FISH PASSAGE CENTER

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MEMORANDUM

TO: Tucker Jones, ODFW

FROM: Michele DeHart

DATE: February 22, 2018

RE: Review of ability to maintain block spill operations in past juvenile survival studies

In response to your request, the Fish Passage Center (FPC) staff has reviewed juvenile passage studies in the FCRPS with respect to their ability to maintain the operations required by the study design. The efficacy and statistical power of the study design are dependent on the ability to maintain planned operations during the study period. If operations vary from the planned study design, the results of the study will not be applicable to other years, operations, and the questions proposed in the study. The results will be confounded.

Juvenile survival studies have been conducted at all FCRPS sites. In general, these studies rely on acoustic tagging to identify routes of juvenile passage under specific dam operations. However, in most studies, river and dam conditions have not allowed operations to remain within the confines of the study design. Below is a summary of our findings and concerns regarding the ability of a block study design to be maintained throughout the entire passage season through all FCRPS dams as proposed by NOAA. The results are summarized in Table 1, with more details provided in Appendix A.

- Survival studies have frequently been conducted during periods when the operations carried out vary widely from the planned study design operations. High or low flows and unplanned turbine outages have contributed to the difference between study design and actual study implementation operations.
- Differences between planned and actual operations have severely reduced the applicability of studies of fish passage within the FCRPS. Often, survivals and other juvenile metrics are calculated under operations that do not meet the expected study design treatments and would not be repeatable in another year. Therefore, the study has a

diminished scope of inference and may not be applicable to the intended management question. Even block spill studies that have been attempted at single projects in a year have produced confounded results because the study treatment spill levels could not be maintained.

- The NOAA Block Study proposal fails to recognize that maintaining the spill treatments for the entirety of the study period at all projects is unlikely in most flow years. If the treatment levels are not maintained for the entirety of the study period, any measureable differences in SARs/survivals would be confounded due to lack of distinction between spill treatments.

Table 1. Summary of performance standards testing results and test conditions where study operations were not maintained. Details are provided in Appendix A.

Project	Year	Study Period	Planned Operation	Days Operations Were Met (% of study)	Avg. Spill (Range)	Description	Surv. Data Source
BON	2008	4/29-5/27	100 Kcfs	5 (18%)	133 Kcfs (95 – 231)	Spill exceeded planned operations sufficiently to prevent answering study questions	Ploskey et al. 2009
BON	2008	6/15-7/13	85 Kcfs (day) /gas cap (night)	10 (36%)	115 (Kcfs) (85 – 188)	Spill exceeded planned operations sufficiently to prevent answering study questions	Ploskey et al. 2009
BON	2009	4/29-5/27	100 Kcfs	20 (71%)	106 Kcfs (85 – 150)	High spill at the end of spring test	Faber et al. 2011
BON	2010	6/15-7/18	Alternating Blocks 95 Kcfs; 85 Kcfs (day)/gas cap (night)	16 (50%)	116 Kcfs (90 – 173)	Half of the blocks were eliminated from study because operations could not be met	Ploskey et al. 2011
BON	2011	4/27-5/31	100 Kcfs	15 (44%)	177 Kcfs (100 – 293)	Spill in second half of study averaged 242 Kcfs, more than double planned operations	Ploskey et al. 2013
TDA	2011	4/29-5/30	40%	18 (58%)	42% (37 – 50%)	Spill averaged 50% for second half the study, required separate survival estimates	Skalski et al. 2012
JDA	2008	5/4-5/29	Alternating Blocks 40%/30%	14 (56%)	34% (29 – 46%)	Only 3 of 7 blocks maintained for study, reduced power of comparison	Weiland et al. 2009
JDA	2008	6/17-7-15	Alternating Blocks 40%/30%	7 (25%)	35% (30-42%)	Only final 2 of 7 blocks maintained for study, reduced power of comparison	Weiland et al. 2009
JDA	2011	4/27-5/30	Alternating Blocks 40%/30%	19 (57%)	38% (30-46%)	Spill levels exceeded all planned blocks in second half of the study, reduced power of comparison	Weiland et al. 2013
JDA	2012	4/30-6/2	Alternating Blocks 40%/30%	0 (0%)	37% (30-44%)	Spill levels exceeded all planned blocks, no comparisons of operations could be made	Skalski et al. 2013a

Project	Year	Study Period	Planned Operation	Days Operations Were Met (% of study)	Avg. Spill (Range)	Description	Surv. Data Source
JDA	2012	6/17-7/19	Alternating Blocks 40%/30%	0 (0%)	38% (30 – 45%)	Spill levels exceeded all planned blocks, no comparisons of operations could be made	Skalski et al. 2013a
MCN	2006	4/26-6/7	Alternating Blocks 40% 12 hours; no spill 12 hours/40% 24 hours	0 (0%)	48% (36 – 56%)	Spill averaged 50% for the entire spring study, so no operations could be tested	Adams et al. 2008
MCN	2008	6/18-7/28	Alternating Blocks 40%/60%	23 (58%)	51% (40 – 60%)	4 of 10 blocks could not be maintained due to high flows, reduced power of the test	Adams et al. 2009
MCN	2012	4/27-5/30	40%	0 (0%)	54% (40 – 70%)	High flows meant planned operations could not be tested	Skalski et al. 2013b
MCN	2012	6/14-7/16	40%	0 (0%)	61% (52 – 73%)	High flows meant planned operations could not be tested	Weiland et al. 2014
MCN	2014	4/27-5/30	40%	0 (0%)	52% (41 – 62%)	High flows meant planned operations could not be tested	Weiland et al. 2015
IHR	2006	5/3-5/31	Alternating Bocks 45 Kcfs (day); gas cap(night)/30-40%	Unknown	45%; 63 Kcfs (30 – 63%)	Not all blocks were met, but study does not state how many or criteria for meeting operations.	Axel et al. 2007
IHR	2008	4/28-5/24	Alternating Bocks 45 Kcfs (day); gas cap(night)/30-40%	14 (52%)	54%; 54 Kcfs (30-77%)	Study blocks were met only for the first two weeks; comparisons of operations were not possible	Axel et al. 2010a
IHR	2008	6/8-7/4	Alternating Bocks 45 Kcfs (day); gas cap(night)/30-40%	0 (0%)	54%; 64 Kcfs (30 – 75%)	Spill levels exceeded all planned blocks, no comparisons of operations could be made	Axel et al. 2010a
IHR	2009	4/28-5/25	Alternating Bocks 45 Kcfs (day); gas cap(night)/30-40%	20 (67%)	50%, 52 Kcfs (30 – 73%)	High flows meant blocks could not be maintained during last 1/3 of study, reduced power of comparisons.	Axel et al. 2010b
LMN	2012	4/30-5/28	20-29 Kcfs to gas cap	11 (38%)	30 Kcfs (24 – 44 Kcfs)	High flows meant seasonal metrics had to be divided into early and late season	Skalski et al. 2013c
LGS	2012	4/29-5/27	30%	12 (41%)	32% (26 – 43%)	High flows meant seasonal metrics had to be divided into early and late season	Skalski et al. 2013d

Project	Year	Study Period	Planned Operation	Days Operations Were Met (% of study)	Avg. Spill (Range)	Description	Surv. Data Source
LGS	2012	6/5-7/6	30%	0 (0%)	39% (30 – 61%)	High flows meant planned operations could not be tested	Skalski et al. 2013d
LGR	2002	4/17-6/6	Alternating Blocks Gas cap (night)/8 Kcfs/16 Kcfs	10 (20%)	36 Kcfs (21 – 79 Kcfs)	High flows meant blocks could not be maintained for most of study, additional treatments added but power significantly reduced	Anglea et al. 2003
LGR	2005	4/21-6/16	Spill with and without RSW	18 (32%)	8 Kcfs (0 – 51 Kcfs)	Could not compare spill with and without RSW, instead compared no spill and spill via RSW. Could not answer basic questions of study design.	Perry et al. 2007

Literature Cited

Bonneville Dam

Faber, D.M. and 9 co-authors. 2011. Evaluation of Behavioral Guidance Structure on Juvenile Salmonid Passage and Survival at Bonneville Dam in 2009. Annual report of research prepared by the Pacific Northwest National Laboratory for the USACE Portland District. 108 pp plus appendices

Ploskey, G.R. and 19 co-authors. 2009. Survival Rates of Juvenile Salmonids Passing Through the Bonneville Dam and Spillway in 2008. Final annual report of research prepared by the Pacific Northwest National Laboratory for the USACE Portland District. 134 pp +Appendices

Ploskey, G.R. and 20 co-authors. 2011. Survival and Passage of Juvenile Chinook Salmon and Steelhead Passing Through Bonneville Dam, 2010. Annual report of research prepared by the Northwest National Laboratory for the U.S. Army Corps of Engineers, Portland District. 90 pp plus appendices

Ploskey, G.R. and 22 co-authors. 2013. Survival and Passage of Juvenile Chinook Salmon and Steelhead Passing Through Bonneville Dam, 2011. Annual report of research prepared by the Northwest National Laboratory for the U.S. Army Corps of Engineers, Portland District.

The Dalles Dam

Skalski, J. R., R. L. Townsend, A. G. Seaburg, G. E. Johnson, and T. J. Carlson. 2012. Compliance Monitoring of Juvenile Yearling Chinook Salmon and Steelhead Survival and Passage at The Dalles Dam, Spring 2011. PNNL-21124, compliance report submitted to the U.S. Army Corps of Engineers, Portland District, Portland, Oregon, by Pacific Northwest National Laboratory, Richland, Washington and the University of Washington, Seattle, Washington.

John Day Dam

Skalski, J.R. and 8 co-authors. 2013a. Compliance monitoring of yearling and subyearling Chinook salmon and juvenile steelhead survival and passage at John Day Dam, 2012. PNNL-22152, Pacific Northwest National Laboratory, Richland, Washington.

Weiland, M.A. and 17 co-authors. 2009. Acoustic telemetry evaluation of juvenile salmonid passage and survival at John Day Dam with emphasis on the prototype surface flow outlet, 2008. Prepared by Pacific Northwest National Laboratory for the U.S. Army Corps of Engineers, Portland District.

Weiland, M. A. and 28 co-authors. 2013. Acoustic Telemetry Evaluation of Juvenile Salmonid Passage and Survival at John Day Dam, 2011. Annual report of research prepared by Pacific Northwest National Laboratory for the U.S. Army Corps of Engineers, Portland District. 88 pp plus appendices.

McNary Dam

Adams, N.S. and 7 co-authors. 2008. Survival and migration behavior of juvenile salmonids at McNary Dam, 2006. Prepared by U.S. Geological Survey to U.S. Army Corps of Engineers, Walla Walla District.

Adams, N.S. and Counihan, T.D. 2009. Survival and migration behavior of juvenile salmonids at McNary Dam, 2007. Prepared by U.S. Geological Survey to U.S. Army Corps of Engineers, Walla Walla District.

Skalski, J.R. and 8 co-authors. 2013b. Compliance monitoring of yearling and subyearling Chinook salmon and juvenile steelhead survival and passage at McNary Dam, 2012. PNNL-22152, Pacific Northwest National Laboratory, Richland, Washington.

Weiland, M.A. and 16 co-authors. 2015. Survival and Passage of Yearling and Subyearling Chinook Salmon and Steelhead at McNary Dam, 2014. PNNL-24522. Final report submitted by the Pacific Northwest National Laboratory to the U.S. Army Corps of Engineers, Walla Walla, Washington.

Ice Harbor Dam

Axel, G. A, and 6 co-authors. 2007. Passage behavior and survival of radio-tagged yearling Chinook salmon and steelhead at Ice Harbor Dam, 2006. Report of research prepared by National Marine Fisheries Service for the U. S. Army Corps of Engineers, Walla Walla District. 43 p. plus appendices

Axel, G.A., and 6 co-authors. 2010a. Passage behavior and survival of radio-tagged yearling and subyearling Chinook salmon and juvenile steelhead at Ice Harbor Dam, 2008. Report of research prepared by National Marine Fisheries Service for the U. S. Army Corps of Engineers, Walla Walla District.

Axel, G.A., and 9 co-authors. 2010a. Passage behavior and survival of radio-tagged yearling and subyearling Chinook salmon and juvenile steelhead at Ice Harbor Dam, 2009. Report of research prepared by National Marine Fisheries Service for the U. S. Army Corps of Engineers, Walla Walla District.

Lower Monumental Dam

Skalski J.R. and 9 co-authors. 2013c. BiOp Performance Testing: Passage and Survival of Yearling and Subyearling Chinook Salmon and Juvenile Steelhead at Lower Monumental Dam, 2012. PNNL-22100, Pacific Northwest National Laboratory, Richland, Washington.

Little Goose Dam

Skalski J.R. and 9 co-authors. 2013d. BiOp Performance Testing: Passage and Survival of Yearling and Subyearling Chinook Salmon and Juvenile Steelhead at Little Goose Dam, 2012. PNNL-22140, Pacific Northwest National Laboratory, Richland, Washington.

Lower Granite Dam

Angela, S.M. and 6 co-authors. 2003. Hydroacoustic evaluation of the removable spillway weir at Lower Granite Dam in 2002. Prepared by Battelle for U.S. Army Corps of Engineers, Walla Walla District.

Perry, R.W. and 11 co-authors. 2007. Survival and migration behavior of juvenile salmonids at Lower Granite Dam, 2005. Prepared by the U.S. Geological Survey to U.S. Army Corps of Engineers, Walla Walla District.

Appendix A

Below is a detailed, project-by-project review of the various survival tests that have been conducted in the FCRPS over the past 15 years where operations were not met as planned for in the study design.

Bonneville Dam

In 2008, a juvenile survival study was conducted at Bonneville Dam for yearling Chinook, steelhead, and subyearling Chinook. This study was implemented to study differences in juvenile survival between deep and shallow flow deflectors in spill bays. However, actual spill far exceeded the planned 100 Kcfs for all but five days of the April 29 to May 27 period of the spring study. Spill over the second half of the spring study averaged 169 Kcfs with a high daily average of 231 Kcfs. Summer spill was planned as 85 Kcfs day/gas cap night and from June 15 through July 13 and was met only for the last ten days of the study period. The study's authors conclude that high spill levels precluded observations of the mechanisms of survival differences between flow detectors, so the study could not fulfil the original purpose.

In 2009, a juvenile survival study was conducted at Bonneville dam in the spring to evaluate the efficacy of the behavioral guidance structure at the second powerhouse for yearling Chinook and steelhead. The planned operation of 100 Kcfs was kept only from the first 20 days of the study. During the last 8 days of the test, spill averaged 142 Kcfs. In addition to high spill levels, the unexpected outages of turbine 15 in the spring and turbine 11 in the summer test periods changed not only project operations, but juvenile passage routes and survival. The study operations do not reflect normal operations and test results comparing BGS operations have limited applicability to other years.

In 2010, a summer survival study for subyearling Chinook was planned to have 16 treatments, each consisting of 2-day blocks of 95 Kcfs (24 hours) and 85 Kcfs (day)/gas cap (night). However, operations were not maintained for the first part of the study, from June 15 through July 1. This eliminated half of the treatments, leaving only 8 treatments between July 2 and July 18. No difference in survival was found between the two treatments, however, it is unclear if this is due to the reduction in power of the test resulting from the elimination of half of the study period.

In 2011, spring survival testing for yearling Chinook and steelhead was conducted. The operation to be tested, 100 Kcfs spill, was only kept from April 27 to May 12. Between May 13 and the end of the study on May 31, daily average spill was 242 Kcfs, more than double the planned operations. The inability to keep the planned study operations makes the results inapplicable to other years.

The Dalles Dam

In 2011, a performance survival test was conducted at The Dalles Dam for yearling Chinook and steelhead. Planned spill for the spring study was 40%. This operation was only maintained for the first half of the study (April 29 through May 17) and averaged over 50% for the second half of the study. Survival estimates for the first half of the study were calculated separately due to the differences in operations.

John Day Dam

In 2008, juvenile survival at John Day Dam was tested for yearling Chinook, steelhead, and subyearling Chinook. To test the differences in survival under different spill operations, spill was planned in blocks of four days, each block consisting of two days of 30% spill and two days of 40% spill. Of the seven blocks in the spring period of May 4 through May 20, only the first three were maintained, meaning that spill levels did not conform to study operations for more than 50% of the test. In the summer period of June 17 through July 15, only the final two of the planned blocks were maintained. This reduced the power of the comparison between the operations, and results of the comparison could not determine if there is a difference in survival between the operations.

In 2011, a performance survival study was conducted for yearling Chinook and steelhead, which included the intent of comparing survivals between 30% and 40% spill levels. Only the first half of the season, April 27 through May 16, had blocks that maintained the planned spill levels. The second half of the study, May 17 through May 30, spill levels exceeded all planned blocks. This limited comparisons between blocks to only the first part of the migration and could not detect a difference in survival between operations.

In 2012, a performance survival was conducted for yearling Chinook, steelhead, and subyearling Chinook. This study included a block design to compare fish passage conditions, including survival, at 30% and 40% spill levels. These spill blocks were not met for the entire spring and summer periods. Instead, survivals were estimated for the entire combined season with spill levels above 30%. The survival estimates generated from this study cannot be used during planned operations in future years.

McNary Dam

In 2006, a study was conducted at McNary Dam to test survivals of yearling and subyearling Chinook under two spill operations. Blocks were to contain two treatments, one of 40% spill for 12 hours and no spill for 12 hours, and the other to have 24 hours of 40% spill. However, high flows made it impossible to maintain blocks for the study period. Spill was approximately 50% for the entire spring study, so no differences in operations could be studied.

In 2008, a study was conducted at McNary Dam to compare survivals of subyearling Chinook under 40% and 60% spill operations. However, spill could not be maintained to the block design for the first four blocks, between June 18 and July 3. Between July 5 and July 28, 6 blocks were able to maintain the planned operations. The power of the comparison was significantly reduced due to the loss of 40% of planned study blocks.

In 2012, a performance survival study was conducted for yearling Chinook, steelhead, and subyearling Chinook. The planned spill of 40% during the spring study actually ranged from 40% to 70% and averaged 54% for the season. The planned summer spill of 50% ranged from 52% to 73% and averaged 61%. The operations could not be maintained to conduct the study as planned.

In 2014, a performance survival study was conducted for yearling Chinook, steelhead, and subyearling Chinook. The planned spill of 40% during the spring study actually ranged from 41% to 61% and averaged 53% for the season. Only summer operations were able to be maintained to conduct the study as planned.

Ice Harbor Dam

In 2006, a study was conducted at Ice Harbor Dam to test survivals of yearling Chinook and steelhead. Planned operations required 2-day blocks alternating between 45 Kcfs (day)/gas cap (night) and 30% - 40%. While some of these blocks could not be maintained due to river flows, the report is not clear about the number of blocks that were eliminated and the impact on the comparisons made in the study.

In 2008, a survival study was conducted at Ice Harbor Dam for yearling Chinook, steelhead, and subyearling Chinook. As in 2006, planned operations required 2-day blocks alternating between 45 Kcfs (day)/gas cap (night) and 30% - 40%. However, these operations could only be maintained through after the first 2 weeks of the study. For the second half of the spring study and the entire summer study, spill levels exceeded 40%. No comparisons were able to be made between blocks.

In 2009, a survival study was conducted at Ice Harbor Dam for yearling Chinook, steelhead, and subyearling Chinook. As in 2006, and 2007, planned operations required 2-day blocks alternating between 45 Kcfs (day)/gas cap (night) and 30% - 40%. However, these blocks could not be maintained through the final third of the spring study, forcing the creation of a "third block" of more than 50% spill. However, low sample size precluded the comparisons of spill operations during the spring study.

Lower Monumental Dam

In 2012, a performance survival study was conducted for yearling Chinook, steelhead, and subyearling Chinook. Spill levels were planned to reach the gas cap of 115%. However, high flows meant that the gas cap spill was exceeded for the first half of the spring study. Survival estimates had to be split into two periods, making differences in seasonality and other factors difficult to determine and reducing the applicability of the study.

Little Goose Dam

In 2012, a performance survival study was conducted for yearling Chinook, steelhead, and subyearling Chinook. Spill levels were planned at 30%. However, high flows meant that planned spill was exceeded for the first half of the study (April 28 through May 10). Survival estimates had to be split into two periods, making differences in seasonality and other factors difficult to determine and reducing the applicability of the study. Summer spill exceeded the planned spill by 30% for the entirety of the season, with an average of 38% and a high of 61%. The results from the planned 2012 study cannot be applied to other years due to the inability to control operations.

Lower Granite Dam

In 2002, a study at Lower Granite Dam was carried out with the intent of comparing fish passage at spill high spill levels without the removable spillway weir (RSW) and low spill levels with the RSW. The study included many unplanned operations of varying times due to an inability to maintain the planned study blocks. The operations under study were not able to be compared due to the forced change in operations.

In 2005, a study at Lower Granite Dam was conducted to compare fish passage with and without the behavioral guidance system (BGS). During the spring study of yearling Chinook and steelhead, low flows prevented the planned treatments. Instead, there was no spill during 68% of the study period and low spill levels for the remaining 32% of the study. The study could not represent normal passage years due to the inability to maintain operations.