

**BROOD YEAR REPORT
DWORSHAK NATIONAL FISH HATCHERY
SPRING CHINOOK SALMON
BROOD YEAR 2005
LIFE CYCLE COMPLETED IN 2010**

PREPARED BY

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BROOD YEAR 2005 OVERVIEW

Life Stage	Number
2005 Rack Return	882
Number of Females Spawned	385
Total Eggs Enumerated¹	1,460,348
Average Eggs per Female	3,863
Eyed Eggs	1,407,946
Smolts Released	963,211
In-River Smolt Survival²	82.2%
Adult Returns to the Hatchery³	1,804
Adults Harvested in Idaho⁴	1,360
Adult Return to Clearwater River	3,879
Adults Collected at Other Locations⁵	859
Total Adult Return to Columbia River	4,738

¹ Number based on only the number of live and dead eggs enumerated.

² Survival to Lower Granite Dam.

³ 1-Ocean, 2-Ocean, and 3-Ocean returns in 2008, 2009, and 2010 to the hatchery rack.

⁴ Tribal and Sport fisheries combined.

⁵ Estimated adults recovered at various other hatchery racks, dams, fish traps, etc. down river of Lower Granite Dam based on expanded coded-wire tag recoveries.

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.

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Acknowledgments

The Complex would like to acknowledge and extend great 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 2005 (BY05) spring Chinook salmon (SCS) at Dworshak National Fish Hatchery (NFH) which completed its life cycle in 2010. 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 BY05 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 are 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 BY05 may have occasionally been combined. In those sections where data for the two stocks are combined, it will be pointed out. Otherwise, data is for Dworshak NFH stock. Production data for BY05 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 a mitigation goal of 45,675: 36,540 available for harvest in the lower Columbia and Snake Rivers and 9,135 adults past Lower Granite Dam (U.S. Army Corp of Engineers 1975; Herrig 1990). Over the years, several changes have been made to the facility and the production program. For BY05, 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. In 2011, Dworshak NFH increased the capacity for incubation to 1,856 trays. Protocol calls for one female's eggs per tray giving the hatchery the capacity to incubate nearly 6.8 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 have been 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.

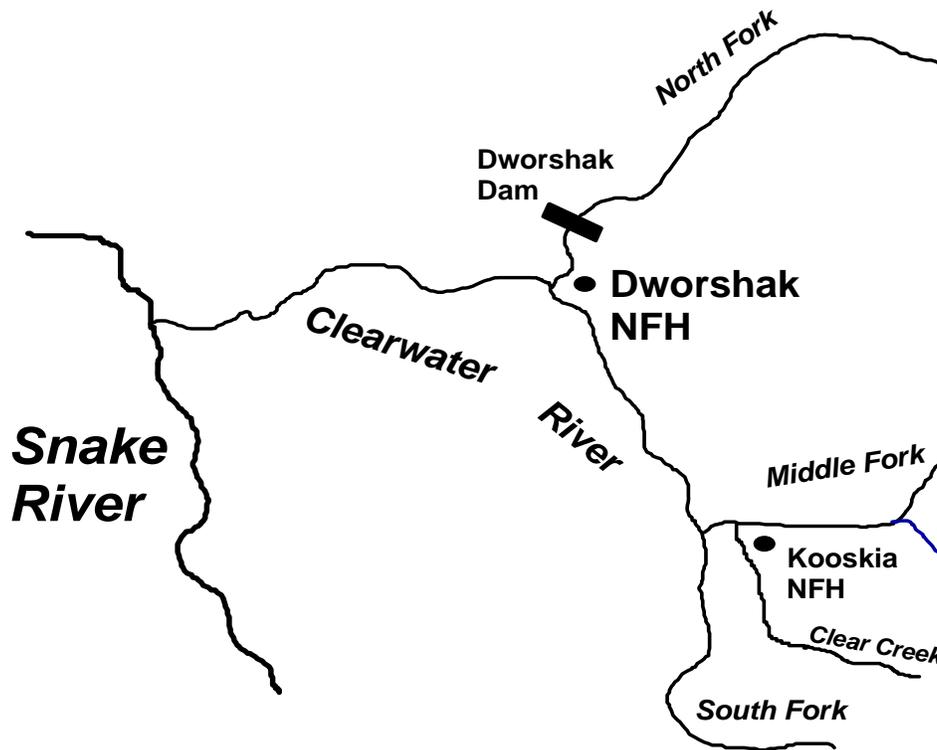


Figure 1. Location of Dworshak National Fish Hatchery (NFH) at the confluence of the North Fork and main stem Clearwater River, Idaho.

2005 ADULT SPRING CHINOOK SALMON RETURN TO DWORSHAK NFH

The brood year is formed from the progeny of the adults that return as brood stock to Dworshak National Fish Hatchery during the 2005 return year. This section provides information on the pre-season predictions compared to the actual returns (total returns to the Clearwater River), the ladder operations and inventory of adults, the age composition of the run, adult holding and mortality, spawning, and handling of adults that were excess to brood stock needs.

Pre-Season Assessment

The Idaho Fishery Resource Office (FRO) used a regression equation based on the 1-Ocean (Jack) returns in the previous year to predict the return of 2-Ocean adults to the Clearwater River the following year. In 2004, the 1-Ocean return to Dworshak NFH was originally estimated to be 184 fish (Idaho Fishery Resource Office 2005, Table 6). Using the regression model, we predicted a return of 2,028 2-Ocean adults for 2005 and a total adult return of 3,011 returning to the Clearwater River for the 2005 season (Idaho Fishery Resource Office 2005, Table 11). This number was much higher than the actual return. **Table 1** lists the predicted return, made in 2004, and the estimated returns of all three age classes of adults that returned in 2005 (Idaho Fishery Resource Office 2012, Table 11 [the returns reported for 2005 in Idaho Fishery Resource Office {2006} were modified in 2012 based on new updated data on Tribal and Sport harvests]). Our prediction for the 1-Ocean return was much higher than the actual return, 199 vs. 85. The regression used for making our prediction gave a very high estimate for 2-Ocean returns, 2,028 predicted vs. 1,260 actual. Our prediction for the 3-Ocean returns was also much higher than the actual return, 784 predicted vs. 245 actual. Although our total prediction was much higher than the actual return, it was still useful for management planning purposes such as anticipating potential harvest opportunity, collecting sufficient brood stock, and planning for adult outplanting. We coordinated ladder operations to maximize the fishing opportunities and to minimize brood stock handling and holding.

Table 1. Pre-season prediction and actual adult returns of Dworshak NFH stock to the Clearwater River, by ocean age, for BY05.

Ocean Age ¹	2004 Prediction for 2005	Actual 2005 Return
1 - Ocean	199	85
2 - Ocean	2,028	1,260
3 - Ocean	784	245
Total	3,011	1,590²

¹ 1-Ocean are BY02, 2-Ocean are BY01, and 3-Ocean are BY00.

² Total return updated with more recent estimates of sport and Tribal harvest. (Idaho Fishery Resource Office 2012, Table 11) compared to data reported in the 2005 Annual Report.

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 2005 adult spring Chinook salmon return to Dworshak NFH was 882 adults (**Table 2**).

Table 2. Actual rack return of adult spring Chinook salmon to Dworshak NFH by ocean age.

Ocean Age	Smolts Released	2005 Rack Return
1 - Ocean	1,078,923 (2004)	74 ¹
2 - Ocean	1,033,982 (2003)	686 ²
3 - Ocean	1,000,561 (2002)	122 ³
Total		882

¹ Appendix Table 13 (Idaho Fishery Resource Office 2012).

² Appendix Table 14 (Idaho Fishery Resource Office 2012).

³ Appendix Table 15 (Idaho Fishery Resource Office 2012).

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. The trap can optimally handle a maximum of about 900 adults. Once per week or on a regular basis the trap is emptied and the adults are inventoried and transferred to one of three adult holding ponds.

The hatchery ladder was opened May 18 and was closed on June 6 in order to clean and chlorinate steelhead rearing ponds. The ladder was reopened June 9 and remained opened until September 20 (Dworshak National Fish Hatchery 2005). **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 6/07/05 to 9/20/05, including trap mortalities (2005 Salmon News, Idaho FRO Files).

Inventory Date	I-Ocean	II-Ocean	III-Ocean	Total
June 7	0	4	0	4
June 28	15	250	36	301
July 12	11	114	24	149
July 26	6	64	11	81
August 10	20	158	39	217
August 16	3	25	7	35
August 23	4	35	2	41
August 30	2	18	0	20
September 6	7	12	3	22
September 13	5	3	0	8
September 20	1	3	0	4
Total	74	686	122	882

Age Composition of Rack Return to Dworshak NFH

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:

- 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 age composition for the 2005 return was 8% 1-Ocean, 78% 2-Ocean, and 14% 3-Ocean, respectively. The five year mean percent returns in the rack for 1-Ocean, 2-Ocean, and 3-Ocean adults are 6%, 88%, and 6%, respectively, for all years from 1999 to 2004 (**Table 4**).

When comparing the percentages of the 2004 to the five-year mean, there is a higher percentage of 2-Ocean adults and a lower percentage of 1-Ocean and 3-Ocean adults. The return in 2005 was similar in structure to that of the 5-year mean, with 2-Ocean adults comprising most of the

return (**Table 4**).

Table 4. Number and percent of adult spring Chinook salmon that returned to Dworshak NFH since 2000, by ocean age (Idaho Fishery Resource Office 2006, Table 4).

Return Year	I-Ocean		II-Ocean		III-Ocean		Total Return
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
2003	580	17%	478	14%	2,364	69%	3,422
2004	142	6%	2,077	88%	137	6%	2,356
Mean	208	6%	2,019	88%	793	6%	3,031
2005	74	8%	686	78%	122	14%	882

Adult Marking

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 stocks, all the Dworshak NFH adult spring Chinook salmon were marked with a left opercle V-notch.

Adult Holding and Mortality

Fish Health Treatments

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 were administered as bath treatments for one hour per day, 3 days per week at a concentration of 1:6,000.

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

Pre-Spawning Mortality

From June 7 to August 16, a total of 27 adult spring Chinook salmon (3.1% of rack return) died.

Mortality During Spawning

From August 18 through September 20, an additional 36 adults died (4.1 % of rack return).

The mortality rate of BY05 spring Chinook salmon adults during holding after the first day of spawning was lower than the 5-year average, with the total mortality lower than any of 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, 2000-2005 (Dworshak National Fish Hatchery 2005, Table 9).

Brood Year	Pre-Spawning Mortality	Mortality During Spawning	Total
2000	5.3%	3.0%	8.3%
2001	4.2%	2.6%	6.8%
2002	4.9%	7.1%	12.0%
2003	4.9%	2.7%	7.6%
2004 ¹	1.5%	7.2%	8.8%
Five-Year Avg	4.2%	4.5%	8.7%
2005	3.1%	4.1%	7.1%

¹ Does not include 134 adults that died in Pond 9 on June 30, prior to being inventoried.

Spawning

Details on the methods and procedures during spawning are provided in the Spawning Report for BY05 (Dworshak National Fish Hatchery 2005). Spawning was started on August 16, about the same time as in 2004. Six egg takes were made with the last ripe females for the Dworshak NFH program taken on September 20. A summary of the number of males and females spawned each week is presented in Table 6.

Fish Health Treatments (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.

Collection of Fish Health Information

92/210 (43.8%) adults tested positive for IHNV (Infectious Hematopoietic Necrosis Virus). Ovarian fluid samples were 3 pooled. Spleens were 1 pooled for Take 2 and 5 pooled for Takes 3 and 4. 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 male spleens

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

Take 4: 2/2 male spleens

All female adults were tested for Bacterial Kidney Disease (*Renibacterium salmoninarum*) by

ELISA (Enzyme-Linked Immunosorbent Assay)

Results: Not Detected - 377

Low - 10

Medium - 9

High - 4

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

Table 6. Number of male and female spring Chinook salmon spawned during each egg take for BY05 at Dworshak NFH (Dworshak National Fish Hatchery 2005). Jacks are incorporated into the number of males spawned.

Egg Take Date	Males Spawned	Females Spawned
8/16/05	48	59
8/23/05	93	134
8/30/05	83	81
9/6/05	98	97
9/13/05	22	13
9/20/05	2	1
Total	346	385

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. The 2005 rack returns to Dworshak were greater than was needed to meet brood stock needs. Arrangements were made with the Nez Perce Tribal Fisheries Department to transport 79 excess adults to the lower Selway River for supplementation purposes.

EGG PRODUCTION AND INCUBATION

Data on early incubation, eye-up, and final incubation and hatching is found in the Dworshak NFH spawning report (Dworshak National Fish Hatchery 2005).

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 385 females were spawned, giving an initial estimate of 1,347,500 green eggs (Dworshak National Fish Hatchery 2005).

Early Incubation

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 (Dworshak National Fish Hatchery 2005).

Eggs Culled for BKD

Kidney samples were taken from all females to test for BKD. For BY05, eggs from 7 females that tested high (≥ 0.199 ODU) for BKD were culled from production (Dworshak National Fish Hatchery 2005).

Eye-Up

At eye-up eggs were shocked, dead eggs were removed, and eggs were enumerated by a mechanized egg picker. A total of 52,402 dead eggs were counted. The total number of eyed eggs enumerated was 1,407,946, producing an average of 3,863 eggs per female (**Table 8**).

Table 8. Summary of egg take and eye-up for Dworshak NFH BY05 spring Chinook salmon (Dworshak National Fish Hatchery 2005, Table 2).

Take	Spawn Date 2005	# of Male ¹	# of Female	Female culled BKD ²	Female Culled Extra	Trays Culled Extra	Dead Eggs Enum	Eyed Eggs Enum	Eggs for Research	Total Eggs	Eggs/Female	Percent Enum Eye-up
1	16-Aug	48	59	1	0	0	10,388	205,000	0	215,388	3,714	95.2
2	23-Aug	93	134	1	0	0	15,712	501,352	0	517,064	3,888	97.0
3	30-Aug	83	81	2	0	0	6,532	312,404	0	318,936	4,037	98.0
4	6-Sep	98	97	2	0	0	17,897	341,890	0	359,787	3,787	95.0
5	13-Sep	22	13	0	0	0	1,873	47,300		49,173	3,783	96.2
6	20-Sep	2	1	1	0	0	0	0	0	0	0	0.0
Tot/Ave		346	385	7	0	0	52,402	1,407,946	0	1,460,348	3,863	96.4

1 Includes 37 jacks spawned during the season

2 BKD culling at minimal level above 0.213 ELISA testing for all Takes

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

Source: BY05 SCS Egg Enumeration and % Survival of Eggs Summary SC2005 EggEnum.xls

IFHC BKD ELISA testing results BY05 SCS

Egg Transfers and Final Incubation

Dworshak eggs were incubated in A, B, and C-banks. Water temperature averaged 41.5°F for egg Takes 1-4 until the chiller was repaired on October 4. Water temperature was then dropped to 39°F. The water temperature of the non-chilled incubator stacks (C bank) averaged 41.3°F throughout the incubation cycle. These stacks contained eggs from Takes 5-6 of Dworshak stock. Water temperature was held at approximately 39°F in A/B banks until the 200,000 Chinook eggs were shipped to Kooskia, and then the temperature was reduced to 37°F for incubation of Dworshak stock over the winter. In addition, 156,594 excess eggs were shipped to the IDFG Clearwater Hatchery on November 23, 2005.

Transfer from Incubation to Raceways

All the eggs had hatched by the end of January 2006 and remained in incubation trays at temperatures averaging 41.5°F. The BY05 SCS were moved from the incubator trays to A-bank raceways (RW's) from April 5-12. There were a total of 1,033,462 SCS ponded during this time. At the end of the month there were 1,023,624 BY05 SCS averaging 886 fish per pound (fpp) and 40 mm (1.6 inches) total length

JUVENILE REARING

The following data and information was summarized from the hatchery production records at Kooskia NFH, the 2006 and 2007 Annual Reports for Dworshak NFH (Dworshak National Fish Hatchery 2006; Dworshak National Fish Hatchery 2007), the Dworshak NFH monthly

production narratives, and the Dworshak NFH monthly inventory summaries (MIS).

Growth and Mortality

Growth was normal and as programmed, reaching the targeted size at release by March 2007. A record of monthly growth and mortality, from the end of April 2006 until the time of release in March 2007, is listed in **Table 10**.

Fish Health Monitoring

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

Results:

11--06 – Not Detected: 10

12-14-06 – Not Detected: 10

2-23-07 – Not Detected: 10

November – Low levels of the parasite *Epitheliocystis* seen on the skin. Fish appeared healthy at this time.

December – Low levels of the parasite *Epitheliocystis* seen on the skin. Two fish had pale livers.

February – No parasites detected on the skin. Five of the 10 fish sampled were moribund and had tail fungus. Low levels of the blood fluke *Sanguinicola* were seen on the gills. The 5 moribund fish had slightly pale gills. The moribund fish also had pale kidneys and low levels or no food in stomachs. It was noted that the tail fungus was most likely a result of trauma due to recent pit tagging. Ponds were noted to appear dirty and in need of cleaning.

Table 10. Summary of monthly growth and mortality of BY05 spring Chinook salmon during outside raceway rearing at Dworshak NFH. Compiled from monthly production narratives and monthly inventory summaries.

Date (End of Month)	Number	Weight (lbs)	FPP (Fish per Pound)	Mean Length (mm)	Mean Growth (mm)	Mortality (%)	Mean Water Temp (°F)
4/06	1,023,624	1,155	886.3	40	-	1.0	42.3
5/06	1,016,257	2,428	418.6	51	11	0.7	46.2
6/06	1,012,964	4,945	205.0	64	13	0.3	47.7
7/06	1,010,860	6,981	145.0	72	8	0.2	43.9
8/06	970,384	10,113	96.0	83	11	0.2	46.0
9/06	969,608	17,558	55.0	100	17	0.1	46.0
10/06	969,162	21,811	44	107	7	0.1	48.8
11/06	968,465	28,442	34	117	10	0.1	48.7
12/06	967,455	34,477	28	125	8	0.1	45.3
1/07	966,508	41,675	23	133	8	0.1	41.6
2/07	965,383	47,318	20	139	6	0.1	40.6
3/07	963,211	54,374	17.7	146	7	0.2	41.5

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 Fisheries Program Office, Vancouver, in August 2006. A total of 130,331 (total number tagged) 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 (**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 2007, prior to release. Tag code 050797 had a retention rate of 99.2% and tag code 051187 had a retention rate of 99.0%.

Table 11. Coded-wire tag release information for BY05 spring Chinook salmon released from Dworshak NFH in 2007.

Hatchery	Tag Code	Number of Tags ¹	Number of Fish Released ²	Mark Rate ³	Purpose
DNFH	051187	64,370	488,821	0.13	Contribution, Raceways 11,12,13
	050797	63,541	474,390	0.14	Contribution, Raceways 26,27,28

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

² Number of Fish Released is the total number of tagged and untagged fish that the tag group represents.

³ Mark Rate is the number of tags divided by the number of fish released that the tag code represents.

PIT tags

A total of 104,227 spring Chinook salmon were PIT tagged to monitor smolt emigration, survival, and adult returns. About 52,000 of these fish were tagged by the Columbia River Fisheries Program Office (CRFPO) in January 2007 as part of the Comparative Survival Study (CSS). An additional 52,500 spring Chinook smolts were PIT-tagged by Biomark in February 2007 as part of the Disease Susceptibility Study (DSS) conducted by the U.S. Army Corp of Engineers. See **SPECIAL STUDIES** section for details of the aforementioned studies.

NOTE: For consistency among brood years, only the Comparative Survival Study PIT tags were used for analysis of smolt emigration, survival and adult returns.

SMOLTS RELEASES

Idaho FRO began monitoring stream flows in the Clearwater River at the beginning of March, 2007 to coordinate spring Chinook salmon smolt releases with increases in the hydrograph. Mean daily flows into Lower Granite Reservoir remained below the 10 year average except for about a week during mid-March (**Figure 3**). Mean daily flow in the Clearwater River remained above the 10-year average most of March reaching nearly 16,000 cfs by release time (**Figure 4**). Releases were made during the afternoon and early evening of March 28 and 29 by pulling the screens and crowding the fish out of the raceways and into the discharge channel. A total of 963,211 smolts were released into the North Fork of the Clearwater River. The smolts averaged 17.7 fish per pound.

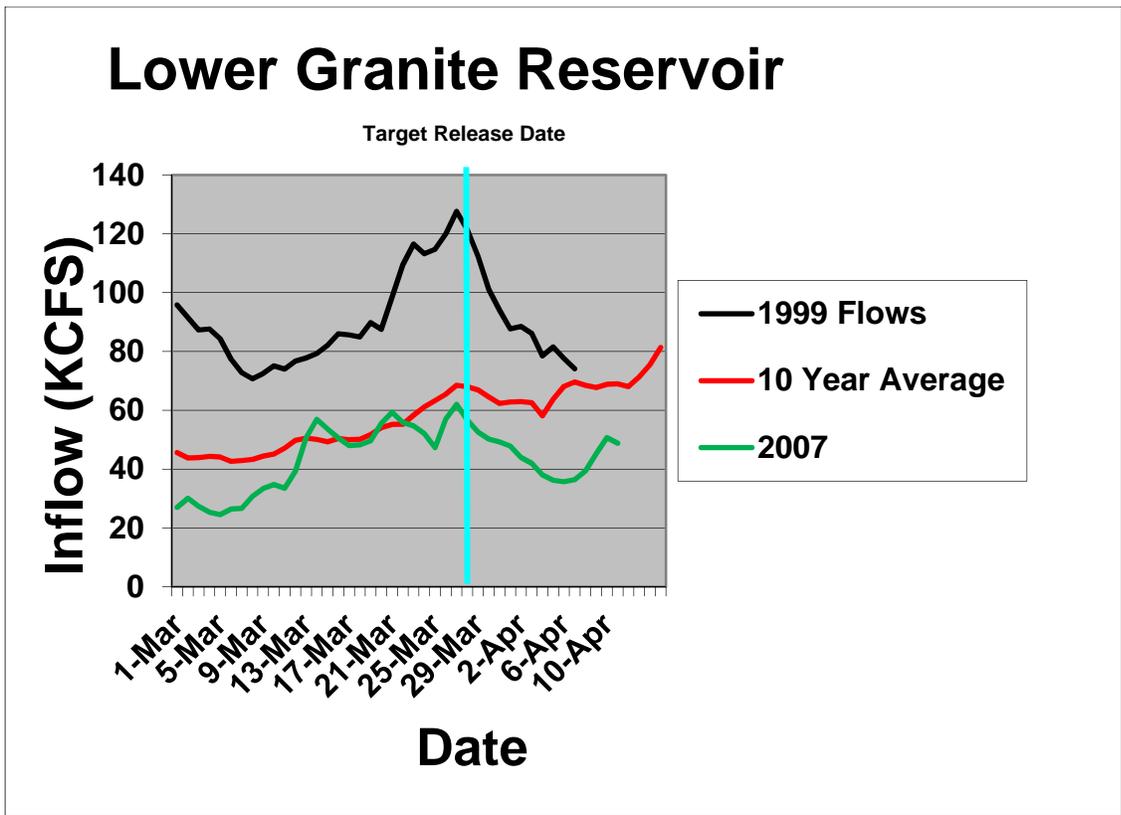


Figure 3. Mean daily flow in Lower Granite Reservoir during March 2007, compared to the 10 year average and the high flows in 1999. Vertical line indicates the dates smolts were released.

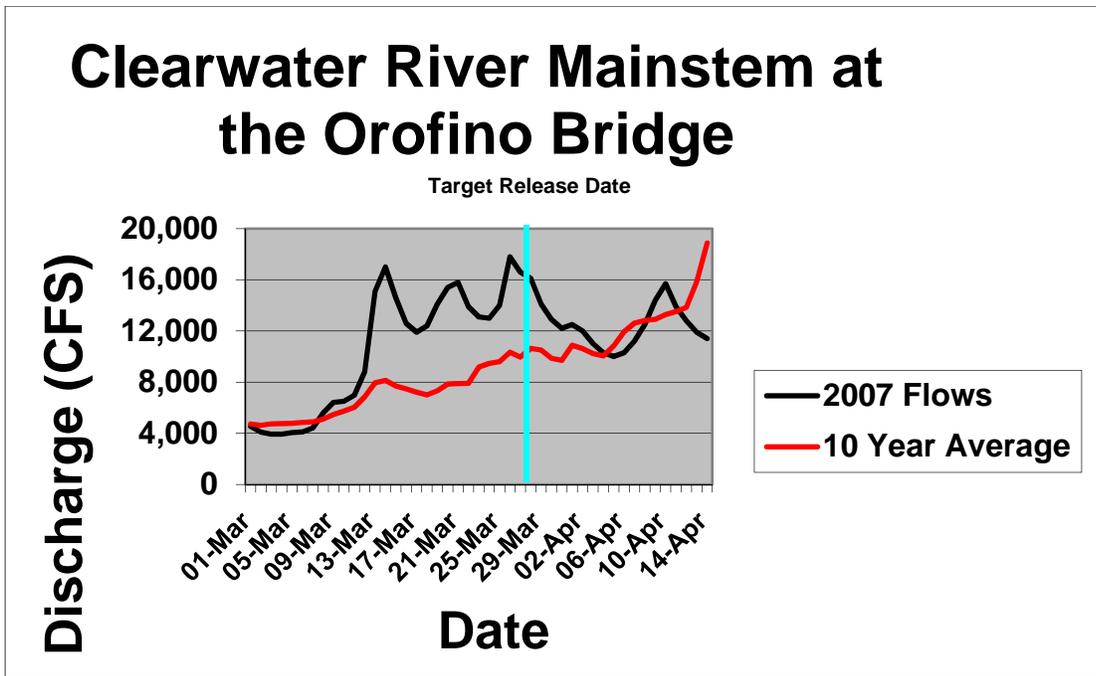


Figure 4. Mean daily stream discharge of the Clearwater River at the Orofino bridge, 2007, compared to the 10-Year Average. Vertical line indicates the dates smolts were released.

Fish Health Pre-release exam

60 fish, collected on 3-19-07.

ELISA Results: Not detected – 56

Low - 1

Medium - 0

High - 3

Viral assays - negative

Bacterial assays - negative

Hematocrits - 20 samples, all in normal range

SMOLT EMIGRATION

The performance of spring Chinook salmon smolts was monitored and evaluated using PIT tags after they were released from the hatchery. Because the smolts are tagged as part of the Comparative Survival Study, the tags are assigned to Separation by Code with 70% of the tags assigned to monitor mode and 30% assigned to return to river. Smolt emigration estimates are based on the cumulative survival of both transported and return to river fish. The tags were 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 5**). PIT tags provide information on travel time and survival during emigration. A total of 104,193 PIT-tagged spring Chinook salmon smolts were released in 2007 as part of two separate studies evaluating the effects of transportation on survival. The goal of both studies is to evaluate adult returns and determine whether transportation affords a survival advantage during spring emigration to the ocean; however, each addresses different aspects of survival. (See **SPECIAL STUDIES** section for details). For consistency among brood years, only the Comparative Survival Study PIT tags were used for analysis of smolt emigration.

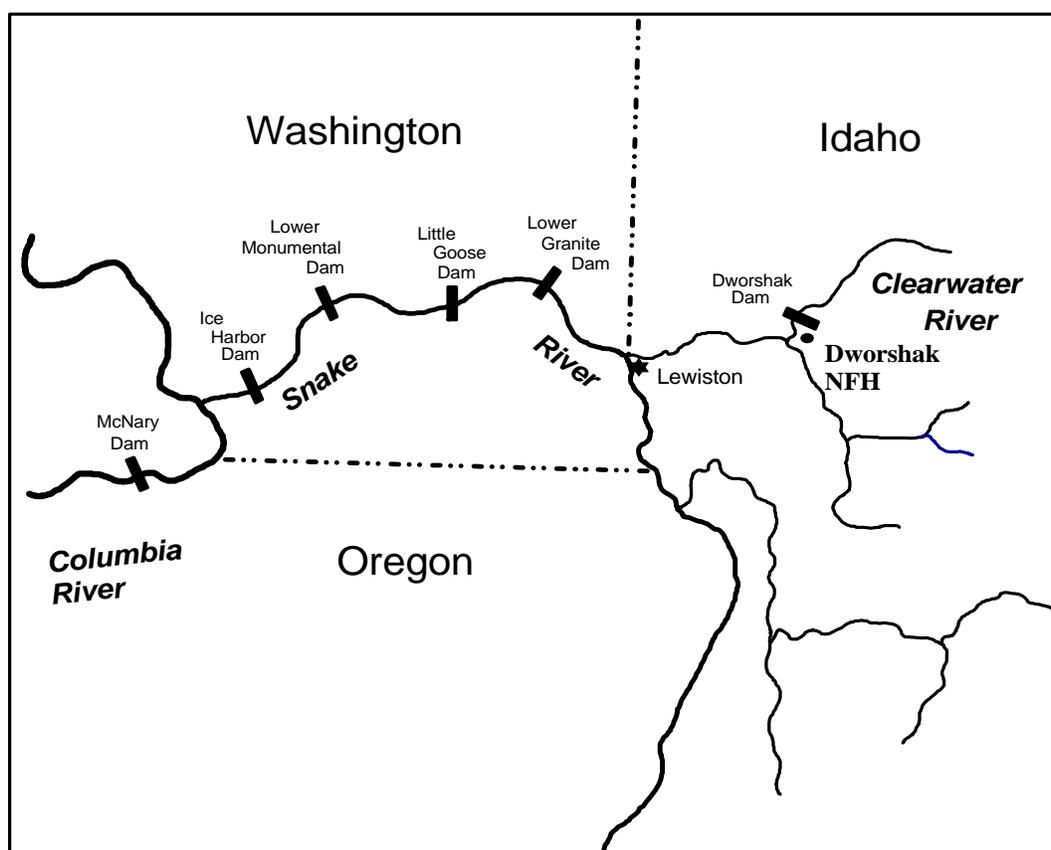


Figure 5. Dams on the lower Snake and Columbia rivers that have PIT tag interrogation facilities for monitoring smolt emigration and adult returns. John Day and Bonneville dams are not shown.

Travel Time

Travel time for BY05 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).

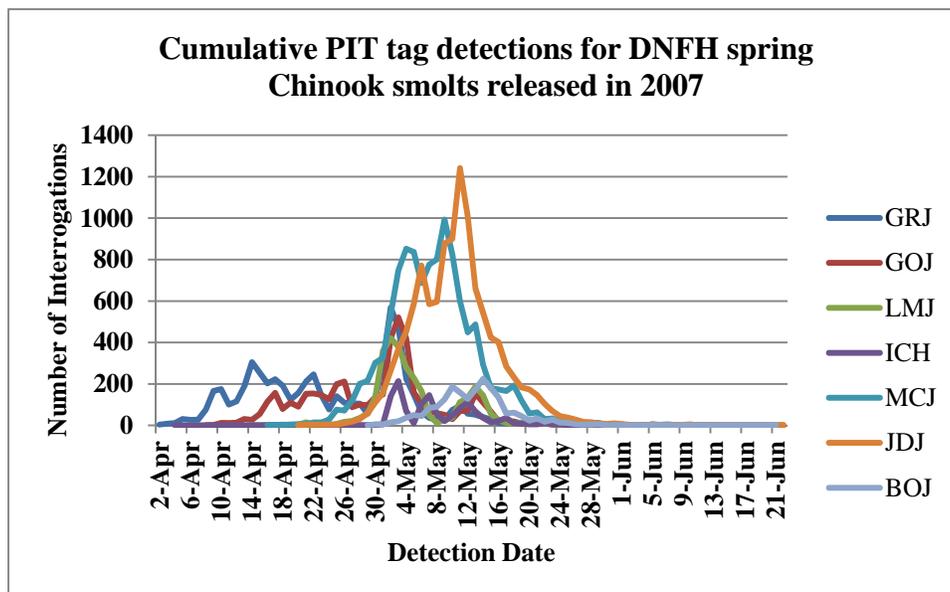


Figure 6. Cumulative PIT tag detections for BY05 Dworshak NFH spring Chinook smolts at juvenile bypass facilities in the Lower Snake and Columbia rivers.

The migration time of BY05 smolts released from Dworshak NFH to Lower Granite Dam ranged from 5.0 days to 67.0 days with a harmonic mean travel time of 22.3 (SE=0.143) days. Ten percent arrived at Lower Granite Dam within 14.0 days; 50% and 90% arrived within 27.0 days and 39.0 days, respectively. Smolts that migrated through the hydro system arrived at Bonneville Dam on average 45.6 days after release.

River Flows

Flows in the Lower Snake River were lower than the 10-year average for most of the time right after release until the end of June (Figure 7). Inflow into Lower Granite Reservoir never exceeded 100,000 cubic feet per second (cfs). Flows increased sharply to about 90,000 cfs but decreased just as sharply by the end of May. Flows continued to decrease steadily all through June for the rest of the emigration period.

Inflow into Lower Granite Reservoir 2007

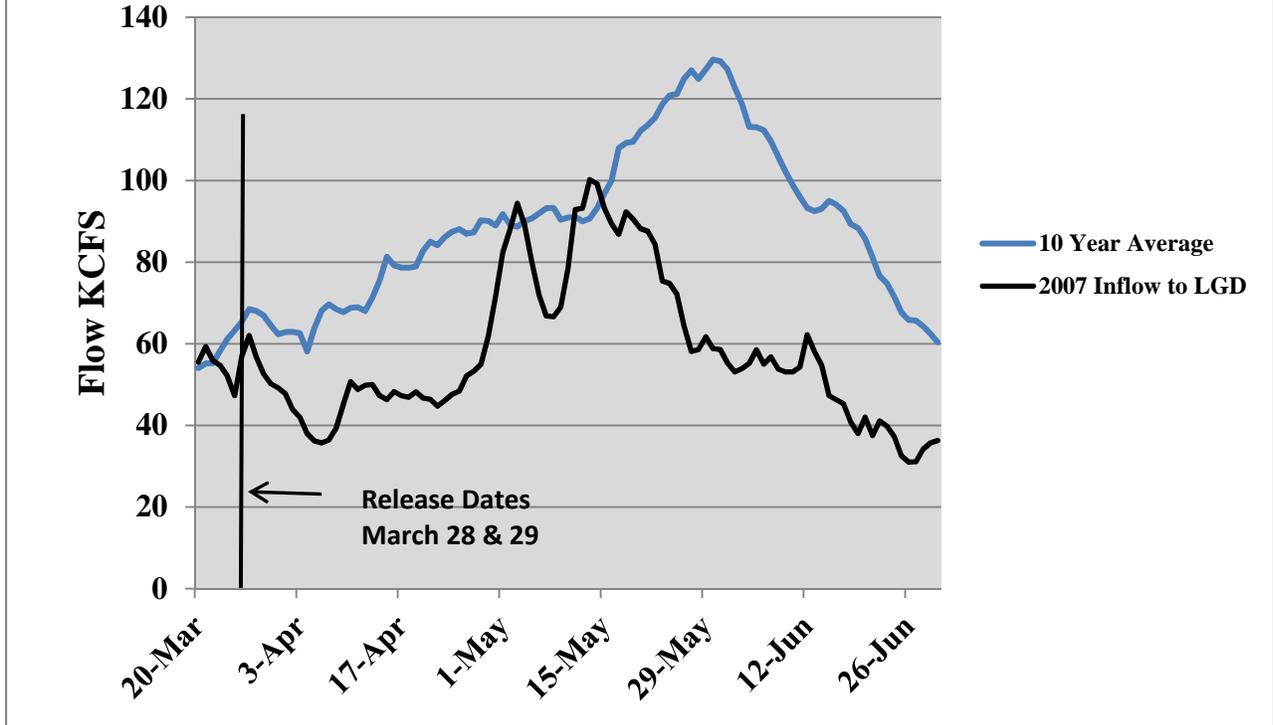


Figure 7. Mean daily inflow to Lower Granite Reservoir from March 20 through June 30, 2007 during spring Chinook salmon emigration after release from Dworshak NFH. The 10 year average is shown for perspective.

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 BY05 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	0.822	0.0098
Lower Granite Dam – Little Goose Dam	0.930	0.0202
Little Goose Dam – Lower Monumental Dam	0.936	0.0279
Lower Monumental Dam – McNary Dam	0.949	0.0244
McNary Dam – John Day Dam	0.911	0.0169
John Day Dam – Bonneville Dam	0.903	0.0654
Overall	0.559	0.0395

River reach survival for spring Chinook smolts ranged from 0.82 (SE= 0.0098) to 0.94 (SE= 0.0244). The lowest survival occurred between Dworshak NFH and Lower Granite Dam and the highest survival occurred between Lower Monumental and McNary dams. Overall survival to Bonneville Dam was 0.56 (SE=0.0395); higher than BY02 through BY04 (**Figure 8**).

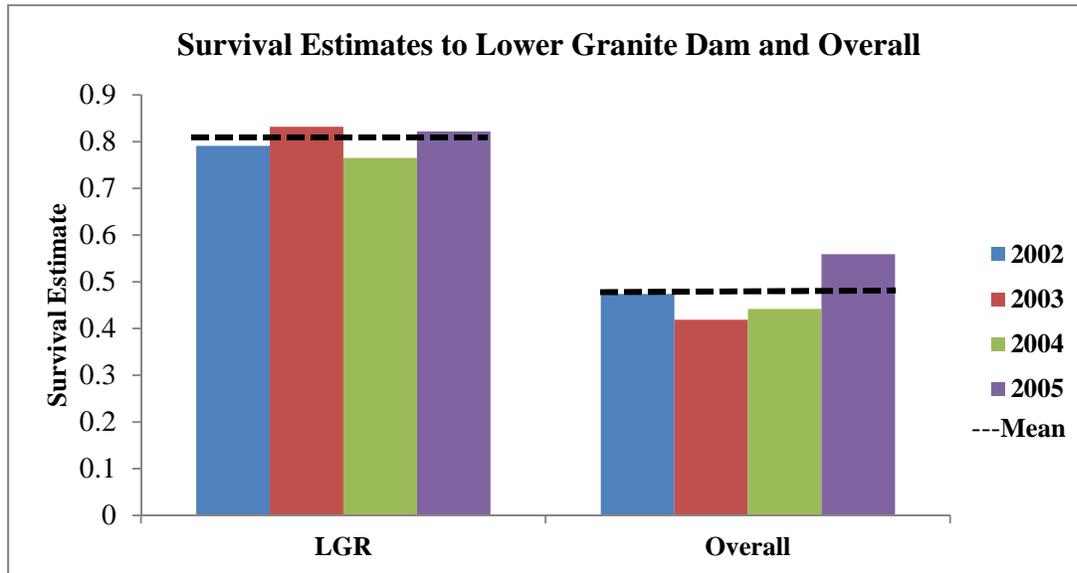


Figure 8. Mean survival estimates to Lower Granite Dam and overall survival estimate through the Federal Columbia River Power System, BY02-BY05.

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, and 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.* 2012). Thus, BY05 adults, released as smolts in 2007, return as 1-Ocean adults in 2008, 2-Ocean adults in 2009, and 3-Ocean adults in 2010.

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 in various sections of the Columbia and Snake Rivers is then estimated by dividing the total number of tags collected by the tagging rate (Jones *et al.* 2012). 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 2008 to 2010, an estimated 256 Dworshak NFH BY05 adults were harvested below Bonneville Dam, 157 in sport fisheries and 99 in non-tribal commercial net fisheries (**Table 14**).

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 2008 to 2010, an estimated 7 Dworshak NFH BY05 adults were reported harvested in Zone 6 sport fisheries and no Tribal harvests were reported (**Table 14**).

Columbia Above McNary Dam and Snake River Below LGD

Both sport and Tribal harvests occur in the this area historically, although Dworshak NFH has contributed very few spring Chinook salmon to these fisheries historically. For 2008, 2009, and 2010, no Dworshak NFH Chinook were reported harvested in these sections (**Table 14**).

Strays in the Columbia River

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. Historically, there have been very few strays of Dworshak NFH adults outside the Clearwater River, although some do occur. Over the years, Dworshak NFH adults have been collected at various hatcheries, fish weirs, fish ladders, or harvested in tributary sport and Tribal fisheries outside the normal migration corridor. From 2008 to 2010, there were no BY05 Dworshak NFH adult strays collected in the Columbia River (**Table 14**).

Lower Snake River from the 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 historically been caught in sport fisheries reported by Washington. There were no BY05 adults reported harvested, no strays reported, or any other adults collected in this section from 2008 to 2010 (**Table 14**).

Table 14. Summary of BY 2005 adult Dworshak NFH spring Chinook salmon collected in various fisheries in the Columbia and Lower Snake Rivers.

		Ocean	Below Bonn		Zone 6			Above McNary							
		HARVEST											STRAYS		
Ocean Age	Return Year	Ocean	Zone 1-5 Sport	Zone 1-5 Tribal	Zones 1-5 non-tribal Net	Zone 6 Sport	Zone 6 Tribes	Zone 6 Tribal	Columbia above MCN	Snake Below LGD	Snake above LGD sport	Snake above LGD tribal	Columbia Below MCN	Coumbi a above Mcn	Snake below LGD
1	2008	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	2009	0	157	0	99	7	0	0	0	0	0	0	0	0	0
3	2010	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals		0	157	0	99	7	0	0	0	0	0	0	0	0	0

Lower Snake and Clearwater River above Lower Granite Dam

It is challenging to account for 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 BY05, an estimate was made based on the Dworshak NFH rack returns, the Nez Perce Tribal subsistence harvests, and the sports harvests that occurred in 2008, 2009, and 2010. Because of data limitations, escapement could only be estimated for the 2-Ocean and 3-Ocean age classes that returned in 2009 and 2010, respectively. Escapement is composed of those fish that do not return to a project area or weir, or are not captured in the sport or Tribal harvests, and escape to the natural environment where they may attempt to spawn. For BY05, the estimate of escapement was limited so the estimate of the total return of spring Chinook salmon to the Clearwater River was a conservative number that is biased low. Assessment of the rack return, sport and Tribal harvest, escapement, and the total return to Lower Granite Dam are provided below.

Rack Return to Dworshak NFH

Brood Year 05 spring Chinook salmon smolts released in 2007 returned as adults in 2008 (1-Ocean), 2009 (2-Ocean), and 2010 (3-Ocean). The total adult return to the hatchery rack was 1,804 fish (**Table 15**).

Idaho 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 523 BY05 Dworshak NFH adults and is reported by estimated age class each year in **Table 15**.

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 BY05 spring Chinook salmon occurred in 2008 (1-Ocean fish), in 2009 (2-Ocean fish) and in 2010 (3-Ocean fish). Based on IDFG reports, a total estimated harvest of 837 BY05 Dworshak NFH origin adult salmon were taken in the sport harvest. A summary of the number harvested by Ocean Age Class is provided in **Table 15**.

Escapement

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. Adequate PIT-tag data was available only for adults returning in 2009 and 2010, so the estimated escapement for the 3-Ocean age class for BY05 could not be calculated. We estimated that the BY05 escapements for the 2009 and 2010 adult returns were 466 and 249, respectively (**Table 15**).

Minimal Estimate of Adult Return to Lower Granite Dam

Based on the rack return, the estimated sport and Tribal harvests, and partial escapement, the minimum estimated adult return to Lower Granite Dam for BY05 is 3,879 (**Table 15**). The estimated 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, and the estimated escapement. For BY05, the estimated minimum total is 3,879 (1,804 rack return and 1,360 harvested, 715 escapement) giving a smolt to adult return rate, for accountable fish, of 0.403 % (Idaho Fishery Resource Office 2011, Appendix Table 5). A total of 963,211 smolts were released from Dworshak NFH in 2007.

Table 15. Summary of adult returns to Dworshak NFH for BY05 spring Chinook salmon (Appendix Tables 13, 14, and 15 in Idaho Fishery Resource Office 2012).

Return Year	Ocean Age	Rack Return	Sport Harvest	Tribal Harvest	Escapement	Strays ¹	Total
2008	1	319	166	21	NA	15	506
2009	2	1,200	629	221	466	38	2,516
2010	3	285	42	281	249	0	857
Total		1,804	837	523	715	54	3,879

¹ Strays are not included in the total and are reported here only for information purposes.

Strays

A total of 54 BY05 Dworshak NFH adults were identified as strays in the Snake River and its tributaries above Lower Granite Dam. The estimated strays are not included in the above analysis in order to maintain consistency in the reported data between the 2009 Annual Report and this report. Strays are not accounted for in the annual reports because the coded-wire tag data needed for making the estimate is not available at that time.

Fish Health Information on the Rack Return

1-Ocean Adults (2008 Return)

37/213 (17.4%) 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: 9/38 ovarians, 10/36 male spleens

Take 2: 0/87 ovarians, 0/25 male spleens

Take 3: 18/27 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 - 320

Low - 55

Medium - 6

High- 4

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

2-Ocean Adults (2009 Return)

61/210 (29.05%) 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: 30/77 ovarians, 5/40 male spleens

Take 3: 21/73 ovarians, 5/20 male 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.

3-Ocean Adults (2010 Return

6/212 (2.8%) adults tested positive for IHNV (Infectious Hematopoietic Necrosis Virus). Ovarian fluid and spleen samples were 1 pooled. All spleen tissues were sampled from males.

Results positive for IHNV by take:

Take 1: 2/72 ovarians, 0/15 male spleens

Take 2: 0/72 ovarians, 0/15 male spleens

Take 3: 0/8 ovarians, 4/30 male spleens

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

Results:

Not Detected - 250

Low - 90

Medium - 3

High- 2

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

SPECIAL STUDIES

Comparative Survival Study

The Dworshak Fishery Complex has been cooperating with the Fish Passage Center in a Comparative Survival Study (CSS) 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 51,656 PIT-tagged BY05 spring Chinook salmon smolts in 2007 as part of the CSS. The goal of the project is to evaluate adult returns and determine whether transportation provides any survival advantage over in-river emigration. Results of the CSS can be found at <http://fpc.org>.

Disease Susceptibility Study

The Disease Susceptibility Study (DSS), was a cooperative study among the U.S. Army Corps of Engineers (Derek Fryer), University of California, Davis (Frank Loge) and the National Oceanic and Atmospheric Administration, was conducted using Dworshak NFH spring Chinook smolts for a single release year, 2007. Fifty-two thousand five hundred and forty- seven PIT tagged smolts were released from Dworshak NFH along with the CSS study group. This study sought to estimate the degree of disease susceptibility in transported, bypassed and in-river migrating juvenile salmon.

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