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EFFECTS OF 2001 MID-COLUMBIA HYDROPOWER OPERATIONS ON FISH: ADDENDUM TO THE FEDERAL COLUMBIA RIVER POWER SYSTEM ISSUE PAPER (COUNCIL DOCUMENT 2001-9)

This addendum analyzes:

1. The total system survival of ESA-listed Upper Columbia spring chinook and steelhead entering the Columbia River above Mid-Columbia Public Utility District dams under various operational scenarios.
2. The effect of individual hydroprojects on juvenile survival under spill and no spill conditions.
3. The total system survival of important non-listed populations under spill and no spill conditions.

Methods

- The NMFS Simulated Passage Model (SIMPAS2) Version 1.0 was used for the analyses.
- The 2001 average flow was estimated by averaging 1944 and 1977 flows.
- Relative percentages of fish entering the Columbia were obtained from the 2001 NMFS juvenile outmigration memo.[1]
- The base case and alternatives were analyzed under low and high transportation benefit scenarios. D values used in the analyses are found in Table 2 of the issue paper.
- Fish passage survival estimates and spill percentages for the Mid-Columbia dams were obtained from Chelan County PUD and Grant County PUD.

Caveats

- Fish passage survival studies for the Mid-Columbia dams are not as extensive as the survival studies on the Snake and Lower Columbia hydroprojects. In particular, the PUD survival estimates used in this analysis were obtained over the last three or four years which were generally better than average water years. Since 2001 will probably be an extremely poor water year, the actual 2001 fish survivals may be lower than the estimates used in this analysis.
- The base case 2001 operational configurations and spill levels are significantly different from a normal water year. The 2001 Biological Opinion operations start from

[1] Memo from Michael Schiewe to Donald Knowles, "Estimation of Percentages for Listed Pacific Salmon and Steelhead Smolts Arriving at Various Locations in the Columbia River Basin in 2001." March 22, 2001.

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.
- The analyses look at some of the important unlisted populations in the Columbia Basin. However, there are many other unlisted stocks and species that migrate in spring and summer, and the following analyses do not examine impacts to those fish.

1. How do changes in spill and transportation operations affect the survival of ESA-listed spring chinook and steelhead entering the Columbia River above Mid-Columbia Public Utility District dams?

Spring-migrating spring chinook and steelhead are the only ESA-listed stocks that pass Mid-Columbia dams-- no listed stocks migrate in summer. Also, it is not anticipated that Douglas PUD's Wells Dam will change its spill operations in 2001 because its surface bypass system is very effective in passing juveniles and uses relatively small amounts of spill. Therefore the analysis focuses on the remaining Mid-Columbia projects-- Rocky Reach, Rock Island, Wanapum and Priest Rapids dams. Specifically, the analysis looks at fish that start from the Rocky Reach and Rock Island reservoirs and migrate pass the Mid-Columbia and lower Columbia River federal dams.

To address Question 1 the staff evaluated five different spill and transportation alternatives by comparing them to an assumed base case for 2001 operations. The base case and alternatives are as follows:

<u>Base Case</u>
Mid-Columbia Base Case- Spill and transport levels contained in the draft Federal Agencies' 2001 FCRPS Plan Proposal and planned 2001 spring spill levels at the Mid-Columbia dams. The base case includes:
- 40% spill (24 hours) at The Dalles Dam
- 75 Kcfs (day) and 90 Kcfs (night) spill at Bonneville Dam
- 30 % spill (12 hours night) at John Day Dam
- No spill at McNary Dam
- 50% fish transport at McNary Dam
- 61% spill (24 hours) at Priest Rapids Dam
- 43% spill (24 hours) at Wanapum Dam
- 31 kcfs spill (24 hours) at Rock Island Dam
- 15 % spill (24 hours) at Rocky Reach Dam

<u>Operational Alternatives</u>
1) No Mid-Columbia Spill- No spill at Rocky Reach, Rock Island, Wanapum or Priest Rapids dams. Maintain base case spill levels at federal dams.

2) No Spill- No spill at Rocky Reach, Rock Island, Wanapum, Priest Rapids, McNary, John Day, The Dalles or Bonneville dams.

3) Maximum Transportation Operations at McNary Dam- Draft federal proposal calls for transporting approximately half of the juveniles collected at McNary. This alternative looks

at transporting all juveniles collected at McNary Dam. Base case spills are maintained in this alternative.

4) No Mid-Columbia Spill and Maximum Transportation Operations at McNary Dam.

5) No Spill and Maximum Transportation Operations at McNary Dam.

Results

Tables 10 through 15 summarize the results of implementing the various alternatives.

Table 10. Total system survival of 1,000 juvenile spring chinook from Rocky Reach and Rock Island pools to below Bonneville Dam under Mid-C base case and alternatives 1 and 2. Low and high transport benefits.

SPRING CHINOOK	NO. OF FISH SURVIVING TO BELOW BONNEVILLE	NO. OF FISH LOST OR GAINED FROM BASE CASE	% CHANGE FROM BASE CASE
Low Transport Benefit			
Base Case	340		
1) No Mid-C Spill	304	-36	-10.6
2) No Spill	288	-52	-15.3
High Transport Benefit			
Base Case	435		
1) No Mid-C Spill	389	-46	-10.6
2) No Spill	373	-62	-14.3

Table 11. Total system survival of 1,000 juvenile steelhead from Rocky Reach and Rock Island pools to below Bonneville Dam under Mid-C base case and alternatives 1 and 2. Low and high transport benefits.

STEELHEAD	NO. OF FISH SURVIVING TO BELOW BONNEVILLE	NO. OF FISH LOST OR GAINED FROM BASE CASE	% CHANGE FROM BASE CASE
Low Transport Benefit			
Base Case	344		
1) No Mid-C Spill	308	-36	-10.5
2) No Spill	291	-53	-15.4
High Transport Benefit			
Base Case	482		
1) No Mid-C Spill	431	-51	-10.6
2) No Spill	414	-68	-14.1

Table 12. Total system survival of 1,000 juvenile spring chinook from Rocky Reach and Rock Island pools to below Bonneville Dam under Mid-C base case and alternative 3 (maximize transport @ MCN). Low and high transport benefits.

SPRING CHINOOK ALTERNATIVE	NO. OF FISH SURVIVING TO BELOW BONNEVILLE	NO. OF FISH LOST OR GAINED FROM BASE CASE	% CHANGE FROM BASE CASE
Low Transport Benefit			
Base Case	340		
3) Maximize Transport at McNary	375	34	10.1
High Transport Benefit			
Base Case	435		
3) Maximize Transport at McNary	564	129	29.7

Table 13. Total system survival of 1,000 juvenile steelhead from Rocky Reach and Rock Island pools to below Bonneville Dam under Mid-C base case and scenarios 3 and 4 (maximize transport @ MCN). Low and high transport benefits.

STEELHEAD ALTERNATIVE	NO. OF FISH SURVIVING TO BELOW BONNEVILLE	NO. OF FISH LOST OR GAINED FROM BASE CASE	% CHANGE FROM BASE CASE
Low Transport Benefit			
Base Case	344		
3) Maximize Transport at McNary	337	-7	-2.1
High Transport Benefit			
Base Case	482		
3) Maximize Transport at McNary	612	130	27.0

Table 14. Total system survival of 1,000 juvenile spring chinook from Rocky Reach and Rock Island pools to below Bonneville Dam under Mid-C base case and alternatives 4 and 5. Low and high transport benefits.

SPRING CHINOOK ALTERNATIVE	NO. OF FISH SURVIVING TO BELOW BONNEVILLE	NO. OF FISH LOST OR GAINED FROM BASE CASE	% CHANGE FROM BASE CASE
Low Transport Benefit			
Base Case	340		
4) No Mid-C Spill and Max. Transport @ McNary	335	-6	-1.7
5) No Spill and Max. Transport @ McNary	331	-10	-2.9
High Transport Benefit			
Base Case	435		
4) No Mid-C Spill and Max. Transport @ McNary	504	69	15.9
5) No Spill and Max. Transport @ McNary	500	65	14.9

Table 15. Total system survival of 1,000 juvenile steelhead from Rocky Reach and Rock Island pools to below Bonneville Dam under Mid-C base case and alternatives 4 and 5. Low and high D transport benefits.

STEELHEAD ALTERNATIVE	NO. OF FISH SURVIVING TO BELOW BONNEVILLE	NO. OF FISH LOST OR GAINED FROM BASE CASE	% CHANGE FROM BASE CASE
Low Transport Benefit			
Base Case	344		
4) No Mid-C Spill and Max. Transport @ McNary	302	-42	-12.3
5) No Spill and Max. Transport @ McNary	298	-46	-13.5
High Transport Benefit			
Base Case	482		
4) No Mid-C Spill and Max. Transport @ McNary	548	66	13.7
5) No Spill and Max. Transport @ McNary	544	62	12.9

Summary

When compared to base case conditions:

- For spring chinook and steelhead, stopping spill at Mid-Columbia dams decreases survivals by about 10.6 percent.
- For spring chinook and steelhead, stopping spill at Mid-Columbia and federal dams decreases survival by approximately 14 to 15 percent.
- For spring chinook, maximizing transportation at McNary and maintaining base case spills increases survival between 10 and 30 percent.
- For steelhead, maximizing transportation at McNary and maintaining base case spills creates a change in survival between a decrease of two percent to a gain of 27 percent.
- For spring chinook, stopping spill at the Mid-Columbia dams and maximizing transportation causes a change in survival between a decrease of two percent to a gain of 16 percent.
- For steelhead, stopping spill at the Mid-Columbia dams and maximizing transportation causes a change in survival between a decrease of 12 percent to a gain of 14 percent.
- For spring chinook, stopping spill at all dams and maximizing transportation causes a change in survival between a decrease of three percent to a gain of 15 percent.
- For steelhead, stopping spill at all dams and maximizing transportation causes a change in survival between a decrease of 13.5 percent to a gain of 13 percent.

Survival decreases and increases are summarized in Table 16.

Table 16. Summary of results for each alternative: Range of percent survival changes from the base case for spring chinook and steelhead.

ALTERNATIVE	CHANGE IN % SURVIVAL FROM BASE CASE: SPRING CHINOOK	CHANGE IN % SURVIVAL FROM BASE CASE: STEELHEAD
1) No Mid-Columbia Spill	-10.6	-10.5 to -10.6
2) No Spill At Any Dam	-14.3 to -15.3	-14.1 to -15.4
3) Maximize Transport at McNary/Maintain Base Case Spills	10.1 to 29.7	-2.7 to 27.0
4) No Mid-Columbia Spill/Maximize Transport at McNary	-1.7 to 15.9	-12.3 to 13.7
5) No Spill at Any Dam/Maximize Transport at McNary	-2.9 to 14.9	-13.5 to 12.9

2. What effect do individual hydroprojects have on juvenile survival under base case spill and no spill conditions?

Staff analyzed the effect of stopping spill at individual Mid-Columbia PUD and lower Columbia federal projects. The tables below describe the survival of 1000 spring chinook and steelhead juveniles passing various dams under the Mid-Columbia base case and no spill alternative. For example, at Bonneville Dam with base case spill, 963 out of 1000 fish survive to below the dam. With no spill at Bonneville, only 938 out of 1000 fish survive to below the dam. The difference between 963 fish and 938 fish is a loss of 25 fish or a negative 2.6 percent change from the base case.

Table 17. The survival of 1,000 juvenile spring chinook to below each dam under the base case and no spill alternative.

SPRING CHINOOK				
PROJECT	**BASE CASE SPILL** NO. OF FISH SURVIVING TO BELOW DAM	**NO SPILL** NO. OF FISH SURVIVING TO BELOW DAM	NO. OF FISH LOST	% CHANGE FROM BASE CASE
Rocky Reach	966	963	-3	-0.3
Rock Island	962	940	-22	-2.3
Wanapum	970	930	-40	-4.1
Priest Rapids	970	930	-40	-4.1
McNary	933	933	0	0.0
John Day	965	958	-7	-0.7
The Dalles	895	835	-60	-6.7
Bonneville	963	938	-25	-2.6

Table 18. The survival of 1,000 juvenile steelhead to below each dam under the base case and no spill alternative.

STEELHEAD				
PROJECT	**BASE CASE SPILL** NO. OF FISH SURVIVING TO BELOW DAM	**NO SPILL** NO. OF FISH SURVIVING TO BELOW DAM	NO. OF FISH LOST	% CHANGE FROM BASE CASE
Rocky Reach	966	963	-3	-0.3
Rock Island	962	940	-22	-2.3
Wanapum	970	930	-40	-4.1
Priest Rapids	970	930	-40	-4.1
McNary	933	933	0	0.0
John Day	972	968	-4	-0.4
The Dalles	895	835	-60	-6.7
Bonneville	963	938	-25	-2.6

The analysis identifies those projects that have the largest biological impact if spill is stopped.[2] Eliminating spill has the greatest fish impact at The Dalles, Priest Rapids and Wanapum dams. Spill elimination has intermediate fish impacts at Bonneville and Rock Island, and little fish impacts at John Day and Rocky Reach dams. Under the base case there is no spill at McNary so there is no net fish loss.

[2] The analysis only evaluates the number of fish lost as a result of passing each dam structure. Spill may also help to disperse predators reducing juvenile mortality. The effect that spill may have on predator dispersal was not evaluated in the analysis.

3. What is the total system survival of important non-listed salmon populations under spill and no spill conditions?

There are several important naturally spawning populations that are not listed under the ESA. While these populations remain relatively healthy they will also be affected by changes in mainstem operations. Probably three of the most important naturally spawning populations are the John Day spring chinook, Deschutes spring chinook and Hanford Reach fall chinook. Staff examined the effect of spill elimination and transportation changes on these populations of fish.

Each population is affected by a different series of dams. John Day spring chinook pass John Day, The Dalles and Bonneville dams. Deschutes spring chinook pass The Dalles and Bonneville dams. Hanford Reach fall chinook pass McNary, John Day, The Dalles and Bonneville dams. Of these populations only the Hanford Reach fall chinook will be transported to below Bonneville. Because all these populations lie below Priest Rapids Dam, changes in spill operations at the Mid-Columbia dams will not affect their survival. Table 19 summarizes the results of the analysis.

Table 19. Total system survival of 1,000 juvenile John Day, Deschutes and Hanford Reach chinook to below Bonneville Dam, under Mid-C base case and alternative 2 (No Spill). D value applied to Hanford Reach fall chinook.

POPULATION	NO. OF FISH SURVIVING TO BELOW BONNEVILLE	NO. OF FISH LOST OR GAINED FROM BASE CASE	% CHANGE FROM BASE CASE
John Day Spring Chinook			
Base Case	539		
No Spill	487	-52	-9.6
Deschutes Spring Chinook			
Base Case	701		
No Spill	638	-63	-9.0
Hanford Reach Fall Chinook			
Base Case	243		
No Spill	232	-11	-4.5

Decreasing spill at the Mid-Columbia PUD dams will affect several stocks and species of non-listed fish. These stocks include, hatchery-reared spring chinook, steelhead, sockeye, summer/fall chinook and coho. Also, non-listed natural populations of summer/fall chinook and sockeye pass Mid-Columbia dams.

During the spring outmigration season, non-listed hatchery spring chinook and steelhead will pass Mid-Columbia projects. It is assumed that these fish will survive at about the same rate as the listed fish outlined in Tables 10 through 18. Non-listed, spring migrating summer/fall chinook and sockeye and summer migrating summer/fall chinook will also be affected by spill reductions. Unfortunately, there is little data on the survival of these fish through the Mid-Columbia projects so survival estimates could not be made.

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