



FISH PASSAGE CENTER

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MEMORANDUM

TO: FPAC

FROM: Michele DeHart

DATE: May 12, 2010

RE: Estimated spill volume, survivals, and spill passage at Ice Harbor under FOP Operations versus IDFG Proposed 50%/50% spill operation

Several FPAC members requested that the FPC review the subject Ice Harbor SOR submitted by the Idaho Department of Fish and Game (IDFG) to assess the potential biological benefit of implementing the SOR. The SOR submitted by IDFG proposes to change spill at IHR Dam to a flat 50% spill. FPAC was advised that the justification for this request came from the data presented in the draft report: "Passage Behavior and Survival of Radio-Tagged Yearling and Subyearling Chinook Salmon and Juvenile Steelhead at Ice Harbor Dam, 2009" (Axel et al, 2010). The FPC reviewed the draft report and using the data from this report, the FPC staff has modeled expected spill volumes at Ice Harbor Dam (IHR) under three spill scenarios: 1) the current operations outlined in the Fish Operations Plan (FOP Operations), 2) the IDFG SOR Proposal (50%/50% spill), and 3) the BIOP operation which is spill of 45 Kcfs/Gas Cap for the entire period. In addition to modeling spill volumes, we also modeled juvenile dam survival and proportions passing through spill at IHR under these three scenarios.

Although the primary focus of the IDFG SOR was the draft report of radio tagged fish at Ice Harbor in 2009 (Axel et al. 2010), recent analytical results of salmon life cycle indicate that spillway passage affects survival throughout the life cycle. Chinook adult returns declined with multiple passages through powerhouses at dams (Petrosky and Schaller, 2010). Analyses conducted by NOAA Fisheries in development of the Biological Opinions showed that smolt to adult return rates for Chinook and steelhead were related to arrival time at Bonneville Dam, and that multiple bypass passage reduced smolt-to-adult return rates (Scheurell and Zabel,

2007). Model analyses conducted of life cycle survival for Chinook and steelhead showed that spill proportion and flow are two of the primary variables affecting adult returns (Schaller and Haeseker; CSS Annual Review presentation, April 2, 2010). Comparison of study results from radio tag studies conducted in the same years as the McNary transport studies revealed differing results. The radio tag studies showed a markedly higher relative benefit of bypass passage for yearling spring summer Chinook, compared to the ratio of bypass SARs to spillway SARs. This suggests that short reach radio tag survival estimates may provide misleading data for passage management decisions (FPC memo, February 17, 2010). This may be because short reach radio tag survival estimates can not account for the long term life cycle benefits of spill passage that are emerging from life cycle analyses. Consideration of the life cycle analysis and project survival and passage analysis indicate that a prudent management objective may be to maximize the proportion of fish passing the project in spill as long as gas cap limits are not violated.

Below is a brief synopsis of our findings, followed by a more detailed overview of the analysis and results.

- Assuming the FOP Operations from May 12th to August 31st, the total estimated spill volume was 5.90 KAF. The IDFG Proposal resulted in a total estimated spill volume of 5.02 KAF over this same period. At 7.26 KAF, the BiOp Operation resulted in the highest spill volume for this period.
- The draft report (Axel et al. 2010) showed higher estimates of dam survival under the FOP Operations (45 Kcfs/Gas Cap and 30%/30%) than under a 50% spill operation, for both yearling Chinook and steelhead. However, these differences in dam survival were not statistically significant for either species.
- Modeling efforts showed that the FOP Operations resulted in higher survivals to the IHR tailrace for yearling Chinook and steelhead than did the IDFG Proposal.
- Modeling efforts showed that the FOP Operations resulted in a larger proportion of the yearling Chinook, steelhead, and subyearling Chinook populations passing IHR through spill than did the IDFG Proposal. However, by far the highest proportion of fish passing in spill is obtained with the BiOp operations.

Idaho Department of Fish and Game (IDFG) recently submitted an SOR requesting a 50%/50% spill operation at IHR for the remainder of the year. The SOR states that this operation will result in increased adult return rates for Chinook and steelhead passing IHR through 50% spill, as compared to the current FOP operations. This is based on the notion that this operation will increase the proportion of juveniles passing IGR through spill. Currently, the FOP calls for alternating 45 Kcfs/Gas Cap vs. 30%/30% spill operations in 2-day blocks through June 21st. The schedule after June 21st is unknown but assumed to be similar to what was seen in 2009. In 2009, these 2-day blocks continued through July 11th, in which case the 45 Kcfs/Gas Cap operation was carried out through August 31st. As mentioned above, we also modeled a third operational scenario, one that involved 45 Kcfs/Gas Cap spill for the entire period.

In order to evaluate the IDFG proposal against the FOP Operation and the BiOp Operation, we: 1) estimated the volume of spill expected under these three operational scenarios; 2) estimated dam survival under each operation using the data presented in the draft report; and, 3) estimated the proportion of fish that would pass in spill under each operation.

Spill Volume Analysis:

Based on the FOP, IHR has a “powerhouse minimum” of 8.5-10.3 Kcfs. In addition, approximately 1.0 Kcfs flows past the project as miscellaneous flows (e.g., adult fishway). Therefore, we assumed a “powerhouse minimum” of 10.5 for the spring period and 10.0 for the summer period. The FPC staff also assumed a spill cap of 95 Kcfs for the entire season. Finally, the 2009 summer FOP indicates a minimum spill at IHR of 15.2 Kcfs when flows are sufficiently low. We assumed this minimum spill level would be in effect in 2010 as well.

The FPC staff modeled spill under the three scenarios outlined above in order to determine whether the three scenarios resulted in differences in spill volumes. To do this, we relied on the May 10th STP modeling effort to predict what the daily flows at IHR would be from May 12th to August 31st. The FOP Operations resulted in an estimated spill volume of 5.90 KAF, while the IDFG Proposal resulted in an estimated spill volume of 5.02 KAF (Table 1, Figure 1). The BiOp operation resulted in the highest total spill volume of 7.26 KAF.

The majority of the difference in spill volume between the FOP Operation and the IDFG Proposal came in the period from July 1st to August 31st. The primary reason for this difference in spill volume in the July 1-August 31 period is the fact that the FOP Operation calls for 45 Kcfs/Gas Cap spill from July 11th to August 31st. Due to the expected low flows in 2010, the average proportion spill during this time is 0.69, whereas that for the IDFG Proposal is 0.50.

Table 1. Estimated spill volume (KAF) under FOP Operations, IDFG Proposal, and BiOp Operation for period of May 12th to August 31st.

Time Period	FOP Operations (45 Kcfs/GC vs. 30%/30%)	IDFG Proposal (50%/50%)	BiOp Operation 45 Kcfs/Gas Cap
May 12 - June 30	3.21	2.98	4.44
July 1 - August 31	2.69	2.04	2.82
Total (May 12-Aug 31)	5.90	5.02	7.26

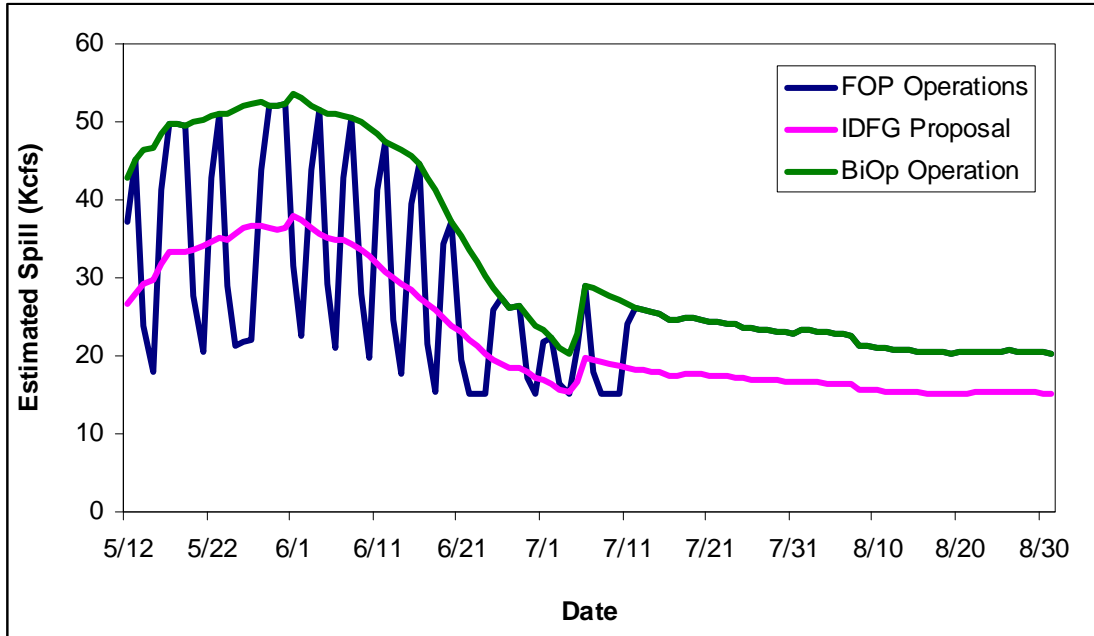


Figure 1. Estimated spill at Ice Harbor Dam under the 2010 FOP Operations, IDFG Proposed Operation, and BiOp spill operations.

Smolt Dam Survival:

Table 2 provides a synopsis of the survival data provided in the draft report: “Passage Behavior and Survival of Radio-Tagged Yearling and Subyearling Chinook Salmon and Juvenile Steelhead at Ice Harbor Dam, 2009” (Axel et al. 2010). To determine the average dam survival of juvenile yearling Chinook and steelhead, we applied these survival estimates to the corresponding operations under the FOP Operations, the IDFG Proposal, and the BiOp Operation. We assumed a daily population of 500 fish per day from May 12th to June 30th. We stopped at June 30th because of the low passage numbers of yearling Chinook and steelhead after June 30th. We did not expect to demonstrate a significant difference in survival using the data from this report. However, we conducted the analysis for illustrative purposes.

Based on the survival estimates in the draft report (Axel et al. 2010), we estimated that, under the FOP operations, 90.9% of yearling Chinook survived to the tailrace, whereas that for the IDFG Proposal was 89.5%. For steelhead, the differences in survival were slightly larger, with 90.8% survival under the FOP Operations and 88.1% survival under the IDFG Proposal. As one would expect, the BiOp Operation resulted in dam survivals of 89.7% for yearling Chinook and 91.1% for steelhead.

Table 2. Dam survival estimates for yearling Chinook and steelhead presented in Tables 1-3 of the 2009 draft report (Axel et al. 2010).

Species	Dam Survival (%) (forebay BRZ to tailrace)		
	FOP Operations		IDFG Proposal
	45 Kcfs/Gas Cap	30%/30%	50%/50%
Yearling Chinook	89.7	92.2	89.5
Steelhead	91.1	90.4	88.1

Proportions Passing Through Spill:

Estimating the proportion of the juvenile population that would pass IHR through spill required three things: 1) a daily population passing the project, 2) an estimate of daily spill proportion, and 3) an estimate of Spill Passage Efficiency (SPE) for each spill proportion. For this modeling effort, we assumed a daily population of 500 yearling Chinook, 500 steelhead, and 500 subyearling Chinook passing IHR. As above, we assumed yearling Chinook and steelhead passed IHR from May 12th to June 30th, while subyearling Chinook passed IHR from June 1st to August 31st. Daily average spill proportions under each of the operational scenarios (FOP Operations, IDFG Proposal, and BiOp Operation) were taken from the spill volume analysis presented above. Estimates of daily Spill Passage Efficiency (SPE) were based on the regression equations provided in the documentation for NOAA’s COMPASS Model. These regressions predict an SPE from the estimate of daily spill proportion. Currently, the COMPASS model does not include SPE estimates for subyearling Chinook. However, for this exercise the SPE estimates for yearling Chinook were assumed for subyearling Chinook in order to have some comparison of the change in fish passage under the two operational scenarios.

Daily population estimates were summed over the entire period when fish were assumed to be passing (May 12-June 30 for yearling Chinook and steelhead, June 1-August 31 for subyearling Chinook) for an estimate of total population. The daily SPE estimates were applied to the daily population estimates in order to estimate the daily population passing the project through spill. This proportion passing through spill for the entire passage period was estimated as the total spilled population divided by the total population for that period. Table 3 summarizes the results from this analysis.

For all three species, the BiOp Operation resulted in the largest proportion of the population passing IHR through spill (Table 3). The difference in proportion passing between the BiOp Operation and the other two operations were large; 0.18-0.21 for yearling Chinook, 0.16-0.17 for steelhead, and 0.08-0.18 for subyearling Chinook.

Between the FOP Operations and the IDFG Proposal, the FOP Operation resulted in the largest proportion of the population passing IHR through spill for all three species. However, for yearling Chinook and steelhead, these differences were small (0.01-0.03) but for subyearling Chinook this difference was quite large (0.10).

Table 3. Estimated proportion of the population of yearling Chinook, steelhead, and subyearling Chinook passing IHR through spill under the FOP Operations versus the IDFG Proposal.

Species	FOP Operations	IDFG Proposal	BiOp Operation
	45 Kcfs/GC vs. 30%/30%	50%/50%	45 Kcfs/Gas Cap
Yearling Chinook	0.65	0.62	0.83
Steelhead	0.72	0.71	0.88
Subyearling Chinook	0.71	0.61	0.79

Even though the FOP Operation calls for a lower spill level at times (30%/30% spill), the 45 Kcfs/Gas Cap portion of this operation compensates for the reduced SPE during this period, particularly after July 11th, when IHR spill is set at this level through August 31st.

Conclusions:

Under the low flow conditions expected in 2010, it appears unlikely that the IDFG Proposal will result in more Chinook and steelhead juveniles passing IHR through spill than the current FOP operations based on the analyses conducted here. The BiOp Operation would maximize the proportion of the juvenile population that passes through spill, based on this analysis. This is primarily due to the differences in spill proportions under these three scenarios. Under the BiOp Operation, the average spill proportion over the entire season (May 12th – August 31st) was 0.71, whereas that for the FOP Operations was 0.61 and 0.50 under the IDFG Proposal. Furthermore, the draft COE report indicates that the dam survivals for yearling Chinook and steelhead under the FOP Operations will be higher than under the IDFG Proposal. Dam survivals under the BiOp Operation would be slightly lower for yearling Chinook but higher for steelhead than under the FOP Operations. While there are differences in spill volumes, proportions passing through spill, and juveniles survivals between the FOP Operations and IDFG Proposal, we do not see a clear biological benefit with either operation. However, we do see a biological benefit to operating under the BiOp Operation, as this clearly resulted in the highest proportion of the population passing through spill (Table 3).

Literature Cited:

Axel, G.A., E.E. Hockersmith, B.J. Burke, K. Frick, B.P. Sanford, W.D. Muir, R.F. Absolon, N. Dumdei, J.J. Lamb, and M.G. Nesbit. 2010. Passage behavior of radio-tagged yearling and subyearling Chinook salmon and juvenile steelhead at Ice Harbor Dam, 2009 (DRAFT).

FPC Memo:

February 17, 2010 - [COE proposal regarding increase smolt transportation at McNary Dam](http://www.fpc.org/documents/memos/16-10) (<http://www.fpc.org/documents/memos/16-10>).

Petrosky, C. and H. Schaller. 2010. Influence of river conditions during seaward migration and ocean conditions on survival rates of Snake River Chinook salmon and steelhead. *Ecology of Freshwater Fish*.

Schaller, H. and S. Haeseker. Environmental and management influenced variables affect survival rates. *Comparative Survival Study Annual Review*. April 2, 2010.

Scheurell, M. and R. Zabel. 2007. Seasonal differences in migration timing lead to changes in the smolt-to-adult survival of two anadromous salmonids. Northwest Fisheries Science Center.



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DATA REQUEST FORM

Request Taken By: Margaret Filardo Date: May 12, 2010

Data Requested By:
Name: FPAC (Charlie Morrill) Phone: _____
Ron Boyce Fax: _____
Address: _____ Email: _____

Data Requested:
Review IDFG JIR and assess biological
benefit to implementation over current FOP
operation

Data Format: Hardcopy Text Excel
Delivery: Mail Email Fax Phone

Comments:

Data Compiled By: Brandon Date: 14-May-2010

Request # 36