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December 2, 2013

Tom Dresser
Fish, Wildlife and Water Quality Manager
Public Utility District No. 2 of Grant County
30 C Street, SW
Ephrata, Washington 98823

Subject: Comparative Survival Study Draft Annual Report

Dear Mr. Dresser:

Thank you for your review comments on the Comparative Survival Study Draft Annual Report. Your comments and the Comparative Survival Study Oversight Committee response will be included in the comments Appendix of the final report. In accord with our normal process and format, in the attached document, CSS Oversight Committee responses follow each of the Grant County PUD comments, both specific and general comments.

The Grant County PUD comments make several references to unpublished data or analyses. These unpublished data and analyses, although used as references, were not provided with the comments so it is difficult to respond to these comments.

A common theme throughout the Grant County PUD comments is the application of acoustic tagging. The Fish Passage Center has reviewed the available acoustic tag project-specific survival studies conducted at upper Columbia River hydroelectric projects, at Snake River hydroelectric projects, and at Middle Columbia hydroelectric projects. These technical reviews are available to the public and are posted on the FPC web site. These reviews identify significant limitations associated with acoustic tag data and raise serious and significant issues regarding the appropriate management application of survival estimates generated by acoustic tag studies. We have repeatedly identified the issues listed below in many reviews of acoustic tag studies including those conducted at Upper Columbia projects. More detailed comments are available in individual reviews.

- Acoustic tag survival results appear to be biased high because of study design issues and non-representativeness of study fish.

- Acoustic tag studies require fish of a particular size and study fish may not represent the run at large.
- The acoustic tag methodology requires subjective judgments by the analyst.
- Acoustic tag data is not available in a public database.
- Acoustic tag data alone does not provide a reliable basis for project operations.
- Recent data and analyses indicate that fresh water passage history affects survival in later life stages. These effects are not reflected in project acoustic tag survival estimates.

Thank you for your comments on the Comparative Survival Study Draft Annual Report for 2013. The specific responses to Grant County PUD comments follow each comment in the attached document. Your comments and our responses will be appended with other comments in the final version of the CSS Annual Report. We appreciate the time and effort invested by Grant County in reviewing the draft CSS Annual Report and in developing the comments on the draft. Thank You.

Sincerely

Michele DeHart

Michele DeHart, Manager
The Fish Passage Center

Grant County
PUBUC UTIUTY DISTRICT

Connecting Generations
Since 1938

October 15, 2013

Ms. Michele DeHart
Fish Passage Center
1827 NE 44th Ave., Suite 240
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Dear Ms. DeHart:

The Public Utility District No. 2 of Grant County, Washington (Grant PUD) would like to thank the Comparative Survival Study Oversight Committee and Fish Passage Center for the opportunity to review the report titled and dated August 31, 2013; *"Comparative Survival Study of PIT-tagged Spring/Summer/Fall Chinook, Summer Steelhead and Sockeye- 2013 Annual Report*". Grant PUD would also like to thank the authors for their effort in trying to improve the overall study design, analyses, and reporting.

In review of the report, Grant PUD offers the following suggestions for further refinement, improvement, and clarification. General and specific comments are listed by Chapters.

Chapter 2: The dynamics of survival throughout the lifecycle of salmonids are complex and a robust life-cycle model could prove insightful, therefore Grant PUD provides the following general comments:

- The authors should quantify how well the models fit the data, as it would be more informative than relying on visual interpretation of figures;
- The report should include tables with model inputs and outputs (e.g. number of smolts, etc.), which would allow readers to further explore survival relationships and generate alternative models; and
- Preliminary analyses of parr-to-smolt survival suggest that the relationships between survival in freshwater and ocean environments may begin earlier than migration through the FCRPS for spring/summer Chinook salmon (Langshaw unpublished analyses). Including parr in life-stage models and other Comparative Survival Study (CSS) analyses could provide additional insight into the dynamics of salmonid survival.

Response:

Model fitting results in revised Chapter 2 include parameter estimates for each model, standard errors, covariance matrix, and AIC results.

Model inputs are available from the NOAA website: (https://www.webapps.nwfsc.noaa.gov/apex/f?p=261:home:0) and from ODFW annual smolt monitoring reports are available from the Pisces database (https://pisces.bpa.gov/release/documents/documentviewer.aspx?doc=P128637). References provided in revised Chapter 2.

Chapter 3: Evaluations relating to effects of the in-river environment on survival are restricted by inherent limitations of PIT-tags (e.g., detection range and efficiency). The route-specific data collected during acoustic telemetry studies within the FCRPS (2006-2013) provide an opportunity to address several weaknesses of analyses and assumptions necessary when relying on PIT-tags.

Response:

We have strong reservations about the applicability of acoustic telemetry to provide applicable data to the CSS. The Fish Passage Center has repeatedly expressed its concerns with these studies (please see FPC Memorandum from June 24, 2009; July 29, 2010; March 24, 2011; February 15, 2012; March 16, 2012; March 23, 2012; January 4, 2013; February 11, 2013; March 19, 2013; March 22, 2013; July 11, 2013; August 2, 2013; October 7, 2013). We believe the technical and design issues with these studies compromise their usefulness and the resulting survival estimates. General concerns are outlined below, with more specific comments where appropriate.

1. Studies Do Not Represent Run-at-Large

   Not all smolts are suitable for acoustic tagging. Smolts may be rejected from tagging due to size. Because smaller fish have a larger tag burden, there may be effects on behavior and survival. Smolts may also be rejected due to health and condition. In the Snake and Lower Columbia studies, fish are rejected due to descaling, malformations, fungal or other infections, and physical injuries. Rejection rates at Snake and Lower Columbia projects due to condition range from 2 to 13% of collected smolts (FPC Memo January 4, 2013) and are not reported at all for Upper Columbia studies in Chelan and Grant Counties (FPC Memos July 11, 2013, and August 2, 2013).

When fish are rejected from tagging studies, the survival estimates apply only to the healthiest and largest portion of the population. These survival estimates therefore cannot be extrapolated to the entire population. Fish size and condition may affect the proportion of juveniles through each passage route and route-specific survival estimates. Therefore, acoustic telemetry does not necessarily provide accurate information for the CSS report. For more detail on this topic, please see FPC memos on March 24, 2011; February 15, 2012; March 23, 2012; and, January 4, 2013.

2. Experimental Design Inflates Overall and Route-Specific Survival Estimates

The virtual/paired-release design used in most of the performance tests in the Snake and Lower Columbia River utilize 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 dam and route-specific 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 concerning upward biases inherent in this study design.

A further cause of differential mortality may be the fact that fish in the R_2 and R_3 groups will not have the vertical or horizontal distribution of fish that are naturally migrating through the hydrosystem. In contrast, fish that pass through the dam are not included in the study group until they have migrated through and survived some distance from their initial release point. 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 increase 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 R_3 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."

Single release estimates for dam survival have not been included in reports for Grant and Chelan counties, and single release estimates for route-specific survivals have not been included in many reports for the Snake and Lower Columbia studies. These omissions make it impossible to evaluate how representative route-specific survival estimates are to overall juvenile survival.

3. Tag Burden May Affect Smolt Behavior

Tags used in acoustic telemetry studies are significantly larger than PIT tags. Tags of these sizes may affect smolt swimming behavior, thereby changing which passage route is most likely taken. Because survival estimates are generated using survival through each passage route and the proportion of smolts using each route, any change in behavior may significantly alter survival estimates.

4. Acoustic Tagging Combines All Smolt Origins

Because smolts for acoustic tag studies are collected in juvenile bypass systems, they cannot distinguish between smolt origins. Wild and hatchery fish are combined, as are all hatchery sources. In the lower Columbia, smolts are a combination of Snake and Mid-Columbia sources. This limits the applicability of acoustic tagging to comparisons such as those made in the CSS.

The range of conditions that fish experienced during acoustic telemetry studies was not as extensive as those in the CSS. However, acoustic telemetry provides the distinct advantages of high detection efficiency and known passage timing and routes. Extremely high detection efficiency and arrays downstream of Bonneville Dam eliminates reliance on the trawl PIT-tag array, which has very low detection efficiency. The low detection efficiency and tagging rates result in imprecise estimates of survival in the final reach, which can have implications for correlation and regression analyses. Furthermore, environmental conditions (i.e., route, timing, travel time, water transit times, percent spill, etc.) and exact passage history are known for nearly all tagged fish and do not need to be estimated, assumed, or derived as with studies using PIT-tags.

Response (see also above comments):
Although passage routes are known for acoustically tagged fish, their timing and passage route may be affected by the extensive handling, tagging, and transportation smolts undergo before detection at the dam. Smolts are collected in the juvenile bypass system, held for some undisclosed amount of time, anesthetized, held for another 12–36 hours, and then trucked to their release sites. In some cases, these release sites are far upstream. This process changes the passage timing, and the tag burden (see above) and handling may affect swimming ability and therefore passage route choice by smolts.

Additionally, acoustic tags have a life of days to months, and are therefore of no use in measuring delayed mortality, which takes years to manifest.

Data already collected can be used to generate cohorts that migrated during the same time and experienced the same environmental conditions, but experienced different passage histories (e.g., all spillways vs. all turbines). This approach could provide valuable insight for delayed mortality and likely address confounding factors that result from relying solely on data from PIT-tags.

Response (see also above comments):
Acoustic tagging has been varied across years, sites, and seasons in both the Snake and Columbia Rivers. Since 2010 in the FCRPS, some sites have not been studied at all (such as Lower Granite), some sites have only 1 year of testing (such as McNary, Lower Monumental, and Little Goose Dams), and many sites have non-consecutive years of study due to the lack of testing in 2013. This patchwork data set makes it impossible to create a comprehensive analysis of project and route-specific survivals across projects, project operations, and water years. This is in sharp contrast to the PIT-tag data used by the CSS, and makes acoustic tagging data of very limited applicability to the CSS.

The limited detection range and efficiency of PIT-tags requires that timing, route, and environmental conditions at the time of passage must be derived for a large portion of the population. Using cohorts and environmental indices can help increase sample size and

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generate insight, but results from any analyses can be sensitive to misinterpretation. It is logical to select freshwater indices for the CSS that can presumably be influenced by operation of the FCRPS (e.g., percent spill, water transit time, etc.). However, relationships between climactic, river, and ocean conditions has been well documented and there is evidence that the indices used for the CSS are confounded. For example, indices relating to copepod communities, ocean conditions, smelt condition, and plume volume are strongly correlated with adult returns for various salmonid stocks from the Columbia River (Jacobson et al. 2012). Further evidence for broader climatic influence is provided by relationships between survival and river discharge. Correlation between survival for adult spring Chinook salmon from the Snake River and discharge from Priest Rapids Dam in the Upper Columbia River is relatively strong ***(r*** = 0.58-0.66; Langshaw unpublished analyses) and nearly identical to the relationship that those fish have with the percent spill that they experienced during migration through the FCRPS ***(r*** = 0.56-0.70; Haeseker et al. 2012).

Relationships between percent spill and survival are also confounded by surface passage. Spill operations (e.g., percent, efficiency, weirs, etc.) have changed over the course of the CSS. Historically, surface passage at Snake River dams was exclusively provided through spill. The "low spill" conditions within the CSS occurred before adequate surface passage was provided at all Snake River dams. These conditions were characterized by relatively low discharge and little or no spill at Lower Granite, Little Goose, and/or Lower Monumental dams. Thus, the broader effects of lower discharge were likely compounded by limited surface passage. Therefore, the predicted benefit of increasing spill under current conditions may be inflated by models that were developed from data that do not represent current conditions.

Multi-model inference techniques further complicate the use of environmental indices. Individual indices contribution to explaining variation in survival cannot be isolated when multi-model inference techniques are used. For example, water transit time (WTT) and percent spill are frequently in the best fitting models (CSS Append. 3.1 & 3.2). However, it is unclear how much percent spill improves model fit over water transit time alone. Model results may be more readily accepted and insightful if more traditional analytical techniques are used and presented. Conclusions presented in the report would also be strengthened if they were supported by analyses of data from acoustic telemetry studies or other methodologies.

Response:
Unlike PIT-tag data used by the CSS, the data used in acoustic telemetry studies is not available for review. Data from studies conducted on the Snake and Lower Columbia are available through 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). Data from studies conducted in Grant and Chelan counties have not been made available at all, despite the fact that reports from these studies omit critical information such as single release survival estimates and route-specific survivals. A publicly accessible database, such as that used for PIT-tag data, would make more analyses possible.

Acoustic telemetry studies in Grant County have suffered from some technical difficulties that have resulted in invalid studies, particularly in Steelhead tagging. If data were available to outside review, difficulties such as these could be reviewed in detail. The absence of these data makes accurate assessment of acoustic telemetry studies impossible.

General comments relating to the methods used for the CSS that are described in Chapter 3:

- What are the implications of using correlated models to generate survival estimates? All the models use the same indices and some spurious correlation is expected as a result of using ratios. Instantaneous mortality (Z) will likely have some spurious correlation with fish transit time (FTT) and survival. This is further complicated because many of the indices co-vary and are correlated with the independent variables. Given the relationships between all components of the models, are the methods to predict survival (i.e., CSS Equation 3.8) appropriate and are all sources of variation accounted for?

Response:

We see no basis for the assertion that spurious correlation is expected because of ratios. As we describe in the methods section, fish are experiencing two processes during their outmigration: the migration rate process and the mortality rate process. These two processes and the factors that influence their rates have been captured by the fish travel time and instantaneous mortality rate models. In our view, the models are appropriate and all of the major sources of variation are properly accounted for.

- The cohort-based approach is a form of pseudo-replication. Within each year, it appears that later migrating cohorts traveled faster and likely overlapped cohorts that began migrating earlier. Please provide information about whether or how cohorts overlapped as they migrated downstream.

Response:

Within each cohort, there is likely some degree of overlap between the slow migrants of one cohort and the fast migrants of the previous cohort. At the upper portions of the reach, the degree of overlap is low, but the degree of overlap increases as the fish move downstream. Because of this, there may be some degree of correlation between release cohorts within years. To address this issue, we employed two forms of mixed-effects models (Millar and Anderson 2004, Chavez 2010) to properly account for any correlation that may be present among the release cohorts. Results indicated that a mixed-effects model with a lag-1 autoregressive process for the within-year random effects was appropriate for the FTT data, while the standard linear regression approach was appropriate for the *Z* data (Table 3.3).

- It is also assumed that non-detected fish migrated at the same rate and experienced the same environmental conditions as the fish within each cohort that were detected. Please provide further evidence and discussion about the validity of this assumption. Data from acoustic telemetry studies could be used to provide additional insight about this assumption.

Response:

While fish that experience the bypass system show an average 16-hour delay relative to non-detected individuals (see Chapter 10 of Tuomikoski et al. 2010), available analyses indicate that the detection process is random (see Chapter 9 of Berggren et al. 2006). Therefore, while there may be 16-hour delays for individual detected fish, the effects on the overall cohort are likely to be negligible.

- It is assumed that environmental conditions and any mortality occurring after smolts pass Bonneville Dam are independent from those above Bonneville Dam. It's well documented that conditions, and likely survival, in the lower Columbia River, estuary, and plume are related to the hydrograph and broader climactic conditions. Please provide further evidence and discussion about the validity of this assumption.

Response:

We did not model mortality after passage at Bonneville Dam in Chapter 3 of the 2013 Annual Report. Other analyses have evaluated the effects of hydrosystem operations and ocean factors on post-Bonneville survival (Haeseker et al. 2012, Petrosky and Schaller 2010).

Specific comments related to Chapter 3:

- Page 48, lines 4-25: This paragraph implies that court ordered spill caused the observed increase in survival for subyearling fall Chinook salmon in the LGR-MCN reach. However, survival is more strongly correlated with WTT and the relative change between the periods is nearly identical to that for percent spill (Langshaw unpublished analyses). Please revise to include alternative explanations.

Response:

The model-averaged coefficients indicate that increases in spill reduce subyearling Chinook travel time. This model result is also supported by the dramatic reduction in fish travel time that has been observed after 2005 (Figure 3.2). As a consequence of reduced travel times, the survival rates have increased. We are not aware of alternative explanations that can account for the timing and magnitude of these changes.

- Page 48, lines 23-25: Is this sentence referring to model results for LGR-MCN or actual data for Ice Harbor Dam? How much did the spill reduction at Ice Harbor Dam actually influence mean spill for the cohorts? Please revise to clarify.

Response:
The sentence is referring to the actual spill data for Ice Harbor Dam. The spill reduction at Ice Harbor Dam coincided with court-ordered increases in spill at Lower Granite, Little Goose, and Lower Monumental Dams after 2005.

- Page 53, lines 12-21: Discussions about FTT are generalized to the reach-scale and can be improved with additional analyses. Data from acoustic telemetry studies are readily available to provide additional insight for the effects of WTT and percent spill on FTT.

Response:
Data from telemetry studies are sparse, intermittent, selectively exclude fish for tagging, suffer from variable tag life, and are conducted at variable spatial scales. Because of these issues, they offer little ability to consistently measure the effects of WTT and percent spill on FTT.

- Page 53, lines 23-24: It is unclear whether the statement "The instantaneous mortality rates tend to be lowest under conditions of fast WTT and high spill levels" is supported by the data and analyses presented. Data presented in Haeseker et al. (2012) indicates WTT generally decreased throughout the season during eight of the nine years studied (i.e., Figure 4, 1998-2006) and there was no consistent pattern for percent spill. Figure 3.2 in the CSS report indicates instantaneous mortality rates are predicted to increase throughout the season during those same years. While WTT and percent spill are generally in the best fitting models to predict instantaneous mortality rates, they are onlyweakly correlated (Langshaw unpublished analyses). It's unclear how much these variables actually contribute to characterizing variation in mortality rates. Please clarify to address apparently contradictory evidence. It would also be informative to display data on environmental indices for each cohort (e.g., Figure 4 in Haeseker et al. 2012).

Response:

The data indicate that WTT and percent spill are negatively correlated (r = -0.48). The model-averaged coefficients and relative variable importance figures presented in the revised Chapter 3 present the information on the importance of WTT and percent spill to explain variability in instantaneous mortality rates (Figures 3.7, 3.8).

- Page 54, lines 40-42: It is implied that powerhouse passage causes delayed mortality. It is unclear whether powerhouse passage is referring to turbine, bypass, or both routes. Please clarify. It is also unclear why lower SAR for detected fish is assumed to be delayed mortality. It is plausible that higher mortality could be occurring for the detected fish during migration. For example, a report was cited (i.e., FPC 2011) as evidence that predation was greater at the Lower Monumental Dam bypass outfall during 2010. Please provide further evidence and/or discussion about the location and cause of observed survival difference between detected and non-detected fish.

Response:

Petrosky and Schaller (2010) showed that increases in powerhouse passage were associated with increased ocean mortality rates. Powerhouse passage refers to both turbine and the collection/bypass systems. Chapter 10 of Tuomikoski et al. (2010) conducted analyses that showed reduced SARs for fish that were detected in the bypass systems relative to fish that were undetected. We agree that higher mortality for detected fish may also be occurring during juvenile outmigration through the hydrosystem.

Adaptive management experiments for hydroelectric operations are complex and generally expensive. Alternative analyses indicate the potential for confounding factors and uncertainty are great enough that additional analyses and evidence are required before considering adaptive management experiments. Increasing precision of estimates for studies using PIT-tags will not address issues with confounding factors and pseudo replication. Data from acoustic telemetry studies are readily available and should be used to supplement, validate, and improve analyses for the CSS.

Response:

Adaptive management experiments could be implemented if the hydrosystem operators elect to do so. The CSS provides the framework to monitor the effects of those changes if implemented. The changes in subyearling Chinook FTT and survival following the implementation of court-ordered spill are an example of an Adaptive Management experiment that has already been implemented and is being monitored to evaluate how various factors have contributed to the observed changes. The mixed-effects models that have been implemented are properly accounting for any correlations amongst the release cohorts.

Chapter 4: General comments:

- Methods to estimate survival during the first year in the ocean (S.o1) result in nearly perfect correlation with total survival in the ocean (S.o1; r2 >0.99). It is unclear how assigning ocean survival rate variability to the S.o1 life-stage provides any benefit for analyses or additional insight. Reporting and interpretation would be simplified by excluding S.o1 from analyses. We suggest additional justification be provided or analyses with S.o1 be eliminated.

Response:

As noted in our response to the ISAB on this issue, we agree that S.o1 and S.oa provide essentially the same information for Snake River spring/summer Chinook and steelhead, as well as other ESUs/DPSs that are largely unexploited in ocean fisheries. However, we suggest that there are two rationales for continuing to report both metrics:

1) S.o1 has been used in the literature and will likely continue to be used in life-cycle models (e.g., matrix models) for these populations. Reporting of both metrics also provides a scalar (albeit, assumption dependent) between expected first year and overall marine survival for these species.

2) For populations that are exploited in ocean fisheries, marine survival calculations need to account for fishing mortality at different ages, incorporating similar assumptions for natural mortality to our assumptions in the S.o1 calculation.

- Given the low sample size, poor precision, and acknowledged potential negative bias for estimates of survival from the upper Columbia River, these analyses provide little additional insight. Furthermore, extensive analyses falsely imply certainty of conclusions and inferences. Please consider revising or removing analyses for the upper Columbia River. It is unlikely that significantly increasing sample size or detection efficiency will address any of the limitations inherent to these analyses of data from PIT-tags.

Response:
We are unsure of the context of this comment, whether it was meant to apply to all upper Columbia PIT-tag groups reported, or just the SMP study groups tagged at Rock Island Dam. We explicitly stated that the component of Upper Columbia SARs upstream of McNary Dam is missing for most populations and study years due to insufficient smolt PIT-tag detection capability, and identified that 2-week juvenile survival rate estimates through this river reach were highly variable. Nevertheless, the geometric mean juvenile survival rates were in the range of 0.57 and 0.59, indicating significant mortality in this reach. We conclude that significantly improving detection efficiency in this reach would address critical data gaps regarding juvenile survival and SARs for upper Columbia populations.

Chapter 5: General comments:

- The number of tables throughout the annual report can be overwhelming to the reader. Is it possible to combine some tables? Similarly, "heat maps" could be used to combine figures and provide additional insight.

Response:
We disagree. Figures were used where possible to consolidate information. However, with Fall Chinook, the number of mark groups and the few years data analyzed at this point makes graphical presentation of overall results less useful.

- A group of fall Chinook salmon is marked at Priest Rapids Hatchery by the Fish Passage Center. It could be informative to include this group in CSS analyses.

Response:
We agree. However, we anticipate there may be some difficultly using these data given the small sample size. See your own comment on Chapter 4 above…"low sample size, poor precision…provide little additional insight."

- Given that evaluating the efficacy of the transport program is a primary objective of the CSS, more detailed analyses and discussions should be included in the annual report. Of particular importance are the relationships between freshwater conditions and survival of transported fish and in-river migrants. Please consider a separate chapter for analyses and discussion related to efficacy of the transport system.

Response:
We believe the entire CSS report is providing information on the efficacy of transportation. All data provided supports the TIR analyses that are included. In response to comments on Chapter 5, additional information was included in Chapter 5 regarding the relationship between transport benefit (TIR) and in-river survival. This TIR vs in-river survival relationship has been provided for yearling Chinook and steelhead for several years.

In summary, the dynamics of survival throughout the lifecycle of salmonids are complex. Freshwater conditions and experiences through the FCRPS are most certainly related to salmonid survival in freshwater and marine environments. However, current evidence based on correlative associations does not justify a large-scale operational experiment. Additional analyses identified several covariates that suggest survivals in freshwater and marine environments are related to broader climactic conditions. Furthermore, freshwater and marine conditions are not independent as is assumed for analyses in the CSS. Additional analyses are necessary to better understand whether relationships between freshwater indices (i.e., percent spill and water transit time) and subsequent salmonid survival are simply a function of the selected indices and their relationships with broader climactic conditions. Data from acoustic telemetry studies are readily available to supplement, validate, and improve analyses for the CSS and provide valuable insight for the relationships between FCRPS operations and subsequent survival.

Thank you again for the opportunity to review and provide comments on the report titled *"Comparative Survival Study of PIT-tagged Spring/Summer/Fall Chinook, Summer Steelhead, and Sockeye – 2013 Annual Report".* If you should have questions regarding Grant PUD's edits, comments or suggestions, please feel free to contact Russell Langshaw via phone (509-989-7305) or email (rlangsh@gcpud.org).

Sincerely,

Tom Dresser

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Cc: Keith Truscott, Chelan PUD Shane
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Priest Rapids Coordinating Committee
NR-Records

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Haeseker, S. L. J. A. McCann, J. Tuomikoski, and B. Chockley. 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

Jacobson, K., and coauthors. 2012. The Marine Ecology of Juvenile Columbia River Basin Salmonids: A Synthesis of Research 1998-2011. Report to the Northwest Power and Conservation Council, Portland, Oregon.

Langshaw, R. B. 2013. Analyses of salmonid survival and environmental data. Public Utility District 2 of Grant County, Ephrata, Washington. Unpublished analyses of data reported in published literature and downloaded from www.fpc.org on October 1, 2013.

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March 16, 2012 - http://www.fpc.org/documents/memos/25-12.pdf

March 23, 2012 - http://www.fpc.org/documents/memos/31-12.pdf

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