crossed over Bonneville and Lower Granite dams, the prediction of a large run made in 1999 materialized. Since the potential was very high for collecting large numbers of spring Chinook salmon adults early in the season, the decision was made to operate the fish ladder at Dworshak intermittently. The ladder was opened and closed four times from June 15 through July 12, 2000. On July 13, the ladder was opened and operated continuously through September 18, 2000 (Dworshak NFH 2000a). Records are not available to document the day the first and last fish entered the hatchery. The first inventory was taken on June 30. Inventories were taken weekly thereafter until the end of the season. By August 10, 2,888 adult fish or 91% of the run had entered the hatchery. The number of spring Chinook salmon entering the hatchery weekly is listed in **Table 3**. Inventories were conducted on the dates listed.

Table 3. Number of spring Chinook salmon entering the hatchery ladder from June 15 through September 18, 2000, by ocean-age class (Idaho FRO database files). Numbers are weekly totals based on inventories and do not include trap mortalities or unmeasured fish.

Date	1-Ocean	2-Ocean	3-Ocean	Total
June 30	20	389	12	421
July 5	22	379	6	407
July 13	35	604	20	659
July 20	34	714	18	766
August 10	45	561	36	642
August 23	25	121	8	154
August 30	36	66	0	102
September 6	14	21	1	36
September 12	2	10	1	13
September 19	0	1	1	2
Total	233	2,866	103	3,202

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 coded-wire tag (CWT) recovery databases. Ocean age categories are listed below:

- 1 - Ocean (Jacks) < 56 cm
- 2 - Ocean = 57 to 81 cm
- 3 - Ocean > 81 cm.

Adult spring Chinook salmon that return to Dworshak NFH are predominately 2-Ocean fish, those that spend two years in salt water before returning to freshwater to spawn. The mean percent returns in the rack for 1-Ocean, 2-Ocean, and 3-Ocean are 16%, 57%, and 26%, respectively, for all years from 1984 to 1999 (**Table 4**). The return in 2000 was somewhat atypical, 7% 1-Ocean, 90% 2-Ocean, and 3% 3-Ocean in that the percentage of 1-Ocean and 3-Ocean adults was lower than average while the 2-Ocean adults were considerably higher than average.

Table 4. Number and percent of adult spring Chinook salmon that returned to Dworshak NFH since 1984, by ocean age (Idaho Fishery Resource Office 2000).

Return Year	1-Ocean		2-Ocean		3-Ocean		Total Return
1984	14	17%	52	63%	16	20%	82
1985	13	4%	285	85%	36	11%	334
1986	78	15%	346	67%	91	18%	515
1987	25	1%	1,614	80%	378	19%	2,017
1988	163	8%	569	29%	1,240	63%	1,972
1989	156	9%	1,323	78%	221	13%	1,700
1990	7	0.3%	1,899	93%	136	6.7%	2,042
1991	16	10%	77	47%	72	43%	165
1992	24	6%	303	82%	43	12%	370
1993	9	1%	454	55%	360	45%	823
1994	3	4%	30	41%	41	55%	74
1995	83	66%	36	29%	6	5%	125
1996	275	28%	663	69%	25	3%	963
1997	12	0.4%	2,394	76%	744	23.6%	3,150
1998	11	1%	176	19%	728	80%	915
1999	670	84%	78	10%	52	6%	800
Mean	97	16.02%	640	57.26%	261	26.21%	1,001
2000	233	7.3%	2866	89.5%	103	3.2%	3,202

Adult Tagging

Because of space and water temperature limitations at Kooskia NFH, all the spring Chinook salmon collected for brood stock at that hatchery are transferred to Dworshak NFH for holding and spawning. To ensure separation of the two stocks, all the Dworshak NFH adult spring Chinook salmon were marked with a left opercul punch and the adults from Kooskia NFH were marked with a right opercul punch.

Adult Holding and Mortality

Formalin treatments were administered to adults in the holding ponds to retard fungus infection. Treatments began on July 6 and ended on September 4. Treatments were given on the average of three times per week. Treatments consisted of dripping 200 mg/l into each pond over the course of an hour.

Adult females were injected with Erythromycin to protect eggs from vertical transmission of *R. salmoninarum*. Each female received a dosage of 20 mg/kg of body weight. 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 June 15 to August 22, a total of 170 adult spring Chinook

salmon (5.3% of rack return) died: 109 females and 61 males (7 jacks).

Mortality During Spawning - From August 23 through September 26, an additional 95 adults died (3.0% of rack return), 36 females and 59 males. Of the 59 males, 21 were jacks.

Compared to previous brood years, the mortality rate of BY2000 spring Chinook salmon adults during holding was very low. Total mortality was the second lowest on record, compared to the previous five years (**Table 5**).

Table 5. Percent mortality of adult spring Chinook salmon during holding (pre-spawning) and during spawning at Dworshak NFH, 1995-2000 (Table 9, Dworshak National Fish Hatchery 2000b.).

Year	Pre-spawning %	During Spawning %	Total %
1995	6.4	23.2	29.6
1996	2.5	14.1	16.6
1997	3.6	4.6	8.2
1998	3.0	5.6	8.5
1999	3.1	17.7	20.8
5 yr Ave	3.7	13.0	16.8
2000	5.3	3.0	8.3

Spawning

Details on the methods and procedures during spawning are provided in the Spawning Report for Brood Year 2000 (Dworshak National Fish Hatchery 2000b). Spawning was started on August 22. Eight takes were made with the last ripe females for the Dworshak NFH program taken on September 19. A summary of the number of males and females spawned each week is presented in **Table 6**.

Adult Out-Planting

In years where the return of adults exceeds the brood stock needs of the program, excess adults that enter the ladder have been transported to various streams within the Clearwater River and released to spawn naturally. These activities are coordinated with the Idaho Department of Fish and Game and the Nez Perce Tribe. In 2000, a total of 1,868 adult spring Chinook salmon were out-planted into various streams to supplement natural production. Dates, locations, and numbers of fish out-planted are listed in **Table 7**.

Table 6. Number of male and female spring Chinook salmon spawned during each egg take for Brood Year 2000 at Dworshak NFH (Table 2, Dworshak National Fish Hatchery 2000b).

Take Date	Males Spawned	Females Spawned
8/22/00	30	28
8/23/00	47	63
8/29/00	63	95
8/30/00	74	115
9/5/00	47	59
9/6/00	31	31
9/12/00	30	30
9/19/00	20	20
Total	342	439

Table 7. Summary of excess adult spring Chinook salmon outplanted into various streams from Table 11, Dworshak National Fish Hatchery (2000b).

Date	Outplanting Site / Disposition	Adults	Jacks	Total
7-19-00	Selway-McGruder	476	28	504
7-26-00	Selway-McGruder	396	35	431
8-09-00	Lolo Creek	507	24	531
9-07-00	Gedney Creek	137	16	153
9-07-00	Meadow Creek	219	30	249
Total		1,735	133	1,868

EGG PRODUCTION AND INCUBATION

Data on early incubation, eye-up, and final incubation and hatching is found in Dworshak NFH annual reports for 2000 and 2001, the hatchery monthly production narratives, as well as the spawning report for BY2000 (Dworshak National Fish Hatchery 2000b).

Green Eggs Taken

Eggs are not enumerated until after eye-up. The number of green eggs taken initially is estimated using an average of 3,500 eggs per female. A total of 439 females were spawned, giving an initial estimate of 1,536,500 green eggs.

Early Incubation (Dworshak NFH)

Early incubation until the time of eye-up was accomplished at Dworshak NFH. Eggs from each female were incubated separately to keep them segregated until their Bacterial Kidney Disease (BKD) status (low/medium/high) could be determined. Status of the female parent was 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. /m.

Eggs Culled for BKD

Generally, eggs from females that test high (≥ 1.0 ODU) for BKD are culled from production. The eggs from 116 females were culled after testing resulted in ODUs indicating high levels of BKD (Dworshak National Fish Hatchery 2000b).

Eye-Up

Takes 1 – 3 were incubated on water chilled to 39 degrees F. Eye-up occurred after 70 days. Takes 4-8 were incubated at water temperatures averaging 45 degrees F with eye-up occurring after 42 days (Dworshak National Fish Hatchery 2000b). Eggs were shocked, dead eggs were removed, and eggs were enumerated by a mechanized egg picker. A total of 56,956 dead eggs were counted. The total number of eyed eggs enumerated was 1,115,448 for a total of 1,172,404 eggs, producing an average of 3,782 eggs per female, higher than the average (**Table 8**).

Table 8. Summary of egg take and eye-up for Dworshak NFH BY2000 spring Chinook salmon (Table 2, Dworshak National Fish Hatchery 2000b).

Take	Spawn Date 2000	No of Male	No of Fmle	Fmles culled BKD >0.10	Fmles culled grn eggs	Dead Eggs Enum	Eyed Eggs Enum	Total Eggs Enum	Eggs/Fmle	Percent Enum Eye-up
1	08/22	30	28	19	1	3,294	33,387	36,681	4,585	91.0
2	08/23	47	63	10	7	9,103	166,728	175,831	3,822	94.8
3	08/29	63	95	15	4	24,761	241,600	266,361	3,505	90.7
4	08/30	74	113	6	1	10,062	389,140	399,202	3,766	97.5
5	09/05	47	59	22	0	7,204	140,350	147,554	3,988	95.1
6	09/06	31	31	14	0	1,201	65,609	66,810	3,930	98.2
7	09/12	30	30	19	0	524	45,614	46,138	4,194	98.9
8	09/19	20	20	11	0	807	33,020	33,827	3,759	97.6
Tot/ Ave		342	439	116	13	56,956	1,115,448	1,172,404	3,782	95.1

Egg Transfers and Final Incubation

In order to delay the time of hatching so that fish would reach the targeted release size without resorting to a feed reduction program, the Dworshak Hatchery Evaluation Team recommended transferring all of Dworshak NFH's spring Chinook salmon eggs to Kooskia NFH to take advantage of 39 degrees F water temperatures, delaying hatching. All of Dworshak NFH's spring

Chinook salmon eggs were shipped to Kooskia NFH in October and November, 2000 immediately after enumeration. **Table 9** lists the number of eggs transferred to Kooskia NFH for final incubation.

Table 9. Date and number of BY2000 spring Chinook salmon eggs transferred to Kooskia NFH for final incubation (Table 4, Dworshak National Fish Hatchery 2000b).

Date Shipped	Spawning Take	Number of Eggs
Oct 16	4	389,140
Oct 20	5	140,350
Oct 20	6	65,609
Oct 26	7	45,614
Nov 2	1	33,387
Nov 2	2	166,728
Nov 3	8	33,020
Nov 16 - 17	3	241,600
Total		1,115,448

JUVENILE REARING

The following data and information was summarized from the 2001 and 2002 Annual Reports for Dworshak NFH, the Dworshak NFH monthly production narratives, and the Dworshak NFH monthly inventory summaries (MIS).

Transfers and Handling

After hatching, the fry were transferred to Dworshak NFH for rearing. From April 10 to 25, 2001, four groups of sac-fry totaling 827,650 fish were stocked into outside raceways for initial rearing. On May 10, 2001, the remaining 227,548 sac-fry were transferred to Dworshak NFH and were stocked into outside raceways, bringing the total number to 1,055,198. The average hatching success from eye-egg to sac-fry was 95%.

Growth and Mortality

By the end of June 2001, the fish averaged 2.3 inches in mean length. A record of daily growth and mortality, from the end of June 2001 until the time of release in March 2002, is listed in **Table 10**.

On September 28, about 30,000 juveniles of Rapid River stock were transferred from Clearwater River State Fish Hatchery to Dworshak NFH. These fish were treated with 350 lbs of salt and a one-hour formalin treatment for caudal-peduncle fungus, believed to be caused by a mechanical

abrasion problem. Caudal peduncle fungus became a semi-chronic problem with a number of different raceways from December 2001 through March, 2002, primarily associated with handling. On December 12, 450 lbs. of salt was added to raceway (RW) 27 to help alleviate tail fungus. Mortality was reduced after treatment. On January 16, fish in RWs 12, 16, 19, 20, 21, and 22 received a one-hour formalin bath to reduce fungus. Fish in raceway 16 had been involved with a study conducted in December by the Nez Perce Tribe to examine the accuracy of subsampling populations. On February 26–28, SCS in raceways (RWs) A1–A3 were given a formalin and salt bath to prevent fungus.

Growth was faster than was desired during by the end of November 2001 and fish were taken off of feed from December 1 -7, 2001. Fish were taken off of feed again from January 10 – 15, 2002. The use of fasting was successful in keeping growth slow enough to meet the targeted release size of about 20 fpp.

Table 10. Summary of monthly growth and mortality of Brood Year 2000 spring Chinook salmon during outside raceway rearing at Dworshak NFH. Compiled from Dworshak NFH 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 (DegreesF)
6/01	1,038,537	3,724	278.9	2.3	-	0.57	49.0
7/01	951,456 ¹	6,432	147.9	2.8	0.5	0.55	48.8
8/01	979,965 ²	10,169	96.4	3.3	0.5	0.23	47.5
9/01	1,008,151 ³	14,379	70.1	3.6	0.3	0.13	43.5
10/01	1,007,126	20,311	49.6	4.1	0.5	0.10	46.2
11/01	1,006,317	28,101	35.8	4.5	0.4	0.08	46.2
12/01	1,005,369	32,922	30.5	4.8	0.3	0.09	45.4
1/02	1,003,366	37,803	26.5	5.0	0.2	0.20	42.1
2/02	1,002,075	43,345	23.1	5.2	0.2	0.13	42.1
3/02	1,000,561	50,123	20.0	5.5	0.3	0.15	40.3

¹ This number reflects mortality (5,712) plus a shortfall of about 80,000 in inventory discovered during the process of fin-clipping and coded-wire tagging.

² This number reflects mortality (2,188) plus an increase in about 29,000 in final inventory at the end of fin-clipping and coded-wire tagging.

³ About 30,000 Rapid River stock from Clearwater SFH was transferred to Dworshak NFH September 13-14, 2001.

Marking and Tagging

Coded-Wire Tags and Adipose Fin Clips- Adipose fin clipping and coded wire tagging was conducted by the U.S. Fish and Wildlife Service, Columbia River Office, Vancouver, between

July 31 and August 2, 2001. A total of 120,225 spring Chinook salmon fingerlings representing Dworshak stock were coded-wired tagged to evaluate the contribution of Dworshak NFH to commercial, sport and tribal fisheries in the lower Snake and Columbia rivers as well as in the ocean (**Table 11**). All the spring Chinook salmon smolts on station were adipose fin clipped to identify them as hatchery fish. Coded-wire tag retention rates were determined by sampling 500 fish from each tag code group in March 2002, prior to release. Tag code 50491 had a retention rate of 87.5% and tag code 50489 had a retention rate of 93.9%.

PIT tags - A total of 54,726 Brood Year 2000 spring Chinook salmon representing Dworshak stock were PIT tagged during February and March, 2002 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 11. Coded-wire tag release information for Brood Year 2000 spring Chinook salmon released from Dworshak NFH in 2002.

Hatchery	Tag Code	Number of Tags	Number of Unmarked Fish	Mark Rate	Purpose
DNFH	050489	55,845 ¹	452,320	0.11	Contribution, Raceways A10 and A15
	050491	52,189	440,207	0.11	Contribution, Raceways B26 and B27

¹ The number reported is adjusted for mortality and tag loss.

SMOLTS RELEASES

Idaho FRO began monitoring stream flows in the Clearwater River at the beginning of March, 2002 to coordinate spring Chinook salmon smolt releases with increases in the hydrograph. Mean daily flows in Lower Granite Reservoir remained well below the 10 year average during the entire month of March. However, by the end of the month flows significantly increased and had reached the 10-year average (**Figure 3**). Mean daily flow in the Clearwater River stayed below the 10-year average during the entire month of March and never quite reached the 10-year average (**Figure 4**). Ordinarily, the Chinook are released into the North Fork of the Clearwater with the Corp of Engineers providing short-term (12-24 hours) increased flows out of Dworshak Reservoir to push the fish into the main stem. Flows out of Dworshak Reservoir increased from 1,500 cfs on March 24 to 10,300 cfs on March 27. Flows in the North Fork remained above 10,300 cfs during the rest of the month, facilitating the release of spring Chinook salmon from Dworshak NFH into the North Fork Clearwater on March 27 and 28, 2002. Releases were made during the afternoon and early evenings. A total of 1,000,561 spring Chinook salmon smolts were released averaging 140 mm in total length.

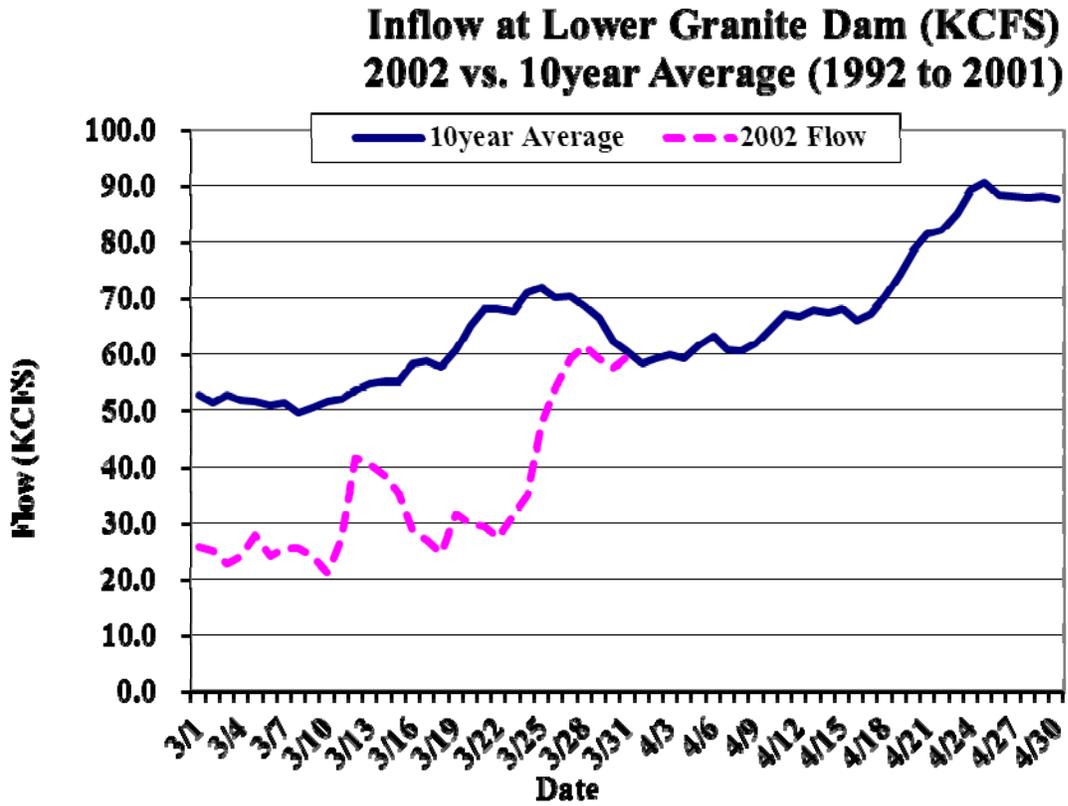


Figure 3. Mean daily flow compared to the 10 year average in Lower Granite Reservoir during March 2002.

Clearwater River Flows At Orofino Bridge 2002 vs. 10 Yr. Ave. (1992-2001)

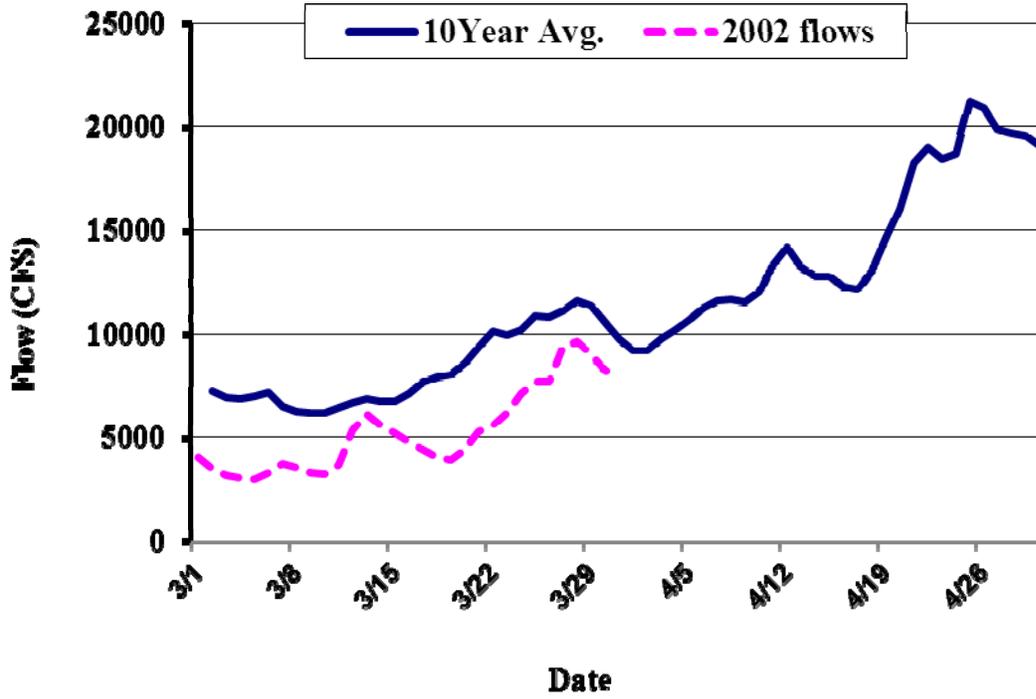


Figure 4. Mean daily stream discharge of the Clearwater River at the Orofino bridge, 2002.

FISH HEALTH

Adults

Holding - During the period of holding prior to spawning, formalin treatments were administered under veterinary prescription to adults to retard fungus infection. Formalin treatments were administered as bath treatments for one hour per day, 3 days per week at a concentration of 1:6,000.

Pre-Spawning - Beginning at 3 weeks prior to spawning, all adult females which returned before start of spawning were injected with the antibiotic Erythromycin under veterinary prescription to decrease levels of *Renibacterium salmoninarum* (Bacterial Kidney Disease) in the eggs. Each female injected received a dosage of 20 mg/kg of body weight.

Spawning -

67/210 (31.9%) adults tested positive for IHNV (Infectious Hematopoietic Necrosis Virus). Ovarian fluid samples were 3 pooled and spleens were not pooled. Not all spleen tissues were sampled from males, so some fish may have been represented twice such as if ovarian fluid and spleen were both sampled from the same female.

Results positive for IHNV by take:

Take 1: 8/38 ovarians, 1/6 spleens

Take 2: 14/69 ovarians, 0/4 spleens

Take 3: 24/42 ovarians, 2/6 spleens

Take 5: 10/21 ovarians, 3/6 spleens

Take 7: 2/11 ovarians, 3/7 spleens

All female adults were tested for Bacterial Kidney Disease (*Renibacterium salmoninarum*) by ELISA (Enzyme-Linked Immunosorbent Assay)

Results:

Not Detected - 365

Low - 104

Medium - 21

High- 5

SCS adults were also positive for the parasite *Ceratomyxa shasta* by examination of wet mounts from scrapes of the walls of the intestines.

Juveniles

Production Monitoring –

Beginning in November, 10 fish per month were sampled for BKD by ELISA.

Results:

11-22-01 – Not Detected: 10

12-12-01 – Not Detected: 9, Low: 1

1-14-02 – Not Detected: 9, High: 1

2-27-02 – Not Detected: 10

May – All fish collected were moribund. Internally most of the fish examined still had egg yolk (9/10) and several also had coagulated yolk (3/10) present. No bacteria seen.

June – No parasites detected on skin or gills. Some fish were slightly bloated due to large amounts of feed in stomachs. A few fish had very small remnants of egg yolk left internally along with coagulated yolk. Bacterial cultures were positive for *Pseudomonas fluorescens* (environmental bacteria). No recommendation for treatment was made due to low mortality levels.

July – Many fish in pond have unilateral white pectoral fins (often seen in association with coagulated yolk syndrome). Low levels of the blood fluke *Sanguinicola* were detected in the gills.

September – Low levels *Epistylis* detected on the skin. Large amounts of fungus seen at the base of tails. No bacteria were grown from kidney samples. Formalin treatment was recommended.

December – Low levels of parasites *Epistylis* and *Costia* seen on the skin of two smaller sized fish. Gills were slightly swollen.

January – Low levels of external parasites *Epistylis* and *Epitheliocystis* were detected on the skin. Very low levels *Sanguinicola* were seen in gills. One fish examined had clinical signs of exophthalmia and abdominal swelling. Internally this fish had excess abdominal fluid, swollen spleen, and swollen and pale kidney. Kidney imprints showed positive for *Renibacterium salmoninarum* (Bacterial Kidney Disease) for this fish. Testing for virus by cell culture was negative.

Another exam in January of moribund fish found all with pale kidneys and low to no food in stomachs. Light levels of *Renibacterium salmoninarum* were seen in kidney imprints.

February – Low levels of the external parasite *Epistylis* was detected on the skin. Low levels *Sanguinicola* were detected in the gills. Ponds were noted to appear dirty and in need of cleaning.

Pre-release exam - 60 fish

ELISA Results: Not detected – 60

Low - 0

Medium - 0

High - 0

Viral assays - negative

Bacterial assays - negative

Hematocrits - 20 samples, all in normal range

Adult Returns

I-Ocean Adults (2003 Return)

67/207 (32.37%) adults tested positive for IHNV (Infectious Hematopoietic Necrosis Virus).

Both ovarian fluid and spleen tissue may have been sampled from the same female. For example in take 1, 39 females spawned, but a total of 52 female samples were taken: 41 were ovarian fluids and 11 were spleens from females. Ovarian fluid samples were 3 pooled and spleens 5 pooled.

Results positive for IHNV by take:

Take 1: 12/41 ovarians, 1/11 female spleens, 1/12 male spleens

Take 2: 9/66 ovarians, 7/12 female spleens, 1/12 male spleens

Take 3: 15/15 ovarians, 4/7 female spleens, 2/7 male spleens

Take 6: 12/18 ovarians, 1/3 female spleens, 2/3 male spleens

All female adults were tested for Bacterial Kidney Disease (*Renibacterium salmoninarum*) by ELISA (Enzyme-Linked Immunosorbent Assay)

Results:

Not Detected - 228

Low - 89

Medium - 32

High- 8

SCS adults were also positive for the parasite *Ceratomyxa shasta* by examination of wet mounts from scrapes of the walls of the intestines.

II-Ocean Adults (2004 Return)

113/213 (53.05%) adults tested positive for IHNV (Infectious Hematopoietic Necrosis Virus). Ovarian fluid samples were 3 pooled and spleens 5 pooled. All spleen tissues were sampled from males.

Results positive for IHNV by take:

Take 1: 12/36 ovarians, 0/9 male spleens

Take 2: 9/18 ovarians

Take 3: 71/95 ovarians, 5/24 male spleens

Take 5: 3/3 ovarians, 13/28 male spleens

All female adults were tested for Bacterial Kidney Disease (*Renibacterium salmoninarum*) by ELISA (Enzyme-Linked Immunosorbent Assay)

Results:

Not Detected - 404

Low - 22

Medium - 6

High- 7

SCS adults were also positive for the parasite *Ceratomyxa shasta* by examination of wet mounts from scrapes of the walls of the intestines.

III-Ocean Adults (2005 Return)

92/210 (43.8%) adults tested positive for IHNV (Infectious Hematopoietic Necrosis Virus).

Ovarian fluid samples were 3 pooled and spleens 5 pooled. All spleen tissues were sampled from males.

Results positive for IHNV by take:

Take 1: 39/62 ovarians

Take 2: 42/87 ovarians, 3/18 spleens

Take 3: 1/1 ovarians, 5/40 spleens

All female adults were tested for Bacterial Kidney Disease (*Renibacterium salmoninarum*) by ELISA (Enzyme-Linked Immunosorbent Assay)

Results:

Not Detected - 327

Low - 45

Medium - 2

High- 0

SCS adults were also positive for the parasite *Ceratomyxa shasta* by examination of wet mounts from scrapes of the walls of the intestines.

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 5**). PIT tags provide information on travel time and survival during emigration. A total of 54,726 PIT-tagged spring Chinook salmon smolts from ten separate raceways were released in 2002 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)

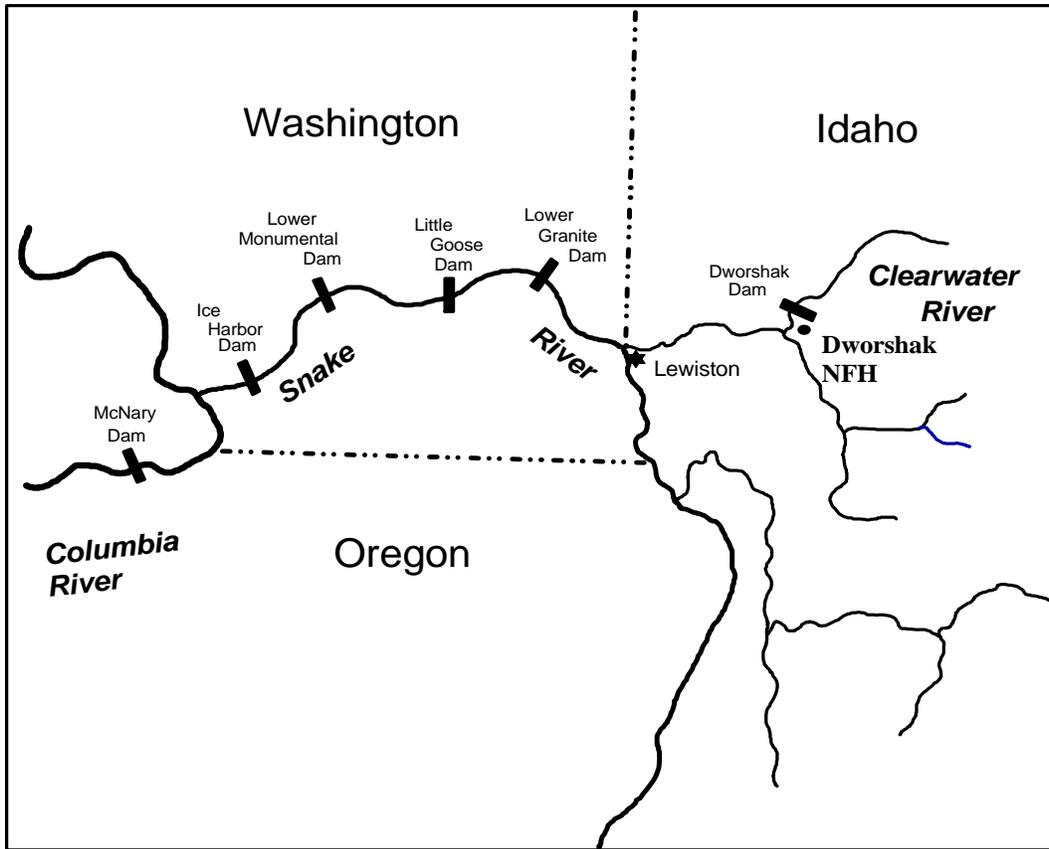


Figure 5. Dams on the lower Snake and Columbia rivers. Lower Granite, Little Goose, Lower Monumental, and McNary dams are PIT-tag interrogation facilities for monitoring smolts emigration.

Travel Time

Travel time for BY2000 spring Chinook smolts released from Dworshak NFH through the Federal Columbia River Power System was monitored using PIT tag interrogations at the juvenile bypass facilities (**Figure 6**).

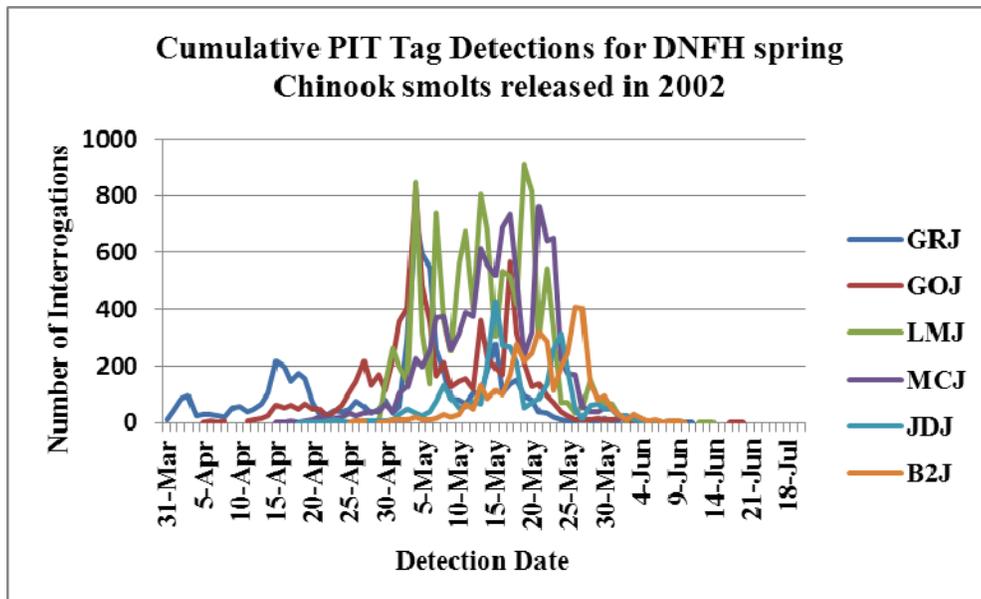


Figure 6. Cumulative PIT tag detections for BY2000 Dworshak NFH spring Chinook smolts at juvenile bypass facilities in the Lower Snake and Columbia rivers.

The migration time of BY2000 smolts released from Dworshak NFH to Lower Granite Dam ranged from 3.5 days to 77.5 days with a harmonic mean travel time of 26.1 (SE=0.284) days. Ten percent arrived at Lower Granite Dam within 16.8 days; 50% and 90% arrived within 37.2 days and 49.8 days, respectively. Smolts that migrated through the hydro system arrived at Bonneville Dam on average 55.0 days after release.

River Flows

After the smolt releases on March 27 and 28, 2002, the inflow to Lower Granite Dam oscillated above and below the 10-year average during entire time of the smolts emigration period of early April through the end of June (**Figure 7**). Inflow into Lower Granite Reservoir remained above 60,000 cfs most of the time and exceeded 120,000 cfs on two occasions, providing more than adequate flows for successful out-migration of smolts.

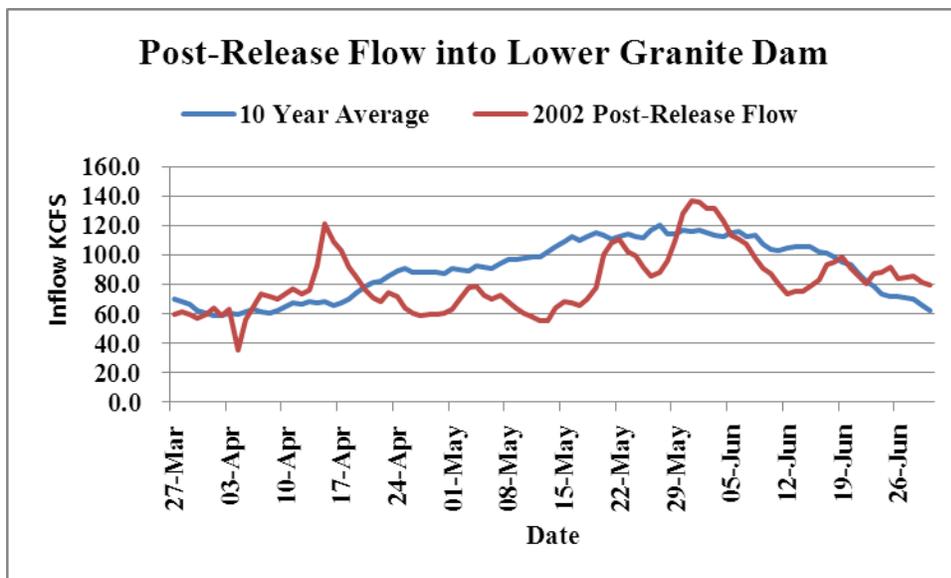


Figure 7. Mean daily inflow to Lower Granite Reservoir from March 27 through June 30, 2002 during spring Chinook salmon emigration after release from Dworshak NFH. The 10 year average is shown for perspective.

Estimated Smolt Survival

Survival probabilities through the Federal Columbia River Power System (FCRPS) were calculated using SURvival under Proportional Hazards 2.1 (SURPH) (Lady *et al.* 2001) (**Table 12**).

Table 12. Cumulative survival estimates of BY2000 spring Chinook smolts released from Dworshak NFH as they pass juvenile bypass facilities in the Lower Snake and Columbia rivers.

River Reach	Survival Estimate	Standard Error
Release (NF Clearwater) – Lower Granite Dam	0.815	0.0111
Lower Granite Dam – Little Goose Dam	0.927	0.0171
Little Goose Dam – Lower Monumental Dam	0.981	0.0142
Lower Monumental Dam – McNary Dam	0.811	0.0116
McNary Dam – John Day Dam	0.932	0.0304
John Day Dam – Bonneville Dam	0.888	0.0777
Overall	0.498	0.0408

River reach survival for spring Chinook smolts ranged from 0.81 (SE= 0.0116) to 0.98 (SE= 0.0142). The lowest survival occurred between Lower Monumental Dam and McNary Dam and release to Lower Granite Dam and the highest survival occurred between Little Goose Dam and Lower Monumental Dam. Overall survival to Bonneville Dam was 0.498 (SE=0.0408).

ADULT RETURNS

Rack Return to Dworshak NFH

Brood Year 2000 spring Chinook salmon smolts released in 2002 returned as adults in 2003 (1-Ocean), 2004 (2-Ocean), and 2005 (3-Ocean). The total adult return to the hatchery rack was 2,779 fish, a smolt-to-adult rate of return to the hatchery rack of 0.278 % (**Table 13**).

Table 13. Summary of adult returns to Dworshak NFH for Brood Year 2000 spring Chinook salmon (**Appendix Tables 13, 14, and 15** in Idaho Fisheries Resource Office 2011). A total of 1,000,561 smolts were released from Dworshak NFH in 2002.

Return Year	Ocean Age	Number of Returns	Smolts to Adult Return Rate (%)
2003	1	580	0.058
2004	2	2,077	0.210
2005	3	122	0.012
	Total Return	2,779	0.278

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 BY2000 spring Chinook salmon occurred in 2003 (1-Ocean fish), in 2004 (2-Ocean fish) and in 2005 (3-Ocean fish). Harvest in Tribal and sport fisheries for those three return years are 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. The total estimated Tribal harvest was 629 and is reported by estimated age class each year in **Table 14**.

Table 14. Estimated number of adult spring Chinook salmon harvested by the Nez Perce Tribe, reported by Ocean Age from 2003-2005 (**Appendix Table 8**, Idaho Fisheries Resource Office 2011).

Harvest Year	Ocean Age	Number Harvested
2003	1	246
2004	2	369
2005	3	14
Total		629

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. Determination of origin is based on coded-wire tag recovery data. Sport fishing occurred in 2003, 2004, and 2005. A summary of the number harvested by Ocean Age Class is provided in **Table 15**.

Table 15. Estimated number of adult spring Chinook salmon harvested by sports fishermen, reported by Ocean Age from 2003-2005 (**Appendix Table 7**, Idaho Fisheries Resource Office 2011).

Harvest Year	Ocean Age	Number Harvested
2003	1	78
2004	2	3,445
2005	3	109
Total		3,632

The Idaho Department of Fish and Game reported a total estimated harvest of 2,228 Dworshak NFH origin adult salmon in 2003, 78 of which were estimated to be 1-Ocean fish. In 2004, the total estimated sport harvest was 3,608 of which 3,445 were estimated to be 2-Ocean fish. In 2005, the total estimated sport harvest was 606 of which 109 were estimated to be 3-Ocean fish. The total harvest of BY2000 spring Chinook salmon by sport fishermen was estimated to be 3,632.

Estimated Minimum Total Adult Return Above Lower Granite Dam

The estimated minimum total number of adult spring Chinook salmon 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 BY2000, the estimated minimum total is 7,040 (2,779 rack return, 629 Tribal harvest, and 3,632 sport harvest) giving a smolt to adult return rate, for accountable fish, of 0.704 %. At the present, we do not have sufficient data to estimate the escapement, the number of fish that are not harvested and do not return to the hatchery rack. Therefore, we know the estimate is biased low and is higher than reported here.

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. Data on coded-wire tag recovery from various commercial, sport, and Tribal fisheries in the Ocean, Columbia River and Snake River were obtained from the Pacific States Marine Fisheries Commission’s Regional Mark Information System and have been updated as of November 2011. For Brood Year 2000, a total of 108,034 coded-wire tagged smolts were released, represented by two coded-wire tag groups (**Table 11**). A total of 435 coded-wire tags were recovered, 86 outside the Clearwater River basin. Twenty-six were collected in Zone 6. Twenty were collected in Columbia River sport fisheries. **Table 16** provides a summary of

recoveries by location and recovery year. Data on recoveries for individual tag codes is available from the Idaho FRO office upon request.

Table 16. Number of coded-wire tagged BY2000 Dworshak NFH spring Chinook salmon that were recovered as adults from various locations in the Columbia, Snake, and Clearwater rivers.

Fishery/Location of Recovery	Recovering Agency	Recovery Year		
		2003	2004	2005
Ocean	CDFO ¹	0	1	0
Zones 1-5 Commerical ²	ODFW ³	0	27	5
Zone 6 Tribal ⁴	ODFW	0	26	0
Columbia River Sport Strays ⁵	ODFW	0	20	1
Mainstem Snake River	WDFW ⁶	0	2	0
Mainstem Clearwater River	IDFG ⁷	0	21	4
North Fork Clearwater River	IDFG	0	17	0
Snake River	IDFG	0	3	0
Dworshak National Fish Hatchery	USFWS ⁸	65	223	11
Kooskia National Fish Hatchery	USFWS	0	8	0
Totals		65	349	21

¹ California Department of Fisheries and Oceans.

² Commerical Fisheries from mouth of Columbia River to Bonneville Dam.

³ Oregon Department of Fish and Wildlife.

⁴ Tribal commercial and subsistence harvests from Bonneville Dam pool to McNary Dam pool.

⁵ Fish collected at any location outside the ordinary migration corridor.

⁶ Washington Department of Fish and Wildlife.

⁷ Idaho Department of Fish and Game.

⁸ United States Fish and Wildlife Service.

Based on expansion factors developed by the various agencies, the following numbers of adults were estimated to have been collected or harvested in various fisheries in the lower Columbia River and tributaries and the lower Snake River and tributaries, outside the Clearwater River (**Table 17**). Adults taken in the ocean and in Zones 1 through 5 (mouth of the Columbia River to Bonneville Dam) represent commercial harvests. Zone 6 represents a combination of commercial, subsistence, and ceremonial harvests by Tribal fisheries. The sport harvest below Lower Granite Dam (LGD) is in the Snake River from the mouth upstream.

Table 17. Numbers of Brood Year 2000 Dworshak NFH adult spring Chinook salmon harvested or collected in various fishery programs in the ocean, the Columbia River, and the Snake River, by return year.

Ocean Age	Return Year	Ocean	Zones		Sport Harvest	Strays- Columbia River	Strays - Snake River	Total
			1-5	Zone 6	Below LGD			
1	2003	0	0	0	0	0	0	0
2	2004	47	443	454	75	9	101	1,129
3	2005	0	56	0	0	0	9	65
Totals		47	499	454	75	9	110	1,194

Estimated Total Adult Return

The total estimated number of Brood Year 2000 Dworshak NFH adults to the mouth of the Columbia River is 8,234, all age groups combined. The estimate is a minimum and is known to be biased low.

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 54,726 PIT-tagged BY2000 spring Chinook salmon smolts in 2002. The goal of the project is to evaluate adult returns and determine whether transportation provides any survival advantage over in-river emigration.

Cryopreservation Study/University of Idaho

Dworshak NFH continued to coordinate with researchers from the University of Idaho in the cryopreservation of salmonid gametes. Rolf Ingermann is studying the relationship between carbon dioxide (CO₂) and the motility and viability of the sperm along with the adenosine triphosphate content of the sperm after exposure to the CO₂. Other studies include examination of pH and aluminum toxicity in salmonid sperm. Continued studies include examining buffering capacities of seminal and blood plasma along with endocrine disrupting effects of various chemicals. Dworshak provided a total of 196 ml milt from 16 Kooskia males. Dworshak also provided a total of 11,500 eggs from 15 Kooskia females along with 102 ml blood from 12 SCS carcasses. All samples were from excess spawning requirements at Dworshak.

Dworshak also provided James Nagler from the U of I with a total of 4 ml milt from four males and a total of 2,000 eggs from four females. These samples are for research on the effect of

fluctuating water temperature on sex inversion in SCS. All samples were from excess spawning requirements at Dworshak.

REFERENCES

- Dworshak NFH. 2002. Annual Report Fiscal Year 2001. Dworshak National Fish Hatchery, Ahsahka, Idaho. 61 p.
- Dworshak NFH. 2000a. Annual Report Fiscal Year 2000. Dworshak National Fish Hatchery, Ahsahka, Idaho. 71 p.
- Dworshak National Fish Hatchery. 2000b. Spawning Report, Brood Year 2000 Spring Chinook Salmon. Annual report by the Dworshak National Fish Hatchery, Dworshak Fisheries Complex, U.S. Fish and Wildlife Service, Ahsahka, Idaho. 14pp.
- Herrig, D.M. 1990. A review of the Lower Snake River Compensation Plan Hatchery Program. Report AFF1/LSR-90-06, Lower Snake River Compensation Plan Office, U.S. Fish and Wildlife Service, Boise, Idaho. 47 p.
- Idaho Fishery Resource Office. 1999. Adult spring Chinook salmon returns to Dworshak Fisheries Complex in 1999 and prognosis for 2000. Annual Report, Fiscal Year 1999, Appendix A, Idaho Fishery Resource Office, Dworshak Fisheries Complex, U.S. Fish and Wildlife Service.
- Idaho Fishery Resource Office. 2000. Adult spring Chinook salmon returns to Dworshak Fisheries Complex in 2000 and prognosis for 2001. Annual Report, Fiscal Year 2000, Appendix A, Idaho Fishery Resource Office, Dworshak Fisheries Complex, U.S. Fish and Wildlife Service.
- Jones, R.N., C. Bretz, C. Peery. 2011. FY2011 annual report of hatchery evaluation activities for spring Chinook salmon at Dworshak and Kooskia National Fish Hatcheries: Brood Years 2009, 2010, and 2011. Technical fisheries report by the Idaho Fishery Resource Office, Dworshak Fisheries Complex, U.S. Fish and Wildlife Service, Ahsahka, ID. 47p.
- Jones, R.N. and W.H. Miller. 1996. An evaluation of rearing density in relation to post-release smolt survival and adult returns of spring chinook salmon at Dworshak National Fish Hatchery. Idaho Fishery Resource Office, U.S. Fish and Wildlife Service, Ahsahka, Idaho. 37 p.
- Lady, J. Westhagen P., and Skalski, J.R. SURPH 2.2b User's Manual. University of Washington, Seattle, Washington. 8pp.
- U.S. Army Corps of Engineers. 1981. Lower Snake River Fish and Wildlife Compensation Plan. Destan Memorandum, No. 9: Dworshak National Fish Hatchery Expansion-Spring chinook rearing.