BROOD YEAR REPORT
DWORSHAK NATIONAL FISH HATCHERY
SPRING CHINOOK SALMON
BROOD YEAR 1992
LIFE CYCLE COMPLETED IN 1997

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BROOD YEAR 1992 OVERVIEW

Life Stage	Number	% Survival
1992 Rack Return	369	-
Number of Females Spawned	138	-
Estimated Green Eggs Taken	510,000	-
Average Eggs per Female	3,750	-
Other Eggs Received[1]	928,349	-
Fingerlings Produced[2]	1,329,763	-
Smolts Released	1,302,687	97.9
In-River Smolt Survival[3]	-	51.5
Adult Returns to the Hatchery[4]	1,856	0.14
Adults Harvested in Idaho[5]	375	-
Known Adult Return to Clearwater River	2,231	0.17
Adults Collected at Other Locations[6]	100	

[1] Surplus eggs received from Rapid River State Fish Hatchery.
[2] End of nursery rearing.
[3] Mimium 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. Number is based on an expansion factor of 2.

INTRODUCTION

This report provides data for Brood Year 1992 spring chinook salmon at Dworshak National Fish Hatchery (NFH) which completed its life cycle in 1997. 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 1992 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 and Program Review for Brood Year 1992 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 1992, 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.

1992 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 1991, the I-Ocean return to Dworshak NFH was very low, only 16 fish, indicating that the II-Ocean return in 1992 would also be low. The prediction for adult returns to Dworshak NFH for the 1992 season was 375. The breakdown by age class for the predicted return is given below in **Table 1** (Idaho FRO 1992).

Table 1. Pre-season prediction of adult returns to Dworshak NFH by ocean age (Idaho FRO 1992).

Ocean Age	1992 Prediction
I - Ocean	50
II - Ocean	300

III - Ocean	25
Total	**375**

Total Rack Return

The 1992 adult spring chinook salmon return to Dworshak NFH was 369 adults, slightly lower than the pre-season prediction of 375 made in 1991 (**Table 2**), and the fourth lowest since the first adults returned in 1984.

Table 2. Number of adult spring chinook salmon that returned to Dworshak NFH since 1984, by ocean age (Idaho FRO 1992).

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

[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 22 and was closed on September 11, 1992. Records are not available to document the day the first and last fish entered the hatchery. Only 369 adult spring chinook returned to Dworshak NFH in 1992, so inventories were not conducted frequently. June 15 was the first time adult spring chinook were inventoried. Between May 22 and June 15, 152 adult spring chinook salmon had entered the hatchery. By June 29, two weeks later, an additional 128 adults entered the hatchery. Only an additional 52 fish entered the hatchery after that date. Thus, it appears that the bulk of the run, over 84%, had entered the hatchery by June 29 indicating that the peak was some time in June. An additional 21 unmeasured fish were included in the return to Dworshak NFH and their contribution to run timing is unknown.

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 1992 was typical, 6% I-Ocean, 82% II-Ocean, and 12% III-Ocean (**Table 3**). **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 periodically during the spring and summer of 1992. Pond mortalities were enumerated as they occurred during but were not included in the inventories.

Date	I-Ocean	II-Ocean	III-Ocean	Cumulative
6/15/92	8	130	14	152
6/29/92	13	96	19	128
8/24/92	0	29	2	31
9/05/92	0	6	0	6
9/08/92	1	13	1	15
Pond Morts	0	12	4	16
Total	**22**	**286**	**40**	**348**

Adult Mortality

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

Pre-Spawning Mortality - From May 22 to August 26, a total of 32 adult spring chinook salmon (8.5%) died: twenty-five females, five males, and two of unknown sex. Pre-spawn mortalities include the 16 adults that were recovered from the adult holding pond during the season. The primary cause of death was fungus, despite the use of regular formalin treatments (Dworshak NFH 1994).

Mortality During Spawning - From August 26 through September 11, an additional 15 adults died, six males and nine females. The rate of mortality usually increases once spawning starts because the fish are crowded up and handled twice a week during that period.

Spawning

Spawning was started on August 19 and was conducted twice weekly until September 11 for a total of six egg takes. No eggs were taken on August 19. One hundred and twenty-four males and 138 females were spawned. Five of the females spawned were identified as originating

from Lookingglass State Hatchery (Rapid River Stock). Eggs from two of these females were culled but eggs from the other three females had already been incorporated into a special study by the National Fishery Research Center Seattle (NBS). 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 4**. Details on spawning procedures, methods, etc., can be found in the spawning report for BY 92 spring chinook salmon, Appendix I. (Dworshak NFH 1993).

Table 4. Number of male and female spring chinook salmon spawned during each egg take for Brood year 1992 at Dworshak NFH (Dworshak NFH 1993).

Take Date	Males Spawned	Females Spawned	Green Eggs Taken[1]
8/19/92	0	0	0
8/25/92	18	29	108,750
8/28/92	30	30	112,500
9/01/92	33	33	123,750
9/04/92	12	2	45,000
9/08/92	27	30	112,500
9/11/92	4	4	15,000
Culled			(7,500)
Total	**124**	**138**	**510,000**

[1] Estimated assuming an average of 3750 eggs/female.

EGG PRODUCTION

Green Eggs Taken

Green eggs were not counted. However, the total number of green eggs taken was estimated at 510,000 by using an average number of 3750 eggs per female (**Table 4**).

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).

Other Eggs Received

In addition to the estimated 510,000 eggs obtained from adults returning to Dworshak NFH, 928,349 spring chinook eggs were received in four shipments from Rapid River Fish Hatchery during October (**Table 5**). About 61% were from females that tested "high" for BKD. Those eggs that were from untested females were presumed to be from females that would have tested high for BKD. Eight thousand eggs were also obtained from Kooskia NFH because they were the progeny of females that tested "high" for BKD status.

Table 5. Egg shipments to Dworshak NFH from Rapid River SFH by date and BKD status.

Shipment Date	Parental BKD Status				Total
	Low	Medium	High	Presumed High	
10/2/92	101,500	69,500	205,000	0	376,000
10/6/92	0	0	0	198,605	198,605
10/7/92	67,676	77,264	83,587	0	228,527
10/8/92	0	41,466	49,290	34,461	125,217
Total	**169,176**	**146,764**	**337,877**	**233,066**	**928,349**

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 their 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 October, routine exams conducted by the Fish Health Center revealed that most fish had very little pyloric caeca fat. The production staff prepared a brief for the Hatchery Evaluation Team which met several times to consider whether any action should be taken. Concern was expressed that the lack of fat my affect downstream survival after release because of little or no energy reserves. The Team recommended to the Managers that rations be increased (See letter in FRO Brood year file - Rearing Data). 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	44625	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

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

[2]A 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 was1,302,687 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, frunculoss, *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. The years 1992 (low flows) and 1997 (high flows) are included for perspective.

Table 12. Number of unique interrogations of PIT-tagged spring chinook salmon released from Dworshak NFH and interrogated at downstream dams in1994.

Study	Group	Number of Tags Released	Number of Unique Interrogations					Percent
			Lower Granite Dam	Little Goose Dam	Lower Monumental Dam	McNary Dam	Total	
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 from Dworshak NFH in 1994 (doesn't include those that were transferred to NMFS).

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 minimum 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. A total of ten adults were recovered from Tribal fisheries in Zone 6 in 1996 and 1997. 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.

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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 1992 AND PROGNOSIS FOR 1993

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Ahsahka, Idaho

December 1992

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 form 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 1992 adult returns of spring chinook salmon to Dworshak and Kooskia NFHs and predictions for the 1993 adult returns.

1992 Run Size

Rack Returns

The 1992 adult SCS return to the Dworshak-Kooskia NFH Complex was the second worst in recent years. Dworshak NFH had a low rack return of 369 adults replacing the 1986 return as our fourth lowest (Table 1). The adult SCS return to Kooskia NFH was the eighth lowest ever for that facility (Table 2), 312 fish. The lower Kooskia NFH return is partially due to a dramatic decrease (from over 750,000 to less than 400,000) in on-site smolt releases for the 1989 and 1990 release years. The 1990 SCS return was a benchmark for plausible return levels from normal production releases from both hatcheries.

In 1992, 440 adults were spawned at Dworshak NFH and an estimated 866,250 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 to Dworshak NFH.

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	1604	376	12	2017
1988	163	569	1240	0	1972
1989	156	1322	221	1	1700
1990	7	1892	135	8	2042
1991	16	77	72	0	165
1992	22	286	40	21	369

Harvest

The 1990 run supported a tribal fishery, a sport fishery, and provided enough eggs for both hatcheries, as well as three Idaho Department of Fish and Game satellite facilities. The 1991 run was so low that there was no sport season and the Nez Perce tribe closed their fishery. Although the 1992 run was also low, a sport season was opened for spring chinook on the Clearwater River and the Nez Perce Tribe opened a subsistence fishery. The estimated sport harvest for 1992 was 54 and the Tribal subsistence harvest was estimated to be 160.

Table 2. Hatchery rack returns and age composition of spring chinook salmon to Kooskia NFH.

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	2539	154	0	3026
1978	23	1676	336	0	2035
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	1141
1991	10	98	350	9	467
1992	14	239	38	21	312

Table 3. Dworshak-Kooskia NFH Complex spring chinook salmon spawning data for 1992.

	Males	Females	Total
Adults Sexed	327	331	658
Adults Spawned	209	231	440
Green Eggs	-	-	866,250
Eyed Eggs	-	-	805,000
Percent Eye-Up	-	-	93

Stock Description

We have complete rack returns for the 1989 release year at Dworshak NFH. We realized a 0.008 percent return with a genetic makeup of 100 percent Rapid River stock. The 1990 release year returned 286 II-salt fish to the Dworshak NFH rack. The 1991 release returned only 22 I-salts. (For the genetic make-up of Dworshak NFH releases see Table 4).

We also have complete rack returns for 1989 release year at Kooskia NFH. We had a smolt-to-adult return of 0.03 percent from Kooskia releases. The 1989 release year returned 9 III-salt fish, 98 II-salt fish, and 11 I-salt fish. The 1991 release returned only 14 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 Makeup[1]	Percent Rack Return
1983	75.1% LW	0.0741
	12.3%RR	
	12.6% LE	
1984	100% LE	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

[1] RR - Rapid River
LW - Little White Salmon
LE - Leavenworth

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

Release Year	Genetic Makeup[1]	Percent Rack Return
1971	85.6 % RR	0.0343
	14.4 % WR	
1972	100 % RR	0.0698
1973	100 % CA	0.0798
1974	100 % CA	0.1498
1975	58 % RR	0.4094
	42 % CA	
1976	100 % SS	0.2338

1977	84 % CA	0.0088
	11 % KK	
	5 % LW	
1978	75 % RR	0.0123
	25 % CA	
1979	69 % KK	0.0327
	31 % CA	
1980	31 % KK	0.0336
	69 % CA	
1981	64 % CA	0.0390
	19 % KK	
	17 % RR	
1982	100 % CA	0.0272
1983	65 % KK	0.0970
	35 % LE	
1984	89 % KK	0.0533
	11 % RR	
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

[1] 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 1992 adult return is displayed in Table 6.

Table 6. Age composition for 1992 spring chinook salmon returning to Dworshak-Kooskia NFH Complex.

Ocean Age	Dworshak NFH		Kooskia NFH	
	Number	Percent	Number	Percent
I - Salt	22	6.3	14	4.8
II - Salt	286	82.2	239	82.1
III - Salt	40	11.5	38	13.1
Total	348	100	291	100

Survival

The III-salt returns in 1992 complete the returns from the 1,651,472 smolts released at Dworshak NFH and the 384,235 smolts released at Kooskia NFH in 1989. Total returns to the North Fork of the Clearwater (not including harvest estimates) from the 1989 release were 22 I-salts, 286 II-salts, and 40 III-salts for a hatchery return survival rate of 0.0077 percent (Table 7). Total returns to Clear Creek (not including harvest estimates) from the 1989 release were 107 I-salts, 921 II-salts, and 350 III-salts for a hatchery return survival rate of 0.1770 percent (Table 8).

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

Release Year	Smolts Released at Hatchery[1]	I - Salts (% Return)	II - Salts (% Return)	III - Salts (% Return)	Total (% Return)
1988	1,547,219	156 (0.0101%)	2709 (0.1751%)	72 (0.0047%)	2937 (0.1898%)
1989	1,651,472	10 (0.0006%)	77 (0.0047%)	40 (0.0046%)	127 (0.0077%)
1990	1,251,247	16 (0.0013%)	286 (0.022%)		
1991	1,094,884	22 (0.0020%)			

[1]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[1]	I - Salts (% Return)	II - Salts (% Return)	III - Salts (% Return)	Total (% Return)
1988	778,407	107 (0.0137%)	921 (0.1183%)	350 (0.0450%)	1378 (0.1770%)
1989	384,235	11 (0.0029%)	98 (0.0255%)	37 (0.0096%)	146 (0.0379%)
1990	403,701	10 (0.0025%)	239 (0.059%)		
1991	396,619	14 (0.0035%)			

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

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 increase in marking has enlarged the CWT recovery database to a point where it is much more useful for hatchery evaluation. It also 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. Almost all recoveries that were not Dworshak NFH marks were part of National Marine Fisheries Service transportation studies. Occasional strays from other hatcheries do occur.

Table 9. Summary of CWT recoveries for adult spring chinook salmon in the Dworshak NFH rack (1987-1992).

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

1992 Preseason Predictions

The 1990 SCS returns to Dworshak-Kooskia NFH Complex was both gratifying and disappointing. The very successful II-salt return gave us cause to celebrate but the abysmal I-salt return (only 7) forecast a grim 1991. We also overestimated the return for III-salts at Dworshak NFH in 1990 and 1991. We believe that this may be because of the shift in recent years to Rapid River stock which yields higher proportion of II-salt returns. The grim forecast came true, as only 77 II-salts returned to Dworshak NFH, for the lowest II-salt return since 1984, which was the first year Dworshak NFH operated their rack. This was not a big surprise for the II-salt portion of the 1991 run to be down, since the 1990 jack return was the lowest ever at Dworshak NFH. But the mammoth drop off in II-salts from 2720 to 77 was greater than expected. The 1991 jack return (16) did not predict a big recovery in 1992.

Kooskia NFH began an off-site distribution program in 1989. This program dictated a direct release of only 400,000 smolts at Kooskia NFH rather than a full production on-site release of around 800,000 smolts like 1987 and 1988. Therefore we expected a decrease in the number of II-salts returning to the 1991 rack (1989 release year). This decrease was greater than expected since there was only one-tenth as many II-salts as the previous year from a release that was one-half as large. However, the III-salt return was the second largest ever (350). Because of the large decrease in on-site releases future Kooskia NFH rack returns were expected to be lower even though Kooskia NFH maintains a relatively consistent rack return percentage. The 1991 jack return (10) and II-ocean return (98) did not indicate a big recovery at Kooskia either.

Dworshak 1992

Ocean Age	1992 Prediction	1992 Rack Return
I - Salt	50	22
II - Salt	300	286
III - Salt	25	40
Unmeasured	-	21
Total	375	369

Kooskia NFH-1992

Ocean Age	1992 Prediction	1992 Rack Return
I - Salt	25	14
II - Salt	200	239
III - Salt	100	38
Unmeasured	-	21
Total	325	312

1993 Run Predictions

The following is our prediction for the 1993 SCS run to the Dworshak-Kooskia Complex.

Ocean Age	Dworshak NFH	Kooskia NFH
I - Salt	58	44
II - Salt	445	235
III - Salt	72	106
Total Prediction	575 $\pm$ 200	385 $\pm$ 100

Total predicted to return both hatcheries in 1993 is 960 $\pm$ 300. The total hatchery spring chinook salmon predicted to return to Dworshak and Kooskia NFH's in 1993 will not meet the hatchery needs for eggs in the Clearwater drainage. The number of adults needed for supplying eggs to fill both hatcheries is estimated at 2500. 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 will be an improvement over 1991 and 1992 but not a big enough improvement to meet our brood stock goal of 2500. However, we think both stations will see dramatic increases in jack counts in 1993 because of smolt assessment data. Better days may be ahead.

APPENDIX II

Brood Year 1992 Spawning Report
Dworshak National Fish Hatchery

SPAWNING REPORT

Spring Chinook Salmon
Brood Year 1992

January 25, 1993

Prepared by
John Streufert

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

Spring Chinook Salmon
Brood Year 1992

Summary of Run

Dworshak's ladder was open to collect returning adult spring chinook salmon from may 22 until September 11, 1992, while Kooskia kept its trap functional from May 9 through August 28. A total of 681 adult SCS returned to the complex this year, with 312 back to Kooskia and 369 to Dworshak (Table 1). On 8/6/92 tribal, state, and federal personnel angled for SCS adults at the mouth of Dworshak's ladder. 15 adults were caught and put into Holding Pond 9. As in years past, II-salt adults predominated, making up 77 percent of all returns.

Table 1. Age Structure Summary - SCS Adults Brood Year 1992.

	Kooskia NFH		Dworshak		NFH Totals
I-ocean (5.3%)	14		22		36
II-ocean (77.1%)	239		286		525
III-ocean (11.4%)	38		40		78
Unmeasured (6.2%)	21		21		42
Totals	312	(45.8 %)	369	(54.2 %)	681

Source: IFRO - 921007

Five spawned females were identified as Looking Glass stock, with the eggs from the first two being culled on 11/2/92. Eggs from the other three already having been included in a National Fisheries Research Center (NFRC) Seattle study group before identification - were kept in Dworshak's production.

The proposed combined target for the Dworshak-Kooskia Complex was initially 1,700 adults (2.5 million green eggs), or 680 females assuming a fecundity of 3,750 eggs per female. Adults were transferred from Kooskia to Dworshak several times from June through September. The run peaked in late May and early June at Kooskia when 220 were transported to Dworshak, and in mid to late June at Dworshak, with 280 of the 369 total returning Dworshak adults on station by 6/29/92. The July to August segment of the Dworshak run was, for -all practical purposes, nonexistent, with only 31 fish being brought across Dworshak's table on August 25.

Table 2. Hatchery returns and age composition of Spring Chinook Salmon to Dworshak-Kooskia Complex.

Year	1-salt	2-salt	3-salt	Unmeasured	Total Returns
1984	14	52	16	0	82
1985	13	281	35	5	334
1986	78	346	91	0	516
1987	25	1,064	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	26	175	422	9	632
1992	36	525	78	42	681

Table 2 illustrates the drastic reduction in returns for the past two brood years (BY 1991 and 1992) compared with the four years preceding.

The male to female chinook ratio was not determinable when the fish first came across the sorting table because of lack of development of secondary sex characteristics. However, during the weeks of spawning, the male and female numbers became apparent. Out of 681 fish, 327 (48.0 percent) were males and 331 (48.6 percent) were females (23 were undetermined - 3.4 percent), yielding a male to female ratio of essentially one to one.

Pre-spawning Summary

Returning brood stock were anesthetized with Tricking Methane sulfonate (MS222) buffered with sodium bicarbonate, sexed, measured, and inoculated with erythromycin Phosphate (20 mg/kg body weight) before being sent to a holding pond. The fish were injected in the dorsal sinus with 20 mg/kg body weight. While a 40 mg/kg rate of injection is recommended, this lower rate was used because a new base, polyethylene glycol, was used for the first time and so caution was exercised.

The adults were also treated three times weekly with a one-hour, 150 mg/l ow-through formalin treatment from 6/2/92 through 8/17/92. Adult mortality .was removed daily, with sex, size, jaw tag numbers, and fin clips being recorded. Most adults received a second injection of erythromycin phosphate. Adults which returned within a week of the first spawning day did not receive an injection. Adults returned from Kooskia were put into Holding Pond 1 and kept separate from Dworshak returns in Holding Pond 2.

Pre-spawning losses totaled 124 fish (19.4 percent) of the 640 fish (Dworshak, 328; Kooskia, 312) on station by 8/26/92 (Table 3).

Table 3. Pre-spawn mortalities - SCS Brood Year 1992.

	Dworshak	Kooskia	Total
Males	24	27	51
Females	5	43	48
Sex Unknown	2	23	25
Total Numbers	31	93	124
Percent Mortality	9.5	29.8	

Kooskias higher losses probably indicate problems with injecting adult SCS with erythromycin under the warm water conditions (up to 750F) that prevailed at Kooskia for part of the holding period. Also, 12 fish were lost using a newly installed floating weir; the floating design replacing an older electric weir. Total mortality for the Complex, both pre-spawning and during spawning, was 159 fish (23.3%). Fungus was a problem in holding fish, with formalin treatments not controlling fungus as well as malachite.

Ten males and 10 females from Kooskia stock were released into Clear Creek above Kooskials intake on August 25.

Spawning Summary

Seven egg takes were accomplished for this brood year, starting August 19 and ending September 11 (Table 4). Two hundred thirty-one (231) females were spawned; 138 from Dworshak returns and 93 from Kooskia returns. 'A total of almost 900,000 green eggs were taken and, judging by the general look of the eggs through October, eye-up should approach historical averages of over 90 percent. Kooskia eggs were incubated with one spawn per individual Heath tray. Only Kooskia eggs were enumerated for eye-up this year. Dworshak eggs were incubated individually in colanders for a NFRC study on low-BKD offspring. Dworshak's egg counting equipment is geared for large takes of 50800,000 eggs, not for counting individual takes of 3-4000 eggs each. As the table below indicates, Dworshak stock fecundity is presumed to be 3,750 eggs per female.

Table 4. Spawning summary - BY 1992 Spring Chinook Salmon.

Take	Take Date	Number Spawned M	F	Green Eggs	Eyed Eggs	Eye-Up Enum egg%	Eye-up Total egg%	Eggs[1] per Female	Eggs Culled Grn	Eyed
Dworshak Returns:										
1	8/19	0	0	na	na	na	na	na	0	0
2	8/25	18	29	108,750	na	na	na	3750	3750	0
3	8/28	30	30	112,500	na	na	na	3750	3750	0
4	9/01	33	33	123,750	na	na	na	3750	0	0
5	9/04	12	12	45,000	na	na	na	3750	0	0
6	9/08	27	30	112,500	na	na	na	3750	0	0
7	9/11	4	4	15,000	na	na	na	3750	0	0
		124	138	517,500	na	na	na	3750	7500	0
Kooskia Returns										
1	8/19	9	9	37,786	33,250	88.0	88.0	4198	0	0
2	8/25	35	43	173,794	168,250	96.8	96.8	4042	0	0
3	8/28	13	13	51,730	47,500	91.8	91.8	3979	0	0
4	9/01	20	20	73,570	71,500	97.2	97.2	3678	0	0
5	9/04	8	8	27,600	26,250	95.1	95.1	3450	0	0
6	9/08	0	0	na	na	na	na	na	0	0
7	9/11	0	0	na	na	na	na	na	0	0
		85	93	364,480	346,750	95.1	95.1	3919	0	0

[1] Note that only KK eggs were enumerated so all data are estimates (except for numbers spawned.

Eight thousand (8,000) eyed eggs from Kooskia adults were from high-BKD parentage and so were moved into Dworshak's production, to be reared with other high-BKD offspring.

After Take 5 the adults were combined into one adult holding pond. Eggs from the two hatcheries were incubated and tracked separately to ensure that fish to be returned to Kooskia in April 1993 are from Kooskia returning adults. it should be noted that it is almost impossible to ensure complete separation of stocks. Adults being returned to holding ponds occasionally

jump from Holding Pond 2's return chute to Holding Pond l's. This resulted in several Dworshak returnees being held with and spawned as Kooskia adults. Fish are also left inadvertently in the small crowding channel at times, winding up being spawned with adults from another pond. These occasional intermixtures of stocks need to be recognized in dealing with the questions of total returns to each hatchery, sex ratios, genetic separation, and in accounting procedures. The possibility of intermixing will continue to occur unless improved holding conditions are available at Kooskia which would eliminte future transfer of Clear Creek stock to Dworshak.

Table 5 summarizes a few details of Brood Year 1992 and compares it with a 5year average.

Table 5. Comparison of BY 1992 spawning with 5-year average. Spring Chinook Salmon.

Brood Year	Adult Return[1]	Fmls. (%)	Green Eggs	Eggs /Fml.	Eye-up (%)	II-salt (%)
1987	2,704	59.3	4,075,666	3,526	92.5	82.1
1988	2,567	52.6	4,890,970	4,615	96.0	36.3
1989	2,673	48.7	3,516,306	3,701	92.8	76.3
1990	3,183	54.9	4,833,104	3,623	94.2	88.4
1991	632	51.9	995,842	4,117	89.0	27.7
5yr Average	2,781	53.5	3,662,378	**3,916**	92.9	**62.2**
1992	681	53.2	881,980[2]	?	?	82.2

[1]Includes trap mortalities and strays from other hatcheries.
[2]Estimate.

Several cooperating agencies had personnel in the spawning area collecting tissue, sperm, or egg samples. The University of Idaho (Aquaculture) took liver and hear@ samples for DNA extractions. The NFRC-Seattle 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.

Rapid River Eggs

Another 928,000 eyed eggs were received in four shipments from Rapid River Fish Hatchery (Table 6). Eggs were placed into incubator stacks for hatching and swim-up. These fish will be kept in a separate lot and should enable Dworshak to fully meet its production goal of a 1.1 million smolt release in Spring 1994. This presumes no BKD problems arise in this lot due to the fact that 61 percent were from high- and presumed high-BKD adults.

Table 6. Egg shipments from Rapid River Fish Hatchery.

Shipment Number	Date	==Egg Numbers by Parental BKD Level=== Low	Medium	High	PresumedHI	Total
1	10/2/92	101,500	69,500	205,000	0	376,000
2	10/6/92	0	0	0	198,605	198,605
3	10/7/92	67,676	77,264	83,587	0	228,527
4	10/8/92	0	41,466	49,290	34,461	125,217
		169,176	146,764	337,877	233,066	928,349

It should be mentioned that the large numbers of high and presumed-high eggs resulted because of many adults not actually having been tested for BKD and because of multiple-spawn incubation.

Spawning Procedures

Spawning procedures were basically those of previous years, and were accompanied by additional extensive health lab sampling for IHNV and BKD.

On a given spawning day all adults were anesthetized with MS-222 (buffered with sodium bicarbonate with oxygen addition) and checked for ripeness. Males were sent directly to the spawning table while 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 unnecessary males. To facilitate record-keeping, spawned adults were identified with numbered, stainless steel pins for later culling and segregation due to disease status. Sperm was collected in styrofoam cups and kept on ice in a cooler until used. Females were cut and eggs collected in pre-iodinated colanders to drain ovarian fluid. Gametes from both males and females were then combined and mixed by hand with the addition of a small amount of water to aid dispersion of the milt.

After two minutes, the fertilized eggs were thoroughly rinsed before the eggs were put into incubator stacks. Crosses were made between one male and one female, with an occasional exception when not enough males were available. This resulted in a male to female spawning ratio of 1.0 to 1.1.

Aseptic procedures were used throughout the entire spawning period to prevent possible cross-contamination of IHNV positive parents or high-BKD parentage, or contamination of health lab sampling equipment. Males, however, were not iodophored because of concerns over extra iodophor dripping into the sperm. Iodophor solutions of 500 mg/l and 250 mg/l were used to disinfect equipment and workers, hands. Fertilized eggs were placed in individual Heath trays or individual colanders, and allowed to water harden for 30 minutes in iodophor (75 mg/1) buffered with sodium bicarbonate.

Adult Disease Sampling

Dworshak Fish Health Center (DFHC) sampled spawned adults extensively for BKD, IHNV, and other diseases, with Table 7 outlining the disease sampling regimen generally followed this year. Spleens from males and ovarian fluids from females were checked to determine IHNV

status. BKD levels were determined solely by the ELISA method.

Table 7. Fish health sampling - SCS Brood Year 1992.

Disease	Dworshak Males	Dworshak Females	Kooskia Males	Kooskia Females	Rapid River Males	Rapid River Females
BKD	100%	100%	100%	100%	Sub.	100%
IHNV	Sub.	50-100%	Sub.	100%	Sub.	Sub.
Other	20-25/spawn		20-25/spawn		Sub.	Sub.

Sub. = subsample

ELISA tests were run on Dworshak adults by the NFRC-Seattle personnel. BKD segregation for egg lots was based on ranges given in Table 8, using ELISA values only from female parents. This assumes, as the literature and onstation observations indicate, that the BKD status of the female should carry more weight than that of the male in the designation of the offspring. All fish involved in the low-BKD segregation study were from adults which both tested below 0.1 ODUS.

Table 8. BKD levels in Dworshak/Kooski-a SCS as defined by optical density units.

BKD Level	Optical Density Units Range
Negative	0.000 - 0.099
Low	0.100 - 0.249
Medium	0.250 - 0.449
High	0.45 and above

High-BKD parentage eggs were not culled this year as was generally done in the past because of the shortage of eggs. High-BKD offspring will be reared as isolated as possible from other fish lots, using separate cultural utensils, low densities, feeding erythromycin feed twice, as well as any other cultural device or method to minimize stress in this group as well as minimizing risks to other fish lots.

IHN incidence in adult chinook sampled this year was fairly low at 4.2 percent (Table 9), compared with 3.6 percent for BY 1991.

Table 9. IHN incidence in sampled adults - BY 1992 SCS.

		===Adults Sampled===			======IHN Positive Adults======= --Males--		-Females-		--@Totals--	
TK	DATE	Males	Females	Total	No.	%	No.	%	No.	%
1	8/19	10	9	19	0	0	1	11.1	1	5.3
2	8/25	38	73	111	0	0	4	5.5	4	3.6
3	8/28	29	43	72	1	3.4	0	0	1	1.4
4	9/01	35	53	88	1	2.9	0	0	1	1.1
5	9/04	31	20	51	1	3.2	3	15.0	4	7.8
6	9/08	27	30	57	4	14.8	2	6.7	6	10.5
7	9/11	4	5	9	0	0	0	0	0	0
		174	233	407	7	4.0	10	4.3	17	4.2

Note that not all spawned adults (209 M, 231 F) were sampled and that not all sampled adults were necessarily spawned.

source: Monthly Activity Report DFHC 921028

Disease sampling proved negative for IPN, VHS, furunculosis, Myxpbolus spp., and EIBS. Five of 145 samples proved positive for ERM (3.4 percent), and 35 percent of samples tested positive for Ceratomvxa shasta.

Incubation- Tanking

All spawns from Kooskia stock were individually incubated in Heath trays, while Dworshak spawns were incubated in colanders. Large Dworshak spawns were split to two colanders. Incubation temperatures were kept at 52OF or below. After eye-up Kooskia eggs were shocked, picked, counted, and put back in trays at 5,000 per tray. Dworshak eggs were shocked, hand picked, then transferred to individual Heath trays so that tracking of individual females was accomplished. Strategy for this year was to tank the fry when 50 to 75 percent reached swim-up in the trays.

Incubating eggs were given a 15-minute 1,667 mg/l formalin treatment three times each week. Once the eggs were sufficiently eyed, dead and fungused eggs were regularly picked out of all trays. Egg shells were also consistently removed from trays to ensure proper water flow. These procedures helped survival to both the eyed egg and swim-up stages, with Kooskia stock attaining a . 95.1 percent eye-up. Eye-up data for Dworshak SCS will not be available until first inventorying at marking in June 1993. Single spawn incubation for the NFRC-Seattle study prevented the mass picking and enumeration that is the normal procedure at Dworshak.

Swim up fry were tanked when 50 to 75 percent of the fry in a tray reached the button-up stage. Loadings generally ranged from 19,000 to 29,000 fish per tank with and overall average of around 26,000 fish. Sixty-three (63) tanks were filled with fry from Kooskia, Dworshak, and

from Rapid River stocks. Fish groups were segregated by BKD incidence (low, medium, high, and presumed high). All high-BKD fish from Kooskia spawns (about 8,000 fish) were transferred into Dworshak's production.

Special Studies

An experiment being conducted in cooperation with the NFRC-Seattle will examine the effect of release timing on the health, smolt development, and migration of spring chinook salmon, reared at Dworshak. Only the offspring from adults ELISA-certified to be essentially negative-BKD are to be used in the study. Negative was defined as an ELISA reading of less than approximately 0.07 ODUS. After testing was completed, the study had enough negative spawns for 12 tanks, each containing the offspring from eight females (approximately 28,000 eggs). Several spawns not needed in the study were merged into the other production groups.

When these fish are ponded, only nine of the 12 groups will be used. Three replicates for each of three release groups will result. These fish will be reared with slight differentials in growth so that all fish will be released on three different dates in 1994 at similar sizes. Between 200-250,000 fish will be involved in the study at time of release.

Production Program objectives

Approximately 1.44 million chinook smolts should result from the 1.77 million eyed eggs incubated at Dworshak (Table 10). This assumes a survival from eyed eggs through released smolt of just over 81 percent, which is the past five brood years average survival. A total of 1.15 million smolts would be available from Dworshak's production program, with another 296,000 produced at Kooskia. Probable numbers for transfer and release are presented in the following schedule:

Table 10. Program proposal - Spring Chinook Salmon Brood Year 1992.

Program (Egg Source)	Number at Rls/Transfer	Type of Rls/Transfer	FPP at Rls/Transfer	Date of Rls/Transfer
Dworshak (Dworshak) (0.481M eyed)	391,000	Smolt	18.0	Apr 94
Dworshak (Rapid R.) (0.928M eyed)	755,000	Smolt	18.0	Apr 94
Kooskia (Kooskia)	(311,000)	Fnglng from DW	250	Apr 93
'(0.364M eyed)	296,000	Smolt	18.0	Apr 94
		objectives based on appx. mortality of:		
		Eyed to ponding	= 14%	
Total Smolts	1,442,000	Ponding to release	= 5%	

Acknowledgement is respectfully given to Dworshak Fish Health Center for their fish sampling efforts and reporting of results, to the National Fisheries Research Center - Seattle for ELISA data, to the Kooskia staff for collection and transfer of Clear Creek stock, to the Idaho Fishery Resource Office for providing age class, sex ratios, and run summary data, to the Dworshak Production crew for performing the fish culture techniques in a professional manner, and to the Dworshak Maintenance crew and Administrative staff in helping in maintenance, operation, and production duties.

APPENDIX III

Brood Year 1992 Production Program Review
Dworshak National Fish Hatchery

Prepared: September 15, 1994

PROGRAM REVIEW
Spring Chinook Salmon - Brood Year 1992
Dworshak NFH

Report covers adult returns and egg collection of summer 1992 through rearing and final release of yearling smolts in May 1994.

Adult collection and holding

Dworshak's ladder was open to collect returning adult spring chinook salmon from May **22** until September 11, 1992, while Kooskia kept-its trap functional from May 9 through August 28. **A** total of 681 adult SCS returned to the complex this year, with **312** back to Kooskia and 369 back to Dworshak (Table 1). On 8/6/92 tribal, state, and federal personnel angled for SCS adults at the mouth of Dworshak's ladder in an effort to collect additional broodfish. Fifteen adults were caught and put into Holding Pond 9. As in years past, II-salt adults predominated, making up 77 percent of all returns. A limited salmon season was opened on the Clearwater River in early Jun6 with only adipose-clipped fish allowed to be caught. Fishing success was very poor with few fishermen on the river.

Table 1. Age Structure Summary - SCS Adults Brood Year 1992.

	Kooskia NFH	Dworshak NFH	Totals
I-ocean	14	22	36 (5.3 %)
II-ocean	239	286	525 (77.1 %)
III-ocean	38	40	78 (11.4 %)
Unmeasured	21	21	42 (6.2 %)
Totals	312 (45.8%)	369 (54.2 %)	681

Ten males and 10 females from Kooskia stock were released into Clear Creek above Kooskials intake on August 25.

The male to female chinook ratio was not determinable when the fish first came across the sorting table because of lack of development of secondary sex characteristics. However, during the weeks of spawning the male and female numbers became apparent. Out of 681 fish, 327 (48.0 percent) were males and 331 (48.6 percent) were females, with 23 (3.4 percent) of indeterminate sex.

Table 2 illustrates the drastic reduction in returns for Brood Years 1991 and 1992 compared with the years preceding.

Table 2. Hatchery returns and age composition of Spring Chinook Salmon to Dworshak-Kooskia Complex.

Year	1-salt	2-salt	3-salt	Unmeasured	Total Returns
1984	14	52	16	0	82
1985	13	281	35	5	334
1986	78	346	91	0	516
1987	25	1,064	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	26	175	422	9	632
1992	36	525	78	42	681

Pre-spawning losses totaled 124 fish (19.4 percent) of the 640 fish (Dworshak, 328; Kooskia, 312) on station by 8/26/92 (Table 3).

Table 3. Pre-spawn mortalities - SCS Brood Year 1992.

	Dworshak	Kooskia	Total
males	24	27	51
Females	5	43	48
Sex Unknown	2	23	25
Total Numbers	31	93	124
Percent Mortality	9.5	29.8	

Kooskias higher percentage losses were apparently from injecting adult SCS with erythromycin under the warm water conditions (up to 750F) that prevailed at Kooskia for part of the holding period. Total mortality was 159 fish, or 23.3 percent of the total Kooskia return. Fungus was a problem in both groups of fish, with formalin treatments not controlling fungus as malachite did.

Spawning and incubation

Seven egg takes were accomplished for this brood year, starting August 19 and ending September 11 (Table 4). 231 females were spawned, 138 from Dworshak returns and 93 from Kooskia returns. Nearly 900,ObO green eggs were taken and, judging by the general look of the eggs at October's end, eye-up approached historical averages of over 90 to 95 percent.

Table 4. Spawning summary - BY 1992 Spring Chinook Salmon.

Take	Take Date	Number Spawned M	F	Green Eggs	Eyed Eggs	Eye-Up Enum egg%	Eye-up Total egg%	Eggs[1] per Female	Eggs Culled Grn	Eyed
Dworshak Returns:										
1	8/19	0	0	na	na	na	na	na	0	0
2	8/25	18	29	108,750	na	na	na	3750	3750	0
3	8/28	30	30	112,500	na	na	na	3750	3750	0
4	9/01	33	33	123,750	na	na	na	3750	0	0
5	9/04	12	12	45,000	na	na	na	3750	0	0
6	9/08	27	30	112,500	na	na	na	3750	0	0
7	9/11	4	4	15,000	na	na	na	3750	0	0
		124	138	517,500	na	na	na	3750	7500	0
Kooskia Returns										
1	8/19	9	9	37,786	33,250	88.0	88.0	4198	0	0
2	8/25	35	43	173,794	168,250	96.8	96.8	4042	0	0
3	8/28	13	13	51,730	47,500	91.8	91.8	3979	0	0
4	9/01	20	20	73,570	71,500	97.2	97.2	3678	0	0
5	9/04	8	8	27,600	26,250	95.1	95.1	3450	0	0
6	9/08	0	0	na	na	na	na	na	0	0
7	9/11	0	0	na	na	na	na	na	0	0
		85	93	364,480	346,750	95.1	95.1	3919	0	0

[1] Note that only KK eggs were enumerated so all data are estimates (except for numbers spawned.

The reason accurate statistics for Dworshak and for overall data were not provided this brood year is due to the fact that Dworshak eggs were not enumerated. Spawns from adults returning to Dworshak were incubated, shocked, and picked individually for a NFRCS (NBS) study requiring low-BKD offspring. Dworshak's egg counting equipment is geared for large takes of 50-800,000 eggs, not for counting individual takes of 3-4000 eggs each. The individual

incubation required picking all dead eggs by hand from these spawns. The spawns were not enumerated because of the time this would have required. Instead, they were simply assumed to average 3,750 green eggs per female. The first real inventory of Dworshak stock occurred later on in the production program when ad-clip and CWT marks were given to the fish.

Five spawned females were identified as Looking Glass stock, with the eggs from the first two being culled on 11/2/92. Eggs from the other three, already having been included in the NFRC study group before identification, were kept in Dworshak's production.

As indicated by Table 5, total egg numbers were considerably below the previous 5-year running average, although the total approximated Brood Year 1991 eggs taken.

Table 5. Comparison of BY 1992 spawning with 5-year average. Spring Chinook Salmon.

Brood Year	Adult Return[1]	Fmls. (%)	Green Eggs	Eggs /Fml.	Eye-up (%)	II-salt (%)
1987	2,704	59.3	4,075,666	3,526	92.5	82.1
1988	2,567	52.6	4,890,970	4,615	96.0	36.3
1989	2,673	48.7	3,516,306	3,701	92.8	76.3
1990	3,183	54.9	4,833,104	3,623	94.2	88.4
1991	632	51.9	995,842	4,117	89.0	27.7
5yr Average	2,781	53.5	3,662,378	**3,916**	92.9	**62.2**
1992	681	53.2	881,980[2]	?	?	82.2

Actual spawning procedures were basically those of previous years, and were accompanied by additional extensive health lab sampling of spawned fish for IHNV and BKD. For specific procedures used, please refer to the "Spring Chinook Spawning Report - Brood Year 19§2'.

Single incubation was used to segregate and track offspring by female parentage IBKD status' (low/medium/high), using optical density unit (ODU) ranges measuring the presence of Renibacterium salmoninarum as presented in Table 6.

Table 6. Levels of R. salmoninarum in Dworshak/Kooskia SCS as defined by optical density units.

BKD Level	Optical Density Units Range
Negative	0.000 - 0.099
Low	0.100 - 0.249
Medium	0.250 - 0.449
High	0.45 and above

Rapid River Eggs

Another 928,000 eyed eggs were received in four shipments from Rapid River Fish Hatchery (Table 7). These eggs were placed into incubator stacks for hatching and swim-up. These fish

were kept in a separate lot towards meeting a production goal of 1.1 million smolt release in Spring 1994. This assumed no BKD problems would arise in this lot due to the fact that 61 percent were from high- and presumed high-BKD adults.

Table 7. Egg shipments to Dworshak NFH from Rapid River Fish Hatchery.

Shipment Level=== Number	Date	==Egg Numbers by Parental BKD Low	Medium	High	PresumedHI	Total
1	10/2/92	101,500	69,500	205,000	0	376,000
2	10/6/92		0	0	0	198,605
3	10/7/92	67,676	77,264	83,587	0	228,527
4	10/8/92		0	41,466	49,290	34,461
	125,217	169,176	146,764	337,877	233,066	928,349

It should be mentioned that the large numbers of high and presumed-high eggs resulted because of many adults not actually having been tested for BKD and because of multiple-spawn incubation.

Incubation temperatures were maintained.at 52'F or below. Incubating eggs were given a 15-minute 1,667 mg/l formalin treatment three times each week. After eye-up the eggs were shocked, picked, and put back in trays. Kooskia spawns were enumerated at 5,000 eggs per tray, while Dworshak spawns were simply hand-picked and put into trays at one female's eggs per tray. Fry were tanked when 75 percent had reached the swim-up stage in the trays.

Nursery Rearing

Initial tank loadings generally ranged from 19,000 to 29,000 fish per tank, with an overall average of around 26,000 fish per nursery tank. 63 tanks were filled with fry from Kooskia, Dworshak, and from Rapid River stocks. Fish groups were segregated by BKD incidence (low, medium, high, and presumed high). All high-BKD fish from Kooskia spawns (about 8,000 fish) were transferred into Dworshak's production. Medium- and low-BKD fry from KK adults were tanked separately so they could be transferred to Kooskia later in the production cycle. Tanking of these fry was finished by midNovember, with the average first day of feeding for the lot being 11/12/92. Total Dworshak, Kooskia, and Rapid River fish at swim-up numbered 1,687,855, providing a 96.3 percent survival from eyed eggs.

These fish performed quite well in the nursery, with no health problems manifesting themselves. No treatments of any kind were necessary and survival from tanked fry to ponded fingerlings was 93.4 percent, slightly above the five-year running average of 91.6 percent (Table 8).

Table 8. Survival summary - SCS Brood Year 1992 vs. 5-year average.

Percent Surviving from Previous Stage					Cumul.	Cumul.	Cumul.
					GRN>smlt	EYD>smlt	TANK>smlt
BY	EYDegg	TANKfry	PONDfing	RLSDsmlt	Survival	Survival	Survival
1987	92.5	86.2	97.4	93.8	72.8	78.8	91.4
1988	96.0	93.9	76.5	93.0	64.1	66.8	71.1
1989	92.8	94.2	89.2	96.5	75.2	81.1	86.1
1990	94.2	98.2	95.6	97.2	86.0	91.3	92.9
1991	89.0	96.1	99.3	96.9	82.3	92.5	96.2
AVG.	92.9	93.7	91.6	95.5	76.1	82.1	87.5
1992	96.4	96.3	93.4	97.9	84.9	88.1	91.4

Note: Data are only for SCS reared entirely at Dworshak NFH.

Source: SRSM92SC.wkl - RV 09/01/94

one observation that should be mentioned was the higher early mortality rates in Dworshak stock offspring. December 1993 through March 1994 monthly losses ranged from 0.58 to 2.73 percent for this group of fish, compared with mortality rates of only 0.28 to 0.77 percent experienced by Kooskia stock. The Dworshak stock eggs had been eyed-up in colanders with a 3/4 gpm upwelling water supply, a set-up suspected for some time of providing poorer water circulation than the Heath incubator trays used for Kooskia stock eggs. While not proven, the higher losses in Dworshak fish may have simply been due to the chronic effects of earlier, but unapparent, oxygen deprivation during colander incubation.

Other than this minor problem, the chinook performed well in nursery rearing, with overall relatively low mortalities and with monthly growth increments of 0.20 to 0.41 inches per month (Table 9).

Table 9. Production Data - SCS Brood Year 1992.

	End of Month				Monthly		
	Numbers	Weight	FPP	L (in.)	Growth(in)	Mort.	Temp*0 F*
11/92	1,673,071	1,114	1,501	1.30	0.07	0.90	50.9
12/92	1,656,813	1,708	1,004	1.50	0.20	1.84	44.3
01/93	1,647,082	2,625	627	1.74	0.24	0.62	41.5
02/93	1,640,471	4,001	410	2.01	0.26	0.41	40.5
03/93	1,626,224	5,493	296	2.24	0.23	0.79	40.8
04/93	1,327,793[1]	7,418	179	2.65	0.41	0.71	41.5
05/93	1,298,042	11,483	113	3.09	0.44	0.81	44.0
06/93	1,329,763[2]	14,424	92.2	3.30	0.21	0.07	46.0
07/93	1,324,860	18,732	70.7	3.61	0.31	0.10	51.8
08/93	1,323,286	24,942	53.1	3.97	0.36	0.12	52.3
09/93	1,319,872	26,773	49.3	4.07	0.10adj.	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
01/94	1,307,318	55,101	23.7	5.19	0.19	0.07	41.3
02/94	1,306,568	62,406	20.9	5.41	0.22	0.06	40.5
03/94	1,278,553	73,062	17.5	5.74	0.33	0.05	41.1
04/94	74,758	4,681	16.0	5.92	0.18	0.02	42.2
Rlsd.	1,302,687	75,386	17.3	5.77			

[1] Transferred 304,861 fish to Kooskia

[2] Inventory gain

Approximately half of the 1.63 million chinook fingerlings in this brood year were transferred to outdoor raceways during April. 520,000 of these were incorporated into an erythromycin study comparing the efficacy of two carriers (Aquamycin vs. Gallimycin). Another 225,000 chinook in nine raceways were involved in a study conducted in cooperation with the National Fisheries Research Center - Seattle (NFRC-S) examining the effects of time of release on smolt development, migration rates, and return rates. The first of two erythromycin feeding was initiated for all study and nonstudy fish groups on April 27. In addition to the two carrier groups being compared, two additional groups (eight raceways) were involved in 21 versus 28 day feedings of medicated (erythromycin) feed.

A total of 304,861 Kooskia stock chinook were transferred from Dworshak's nursery to Kooskia NFH on April 7 - 9, 1994. The total weight of transferred fish was 1,379 pounds (244.6 FPP) and mean length was 2.39 inches.

Ponding of BY 1992 SCS was completed in May, during which month erythromycin feed trials were also completed. Over 30,000 chinook were ponded in BP49 to keep C-bank loadings it 30,000 fish per rearing unit. Fish marking (ad-clipping, coded wire tagging, and freeze branding) was begun in early June and completed in mid-July. All fish received an adipose fin clip while additional marks (coded-wire tags, freeze brands) were given to groups of fish involved in experiments and -field trials.

The final number of fish from the inventory was 3,460 less than the final number of fish from the

books. This 0.3 percent difference is similar to recent years, and indicates accurate and consistent first inventories as the fish are moved from the nursery tanks to the raceways. Marking was done in conjunction with splitting to final rearing densities.

Chinook growth in raceways during summer 1993 varied somewhat from month to month, with April and may growth increments over 0.4 in while June through August growths ranged from 0.1 to just over 0.3 (Table 9). These later reduced growth rates were due to both colder water periods in June (46'F) and July (51.8') and to a deliberate attempt to slow growth. In early June the lot was well ahead of target length and so was put on a 5-day on/2-day off feeding regime. Concerns about keeping Dworshak's SCS smolt release size within the range of 18 to 20 fish per pound prompted the reduced feeding rates. Cold water releases from Dworshak Reservoir aided this attempt to restrict growth. August "growth' of 0.1 in was partially due to data handling errors.

On September 21 the spring chinook fingerlings were put back on a seven day feeding schedule to accommodate the second feeding of erythromycin medicated feed.

Low body fat levels were observed on fish sampled by the Dworshak FHC during September 1993 prior to the increase in the feeding rate at the end of that month. Subsequent discussions were held involving the Fish Health Center, Idaho Fisheries Resource Office, and the hatchery regarding average growth rates for Dworshak's spring chinook program. An analysis of the program indicated the 0.26 inches per month growth averaged for the 17 month program was only 80 percent of what manufacturers' recommended growth rate (and feeding rate) would be. The Dworshak Hatchery Evaluation Team is attempting to determine what effect this has on fish quality, and what criteria need to be routinely monitored to ensure good smolt quality of the chinook when they are released. While clear answers to these questions require long-term analysis, an interim solution to the sub-optimal feeding was to feed this brood year of SCS at 90 percent of manufacturers' recommended rates. While this resulted in the average smolt size being greater than 18 FPP, it also led to more appropriate body fat levels.

Average mortality increased from 0.26 percent in September to 0.51 percent in October. This increase was attributed to a substantial loss in BP49 (12.61 percent) due to an outbreak of Ich (Ichthvophthirius spp.) the last week of September. Ich problems were not necessary for any chinook reared in raceways.

Performance of these fish continued to be quite satisfactory from October 1993 through release in April 1994, as indicated above in Table 9. Feeding continued at 90 percent of manufacturers recommended feeding rates, which produced an average smolt size of 17.3 FPP. Mortality rates remained subdued, well under 0.5 percent. Signs and clinical indications of EIBS were absent, and pre-release BKD symptoms also remained low.

PIT tag marking of this brood year was conducted by Biomark (Scott McCutcheon) from February 22 through March 1, with 2,000 fish from each of the nine release study raceways (18,000'fish) and 150 from each of the sixteen erythromycin study raceways (2,400 fish) receiving tags.

In March personnel from the Columbia River Field Station of the National Biological Service (NBS) - Seattle took tissue samples and morphometric measurements of the chinook involved in the serial release study. The nonlethal sampling of gill tissues for ATPase measurements allowed these fish to be placed back into rearing units. Reflectance values were taken using digital imaging, a technique which is proving to offer consistent, objective measures of this

smolting criterium.

The National Marine Fisheries Service (NMFS) received a total of 24,414 SCS from two rearing units during March. These fish were to be used to test the fish bypass facilities at McNary and Lower Monumental Dams.

Cumulative survival through release was 84.9 percent (Table 8), considerably above the 76.1 percent average of the preceding five brood years and almost three percent above BY 1991's 82.3 percent. Several factors may have played a role in Brood Year 1992's excellent quality smolts: 1) erythromycin injection of adults, 2) BKD egg segregation, 3) two prophylactic feedings of erythromycin, 4) medium densities of chinook during rearing, averaging just over 30,000 fish per raceway compared with historical densities of 45,000 fish per-raceway, and 5) feeding rates closer to manufacturers' recommended feeding levels.

Distribution

Scheduled releases of these spring chinook smolts went without incident and took place from April 8 through May 6 on the five days listed in Table 10 below. The additional 24,414 smolts transferred to NMFS for smolt bypass facility testing might also be considered part of the station's smolt distribution, which would result in a total of 1.30 million BY 1992 SCS smolts being released. Water flow From Dworshak Reservoir increased from 1,300 cfs to 4,500 cfs during six hour periods on April 14 and 15 at the time of the general chinook release. Reservoir flows increased from 1,300 cfs to 10,000 cfs on April 28 and to 20,000 cfs on April 29 to provide for Ismolt flushing'. These higher flows were maintained for the next several weeks to assure down-river water needs were met.

Table 10. Distribution summary - SCS Brood Year 1992 (April 8 - May 6, 1994).

Date	Water	Group	No.	Wt.	No/Lb	-Length in	mm
Serial Release Study:							
04/08/94	N.F. CLEARWTR. R.	Rels.Grp.1	69,642	4,426	15.7	5.96	151
04/22/94	N.F. CLFARWTR. R.	Rels.Grp.2	84,654	5,182	16.3	5.89	150
05/06/94	N.F. CLEARWTR. R.	Rels.Grp.3	74,500	5,471	13.6	6.26	159
General Production:							
04/14-15/94	N.F. CLF.ARWTR. R.	Production	69,642	4,426	15.7	5.96	151
Sub-Totals/averages			1,278,273	73,955	17.3	5.78	147
BVpass Test Fish:							
March 1994	NMFS (McNary, LGs)	Bypass Test	24,414	1,431	17.1	5.80	147
	Grand Total/Averages		1,302,687	75,386	17.3	5.78	147

Smolt Quality Assessment

According to Dworshak FHC BY 1992 the spring chinook released from Dworshak NFH in Spring 1994 rated excellent in terms of health, condition, and quality. Neither EIBS nor BKD were significant problems at the time. Scott McCutcheon of Biomark, Inc., who was involved in PIT tag marking several groups of these fish, stated that the chinook were"'the best looking hatchery chinook I have ever had the pleasure to handle". Monthly mortality rates preceding release were well under one percent.

Supporting these comments are the more objective data provided by Dworshak FHC in its routine assessment of smolt quality (Table 11). The 60 fish selected randomly from production raceways indicated that overall, the chinook in this brood year were of very good quality. The average condition factor was just over 4.OE-10, demonstrating good fat levels. An average mesenteric fat level of 1.8 confirmed this, as well. It should be noted this was a considerable improvement over BY 1991 when mesenteric fat averaged only 0.8. Gills were in good condition, and hematocrits averaged a satisfactory 47.5.

Table 11. Smolt assessment indices - spring chinook salmon Brood Year 1992.

System	No. Fish Sampled	Condition Factor	Hematocrit (35+=good)	Gill Condition (Normal/Swelled)	Mesenteric Fat (Scale 0 to 4)
B-bank	60	4.01E-10	47.5	93%nrml- O%swell	1.8

Source: Summary of Fish Autopsy - DFHC 04/04/94

Chemical and drug treatments

This brood year on the whole was treated in a relatively drug-free manner with only one rearing unit receiving treatment for an actual health problem. The chinook reared in BP49 were given one 30-mi-nute treatment of formalin to address an occurrence of Ich in September 1993. Burrows ponds have shown themselves to be conducive to parasite problems at Dworshak in the rearing of chinook, for which reason they are avoided when at all possible.

Erythromycin treatments were provided all SCS in this brood year as a standard prophylactic measure. Spring and fall (1993) treatments were given at a nominal 100 mg/kg/day rate for 21 and for 28 days, depending on the test group a lot of fish was in. The INAD experiment conducted during this period also investigated two different erythromycin carriers, Gallimycin and Aquamycin.

No other drug or chemical treatments were given these spring chinook salmon during their approximate year and a half rearing program at Dworshak.

BKD-ELISA Evaluation

Monitoring of Renibacterium salmoninarum levels in the chinook by Dworshak FHC began in October 1993. 30 fish from each of six specific raceways were sampled each month through smolt release. Fluorescent Antibody Testing (FAT) was used as the test procedure until the fish were large enough to test individual fish kidney tissues, at which time ELISA testing was initiated. For a summary of these procedures, data, and results the reader is referred to the report on this subject prepared by the Dworshak Fish Health Center. It might be mentioned, however, that overall levels of the causative agent of BKD did remain fairly low through the time of smolt release.

Special Studies

Serial Release Study

An experiment was conducted in cooperation with the NFRC-Seattle to examine ,the effect of release timing on the health, smolt development, and migration of spring chinook salmon" reared at Dworshak. Only the offspring from adults ELISA-certified to be essentially negative-BKD were used in the study. Negative was defined as an ELISA reading of less than approximately 0.07 ODUS. After adult testing was completed, the study had enough negative spawns for 12 tanks, each containing the offspring from eight randomly combined females (approximately 28,000 eggs). Several spawns were not needed in the study and were merged into the other production groups.

When these fish were ponded, only nine of the 12 groups were used. Three replicates for each

of three release groups resulted. The three groups were released two weeks apart from April 8 to May 6 (Table 10). Idaho FRO was also involved in this study, collecting out-migration data. The results of this study will be presented in a separate report.

Erythromycin Studies

Two INAD studies were conducted with BY 1992 chinook involving erythromycin medicated feed. Each test involved the comparison of two treatments, with each treatment group involving four raceways of chinook, or approximately 120,000 fish in each of the four treatment groups. The first test compared the on-station performance of fish fed medicated feed for 21 days with the performance of fish fed medicated feed for 28 days. The second test involved 21 day feedings of medicated feed using two different erythromycin carriers, Gallimycin (the original carrier developed originally for the poultry industry), and Aquamycin (developed for aquaculture applications).

The preliminary analysis of data does not indicate any clear difference in on-station performance between groups in either test. Mortality, growth, and overall quality of fish appeared similar. Statistical testing remains to be conducted. In addition, the out-migration and adult return data for these groups will be gathered and analyzed in the future. The reader is referred to the reports and updates that will appear communicating findings and developments regarding these two experiments.

Problems and Concerns

1. Developing and measuring proper fish quality criteria have occupied hatchery and HET efforts during the past production cycle. Meeting these criteria will occupy Hatchery Complex considerations over the next several years. Articulating and resolving some inherent conflicts between producing a top quality smolt and meeting historical/biological/political targets will further complicate this matter.

2. Intertwined with the above concern is the issue of proper feeding level for spring chinook. Recognizing that the historical production programs called (effectively) for feeding rates of 80 percent of those recommended by feed manufacturers, the current program aims to cool chinook eggs in the fall so that full feeding rates can be applied to these fish. Smolts averaging 18 to 20 FPP (historical target range) should result.

3. The most apparent immediate concern for the next two brood years (1994 and 1995) will be the lack of returning'broodstock. Hopefully, this situation will reverse or improve with time. Related to this is the issue of what eggs can and will be brought in (to Dworshak's program, anyhow). For BY 1994 there will be none available, but, if 1995 produces any local surpluses, advance discussions and agreements would certainly help avoid interagency scrapping.

4. The proper disposal, i.e. rearing, of Kooskia stock surplus to its capabilities and to its release limits should be further discussed and eventually clearly articulated. How proper is it to rear Kooskia stock at Dworshak, and to release them from Dworshak for future returns? Given the multiple stocks involved in Dworshak's current gene pool, this is not likely a grave concern.

5. Recommended erythromycin injection sites, amounts, dates, and multiples for adult spawners will hopefully be resolved by the current studies being conducted.

6. With the fish health policy currently calling for the-culling of spawns from hi-BKD

spawners, current local hatchery practice is to cull these spawns even when returning adult numbers are low, and despite the hatchery's having kept these offspring some years in recent production. Continued concerns about horizontal transmission of the disease to other production fish remains the over-riding concern.

7. The question of the efficacy of two 21-day feedings of erythromycin will hopefully be resolved by studies being conducted with BY 1993 spring chinook. The inclusion of a control group not receiving medicated feed should help in evaluating this concern.

8. Future Kooskia rearing oh station is limited to 600,000 fingerlings through the warm summer months. Clear Creek water temperatures prevent carrying additional numbers. Efforts should be made to establish Kooskials rearing capacity at the lowest number that can be safely reared a full 18 month period on station.

9. Review options of releasing additional Kooskia 'stock' smolts from Dworshak into Clear Creek, with acclimation, considering trapping efficiency is higher at Kooskia.

10. Dworshak and Kooskials total adult return needs are 1400 fish with Dworshak at 945 and Kooskia 455. Consider 'complex' needs when establishing Tribal fishery in Clear Creek as Dworshak's requirements may come from Kooskia.

File: PGRV92SC - 09/15/94