# SYSTEM OPERATIONAL REQUEST: #2003-11

***The following State, Federal, and Tribal Salmon Managers have participated in the preparation and support this SOR: U.S. Fish & Wildlife Service and the Oregon Department of Fish and Wildlife.***

| | | |
|---|---|---|
| **TO:** | **B. G. Fastabend** | **COE-NWD** |
| | **William Branch** | **COE-Water Management** |
| | **Cindy Henriksen** | **COE-RCC** |
| | **Witt Anderson** | **COE-P** |
| | **Col. Richard Hobernicht** | **COE-Portland District** |
| | **LTC Kertis, Jr.** | **COE-Walla Walla District** |
| | **J. William McDonald** | **USBR-Boise Regional Director** |
| | **Steven Wright** | **BPA-Administrator** |
| | **Greg Delwiche** | **BPA-PG-5** |

**FROM:** **David A. Wills, USFWS**

**Ron Boyce, ODFW**

**DATE:** **July 8, 2003**

**SUBJECT**: Dworshak Summer Operations

**SPECIFICATIONS**:

- Implement the Biological Opinion measures at Dworshak Reservoir drafting to elevation 1520 feet by August 31, 2003.
- Increase outflow from Dworshak to 14 kcfs on July 8 and maintain as long as possible. Based on the July 1 STP run we estimate that an outflow of 14 Kcfs can be maintained through August 24th, with a decrease to 5.7 Kcfs the last week of August, ending in an August 31 elevation of 1520 feet.
- Initial releases temperature should be at 48°F, but should be decreased to 45°F prior to the proposed work being conducted at Dworshak Dam.

**JUSTIFICATION**:

We have reviewed all of the physical and biological information available and based on these data our recommendation is to implement the Biological Opinion (BIOP) as described in the specifications. It is important to consider Dworshak augmentation in terms of its ability to provide both flow augmentation and temperature mediation. Both parameters are important for the juvenile fish migration and survival. The following summarizes the data and information reviewed in developing this recommendation:

**Juvenile Fall Chinook Passage Timing**

The passage of juvenile fall chinook is progressing as expected. The hatchery fall chinook that were marked and released from acclimation ponds in various Snake and Clearwater River locations suggest that most of the migrants are in-river, having been detected at Lower Granite Dam. This is likely a response to the high flows experienced by these fish during the month of June. The wild subyearling fall chinook are migrating more similarly to how they were observed to migrate in past years. The latest forecast provided by the USFWS suggests that well over half the wild subyearling migrants from the Snake River have passed Lower Granite Dam. The remaining fish are expected to migrate throughout July and August.

**Flows**

The BIOP summer flow objective for Lower Granite in 2003 is 50.9 Kcfs. Flows at Lower Granite are already below that objective (44.6 Kcfs through July 6, 2003) and will remain so for the remainder of the summer season even with implementation of the Biological Opinion measures. Wild subyearling fall chinook salmon spend from 20 to 42 days in Lower Granite Reservoir primarily during the months of July and August. Survival of wild subyearling Snake River fall chinook is influenced simultaneously by flow and temperature. Meeting summer flow targets increases flow and decreases temperature. Meeting summer flow targets in July and August increases survival of wild subyearling fall chinook migrants. Shifting flow augmentation from July and early August to later times in the year would decrease survival of the largest portion of the wild subyearling fall chinook salmon run.

**Travel Time Survival of juvenile fall chinook**

In the compilation of travel time and survival data by NOAA Fisheries "Travel Time/Survival White Paper" (March 2000), NOAA Fisheries concludes that “Estimated survival probability from release points in the Snake River Basin to Lower Granite Dam was significantly correlated with flow, water temperature and turbidity”. NOAA Fisheries also concludes that the high correlation among variables precludes the determination of effects of these variables individually. A flow travel time relationship has been established for sub-yearling chinook migrants. The flow travel time relationship has been confirmed consistently in various studies and monitoring programs. Recent information (Connor, 2003) has shown statistically significant relations between flow, temperature and survival for subyearling fall chinook.

Historical passage timing and distribution of fall chinook shows that 90% of the wild chinook passage at Lower Granite occurs prior to August 30 and 97% of hatchery sub-yearling fall chinook of Clearwater and Snake River origin pass Lower Granite Dam prior to August 30.

**Water Temperature**

An extensive literature review was compiled for the Environmental Protection Agency entitled, “A Review and Synthesis of Effects of Alterations to the Water Temperature Regime on Freshwater Life Stages of Salmonids with Special Reference to Chinook Salmon”. This review establishes water temperature as an important factor in all life stages of salmon. The review documents the detrimental effects of elevated water temperatures on all life stages of salmon, both juvenile and adult. The literature review has identified a water temperature of 21 degrees C as the incipient lethal temperature for adult salmon. Washington State water quality standards for temperatures in the mainstem Snake is 20°C.

Studies conducted on migration and survival of wild juvenile fall chinook in the Snake River by USFWS indicate that colder water from Dworshak Dam and water from Brownlee Dam

should be released when Lower Granite tailrace temperatures exceed 17°C. The tailrace temperature at Lower Granite Dam on June 29th exceeded 17°C. Presently, the Lower Granite tailrace monitor is reading just above 19°C.

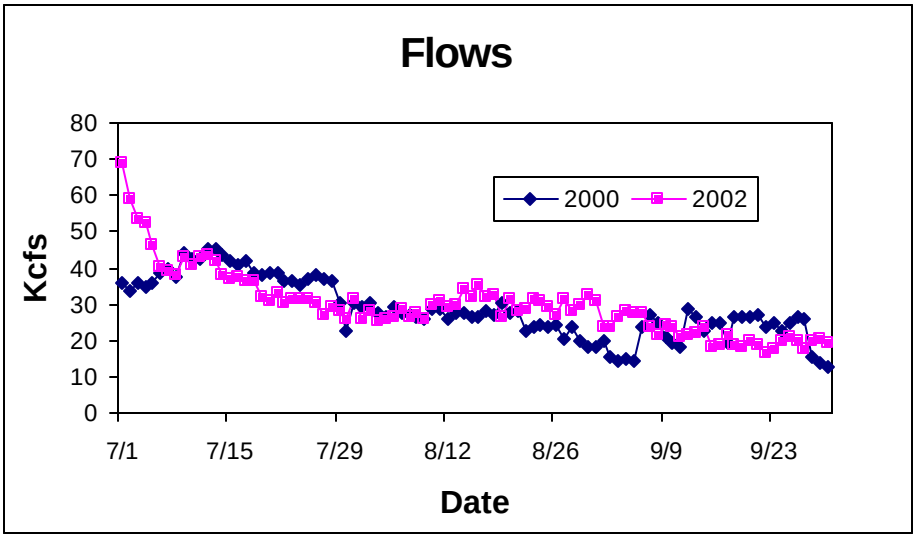
Temperature modeling provided by EPA considered several alternative scenarios for drafting water from Dworshak and its effect on flows and temperatures at Lower Granite Dam. From this information it was shown that drafting cool water from Dworshak, as anticipated in the Biological Opinion, provided the most improved flow and temperature conditions for juvenile fall chinook.

**Adult Migrants**

Dworshak Reservoir has been used to benefit juvenile migrants by increasing flow and moderating temperatures; and, by moderating temperature in the Lower Snake to also enhance the survival of adult migrants. No separate provisions were made in the Biological Opinion for adult migrants in the Snake River. Biological Opinion flow targets were not met in most years with full use of the mitigation water from Dworshak by August 31. However, there have been persistent recommendations to forgo some of the summer mitigation and move it into the fall time period to aid upstream migrating salmonids. The Biological Opinion is clear (Action 34) that evaluations of drafting of Dworshak to benefit adult passage was not to be done at the expense of volumes dedicated for juvenile migrations, but with volumes below the lower limit established for juvenile flow augmentation of 1520 ft (i.e.1500 ft).

A preliminary test of this management option was conducted in 2002. Water was moved out of the juvenile migration timeframe and provided at a rate of 10 Kcfs per day for a ten-day period during September.

A June 18 memo from Dr. Chris Peery (University of Idaho) discusses a comparison of 2000 and 2002 adult steelhead conversion rates (an index of survival) between Ice Harbor and Lower Granite dams. Dr. Peery concludes that 2002 was slightly better than 2000, a year with similar temperatures and flows. The data are difficult to interpret. While the two years did have similar average flows during September, it can be seen from the graph that late August flows at Lower Granite Dam in 2000 were considerably less than observed in 2002. It is difficult to assess how this might have affected conversion rates.



The memo also compares body temperatures of fish that migrated during 2002 versus fish that migrated in 2001. It is impossible to determine if Dworshak releases during September have any impact on fish body temperatures from these data. In 2001, average air temperatures during August and September at Lewiston, Idaho were much higher than in 2002, indicating the environmental impact may have been greater in 2001.

The memo concludes that there were some benefits to releasing Dworshak water during September, but the effects were not dramatic. The data does not support any conclusion on the benefits of these releases to adult migrants.

Equally important to the whole issue regarding shifting water from the summer to the fall is potential impacts to juvenile passage and survival. Estimates of juvenile survival probability (table 1) to the tailrace of Lower Granite dam for wild subyearling chinook for the latest cohort migrating through the Snake River was less than half (19.4 +/- 2.0) observed for the previous cohort (39.2 +/- 3.0), and overall survival of juvenile fish in 2002 was the second lowest observed since 1998. It is impossible to determine what role the water shifted into September, away from the July/August time frame, may have played in this survival estimate.

**Table 1. Estimates of survival probability (% ±SE) to the tailrace of Lower Granite Dam for cohorts of wild subyearling fall chinook salmon, 1998 to 2002. (Connor, 2003 personal communication)**

| | Survival by year | | | | | |
|---|---|---|---|---|---|---|
| **Cohort** | **1998** | **1999** | **2000** | **2001** | **2002** | **means** |
| 1 | 70.8±2.9 | 87.7±4.6 | 57.1±4.1 | 40.1±3.1 | 55.4±3.0 | 63.9 |
| 2 | 66.1±3.3 | 77.0±3.8 | 53.4±4.2 | 20.5±2.5 | 48.3±3.0 | 54.3 |
| 3 | 52.8±3.1 | 81.2±5.8 | 44.4±3.6 | 17.2±3.0 | 39.2±3.0 | 48.9 |
| 4 | 35.6±2.9 | 36.4±3.5 | 35.7±4.3 | 4.0±1.3 | 19.4±2.0 | 27.9 |
| **Annual means** | 56.3 | 70.6 | 47.7 | 20.5 | 40.6 | |

## Simulation Modeling

For the last several years the Environmental Protection Agency has been providing temperature scenarios that result from different flow management options. In 2003, the USFWS has employed the available biological information and coupled it with the physical (temperature) simulations. The approach evaluates alternative flow augmentation options in terms of expected survival of subyearling chinook. Data inputs include expected temperature and flow at Lower Granite and historical migration timing of subyearling chinook at Lower Granite based on the passage index. The expected survival rate is based on the multiple regression equations produced by Connor. Two equations are available for consideration: one is based on 1998-2000 data (Connor, 2003) and the other is based on 1998-2002 data. The outcome of this analysis was that the highest juvenile survival is obtained under the implementation of the Biological Opinion, when all of the water is used prior to August 31.

Concern was expressed regarding the potential importance of late migrating fall chinook in terms of contribution to adult returns. To address this concern additional evaluations were

made incorporating preliminary information from NOAA Fisheries. These additional evaluations again indicated that the highest survivals were obtained under the Biological Opinion operation.

**Summary**

In conclusion, we have reviewed all existing information and recommend the operation as specified based on the fact that:

- Flows in 2003 are significantly less than the BIOP flow target to-date and are expected to continue to decrease. Any further reductions in flow are not appropriate given the relation between flow, temperature and juvenile subyearling chinook survival.
- In season information indicates that more than half the juvenile fall chinook have entered the migration corridor,
- Juvenile fall chinook respond to both flow and temperature,
- Water temperatures have already exceeded the 17°C trigger and the EPA modeling has shown the best control of summer temperatures from the implementation of the Biological Opinion,
- The information collected during the adult passage study conducted in 2002 does not demonstrate an improvement for adult migrants,
- Simulation modeling shows that juvenile survival through to adulthood is highest when all the water is used prior to August 31.

References:

Connor, W. P., H. L. Burge, J. R. Yearsley, and T. C. Bjornn. 2003. The influence of flow and temperature on survival of wild subyearling fall chinook salmon in the Snake River. North American Journal of Fisheries Management.

June 18 memo from Dr. Chris Peery to Fish Passage Advisory Committee. Preliminary summary of effects of Dworshak water on passage of adult salmon and steelhead: 2002 September releases.

Connor, W. P., R. K. Steinhorst, and H. L. Burge. 2000. Forecasting survival and passage for migratory juvenile salmonids. North American Journal of Fisheries Management 20:650-659.

Connor, W. P., H. L. Burge, R. Waitt, and T. C. Bjornn. 2002. Juvenile life history of wild fall chinook salmon in the Snake and Clearwater rivers. North American Journal of Fisheries Management 22:703-712.

Connor, W. P., R. K. Steinhorst, and H. L. Burge. 2003. Migrational behavior and seaward movement of wild subyearling fall chinook salmon in the Snake River. North American Journal of Fisheries Management.

National Marine Fisheries Service (NMFS). 2000. White Paper: Salmonid travel time and survival related to flow in the Columbia River Basin. Seattle, WA. 68 p.