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Note: This staff issue paper is a preliminary analysis only. It has not been reviewed or approved by the Northwest Power Planning Council and should not be cited as a Council endorsement of any action based upon its content. Comments on this issue paper will be accepted through Friday, June 22, 2001. The Council will discuss the findings of this analysis at its next regular meeting in Pendleton, Oregon on June 26-27, 2001.

ISSUE PAPER: ANALYSIS OF FEDERAL COLUMBIA RIVER POWER SYSTEM OPERATIONS ON FISH SURVIVAL DURING SUMMER 2001 (COUNCIL DOCUMENT 2001-14)

This issue paper summarizes the results of a staff analysis that examined the effects of summer spill and fish transport on the survival of outmigrating juvenile fall chinook. In particular, the analysis focuses on the total system survival of ESA-listed Snake River fall chinook and unlisted Hanford Reach fall chinook.

Caveats

- The base case 2001 operational configurations and spill levels are significantly different from a normal water year. In 2001, Biological Opinion operations start from significantly reduced spill and increased transportation levels. The findings of the analyses are applicable to 2001 water conditions and may not apply to other years.
- Good empirical survival data does not exist for 2001 water conditions. Hydroproject survival estimates used in the model were obtained from 1994 to 1999 survival studies which may or may not accurately reflect 2001 survivals.
- The analysis does not consider all populations of fall chinook. Besides the Snake River and Hanford Reach, there are several other small, naturally spawning populations of fall chinook that migrate during the summer months. Likewise, the analysis does not examine the impact to various hatchery stocks of fall chinook that also migrate during the summer.

Methods

- Council staff used a version of the Simulated Passage Model (SIMPAS) to analyze the relative effects of various spill and transportation alternatives on fish survival in the Snake River and upper Columbia River basins.[1] SIMPAS is a spreadsheet model developed by the NMFS Hydro Program staff that uses empirical fish passage data to estimate relative juvenile survival through the hydrosystem for various alternatives. The model was used by the

[1] A description of SIMPAS and model documentation can be found in Appendix D of the 2000 Biological Opinion.

Federal Biological Effects Team to help develop the 2000 Biological Opinion and is currently used to analyze the relative consequences of hydropower operational changes on the survival of listed stocks.

- The NMFS Simulated Passage Model (SIMPAS2) Version 1.0 was used for the analysis.
- Flows for 2001 were estimated by averaging 1944 and 1977 summer flows. Flows used in the analysis were Snake River, 28 kcfs; Lower Columbia River, 122 kcfs.
- Transportation survivals were adjusted using "D values" found in the 2000 Biological Opinion.
- Total system survival was calculated by summing in-river juvenile survival with "D-adjusted" transport survival.

Spill and Transport Scenarios

- Under the 2000 Biological Opinion, no spill will occur during the summer months at collector dams and all juveniles collected at those projects will be transported. This transportation operation is assumed for all model runs.
- Staff evaluated five different spill alternatives. The base case approximates the spill levels called for under the 2000 Biological Opinion. Other alternatives assumed decreasing levels of spill at the various projects. Spill levels for the alternatives are summarized in Table 1.
- Spill in megawatt-months (for one month) was estimated for each alternative.[2]

Table 1. Operational Alternatives with approximate megawatt-months in spill.

PROJECT	BASE CASE (BIOP) 1000 MW-MOS[3]	ALT. 1 600 MW-MOS	ALT. 2 400 MW-MOS	ALT. 3 200 MW-MOS	NO SPILL 0 MW-MOS
Bonneville	92 kcfs night 75 kcfs day	50 kcfs night 50 kcfs day	No spill	No spill	No spill
The Dalles	40% of flow for 24 hours	40% of flow for 24 hours	40% of flow for 24 hours	30% of flow for 24 hours	No spill
John Day	72 kcfs for 12 hours at night	30% of flow for 12 hours at night	30% of flow for 12 hours at night	No spill	No spill
McNary	No spill	No spill	No spill	No spill	No spill
Ice Harbor	20 kcfs for 24 hours	No spill	No spill	No spill	No spill
Lower Monumental	No spill	No spill	No spill	No spill	No spill
Little Goose	No spill	No spill	No spill	No spill	No spill
Lower Granite	No spill	No spill	No spill	No spill	No spill

[2] Calculated mw-months based on assumed flow and spill levels used in this analysis. The mw-months give a relative idea on how the various alternatives compare to one another. Power factors (H/K values) used to calculate mw-months were obtained from federal agencies' worksheets.

[3] Biological Opinion spill levels are restricted by powerhouse requirements at Ice Harbor (8.5 kcfs), John Day (50 kcfs) and Bonneville (50 kcfs).

Results

Tables 2 through 5 summarize the results of implementing the different alternatives.

Table 2. Starting with 1,000 fish at the head of Lower Granite reservoir, the number of transported and inriver Snake River fall chinook arriving below Bonneville Dam for different alternatives.

SNAKE RIVER FALL CHINOOK	NO. OF FISH TRANSPORTED BELOW BONNEVILLE	NO. OF INRIVER FISH ARRIVING BELOW BONNEVILLE	TOTAL NO. OF FISH ARRIVING BELOW BONNEVILLE
Base Case	164	1	165
Alternative 1	162	1	163
Alternative 2	162	1	163
Alternative 3	162	1	163
No Spill	162	0	162

Table 3. Total system survival of 1,000 juvenile Snake River fall chinook from Lower Granite Dam pool to below Bonneville Dam for various alternatives (total system survival = no. "D-adjusted" transported fish + no. inriver fish). Relative change in total system survival from base case for each alternative is calculated.

SNAKE RIVER FALL CHINOOK	TOTAL SYSTEM SURVIVAL TO BELOW BONNEVILLE	NO. OF ADDITIONAL FISH LOST FROM BASE CASE	% CHANGE FROM BASE CASE
Base Case	41		
Alternative 1	40	-1	-2.9%
Alternative 2	40	-1	-3.0%
Alternative 3	40	-1	-3.0%
No Spill	39	-2	-4.1%

Table 4. Starting with 1,000 fish at the head of McNary reservoir, the number of transported and inriver Hanford Reach fall chinook arriving below Bonneville Dam for different alternatives.

HANFORD REACH FALL CHINOOK	NO. OF FISH TRANSPORTED BELOW BONNEVILLE	NO. OF INRIVER FISH ARRIVING BELOW BONNEVILLE	TOTAL NO. OF FISH ARRIVING BELOW BONNEVILLE
Base Case	500	125	625
Alternative 1	500	122	622
Alternative 2	500	120	620
Alternative 3	500	117	617
No Spill	500	112	612

Table 5. Total system survival of 1,000 juvenile Hanford Reach fall chinook from McNary Dam pool to below Bonneville Dam for various alternatives (total system survival = no. "D-adjusted" transported fish + no. inriver fish). Relative change in total system survival from base case for each alternative is calculated.

HANFORD REACH FALL CHINOOK	TOTAL SYSTEM SURVIVAL TO BELOW BONNEVILLE	NO. OF ADDITIONAL FISH LOST FROM BASE CASE	% CHANGE FROM BASE CASE
Base Case	245		
Alternative 1	242	-3	-1.2%
Alternative 2	240	-5	-2.0%
Alternative 3	237	-8	-3.3%
No Spill	232	-13	-5.3%

Discussion

Snake River Fall Chinook

- Spill has little to no benefit for Snake River fall chinook as compared to the operations in the base case. The number of fish lost from reducing spill is negligible. Under the Biological Opinion spill levels, total system survival is 41 fish out of 1,000. By eliminating spill at all dams, total system survival is 39 fish out of 1,000.
- Snake River fall chinook do not benefit from spill operations primarily because: 1) The survival of juveniles migrating through Lower Granite reservoir is very low and fewer fish reach federal projects; and 2) Most of the remaining fish are transported, leaving very few in-river.

Hanford Reach Fall Chinook

- Spill has some benefit to Hanford Reach fall chinook as compared to the operations in the base case. More Hanford Reach fish remain in the river than Snake River fish because McNary Dam is the only project where Hanford Reach fish are collected and transported. Under the Biological Opinion spill levels, total system survival is 245 fish out of 1,000. By eliminating spill at all dams, total system survival is 232 fish out of 1,000.
- The reduction in survival caused by eliminating spill may be relatively innocuous for the population. Hanford Reach fall chinook are a healthy population that generally exceeds escapement goals and maintains mainstem harvest rates of about 30 percent, and overall harvest/exploitation rates (which includes ocean harvest) of about 40 to 50 percent.[4]

- For migrating fall chinook juveniles, spill provides the greatest benefit in the following order of priority: 1) The Dalles; 2) John Day; 3) Bonneville; 4) Ice Harbor.
- BPA is now forecasting lower summer flows than those used in this analysis. Depending on how these flows are allocated between spill and powerhouse requirements, these lower flows may tend to decrease Biological Opinion spill levels and make spill comparatively less effective in increasing fish survival.
- The results of this analysis for Snake River fall chinook are different from the results presented in the March 30, 2001 issue paper (Council Document 2001-6). In the March 30 issue paper, Snake River fall chinook total system survival was calculated to be approximately 11%. The latest results show a total system survival closer to 4%. The

[4] John Skidmore, BPA, personal communication.

discrepancy is primarily due to lowering the Lower Granite reservoir survival estimates (recent NMFS data) for fall chinook.

- Hanford Reach fall chinook survival in the current analysis is generally the same as the results reported in the April 30, 2001 addendum (Council Document 2001-9). The slight discrepancy is due to variations in spill assumptions at the federal dams.
