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MEMORANDUM

TO: Brad Trumbo, COE

FROM: Michele DeHart

DATE: May 22, 2012

RE: CSS Annual Review response to comments

Following is the response to the questions you submitted to Steve Haeseker, USFWS, regarding the presentations at the April 12, 2012 Comparative Survival Study Annual Review meeting. The CSS Oversight Committee has reviewed your questions and provided the following responses. The Comparative Survival Study is a life cycle monitoring program which evaluates routes of passage. The CSS holds an Annual review meeting each April to present analyses and findings. The question and answer session at the end of the meeting is recorded and is transcribed and included in the CSS Annual Report along with the presentations. In this years' Annual Review we discussed new groups that had been added to the CSS analyses, and presented the findings and discussions of a workshop held in July of 2011. The report of the July workshop is posted on the Fish Passage Center website and is included as an appendix in the 2011 CSS Annual Report (Tuomikoski et al. 2011). Reviewing this document would provide valuable background information and addresses some of your questions. The CSS has been implemented for over a decade and has generated long time series' of data from many stocks within the Columbia River Basin. Each CSS report is posted on the FPC website, along with regional and Independent Scientific Advisory Board comments, recommendations and responses. The analyses, data and methods discussed at the CSS Annual review synthesize the information that has been collected to date over the years of the study. Reviewing these reports will provide additional understanding of methods and analyses and address your questions. Your questions regarding weighting of passage route data, can be answered by a review of the extensive methods sections in the CSS Annual Reports. The brief point responses to your questions are:

- There is no weighting by passage route in these analyses
- Multiple spill passages are assessed in CSS analyses
- Your statements regarding lack of attention on tailrace egress issues is not accurate

- Increasing spill levels will allow more fish to avoid powerhouse passage, avoid delayed mortality, experience less forebay delay, experience faster travel time, and experience higher reach survival
- Delayed mortality associated with smolt transportation is recognized by the region
- A significant body of scientific information, and work by various researchers indicate that delayed mortality is associated with powerhouse passage

Question 1 (actually asked of Howard by Chelan PUD):

Q: Howard demonstrated multiple powerhouse passages during the outmigration led to greater delayed mortality but how did multiple powerhouse passages compare to multiple spill passages? A comparison has not been made between multiple powerhouse and multiple spillway passages relative to delayed mortality. Howard reiterated how heavily powerhouse passage affected delayed mortality and also claimed that route specific passage data was not available for the spillway to make the comparison.

I am certain there are spillway passage and survival data available and this would have been just as simple to model as the powerhouse passage. Please clarify what was meant by route specific spillway passage and survival not being available.

Response:

Howard presented three sets of models, which provide multiple lines of evidence with respect to the association of delayed mortality with powerhouse passage. The first set of models were multiple regressions relating long time series of spawner-recruit residuals, annual SARs and first-year ocean survival rates to ocean conditions and conditions in the FCRPS during seaward migration (Petrosky and Schaller 2010; Schaller et al. in prep.). These results indicate that both river and ocean conditions are important to marine survival rates and reduced survival in the marine life stage was associated with increases in water travel time, number of powerhouse passages and proportion of smolts transported. Because the 'number of powerhouse passages' variable is the inverse of proportion spill (see Petrosky and Schaller 2010 methods), these results indicate that delayed mortality would decrease with increased spill proportions.

The second set of models were multiple regressions relating CSS PIT- tag juvenile survival rates, SARs and marine survival rates to ocean conditions and conditions in the FCRPS during seaward migration (Haeseker et al. 2012). These results also indicate, with finer-scale data, that both river and ocean conditions are important and that reduced survival in the marine life stage was associated with decreases in spill proportion. The first and second sets of data modeled observed responses of cohorts of fish (annual or biweekly) to passage and ocean conditions experienced by that cohort,.

The third set of models described in Howards' presentation were based on SARS of PIT tag detections or non-detections at the various FCRPS dams (Tuomikoski et al. 2010). Detected smolts were known to have been collected/bypassed at specific project(s); non-detections would have passed via either spill or turbine routes. We do not have precise knowledge of spill vs. turbine routes for individual non-detected fish at specific projects; however, when spill proportion is high, most non-detects pass via spill. The key point of Howard's presentation was that multiple lines of evidence reach the same conclusion regarding delayed mortality associated with powerhouse passage and that marine survival is related to freshwater passage conditions.

In addition, the CSS annual report for 2010 (Tuomikoski et al. 2010), provides some insight into multiple spillway passage and multiple powerhouse passage. The 2010 report included analyses of SAR relative to downstream migration history. In these analyses the study group consisted of juvenile Chinook and steelhead that were alive and detected at Bonneville Dam. Their subsequent survival to Bonneville as an adult was analyzed relative to their specific downstream passage history. The smolt-to-adult return rates of juvenile fish that were detected at individual projects, multiple projects and never-detected as juveniles were compared relative to their juvenile passage history. In this analysis, juveniles that were never-detected primarily represent fish that experienced multiple spillway passages. These never-detected juveniles also include fish that may have passed through turbine units. We know from decades of spillway versus turbine survival studies that mortality from spillway passage averages about 1%, compared to an average mortality of 15% through turbine units. These analyses of migration history in the 2010 CSS report may underestimate that actual impact of powerhouse passages because: 1) fish had to arrive at Bonneville alive to be included in the study group, and 2) a small proportion of the fish that are not detected at each project pass through the turbine route. Despite these issues, the analysis found that each bypass system experience reduced subsequent survival in the ocean, and that multiple bypass system experienced further reduced ocean survival, indicating that delayed mortality is occurring with bypass system experience. The NPCC Independent Scientific Advisory Board reviewed the 2010 CSS report and concluded that delayed mortality is associated with powerhouse passage. In addition the FPC summarized several analyses by different researchers that indicate that delayed mortality is occurring as a result of powerhouse passage (FPC memo date)

The 2010 CSS Annual Report also compared SARs for single or multiple bypasses at Lower Granite, Little Goose, and Lower Monumental dams vs. a group not detected at the same three dams. Again, the non-detected group primarily represented multiple spillway passed smolts but may underestimate the actual SAR for this group (see caveat above because the undetected group includes turbine passed fish). Here, the SAR compared for each treatment was measured from Lower Granite as a smolt to Lower Granite as an adult. Those analyses found that SARs for non-detected yearling Chinook SARs averaged 52% higher, and non-detected steelhead SARs averaged 91% higher, than smolts that were bypassed at one or more of the three collector dams.

Question 2:

Steve, you were asked a similar question about shifting powerhouse passage proportion to the spillway to manipulate the analysis and results essentially getting the result you want to see either way. The simple answer that you gave reiterated that SAR predictions rely on delayed mortality that is affected much more by powerhouse passage.

What I want to know here is how the different passage routes are weighted in the models you folks have created. If powerhouse passage is weighted greater than spill passage this would essentially point to a breakdown of a proportionally larger number of powerhouse passages relative to spillway passages for the overall run which may be misleading given the passage and survival data from the many studies the Corps has supervised in the past.

Response: The models are not "weighted" according to passage route; the passage histories of bypass (detected) vs. not bypassed (non-detected) are analyzed using logistic regression. See Methods section in Chapter 7 of the CSS 2010 annual report (Tuomikoski 2010).

Question 3:

Steve, the following are statements you made during the Q&A session:

"BioP performance standards are not sufficient because mortality and survival complications occur system wide, not only at the dams and concrete survival does not address this."

I agree with you, but you followed that up with this:

"If we want to keep status quo on survival and SAR we should just continue what we are doing, but if we really want to improve these fisheries we need to broaden our horizons and evaluate alternative operations such as more spill."

What I would like to know about the above statement is this; how is more spill an alternative operation or something that has not already been addressed? More spill has been the agenda for years while powerhouse passage has been shunned and egress continues to suffer because we are only focusing on one passage route.

Response: For decades since the late 60s powerhouse passage and smolt transportation has been the singular focus of fish passage mitigation for hydro system development in the Columbia Basin. Over three decades, significant funding and research investments have been focused on powerhouse bypass and collection systems development, barge and truck transportation, screen bypass systems, turbine modification, bypass outfalls and turbine intake structures. The expenditures on all types of engineering solutions and contraptions are stunning. Spill for fish passage only began to be considered when these approaches failed. The decades of singular focus on powerhouse bypass systems and smolt transportation ended with the ESA listings of Snake River salmon and steelhead populations. Only after these populations were listed as threatened and endangered was spill considered as an alternative through federal court decisions. Most recently, spring and summer spill for fish passage was ordered by the federal court beginning in 2005. The results of implementing spill for fish passage are clear in the data since 2005.

More spill is an alternative operation because data indicates that it may allow increase in SAR with the present hydrosystem configuration. More spill is an alternative operation because more spill will allow more juvenile migrants to avoid powerhouse passage and the delayed mortality that is associated with powerhouse passage. More spill is an alternative to the present set of operations because the current set of operations does not attempt to maximize spill levels at each of the projects. Spill levels can be increased within the present dissolved gas standards. Studies at some projects such as John Day show that project survival is higher with higher spill levels. A large body of scientific work shows that higher spill levels decrease fish travel time, increase reach survival, decrease forebay delay, speed up juvenile egress times and increase SAR.

(There was no question 4 in the list we received.)

Question 5:

There was a lot of discussion about ocean conditions relating to survival at the workshop, but how confident are we with what is known about ocean conditions and fish survival? Where did the data come from?

Response: We are confident from the literature and our own studies that ocean conditions, particularly during the year of ocean entry, affect marine survival rates of anadromous salmonids. We are also confident that the migration experience through the FCRPS also affects marine survival rates of Snake River salmon and steelhead. Using information-theoretic approaches, we have identified ocean and seaward migration variables which best explained the survival rate variation for several data sets including: long time-series of spawner-recruit residuals (Schaller et al. in prep.), SARs and first year ocean survival rates (Petrosky and Schaller 2010), and PIT-tag based SARs and marine survival rates (Haeseker et al. 2012). In general, the river and ocean variables that most consistently describe marine survival rate variation include: % spill, number of powerhouse passages, water travel time, Pacific Decadal Oscillation and upwelling index. These papers provide detailed descriptions of the environmental and survival rate data sources.

Question 6:

It was clearly stated at the workshop that survival will suffer during the ocean stage of life history for powerhouse passed fish, but how much confidence is put into that data? This ties back to me question of how are the passage routes weighted in the models? Is this assumption based on models or actual PIT tag data that shows higher returns of adults who experienced fewer powerhouse passages during the outmigration? I don't believe the data is strong enough to provide an assumption like that when it is not unheard of for SARs to be below 1%. While 1% may be 10,000 fish, this percentage is still too small to make that assumption based on 1 million outmigrants that never returned. I know for steelhead, transport brings a lot of B-run fish back to Idaho each year and you include transport as a powerhouse passage route.

Response: Again there is no weighting of powerhouse passage routes. All of the analyses are based upon actual PIT tag data. We have confidence in the empirical model result that bypassed fish return at lower rates than fish that passed projects undetected (primarily spill, when provided). As stated in response #2, the models are not "weighted" according to passage route; the passage histories of bypass vs. not bypassed are analyzed using logistic regression. The CSS results (slide 37 of Tuomikoski presentation) have also indicated for steelhead and spring/summer Chinook that transportation will not be beneficial when juvenile survival exceeds about 55%. The CSS prospective models suggest that it would be possible to achieve juvenile survival well exceeding 55%, through increased spill passage. Clearly transportation is beneficial only when steelhead in-river survival is below 55%, and this is based on empirical PIT tag data. We cannot address "your belief" that the data is strong enough. These analyses are based upon PIT tag data collected since 1998 and multiple lines of evidence that consistently point to the same results. Many years of data and analyses show that delayed mortality is associated with smolt transportation. In addition a growing body of evidence clearly shows that smolt transportation impairs adult upstream success and increases straying into non-natal tributaries, especially for steelhead. We should also point out that until spill was implemented as a passage measure, upwards of 90% of Snake River steelhead were transported in some years. However, these high transportation rates did not preclude the listing of A run and B run steelhead under ESA.

Literature cited:

Haeseker, S.L., McCann, J.A., Tuomikoski, J., Chockley, B. 2012. Assessing freshwater and marine environmental influences on life-stage-specific survival rates of Snake River spring-summer Chinook salmon and Steelhead. Transactions of the American Fisheries Society 141:121-138

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