FISH PASSAGE CENTER

847 NE 19th Avenue, #250, Portland, OR 97232
Phone: (503) 833-3900 Fax: (503) 232-1259
www.fpc.org/
e-mail us at fpcstaff@fpc.org

MEMORANDUM

TO: Jon Rerecich, U.S. Army Corps of Engineers

Michele DeHart

FROM: Michele DeHart

DATE: March 31, 2016

SUBJECT: Review comments on draft report *Passage Evaluation of Spring Creek Hatchery Subyearling Chinook Salmon at Bonneville Dam Second Powerhouse, 2015*

In response to your request to the Studies Review Work Group (SRWG), the Fish Passage Center staff has reviewed the draft report *Passage Evaluation of Spring Creek Hatchery Subyearling Chinook Salmon at Bonneville Dam Second Powerhouse, 2015* (Absolon and Sandford 2016) and offers the following comments for your consideration. Our overall conclusion is that there are considerable confounding factors in the study design and the analytical methods that raise serious doubts regarding the management application of the research results. Given the confounding factors in the study design, results from this study should not be considered as support for operating the turbines in the Bonneville Dam Second Powerhouse at the upper end of the 1% operating range. Furthermore, these confounding factors limit the use of results from this study in judging the effectiveness of the flow control plates and/or modifications to the vertical barrier screens (VBS) to improve gatewell conditions at the Bonneville Dam Second Powerhouse juvenile bypass system.

- We agree with the authors that results from this study should not be assumed predictive of results for other juvenile migrants, including juvenile sockeye and subyearling Chinook that did not originate from Spring Creek NFH.
- There are considerable confounding factors in the study design that raise doubts regarding the management application of the research results.
- The estimate of 3% mortality as the expected background or control effect (p_1) does not seem to be supported by previous studies (Gilbreath et al. 2012, Gilbreath et al. 2013).

Furthermore, it is unclear as to why the "background" mortality level used in these analyses is from the lower end of the 1% operating range.

- The mortality levels observed in slot 14A of Test Series 1 appear to be much higher than those observed under similar operations in Test Series 2 (slot 14A), previous studies involving Spring Creek NFH subyearlings, and observed mortalities from the SMP during similar periods. These unusually high mortalities observed in Test Series 1 (slot 14A) cast doubt as to the applicability of these study results.
- The significantly different recovery rates observed in Test Group 1 suggest that there are some other uncontrolled factors that are not related to the flow control device and raise considerable questions about the resulting survival estimation.
- The survival estimation methodology utilized by the authors does not take into account the large difference in tag recovery rates between the two treatments. This could result in an inflated survival estimate of the flow control plate, upper 1% treatment (Test Series 1, Slot 15A).
- We have concern with the hypothesis that most of the never-detected fish likely passed through the turbines, as increasing turbine passage would not be a desired outcome from flow control plates, modifications to the VBS, and/or operating at the upper end of the 1% operating range. Furthermore, if increased turbine passage is occurring, this study is underestimating the impacts of the Slot 15A treatment (Test Series 1), as increasing turbine passage likely increased mortality for this group.

Impacts to Other Species

As the authors note, the tests from this study focused solely on subyearling fall Chinook tules from Spring Creek NFH that were released at a single location within the turbine intakes. Therefore, assuming similar results for other species is not appropriate. In 2012, the Fish Passage Center was asked to conduct an analysis of operations data from the Bonneville Dam Second Powerhouse and juvenile sample mortality data from the Smolt Monitoring Program (SMP) (FPC 2012). These analyses revealed that the percent of units operating above the mid-range of the 1% operating range often had a significant effect on sample mortalities, particularly for subyearling Chinook, sockeye, and yearling Chinook. In general, as the percentage of units operating above the mid-range increased, mortality increased. Results from the FPC analysis (FPC 2012) indicated that sockeye and subyearling Chinook originating from locations other than Spring Creek NFH have experienced higher levels of facility mortality when turbines operate outside the mid-range. The focus on only Spring Creek Hatchery fall chinook limits the management application of these research results.

Confounding Factors

Test Series 1 includes two treatments that differ by several factors: (1) vertical barrier screen (VBS) configuration (modified versus standard), (2) presence or absence of flow-control plates, and (3) turbine operations (mid-range vs. upper end of 1% operating range). Therefore, it is difficult to determine to what degree the observed differences in mortality and residence times are due to any one factor or some combination of the three. Likewise, Test Series 2 includes two treatments that also differ in two factors: (1) vertical barrier screens (modified versus standard) and (2) turbine operations (mid-range vs. upper end of 1% operating range). Test Series 2 is further confounded because gatewell slots are known to have differing flows. Gilbreath et al. (2013) expressed this concern by stating that study fish were released at a single location within the intake, and "A" gatewells are known to have higher flows than "B" or "C" gatewells. With these confounding factors, it is difficult to assess how mortality and/or residence time may be affected by any one or combination of the two factors. Given the confounding factors in the two Test Series, it is difficult to determine a single causal effect related to mortality and/or residence time. Thus, the results from these studies may not be useful to inform management decisions.

Baseline Survival (p_1)

The estimate of 3% mortality as the expected background or control effect (p_1) does not seem to be supported by previous studies (Gilbreath et al. 2012, Gilbreath et al. 2013). Furthermore, it is unclear as to why the "background" mortality level used in these analyses is from the lower end of the 1% operating range that was tested in Gilbreath et al. (2012) and Gilbreath et al. (2013). FPC staff reviewed the two studies that were cited as the basis for the p_1 estimate (Gilbreath et al. 2012, Gilbreath et al. 2013) and cannot determine where the 3% background mortality rate is assumed from (Table 1). The average mortality rate among all the tests involving the lower 1% operating range (Intake 14A) was approximately 1.7% (Table 1). Among the tests of the middle 1% operating range (Intake 14A), the average mortality rate was about 4.3% (Table 1). Given that all the lower end of the 1% operating range was not used in the 2015 tests, it appears that the background mortality (p_1) should have been based on the mid-range of the 1% operating range. If one assumes a value of 4.3% for p_1, the necessary sample size to detect an effect size of 3% would increase.

Unusual Results (Test Series 1, Slot 14A)

The high mortality levels (20.9%) observed in Slot 14A of Test Series 1 appear to be much higher than those observed under similar operations in Test Series 2 (Slot 14A) and from previous studies (Gilbreath et al. 2012, Gilbreath et al. 2013) (Table 1). Although fish size differences likely account for some of the mortality differences between the two Test Series in 2015 (when comparing slot 14A) and results from previous year's studies, one would not expect differences in fish size or temporal differences to result in such dramatic differences in mortality levels as were observed in 2015.

Furthermore, if the mid-range operation actually resulted in mortality levels of 20%, we would have expected to see elevated levels of sample mortality in the SMP sample throughout the period when Spring Creek subyearlings were passing through the project. In 2015, Spring Creek NFH released subyearling Chinook on April 13th and April 27th. Peak passage of subyearling Chinook from these releases occurred from April 15–April 21 and April 29–May 3. During these periods, average sample mortality for subyearling Chinook in the SMP sample was only 1.06% (range: 0.0%–2.7%) and 0.26% (range: 0.0%–1.3%), respectively. Therefore, it is our conclusion that the unusually high mortalities seen in Test Series 1 (slot 14A) are suspect and cast doubt as to the applicability of these study results.

Table 1. Summary of results from other tests of bypass passage conditions at Bonneville Dam involving subyearling fall Chinook tules from Spring Creek NFH.

Study	Test Year	Test Series	Treatment	Mortality
Gilbreath et al. 2012	2008	Series 1	Collection Channel – Reference	0.3%
			Gatewell 12A – Lower 1%	1.9%
			Gatewell 12A – Middle 1%	14.2%
			Gatewell 12A – Upper 1%	32.3%
		Series 2	Collection Channel – Reference	0.5%
			Intake 14A – Lower 1%	1.7%
			Intake 14A – Upper 1%	6.0%
			Gatewell 14A – Lower 1%	4.4%
			Gatewell 14A – Upper 1%	5.8%
		Series 3	Collection Channel – Reference	0.0%
			Intake 14A – Lower 1%	1.3%
			Intake 14A – Upper 1%	12.0%
			Gatewell 14A – Lower 1%	0.8%
			Gatewell 14A – Upper 1%	5.9%
		Series 4	Collection Channel – Reference	0.2%
			Intake 14A – Middle 1%	2.7%
			Intake 14A – Upper 1%	18.1%
			Gatewell 14A – Middle 1%	1.3%
			Gatewell 14A – Upper 1%	12.5%
	2009	Early	Collection Channel – Reference	1.0%
			Intake 14A – Lower-Middle 1%	4.4%
			Intake 14A – Middle 1%	6.8%
		Late	Collection Channel – Reference	0.0%
			Intake 14A – Lower-Middle 1%	1.8%
			Intake 14A – Middle 1%	3.3%
Gilbreath et al. 2013	2013		Collection Channel – Reference	0.0%
			Intake 14A – No TRD, Lower 1%	2.1%
			Intake 14A – TRD, Upper 1%	19.1%
			Intake 14A – No TRD, Upper 1%	23.6%
Absolon and Sandford 2016	2015	Series 1	Collection Channel – Reference	0.0%
			Intake 14A – No plate, standard VBS, Middle 1%	20.9%
			Intake 15A – Flow plate, modified VBS, Upper 1%	2.1%
		Series 2	Collection Channel – Reference	0.0%
			Intake 14A – No plate, standard VBS, Middle 1%	2.1%
			Intake 15C – No plate, standard VBS, Upper 1%	0.6%

Note: TRD = turbulence reduction device; VBS = vertical barrier screens.

Survival Estimation Methods and Differing Recovery Rates between Treatments

Issues are apparent with the methodological approach of estimating mortality in this study. It appears that the mortality estimates are determined only from the recaptured tags. This approach differs from a Cormack-Jolly-Seber model that would use all the tags to estimate mortality, recognizing that later detection is not observed perfectly so there is a need to account for the probability of detection (i.e., expand the recaptured fish by an estimate of detection probability). When conducting control-treatment comparisons, all factors not related to the treatment should be equal so that it is possible to conclude that the treatment is indeed responsible for the pattern that is observed, and not some other exogenous factor. The survival estimation methodology utilized in this study does not take into account the large difference in recovery rates between the two treatments, particularly in Test Series 1. The lower recovery rate for the Slot 15A release could result in an inflated survival estimate for this group. In addition, the differences in recovery rates observed in Test Series 1 suggest that there are some other uncontrolled factors that are not related to the flow control plates, modifications to the VBS, and/or operating at the upper 1% of the operating range.

As the authors state, the fate of these never-detected fish could change the conclusions regarding differences in mortality levels between the two treatments. Of additional concern is that these never-detected fish likely passed through the turbines, as noted by the authors. This means that the installation of the flow control plates, modifications of the VBS, and/or operation of Unit 15 at the upper end of the 1% operating range likely increased turbine passage. If this is the case, this study is underestimating the impact to the Intake 15A treatment group, as increasing turbine passage likely increased mortality for this group. However, this increase in mortality is not accounted for in this study.

Literature Cited

Absolon, R.F. and B.P. Sandford. 2016. Passage evaluation of Spring Creek Hatchery subyearling Chinook salmon at Bonneville Dam Second Powerhouse, 2015. Draft Report of the National Marine Fisheries Service to the U.S. Army Corps of Engineers, Portland, Oregon.

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