

**BROOD YEAR REPORT
DWORSHAK NATIONAL FISH HATCHERY
SPRING CHINOOK SALMON
BROOD YEAR 1993
LIFE CYCLE COMPLETED IN 1998**

PREPARED BY

**Ray Jones and Ralph Roseberg
Idaho Fishery Resource Office**

**Thomas Trock and Bob Semple
Dworshak National Fish Hatchery**

**U.S. Fish and Wildlife Service
Dworshak Fisheries Complex
P.O. Box 18
Ahsahka, Idaho 83520**

**Kathy Clemens
Idaho Fish Health Center
U.S. Fish and Wildlife Service
P.O. Box 272
Orofino, Idaho 84544**

PREPARED FOR

**Complex Manager
Dworshak Fisheries Complex
U.S. Fish and Wildlife Service
P.O. Box 18
Ahsahka, Idaho 83520**

and

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

March 2000

Table of Contents

BROOD YEAR 1993 OVERVIEW	iii
INTRODUCTION	1
Program Goal	1
Site Description	1
1993 ADULT SPRING CHINOOK SALMON RETURN TO DWORSHAK NFH	3
Pre-Season Assessment	3
Total Rack Return	3
Run Timing.....	4
Age Composition of Return.....	4
Adult Mortality	5
Pre-Spawning Mortality	5
Mortality During Spawning	5
Spawning.....	5
EGG PRODUCTION	6
Green Eggs Taken.....	6
Incubation.....	6
Percent Eggs Eyed.....	7
Other Eggs Received.....	7
Tanking.....	7
NURSERY REARING	8
Growth and Mortality	8
JUVENILE REARING	8
Ponding	8
Growth and Mortality	9
Marking and Tagging.....	10
SMOLT RELEASES	10
FISH HEALTH	11
Adult Injections with Erythromycin (INAD 6430)	11
Adult Formalin Treatments	11
Adult Disease Testing	11
Monthly Disease Sampling.....	12
Erythromycin treatments	12
Smolt Assessments.....	12

SMOLT EMIGRATION	13
Travel Time	13
River Flow.....	13
Estimated Smolt Survival.....	14
ADULT RETURNS	17
Rack Return to Dworshak NFH	17
Harvest	17
Idaho Tribal Fisheries	17
Idaho Sport Fisheries.....	18
Total Adult Return Above Lower Granite Dam	18
Other Adult Recoveries	18
SPECIAL STUDIES	20
Serial Release.....	20
INAD 4333	20
REFERENCES.....	21
APPENDIX I.....	22
Adult Spring Chinook Salmon Returns to Dworshak-Kooskia NFH Complex in 1993 and Prognosis for 1994	22
APPENDIX II.....	34
Brood Year 1993 Spawning ReportDworshak National Fish Hatchery	34
APPENDIX III	45
Brood Year 1993 Production Program ReviewDworshak National Fish Hatchery ..	45

BROOD YEAR 1993 OVERVIEW

Life Stage	Number	Percent
1993 Rack Return	369	-
Number of Females Spawned	138	-
Estimated Green Eggs Taken	510,000	-
Average Eggs per Female	3,750	-
Other Eggs Received¹	928,349	-
Fingerlings Produced²	1,329,763	-
Smolts Released	1,302,687	97.9
In-River Smolt Survival³	-	51.5
Adult Returns to the Hatchery⁴	1,856	0.14
Adults Harvested in Idaho⁵	375	-
Total Adult Return to Clearwater River	2,231	0.17
Adults Collected at Other Locations⁶	50	

¹ Surplus eggs received from Rapid River State Fish Hatchery.

² End of nursery rearing.

³ Minimum survival to Lower Granite Dam based on PIT tag interrogations.

⁴ I-Ocean, II-Ocean, and III-Ocean returns in 1995, 1996, and 1997 to the hatchery rack.

⁵ Tribal and Sport fisheries combined.

⁶ Coded-wire tagged fish recovered at various other hatchery racks, dams, fish traps, etc. down river of Lower Granite Dam.

INTRODUCTION

This report provides data for Brood Year 1993 spring chinook salmon at Dworshak National Fish Hatchery (NFH) which completed its life cycle in 1998. Data on the adults that were spawned to create the brood year, egg production, nursery rearing, juvenile rearing, smolt releases, fish health, smolt out migration, adult contribution to fisheries, and adult returns to the hatchery are summarized. Evaluation projects and other research studies involving this brood year are only briefly described in this report and the reader is referred to the specific project reports for details.

This Brood Year Report is one of several products called for in the Region One, U.S. Fish and Wildlife Service, Fisheries Vision Action Plan and is intended to provide a broad overview of stock performance and is a compilation of data from various other reports generated by the Dworshak Fishery Complex.

The reporting of production data for Brood Year 1993 spring chinook salmon for Dworshak NFH is complicated because of the adult holding, spawning, incubation, and nursery rearing of the spring chinook salmon from Kooskia NFH. Although the two programs were kept separate as much as possible, the data were not always reported separately for the two stocks and summaries provided in the Spawning Report for Brood Year 1993 were for both stocks combined. In those sections where data for the two stocks are combined, it will be pointed out. Otherwise, data is for Dworshak NFH stock..

Program Goal

The spring chinook salmon production program at Dworshak NFH was started in 1982 as part of the Lower Snake River Compensation Plan (LSRCP) and was originally designed to rear 1.4 million smolts to a size of 20 fish per pound (FPP) for direct release from the hatchery into the Clearwater River (U.S. Army Corps of Engineers 1981). This level of production was designed to meet the mitigation goal of 9,135 adults returning to Lower Granite Dam from the ocean (Herrig 1990). Over the years, several changes have been made to the facility and the production program. For Brood Year 1993, the smolt release target was 1,135,000 smolts reared to a size of between 18 to 20 FPP. The reduction in the number of smolts to be released was based on the result of an evaluation of rearing density (Jones and Miller 1996).

Site Description

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

Dworshak NFH has 870 trays. Protocol calls for one female per tray giving the hatchery the capacity to incubate nearly 3.0 million spring chinook salmon eggs. After hatching, fry are

transferred to inside nursery tanks. Dworshak NFH has 64 cement tanks and 64 fiberglass tanks that hold about 667 and 643 gallons of water, respectively. 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. Another bank of 10 raceways (C bank) are located adjacent to the adult holding ponds and are 8' X 63' X 2'. All the raceways are supplied with single pass ambient river water from the North Fork Clearwater River.

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

1993 ADULT SPRING CHINOOK SALMON RETURN TO DWORSHAK NFH

Pre-Season Assessment

The Idaho FRO uses a regression equation based on the I-Ocean (Jack) returns in the previous year to forecast or predict the return of II-Ocean adults the following year. In 1992, the I-Ocean return to Dworshak NFH was very low, only 22 fish, indicating that the II-Ocean return in 1993 would also be low. The prediction for adult returns to Dworshak NFH for the 1993 season was 575. The breakdown by age class for the predicted return is given below in **Table 1** (Idaho FRO 1993).

Table 1. Pre-season prediction of adult returns to Dworshak NFH by ocean age (Idaho FRO 1993).

Ocean Age	1993 Prediction
I - Ocean	58
II - Ocean	445

III - Ocean	72
Total	575

The pre-season prediction was well below what was going to be needed for broodstock needs for the hatchery. This prompted the Idaho FRO to request that the Nez Perce Tribe consider a conservation closure to tribal subsistence fishing on the North Fork and Clear Creek (see letter in Brood Stock File - PreSeason Assessment). However, by May 1993, the original predicted return to the Columbia River was upgraded by 42% based on an analysis of the Technical Advisory Committee, with projected impacts on Snake River stocks expected to be less than what was anticipated in pre-season.

Total Rack Return

The 1993 adult spring chinook salmon return to Dworshak NFH was 823 adults (**Table 2**), greater than the pre-season prediction of 575 made in 1992. This was the highest return since 1990.

Table 2. Number of adult spring chinook salmon that returned to Dworshak NFH since 1984, by ocean age (Idaho FRO 1993).

Year	I-Ocean	II-Ocean	III-Ocean	Unmeasured ¹	Total Return
1984	14	52	16	0	82
1985	13	281	35	5	334
1986	78	346	91	0	516
1987	25	1,604	376	12	2,017
1988	163	569	1,240	0	1,972
1989	156	1,322	221	1	1,700
1990	7	1,892	135	8	2,042
1991	16	77	72	0	165
1992	22	286	40	21	369
1993	9	452	359	3	823

¹ Unmeasured fish are those that escaped out of the preliminary adult holding pond without being inventoried prior to spawning.

Run Timing

The hatchery ladder was opened on May 21 and was closed on August 24, 1993. The first fish was recorded on the counter May 22. Fish continued entering the ladder until it was closed. However, over 80% of the adults entered the holding pond between June 17 and July 7.

Age Composition of Return

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

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

Adult spring chinook salmon that return to Dworshak NFH are predominately II-Ocean fish, those that spend two years in salt water before returning to freshwater to spawn. The return in

1993 was not typical of most years, 1% I-Ocean, 55% II-Ocean, and 44% III-Ocean (**Table 3**). The major difference was in the low number of I-Ocean (Jacks) and high number of III-Ocean returns, a very atypical return. **Table 3** does not include the unmeasured adults that were added to the total return at the end of the spawning season. During inventory of new adults, females were inoculated with Erythromycin Phosphate before being transferred to the adult holding ponds (see Fish Health Section for details).

Table 3. Number of adult spring chinook salmon removed from the adult holding pond and inventoried at Dworshak NFH during 1993.

Date	I-Ocean	II-Ocean	III-Ocean	Cumulative
8/04/93	8	394	345	747
8/24/93	0	21	10	31
Pond Morts	1	17	26	44
Total	9	432	381	822

Adult Mortality

Adult mortality is reported for two separate periods: pre-spawning, or holding mortality and mortality during spawning.

Pre-Spawning Mortality - From May 21 to August 23, a total of 75 adult spring chinook salmon (9.2%) died: 29 males and 46 females.

Mortality During Spawning - From August 23 through September 13, an additional 45 adults died, 18 males and 27 females.

The age composition by sex of the adult mortalities is listed in **Table 4**.

Spawning

Spawning was started on August 23. Spawning was completed on September 13 for a total of seven egg takes. Three hundred and twenty-three males and 343 females were spawned. Every female was sampled to determine the level of infection by *Renibacterium salmoninarum* (see Fish Health section for details). A summary of spawning is presented in **Table 5**. Details on spawning procedures, methods, etc., can be found in the spawning report for BY 93 spring chinook salmon, Appendix I. (Dworshak NFH 1994). The age/sex composition of the adults that were spawned is presented in **Table 6**.

Table 4. Adult mortality of Dworshak NFH BY93 spring chinook salmon by ocean age class during the pre-spawning holding period and after spawning was started at Dworshak NFH, Idaho, 1993. Data was compiled from the adult mortality records.

Period	Sex	Ocean Age Class				Total
		I	II	III	Unmeasured	
Pre-Spawning ¹	Males	0	10	18	1	29
	Females	1	22	22	1	46
	Totals	1	32	40	2	75
Spawning ²	Males	0	9	9	0	18
	Females	0	20	7	0	27
	Totals	0	29	16	0	45

¹ May 21 to August 23, 1993.

² August 24 to September 13, 1993.

Table 5. Number of male and female spring chinook salmon spawned during each egg take for Brood year 1993 at Dworshak NFH (Dworshak NFH 1994).

Take Date	Males Spawned	Females Spawned	Green Eggs Taken ¹
8/24/93	62	62	272,140
8/27/93	50	52	241,020
8/31/93	83	83	347,365
9/03/93	54	54	239,066
9/07/93	33	44	193,478
9/10/93	26	31	133,950
9/13/93	15	17	55,102
Total	323	343	1,482,121

¹ Estimated assuming an average of 3750 eggs/female.

Table 6. Age and sex composition of Dworshak NHF BY93 spring chinook salmon used for spawning in 1993 (Dworshak NFH 1994)

Sex	I-Ocean		II- Ocean		III- Ocean		Total
	Number	Percent	Number	Percent	Number	Percent	
Male	5	2	153	47	165	51	323
Female	1	>1	214	62	128	37	343
Total	6	>1	367	55	293	44	666

EGG PRODUCTION

Green Eggs Taken

Green eggs were not counted. However, the total number of green eggs taken was estimated at 1,482,121 by using an average number of 3750 eggs per female (**Table 5**).

Incubation

Eggs from each female were incubated separately in individual colanders to segregate and track offspring by the ‘BKD’ status (low/medium/high) of the female parent based on ELISA tests. Incubation temperature was held at or below 52 degrees F. Incubating eggs were given a 15 minute 1,667 mg/l formalin treatment three times weekly (Dworshak NFH 1994).

Percent Eggs Eyed

After eye-up, eggs from each colander were shocked, dead eggs removed by hand, and then transferred to individual Heath trays. Since eggs were not counted and number of green eggs only estimated, the percent egg eye-up could not be calculated until after the first complete inventory at marking time (Dworshak NFH 1994).

Tanking

Tanking commenced when approximately 50 to 75% of the fry in a tray reached button-up stage. Button-up fry were stocked into nursery tanks at a loading of about 19,000 to 29,000 fish per tank with an average of 26,000 per tank. Fry were segregated according to the parental female’s “BKD status”. Tanking was completed by mid-November. Combining the estimated number

of Dworshak Stock, the 8,000 eggs from Kooskia Stock from high BKD status females, and the eggs from Rapid River SFH, the total number of fry tanked was over 1.3 million. Because the Dworshak Stock eggs were not counted, but only estimated, percent survival to swim-up from eyed eggs could not be calculated. However, for eggs from Kooskia NFH and Rapid River SFH, survival was estimated at about 96%, slightly higher than the previous five-year average of 94% (Dworshak NFH 1994).

NURSERY REARING

The summary of production data for the nursery reported in the Program Review for Brood Year 1992 Spring Chinook Salmon, Appendix II (Dworshak NFH 1994) combines data for the Dworshak , Rapid River, and Kooskia Stocks.

Growth and Mortality

Growth was very good in the nursery with no health problems and no disease treatments being required. A monthly summary of growth and mortality in the nursery from December 1 to June 1, 1993 is listed in **Table 6**.

Table 6. Summary of monthly growth and mortality of Brood Year 1992 spring chinook salmon (all stocks combined) during nursery rearing at Dworshak NFH (Dworshak NFH 1994).

Date (End of Month)	Number	Weight (lbs)	FPP	Mean Length (in.)	Mean Growth (in.)	Mortality (%)	Mean Water Temp (F)
11/92	1,673,071	1,114	1,501	1.3	0.07	0.90	50.9
12/92	1,656,813	1,708	1,004	1.5	0.2	1.84	44.3
1/93	1,647,082	2,625	627	1.74	0.24	0.62	41.5
2/93	1,640,471	4,001	410	2.01	0.26	0.41	40.5
3/93	1,626,224	5,493	296	2.24	0.23	0.79	40.8
4/93	1,327,793 ¹	7,418	179	2.65	0.41	0.71	41.5
5/93	1,298,042	11,483	113	3.09	0.44	0.81	44.0

¹ All 304,861 of Kooskia NFH stock on station were transferred to Kooskia NFH during April.

JUVENILE REARING

Ponding

The transfer from the nursery to outside raceways was completed during May 1993. All of the fish from untested Rapid River females were put into the 10 C-Bank raceways at about 30,000 fish per raceway. The remaining fish were put into the 30 A- and B-Bank raceways at between 22,000 and 38,000 fish per raceway. Densities varied because of ongoing evaluation studies and experimental design requirements.

Growth and Mortality

Growth varied somewhat from month to month, with April and May growth increments over 0.4 in., while June through August ranging from 0.1 to slightly over 0.3 in. (**Table 7**). In early June, chinook were well ahead of targeted length of between 18-20 fish per pound. In order to slow growth, the chinook were put on a modified feeding schedule of five days on feed and two day off feed. Cold water releases from Dworshak Reservoir into the North Fork also aided in slowing growth. On September 21 chinook were returned to a regular feeding schedule of seven days a week. During outside rearing, erythromycin was administered prophylactically to reduce Bacterial Kidney Disease (see the Fish Health section for details).

Table 7. Summary of monthly growth and mortality of Brood Year 1992 spring chinook salmon during outside raceway rearing at Dworshak NFH (Dworshak NFH 1994).

Date (End of Month)	Number	Weight (lbs)	FPP	Mean Length (in.)	Mean Growth (in.)	Mortality (%)	Mean Water Temp (F)
6/93	1,329,763 ¹	14,424	92.2	3.3	0.21	0.07	46.0
7/93	1,324,860	18,732	70.7	3.6	0.31	0.10	51.8
8/93	1,323,286	24,942	53.1	3.97	0.36	0.12	52.3
9/93	1,319,872	26,773	49.3	4.07	0.10	0.26	53.7
10/93	1,313,098	36,872	35.6	4.53	0.46	0.51	53.1
11/93	1,309,803	44,625	29.4	4.84	0.31	0.25	48.2
12/93	1,308,226	49,439	26.5	5.00	0.16	0.12	43.3
1/94	1,307,318	55,101	23.7	5.19	0.19	0.07	41.3
2/94	1,306,568	62,406	20.9	5.41	0.22	0.06	40.5

3/94	1,278,553	73,062	17.5	5.74	0.33	0.05	41.1
4/94	74,758 ²	4,681	16.0	5.92	0.18	0.02	42.2

¹Number on hand adjusted upward after fish were completely inventoried during marking.

²A total of 1,203,795 fish were released during April 1994.

Marking and Tagging

All spring chinook salmon receive an adipose fin clip to identify them as hatchery fish. During the process of adipose fin clipping, coded-wire tagging and freeze branding was completed for groups designated for production monitoring or special evaluation studies. For Brood Year 1992, adipose fin clipping, coded-wire tagging, and freeze branding was started in June and completed in July, 1993. A total of 655,726 spring chinook salmon (11 coded-wire tag groups) were marked to represent four different special evaluation studies. Of those groups, 3 were also freeze-branded as part of an evaluation study being conducted by the National Biological Survey (NBS). The coded-wire tag rate was about 50%. In addition, a number of chinook were PIT-tagged to monitor travel time and estimate survival to Lower Granite Dam after release. PIT-tagging took place the last week in February 1994. A summary of the numbers of fish that were coded-wire tagged, freeze-branded, and PIT-tagged is listed in **Table 8**.

Table 8. Number of marked and tagged Brood Year 1992 spring chinook salmon that were released from Dworshak NFH in 1994.

Study Group	Coded-Wire Tags	Freeze-Brands	PIT-Tags
Serial Release (3 release groups)	196,065 (Three codes)	199,055 (Three brands)	17,903
INAD 4333 21 vs. 28 day	223,946 (Four codes)		1,197
INAD 4333 Galimycin vs. Aquamycin	235,715 (Four codes)		1,196
Totals	655,726	199,055	20,298

SMOLT RELEASES

The general production release for Brood Year 1992 spring chinook smolts at Dworshak NFH occurred on April 14 and 15, 1994. Prior to the release, arrangements were made with the Corps of Engineers to release additional water from Dworshak Reservoir to facilitate smolt migration down river. The additional release increased flows in the North Fork from 1,300 to 4,500 cfs. Three groups of chinook were released on three separate dates in April and May as part of an evaluation of the effect of release time on smolt out-migration performance. A small group of 24,414 smolts were transferred to the NMFS for a bypass test at McNary Dam. The total release from Dworshak NFH was 1,302,687 smolts (Dworshak NFH 1994). A summary of release dates and numbers is provided in **Table 9**.

Table 9. Summary of spring chinook smolt release information for Brood Year 1992 at Dworshak NFH in 1994.

Date	Group	Number	Mean Size (FPP)
April 8	Early Release Group	69,642	15.7
April 14	General Production	525,748	17.8
April 15	General Production	523,729	17.7
April 22	Mid Release Group	84,654	16.3
May 6	Late Release Group	74,500	17.7
March ¹	NMFS Test Group	24,414	17.1
Total		1,302,687	

¹ These fish were transferred to the National Marine Fisheries Service for by-pass testing at Lower Monumental and McNary dams.

FISH HEALTH

Adult Injections with Erythromycin (INAD 6430)

Adults were inoculated with Erythromycin Phosphate during initial inventory before being sent to the adult holding ponds. Fish were injected in the dorsal sinus with 20 mg/kg of body weight rather than the normal 40 mg/kg body weight in order to evaluate the new polyethylene glycol base for the antibiotic.

Adult Formalin Treatments

Adults were treated three times per week with a one-hour, 150 mg/l flow-through treatment of formalin from 6/2/92 to 8/17/92 to reduce mortality from fungus.

Adult Disease Testing

During spawning, adults were sampled to test for infection with Bacterial Kidney Disease (BKD), IHNV, IPN, VHS, frunculosis, *Myxpholus spp.*, and EIBS. All males and females were tested for BKD levels using ELISA. Eggs from females were segregated based on the level of infection (**Table 10.**)

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

Level of Infection	Optical Density Units (ELISA)
Negative	0.000 - 0.099
Low	0.100 - 0.249
Medium	0.250 - 0.449
High	0.45 and above

Adults were only sub-sampled to test for IHNV. Spleens were sampled in male chinook and the ovarian fluid was sampled in female chinook. The incidence of IHNV was fairly low, 4.2 % overall. The level in 1991 was 3.6 %. Five of 145 samples were positive for ERM (3.4 %) and 35 percent of the samples tested were positive for *Ceratomyxa shasta*. No other diseases were detected for adult chinook.

Monthly Disease Sampling

One group of spring chinook was raised in Burrows pond 49 and became infected with Ich in September 1993. The fish were treated with one 30 minute administration of formalin. No other disease treatments were given during juvenile rearing

In September 1993, routine sampling indicated that fat levels were relative low as a result of the attempt to reduce growth rate to meet the size at release target. The Hatchery Evaluation Team discussed the strategy of using reduced feeding levels to meet the release size target and the consequence on fish health and condition. The Team agreed that restricting rations to reduce growth while maintaining ambient water temperatures was not consistent with good fish health culture and determined to review the spring chinook production program with the intent of developing an acceptable alternative production strategy.

Erythromycin treatments

Juveniles were given two prophylactic treatments of erythromycin during rearing to reduce Bacterial Kidney Disease. Standard 21-day treatments were administered during the spring and fall of 1993 at a rate of 100 mg/kg/day.

Smolt Assessments

Brood Year 92 spring chinook salmon were rated as excellent in the spring of 1994 prior to release. Sixty fish were examined using the Goede's index of condition.

SMOLT EMIGRATION

The performance of spring chinook salmon smolts is monitored and evaluated using passive integrated transponder (PIT) tags after they are released from the hatchery. The tags are interrogated at Lower Granite, Little Goose, and Lower Monumental dams on the Lower Snake River and at McNary Dam on the lower Columbia River (**Figure 2**). PIT tags provide information on travel time and survival during emigration. Four groups of PIT-tagged fish were released in 1994 to evaluate effects of release time on migration time and survival.

Travel Time

Mean travel time from Dworshak NFH to Lower Granite Dam varied considerably depending on the time of release. The averages for all the PIT-tagged groups ranged from 11 to 25 days. Generally, groups that were released later had faster travel times to Lower Granite Dam than groups released earlier. Summary of travel times for each of the release groups is listed in **Table 11**.

Table 11. A statistical summary of travel time from Dworshak NFH to Lower Granite Dam for groups of PIT-tagged spring chinook salmon released on different dates in 1994.

Date	Group	Travel Time (Days)		
		Mean	Minimum	Maximum
April 8	Early Release Group	25	10	75
April 14/15	General Production ¹	17	5	29
April 22	Mid Release Group	18	4	55
May 6	Late Release Group	11	2	40

¹ These fish were part of an evaluation being conducted under the auspices of INAD 4333.

River Flow

Flows in the Lower Snake River were relatively low during the smolt emigration period of April, May, and June, similar to 1992, one of the lowest flows recorded during the 1980s and 1990s (**Figure 3**). Inflow into Lower Granite Reservoir was less than 50,000 cubic feet per second (cfs) at the time of the Early and Production releases. Flows for the Mid and Late Releases were well above 50,000 cfs. Daily mean flows increased after that to levels as high as 90,000 cfs during May and then decreased throughout June. Flows exceeded 100,000 cfs. One of the highest flow years on record since 1980 occurred in 1997 (**Figure 3**).

Estimated Smolt Survival

A minimum estimate of smolt survival to Lower Granite Dam is calculated by summing the cumulative number of unique PIT-tag interrogations at Lower Granite, Little Goose, Lower Monumental, and McNary dams. The mean rate of survival for the various PIT-tagged groups of Brood Year 1992 spring chinook salmon ranged from 47.5 to 63.6 %. (**Table 12**).

Figure 2. Dams on the lower Snake and Columbia rivers where PIT-tag interrogation facilities are located for monitoring smolt emigration.

Figure 3. Mean daily inflow to Lower Granite Reservoir from April through June, 1994 during spring chinook salmon emigration after release from Dworshak NFH.

Table 12. Number of unique interrogations of PIT-tagged spring chinook salmon released from Dworshak NFH and interrogated at downstream dams in 1994.

Study	Group	Number of Tags Released	Number of Unique Interrogations				Total	Percent
			Lower Granite Dam	Little Goose Dam	Lower Monumental Dam	McNary Dam		
Serial Release	Early	5,955	1326	484	467	613	2,890	48.5
	Mid	5,971	1438	495	417	807	3,157	52.9
	Late	5,799	818	761	427	832	2,838	47.5
Erythro 1	Galimycin	596	191	64	86	37	378	63.6
	Aquamycin	600	198	47	72	55	372	62.0
Erythro 2	28 Day	599	209	32	65	63	369	61.6
	21 Day	598	193	43	66	46	348	58.2

ADULT RETURNS

Rack Return to Dworshak NFH

Brood Year 1992 spring chinook salmon smolts released in 1994 returned as adults in 1995 (I-Ocean), 1996 (II-Ocean), and 1997 (III-Ocean). The total adult return to the hatchery rack was 1,856 and is summarized in **Table 13**.

Table 13. Summary of adult returns to Dworshak NFH for Brood Year 1992 spring chinook salmon (IFRO 1998). A total of 1,278,273 smolts were released in 1994.

Return Year	Ocean Age	Number of Returns	Smolt to Adult Return Rate (%)
1995	I	83	0.0065
1996	II	663	0.0517
1997	III	1,110	0.0868
	Total Return	1,856	0.1452

Harvest

The spring chinook salmon production program at Dworshak NFH is part of the Lower Snake River Compensation Plan program and is designed to provide opportunities for harvest that were lost after the construction of four dams on the lower Snake River downstream from Lewiston, Idaho. Harvest in Tribal and sport fisheries for the three return years is reported below.

Idaho Tribal Fisheries - The Nez Perce Tribe reported harvesting 24 spring chinook in 1996 and 835 spring chinook in 1997 during Tribal Ceremonial and Subsistence fisheries in the North Fork Clearwater River (Mauney 1998). However, not all the fish harvested in each year were Brood Year 1992 adults. In 1996, only the II-Ocean fish harvested would have been Brood Year 1992 adults. Likewise in 1997, only the III-Ocean fish harvested would have been Brood Year 1992 adults. The Nez Perce Tribe did not report the age composition of the harvest, so the only way to estimate the number of Brood Year 1992 spring chinook salmon adults harvested in each year would be to apply the age composition that returned to the hatchery each year to the harvest.

In 1996, 68.8 % of the hatchery return was II-Ocean adults (Idaho FRO 1998). Applying that rate to the 1996 Tribal harvest of 24 fish gives an estimate of 17 Brood Year 1992 adults harvested. In 1997, 23.4 % of the hatchery return was III-Ocean adults (Idaho FRO 1998). Applying that rate to the 1997 Tribal harvest of 835 fish gives an estimate of 196 Brood Year

1992 adults harvested.

Idaho Sport Fisheries - The only sport fishery for the period 1995-1997 was in 1997. The Idaho Department of Fish and Game reported a total estimated harvest of 738 hatchery spring chinook salmon in the North Fork Clearwater (Barrett 1998). Of these, 49 were coded-wire tagged; 46 (94%) from Dworshak NFH and 3 (6%) from Kooskia NFH. Applying the 94% rate to the total harvest gives an estimate of 694 Dworshak NFH spring chinook salmon harvested during the 1997 sport season. Applying the 23.4 % rate of return for III-Ocean adults to the hatchery to the harvest gives an estimate of 162 Brood Year 1992 spring chinook adults harvested in the 1997 sport fishery.

Total Adult Return Above Lower Granite Dam

The total number of adults returning above Lower Granite Dam is estimated by combining the number of adults returning to the hatchery rack with the estimated numbers harvested in Tribal and sport fisheries. For BY92, that total is 2,231 giving a smolt to adult return rate of 0.17%. This is 24.4% of the LSRCP mitigation goal of 9,135 adults to Lower Granite Dam.

Other Adult Recoveries

Spring chinook salmon from Dworshak NFH have been recovered from a number of locations throughout the Columbia and Snake rivers. The only way to positively identify these fish is by recovering coded-wire tags. In some cases, coded-wire tag recoveries are expanded to estimate totals, but only actual recoveries are reported here. The data was obtained from the Pacific States Marine Fisheries Commission's (PSMFC) Regional Mark Information System. Thus, data reported here is up to date as of October 1999. For Brood year 1992 spring chinook released from Dworshak NFH as smolts in 1994, a total of 50 coded-wire tagged adults were recovered from locations other than in Idaho (**Table 14**). Only one I-Ocean adult was recovered in 1995 and that was at Leavenworth NFH. Forty-one II-Ocean adults were recovered in 1996 and eight III-Ocean adults were recovered in 1997. Ten adults were recovered from Tribal fisheries in Zone 6. Twenty adults were recovered from various state and federal hatcheries in the Columbia and Snake rivers. The remaining adults were recovered at various dams and traps throughout the system. About 50% of Brood year 1992 spring chinook smolts were coded-wire tagged prior to release from Dworshak NFH. Assuming equal mortality between tagged and untagged fish, an expansion factor of 2 would give a total estimate of 100 adults recovered outside of Idaho.

Table 14 . Number of coded-wire tagged Brood year 1992 Dworshak NFH spring chinook salmon that were recovered as adults from various locations in the Columbia and Snake rivers.

Fishery/Location of Recovery	Recovering Agency	Recovery Year		
		1995	1996	1997
Bonneville Pool Net	ODFW ¹	-	-	1
Bonneville Pool Ceremonial	ODFW	-	6	1
John Day Pool Ceremonial	ODFW	-	1	-
Upper John Day Pool	ODFW	-	1	-
Wells W Ladder Trap	WDFW ²	-	7	2
Pelton Dam	ODFW	-	3	2
Sherar Falls Sport Fishery	ODFW	-	3	-
Round Butte Trap	ODFW	-	-	1
Warm Springs NFH	FWS ³	-	8	1
Leavenworth NFH	FWS	1	2	-
Kalama Falls Hatchery	WDFW	-	1	-
Entiat NFH	FWS	-	2	-
Ringold Springs Hatchery	WDFW	-	3	-
Prairie Channel Test Fishery	ODFW	-	1	-
Klickitat Hatchery	WDFW	-	1	-
Lookingglass Hatchery	ODFW	-	1	-
Minam River	ODFW	-	1	-
Totals		1	41	8

¹ Oregon Department of Fish and Wildlife

² Washington Department of Fish and Wildlife

³ U.S. Fish and Wildlife Service

⁴ Idaho Department of Fish and Game

SPECIAL STUDIES

Serial Release

Three groups of spring chinook salmon were used to evaluate the effects of release time on smolt survival and adult returns. Each group consisted of three replicates. Releases were made on April 8, April 22, and May 6, 1994. This was the third year of the evaluation. PIT-tag data indicated that later releases traveled faster and were interrogated at a higher rate than earlier releases. Coded-wire tag data indicated that earlier releases returned more adults than later releases. The Seattle Research Laboratory, National Biological Survey, funded the study through a U.S. Army Corps of Engineers contract to examine the effects of release time on the incidence of Bacterial Kidney Disease during out migration.

INAD 4333

Two experiments were conducted to evaluate different aspects of using erythromycin to help avoid BKD during rearing. A 21 vs. 28 day administration time was evaluated and two different carriers, Galimycin and Aquamycin were evaluated. In each experiment, each treatment consisted of four replicates. Fish were marked with PIT-tags and coded wire tags for evaluation of smolt performance and adult returns. All these fish were released as General Production releases.

REFERENCES

- Barrett, L. 1998. Clearwater River, Idaho, spring chinook salmon (*Oncorhynchus tshawytscha*) 1997 sport harvest report. IDFG 98-49. 8p.
- Dworshak NFH 1994. Spawning report, spring chinook salmon brood year 1993. U.S. Fish and Wildlife Service, Dworshak-Kooskia National Fish Hatchery Complex, Ahsahka, Idaho. 10 p.
- Dworshak NFH 1994. Program review, spring chinook salmon Brood Year 1992. U.S. Fish and Wildlife Service, Dworshak-Kooskia National Fish Hatchery Complex, Ahsahka, Idaho. 12 p.
- Herrig, D.M. 1990. A review of the Lower Snake River Compensation Plan Hatchery Program. Report AFF1/LSR-90-06, Lower Snake River Compensation Plan Office, U.S. Fish and Wildlife Service, Boise, Idaho. 47 p.
- Idaho FRO 1992. Adult spring chinook salmon returns to Dworshak-Kooskia NFH Complex in 1992 and prognosis for 1993. Annual Report, Fiscal Year 1992, Appendix A, Idaho Fishery Resource Office, Ahsahka, Idaho. 49 p.
- Idaho FRO 1998. Adult spring chinook salmon returns to Dworshak-Kooskia NFH Complex in 1998 and prognosis for 1999. Annual Report, Fiscal Year 1998, Appendix A, Idaho Fishery Resource Office, Ahsahka, Idaho. 33 p.
- 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.
- Mauney, J.L. 1998. Nez Perce Ceremonial and subsistence fisheries for chinook salmon (*Oncorhynchus tshawytscha*), in upper Snake River system tributaries, 1997. Department of Fisheries Management, Nez Perce Tribe. Technical Report 98-1, 42p.
- U.S. Army Corps of Engineers. 1981. Lower Snake River Fish and Wildlife Compensation Plan. Destan Memorandum, No. 9: Dworshak National Fish Hatchery Expansion-Spring chinook rearing.

APPENDIX I

**Adult Spring Chinook Salmon Returns
to Dworshak-Kooskia NFH Complex in 1992
and Prognosis for 1993**

Idaho Fishery Resource Office

APPENDIX A

**ADULT SPRING CHINOOK SALMON RETURNS
TO DWORSHAK-KOOSKIA NFH COMPLEX
IN 1993 AND PROGNOSIS FOR 1994**

Prepared by:

**Ray Jones
Fishery Biologist**

**William Miller
Project Leader**

**Doug Burum
Fishery Technician**

U.S. Fish and Wildlife Service

Idaho Fishery Resource Office

Ahsahka, Idaho

December 1993

Introduction

Dworshak NFH is located at the confluence of the North Fork and the main-stem of the Clearwater River near Ahsahka, Idaho. Construction of the hatchery was included in the authorization for Dworshak Dam and Reservoir (Public Law 87-847, October 23, 1962) to mitigate for losses of anadromous 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 since the first phase of construction was completed in 1969. At that time, the hatchery had 25 Burrows ponds on a reuse system and 59 ponds on a single-pass system for rearing steelhead. In 1972, a second phase of construction placed all ponds on the reuse system with the option of operating some ponds on either reuse or single pass. Additional construction was completed in 1982 under the Lower Snake River Compensation Plan to provide rearing facilities for spring chinook salmon (*O. tshawytscha*). A total of 30 8-foot by 80-foot raceways were constructed. Starting in 1986, 12 8-foot by 75-foot raceways were converted from rainbow trout rearing to chinook salmon rearing.

Dworshak NFH formed a "Complex" with Kooskia NFH on April 9, 1978. All administrative responsibilities and operations for both hatcheries were assigned to the Project Leader at Dworshak NFH. Kooskia NFH is located about 1.5 miles southeast of Kooskia, Idaho, near the confluence of Clear Creek and Middle Fork of the Clearwater River. Because of production constraints, disease considerations, and other factors, Dworshak NFH has held and spawned spring chinook salmon adults returning to Kooskia NFH, as well as incubated eggs and reared juveniles. With the inception of the Lower Snake River Compensation Plan (LSRCP) program for spring chinook salmon at Dworshak NFH, transfers between hatcheries have occurred frequently and for several years, the programs were combined. Recently, however, the programs have been separated and adults and offspring are being handled separately.

This report includes a summary of the 1993 adult returns of spring chinook salmon to Dworshak and Kooskia NFHs and predictions for the 1994 adult returns.

1993 Run Size

Rack Returns

The 1993 adult SCS return to the Dworshak-Kooskia NFH Complex was an improvement over 1991 and 1992 returns. Dworshak NFH had a rack return of 823. Although an improvement over the last two years, it was much lower than the returns for the 1986-90 period (Table 1). The adult SCS return to Kooskia NFH was 1180, the highest return since 1978 (Table 2). In 1993, adults were spawned at Dworshak NFH and an estimated 3,489,391 green eggs were taken (Table 3). This is the combined take for the Dworshak-Kooskia NFH Complex, since all

spawning operations occurred at Dworshak NFH.

Table 1. Hatchery rack returns and age composition of spring chinook salmon for Dworshak NFH, 1984-1993.

Year	I - Salt	II - Salt	III - Salt	Unmeasured	Total Return
1984	14	52	16	0	82
1985	13	281	35	5	334
1986	78	346	91	0	516
1987	25	1,604	376	12	2,017
1988	163	569	1,240	0	1,972
1989	156	1,322	221	1	1,700
1990	7	1,892	135	8	2,042
1991	16	77	72	0	165
1992	23	286	40	21	370
1993	9	452	359	3	823

Harvest

Since a low return was predicted in 1993 for Clearwater River spring chinook salmon, a sport fishery season was not opened and the Nez Perce tribe did not open a subsistence season.

Table 2. Hatchery rack returns and age composition of spring chinook salmon for Kooskia NFH, 1972-1993.

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

Table 3. Dworshak-Kooskia NFH Complex spring chinook salmon spawning data for 1993.

	Males	Females	Total
Adults Spawned	765	817	1,582
Green Eggs	-	-	3,489,391
Eyed Eggs	-	-	2,817,200
Percent Eye-Up	-	-	81%

Stock Description

We have complete rack returns for the 1990 release year at Dworshak NFH. We realized a 0.0528 percent return with 359 III-salt fish returning this year. (For the genetic make-up of Dworshak NFH releases see Table 4).

We also have complete rack returns for 1990 release year at Kooskia NFH. We had a smolt-to-adult return of 0.163 percent from Kooskia releases. The 1990 release year returned 409 III-salt fish, 239 II-salt fish, and 10 I-salt fish. The 1992 release returned only 11 I-salts. (For the genetic make-up of Kooskia NFH releases see Table 5).

Table 4. Genetic make-up of Dworshak NFH spring chinook salmon releases at the hatchery as smolts.

Release Year	Genetic Make-Up ¹	Percent Rack Return
1983	75.1 % LW	0.0741
	12.3 % RR	
	12.6 % LE	
1984	100 %	0.2831
1985	67.8 % LW	0.2570
	32.2 % LE	
1986	100 % LE	0.1610
1987	100 % RR	0.0981
1988	100 % RR	0.1898
1989	100 % RR	0.0077
1990	100 % DW	0.0528

RR - Rapid River

LW - Little White Salmon

LE - Leavenworth

DW - Dworshak

Table 5. Genetic make-up of Kooskia NFH spring chinook salmon released in Clear Creek as smolts.

Release Year	Genetic Make-Up*	Percent Rack Return
1971	85.6 % RR - 14.4% WR	0.0343
1972	100 % RR	0.0698
1973	100 % CA	0.0798
1974	100 % CA	0.1498
1975	58 % RR - 42 % CA	0.4094
1976	100 % SS	0.2338
1977	84 % CA - 11 % KK - 5 % LW	0.0088
1978	75 %RR - 25 % CA	0.0123
1979	69 % KK - 31 % CA	0.0327
1980	31 % KK - 69 % CA	0.0336
1981	19 % KK - 17 % RR - 64 % CA	0.0390
1982	100 % CA	0.0272
1983	65 % KK - 35 % LE	0.0970
1984	89 % KK - 11 % RR	0.0533
1985	100 % KK	0.2721
1986	100 % KK	0.1483
1987	100 % CL	0.1263
1988	100 % CL	0.1770
1989	100 % CL	0.0300
1990	100 % KK	0.1630

*RR - Rapid River
CA - Carson
SS - South Santiam
LW - Little White Salmon
KK - Kooskia
LE - Leavenworth

CL - Clearwater
Age Composition

Age composition of the run is presently based on fork length categories. These length categories were derived from known age/length/sex data from CWT recovery databases. I-salts are 56 cm or less, II-salts are 57 through 81 cm, and III-salts are larger than 81 cm. The age composition for the 1993 adult return is displayed in Table 6.

Table 6. Age composition for 1993 spring chinook salmon returning to Dworshak-Kooskia NFH Complex.

Dworshak NFH			Kooskia NFH		
Age	Number	Percent	Age	Number	Percent
I- Salt	9	1.1	I- Salt	11	0.9
II - Salt	452	55.1	II - Salt	749	64.1
III - Salt	359	43.8	III - Salt	409	35.0
Total Measured*	820	100	Total Measured*	1,169	100

*The values in this table do not represent the total rack returns (Tables 1. and 2.) because there were several fish from each hatchery that were not measured.

Survival

The III-salt returns in 1993 complete the returns from the 1,251,427 smolts released at Dworshak NFH and the 403,701 smolts released at Kooskia NFH in 1990. Total returns to the North Fork of the Clearwater (not including harvest estimates) from the 1990 release were 16 I-salts, 286 II-salts, and 359 III-salts for a hatchery return survival rate of 0.0528 percent (Table 7). Total returns to Clear Creek (not including harvest estimates) from the 1990 release were 10 I-salts, 239 II-salts, and 409 III-salts for a hatchery return survival rate of 0.1630 percent (Table 8).

Table 7. Return vs. release numbers for adult spring chinook salmon returns to Dworshak NFH.

Release Year	Smolts Released at Hatchery	I - Salts (% Return)	II - Salts (% Return)	III - Salts (% Return)	Total (% Return)
1988	1,547,219	156 (0.0101 %)	2,709 (0.1751 %)	72 (0.0047 %)	2,937 (0.1898 %)
1989	1,651,472	10 (0.0006 %)	77 (0.0047%)	40 (0.0024%)	127 (0.0077%)
1990	1,251,247	16 (0.0013%)	286 (0.0229%)	359 (0.0287%)	661 (0.0528%)
1991	1,094,884	23 (0.0021%)	452 (0.0413%)		
1992	959,369	9 (0.0009%)			

*Includes smolt releases at hatchery only. Does not include off-site releases or fry/fingerling releases.

Table 8. Return vs. release numbers for adult spring chinook salmon returns to Kooskia NFH..

Release Year	Smolts Released at Hatchery	I - Salts (% Return)	II - Salts (% Return)	III - Salts (% Return)	Total (% Return)
1988	778,407	107 (0.0137 %)	921 (0.1183 %)	350 (0.0450 %)	1,378 (0.1770 %)
1989	384,235	11 (0.0029 %)	98 (0.0255 %)	38 (0.0096 %)	147 (0.0383 %)
1990	403,701	10 (0.0025 %)	239 (0.0590 %)	409 (0.1013 %)	658 (0.1630 %)
1991	396,619	14 (0.0035 %)	749 (0.1888 %)		
1992	727,251	11 (0.0015 %)			

*Includes smolts released at hatchery only. Does not include off-site releases or fry/fingerling releases.

Coded-wire Tag (CWT) Recoveries

Our facilities have significantly increased SCS marking from the contribution only level (1987 release year, at Dworshak, one CWT group) to the several studies level (1988-1992 release years, 9 to 24 CWT groups). At Kooskia NFH, we occasionally released CWT groups (1984, 1990). Now we mark everything at both hatcheries to allow separation of returning adults (1993 release year). This increased marking has enlarged the SCS CWT recovery database to a point where it is much more useful for hatchery evaluation. It also dramatically increased the workload for

CWT sampling, recovery, and data processing.

A summary of adult SCS recoveries in the Dworshak NFH rack is shown in Table 9. All recoveries at the Dworshak rack were Dworshak NFH marks this year. Rack recoveries in previous years have included strays from other hatcheries and National Marine Fisheries Service transportation study marks.

Table 9. Summary of CWT recoveries for adult spring chinook salmon in the Dworshak NFH rack (1987-1993).

Rack Year	Total Recoveries	Recoveries of Dworshak Marks
1987	25	19
1988	55	49
1989	77	47
1990	306	302
1991	30	10
1992*	183	177
1993*	449	449

*1992 and 1993 recoveries include fish tagged at Kooskia NFH. Previous recoveries were only of fish tagged at Dworshak NFH.

1993 Preseason Predictions

The 1993 SCS returns to Dworshak NFH were both surprisingly good and disappointing. The very successful III-salt return gave us cause to celebrate but the abysmal I-salt return (only 9) forecast a grim 1994. We drastically underestimated the return for III-salts at Dworshak NFH.

The Technical Advisory Committee (TAC) also underestimated the SCS run at Bonneville Dam. The original TAC estimate was 76,200 adults, but the draft final estimate available at this writing was 111,500. We were not alone in underestimating this run. This run was especially strong on III-salts at other Idaho locations as well (Tom Rogers, personal communication). Our II salt prediction was close (445 estimate vs. 452 actual) but our III-salt estimate was under the actual return (72 estimate vs. 359 actual).

Kooskia NFH began an off-site distribution program in 1989. This program provided for a direct release of only approximately 400,000 smolts at Kooskia NFH rather than a full production on-site release of around 800,000 smolts as in 1987 and 1988. Therefore we expected a decrease in the total number of returns to the rack. This did not happen in 1993 unlike other recent years. The III-salt return was the largest ever (409). At Kooskia both our II-salt (estimate 235 vs. actual 749) and III-salt estimates (estimate 106, actual 409) were drastically under the actual returns.

Several factors may have enhanced the SCS run at Kooskia, including 1) the highest stream flows (and corresponding lower temperatures) in Clear Creek in at least a decade, 2) the new weir was modified before the 1993 runs, 3) the adult trap entrance was modified before the 1993 run, and 4) high spring flows in the Snake and Clearwater rivers improved adult passage at all the downstream dams allowed more adults to return.

Dworshak NFH-1993

1993 Run Prediction

I-salt = 58
II-salt = 445
III-salt = 72
Total n = 575

1993 Rack Return

I-salt = 9
II-salt = 452
III-salt = 359
Unmeasured = 3
Total run = 823

Kooskia NFH-1993

1993 Run Prediction

I-salt = 44
II-salt = 235
III-salt = 106
Total n = 385

1993 Rack Return

I-salt = 11
II-salt = 749
III-salt = 409
Unmeasured = 11
Total Run = 1180

1994 Run Predictions

The following is our prediction for the 1994 SCS run to the Dworshak-Kooskia Complex.

Dworshak NFH

I-salts 21
II-salts 290
III-salts 100
TOTAL 411

Kooskia NFH

I-salts 26
II-salts 247
III-salts 187
TOTAL 460

Prediction 411 ± 200

Prediction 460 ± 100

Total predicted to return both hatcheries in 1994 is 871 ± 300.

The total hatchery spring chinook salmon predicted to return to Dworshak and Kooskia NFH's in 1994 will not meet the hatchery needs for eggs in the Clearwater drainage. However, that was last year's prediction also. We did surpass Kooskia goals. The number of adults needed for supplying eggs to fill both hatcheries is estimated at 1700. Actual number needed varies, depending on number of eggs per female (which varies with size and age of fish returning) and sex ratio of any particular run. The Dworshak-Kooskia NFH Complex 1989 and 1990 spawning operations satisfied their needs as well as the egg requirements for the Lower Snake River Compensation Plan satellite station at Powell, Red River, and Crooked River. Unfortunately, this was not the case in 1991 or 1992. The 1993 run was an improvement over 1991 and 1992 but not a big enough improvement, at Dworshak NFH, to meet our broodstock goal, and we certainly did not meet our LSRCP mitigation goal of 9,000 adults returning to Lower Granite Dam. The 1994 run is also predicted to not meet our broodstock goals.

APPENDIX II

Brood Year 1993 Spawning Report Dworshak National Fish Hatchery

SPAWNING AND INCUBATION REPORT

Spring Chinook Salmon
Brood Year 1993

Prepared By:

Kevin N. Sloan and Jon Streufert
Dworshak National Fish Hatchery

Doug Burum and Ray Jones
Idaho Fishery Resource Office

Joe Lientz
Dworshak Fish Health Center

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

January 21, 1994
RACK RETURN MEASUREMENTS

Ladder Operation

Dworshak's ladder was opened to collect returning spring chinook salmon from

May 21 until August 24, 1993, while KoOBkia kept its trap functional from May 28 through August 5. A total of 2,003 adult SCS returned to the complex this year, with 1,180 back to Kooskia and 823 to Dworshak.

Return Timing

Kooskia NFH does not have a fish counting device. Data on run timing is based on regular observations made by hatchery staff. Table 1 lists the date and numbers of adult chinook salmon that were routinely transferred from Kooskia NFH to Dworshak NFH for holding and spawning.

Chinook salmon were first observed in the adult holding pond at Kooskia NFH on May 19, 1993 (Kip Bottomley, per. comm.). A total of 178 fish had entered the facility by May 28. About 82 percent of the total return had entered the facility by June 24. Trapping ended on August 19.

Dworshak NFH's ladder was opened on May 21, 1993, and was closed on August 24. However, most of the fish activity in the ladder occurred between June 17 and July 7.

Pre-spawning Sununary

Returning brood stock were anesthetized with Tricaine Methanesulfonate (MS-222) buffered with sodium bicarbonate, sexed, measured, and inoculated with erythromycin phosphate before being sent to a holding pond. Kooskia adults were periodically brought to Dworshak for holding until ready for spawning. All Kooskia fish were tagged so as not to be confused with Dworshak adults.

Formalin Treatment for Adults

Adult spring chinook salmon returning to Dworshak and Kooskia NFHs were treated with formalin in an effort to control external fungus and reduce pre-spawning mortality. Beginning on June 6, 1993, adults were treated three times a week with formalin at 167 mg/l for one hour. In previous years holding ponds were treated with a continuous drip method, but efficacious levels of formalin were difficult to maintain for a one hour treatment. This year a new method of formalin treatment was tested during the pre-spawn holding period. To begin a treatment, holding pond flows were reduced to 500 gpm, then 15 gal of formalin were added to charge the system to 167 ppm. Formalin was then dripped into the ponds at 225 ml/min for one hour. on July 19, formalin treatments were expanded to 5 days per week (Monday - Friday) with the new treatment regime. Oxygen and formalin levels were measured at the head and tail of holding ponds at 15 or 30 minute intervals. High levels of formalin (167 - 100 ppm) were maintained at the head of ponds for the treatment duration. At the end of the ponds, formalin levels averaged 100 ppm at 30 minutes, but were lower (50 ppm) by 60 minutes.

Pre-spawning mortality of adult spring chinook was slightly over seven percent for Dworshak and Kooskia stocks combined (Table 2). Pre-spawning and total mortality was considerably lower than that of recent prior years. While other extrinsic and intrinsic factors can affect survival rates during the pre-spawn holding period, the new formalin treatment regime appears to have helped reduce the prevalence and extent of fungus during this period.

Table 1. Run Timing of spring chinook salmon returning to Kooskia NFH in 1993.

Date	Number ¹	Disposition
5-28-93	178	148 to Dworshak NFH ² 30 to Clear Creek ³
6-03-93	210	to Dworshak NFH
6-04-93	170	to Dworshak NFH
6-08-93	130	100 to Dworshak NFH ² 30 to Clear Creek ³
6-10-93	65	to Dworshak NFH
6-19-93	127	to Dworshak NFH
6-24-93	82	to Dworshak NFH
7-02-93	56	to Dworshak NFH
7-13-93	55	to Dworshak NFH
7-22-93	24	to Dworshak NFH
7-30-93	16	to Dworshak NFH
8-05-93	17	to Dworshak NFH
8-10-93	11	to Clear Creek ³
8-19-93	28	20 to Clear Creek ³ 8 killed for CWT removal
Mortalities	11	
Total Return	1180	

¹ does not include 11 mortalities that occurred in Kooskia NFH adult holding pond.

² Adults shipped to Dworshak NFH for holding and spawning.

³ Adults placed above weir for natural spawning.

2

Table 2. Percent mortality in adult spring chinook salmon held from June 1993 through spawning (September 1993) - Brood Year 1993 SCS.

	Percent mortality		
	Dworshak	Kooskia	Avg
Pre-spawning*	9.2	5.7	7.4
During spawning	5.8	6.4	6.1
Total	14.5	11.8	13.2

Mortality picked from holding ponds from ladder opening on May 21, 1993 through first spawn on August 23, 1993.

Pre-spawning losses totaled 132 fish of the 1,892 fish on station by August 23, 1993 (Dworshak - 823 returnees, Kooskia - 1,070). This 7.4 percent loss is a significant drop from the 19.4 percent mortality experienced by Brood Year 1992 adults, and is considerably below the five year average (Table 3). mortality during spawning of 6.1 percent is comparable to the five year average, while total mortality of 18.7 is somewhat below the 23.3 percent five year average.

Table 3. Comparison of BY 1993 prespawning and total holding mortality with previous five brood years.

Brood Year	Pre-spawn Mort.	During spawn Mort.	Total Mortality
1988	9.1	5.1	12.5
1989	10.3	14.0	22.9
1990	6.8	5.0	11.1
1991	20.8	4.0	23.7
1992	19.4	5.1	23.3
5 YR Avg	13.3	6.6	18.7
1993	7.4	6.1	13.2

Dis)osition of Adults Not Used for Spawning

All of the adult spring chinook that returned to Dworshak NFH were held for spawning. At Kooskia NFH, 91 adult spring chinook were released above the weir on Clear Creek for natural spawning as part of a supplementation experiment being conducted in conjunction with the Idaho Department of Fish and Game.

3

Scale Samples

scales were not sampled from either Dworshak or Kooskia adult spring chinook salmon in 1993. Scales were sampled in 1992 but the scale margins were resorbed so extensively that age determinations were very inaccurate and the decision was made to discontinue scale sampling. Instead, age-length relationships are being developed using known age fish from coded-wire tag returns.

SPAWNING S

Age Structure of Spawned Fish

The age-sex composition of adult spring chinook salmon from Dworshak and Kooskia NFHs that were spawned in 1993 is listed in Tables 4 and 5, respectively.

Table 4. Age-sex distribution of spring chinook salmon spawned at Dworshak NFH in 1993 - Dworshak stock.

	I-SALT		II-SALT		III-SALT		TOTAL
	N	%	N	%	N	%	
MALE	5	2	153	47	165	51	323
FEMALE	1	>1	214	62	128	37	343
TOTAL	6	>1	367	55	293	44	666

Table 5. Age-sex distribution of spring chinook salmon spawned at Dworshak NFH in 1993 - Kooskia stock.

	I-SALT		II-SALT		III-SALT		TOTAL
	N	%	N	%	N	%	
MALE	8	2	271	61	163	37	442
FEMALE	1	>1	322	68	151	32	474
TOTAL	9	>1	593	65	314	34	916

Spawning Summary

Seven egg takes were accomplished for this brood year, starting August 23 and ending September 13 (Table 6, next page). 817 females were spawned, 343 from Dworshak returns and 474 from Kooskia returns. A total of 3.48 million eggs

4

were taken. Fecundity for the 1993 spawn was 4,270 eggs per female, which was slightly higher than the five-year average. This was due to the abnormally high 43.6 percent of III-salt fish.

Eye-ups for enumerated eggs averaged 87.2 percent (Table 6), 87.0 percent for Kooskia eggs and 87.5 percent for Dworshak eggs. When spawns that were discarded because of being totally dead are considered, eye-up overall was just 80.1 percent. The problem with comparing any of these eye-ups with historical eye-up data is that it is only within the last two years that Dworshak has begun distinguishing between the two types of eye-up, i.e. total egg eye-up or enumerated egg eye-up. Unfortunately, few if any, data from other rearing facilities make this distinction so that hatchery to hatchery, as well as year to year, comparisons are often misleading. It should be mentioned, however, that despite the historical lack of clarity in what constitutes eye-up, eye-up this year was definitely below historical averages.

While nothing particular stands out as a possible cause, a couple egg handling procedures (saline use and rinsing procedures) may be investigated during the next brood year to help prevent a recurrence of this phenomenon.

Table 7. Comparison of BY 1993 spring chinook salmon spawning with 5-year average.

Brood Year	Adult Returns	% Fmls.	Green Eggs	Eggs /Fml.	% Eye-up
1988	2,567	52.6	4,890,970	4,615	96.0
1989	2,673	48.7	3,516,306	3,701	92.8
1990	3,183	54.9	4,833,104	3,623	94.2
1991	632	51.9	995,842	4,117	89.0
1992	681	53.2	881,980-	7	?
5 Yr Avg	1,947	52.3	3,023,640	4,014	93.0
1993	2,003	51.7	3,489,391	4,270	87.2

Estimate.

During spawning several cooperating agencies had personnel in the spawning area collecting tissue, sperm, or egg samples. The University of Idaho (Aquaculture) took liver and heart samples for DNA extractions. The NFRC-S sampled kidney and other tissues in an attempt to determine certain allele frequencies in adult SCS with varying levels of BKD infection. IFRO preserved some SCS sperm using cryopreservation.

6

Spawning Procedures

Adults were anesthetized with MS-222 and checked for ripeness. Males were sent directly to the spawning table while ripe females were killed using a pneumatic knife and bled for 5-10 minutes in a spawning rack. Green females were sent back to the holding ponds along with males that were not needed. Spawned females were identified with numbered pins, which is necessary for later identification and segregation/culling of eggs according to disease status. Sperm was collected in reusable sample cups and kept on ice until needed. Females were cut and eggs collected in disinfected colanders to drain ovarian fluid. Gametes from both males and females were mixed with the addition of a small amount of one percent saline solution.

After approximately two minutes the fertilized eggs were thoroughly rinsed and placed into incubators where they were disinfected with 75 ppm iodophore (buffered with sodium bicarbonate) for 30 minutes. One to one spawning was practiced in all but a few instances when insufficient males were available. This resulted in a male to female spawning ratio of 1.00 to 1.07.

Aseptic procedures were used throughout the entire spawning period. Females were swabbed with iodophor before spawning. males, however, were not iodophored to avoid contaminating the sperm. 250 and 500 mg/l iodophor solutions were used to disinfect equipment and workers, hands.

It should be mentioned that Kooskia stock adults were spawned exclusively with other Kooskia adults, while Dworshak adults were spawned only with other Dworshak adults.

Adult Disease Sampling

Table 8 outlines the disease sampling regimen generally followed this year.

Table 8. Fish health sampling proposal - SCS Brood Year 1993.

Disease	Dworshak		Kooskia	
	Males	Females	Males	Females
BKD	none	100%	none	100%
IHNV	none	subsample	none	subsample
Other	subsample		subsample	

Source: Pre-spawning conference summary - 08/12/93

Segregation of BY 93 SCS by use of ELISA for BKD was based on optical density unit ranges in Table 9. only values from females were used to segregate progeny. This approach assumes, as the literature and on-station observations indicate, that the BKD status of the female should carry more weight in the designation of the offspring than that of the male.

7

Table 9. Optical density units associated with BKD levels in Dworshak/Kooskia SCS.

BKD Level	Optical Density Units Range
Negative	0.000 - 0.099
Low	0.100 - 0.249
Medium	0.200 - 0.449
High	0.45 and above

Source: Monthly Activity Report, Dworshak FHC - 3/29/93.

Segregation of Dworshak's BY 1993 eggs was based on ovarian samples from female adults, with the NFRC-S providing the ELISA analyses and results. While Dworshak FCH recommends using only kidney/spleen samples as the basis of egg classification and segregation, these values were not received in time from the NFRC-S. As a result, two females that had tested low based on the ovarian sample results were later shown to be high based on the kidney/spleen sample values. The eggs from these two females were picked and enumerated

with low-BKD eggs because the kidney/spleen readings were not available. Two other "medium"-BKD females also tested high by the later readings, but their eggs were culled along with those of other medium females.

Eggs transferred to Kooskia were segregated based on ELISA values from kidney/spleen samples. The Dworshak FHC used ELISAs to test all Kooskia fish and on Takes 9, 10, and 11, while NFRC-S conducted ELISAs on Dworshak-Takes 2, 4, 6, and 8.

Table 10 summarizes the BKD infection levels in the 766 adult chinook sampled this brood year from the two fish stocks. Proportions of fish in the various BKD infection levels were remarkably similar, with over 94 percent classified as lows and negatives, about one percent being moderates, and three to five percent exhibiting high BKD levels. These values are well in line with historical trends in BKD levels.

Table 10. BKD ELISA levels in Kooskia and Dworshak BY 1993 adult SCS.

BKD Infection Level	Kooskia			
	No. Fish	Percent	No. Fish	Percent
Negative	358	76.8	216	72.0
Low	90	19.3	67	22.3
Moderate	5	1.1	3	1.0
High	13	2.8	14	4.7
Totals	466		300	

Source: DFHC 1993 SCS Adult Sampling Summary - 09/17/93

All spawns from high-BKD female parentage were discarded at the green egg stage this year. This included 15 Kooskia spawns and 12 Dworshak spawns. The three medium-BKD spawns, one from Kooskia fish and two from Dworshak fish,

APPENDIX III

Brood Year 1992 Production Program Review Dworshak National Fish Hatchery