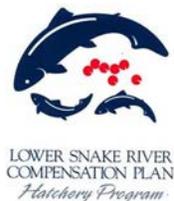
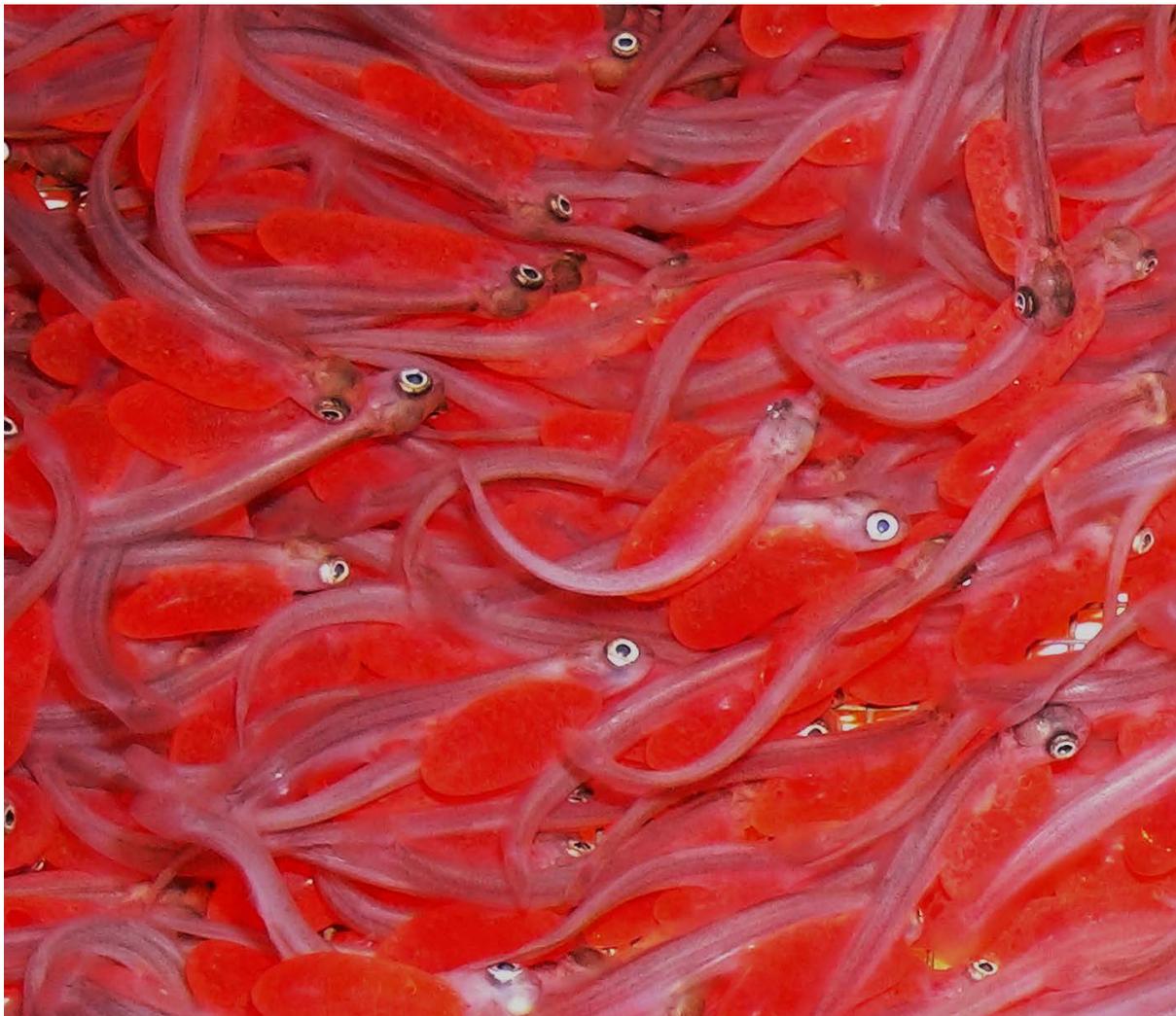


FY2015 ANNUAL REPORT OF HATCHERY
EVALUATION ACTIVITIES FOR SPRING CHINOOK
SALMON AT DWORSHAK NATIONAL FISH
HATCHERY

Idaho Fishery Resource Office

April 2016



LOWER SNAKE RIVER
COMPENSATION PLAN
Hatchery Program

Idaho Fishery Resource Office
Dworshak Fishery Complex
U.S. Fish and Wildlife Service
276 Dworshak Complex Drive
Orofino, Idaho 83544



**FY2015 ANNUAL REPORT OF HATCHERY EVALUATION
ACTIVITIES FOR SPRING CHINOOK SALMON AT
DWORSHAK NATIONAL FISH HATCHERY**

**Brood Year 2013 Smolt Releases
Brood Year 2014 Marking/Tagging and Parr Releases
Brood Year 2015 Adult Returns
Brood Year 2010 SAR
Prediction for 2016 Adult Returns**



Prepared by:

John Hook, Ray N. Jones, Carrie Bretz, and Chris Peery

Prepared for:

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

And

Lower Snake River Compensation Plan Program
U.S. Fish and Wildlife Service
Boise, Idaho 83709

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.

Note: Analysis of adult returns is incomplete. The 3-Ocean adult returns in 2015 complete all the adults returning for BY10, released as smolts in 2012. However, until all the coded-wire tags recovered in various fisheries throughout the Columbia, Snake, and Clearwater rivers are reported and recorded in the PSMFC RMIS database, a final accounting cannot be completed. The final accounting will be available after the completion of the BY10 Brood Year Report in FY2017.

CITATION FOR THIS REPORT

Hook, John, Jones, R.N., C. Bretz, and C. Peery. 2016. FY2015 annual report of hatchery evaluation activities for spring Chinook salmon at Dworshak National Fish Hatchery: Brood Years 2013 Smolt Releases, Brood Year 2014 Marking/Tagging and Parr Releases, and Brood Year 2015 Adults Returns, Brood Year 2010 SAR, and Prediction for 2016 Adult Returns. Technical fisheries report by the Idaho Fishery Resource Office, Dworshak Fisheries Complex, U.S. Fish and Wildlife Service, Ahsahka, ID. 24p.

ACKNOWLEDGMENTS

The Dworshak NFH would like to acknowledge and extend great appreciation to all the other administrative, production, maintenance, and fish health staff members at the Dworshak Fisheries Complex and Kooskia NFH who accomplish all the fundamental work of producing spring Chinook salmon 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.

Cover photograph by Angela Feldmann

TABLE OF CONTENTS

LIST OF TABLES	v
INTRODUCTION	1
BROOD STOCK ORIGIN AND HISTORY	2
BROOD YEAR 2013 SMOLT RELEASES	3
Release Timing	3
Numbers, Sizes, and Release Locations	5
PIT-Tagging for Estimating Smolt Emigration Performance and Survival.....	6
Coded-Wire Tagging for Estimating Adult Contribution and Survival.....	6
BROOD YEAR 2014 MARKING, TAGGING, AND PARR RELEASES	7
Marking and Tagging.....	7
ADULT RETURNS in 2015.....	7
Adult Return Monitoring and Run Assessment.....	8
Ladder Operations and Broodstock Collection.....	8
Total Estimated Adult Return to the Clearwater River.....	11
<i>Sport Harvest</i>	12
<i>Tribal Harvest</i>	12
Adult PIT Tag Returns.....	13
BROOD YEAR 2010 SMOLT TO ADULT RETURN RATE (SAR)	14
PREDICTION FOR 2016 ADULT RETURNS	15
Review of 2015 Predictions.....	15
2016 Run Predictions	16
REFERENCES	17

LIST OF TABLES

Table 1. Brood stock history of Dworshak NFH spring Chinook salmon smolts directly released from the hatchery, 1983-2015.....	3
Table 2. Location, date, number, length, weight, and size of BY2013 smolt releases from Dworshak NFH in 2015 (Dworshak Monthly Activity Report-March, 2015).	5
Table 3. Coded-wire tag release information for Brood Year 2013 spring Chinook salmon released from Dworshak NFH in 2015.	7
Table 4. Coded-wire tag information for Brood Year 2014 spring Chinook salmon scheduled for release from Dworshak NFH in 2016.	7
Table 5. Dates and number of adult spring Chinook salmon trapped and inventoried at Dworshak NFH in 2015 (Dworshak National Fish Hatchery 2016).	9
Table 6. Stock composition of adult spring Chinook salmon collected at Dworshak NFH in 2015, estimated using expanded coded-wire tags.	10
Table 7. Number, length range, average length and percent composition of adult males and female Dworshak NFH Chinook salmon collected at Dworshak NFH in 2014, based on known age analysis using code-wire tags.	11
Table 8. Adult returns of Dworshak NFH adult spring Chinook salmon to the Clearwater River from 2010-2015.	13
Table 9. Conversion rates of PIT tagged adult Dworshak NFH spring Chinook salmon between Bonneville Dam, Lower Granite Dam, and Dworshak NFH.	14
Table 10. The estimated number of Dworshak NFH spring Chinook salmon adults of each ocean age class in Clearwater River fisheries for Return Year 2015.	14
Table 11. Brood Year, release year, number of smolts released, and the numbers and percent survival of Dworshak NFH adult returns to the Clearwater River by age class for Brood Years 2006 to 2011.	15
Table 12. Predicted and calculated returns of Dworshak NFH spring Chinook salmon by ocean age class, 2015, which includes sport and Tribal harvest estimates and an estimate of escapement.	15
Table 13. Predicted returns of spring Chinook salmon to the Clearwater River at Lower Granite Dam from the Dworshak Fishery Complex by ocean age class, 2016.	16

INTRODUCTION

Dworshak National Fish Hatchery (NFH) is located at the confluence of the North Fork and the main stem Clearwater River near Ahsahka, Idaho. Construction of the hatchery was included in the authorization for Dworshak Dam and Reservoir (Public Law 87-847, October 23, 1962) to mitigate for losses of steelhead (*Oncorhynchus mykiss*) caused by the dam and reservoir. The hatchery was designed and constructed by the U.S. Army Corps of Engineers (COE) and has been administered and operated by the U.S. Fish and Wildlife Service (FWS) since the first phase of construction was completed in 1969.

The spring Chinook salmon production program was added to Dworshak NFH in 1982 as part of the Lower Snake River Compensation Plan (LSRCP). The LSRCP program was designed to mitigate for the loss of harvest and habitat of spring Chinook salmon in the lower Snake River resulting from the construction of four main stem dams between Lewiston, Idaho, and the mouth of the Snake River. Thirty 2.44 meter by 24.4 meter raceways were built 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). The program goal at Dworshak NFH was to return 45,675 adults: 36,540 available for harvest in the lower Columbia and Snake Rivers and 9,135 adults past Lower Granite Dam, assuming a smolt-to-adult return rate of 0.87% (U.S. Army Corp of Engineers 1975; Herrig 1990).

In the early 1990's, based on results of a rearing density evaluation (Jones and Miller 1996), the number of smolts released was reduced to 1.05 million at a size of 15 fish per pound. In 2010, flows in the raceways were increased as a result of adjustments made to reduce dissolved gas levels. With the increased flows, rearing capacity in terms of Flow Index was increased, allowing the rearing profile of 35,000 fish per raceway (1.05 million total release) to be increased to 45,000 fish per raceway (1.35 million total release).

Since the inception of the program, the adult return goal has not been consistently met and we are currently conducting an evaluation of using a higher rearing density to increase adult returns of Dworshak NFH Chinook salmon. This evaluation will be carried through the adult returns for broodyears 2012, 2013 and 2014 with a smolt release target of 1.47 million annually for those three cohorts (Dworshak Complex Hatchery Evaluation Team 2011). Beginning with broodyear 2015, the smolt release goal was raised to 1.65 million annually.

This report includes the stock origin and history of the program, the smolts released and emigration performance for Brood Year 2013, marking and tagging for Brood Year 2014, and the age composition of the rack return, estimates of the sport and Tribal harvests, and an estimate of the total adult return to the Clearwater River during 2015. The smolt to adult survival for Brood Year 2010 is estimated. The predictions made for the 2015 adult return are reviewed and the pre-season predictions for the adult return in 2016 are presented.

BROOD STOCK ORIGIN AND HISTORY

The Dworshak National Fish Hatchery (NFH) spring Chinook salmon program was started using spring Chinook salmon stock from the Leavenworth and Little White Salmon NFH programs. Eggs were transferred from these facilities to Dworshak NFH and made up the smolt releases from 1983 to 1986 (**Table 1**). Since these stocks were very strongly influenced by transfers from Carson NFH to Leavenworth and Little White Salmon NFHs, the early Dworshak spring Chinook salmon stock was considered a Lower Columbia River derivative. The spring Chinook salmon program for brood years 1985 and 1986 consisted entirely of eggs that had been transferred from Rapid River State Fish Hatchery (SFH). Rapid River State Fish Hatchery used spring Chinook salmon trapped at Hells Canyon Dam (considered an upper Snake River stock) as an original parent stock. Thus, smolts released from Dworshak NFH in 1987 and 1988 were entirely Rapid River stock, shifting the program away from using the Lower Columbia River Chinook salmon stock. In the 26 years since 1988, Dworshak NFH has maintained its program from fish that have returned directly to the North Fork Clearwater River, with the exception of two years when the program was below full production. In 1995, releases from Dworshak NFH were one third Kooskia stock spring Chinook salmon. Then in 2001 about one-third of the Dworshak NFH release was Rapid River stock (Lookingglass Fish Hatchery adults collected at Lower Granite Dam). The recent returns to Dworshak NFH (1989 and later) were referred to as Dworshak stock, since they are progeny of returns to Dworshak NFH, rather than direct products of transfers of Rapid River stock. However, since 2012, progeny from those spawned at Dworshak NFH are no longer considered unique to Dworshak NFH and are considered Clearwater River stock, since the broodstock is known to include adults from the other hatchery programs in the Clearwater Basin that stray into the Dworshak NFH ladder.

Over the years, the spring Chinook salmon artificial production program in the Clearwater River Basin has expanded significantly to include two federal hatcheries (Dworshak and Kooskia NFH's), a state hatchery (Clearwater Fish Hatchery), and a Tribal hatchery (Nez Perce Tribal Hatchery). The program includes several satellite facilities and a number of off-site acclimation and release locations. In 2011, the coded-wire tags recovered from spring Chinook salmon broodstock at Dworshak NFH indicated a noticeable degree of straying from locations other than Dworshak NFH into the hatchery. Thus, the broodstock for Dworshak NFH incorporates adults from other programs in the Clearwater Basin and these percentages are reported in the "*Stock Composition - Rack Return*" section in the **2015 Adult Returns** portion of this report. However, for purposes of broodstock history, all the adults returning to Dworshak NFH, including strays from other Clearwater River programs, are considered stock for that hatchery (Clearwater River Stock). **Table 1** will only reflect changes in brood stock composition resulting from out-of-basin transfers from other hatcheries in situations where broodstock shortages cannot be met from within the Clearwater River Basin.

Table 1. Brood stock history of Dworshak NFH spring Chinook salmon smolts directly released from the hatchery, 1983-2015.

Release Year	Brood Stock Composition
1983	75% LW, 12% RR, 13% LE
1984	100% LE
1985	68% LW, 32% LE
1986	100% LE
1987 – 1988	100% RR
1989 – 1994	100% DW
1995	66% DW, 34% KK
1996 – 2000	100% DW
2001	64% DW, 36% RR
2002-2015	100% CW

CW = Clearwater River

LE = Leavenworth

DW = Dworshak

LW = Little White Salmon

KK = Kooskia

RR = Rapid River

BROOD YEAR 2013 SMOLT RELEASES

Brood Year 2013 was established from adults returning to Dworshak NFH in 2013 (Dworshak National Fish Hatchery 2013). The production cycle for this brood year marked the second year of smolt releases for the rearing density evaluation study.

Incubation and early rearing was completed in late spring 2014. Dworshak NFH maintains an average water temperature of 45° F in the outdoor spring Chinook salmon rearing raceways throughout the rearing cycle. The target release size is 20 fish per pound (fpp). The five year average size-at-release is 20.2 fpp for release years 2010 - 2014. Coded-wire tagging, adipose fin clipping, and re-stocking at final rearing densities was completed in August, 2014. PIT-tagging was completed in January and February of 2015. Final rearing was completed during the early spring of 2015.

Release Timing

Survival of out-migrating salmonids through the Snake and Columbia Rivers and during the first year of ocean residency is positively related to stream discharge experienced during migration (Haeseker *et al.* 2012, Petrosky & Schaller 2010, Plumb *et al.* 2006, Connor *et al.* 2003, Smith *et al.* 2003). In order to coordinate spring Chinook salmon smolt releases with elevated spring stream flow, mean daily discharge in the Clearwater River and into Lower Granite Reservoir is monitored beginning March 1. Releases are targeted between the last week of March and the first two weeks in April. The Idaho FRO began monitoring flows and river conditions starting March 1, providing weekly updates. By March 15, the mean daily discharge of the main stem Clearwater River at the Orofino Bridge (**Figure 1**) and the mean daily inflow into Lower Granite

Reservoir (**Figure 2**) peaked at over 15,000 cfs and 31,600 cfs, respectively, providing better than normal release conditions in the Clearwater River, but far below optimal conditions in the Snake River. However, projections were for flows to increase in the Snake River by the end of the month and decision was made to schedule releases for the 25th and 26th of March.

The U.S. Army Corp of Engineers was contacted to arrange for increased flows from Dworshak Reservoir into the North Fork Clearwater River up to 20,000 cfs on 25th and 26th of March and releases were made on those evenings. In addition, 1,050 smolts were released from Burrows Pond 71 on April 6 as part of an Army Corp of Engineers project. Brood Year 2013 Chinook salmon will return in 2016, 2017, and 2018 as 1-, 2-, and 3-Ocean adults, respectively.

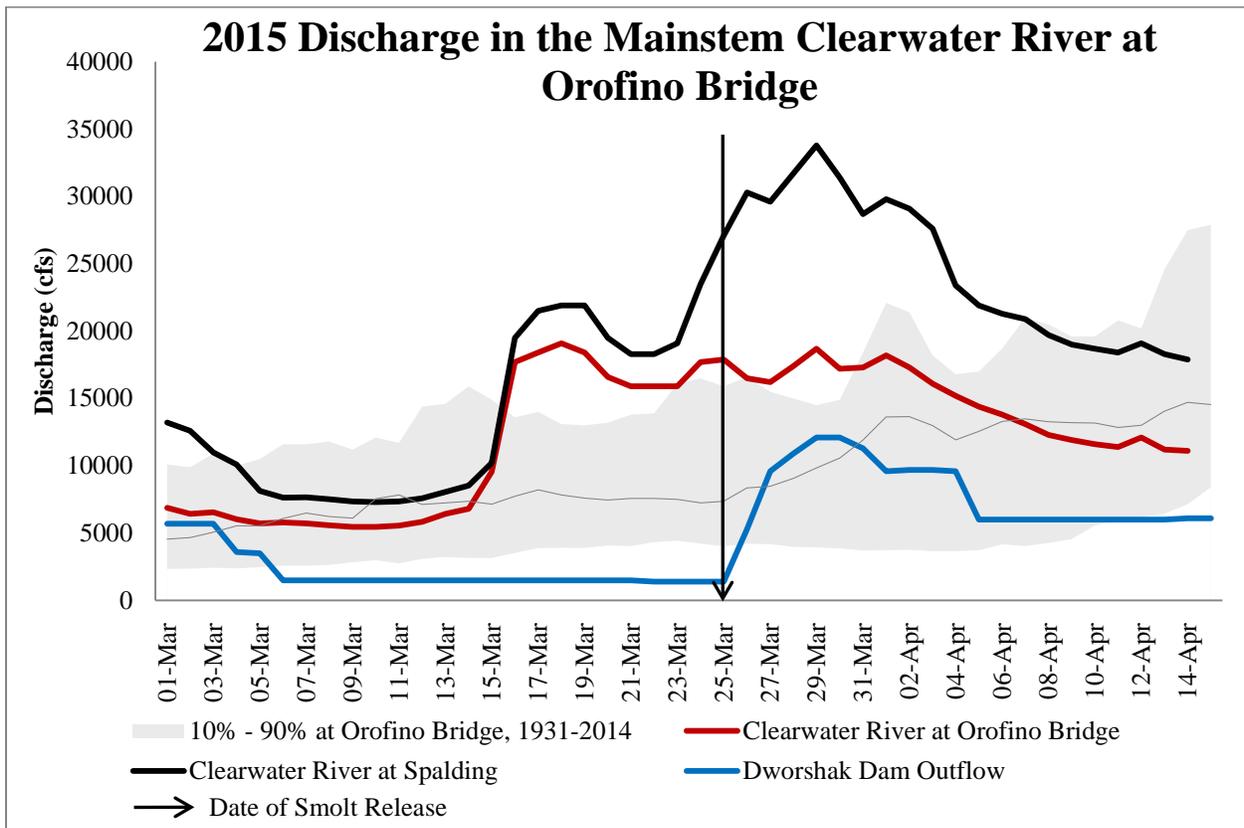


Figure 1. Discharge in the main stem Clearwater River in 2015 and historical discharge from 1931 - 2014.

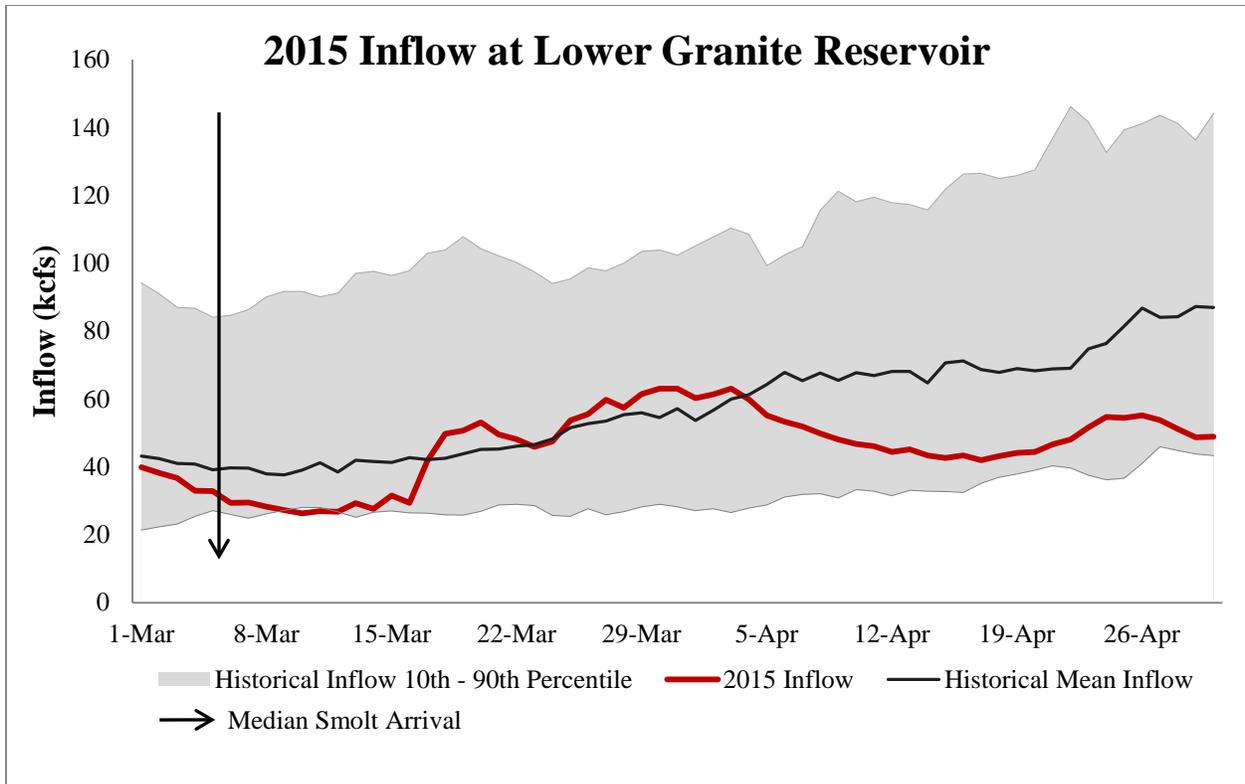


Figure 2. Flow into Lower Granite Reservoir in 2015 and historical inflow from 1988 - 2013.

Numbers, Sizes, and Release Locations

A total of 1,550,313 smolts were released from the hatchery into the North Fork Clearwater River. The mean size of smolts released from Dworshak NFH was 21.6 fpp, only slightly small of the 20 fpp target size. The dates, numbers, and sizes for each release group are listed in **Table 2**.

Table 2. Location, date, number, length, weight, and size of BY2013 smolt releases from Dworshak NFH in 2015 (Dworshak Monthly Activity Report-March, 2015).

Location	Date	Number	Length (mm)	Weight (lbs)	Size (fpp)
NF Clearwater R ¹	3/25/2015	714,299	136	32,917	21.7
NF Clearwater R ²	3/26/2015	834,964	137	38,908	21.5
NF Clearwater R ³	4/6/2015	1,050	136	48	21.7

¹ A-Bank Raceways

² B-Bank Raceways

³ Burrows Pond 71

PIT-Tagging for Estimating Smolt Emigration Performance and Survival

PIT-tags are used to help evaluate the effectiveness of the production program at Dworshak NFH. Information is collected at the lower Snake and Columbia River dams 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 estimate adult return as fish are detected at Columbia and Snake River dams.

A total of 41,774 pit-tagged smolts were released at Dworshak NFH as part of the Comparative Survival Study being conducted by the Fish Passage Center. The Comparative Survival Study evaluates the effectiveness of transporting smolts past the Snake and Columbia River dams as opposed to migration through the hydro system. The study is designed for long term, multi-year monitoring and evaluation of transported vs. non-transported smolts from multiple production facilities within the Clearwater and Snake basins. As such, the study design requires that PIT-tags are distributed within representative production groups. PIT-tags were distributed representatively among spring Chinook smolts reared in both the A Bank and B Bank raceways at Dworshak NFH and released into the North Fork Clearwater River as part of "normal" Dworshak production.

The migration time of smolts released from Dworshak NFH to Lower Granite Dam ranged from 4 days to 64 days with a harmonic mean travel time of 24 days. Ten percent arrived at Lower Granite Dam within 16 days; 50% and 90% arrived within 30 days and 42 days, respectively. Smolts that migrated through the hydro system arrived at Bonneville Dam on average 47 days after release. Survival probabilities through the Federal Columbia River Power System were calculated using SURvival under Proportional Hazards 2.1 (SURPH) (Lady *et al.* 2001). The estimated survival for BY13 spring Chinook smolts to Lower Granite Dam was 77.6% (SE=0.018), slightly lower than the 5-year average of 78% from 2010 to 2014. The overall estimated survival to Bonneville Dam was 42.7% (SE=0.0383), much lower than the 70.2% in 2014.

Coded-Wire Tagging for Estimating Adult Contribution and Survival

Coded-wire tags are used to estimate the contribution of adults to various commercial, sport and Tribal fisheries in the ocean, in the lower Columbia River, in the lower Snake River, and in the Clearwater River when they return as adults. Coded-wire tag groups are also used to represent treatment and control groups for both on- and off-station research projects and provide information on the effectiveness of alternative production methods.

A total of 120,452 fish were coded-wire tagged at the time of adipose fin clipping (**Table 3**). Coded-wire tag retention rates for these salmon were checked pre-release on March 24, 2015. The coded-wire tag retention rates for Dworshak NFH BY13 spring Chinook smolts was 99.0%. Retention rates for all raceways were derived from a single 100% coded-wire tagged raceway (A15). **Table 3** lists the tag codes, the number tagged, the estimated number of non-CWT fish each code represents, the estimated mark rate, and the raceways containing tagged fish.

Table 3. Coded-wire tag release information for Brood Year 2013 spring Chinook salmon released from Dworshak NFH in 2015.

Tag Code	Fish Tagged with Coded-wire	Coded-wire Tagged Fish Released	Untagged Fish in Tag Group	Mark Rate ¹	Rearing Raceways
055689	60,386	59,455	654,844	0.08	A15 and A12
055690	60,066	54,019	780,945	0.06	B17, B19, B21, B22, B24, B26

¹ Number of CWT Released divided by Total Number of Fish Released.

BROOD YEAR 2014 MARKING, TAGGING, AND PARR RELEASES

Marking and Tagging

Brood Year 2014 was established with the adult Chinook salmon that returned to Dworshak NFH in 2014 (Dworshak National Fish Hatchery 2013). Incubation and early rearing was completed in late July and August, 2015. Juveniles were inventoried, marked by removing their adipose fins, and split into final rearing raceways at that time (**Table 4**). The coded-wire tag retention rates for Dworshak NFH BY14 spring Chinook smolts were estimated to be 99%. Retention rates were measured from a single raceway containing only coded-wire tagged smolts (A4). The retention rate was assumed to be the same for the remaining raceways, which were composed of both coded-wire tagged and untagged smolts. **Table 4** lists the tag codes, the number tagged, the estimated number of unmarked fish each code represents and the estimated mark rate. Most of Brood Year 2014 will be released in the spring of 2016 and the final release numbers will be reported in the 2016 annual report.

Table 4. Coded-wire tag information for Brood Year 2014 spring Chinook salmon scheduled for release from Dworshak NFH in 2016.

Tag Code	Coded-wire Tagged Fish in tag Group	Untagged Fish in Tag Group	Mark Rate	Rearing Raceways
055812	60,040	645,987	0.09	A4 and A5
055813	60,038	759,968	0.08	B25 and B26

ADULT RETURNS in 2015

In this section, we present information on the pre-season adult return monitoring and run assessment, ladder operations and broodstock collection, and an assessment of the adult return to Dworshak NFH in 2015 (adults that originated from smolts released at the hatchery).

Adult Return Monitoring and Run Assessment

Spring Chinook salmon began returning to the mouth of the Columbia River during January 2015. Federal, state, and Tribal fishery management agencies began participating in weekly coordination meetings, starting in April, to review the progress and status of the spring Chinook salmon run as the adults migrated upstream through the Lower Columbia and Snake rivers, crossed Lower Granite Reservoir, and entered into terminal fisheries, hatcheries, and other fishery programs. Information on run strength and timing was used to help managers anticipate broodstock needs and manage sport and Tribal harvest.

The pre-season prediction for Dworshak NFH spring Chinook salmon to the Clearwater River was originally estimated at 5,759 adults (Hook *et al.* 2015). The estimate was updated to 5,452 in the final 2015 AOP tables (U.S. Fish and Wildlife Service *et al.* 2016).

Ladder Operations and Broodstock Collection

Broodstock collected at Dworshak NFH is a mixed stock that includes not only those originating from smolts released at the hatchery, but strays from other production programs in the Clearwater River basin.

The adult trap at Dworshak NFH was opened on June 15 and was operated continuously until August 7. The trap was re-opened on August 11 and was operated for one day. A holding mortality event in early September required re-opening the trap until September 21 (see Dworshak National Fish Hatchery 2016 for details).

Periodically, adults were moved from the adult collection pond to the spawning room where they were checked for tags, measured for length, and transferred to the adult holding ponds to mature for spawning. Nine inventories were conducted from July 7 through September 22. **Table 5** lists the numbers of adult spring Chinook inventoried on each date. Three thousand three hundred and seventy-three (3,373) adults entered the trap at Dworshak NFH in 2015. The final disposition of all the adults is listed in the 2015 spring Chinook salmon spawning Report (Dworshak National Fish Hatchery 2016).

Table 5. Dates and number of adult spring Chinook salmon trapped and inventoried at Dworshak NFH in 2015 (Dworshak National Fish Hatchery 2016).

Date	Number of Fish Collected
July 7, 2015	502
July 14, 2015	501
July 21, 2015	209
July 28, 2015	433
August 4, 2015	455
August 10, 2015	380
August 24, 2015	681
September 15, 2015	145
September 22, 2015	67
Total	3,373

Adult Return to Dworshak NFH

In this section, we assess that total number of spring Chinook salmon adults actually returning to Dworshak NFH from smolts released at the hatchery by looking at the stock composition of the total number collected in the trap and the sex and age composition.

Stock Composition –Adults entering the ladder at Dworshak NFH are not all Dworshak NFH stock but include strays from other federal, state and Tribal spring Chinook salmon production programs in the Clearwater River Basin as well as occasional strays from programs outside the basin. The origin and approximate contribution of other production programs in the Clearwater River is determined by analysis of the coded-wire tags that are recovered from adults collected in the trap. We recovered a total of 372 coded-wire tags during spawning, representing four different programs released at seven different locations. **Table 6** lists the agency, program origin, the release site, the number of tags recovered, the expanded number of adults represented by those tags based on the tagging rate, the total estimated rack return and the percent stock composition.

The number of fish recovered in each tag group was divided by that tag group’s original mark rate to create an expanded count for that tag group. When pooled, the expanded counts are representative of the untagged salmon in the rack and are used to derive the relative proportion each tag group contributes to the total rack return. The untagged component of the rack is assigned to each tag group in proportion to that tag group’s representation in the expanded totals. When combined with the known composition of the tagged portion of the rack, this is the estimate of the stock composition of the entire rack return. The stock composition of the adults collected in the ladder at Dworshak NFH is listed in **Table 6**. A total of 2,862 Dworshak NFH origin spring Chinook salmon, or 84.9% of the total adults collected, were estimated in the Dworshak NFH ladder in 2015.

Table 6. Stock composition of adult spring Chinook salmon collected at Dworshak NFH in 2015, estimated using expanded coded-wire tags.

Agency	Program Origin	Release Site	Number of Tags Recovered	Expanded Contribution to DNFH Rack	Stock Comp %
USFWS	Dworshak NFH	NF Clearwater R.	197	2,862	84.9
USFWS	Kooskia NFH	Clear Cr.	4	35	1.0
IDF&G	Clearwater SFH	Clear Cr.	49	61	1.8
IDF&G	Clearwater SFH	Selway R.	48	109	3.2
IDF&G	Clearwater SFH	Red R.	21	238	7.1
IDF&G	Clearwater SFH	Powell	6	21	0.6
IDF&G	Clearwater SFH	Crooked R.	5	5	0.1
NPTF	Nez Perce TH	NPTH	42	42	1.2
Total			372	3,373	100

Male to Female Ratio

The male to female ratio of Dworshak NFH origin adults was estimated using the numbers of coded-wire tags collected. A total of 197 coded-wire tagged Dworshak NFH origin adults of known sex were collected in the racks at Dworshak and Kooskia NFHs. Of these, a total of 98 (49.7%) were males (including 1-Ocean fish) and 99 (50.3 %) were females, providing an estimated male to female ratio of 0.99:1.0, or 1,424 males and 1,438 females.

Age Composition – Estimating the age composition of Dworshak NFH origin adults is complicated because of the mixed stock composition in the rack return. We used only the coded-wire tags from Dworshak NFH reared adults that returned to Dworshak NFH for the analysis. Length separation between 1-Ocean and 2-Ocean age classes and between the 2-Ocean and 3-Ocean age classes was accomplished by taking the mid-point of the overlap in lengths between the groups.

For males, examination of the length data indicated an overlap in lengths between 1- and 2-Ocean adults with the division occurring at 590 mm. One coded-wire tagged 2-Ocean was below the division at 550 mm. Only one coded-wire tagged 3-Ocean male was collected in 2015; this fish measured 800 mm. Forty coded-wire tagged 2-Ocean males were 800 mm or greater, the largest of which was 910 mm. 910 mm was used as the upper limit for 2-Ocean males.

All but two of the coded-wire tags collected from females were from 2-Ocean fish. Lengths ranged from 630 to 860 mm. No tags were collected from 1-Ocean females. Two tags were collected from 3-Ocean females, both greater than 840 mm.

	<u>Males</u>	<u>Females</u>
1-Ocean	≤ 590 mm	
2-Ocean	591to 910 mm	≤ 840 mm
3-Ocean	≥ 911 mm	≥ 841 mm

Application of the age/length classifications would not result in substantial misidentification of fish age. Thus, there would be no management implication for spawning.

The age class, number, the length range (mm), average length, and the percent composition for male and female coded-wire tagged Dworshak NFH adults collected in the trap is reported in **Table 7**.

Table 7. Number, length range, average length and percent composition of adult males and female Dworshak NFH Chinook salmon collected at Dworshak NFH in 2014, based on known age analysis using code-wire tags.

Age Class	Males				Females			
	Number of Tags	Length Range (mm)	Average Length (mm)	Percent Composition	Number of Tags	Length Range (mm)	Average Length (mm)	Percent Composition
1-Ocean	9	< 590	516	9.1	0	-	-	0
2-Ocean	89	591to 910	792	89.9	97	< 840	749	98.0
3-Ocean	1	> 911	800	1.0	2	> 841	855	2.0

Total Estimated Adult Return to the Clearwater River

The number of Dworshak NFH origin adult spring Chinook salmon that returned to the Clearwater River in 2015 is challenging to determine because of the mixed stock fisheries and harvests that occur in the Clearwater River basin. The adults that entered the Clearwater River in 2015 originated from smolt releases in 2012, 2013, and 2014 at Dworshak NFH, Kooskia NFH, Idaho Department of Fish and Game (IDFG) facilities at Powell, Red River, and Crooked River and at sites in the Selway River and Clear Creek. The Nez Perce Tribal Hatchery released fish into Lolo Creek, Newsome Creek, and the Selway River. The estimated returns of adults for the Dworshak NFH stock are based on the development of expansion factors derived from the ratio of PIT-tagged to un-PIT tagged adults detected at Lower Granite Dam and in the hatchery trap (Peery *et al.* 2012). It is understood that the original PIT tag expansion rates, based on the ratio of tagged to untagged smolts at the time of release are likely biased low for returning adults due to possible tag loss and/or differential mortality during the period from time of release to time of adult return. Because of this, we used the observed ratio of tagged to untagged fish for adults collected at Dworshak NFH as an expansion rate for PIT-tagged salmon detected at Lower Granite Dam.

For 2015, the total estimated return to Lower Granite Dam based on expanded numbers of PIT tagged adults detected at Lower Granite Dam was 12,873 (**Table 8**). The estimate is a summary of the separate estimates made for each age class (including 95% confidence intervals) based on mark-recapture estimate using PIT tag detections at Lower Granite Dam and the Dworshak NFH trap. Confidence intervals were calculated by running 1,000 bootstrap iterations of the estimator using a normal probability function to estimate potential recapture rates of PIT-tagged adults in the Dworshak trap: 1-Ocean (Jacks) = 363 (269 - 951) ; 2-Ocean = 12,408 (12,408 – 23,961) and 3-Ocean = 102 (66 – 312).

Sport Harvest - Estimates of the numbers of adults and jacks harvested in the sport fishery for Dworshak NFH origin spring Chinook salmon are based on expanded numbers of coded-wire tags collected during sport fish harvest surveys by the Idaho Department of Fish and Game. These tags are expanded by tagging and sample rates, across multiple creel survey river sections (Sullivan, IDFG personal communication). The total estimated harvest of Dworshak NFH stock in the Clearwater River in 2015 was 3,701; 144 1-Ocean males and 3,557 2-Ocean males and females. There were no 3-Ocean fish caught in the sport harvest based on coded-wire tag recovery (**Table 8**).

Tribal Harvest - The Nez Perce Tribe provides estimates of Tribal harvest, most of which occurs near the ladder entrance at Dworshak NFH in the North Fork Clearwater River and in Clear Creek downstream from the adult trap at Kooskia NFH, on the Middle Fork of the Clearwater River (U.S. Fish and Wildlife Service *et al.* 2014). The total estimated 2015 harvest was 1,201 between the North Fork of the Clearwater and Clear Creek, 1,195 fish in the North Fork and six in Clear Creek (**Table 8**). The breakdown by age class is provided for each tributary, below.

North Fork Harvest - It is assumed that harvest at the Dworshak NFH ladder is in proportion to the rack return and would directly reflect the stock composition in the rack. Therefore, only 85% of the harvest would actually be Dworshak NFH stock, or 1,195 fish. Ninety-one percent (1,195) of those would be 2- and 3-Ocean fish, and 9% (106) would be 1-Ocean fish. The Tribe does not provide age composition estimates of the harvested adults (2- and 3-Ocean adults). Those numbers are estimated using the percentages of 2- and 3-Ocean adults collected in the Dworshak NFH trap, assuming that harvest occurred in proportion to the rack return. For 2015, we collected a total of 198 coded-wire tagged 2- and 3-Ocean adults at Dworshak NFH (males and females combined). Three were 3-Ocean fish (1.6%) and 186 (98.4%) were 2-Ocean fish. Thus, we estimated the 2- and 3-Ocean contribution in the Tribal harvest in the North Fork Clearwater River to be 1,072 2-Ocean fish and 17 3-Ocean fish.

Clear Creek Harvest- It is assumed that Chinook salmon harvested in Clear Creek reflects the stock composition of the fish collected at Kooskia NFH. Based on code-wire tag analysis, 1 (0.4%) of 237 coded-wire tags collected at Kooskia NFH were Dworshak NFH stock. Based on that, of the 1,161 fish harvested by the Tribe in Clear Creek, only 6 would have been Dworshak NFH adults, all 2-Ocean.

Escapement - Using the estimated total return to Lower Granite Dam and subtracting the harvest and the rack return, the escapement of Dworshak NFH stock (those fish not captured in a trap or weir, nor harvested in a fishery) was estimated to be 5,109 (**Table 8**).

Table 8. Adult returns of Dworshak NFH adult spring Chinook salmon to the Clearwater River from 2010-2015.

Return Year	Rack Return	Sport Harvest	Tribal Harvest	Escapement	Total Run
2010	1,225	1,476	10,771	282	4,060
2011	1,250	2,381	943	4,091	8,665
2012	1,322	2,068	871	5,792	10,053
2013	1,520	332	635	2,232	4,719
2014	2,389	1,335	577	2,336	6,637
<i>Mean</i>	<i>1,541</i>	<i>1,518</i>	<i>2,759</i>	<i>2,947</i>	<i>6827</i>
2015	2,862	3,701	1,201	5,109	12,873

Table 11 in Idaho Fishery Resource Office (2012) provides a historical summary of the number of Dworshak NFH stock adults returning to the rack, harvested in the sport and Tribal fisheries, and the estimated number in the escapement broken down by ocean age class for return years 1984 to 2008.

Adult PIT Tag Returns

The conversion rate of Dworshak NFH spring Chinook salmon was calculated using Columbia River Data Access in Real Time software (Columbia Basin Research, available at www.cbr.edu/dart/dart.html). The conversion rate from Lower Granite Dam to the Dworshak NFH adult ladder was calculated using the number of interrogations at Dworshak NFH adult ladder divided by the interrogations at Lower Granite Dam.

Table 9 provides a summary of PIT-tagged adult spring Chinook salmon released from Dworshak NFH in 2012, 2013, and 2014 and subsequently detected at Bonneville Dam, Lower Granite Dam and Dworshak NFH. During the 2015 migration, a total of 365 PIT tagged adults were detected at Bonneville Dam. Of those, 72 were detected at Lower Granite Dam, giving a conversion rate of 0.20 from Bonneville Dam to Lower Granite Dam. The PIT-tagged adults detected at LGD consisted of 6 1-Ocean fish (BY12 released in 2014), 53 2-Ocean fish (BY11 released in 2013) and 13 3-Ocean fish (BY10 released in 2012). Sixteen of those were collected in the Dworshak NFH adult ladder giving a conversion rate from LGD to Dworshak NFH of 0.22. The first detection date for Dworshak origin spring Chinook salmon at Lower Granite Dam was April 10, 2015. The last detection was on June 26, 2015. The first detection at the Dworshak adult ladder (DWL) was June 25, 2015. The last detection was September 13, 2015.

Table 9. Conversion rates of PIT tagged adult Dworshak NFH spring Chinook salmon between Bonneville Dam, Lower Granite Dam, and Dworshak NFH.

Brood Year	Release Year	Ocean Age	Bonneville	Lower Granite Dam	Bonn-LGD Conversion Rate	Dworshak NFH	LGD-DNFH Conversion Rate
2010	2012	3	8	6	0.75	1	0.1667
2011	2013	2	341	53	0.1554	12	0.2264
2012	2014	1	16	13	0.8125	3	0.2308
Total			365	72	0.1973	16	0.2222

BROOD YEAR 2010 SMOLT TO ADULT RETURN RATE (SAR)

The smolt-to-adult-return-rate, or SAR, is the ratio of the number of smolts that are released divided by the number of adults that return from that release. The SAR is one of the metrics to measure production performance in the LSRCP program. With the return of the 3-Ocean adults in 2015, estimating the SAR for Brood Year 2010 (released in the spring of 2012) can be completed.

Table 10 lists the estimated numbers of Dworshak NFH spring Chinook salmon that returned to Lower Granite Dam during 2015, and the estimated fates of those fish by ocean age class. The numbers of fish in each age class for the escapement was estimated by subtracting the total number of adults in the rack and harvests (males and females combined) from the total estimated return for each age class. For 2015, this resulted in a negative estimate for the 1-Ocean age class in the escapement, most likely a reflection of the variability in the estimates of the other numbers in **Table 10**. Such results should not be unexpected from time to time, since all the data in **Table 10** are estimates based on coded-wire tag and PIT tag expansions.

Table 10. The estimated number of Dworshak NFH spring Chinook salmon adults of each ocean age class in Clearwater River fisheries for Return Year 2015.

Program	1-Ocean BY12	2-Ocean BY11	3-Ocean BY10	Total
Hatchery Rack	120	2,521	40	2,862
Sport Harvest	144	3,557	0	3,701
Tribal Harvest	106	1,078	17	1,201
Escapement	-7	5,252	45	5,109
Total	363	12,408	102	12,873

Table 11 lists the numbers of smolts released, and numbers and percent survival of adults returning by age class for Brood Years 2006 through 2010 (release years 2008 to 2012). These include the rack return, the harvest estimates from the sport and Tribal fisheries, and estimates of

escapement. The historical numbers, from Brood Years 1981 to 2005 (release years 1983 to 2007) are listed in Idaho Fisheries Resource Office (2012). Estimated smolt-to-adult-return, or survival, for Brood Year 2010, released as smolts in 2012, was 0.0072.

Table 11. Brood Year, release year, number of smolts released, and the numbers and percent survival of Dworshak NFH adult returns to the Clearwater River by age class for Brood Years 2006 to 2010.

Brood Year	Release Year	Smolts Released ¹	1-Ocean Returns			2-Ocean Returns			3-Ocean Returns			Total Return	
			Return Year	Number	SAR	Return Year	Number	SAR	Return Year	Number	SAR	Return	SAR
2006	2008	939,000	2009	1,847	0.00197	2010	5666	0.00603	2011	983	0.00104	8,496	0.00904
2007	2009	1,014,748	2010	427	0.00042	2011	3,281	0.00323	2012	2,024	0.00199	5,732	0.00564
2008	2010	1,109,195	2011	4,401	0.00397	2012	7,724	0.00696	2013	448	0.0004	12,573	0.0113
2009	2011	1,078,250	2012	305	0.00028	2013	2,763	0.00256	2014	67	0.00006	3,135	0.0029
2010	2012	1,044,080	2013	1,548	0.00148	2014	5,899	0.00565	2015	102	0.00001	7,549	0.0072
2011	2013	1,377,508	2014	671	0.00049	2015	12,408	0.00900					
2012	2014	2,039,611	2015	363	0.00018								

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

PREDICTION FOR 2016 ADULT RETURNS

Review of 2015 Predictions

The total number of spring Chinook salmon that we predicted would return to Dworshak NFH and associated fisheries in 2015 was 5,759 (Hook *et al.* 2015). The number of Dworshak NFH Chinook salmon estimated to have returned to the Clearwater River was 12,873, over twice the prediction. The greatest disparity was in the number of 2-, and 3-Ocean fish returning. The 2-Oceans were under-estimated by 8,017 fish while the 3-Oceans were over-estimated by 959 fish. **Table 12** lists the predicted returns and the estimated returns of all three age classes of adults in 2015.

Table 12. Predicted and calculated returns of Dworshak NFH spring Chinook salmon by ocean age class, 2015, which includes sport and Tribal harvest estimates and an estimate of escapement.

Ocean Age Class	Prediction	Total Return
1-Ocean	307	363
2-Ocean	4,391	12,408
3-Ocean	1,061	102
Total	5,759	12,873

2016 Run Predictions

Our forecast for the 2016 spring Chinook salmon return to the Clearwater River for the Dworshak NFH stock is given in **Table 13** (U.S. Fish and Wildlife Service *et al.* 2016). Brood stock requirements are 1,468 adults. If the prediction is at all close, the Idaho Department of Fish and Game and the Nez Perce Tribe will have the opportunity to open sport and Tribal fisheries in the Clearwater River in the summer of 2016. However, decisions on harvest management will be made only after dam counts of PIT tagged adults provide actual estimates of returning adults in the late spring of 2016.

Table 13. Predicted returns of spring Chinook salmon to the Clearwater River at Lower Granite Dam from the Dworshak Fishery Complex by ocean age class, 2016.

Ocean Age Class	Dworshak NFH
1-Ocean	1,478
2-Ocean	4,536
3-Ocean	1,202
Total	7,216

REFERENCES

- Bowles, E. and E. Leitzinger. 1991. Salmon Supplementation Studies in Idaho Rivers (ISS). Experimental design. Idaho Dept. of Fish and Game. Prepared for the U.S. Department of Energy, Bonneville Power Administration, Portland, Oregon.
- Columbia River Data Access in Real Time. 2011.
Available: www.cbr.washing.edu/dart/dart.html
- Connor, W. P., H. L. Burge, J. R. Yearsley and T. C. Bjornn. 2003. "Influence of flow and temperature on survival of wild subyearling fall chinook salmon in the Snake River." North American Journal of Fisheries Management 23(2): 362-375.
- Dworshak Complex Hatchery Evaluation Team. 2011. Increasing production of spring Chinook salmon at Dworshak National Fish Hatchery, An assessment and proposal. Report to the Dworshak National Fish Hatchery Co-Managers, Dworshak Fishery Complex, U.S. Fish and Wildlife Service, Orofino, Idaho. 10 pp.
- Dworshak National Fish Hatchery. 2010. Spawning Report, Brood Year 2010 Spring Chinook Salmon. Annual report by the Dworshak National Fish Hatchery, Dworshak Fisheries Complex, U.S. Fish and Wildlife Service, Ahsahka, Idaho. 8 pp.
- Dworshak National Fish Hatchery. 2011. Spawning Report, Brood Year 2012 Spring Chinook Salmon. Annual report by the Dworshak National Fish Hatchery, Dworshak Fisheries Complex, U.S. Fish and Wildlife Service, Ahsahka, Idaho. 8 pp.
- Dworshak National Fish Hatchery. 2012. Spawning Report, Brood Year 2011 Spring Chinook Salmon. Annual report by the Dworshak National Fish Hatchery, Dworshak Fisheries Complex, U.S. Fish and Wildlife Service, Ahsahka, Idaho. 8 pp.
- Dworshak National Fish Hatchery. 2015. Spawning Report, Brood Year 2013 Spring Chinook Salmon. Annual report by the Dworshak National Fish Hatchery, Dworshak Fisheries Complex, U.S. Fish and Wildlife Service, Ahsahka, Idaho. 8 pp.
- Dworshak National Fish Hatchery. 2016. Spawning Report, Brood Year 2013 Spring Chinook Salmon. Annual report by the Dworshak National Fish Hatchery, Dworshak Fisheries Complex, U.S. Fish and Wildlife Service, Ahsahka, Idaho. 8 pp.
- Elliot, D.G. and R. J. Pascho. 1994. Juvenile fish transportation: Impact of bacterial kidney disease on survival of spring/summer Chinook salmon stocks. Annual Report. U.S. Army Corps of Engineers. Contract E86920048. 79p.
- Haeseker, S. L., J. A. McCann, J. Tuomikoski and B. Chockley. 2012. "Assessing Freshwater and Marine Environmental Influences on Life-Stage-Specific Survival Rates of Snake River Spring-Summer Chinook Salmon and Steelhead." Transactions of the American Fisheries Society 141(1): 121-138.

- Hook, J.D., Jones, R.N., C. Bretz, and C. Peery. 2014. FY2013 annual report of hatchery evaluation activities for spring Chinook salmon at Dworshak and Kooskia National Fish Hatcheries: Brood Years 2011 Smolt Releases, Brood Year 2012 Marking and Tagging, and Brood Year 2013 Adults Returns, Brood Year 2008 SAR, and Prediction for 2014 Adult Returns. Technical fisheries report by the Idaho Fishery Resource Office, Dworshak Fisheries Complex, U.S. Fish and Wildlife Service, Ahsahka, ID. 25p.
- Idaho Fishery Resource Office. 2012. An historical record of the adult spring Chinook salmon returns to Dworshak and Kooskia National Fish Hatcheries, through 2011. Technical fisheries report by the Idaho Fishery Resource Office, Dworshak Fisheries Complex, U.S. Fish and Wildlife Service, Orofino, ID. 28 pp.
- Hook, John, Jones, R.N., C. Bretz, and C. Peery. 2015. FY2014 annual report of hatchery evaluation activities for spring Chinook salmon at Dworshak National Fish Hatchery: Brood Years 2012 Smolt Releases, Brood Year 2013 Marking/Tagging and Parr Releases, and Brood Year 2014 Adults Returns, Brood Year 2009 SAR, and Prediction for 2015 Adult Returns. Technical fisheries report by the Idaho Fishery Resource Office, Dworshak Fisheries Complex, U.S. Fish and Wildlife Service, Ahsahka, ID. 20p.
- 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. 2001. SURPH 2.2b User's Manual. University of Washington, Seattle, Washington. 8pp. Dworshak National Fish Hatchery. 2007. Spawning Report, Brood Year 2007 Spring Chinook Salmon. Annual report by the Dworshak National Fish Hatchery, Dworshak Fisheries Complex, U.S. Fish and Wildlife Service, Ahsahka, Idaho. 8pp.
- Petrosky, C. E. and H. A. Schaller. 2010. "Influence of river conditions during seaward migration and ocean conditions on survival rates of Snake River Chinook salmon and steelhead." *Ecology of Freshwater Fish* 19(4): 520-536.
- Plumb, J. M., R. W. Perry, N. S. Adams and D. W. Rondorf. 2006. "The effects of river impoundment and hatchery rearing on the migration behavior of juvenile steelhead in the lower Snake River, Washington." *North American Journal of Fisheries Management* 26(2): 438-452.
- Smith, S. G., W. D. Muir, E. E. Hockersmith, R. W. Zabel, R. J. Graves, C. V. Ross, W. P. Connor and B. D. Arnsberg. 2003. "Influence of river conditions on survival and travel time of Snake River subyearling fall chinook salmon." *North American Journal of Fisheries Management* 23(3): 939-961.

- U.S. Fish and Wildlife Service, Idaho Department of Fish and Game, and Nez Perce Tribe Fisheries. 2012. 2012 AOP Final Release Tables, 2012 Annual Operating Plan for Fish Production Programs in the Clearwater River Basin. 42 pp.
- U.S. Fish and Wildlife Service, Idaho Department of Fish and Game, and Nez Perce Tribe Fisheries. 2013. 2013 AOP Final Release Tables, 2013 Annual Operating Plan for Fish Production Programs in the Clearwater River Basin, 2013 AOP Projected Release and Marking Tables, April 3, 2013.
- U.S. Fish and Wildlife Service, Idaho Department of Fish and Game, and Nez Perce Tribe Fisheries. 2014. 2014 AOP Final Release Tables, 2014 Annual Operating Plan for Fish Production Programs in the Clearwater River Basin, 2014 AOP Projected Release and Marking Tables, January 28, 2014.
- U.S. Fish and Wildlife Service, Idaho Department of Fish and Game, and Nez Perce Tribe Fisheries. 2016. 2015 AOP Final Release Tables, 2015 Annual Operating Plan for Fish Production Programs in the Clearwater River Basin, 2015 AOP Final Projected Release and Marking Tables, March 3, 2016.
- U.S. Fish and Wildlife Service, Idaho Department of Fish and Game, and Nez Perce Tribe Fisheries. 2016. 2016 Annual Operating Plan for Fish Production Programs in the Clearwater River Basin. 56pp.