



FISH PASSAGE CENTER

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MEMORANDUM

TO: Rick Kruger, ODFW

FROM: Michele DeHart

DATE: March 19, 2013

RE: Performance Testing at Lower Monumental and Little Goose Dams, 2009 and 2012

In response to your request, the FPC staff has reviewed radio tag studies performed at Lower Monumental and Little Goose Dams in 2009. The COE has proposed using these studies to show compliance with performance requirements outlined in the Biological Opinion, although these studies were not conducted with this intention. FPC also reviewed 2012 performance testing at Lower Monumental and Little Goose Dams on February 11, 2013 (see attached). An overview of performance testing comments was also provided on January 4, 2013 (also attached).

This memo provides a brief summary of issues related to the 2009 radio tag tests. Many of these issues are also outlined in previous FPC Memos (June 24, 2009; July 29, 2010; Feb 16, 2011; March 24, 2011; June 21, 2011; Feb 15, 2012; March 16, 2012; March 23, 2012; Jan 4, 2013) and are pertinent to these studies as well. Additionally, we have found numerous concerns specific to using the 2009 testing for compliance. These concerns include:

1. High rejection rates for sampled fish.
 - If significant numbers of fish are excluded from a study because they are too small for tag insertion, or not sufficiently healthy to survive tag implantation, then it is questionable if the results are applicable to the run at large. This issue has

been raised relative to all the performance standards testing thus far and is a significant concern in 2009 studies.

- The summary of 2009 testing provided to SRWG on March 8, 2013, is difficult to interpret with regards to rejection rates. For Little Goose Dam, the reported rejection rate in the summary for Yearling Chinook is 0% rejection due to size and < 2% rejection due to condition. However, the 2009 report states a rejection rate of 13% due to size for Yearling Chinook. This indicates that the rejection rates provided in summary to SRWG were potentially calculated AFTER fish that were too small to mark had already been rejected. By taking the data from the summary and the 2009 report we can surmise the rejection rate was greater than 15%, but the actual rate is not available.
- Rejection rates for Lower Monumental in 2009 were not reported during the study. Rejection rates were estimated post-hoc from condition reported conducted by the SMP and ranged from 4 to 10%. However, the SMP does not record condition or magnitude of condition in the same categories used by performance testing in 2012. For instance, an “injury” recorded in the SMP gives no indication of the severity of the injury and if the injury would disqualify the smolt from testing. If all conditions are recorded by the SMP were also used as testing criteria in 2009, the SMP data could be used to estimate maximum rejection rates. However, the selection criteria used for fish condition are not available for 2009 studies and it is known they differed from the criteria used in 2012. It is possible that criteria were used to reject fish that were not counted by the SMP project. In that case, rejection rates could be higher than those estimated by the SMP.

2. Tag burdens.

- The tag burden can be significant for smolts, and may affect behavior such as choice of passage route due to impairment of swimming ability. A tag burden, defined as the ratio of tag weight to body weight, is some indication of the potential effects on fish behavior and mortality. Tag burdens from 2 to 4% have been used and recommended in the Columbia basin for smolts of this size (Winter 1983, 1996, 2000 and Zale 2005).
- The radio tags used in 2009 studies were significantly larger than the JSATS tags currently in use, with a maximum tag burden of 5%. Radio tags weighed 0.80 g and 0.64 g at Lower Monumental and Little Goose respectively, in comparison to 0.346 g for the JSATS tags used in 2012. Tag burdens of this magnitude may have a significant impact on swimming behavior, which will affect the choice of passage route and overall dam survival estimates. Fish with large tag burdens may be less able to avoid predators, which may disproportionately affect smolts released directly into the tailrace of the dam as controls.

3. Release-Control vs. Virtual-Paired Release study design.

- The tests in 2009 were conducted with a single control group released in the tailrace. This study design has since been abandoned in favor of the Virtual-Paired Release design, to avoid inflation of survival estimates due to high mortality in the control group. Consequently, adjusted survival estimates from 2009 are not comparable to the adjusted estimates generated for 2012.
4. Locations of release groups.
- The significance of where control groups are released has been a topic of discussion at numerous SRWG meetings. The control group must be released in a distribution that is representative of the distribution the treatment fish will assume upon passage through the dam. If not, the survival estimates of the control group used to adjust dam survival are being misused.
 - The release points for control groups in the 2009 studies are not the same release points used in the 2012 studies. This may have a significant impact on control group survival rates and therefore on the adjusted survival rates from 2009.
5. Subyearling Chinook
- Subyearling Chinook tests in 2009 not only rejected large numbers of smolts due to size at both Lower Monumental (57%) and Little Goose (44%), but these studies also missed large portions of the run (65% and 46%, respectively). Results from these studies should not be accepted as having met performance standards outlined in the Biological Opinion.

The following table provides survival estimates and rejection rates from each study conducted at Lower Monumental and Little Goose Dams in 2009 and 2012. Information in this table is from actual reports as well as summary information provided to SRWG.

Year	Site	Run	Survival Estimates			Rejection Rates	
			Single-Release	Control	Adjusted	Size	Condition
2009	LGS	CH1	96.1%	96.7%	99.4%	13.0%	2%*
2012	LGS	CH1	95.8%	96.9 - 99.4%**	98.2%	0.5%	4.3%
2009	LMN	CH1	95.0%	97.4%	97.5%	6%***	<4%***
2012	LMN	CH1	97.1%	95.8 - 97.4%**	98.7%	0.5%	4.3%
2009	LGS	ST	99.4%	99.6%	99.8%	0.0%	2%*
2012	LGS	ST	97.1%	96.2 - 98.6%**	99.5%	0.0%	6.6%
2009	LMN	ST	96.9%	99.2%	97.6%	0%***	<10%***
2012	LMN	ST	98.3%	93.2 - 93.2%**	98.2%	0.0%	6.6%
2009	LGS	CH0	84.0%	88.2%	95.2%	44.0%	Unknown
2012	LGS	CH0	92.7%	92.6 - 95.3%**	95.4%	4.0%	2.2%
2009	LMN	CH0	90.7%	97.5%	93.0%	57.0%	2%*
2012	LMN	CH0	94.2%	93.4 - 97.1%**	97.9%	4.0%	2.2%

* Rejection rate estimated from sample after initial rejection

** Survival Estimates from R2 and R3

*** Estimated from SMP, not from report data



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MEMORANDUM

TO: Tom Lorz, CRITFC
Michele DeHart

FROM: Michele DeHart

DATE: February 11, 2013

RE: 2012 Performance Testing at Lower Monumental and Little Goose Dams

In response to your request, the FPC staff has reviewed the draft PNNL reports prepared for the US Army Corps of Engineers titled “BiOp Performance Testing: Passage and Survival of Yearling and Subyearling Chinook Salmon and Juvenile Steelhead at Little Goose Dam, 2012” and “BiOp Performance Testing: Passage and Survival of Yearling and Subyearling Salmon and Juvenile Steelhead at Lower Monumental Dam, 2012.” These studies raise several concerns about study conditions, experimental design, and the analyses.

This memo provides a brief summary of issues specific to 2012 testing at Lower Monumental and Little Goose Dams. There are a number of concerns that have been raised in previous FPC Memos (June 24, 2009; July 29, 2010; Feb 16 2011; March 24, 2011; June 21, 2011; Feb 15, 2012; March 16, 2012; March 23, 2012) and were summarized in an FPC Memo on January 4th, 2013. These issues include spill levels, survival inflation through usage of the Virtual-Paired Release design, rejection rates of tagged fish, mortality in control groups, smolt behavior potentially biasing results, and the failure of evaluation to take into account factors other than concrete survival, such as latent mortality. All of these issues also apply to the 2012 studies. These issues are addressed in detail in previous reviews, and therefore they are not repeated again in this review. The issues discussed in previous reviews are significant and provide an adequate basis to question the applicability of these study results to operations management decisions. Additional concerns raised by the 2012 studies may further limit the applicability of results. These concerns include:

- High flows in 2012 created spill levels greater than court-ordered spill through much of the performance testing. Survival estimates from smolts released during high spill should not be extrapolated to generate survival estimates during normal or low flow years.

- Rejection rates for tagging average 6% of smolts. This means that survival estimates represent survival only for the healthiest 94% of the population, and survival estimates are likely be considerably lower for the run-at-large.
- Many of the control group releases had low survivals in comparison to the V₁ group that passes through at least one project. This raises concerns that upriver release of the V₁ group may eliminate weaker fish before inclusion in the V₁ group, while control groups include all tagged fish. This will distort survival estimates.
- The detection of dead smolts at Little Goose Dam violates the basic assumptions of the study design and requires correction factors that have not been used in these studies before. These corrections add an additional potential source of error in the analyses.



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MEMORANDUM

TO: Charlie Morrill, WDFW

Michele DeHart

FROM: Michele DeHart

DATE: January 4, 2013

RE: Summary of Comments on Performance Testing

At your request, we have reviewed and summarized the comments and analyses that the FPC has previously made regarding Performance Testing in the Columbia and Snake Rivers. These include three years of testing at The Dalles, John Day, and Bonneville (2010 – 2012) and one year of testing at McNary, Lower Monumental, and Little Goose (2012). We have also included comments on the most recent performance standards test which have not been previously reviewed due to the unavailability of final results. This memo also gives an update as to the status of concerns that have been raised by salmon managers.

To pass performance testing, forebay to tailrace survival benchmarks must be met (96% for yearling Chinook and Steelhead, 93% for subyearling Chinook) with a standard error equal to or less than 0.015. Although these requirements have been met for some species in some years at some dams, we have serious concerns about the applicability of these results to the requirements of the Biological Opinion. Many concerns have not been addressed, or have been addressed in later studies while still accepting the potentially flawed results of earlier tests. Recent studies on oceanic survival and adult returns also cast into doubt the connection between passing performance standards and recovery of salmonid populations. Below you will find an outline of our concerns, followed by a detailed description of each.

- Although the results of performance tests are being used for management decisions and to determine which standards have been met, the final reports are still not available for 10 of 12 performance tests completed to date. As of December 2012, final reports have only been completed for The Dalles and Bonneville in 2010. Three years of performance testing have been completed at John Day without a single final report being made available to salmon managers. The dates for receiving summary, draft, and final reports are not clear and are consistently not met.

- During many tests, actual operations such as spill levels have not conformed to the FOP. Although these modifications to spill level have been unavoidable due to high flows and/or turbine outages, they significantly reduce the applicability of the results to other years.
- The use of the Virtual-Paired Release design has the potential to artificially inflate dam survival if mortality is unequal in the two control groups. Although this has been shown to not affect the results for some tests in some years, the considerable inflation of dam survival estimates for McNary Dam in 2012 is especially concerning. Before results of this study design are accepted, a careful examination of this effect should be conducted.
- There are a number of places in the Virtual-Paired Release design where the study fails to represent the run of the river.
 - Due to size and fish condition, not all smolts can be tagged with the JSATS tags used in the performance studies. The number of fish rejected indicates that the study fish do not represent the run of the river, and so the results may not be applicable to estimating overall survivals. These rejection rates have been reduced since the first tests in 2010, but 2010 results are still being accepted as having met the standards.
 - The Virtual Release group is released upriver and included in the dam-passage study group upon reaching the forebay of the dam. For some performance standards testing, V_1 fish have passed through multiple dams. The distance between the actual release and the forebay of the dam represents considerable potential for selection against smaller, weaker fish.
 - Performance testing uses only fish that have survived at least one juvenile bypass facility. If these fish have a behavior that predisposes them to juvenile bypass facilities, or physical characteristics that increase the probability of bypass survival, results obtained from these fish will not represent the run at large.
- A public database for raw and processed data, when available with detailed descriptions of post-hoc inclusion and rejection of data, would make outside evaluation more straightforward.
- Although the performance testing generates a series of easily testable checkmarks for compliance with regards to survival from one side of a dam to the other, they do not measure a myriad of impacts that dam operations have on the recovery of salmon populations. Smolts passed through bypass facilities are known to have lower survival through the estuary and oceanic stages than fish that pass without detection. Forebay residence time and water travel time have both been shown to have an impact on adult returns. These performance standards should not be expected to indicate the effect that the hydrosystem has on recovery of salmonid populations. Performance standards should be a single component of a decision making framework that includes multiple population metrics.

Performance Tests Lack Final Reports

The information on performance tests that have been made available for 2011 is not sufficient for the complete evaluation necessary for salmon managers before accepting performance standards as met. Apprising factors such as sample size, rejection rates, and the effects of multiple release groups on the final estimates require full and complete reports.

On August 13, 2012, there was an SRWG meeting to discuss the possibility of using survival estimates from studies that were carried out before performance testing in 2010. If past results are used, some performance criteria will have been met for two years, removing the need for future performance testing. On this basis, performance tests for 2013 may be cancelled. However, the data needed for accepting old studies, such as rejection rates, have also not been made available. Therefore, performance criteria are being considered as met, without any reports having been made available for evaluation.

High Flows in 2011 and 2012 Limit Applicability of Results

In both 2011 and 2012, spill levels during performance testing were much higher than those outlined in the FOP. Although survival estimates may meet the minimum requirements of performance testing, they reflect survivals only during periods of high flow and high spill, and have limited applicability to normal or low-flow water years. This issue has previously been outlined in an FPC Memo on February 15, 2012.

Inflated Survival Estimates Due to Experimental Design

The virtual/paired-release design used in most of the performance tests utilizes two control groups, one released in the tailrace of the dam (R_2) and one released further downstream (R_3). The R_3 group is intended to account for any handling mortality experienced by the R_2 group which could inflate survival estimates.

Under this experimental design, however, upward biasing of survival estimates could be caused by high mortality in the R_2 group. It is unlikely that tagged fish in both stretches of river encounter the same environmental conditions, especially since predation rates are higher in the forebay and tailrace than mid-reservoir at many projects (Petersen 1994, Ward et al. 1995). If survival in the R_2 group is lower than survival in the R_3 group, the ratio of survivals (S_2/S_3) will be biased low and will artificially increase estimates of dam survival. Please see Beeman et al. (2011) and FPC Memos (March 24, 2011; February 15, 2012; March 23, 2012) for detailed descriptions upward biases inherent in this study design.

A further cause of differential mortality may be the fact that fish that are released at a specific location will not have the vertical or horizontal distribution of fish that have been released upriver. At The Dalles Dam, release of the R_2 group occurs near islands

downriver of the dam. At the February 6, 2012 SRWG meeting, concern was expressed that this release occurs in an equal distribution across the river, rather than attempting to mimic natural migration patterns. Therefore, it is unlikely that mortality will be equal between release groups and that these releases represent mortality of the run-at-large.

Survival estimates generated with this multiple-release design may further increased dam survival estimates due to random sampling effects, in some cases moving survival estimates upward enough to meet performance standards when they would not have with only one control group. If there is limited handling and transportation mortality, the use of the R₃ group will introduce additional variation to the study. Beeman et al. (2011) concluded that this result is “contrary to the goal of adjusting a paired-release estimate downward to account for handling mortality.”

An example of inflation due to experimental design is the performance testing results from McNary Dam in 2012. The single-release survival estimates were 0.9136 (Steelhead), 0.9171 (yearling Chinook), and 0.9149 (subyearling Chinook). None of these survival estimates met the performance testing criteria. After corrections with R₂ and R₃, these survival estimates were inflated to 0.9908 (Steelhead), 0.9616 (yearling Chinook), and 0.9747 (subyearling Chinook). In this case, the experimental design of the performance test has clearly artificially inflated dam survival estimates.

Another example of this inflation is reflected in survival estimates greater than 100%. Survivals of greater than 100% were reported for 3 route-specific estimates in 2011 and 5 estimates in 2012.

Study Fish May Not Represent Run at Large

JSATS tagging protocol require rejection of fish based on multiple criteria, including size and condition. In 2010, overall rejection rates (including those rejected for size or condition) were 16%. PNNL reports that these rejection rates have decreased for 2011 and 2012 studies, but because final reports have not been made available, actual rejection rates cannot be evaluated. Even if rejection rates are lower in recent studies, sampling only the healthiest portions of the population will inflate results relative to survival of the run at large. Also of concern is that rejection rates used in 2010 were deemed too high for future studies, but the results from these studies are still being used as acceptable results. This issue has been raised in previous FPC Memos (March 24, 2011; February 15, 2012; March 23, 2012).

In the Virtual-Paired Release design, fish are released upstream of the dam so they achieve a distribution through passage routes that reflects the run at large. Fish that die between tagging and the forebay of the dam are not included in the study. However, this means that fish that have lower survival through the reaches will not be included in the study. Mortality between tagging and detection was as high as 12.5% in yearling Chinook in 2012. As with the effects of tagging only healthy fish, this means that only the healthiest of tagged fish are included in the dam survival estimates.

Performance testing utilizes fish collected at the juvenile bypass unit at John Day Dam (lower Columbia testing) or Lower Monumental Dam (Snake River testing). These fish have successfully survived a minimum of one bypass, as fish that die in the bypass are not included in the study. Therefore, these fish may not represent the survival probabilities of previously undetected fish not included by the study design. Survival estimates greater than 100% for juvenile bypass systems may be due to this aspect of the study design.

JSATS Data Should Be in Public Database

Currently, the data collected during performance testing, both raw and filtered, is available only through request to the Army Corps of Engineers. However, this method is time consuming and can lead to confusion regarding analyses (see FPC Memos July 29, 2010; February 16, 2011; March 24, 2011; June 21, 2011). A publicly accessible database, such as that used for PIT-tag data, would minimize these types of discussions and could potentially make results available sooner than the current speed of receiving final reports.

Management Decisions Should Not Be Based On Single-Dam Performance Standards

Past FPC memos have reviewed performance standards testing throughout the hydrosystem (June 24, 2009; July 29, 2010; March 24, 2011; February 15, 2012; March 16, 2012; March 23, 2012). Repeatedly, these memos have raised concerns regarding the usage of these studies for project management decisions. Management decisions should reflect the entire life cycle of the fish, rather than survival at projects considered in isolation. All available data should be utilized, rather than ignored in favor of simplistic but out of date performance standards that do not reflect the current understanding of salmonid populations.

The long term effects of passage routes for juvenile fish have been well documented in recent years. Even fish that survive juvenile bypass systems or powerhouse passage are less likely to survive the first ocean year, and less likely to return as adults, than those that pass undetected through the hydrosystem (Haeseker et al 2012, Petrosky and Schaller 2010, Tuomikoski et al 2010, FPC Memos October 6, 2010; January 19, 2011; July 14 2011). These effects of project operations on these metrics are not included in the current performance testing requirements.

Acoustic tag studies provide only short-term survivals for specific projects, and current performance testing does not include important metrics like forebay residence time, travel time, or latent mortality. Performance testing cannot fully inform policy makers about methods for improving adult returns. We recommend a decision making framework for the Columbia Basin that will incorporate the strengths and limitations of each data type as part of a straightforward guide to the results of project operations.

References

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DATA REQUEST FORM

Request Taken By: Erin Cooper Date: March 19 2013

Data Requested By:

Name: Rick Kruger Phone: _____
Address: _____ Fax: _____
ODFW Email: rick.kruger@state.or.us

Data Requested:

review of 2009 LMN + LAS testing as potential
performance testing

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

Comments:

Request Made At FPAC

Data Compiled By: Erin Cooper Date: March 19 2013

Request # ~~1111~~ 110