

**BROOD YEAR REPORT
DWORSHAK NATIONAL FISH HATCHERY
SPRING CHINOOK SALMON
BROOD YEAR 2003
LIFE CYCLE COMPLETED IN 2008**

PREPARED BY

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June 2011

BROOD YEAR 2003 OVERVIEW

Life Stage	Number
2003 Rack Return	3,422
Number of Females Spawned	363
Total Eggs Enumerated¹	1,264,462
Average Eggs per Female	4,959
Eyed Eggs	1,212,043
Smolts Released	1,072,359
In-River Smolt Survival²	83.2%
Adult Returns to the Hatchery³	1,208
Adults Harvested in Idaho⁴	360
Known Adult Return to Clearwater River	1,568
Adults Collected at Other Locations⁵	189

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

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

³ I-Ocean, II-Ocean, and III-Ocean returns in 2006, 2007 and 2008 to the hatchery rack.

⁴ Tribal and Sport fisheries combined.

⁵ 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.

Citation for this report

Jones, R.N., C. Bretz, L. Gauthier, T. Trock, and M. Blair. 2011. Brood year report, Dworshak National Fish Hatchery spring Chinook salmon brood year 2003, life cycle completed in 2008. Technical fisheries report by Dworshak Fisheries Complex, U.S. Fish and Wildlife Service, Ahsahka, ID. 26p.

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) 2003 spring Chinook salmon (SCS) at Dworshak National Fish Hatchery (NFH) which completed its life cycle in 2008. 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 2003 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 2003 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.

Program Goal

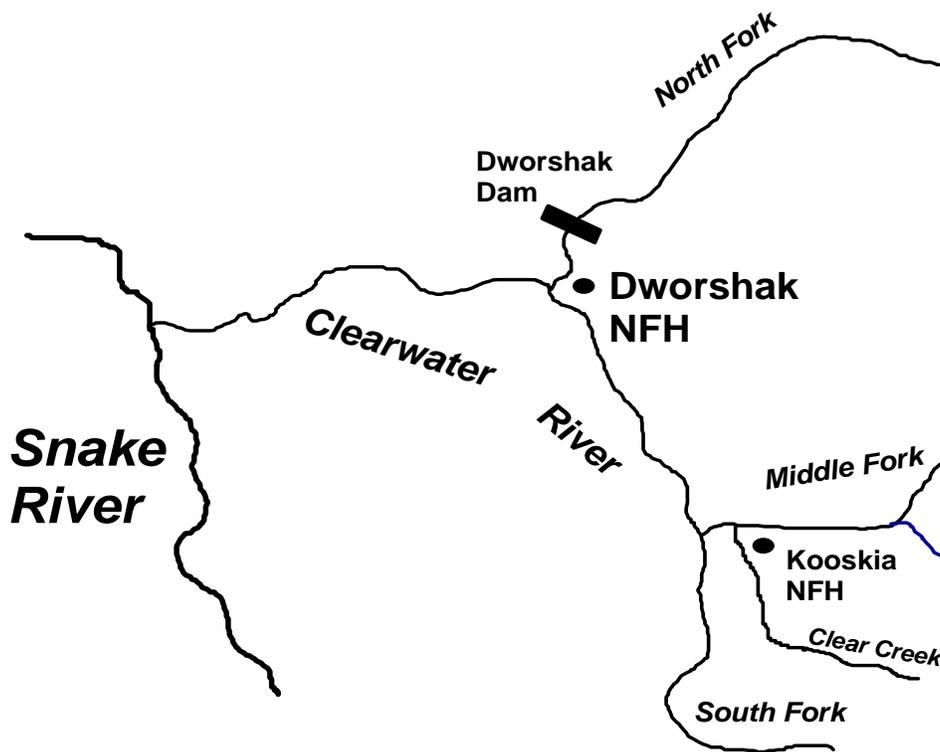
The spring Chinook salmon production program at Dworshak NFH was started in 1982 as part of the Lower Snake River Compensation Plan (LSRCP) and was originally designed to rear 1.4 million smolts to a size of 20 fish per pound (FPP) for direct release from the hatchery into the Clearwater River (U.S. 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 2003, 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 where they are held until they can be inventoried. Fish are mechanically crowded out of the holding pond, into a transfer channel, and into the spawning room where they can be measured and sorted. From the spawning room, adults are transferred to one of three long term adult holding ponds until they become mature and are spawned, are out-planted, or provided to the Nez Perce Tribe for ceremonial/subsistence use. 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 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 BY1998, the production staff decided to transfer the fry 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 thirty 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.



2003 ADULT SPRING CHINOOK SALMON RETURN TO DWORSHAK NFH

Pre-Season Assessment

The Idaho Fishery Resource Office (FRO) used 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 2002, the I-Ocean return to Dworshak NFH was 62 fish providing a prediction of 3,882 adults returning to Dworshak NFH for the 2003 season. The breakdown by age class for the predicted return is given below in **Table 1** (Idaho Fishery Resource Office 2002, Table 11).

Table 1. Pre-season prediction (Idaho Fishery Resource Office 2002, Table 11) and the estimated actual return (Idaho Fishery Resource Office 2004, Table 9) of adult returns to the Clearwater River, by ocean age.

Ocean Age	2002 Prediction for 2003	Actual 2003 Return
I - Ocean	150	847
II - Ocean	2,895	878
III - Ocean	837	4,930
Total	3,882	6,655

The reasons are not clear, but our pre-season predictions for the 2003 return was not accurate at all, underestimating the actual return by 2,773 fish. Our prediction to the rack was low, primarily due to the extreme underestimate for the III-Ocean return, which returned 4,093 more than predicted. The I-Ocean age class was also underestimated but only by 697 fish. The II-Ocean prediction over-estimated the actual return by 2,017 fish (**Table 1**).

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 2003 adult spring Chinook salmon return to Dworshak NFH was 3,422 adults (**Table 2**).

Table 2. Actual rack return of adult spring Chinook salmon to Dworshak NFH by ocean age (Idaho Fishery Resource Office 2004, Tables 4 and 6).

Ocean Age	Smolts Released	2003 Rack Return
I - Ocean	1,000,561 (2002)	580
II - Ocean	333,120 (2001)	478
III - Ocean	1,017,511 (2000)	2,364
Total		3,422

Ladder Operations and Adult Inventories

Ladder operations at Dworshak NFH vary annually based on run strength and fishery management objectives. Once the ladder is opened, a fish counter monitors the number of adults entering the trap. A PIT tag detector was installed in the adult ladder in April, 2005 by Abernathy Fish Technology Center in order to improve our PIT tag detection capabilities. Detection efficiency was highly variable, ranging from 50 to 100%, most likely the result of a high degree of interference created by the surrounding structures. The trap can optimally handle a maximum of about 900 adults. Prior to the start of spawning, the trap is emptied on a regular basis and the adults are then inventoried and transferred to one of three adult holding ponds. During 2003, the hatchery ladder was operated intermittently from May 28 through August 7 for the collection of broodstock for Dworshak NFH.

At the end of August, 2003, personnel from Idaho Department of Fish and Game (IDFG) contacted Dworshak NFH about a shortfall of spring Chinook salmon eggs for the state and requested assistance in trapping broodstock. The ladder and trap was re-opened on August 26 and was operated until September 22, 2003 (Dworshak National Fish Hatchery 2003, Table 1). **Table 3** lists the inventory dates and the numbers of adults collected during that time period, by age.

Table 3. Number of spring Chinook salmon, by age class, on each inventory date from 6/17/03 to 9/23/03, including trap mortalities and fish sampled for coded-wire tags (2003 Salmon News, Idaho FRO Files).

Inventory Date	I-Ocean	II-Ocean	III-Ocean	Total
June 17	181	73	455	709
June 24	101	58	333	492
July 2	70	51	372	493
July 16	68	49	433	550
July 31	53	58	411	522
August 7	24	21	186	231
August 27	14	19	52	85
September 3	40	63	77	180
September 9	13	36	21	70
September 16	9	19	6	34
September 23	6	22	3	31
Trap Mortalities And CWTs	1	9	15	25
Total	580	478	2,364	3,422

Age Composition of Return

Age composition of spring Chinook salmon returning to the hatchery is 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:

I - Ocean (Jacks) < 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 age composition for the 2003 return was 17% I-Ocean, 14% II-Ocean, and 69% III-Ocean, respectively. The five year mean percent returns in the rack for I-Ocean, II-Ocean, and III-Ocean adults were 19%, 54%, and 27%, respectively, for all years from 1998 to 2002 (**Table 4**).

When comparing the percentages of the 2003 to the five year returns, the II-Ocean return was much lower than the mean, while the III-Ocean returns were higher, very dissimilar to the 5-year mean, with III-Ocean adults comprising most of the return (**Table 4**).

Table 4. Number and percent of adult spring Chinook salmon that returned to Dworshak NFH from 1998 to 2003, by ocean age (Idaho Fishery Resource Office 2004).

Return Year	I-Ocean		II-Ocean		III-Ocean		Total Return
1998	11	1%	176	19%	728	80%	915
1999	670	84%	78	10%	52	6%	800
2000	221	7%	2,827	90%	104	3%	3,202
2001	36	1%	3,235	80%	747	19%	4,018
2002	62	3%	1,480	69%	615	28%	2,157
Mean	200	19%	1559	54%	449	27%	2,218
2003	580	17%	478	14%	2,364	69%	3,422

Adult Marking

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

Adult Holding and Mortality

Formalin treatments were administered to adults in the holding ponds to retard fungus infection. All the Dworshak NFH stock was held in Holding Pond Two. Kooskia NFH stock was held in Holding Pond 3. Formalin treatments began on May 8, 2003 and were administered for one hour per day, 3 days per week at a rate of 15 gallons per hour (200 mg/l). The last treatment was administered on August 29, 2003.

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.

Despite efforts to the contrary, adult mortalities occur. Adult mortality is reported for two separate periods: pre-spawning (holding mortality) and mortality during spawning.

Pre-Spawning Mortality - From June 19 to August 19, a total of 168 adult spring Chinook salmon (4.9% of rack return) died.

Mortality During Spawning - From August 20 through September 19, an additional 93 adults died (2.7 % of rack return).

The total mortality was 261. Compared to previous brood years, the mortality rate for BY2003 spring Chinook salmon adults during holding was a little lower than average (**Table 5**).

Table 5. Percent mortality of adult spring Chinook salmon during holding (pre-spawning) and during spawning at Dworshak NFH, 1998-2003 (Dworshak National Fish Hatchery 2003).

Year	Pre-Spawning %	During Spawning %	Total %
1998	3.0	5.6	8.5
1999	3.1	17.7	20.8
2000	5.3	3.0	8.3
2001	4.2	2.6	6.8
2002	4.9	7.1	12.0
5 yr Ave	4.1	7.2	11.3
2003	4.9	2.7	7.6

Spawning

Details on the methods and procedures during spawning are provided in the Spawning Report for BY2003 (Dworshak National Fish Hatchery 2003). Spawning was started on August 19, 2003. A total of seven egg takes were conducted with the last ripe females being spawned on September 16, 2003. A summary of spawning each week is presented in **Table 6**.

A total of 177 females were spawned for IDFG during egg takes 4-7, August 27 through September 16. Eggs from eighty-six of the females were incubated at Dworshak NFH because of a lack of space at Clearwater Hatchery. The eggs from the remaining 91 females were sent to Clearwater Hatchery the same day of spawning. The details of this operation are not included in **Table 6 since they are not part of the Dworshak SCS program.**

Table 6. Summary of spring Chinook salmon spawning during each egg take for BY2003 at Dworshak NFH (Dworshak National Fish Hatchery 2003, Table 2). Jacks are incorporated into the number of males spawned. Does not include information on the 177 females spawned for the IDFG program.

Take	Spawn Date 2003	No of Male*	No of Female	Female culled BKD**	Female culled dead tray	Trays culled extra	Dead Eggs Enum	Eyed Eggs Enum	Eggs for Research	Total Eggs	Eggs/Fmle	Percent Enum Eye-up
1	08/19	40	39	8	0	0	9,244	163,822	0	173,066	5,583	94.7
2	08/20	49	66	9	0	0	15,252	262,960	0	278,212	4,881	94.5
3	08/26	51	56	12	1	14	5,448	140,000	0	145,448	5,015	96.3
4	08/27	64	72	3	3	40	3,956	135,000	0	138,956	5,344	97.2
5	09/02	83	89	14	0	0	10,833	359,500	0	370,333	4,938	97.1
6	09/09	29	29	3	0	0	5,280	108,073	700	114,053	4,387	95.3
7	09/16	12	12	1	0	0	1,706	42,688	0	44,394	4,036	96.2
Tot/ Ave		328	363	50	4	54	51,719	1,212,043	700	1,264,462	4,959	95.9

* Includes 20 jacks spawned during the season.

** BKD culling at medium and above level of ELISA testing for all Takes

Percent enumerated eye-up does not include eggs/females culled before enumeration

Source: BY2003 SCS Egg Enumeration and % Survival of Eggs Summary SC2003 EggEnum.wk4

IFHC BKD ELISA testing results BY03 SCS

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. In 2003, the adult return was sufficiently large enough to supply excess adults for this purpose and 1,957 adults were out-planted. These activities were coordinated with the Idaho Department of Fish and Game and arrangements were made with the Nez Perce Tribal Fisheries Department to transport excess adults to various tributaries throughout the Clearwater River basin for supplementation purposes. **Table 7** provides details on the dates, locations, and numbers of fish out-planted from Dworshak NFH.

Table 7. Numbers of adult spring Chinook salmon transported from Dworshak NFH to the Selway-McGruder, Clearwater River, to supplement natural production, 2003 (Idaho Fishery Resource Office 2004, Table 12).

Date	Location	Adults	Jacks	Total	Comments
July 8	Selway-McGruder	341	58	399	164 males; 177 females; 58 jacks
July 10	Selway-McGruder	305	96	401	134 males; 171 females; 96 jacks
July 24	Selway-McGruder	346 ¹	54	400	180 males; 166 females; 54 jacks
August 12	Selway-McGruder	337	66	403	182 males; 155 females; 66 jacks
August 14	Selway-McGruder	299 ²	101	400	164 males; 135 females; 101 jacks
Totals		1,628	375	2,003	

¹ Includes 18 adults of Kooskia NFH stock

² Includes 28 adults of Kooskia NFH stock

Adult Disposition

Of the total 3,422 adult spring Chinook salmon that entered the hatchery, the following is an accounting of adult disposition.

Number Spawned	691
Number Out-planted	1,957 (2003 minus 46 Kooskia fish – Table 7)
Mortality During Holding	261
Adults Collected for IDFG	351
WSU Bear Program	125
<u>Surplus Fish to the Landfill</u>	<u>37</u>
Total	3,422

EGG PRODUCTION AND INCUBATION

Only data for the Dworshak NFH program is reported here (for information on eggs taken for the IDFG program, contact IDFG). Data on early incubation, eye-up, final incubation and hatching is found in Dworshak NFH annual reports for 2003 (Dworshak National Fish Hatchery 2004) and 2004 (Dworshak National Fish Hatchery 2005), the hatchery monthly production narratives, as well as the spawning report for BY2003 (Dworshak National Fish Hatchery 2003).

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 363 females were spawned, giving an initial estimate of 1,270,500 green eggs.

Early Incubation (Dworshak NFH)

All eggs were incubated in Heath trays. Eggs from each 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./m. Water temperatures averaged between 39-42°F (Dworshak National Fish Hatchery 2003).

Eggs Culled for BKD

For brood year 2003, a total of 50 females were culled from production for BKD.

Other Females Culled

The eggs from four additional females died and were also removed from production. A total of 54 females from Takes 3 and 4 were extra and were culled making a total of 104 females having to be culled from the program.

Eye-Up

At eye-up, eggs were shocked, dead eggs were removed, and eggs were enumerated by a mechanized egg picker. A total of 51,719 dead eggs were counted. The total number of eyed eggs enumerated was 1,212,043, giving an average of 4,959 eggs per female and an average percent eye-up of enumerated eggs of 95.9% (**Table 6**).

Egg Transfers and Final Incubation

About half of the Dworshak NFH eggs were kept at Dworshak NFH for incubation and half were transferred to Kooskia NFH for incubation and initial rearing. **Table 8** lists the date and the numbers of eggs transferred (Dworshak National Fish Hatchery 2003).

Eggs taken for IDFG on August 27 and September 3 were transferred to Clearwater Hatchery those days. The remaining eggs were incubated at Dworshak NFH and transferred to Clearwater Hatchery after eye-up and enumeration. Numbers for that program are not reported here.

Table 8. Dworshak NFH BY2003 spring Chinook salmon eyed egg numbers shipped to Kooskia NFH in 2003 (Dworshak National Fish Hatchery 2003, Table 4).

Date Shipped to Kooskia 2003	Dworshak Egg Take	Number of Eyed Eggs
October 28	5	359,500
November 6	6	107,873
November 12	3	140,000
Total		607,373

JUVENILE REARING

The following data and information was summarized from the 2003 and 2004 Annual Reports for Dworshak NFH, the Dworshak NFH monthly production narratives, and the Dworshak NFH monthly inventory summaries (MIS).

Transfers and Handling

About 590,000 Dworshak stock fry at Kooskia NFH were transferred back to Dworshak NFH April 16 and 22, 2004.

Growth and Mortality

Table 9, (compiled from the Dworshak NFH monthly production narratives), provides a record of the estimated growth from April 2003 through March, 2004.

Table 9. Summary of monthly growth and mortality of Brood Year 2003 spring Chinook salmon during outside raceway rearing at Dworshak NFH.

Date (End of Month)	Number	Weight (lbs)	FPP	Mean Length (mm.)	Mean Growth (mm.)	Mortality (%)	Mean Water Temp (°F)
4/04	1,095,497	800	1370	34	-	0.41	43.1
5/04	1,086,836	2,574	422	51	16	0.80	45.5
6/04	1,083,913	4,457	243	61	10	0.30	50.6
7/04	1,082,359	7,661	141	73	12	0.10	46.2
8/04	1,147,108 ¹	12,507	92	84	11	0.10	46.6
9/04	1,076,219	15,790	68	93	9	0.10	47.1
10/04	1,075,672	21,253	51	103	10	0.05	47.6
11/04	1,075,184	27,971	38	112	10	0.05	46.8
12/04	1,074,588	35,472	30	122	10	0.06	46.4
1/05	1,074,051	42,230	25	129	7	0.05	43.0
2/05	1,073,396	48,296	22	135	6	0.06	42.1
3/05	1,072,509	55,026	19	141	6	0.08	43.1

¹ Adjustment in inventory after a complete count during adipose fin clipping.

Marking and Tagging

Coded-Wire Tags and Adipose Fin Clips- Adipose fin clipping and coded wire tagging of Dworshak spring Chinook fingerlings was conducted by the U.S. Fish and Wildlife Service, Lower Columbia River Fishery Office, between August 10 and 11, 2004. A total of 140,190 Dworshak spring Chinook salmon fingerlings 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. All the spring Chinook salmon smolts on station were adipose fin clipped to identify them as hatchery fish, providing the first complete and accurate inventory of spring Chinook salmon since spawning. Coded-wire tag retention rates, which ranged from 0.98 to 0.99, were determined by sampling about 500 fish from each tag code group in March 2005, prior to release. Details on coded-wire tagging are provided in **Table 10**.

Table 10. Coded-wire tag release information for Brood Year 2003 spring Chinook salmon released from Dworshak NFH in 2005.

Hatchery	Tag Code	Number of Tags	Number of Unmarked Fish	Mark Rate	Purpose
DNFH	050973	69,010 ¹	464,284	0.15	Contribution, B-Bank Representation ²
	050864	69,127	469,938	0.15	Contribution, A-Bank Representation ³

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

²Raceways B27 and B28.

³Raceways A1 and A2.

PIT tags - PIT tagging of BY03 spring Chinook smolts was conducted by the Idaho Fishery Resource Office between January 4 and 8, 2004. A total of 51,944 spring Chinook salmon were PIT tagged 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).

SMOLTS RELEASES

Idaho FRO began monitoring stream flows in the Clearwater River March 1, 2005 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 by the 25th of March. Flows in the Clearwater were also below the 10 year average, but not to the same degree. By the 30th of March, heavy rainfall has significantly increased flows in both the Snake and Clearwater Rivers, nearly reaching the 10 year average in the Snake and exceeding it in the Clearwater River (**Figures 2 and 3**). However, releases had to be delayed until the next week and flows subsided to below the 10 year averages in both streams by the releases dates of April 4th and 6th. Releases were made into the North Fork Clearwater River the late afternoons on those dates. A total of 1,072,359 chinook were released at a size of 19 fish per pound, 142 mm TL.

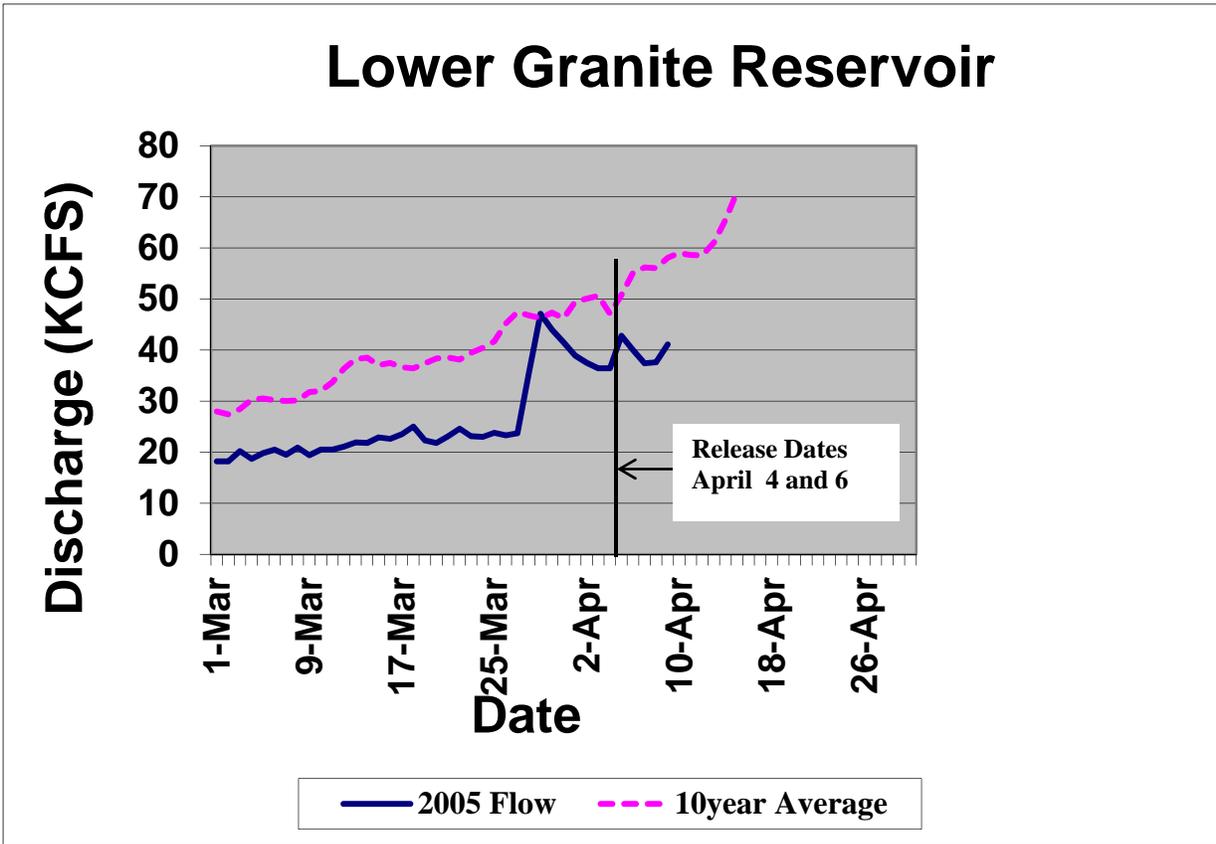


Figure 2. Mean daily flow compared to the 10 year average in Lower Granite Reservoir during March and April 2005.

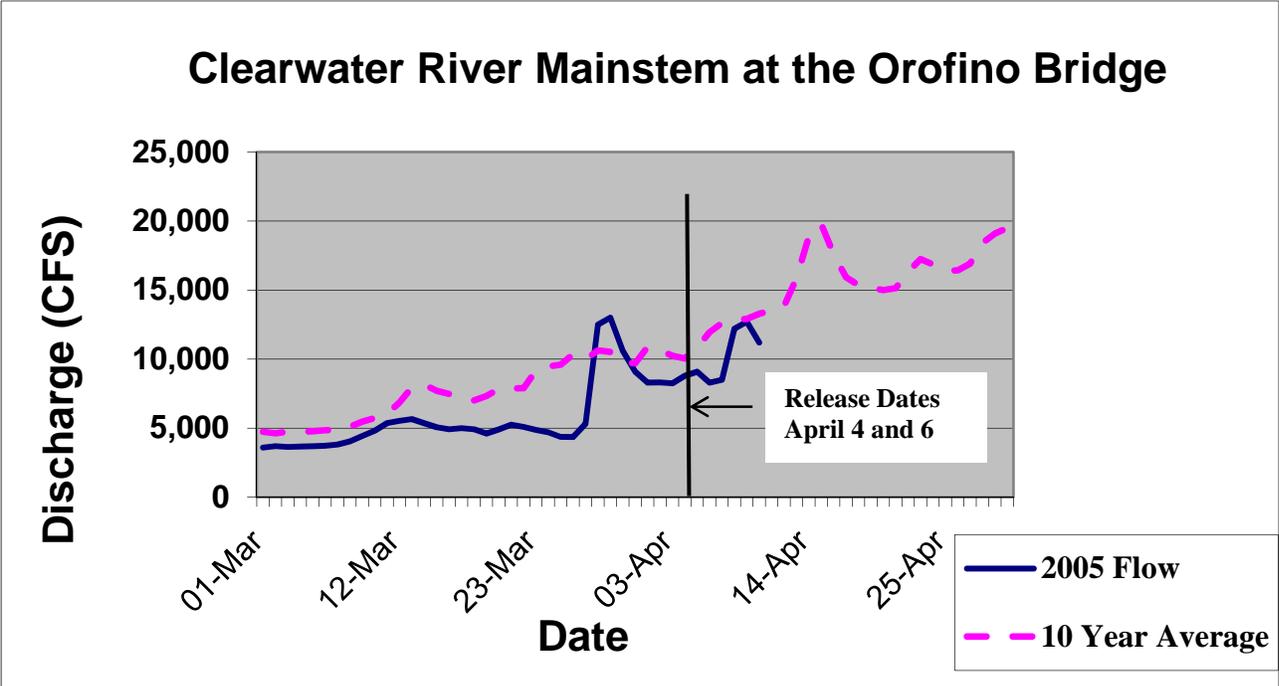


Figure 3. Mean daily stream discharge of the Clearwater River at the Orofino bridge, 2005.

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. All the Dworshak NFH stock was held in Holding Pond Two. Formalin treatments began on May 8, 2003 and were administered as bath treatments for one hour per day, 3 days per week at a concentration of 1:6,000. The last treatment was administered on August 29, 2003.

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 -

67/207 (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.

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 ovarian fluid samples were 3 pooled and spleens were 5 pooled.

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.

Juveniles

Production Monitoring –

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

Results:

11-30-04 – Not Detected: 10

12-30-04 – Not Detected: 10
1-19-05 – Not Detected: 10
2-24-05 – Not Detected: 10

December – No parasites seen. Dworshak SCS appear healthy at this time.

January - Low levels of external parasites including *Epistylis*, *Ambiphyra*, and *Gyrodactylus* were found on the skin of Dworshak SCS. No treatment necessary.

February – Low levels of external parasites *Epistylis* and *Gyrodactylus* were detected on the skin, and one *Tricophyra* was seen on the gill of one fish. Fungus was seen on some of the moribund fish. No treatment necessary.

Pre-release exam - 60 fish (kidneys 2-pooled)

ELISA - Not detected – 58

Low - 2

Medium - 0

High - 0

Viral assays - negative

Bacterial assays - negative

Hematocrits - 20 samples, all in normal range

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, John Day and Bonneville dams on the lower Columbia River (**Figure 4**). PIT tags provide information on travel time and survival during emigration. A total of 51,677 PIT-tagged spring Chinook salmon smolts were released in 2005 as part of the Comparative Survival Study, (CSS). The CSS is a multi-year program that estimates survival rates over different life stages for spring and summer Chinook and steelhead produced in major hatcheries. (See **SPECIAL STUDIES** section for details)

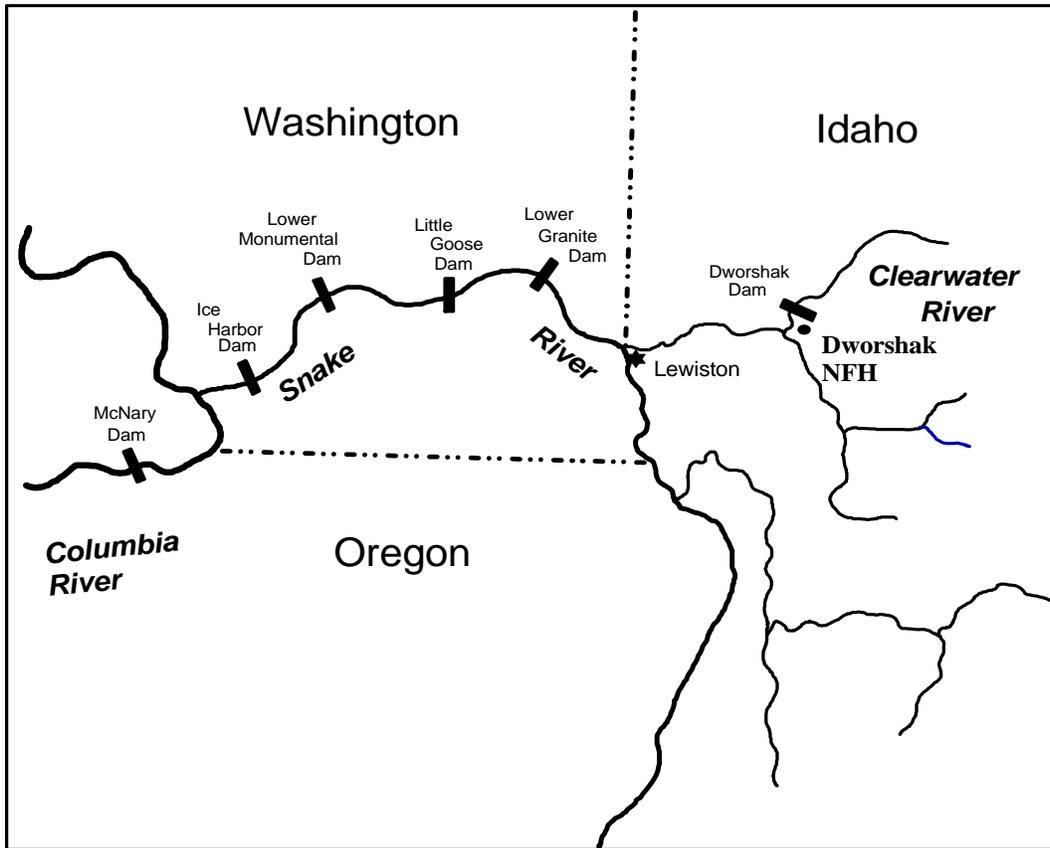


Figure 4. Dams on the lower Snake and Columbia rivers. Lower Granite, Little Goose, Lower Monumental, and McNary dams are PIT-tag interrogation facilities for monitoring smolts emigration. Bonneville and John Day dams are not shown.

PIT-tags are used to help evaluate the effectiveness of the production program at Dworshak NFH. Information is collected at the various dams throughout the lower Snake and Columbia rivers and is used to provide estimates on emigration time and survival. PIT-tags also provide real-time data on adult return timing and a means to assess total return as fish are detected at Columbia and Snake river dams.

Travel Time

Travel time for BY03 spring Chinook smolts released from Dworshak NFH through the FCRPS is monitored using PIT tag interrogations at the juvenile bypass facilities (**Figure 5**).

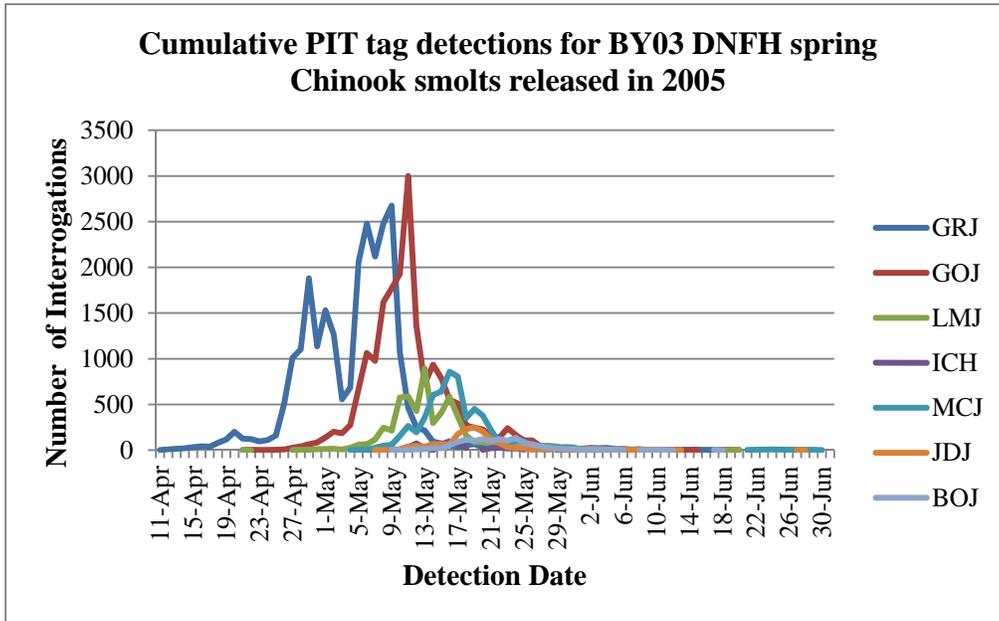


Figure 5. Cumulative PIT tag detections for BY2003 DNFH spring Chinook smolts at juvenile bypass facilities in the Lower Snake and Columbia rivers.

The migration time of BY2003 smolts released from Dworshak NFH to Lower Granite Dam ranged from 5.6 days to 76.0 days with a harmonic mean travel time of 27.6 (SE=0.047) days. Ten percent arrived at Lower Granite Dam within 21.9 days; 50% and 90% arrived within 30.1 days and 35.2 days, respectively. Smolts that migrated through the hydro system arrived at Bonneville Dam on average 46.2 days after release.

River Flows

Flows in the Lower Snake River were lower than the 10-year average during most of the time of the smolts emigration period of early April through mid-July (**Figure 6**). Inflow into Lower Granite Reservoir only exceeded 100,000 cubic feet per second (cfs) from May 28 through June 8, a much narrower time period than the 10-year average. Flows remained at or below 80,000 cfs for most of the rest of the time of emigration.

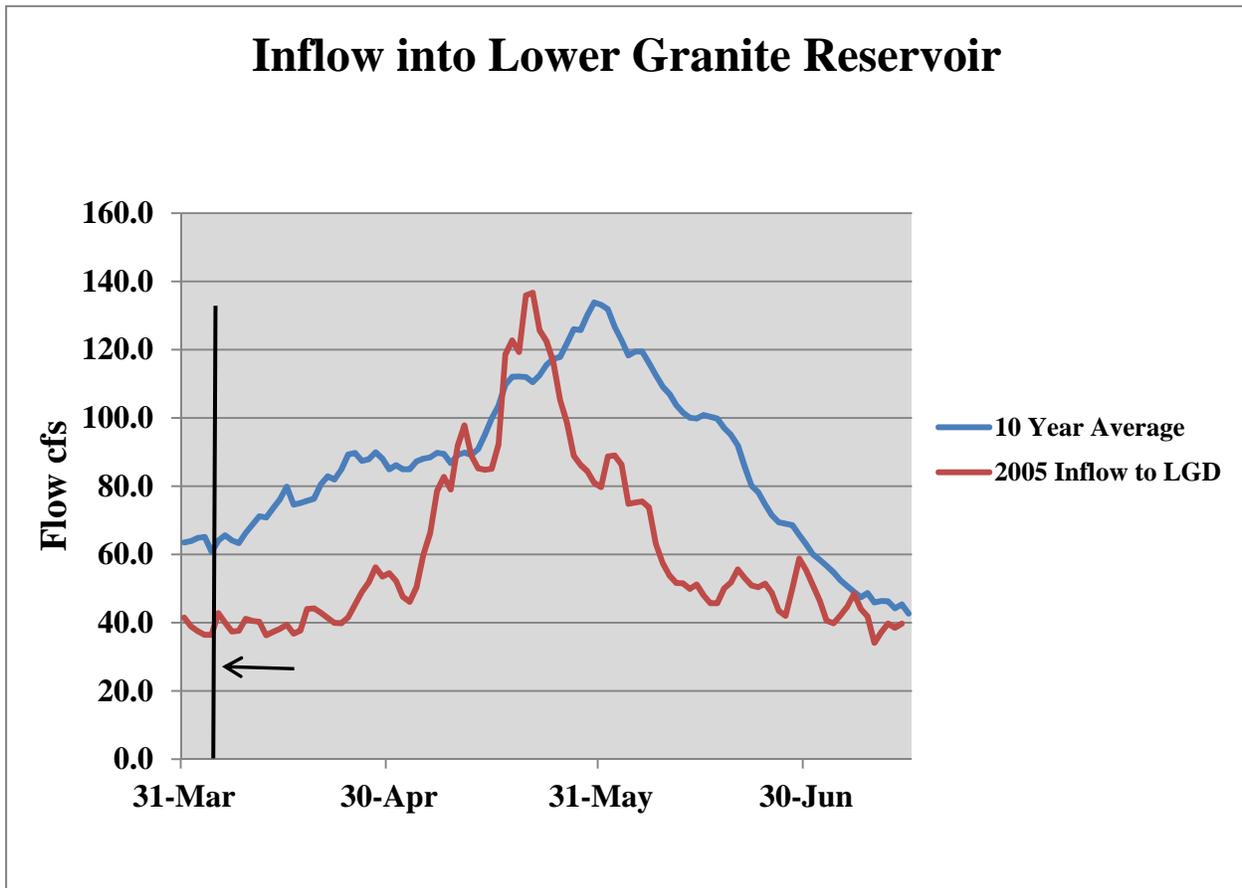


Figure 6. Mean daily inflow to Lower Granite Reservoir from March 31 through July 15, 2005 during spring Chinook salmon emigration after release from Dworshak NFH. The vertical line indicated the date smolts were released. The 10 year average is shown for perspective.

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 11**).

Table 11. Cumulative survival estimates of BY2003 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	0.832	0.0027
Lower Granite Dam – Little Goose Dam	0.922	0.0053
Little Goose Dam – Lower Monumental Dam	0.889	0.0128
Lower Monumental Dam – McNary Dam	0.965	0.0263
McNary Dam – John Day Dam	0.866	0.0661
John Day Dam – Bonneville Dam	0.73	0.1252
Overall	0.419	0.0645

River reach survival for spring Chinook smolts ranged from 0.73 (SE= 0.1252) to 0.96 (SE= 0.0263) just slightly lower than BY2002. The lowest survival occurred between John Day and

Bonneville dams and the highest survival occurred between Lower Monumental and McNary dams. Overall survival to Bonneville Dam was 0.419 (SE=0.0645); lower than BY02 by 0.05 (Figure 7).

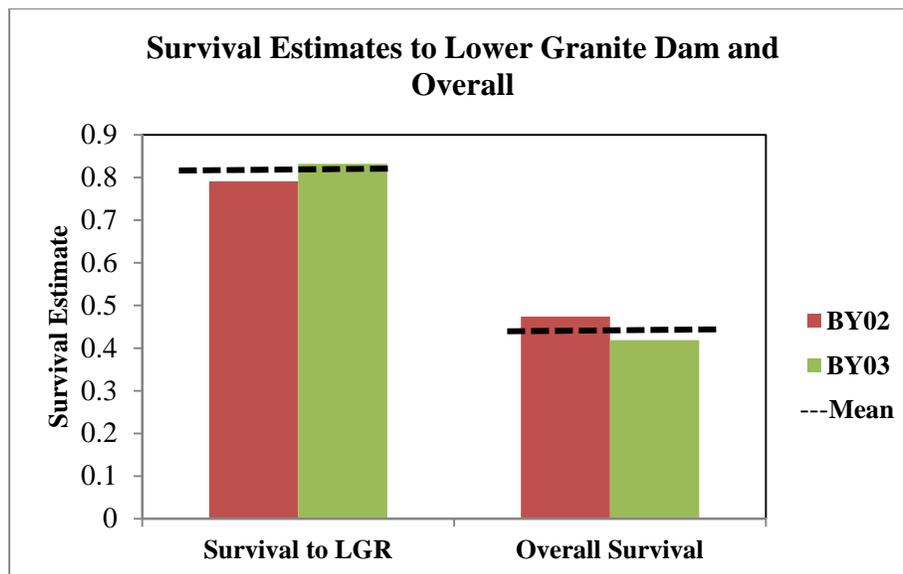


Figure 7. Mean survival estimates to Lower Granite Dam and overall survival estimate through the Federal Columbia River Power System, BY2002-BY2004.

ADULT RETURNS

Estimating the numbers of Dworshak NFH origin adult spring Chinook salmon that return from the ocean for a single brood year is quite complicated and challenging for several reasons. First, the adult returns entering the mouth of the Columbia River from the ocean are composed of mixed stocks from various state, Tribal, and federal fishery programs and are harvested in the ocean, the Columbia, Snake, and Clearwater rivers. The adults that enter the Clearwater River each year originate from smolt release programs at Dworshak NFH, Kooskia NFH, Idaho Department of Fish and Game (IDFG) facilities at Powell, Red River, and Crooked River, and Nez Perce Tribal Hatchery program releases in Lolo Creek, Newsome Creek, and the Selway River. The challenge is further complicated because the adults return over three successive years at different ages after spending one to three years in the ocean (Jones *et al.* 2011a). Thus, Brood Year 2003 adults, released as smolts in 2005, return as I-Ocean adults in 2006, II-Ocean adults in 2007, and III-Ocean adults in 2008.

Except for the actual rack return to Dworshak NFH, estimates of the numbers of adults that are harvested (commercial, sport, and Tribal) or are collected in other fishery programs, are based on coded-wire tag information. Coded-wire tags are used to help identify Dworshak NFH adult salmon in the mixed stock fisheries of the Columbia, Snake, and Clearwater rivers. The coded-wire tag data is obtained from the Regional Mark Information System maintained by the Pacific States Marine Fisheries Commission. The number of coded-wire tags collected in a sample is first expanded by the sampling rate to provide an estimate of the total number of tags that would have been collected if the sampling rate would have been 100%. The total number of adults harvested or collected is then estimated by dividing the total number of tags collected by the hatchery tagging rate (Jones *et al.* 2011b). Estimates for various fisheries are provided below.

Ocean and Lower Columbia River Below Bonneville Dam

Very few adults are harvested in the ocean and the lower Columbia River below Bonneville Dam, although in years when returns are high, some are reported from various Oregon and Washington sport and commercial fisheries. From 2006 to 2008, an estimated 141 Dworshak NFH BY2003 adults were harvested; 71 in sport fisheries and 70 in non-tribal commercial net fisheries.

Columbia River from Bonneville Dam to McNary Dam

The Columbia River from Bonneville Dam to McNary Dam is the section designated for Tribal Treaty commercial, ceremonial, and subsistence harvest, although Oregon and Washington sports harvest occurs there also. From 2006 to 2008, an estimated 16 Dworshak NFH BY2003 adults were reported harvested in Tribal fisheries.

Strays Below and Above McNary Dam

For purposes of adult return accounting, strays are defined as fish that are collected or harvested in any fishery or are captured at any hatchery rack or tributary weir outside the normal adult migration corridor. Over the years, Dworshak NFH adults have strayed out of the normal migration corridor and have been collected at various hatcheries, fish weirs, fish ladders, or harvested in tributary sport and Tribal fisheries. From 2006 to 2008, 32 BY2003 Dworshak NFH adult strays were collected in the Columbia River above McNary Dam. There were no strays reported below McNary Dam or in the Snake River basin.

Lower Snake River from Mouth to Lower Granite Dam

Very few Dworshak NFH adults are reportedly harvested from the mouth of the Snake River up to Lower Granite Dam and those that are have been caught in sport fisheries reported by Washington. There were no BY2003 adults reported harvested or otherwise collected in this section from 2006 to 2008.

Lower Snake and Clearwater River above Lower Granite Dam

It is challenging to account for the all the Dworshak NFH origin adults that return to the project area above Lower Granite Dam because of the mixed stock fishery, accounting for adults among the various harvest programs, and accounting for the contribution of the various age classes returning over three years. For BY2003, an estimate was made based on the Dworshak NFH rack returns, the Nez Perce Tribal subsistence harvests, and the sports harvests that occurred in 2006, 2007, and 2009. Because of data limitations, escapement could not be estimated, so our total adult return estimate is biased low. Assessment of the rack return, and the sport and Tribal harvests are provided below.

Rack Return to Dworshak NFH

A total of 1,072,359 Brood Year 2003 spring Chinook salmon smolts were released in 2005 and returned as adults in 2006 (I-Ocean), 2007 (II-Ocean), and 2008 (III-Ocean). The total adult return to the hatchery rack was 1,208 fish, a smolt-to-adult rate of return of 0.11 % (**Table 12**).

Tribal Fisheries

The Nez Perce Tribal Department of Fisheries Resource Management is responsible for reporting harvest data in the Tribal fishery. Harvest occurs primarily in the North Fork of the Clearwater River near the ladder at Dworshak NFH. Data on the age composition of the harvest is generally not available. For that reason, in years when it is not available from harvest sampling, 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 249 and is reported by estimated age class each year in **Table 12**.

Idaho Sport Fisheries

The Idaho Department of Fish and Game (IDFG) is responsible for collecting and reporting information on sport harvest. Estimates of the numbers of adults and jacks harvested in the sport fishery are based on expanded numbers of coded-wire tags collected during sport fish harvest surveys by the IDFG. These tags are expanded by tagging and sample rates, across multiple creel survey river sections (J. Cassinelli, IDFG personal communication).

Sport harvest of BY2003 spring Chinook salmon occurred in 2006 (I-Ocean fish), in 2007 (II-Ocean fish) and in 2008 (III-Ocean fish). IDFG reported a total estimated harvest of four I-Ocean fish in 2006, 148 II-Ocean fish in 2007, and 97 III-Ocean fish in 2008 for a total of 249 BY2003 Dworshak NFH origin adult salmon harvested by the sport fishery (**Table 12**).

Escapement and Strays

Currently, escapement is estimated through a process of elimination. The Idaho FRO and IDFG have recently cooperated in developing a method to use adult PIT tag returns at Lower Granite Dam to estimate the total adult return of Dworshak NFH spring Chinook salmon to Lower Granite Dam using expansion factors (Peery *et al.* 2011). Escapement is estimated by subtracting the rack return and the total harvest from the estimated adult return to Lower Granite Dam. However, adequate PIT-tag data was not available to calculate escapement for any of the adult return years for BY2003 and there were no strays reported above Lower Granite Dam in the RMIS coded-wire tag database.

Estimated Minimum Total Adult Return Above Lower Granite Dam

Based on the rack return and the estimated sport and Tribal harvests, the minimum estimated adult return to Lower Granite Dam for BY2003 is 1,568 (**Table 13**). Since we were not able to calculate an escapement, our estimate is biased low.

Table 12. Summary of adult returns to Dworshak NFH for Brood Year 2003 spring Chinook salmon (Idaho Fishery Resource Office 2011). A total of 1,072,359 smolts were released from Dworshak NFH in 2005.

Return Year	Ocean Age	Rack Return ¹	Sport Harvest ²	Tribal Harvest ³	Escapement	Total
2006	I	62	14	20	NA	96
2007	II	809	148	78	NA	1,035
2008	III	337	97	13	NA	447
Total		1,208	249	111	NA	1,568

¹ Idaho Fishery Resource Office 2011, Appendix Table 3.

² Idaho Fishery Resource Office 2011, Appendix Table 7.

³ Idaho Fishery Resource Office 2011, Appendix Table 8.

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. The CSS is a multi-year program that estimates survival rates over different life stages for spring and summer Chinook and steelhead produced in major hatcheries.. A pilot study was started in 1997. Dworshak NFH released 51,819 PIT-tagged BY2003 spring Chinook salmon smolts in 2005. .Results of the Comparative Survival Study can be found at www.fpc.org.

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