

**EVALUATION OF USING KOOSKIA NFH TO INCUBATE AND PROVIDE EARLY  
REARING FOR DWORSHAK NFH SPRING CHINOOK SALMON IN ORDER TO  
REDUCE SIZE AT RELEASE**

**BROOD YEARS 1998-2001**

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## INTRODUCTION

Spring chinook salmon production at Dworshak National Fish Hatchery (NFH) started in 1982 as part of the Lower Snake River Compensation Plan program (LSRCP). The program at Dworshak NFH calls for the rearing and release of 70,000 lbs of spring chinook salmon or about 1.4 million smolts at a size of 20 fish per pound (COE 1981). This level of production was originally estimated to be sufficient to produce a return of 9,135 adult spring chinook salmon to Lower Granite Dam, the established mitigation goal for the program at Dworshak NFH.

The first spring chinook salmon eggs were brought to Dworshak NFH in 1981 and the first smolts were released in 1983. Despite the ability of the program to meet production goals in most years, the number of adults that have subsequently returned have rarely met the mitigation goal or been adequate to provide opportunities for tribal subsistence and sport harvest. Generally, adult returns have only been adequate to meet broodstock needs. Several research and evaluation projects have been conducted at Dworshak NFH to improve production and increase adult returns. However, the success of the program has continued to be quite variable. One particular issue that has constantly been discussed and considered over the last 10 to 15 years has been smolt size at release. Dworshak NFH has always had difficulty in growing spring chinook salmon slow enough to meet the size at release target of 20 fish per pound (140 mm mean total length) without resorting to production strategies based on restricted diets. Using colder water temperatures at various stages of production has not been an option, either because of the physical constraints of the hatchery or because of conflicts with the summer steelhead production program that require using warmer sources of water in order to accelerate steelhead growth rate.

Several strategies have been used to slow the growth rate of spring chinook salmon at Dworshak NFH by manipulating feeding rates. The most common method has been to simply reduce the daily rate of feeding to a level below the manufacturer's recommendation for a given water temperature. In the past, this strategy was generally used several months prior to release. Another method that has been used more recently is that of fasting/feeding, where the fish are taken completely off feed for a period of time followed by a feeding period. While these and other methods that employ manipulation of feed can be generally successful in terms of helping to meet the size at release criteria, the quality and general health of the fish have been questioned. Recent literature indicates that one factor important in the process of smoltification prior to release is growth rate. Accelerated growth rate several months prior to release results in better emigration performance after release (Beckman *et al.* 1998). Using production strategies such as fasting/feeding to reduce growth rate of juvenile spring chinook salmon have to be used with great prudence and understanding in order not to interfere with proper physiological development.

In light of the concern over fish quality and health, the Dworshak Hatchery Evaluation Team reviewed the Dworshak NFH spring chinook salmon rearing program to identify possible ways to reduce growth rates and meet the targeted release size without having to resort to restricting feed. The most logical way to reduce growth rate with fish is to reduce rearing water temperatures and hence metabolism. The Team found no acceptable alternatives at Dworshak NFH that would not compromise the summer steelhead production program. However, after

considering the facilities at Kooskia NFH, it became apparent that the colder water temperatures at this facility during incubation and early rearing might solve the problem. Incubation temperatures at Dworshak NFH usually range between 45 and 48 °F, resulting in the early egg takes beginning to hatch in late November or early December. Incubation temperatures at Kooskia NFH can be as low as 38 °F, delaying hatching until late March or early April. If the eggs for the Dworshak NFH spring chinook salmon program could be incubated at Kooskia NFH until hatching and then returned to Dworshak NFH for final rearing, the delay in hatching might be sufficient to allow programmed growth at recommended feeding levels and still meet the size at release criteria.

After a detailed analysis of available incubation space and water at Kooskia NFH, the Team concluded that Kooskia NFH had the ability to incubate nearly 2.025 million eggs. However, space was available to tank only 1.6 million fry. In 1998, the Dworshak Hatchery Evaluation Team recommended to the Complex Manager and Project Leaders that all Dworshak NFH BY98 spring chinook salmon eggs be shipped to Kooskia NFH for final incubation after initial incubation and eye-up (Dworshak HET 1998, Appendix I). To date, Dworshak NFH spring chinook salmon brood years 1998, 1999, 2000, and 2001 have been incubated at Kooskia NFH and then shipped back to Dworshak NFH for the remainder of the production cycle and release.

The objective for the project was to delay the hatching date and slow growth sufficiently so that smolts are released at an size no larger than 20 fpp without reducing the recommended rate of feeding. This report is a summary evaluation of the success of that strategy for brood years 1998 to 2001.

## PRODUCTION HISTORIES

Production histories were summarized from Dworshak NFH and Kooskia NFH annual reports, monthly production narratives, monthly inventory summaries, and various Idaho FRO and hatchery data files.

### Brood Year 1998

After eye-up and enumeration, Dworshak NFH had about 1,366,820 spring chinook salmon eggs for their program. They were shipped to Kooskia NFH during October and November 1998 (**Table 1**).

**Table 1.** Date and numbers of brood year 1998 spring chinook salmon eggs from each spawning take that were shipped to Kooskia NFH for final incubation and tanking (Dworshak NFH 1999).

Date Shipped 1998	Spawning Take	Number of Eyed Eggs Shipped
October 7	1	151,088
October 5	2	293,830
October 16	3	231,286
October 22	4	424,985
October 23	5	92,041
October 28	6	97,226
October 28	7	49,128
November 3	8	25,000
November 10	9	2,236
<b>Total</b>		<b>1,366,820</b>

At Kooskia NFH, the eggs were recounted and disinfected. The inventory was slightly higher than the numbers reported by Dworshak NFH (**Table 2**). Trays were loaded with about 5,000 eggs each. With 15 trays per stack, a total of 27 stacks were used. Chilled water (38°F) at a flow of about 5 gallons per minute was used. Trays were inspected and dead eggs were removed once weekly.

During incubation at Kooskia NFH, a pump problem occurred. Well water to the incubators was interrupted for approximately two hours immediately after a well pump shaft broke. During this emergency, water from Clear Creek was supplied to incubators for a short time period until well water and chiller operation was restored. Continual monitoring throughout the remainder of

incubation revealed no apparent problems or negative effects.

**Table 2.** Summary of incubation and hatching for each take of Dworshak NFH's brood year 1998 spring chinook salmon eggs at Kooskia NFH (Kooskia NFH data files).

Date Delivered 1998	Take	Number	Date Hatched	Number	Percent	Date Tanked
Oct. 7	1	149,200	Nov. 22	146,562	98.2	Mar. 24
Oct.15	2	304,128	Dec. 7	297,233	97.7	Mar. 29
Oct. 16	3	252,840	Dec. 12	250,602	99.1	Mar. 30
Oct. 22	4	422,411	Dec. 18	418,475	99.1	Mar. 30
Oct. 23	5	98,904	Dec. 22	97,277	98.4	Mar. 31
Oct. 28	6	105,840	Dec. 24	100,066	94.5	Mar. 31
Oct. 28	7	49,128	Dec. 26	48,561	98.8	Mar. 31
Nov. 3	8	26,287	Dec. 29	25,826	98.3	Mar. 31
Nov. 10	9	2,236	Dec. 25	2,126	95.1	Mar. 31
<b>Total</b>		<b>1,410,974</b>		<b>1,386,728</b>	<b>97.7</b>	

Hatching began in late November and was completed by the end of December. The fry were tanked into the outside nursery tanks during late March 1999 on recirculating chilled well water (53-55°F). Because of limited space at Kooskia NFH, 233,906 unfed fry were transferred to Dworshak NFH on March 31 and April 1-2, 1999, and were put into Raceway 11. This was about six weeks earlier than planned. The fish were about 890 fpp in size. The remaining fry, 1,041,451, were transferred to Dworshak NFH from May 13-27, 1999 and placed directly into raceways to complete rearing. This number is slightly less than the number reported by Kooskia NFH. Fish were about 250 - 300 fpp in size.

A summary of monthly growth at Dworshak NFH is provided in **Table 3**. On August 4, 1999, feeding was reduced from three to two feedings/day to help reach the target release size of 20 fpp. On September 10 the percent of feed fed was reduced from the recommended 1.4-1.6% to 0.8-0.9 % body weight. These feeding strategies were continued through January 2000 and ended on February 1, 2000.

Bacterial kidney disease (BKD) was diagnosed in fish in raceways 21-24. Fish in raceways 21, 23, and 24 received manufactured erythromycin medicated feed for 21 days. Fish in raceway 22 received fish pills top coated with erythromycin and using vegetable oil as a carrier. The fish-pill treatment was unsuccessful and ended after nine days as the fish would not eat the medicated feed. The fish in raceway 22 were put on manufactured medicated feed on November 29, 1999. On November 27 BKD was diagnosed in raceway 27 and Erythromycin feeding began on

November 30 and ended on December 13.

**Table 3.** Numbers and sizes of BY98 spring chinook salmon smolts released at Dworshak NFH in 2000.

Date	Number	Weight (lbs)	Mean Water Temp.(°F)	Fish Per Pound	Length (mm)
5/1/99	232,303	261	44.9	891	39
6/1/99	1,271,567	4,280	46.8	297	57
7/1/99	1,262,562	7,092	51.6	179	67
8/1/99	1,126,569	10,701	48.0	105	80
9/1/99	942,627	11,288	48.1	83	87
10/1/99	941,186	14,273	48.5	66	94
11/1/99	939,710	17,222	47.4	54	100
12/1/99	937,116	20,349	44.0	46	106
1/1/00	934,780	22,780	42.8	41	110
2/1/00	933,129	26,385	42.1	35	116
3/1/00	929,928	31,592	41.7	29	123
4/1/00	953,180	39,477	-	24	131

The fish were released from Dworshak NFH into the North Fork Clearwater River on April 5-6, 2000. At the time of release, the average size and total length were 24 fpp and 131 mm.

### **Brood Year 1999**

After eye-up, Dworshak NFH had 232,990 Dworshak stock spring chinook salmon eggs for their program (does not include the Rapid River stock received through the Nez Perce Tribe). These were all shipped to Kooskia NFH for final incubation and hatching in October and November 1999 (**Table 4**).

At Kooskia NFH, the eggs were recounted, disinfected, and placed into vertical stack incubators (5,000 eggs per tray) supplied with chilled well water (38°F) at a flow of about 5 gallons per minute. Trays were inspected and dead eggs were removed once weekly. A summary of incubation, hatching, and tanking success by spawning take is listed in **Table 5**.

**Table 4.** Date and numbers of brood year 1999 spring chinook salmon eggs from each spawning take that were shipped to Kooskia NFH for final incubation and tanking (Dworshak NFH Spawning Report 1999).

Date Shipped 1999	Spawning Take	Number of Eyed Eggs Shipped
October 29	1	41,904
November 4	2	82,430
November 12	3	71,650
November 18	4	34,258
November 18	5	2,748
<b>Total</b>		<b>232,990</b>

**Table 5.** Summary of incubation and hatching for each take of Dworshak NFH's brood year 1999 spring chinook salmon eggs at Kooskia NFH (Kooskia NFH data files).

Date Delivered 1999	Take	Number	Date Hatched 1999-2000	Number	Percent	Date Tanked 2000
Oct. 29	1	41,904	Dec. 22	41,408	98.8	Mar. 24
November 4	2	82,430	Dec. 28	81,807	99.2	Mar. 24
November 12	3	71,650	Jan. 3	70,336	98.2	Mar. 24
November 18	4	34,258	Jan. 4	33,197	96.9	Mar. 24
November 18	5	2,748	Jan. 9	2,014	73.3	Mar. 24
<b>Total</b>		<b>232,990</b>		<b>228,762</b>	<b>98.2</b>	

Hatching began in December 1999 and was completed by January 9, 2000. The fry were tanked into the outside nursery tanks during late March 2000 on recirculating chilled well water (53-55°F). Fry were transferred to Dworshak NFH, 109,923 on May 31 and 110,000 on June 1, 2000. All were placed directly into raceways to complete rearing.

A summary of growth during raceway rearing is presented in **Table 6**. On August 1, 2000 the feeding frequency was reduced from three feedings/day to two feedings/day. A fast/feed regime began on September 1, 2000 to ensure the fish did not exceed the target size of 20 fpp at release. The feed rate was reduced from 1.6 % body weight to 0.85 % body weight throughout the month. This feeding regime was ended on December 5, 2000. The fish were fed manufactures

recommended amounts the remainder of December. On January 19, 2001 all SCS were treated for *Costia* with formalin. Treatment with oxytetracycline was started on February 16, 2001 for coldwater disease and was ended on March 2, 2001. Mortalities were reduced during and after treatment.

**Table 6.** Numbers and sizes of BY99 Dworshak NFH stock spring chinook salmon smolts reared at Dworshak NFH.

Date	Number	Weight (lbs)	Mean Water Temp.(°F)	Fish Per Pound	Length (mm)
6/1/00	109,923	637	51.7	173	68
7/1/00	219,129	1,921	48.3	114	78
8/1/00	219,008	3,008	48.8	73	91
9/1/00	208,420	3,436	46.0	61	97
10/1/00	207,932	4,284	49.1	49	104
11/1/00	208,178	5,489	43.6	38	114
12/1/00	208,094	6,401	43.6	33	119
1/1/01	208,017	8,044	41.4	26	130
2/1/01	207,949	9,058	40.7	23	135
3/1/01	207,830	9,524	41.5	22	137
4/1/01	211,496	10,192	-	21	138

Release of BY99 occurred the evening of March 28, 2001. There were 211,496 BY99 Dworshak NFH stock (does not include the Rapid River stock) released from Dworshak NFH into the main stem of the Clearwater River at an average size and total length of 21 fpp and 138 mm.

### Brood Year 2000

After eye-up, a total of 1,115,448 Dworshak NFH BY00 spring chinook salmon eggs were enumerated and shipped to Kooskia NFH during October/November 2000 for final incubation and early rearing (**Table 7**).

**Table 7.** Date and numbers of brood year 2000 spring chinook salmon eggs from each spawning take that were shipped to Kooskia NFH for final incubation and tanking (Dworshak NFH Spawning Report 2000).

Date Shipped 2000	Spawning Take	Number of Eyed Eggs Shipped
October 16	4	389,140
October 20	5	140,350
October 20	6	65,609
October 26	7	45,614
November 2	1	33,387
November 2	2	166,728
November 3	8	33,020
November 16-17	3	241,600
<b>Total</b>		<b>1,115,448</b>

Incubation trays at Kooskia NFH were supplied with well water chilled to an average temperature of 39°F. The incubators were shifted from chilled well water to raw water from Clear Creek on November 13, 2000 to conserve energy and to save station funds. This maneuver also decreased the daily average incubation water temperature for November to 36.5 °F. The daily average Clear Creek incubation water temperatures for December 2000 and January 2001 were 35 °F and 35.3 °F, respectively. Hatching occurred during January 2001. A summary of incubation, hatching, and tanking for each spawning take is presented in **Table 8**.

Weather turned warm at the beginning of February and Clear Creek started running very muddy. On February 5, 2001, we changed from Clear Creek to chilled well water for incubation which averaged 40 °F.

The strategy for transferring fish back to Dworshak NFH for final rearing and release was modified from BYs98 and 99. Instead of keeping the fish and rearing them on 53-55°F well water until they were 250 fpp, it was decided to make the transfer to Dworshak NFH right after button-up as sac-fry. Water temperatures at Dworshak NFH during this period average in the low 40s °F. This kept the fry on colder water for a longer period of time.

Five transfers from Kooskia NFH to Dworshak NFH occurred from April 10 to May 10. Initially, the sac-fry were placed directly into the tanker truck, but this method resulted in difficulties in getting the fry out of the tanker. As a result, about 11,000 sac-fry were lost during the second transfer. Afterwards, it was decided to leave the fry in the incubation trays, wrap rubber bands around the trays to keep the lids from coming off, transporting the trays in the

tanker, then empty the trays directly into the raceways at Dworshak NFH.

**Table 8.** Summary of incubation and hatching for each take of Dworshak NFH's brood year 2000 spring chinook salmon eggs at Kooskia NFH (Kooskia NFH data files).

Date Delivered 2000	Take	Number	Date Hatched 2001	Number	Percent	Date Tanked 2001
Oct. 16	4	389,140	Jan. 1	380,993	97.9	Apr. 10
Oct. 20	5	140,350	Jan. 21	135,296	96.4	Apr. 18
Oct. 20	6	65,609	Jan. 26	64,417	98.2	Apr. 18
Oct. 26	7	45,614	Feb. 2	44,585	97.7	Apr. 20
Nov. 2	1	33,387	Feb. 2	31,454	94.2	Apr. 25
Nov. 2	2	166,728	Feb. 2	161,784	97.0	Apr. 25
Nov. 3	8	33,020	Feb. 2	32,690	99.0	Apr. 25
Nov. 16	3	241,600	Feb. 2	231,984	96.0	Apr. 30
<b>Total</b>		<b>1,115,448</b>		<b>1,083,203</b>	<b>97.1</b>	

At Dworshak NFH, the fry were loaded into raceways. By the end of April there were an estimated 827,650 BY00 Dworshak NFH spring chinook salmon on station at Dworshak NFH averaging 976 fpp and 38 mm total length. The remaining 227,548 Dworshak NFH spring chinook salmon sac-fry were returned to Dworshak NFH from Kooskia NFH May 10. A completed inventory was obtained at the time of fin clipping and tagging. A summary of monthly growth and production to time of release is presented in **Table 9**.

From December 1–7, the fish were fasted to help slow growth and obtain the projected release size at release of 20 fpp. Fish were fed normal rations during the remainder of the month.

From January 10–15, 2002, the fish were fasted to help slow growth and obtain the projected release size at release of 20 fpp. Fish were fed normal rations during the remainder of the month.

On March 27 and 28, there were 970,956 Dworshak NFH BY00 spring chinook salmon smolts released from Dworshak NFH. These smolts averaged 20 fpp and 140 mm total length.

**Table 9.** Numbers and sizes of BY00 Dworshak NFH stock spring chinook salmon smolts released at Dworshak NFH (Dworshak NFH monthly production narratives).

Date	Number	Weight (lbs)	Mean Water Temp. (°F)	Fish Per Pound	Length (mm)
5/1/01	827,650	848	44.1	976	38
6/1/01	1,044,735	2,179	44.0	480	48
7/1/01	1,038,537	3,724	49.3	279	58
8/1/01	951,456	6,432	48.8	148	72
9/1/01	979,965	10,169	47.5	96	83
10/1/01	978,169	13,907	43.5	70	95
11/1/01	977,291	19,594	46.2	50	103
12/1/01	976,503	27,239	46.2	36	115
1/1/02	975,562	31,680	45.4	31	121
2/1/02	973,583	36,535	42.1	27	127
3/1/02	972,321	42,070	42.1	23	133
4/1/02	970,956	48,615	40.3	20	141

On February 26–28, SCS in raceways (RWs) A1–A3 were given a formalin and salt bath to prevent fungus. A total of 3,566 fish in RW A1, 4,758 fish in A2, and 5,988 in A3 received PIT tags. The tagging was done as part of a comparative-survival study of transported (trucking and barging) vs. river-run smolts. The study looks at the adult survival rate of each group.

### **Brood Year 2001**

After eye-up, a total of 1,163,838 Dworshak NFH BY01 spring chinook salmon eggs were enumerated and shipped to Kooskia NFH during October/November 2001 for final incubation and early rearing (**Table 10**).

**Table 10.** Date and numbers of brood year 2001 spring chinook salmon eggs from each spawning take that were shipped to Kooskia NFH for final incubation and tanking (Dworshak NFH Spawning Report 2001).

Date Shipped 2001	Spawning Take	Number of Eyed Eggs Shipped
October 31	1	73,094
October 31	2	298,524
November 5	4	427,900
November 6	5	14,320
November 7	3	350,000
<b>Total</b>		<b>1,163,838</b>

Upon arrival at Kooskia NFH, eggs were placed into incubation tray supplied with chilled well water averaging 40°F. The incubators were switched from chilled well water to Clear Creek water on November 13, 2001. Average water temperature in Clear Creek for the month of November was 42.3 °F. The average Clear Creek incubation water temperature for December was 37°F. Cold weather caused Clear Creek to freeze and reduce water flows available for hatchery production. To remedy this, chilled well water was used for incubation December 24–27. The average Clear Creek incubation water temperature for January was 37.3°F. All of Dworshak’s eggs hatched in January 2001. The average Clear Creek incubation water temperature for February was 35.7°F. Incubators were shifted back to chilled well water (40°F) in March. In April, fry began to button up.

All BY01 Dworshak stock SCS fry were successfully transferred to Dworshak NFH in April and May: a total of 360,786 SCS (Takes 1 & 2) were delivered April 25; 428,614 (Takes 4 & 5) were delivered May 2; and 340,195 (Take 3) were delivered May 6. The number of BY01 SCS Dworshak stock delivered was 1,129,595. Similar to BY00, the fry were transferred from Kooskia NFH to Dworshak NFH inside incubation trays hauled in the tanker truck.

**Table 11.** Summary of incubation and hatching for each take of Dworshak NFH's brood year 2001 spring chinook salmon eggs at Kooskia NFH (Kooskia NFH data files).

Date Delivered 2001	Take	Number	Date Hatched 2001-2002	Number	Percent	Date Tanked 2002
Oct. 31	1	73,094	13 Dec.	72,403	99	25 Apr.
Oct. 31	2	298,524	26 Dec.	295,957	99	25 Apr.
Nov. 5	4	427,900	26 Dec.	423,789	99	02 May
Nov. 6	5	14,320	08 Jan.	13,317	93	02 May
Nov. 7	3	350,000	10 Jan.	345,184	99	06 May
<b>Total</b>		<b>1,163,838</b>		<b>1,150,650</b>	<b>98</b>	

At Dworshak NFH, the fry were loaded into raceways. A summary of monthly growth and production through the end of July 2002 is presented in **Table 12**.

**Table 12.** Numbers and sizes of BY01 Dworshak NFH stock spring chinook salmon smolts released at Dworshak NFH (Dworshak NFH monthly production narratives).

Date	Number	Weight (lbs)	Mean Water Temp. (°F)	Fish Per Pound	Length (mm)
5/1/02	359,486	250	41.4	1,438	34
6/1/02	1,114,089	2,111	44.4	528	47
7/1/02	1,105,590	3,898	48.1	284	58
8/1/02					
9/1/02					
10/1/02					
11/1/02					
12/1/02					
1/1/03					
2/1/03					
3/1/03					
4/1/03					

## SUMMARY AND CONCLUSIONS

The production cycle for BY01 will not be completed until the fish are released in the spring of 2003, so only three years of complete rearing and release data are available for comparison. However, all four years of incubation and hatching data can be compared.

All the spring chinook salmon eggs for Dworshak NFH from brood years 1998, 1999, 2000, and 2001 were successfully transferred at the eye-egg stage to Kooskia NFH for final incubation and hatching. Percent hatching was above 97% all four years. Date of hatching was successfully delayed by one to two months compared to the historical date of hatching at Dworshak NFH. Except for BY98, hatching generally began in late December and was completed by mid-January. This was a direct result of the colder water temperatures available at Kooskia NFH for incubation. The ability of delaying time of hatching was particularly demonstrated when the water source was shifted from chilled well water averaging about 40°F to Clear Creek water with temperatures below 40°F for BYs 00 and 01.

For BYs 98, 99, and 00, smolts were released at 20 fish per pound or smaller, meeting or exceeding the target release size. At the size that BY01 is currently, it appears that this brood year will also meet the release size target.

Despite successes, the project did not completely meet the original objective of eliminating the need for reduced rations in order to meet size criteria. This was especially apparent for BYs 98 and 99. Both those BYs had to be put on restricted diets during rearing at Dworshak NFH to slow growth. The primary reason was the size at which they were returned to Dworshak NFH. Both BYs were tanked into well water averaging 53-55°F and were transferred back to Dworshak at sizes ranging from 250 to 175 fish per pound in May and June. For BYs 00 and 01, the time of transfer to Dworshak NFH was changed from tanked fry to button-up fry. By transferring the fish back to Dworshak NFH at the button-up fry stage, advantage could be taken of Dworshak NFH's colder water temperatures at that time. Instead of rearing the fry at Kooskia NFH on 53-55°F well water, rearing could occur in Dworshak NFH's raceways at near 40°F. The advantage of this strategy was demonstrated by the fact that BYs 00 and 01 were much smaller than BYs 98 and 99 by June after being returned to Dworshak NFH. Although BY00 still had to be put on a restricted diet for a one week period in December 2001 and a one week period in January 2002, this was significantly less than the lengthy period of fasting and feeding from September to December that was required for BY99. The fact that BY01 was even smaller than BY00 at the time of transfer from Kooskia NFH to Dworshak NFH may eliminate the need for a restricted diet at all for BY01.

One very clear advantage of using Kooskia NFH to incubate and hatch all of the spring chinook salmon eggs for Dworshak NFH is that the need for Dworshak NFH's nursery for early rearing of spring chinook salmon is totally eliminated. The button-up fry are transferred from Kooskia NFH in incubation trays and are placed directly into raceways. This frees up the nursery completely for the summer steelhead program. In the past, these programs have always overlapped in the nursery and have conflicted with one another. Steelhead need to be put on warmer water and grown faster in order to meet the size at release criteria. At the same time, water temperatures for spring chinook were kept colder to slow growth rate. This conflict made

production logistics in the nursery extremely complicated and often difficult to meet production goals.

In conclusion, the strategy of using Kooskia NFH to incubate and hatch Dworshak NFH's spring chinook salmon eggs was successful after the program was modified so that the transfer back to Dworshak NFH was made at the time of button-up fry rather than as young fingerlings. Using the colder water from Clear Creek rather than chilled well water for incubation was also an improvement and further delayed time of hatching. The strategy is also advantageous to the steelhead production program Dworshak NFH since it reduces the conflict between the steelhead and spring chinook production programs in the nursery.

At the same time, the Kooskia HET has two specific cautions if the strategy is to be used in the future. First, having all the spring chinook salmon eggs for both hatcheries all together could present a serious risk to the program if mechanical and/or electrical problems should occur. Failure in the alarm system could jeopardize an entire year class of spring chinook salmon for both hatcheries. Second, the use of Clear Creek water for incubation presents a fish health risk after hatching occurs. The Idaho Fish Health Center strongly recommends discontinuing the use of Clear Creek water after hatching occurs. Another option is the use of formalin treatments in the incubator trays.

### **RECOMMENDATION**

Modifications being made at Dworshak NFH this year may allow the use of colder water in the incubation and reduce or eliminate the need to use Kooskia NFH for egg incubation for spring chinook salmon. Evaluation of the modifications will need to be conducted to make that determination. Regardless of whether incubation occurs at Dworshak or Kooskia NFH, it is quite apparent that using colder water during incubation is a very effective means of delaying hatching. Used correctly, it could completely eliminate the need to use a restricted feeding protocol in order to meet size at release criteria. Therefore, the recommendation of the Kooskia and Dworshak HETs that this production strategy be continued.

## REFERENCES

- Beckman, Brian, R., Larsen, D.A., Lee-Pawlak, B., and W.W. Dickhoff. 1998. Relation of fish size and growth rate to migration of spring chinook salmon smolts. *North American Journal of Fisheries Management* 18:537-546.
- U.S. Army Corps of Engineers (COE). 1981. Lower Snake River Fish and Wildlife Compensation Plan. Destan Memorandum. No. 9: Dworshak National Fish Hatchery Expansion-Spring chinook rearing.
- HET 1998. Memo to Dworshak NFH Complex Manager and Project Leaders: Disposition of BY98 Spring Chinook Eggs.

## APPENDIX I

### MEMORANDUM

To: Bill Miller, Complex Manager  
Dworshak Fishery Complex

From: Team Leader  
Dworshak and Kooskia HET Leader

Subject: Disposition of BY98 Spring Chinook Eggs

October 29, 1998

The Dworshak and Kooskia HET members met on October 29, 1998 to discuss the disposition of BY98 spring chinook eggs for Dworshak and Kooskia NFHs. The main topic of discussion centered on capacity for incubation of eggs and ponding of fry at Kooskia NFH and recommendations for handling surplus eggs.

Earlier this year, the HET decided to try incubating all of the spring chinook eggs for both Dworshak and Kooskia NFHs at Kooskia NFH. This strategy would accomplish several objectives: 1) the eggs would be incubated at colder water temperatures and size at release could be reduced over previous years. This would eliminate or reduce the need to use a 'fasting/feeding' regime to keep size at release within acceptable limits, and 2) nursery space at Dworshak would be made available exclusively for the rearing of steelhead, allowing the use of warmer water in the nursery so that steelhead could be ponded at a larger size. The strategy was dependent upon several logistic considerations: 1) sufficient space at Kooskia NFH for incubation, 2) sufficient space at Kooskia NFH for ponding of fry, and 3) obtaining finer mesh screens for Dworshak so that smaller fish could be ponded in the raceways.

Kooskia NFH has the ability to incubate nearly 2.025 million eggs but can tank only about 1.6 million fry. The tanking capacity will probably be less than that because of the Idaho Supplementation Study (ISS) which requires keeping their study fish separate from production fish. At tanking, we estimate about 73,000 ISS fry which will require four circular tanks. One tank will be shorted by about 10,000 fry, reducing the full tanking capacity of Kooskia NFH.

This year, the total number of eggs that we will have from BY98 for incubation is estimated at 1.98 million; 469,000 from Kooskia NFH and about 1,511,000 for Dworshak NFH. This leaves about 380,000 eggs from Dworshak NFH that are surplus because there will be no room to tank them at Kooskia NFH after they hatch ( $1,980,000 - 1,600,000 = 380,000$ ). In order to spread the surplus out over the run and to insure that each Take is represented in production, the decision was made to keep about 135,000 Dworshak eggs from Takes 6, 7, and 8 at Dworshak NFH and remove the remaining 245,000 surplus eggs from Dworshak's Take 4 already at Kooskia NFH. This strategy would insure that Kooskia NFH keeps all of their eggs (469,000) and the surplus would come entirely from the Dworshak stock, leaving about 1, 131,000 eggs for the Dworshak program. Basically, the HET considered all options for trying to keep the 380,000 eggs within

the Complex but the room is just not there without disrupting other programs.

The HET recommends that Idaho Department of Fish and Game be contacted to see if they would be willing to take the surplus eggs. It would be the preference of the HET to keep the eggs in the Clearwater River basin for rearing and release. The State should be made aware of the BKD status of the surplus eggs. Marilyn at the Fish Health Center reported that two females in Take 4 and 1 female in Take 6 tested out as “mediums” for BKD, with ELISA values between 0.8 and 1.0. Because we do not keep every female separate all the way through incubation, we cannot insure that all the surplus eggs are from females that tested low or negative.

A decision has to be made soon since the eggs at Dworshak NFH will probably begin hatching sometime near the middle of November. The eggs at Kooskia NFH will probably begin hatching the first week in December. If the HET can be of further assistance or provide further information, please let us know.

Ray N. Jones

Distribution List:

Howard Burge, Idaho FRO  
Dave Owsley, Dworshak Fisheries Complex  
Bob Semple, Dworshak NFH  
Thomas Trock, Dworshak NFH  
Ray Jones, Idaho FRO  
Marilyn Blair, Dworshak FHC  
Ralph Roseberg, Idaho FRO  
Jill Olson, Idaho FRO  
Kip Bottomley, Kooskia NFH

## HET meeting notes August 5 , 1998

Bob Semple , Craig Eaton , Kathy Clemens , Kip Bottomley , and Ralph Roseberg were the attendees at this meeting at 9 am at Dworshak. The discussion item was incubation of all SCS eggs (both Dworshak & Kooskia stock) at Kooskia NFH.

Kip had done the home work on hatching times, tanking times, chiller capacity, and numbers. The transfer of eggs will be at the eyed stage. Enumeration and picking of eggs will be done at Dworshak NFH before the transfer. Some additional egg picking will still be necessary after the transfer. High BKD eggs will be placed in the bottom trays and will not effect the eggs of medium, low, or negative BKD status. Gerry checked out the small chiller and says that we can get the desired temperatures (38f) and volume(100 gpm). The eggs will hatch in December. Button up fry will be tanked in April. All the tanks will have to be on reuse at Kooskia. Therefore, any high BKD fry will have to be moved back to Dworshak before fry are tanked or Kooskia goes on reuse. We all think this will be only a small group of Kooskia stock , since we have enough Dworshak stock to cull high BKD eggs. One or two round tanks set up at Dworshak can hold those high BKD fish until they are large enough to go to a raceway at Dworshak. They will remain at Dworshak until Kooskia goes off reuse, sometime in the fall. All the rest of the SCS fry will be reared at Kooskia in tanks during April and May. On or around June 1 the Dworshak stock (at 200 fpp) will be transferred to Dworshak. Two stacks of incubators will need to be sent from Dworshak to Kooskia to give Kooskia the incubator space for 1.65 million eyed eggs. Kooskia has 6 plumbed in spots for stacks that are not currently fitted with stacks. Kooskia currently has 32 circular tanks (they used to have 8 more) and 32 rectangular tanks. At normal fry densities (20 K in circular & 30 K in rectangular) this allows space for 1.6 million fry. *If there is to be a benefit to the Dworshak steelhead program , all the SCS eggs must go to Kooskia.*

There will be extra work at shipping time and transfer times. There will be an increased workload at Kooskia since this is a larger program than they have dealt with in recent years. Additional help will be required to pick eggs and during tank rearing. Kip sought a commitment of help for picking eggs and on weekends for fry rearing.

Risks were discussed. The all your eggs in one basket idea came up. Kooskia has a good record at handling emergencies. During incubation and early rearing, the water source will be chilled well water. There is a back up well and creek water can also be used in the event of a mechanical emergency. There is also some additional risk associated with each transfer. This group thought the risks were minimal and that there were desirable benefits to be gained. If we do this we help the Dworshak steelhead early rearing and we get chinook fingerlings back at a smaller size on June 1, which should lead to a smaller smolt at release

We also reviewed policy on Nez Perce usage of FWS facilities. Unused space and water are made available to the tribe but we do not sacrifice ongoing programs for tribal hatchery programs.