FISH PASSAGE CENTER
847 NE 19th Ave., Suite 250, Portland, OR 97232
Phone: (503) 833-3900 Fax: (503) 232-1259
http://www.fpc.org/ e-mail us at fpcstaff@fpc.org

MEMORANDUM

TO: Charles Morrill, WDFW
Erick Van Dyke, ODFW
Gary Fredricks, NOAA Fisheries
Ritchie Graves, NOAA Fisheries
James Faulkner, NOAA Fisheries Science Center

FROM: Michele DeHart, FPC

DATE: January 23, 2017

RE: NOAA Data Team hydroelectric project and route of passage juvenile salmon and steelhead survival estimates for COMPASS model input data

In response to requests from Oregon Department of Fish and Wildlife and the Washington Department of Fish and Wildlife, the Fish Passage Center staff reviewed the juvenile salmon and steelhead passage survival spreadsheet compiled by NOAA Fisheries and distributed by email on November 21, 2016. The spreadsheet was discussed on a conference call on November 22, 2016. The action agencies, NOAA, ODFW, WDFW and the FPC participated in the call. The NOAA Data Team is tasked with developing the juvenile salmon and steelhead at dam and route of passage survivals to be used for COMPASS model inputs.

Over the past decade the Fish Passage Center staff has reviewed each of the studies, analyses and subsequent reports from which the survival estimates in the NOAA spreadsheet are generated. The following discussion is based upon FPC technical reviews of the studies and analyses that generated the survival estimates in the NOAA Data Team spreadsheet. In addition, results of analyses that apply to and inform the COMPASS modeling process are discussed. Our conclusions based on this decade of technical involvement are as follows, followed by a detailed discussion of the limitations associated with each of the specific studies included in the spreadsheet that are proposed for use in the COMPASS modeling exercises:

- **Performance standards testing study design has been plagued by numerous shortcomings and, therefore, data produced do not accurately represent the impact of dam passage on smolt survival.**

- **NOAA has stated that these are the best available data and, therefore, are to be used as the input data for the COMPASS model. Even the "best available data" when utilized in modeling efforts can result in misleading or erroneous predictions and conclusions if the limitations of the "best available data" are not identified, considered and analyzed in terms of how those data limitations impact model outputs.**

- **Performance testing route of passage survival estimates (included in the Data Team spreadsheet) underestimate the actual impact of powerhouse passage. Consequently, utilizing these routes of passage survival estimates in COMPASS model analyses will underestimate the actual impact of dam passage on juvenile salmon and steelhead by ignoring the documented "delayed" mortality associated with powerhouse passage.**

Performance standards testing study design has been plagued by numerous shortcomings and, therefore, data produced do not accurately represent the impact of dam passage on smolt survival.

Survival studies using JSATS tags have been conducted at each site in the FCRPS. These survival estimates, discussed here as potential inputs for the COMPASS model, include inherent problems which make the estimates a misleading representation of the impacts of the hydrosystem on the migration of juvenile salmonids. Below is a general overview of the inherent reasons these studies do not represent the actual survivals of the run-at-large, followed by a detailed review of each report.

- Each study represents the individual flow conditions and operations of that site and year. By combining these into a survival for each site, or averaging across years, the implications of the impacts of operations on survival are lost. Treating an averaged survival estimate as representative of all water years and operations is a misuse of the data.
- The collection of smolts for tagging does not represent the run-at-large.
    - By only tagging fish caught in the juvenile bypass systems, the study is potentially biased for particular behaviors or fish conditions. If smolts collected in the juvenile bypass facility have behavior which predisposes them to the bypass, or physical characteristics that increase the probability of bypass survival, results obtained from these fish will not represent the run-at-large.
    - JSATS tags require a minimum size of 95mm and are not used in smolts already known to be in poorer condition (e.g., diseased or descaled). For many smolts, the tags can cause a tag burden which may significantly affect swimming ability, route of passage, and overall survival. A large tag with an invasive tagging

process will always eliminate the smolts least likely to survive dam passage, thereby inflating survival estimates.
    - The run timing often reflects the passage of individual genetic stocks. When the tagging period excludes a large portion of the beginning or the end of the run, it will not represent genetic diversity. In addition, the particular outmigration conditions studied may not reflect those experienced by these portions of the population.
- Many of the study designs used to produce the estimates for use in the COMPASS model artificially inflate estimates through the use of one or two "reference" groups released downstream of the dam. If smolts released directly into the tailrace experience higher mortality than run-of-river fish due to predation or random effects, the single-release survivals will increase. This survival inflation may be a result of the experimental design rather than a true measurement of dam survival.

The best available data may not be representative of actual passage conditions, but study weaknesses are not included in the COMPASS model.

- Although each study used as input for the COMPASS model has numerous weaknesses and constraints, these are not incorporated into the model or given any weight in the model outcome.
- Performance tests exclude the early and late portions of each run, as well as rejecting a large percentage of smolts due to size or condition. However, results from these studies are assumed to represent the entirety of the run.
- The COMPASS model, as constructed, does not include the ability to incorporate any uncertainty around point estimates of survival. The confidence intervals vary widely from study to study, and to treat all studies as equal is misleading and may skew the model results. It has been suggested during Data Team meetings that the COMPASS model be modified to allow for either prior probabilities as a Bayesian model, or to use penalized likelihoods. However, these changes have not been included in any version of the model.

Performance testing route of passage survival estimates underestimate the actual impact of powerhouse passage. Consequently, utilizing the survival estimates of routes of passage in the COMPASS model analyses will underestimate the actual impact of dam passage on juvenile salmon and steelhead by ignoring the documented delayed mortality associated with powerhouse passage.

Several independent analyses have documented the reduced smolt-to adult return rates associated with powerhouse passage encounters of juvenile steelhead and Chinook. Buchanan et al. (2011) found that fish that were never bypassed were found to return at higher than expected rates under the null hypothesis of homogeneous survival. Adult return rates tended to decline the more often a fish was bypassed during outmigration. Furthermore, preliminary tests of competing hypotheses including fish length failed to conclusively explain why bypass at dams was associated with reduced adult return rates. Tuomikoski et al. (2010) conducted analyses which showed evidence of significant migration delay of bypassed yearling Chinook and steelhead smolts relative to undetected smolts. Analyses found that bypass history was important for characterizing variation in post-BON SARs of yearling Chinook and steelhead. The best-fitting model for yearling Chinook indicated that post-BON SARs were reduced by 10% per bypass experience at upriver dams. The best fitting model for steelhead indicated a 6% reduction in post-BON SARs per bypass experience at Snake River dams and a 22% reduction in post-BON SARs per bypass experience at Columbia River dams. Combining data across years through meta-analysis, the means of SAR(C1)/SAR(C0) for both species indicated a significant mortality effect from bypass at one or more of the collector facilities. Non-bypassed yearling Chinook SARs averaged 52% higher, and non-bypassed steelhead SARs averaged 91% higher, than smolts that were bypassed at one or more of the powerhouse juvenile bypass/collection systems. McCann et al. (2016), analyzed powerhouse bypass effects on smolt-to-adult return rates. At all dams, logit SARs were 13% lower at each dam for Chinook smolts encountering juvenile bypass system compared to those fish that avoided the bypass system. This 13% difference implies that the odds of survival from BON to BOA decreased by 12% for smolts encountering each of the juvenile bypass systems between John Day and Lower Granite Dam. For steelhead, model-averaged estimates ranged from -8% to -12% implying 8% to 11% reductions in the odds of survival from BON to BOA for juvenile bypass encounters at all dams between John Day and Lower Granite dams. These findings are consistent with Budy et al. (2002), which discussed passage through juvenile bypass systems as one potential mechanism that results in delayed mortality, defined as mortality that rakes place in the estuary and ocean that is related to prior hydrosystem experience during the downstream migration.

The best available scientific data and analyses indicate that the adverse impact of bypass passage/collection systems on survival of juvenile Chinook and steelhead are not captured in the at dam route of passage survival estimates. Therefore the impact of hydrosystem project operations will be an underestimate of the actual impact.

Comments on Specific Survival Studies

In the following sections, the specific limitations of the study designs that have been used to generate survival estimates are discussed in detail. Shortcomings include tagging rejection criteria, poor representation of run timing, and operations that do not reflect the normal or current planned operations. In addition, a number of the survival estimates included for the COMPASS model are from studies not designed to generate overall dam survival or route-specific survival estimates. Please see below for potential issues associated with each study.

Bonneville

BON 2007- Ploskey et al. 2008

The purpose of this study was to compare spillway survival of yearling Chinook with deep and shallow flow detectors. Because data were only collected through the spillway, no survivals for other passage routes are available from 2007. Survivals were calculated with a paired release, in contrast to the virtual-paired release used in later performance testing. Conditions and operations vary from year to year, but the current COMPASS methodology means that spillway survivals from 2007 will be combined with survivals from other routes of passage in other years and different study designs. These combinations of survival estimates from separate years will obscure year-to-year variation in conditions and operations that affect survival.

The tagging period in Ploskey et al. (2008) covered only 70% of the spring Chinook run in 2007 (April 29th through May 23rd). If sampling does not include the entire run, particular runs representing genetic stock, and timing involving particular outmigration conditions, will not be included in the study and make results inapplicable to the overall passage experience. The non-representation of 30% of the spring Chinook run is a considerable oversight of the study and should be carefully considered before inclusion in the COMPASS model.

Ploskey et al. (2008) report a rejection rate of 3% for gas bubble trauma, descaling, disease, and other abnormalities, and a 0% rejection rate for size for yearling Chinook. Other survival studies have much higher rejection rates, often higher than 5%. We believe there is the possibility that this rejection rate is a reflection of fish rejected due to condition after some selection process carried out by the Smolt Monitoring Program (SMP)(FPC Memo March 19, 2013). If rejection rates from the overall run-at-large are higher than those reported, it is impossible to evaluate to evaluate how representative the survival estimates are for the overall migration experience of yearling Chinook. The rejection of fish least likely to survive dam passage inflates survival estimates over the actual conditions.

BON 2008- Faber et al. 2010

This study was carried out to evaluate the behavioral guidance structure (BGS) at the second powerhouse of Bonneville Dam. Smolts were collected and tagged in the juvenile bypass system at John Day dam and released at a number of locations upstream of Bonneville. Control fish were collected in the juvenile bypass system at Bonneville Dam and released in the Bonneville tailrace. Because groups released above and below Bonneville Dam came from different projects, they may represent different stocks, run timing, and representation of fish condition. The paired release estimates provided in this study do not utilize a true control and therefore only the single release estimates should be considered.

Faber et al. (2010) report rejection rates due to condition of 0.8% for yearling Chinook and 0.7% for steelhead at John Day. At Bonneville, a rejection rate of 3.6% was noted, but no rejection rate for steelhead was provided. Other survival studies have much higher rejection rates, often higher than 5%. We believe there is the possibility that this rejection rate is a reflection of fish rejected due to condition after some selection process carried out by the Smolt Monitoring Program (SMP)(FPC Memo March 19, 2013). If rejection rates from the overall run-at-large are higher than those reported, it is impossible to evaluate to evaluate how representative the survival estimates are for the overall migration experience of migrating smolts. The rejection of fish least likely to survive dam passage inflates survival estimates over the actual conditions.

The passage conditions during the test period do not reflect standard operations at Bonneville Dam. Spring spill at Bonneville Dam has a target of 100 Kcfs. Average spill during the test period, April 29 through May 27, was 134 Kcfs. Although spill remained close to 100 Kcfs during the first part of the study, during the second half of the test period spill averaged 169 Kcfs, with a high daily average of 231 Kcfs. The survival estimates generated in Faber et al. (2008) reflect conditions of high spill levels and cannot be used to extrapolate survival estimates at lower flow and spill volumes.

Information essential to a rigorous evaluation of the study have not been made available. The percentage of the run covered by the tagging period at Bonneville and John Day are not reported, although the graphical representation indicates that a large proportion of the yearling

Chinook run was not included in tagging. The percentage of the run that passed outside of the tagging period at Bonneville Dam is not provided, although run timing, and therefore the applicability of the study to the run-at-large may differ between sites.

BON 2008- Ploskey et al. 2009

The purpose of this study was to compare spillway survival of yearling Chinook with deep and shallow flow detectors. Because data were only collected through the spillway, no survivals for other passage routes are available from 2008. Survivals were calculated with a paired release, in contrast to the virtual-paired release used in later performance testing. Smolts were collected and tagged in the juvenile bypass system at John Day dam and released at a number of locations upstream of Bonneville. Control fish were collected in the juvenile bypass system at Bonneville Dam and released in the Bonneville tailrace. Because groups released above and below Bonneville Dam came from different projects, they may represent different stocks, run timing, and representation of fish condition. The paired release estimates provided in this study do not utilize a true control and therefore only the single release estimates should be considered.

The tagging period in Ploskey et al. (2009) covered only 70% of the spring Chinook run and 93% of the steelhead run in 2008 (April 29th through May 23rd). If sampling does not include the entire run, particular runs representing genetic stock, and timing involving particular outmigration conditions, will not be included in the study and make results inapplicable to the overall passage experience. The non-representation of 30% of the spring Chinook run, with 28% of the missed run occurring before the start of tagging, is a considerable oversight of the study and should be carefully considered before inclusion in the COMPASS model.

As in Faber et al. (2010), Ploskey et al. (2009) report rejection rates due to condition of 0.8% for yearling Chinook and 0.7% for steelhead at John Day. At Bonneville, a rejection rate of 3.6% was noted, but no rejection rate for steelhead was provided. Other survival studies have much higher rejection rates, often higher than 5%. We believe there is the possibility that this rejection rate is a reflection of fish rejected due to condition after some selection process carried out by the Smolt Monitoring Program (SMP)(FPC Memo March 19, 2013). If rejection rates from the overall run-at-large are higher than those reported, it is impossible to evaluate to evaluate how representative the survival estimates are for the overall migration experience of migrating smolts. The rejection of fish least likely to survive dam passage inflates survival estimates over the actual conditions.

The passage conditions during the test period do not reflect standard operations at Bonneville Dam. Spring spill at Bonneville Dam has a target of 100 Kcfs. Average spill during the test period, April 29 through May 27, was 134 Kcfs. Although spill remained close to 100 Kcfs during the first part of the study, during the second half of the test period spill averaged 169 Kcfs, with a high daily average of 231 Kcfs. The survival estimates generated in Faber et al. (2008) reflect conditions of high spill levels and cannot be used to extrapolate survival estimates at lower flow and spill volumes.

BON 2009- Faber et al. 2011

This study was carried out to evaluate the behavioral guidance structure (BGS) at the second powerhouse of Bonneville Dam. Smolts were collected and tagged in the juvenile bypass system at John Day dam and released upstream of Bonneville Dam. In this study, smolt survival through the Corner Collector, a single-release estimate, is used as the control to generate paired estimates for the rest of the passage routes. Because one objective of the study is to test efficiency and survival through the Corner Collector, the use of this as a "control" is not an appropriate methodology. Only the single-release estimates for each route of passage should be used.

Faber et al. (2011) reports an overall rejection rate of 0.82%, although this is not broken down by species. Other survival studies have much higher rejection rates, often higher than 5%. We believe there is the possibility that this rejection rate is a reflection of fish rejected due to condition after some selection process carried out by the Smolt Monitoring Program (SMP)(FPC Memo March 19, 2013). If rejection rates from the overall run-at-large are higher than those reported, it is impossible to evaluate to evaluate how representative the survival estimates are for the overall migration experience of migrating smolts. The rejection of fish least likely to survive dam passage inflates survival estimates over the actual conditions.

This study reports coverage of 79% of the yearling Chinook run and 93% of the steelhead run. If sampling does not include the entire run, particular runs representing genetic stock, and timing involving particular outmigration conditions, will not be included in the study and make results inapplicable to the overall passage experience.

Detections of fish tagged at John day Dam at Bonneville occurred from April 29th through June 8th. The passage conditions during this period do not reflect standard operations at Bonneville Dam. Spring spill at Bonneville Dam has a target of 100 Kcfs. Average spill during the test period was 119 Kcfs. Although spill remained close to 100 Kcfs during the first part of the study, after May 20th spill increased significantly. During the last 20 days of the test, spill averaged 142 Kcfs. The survival estimates generated in Faber et al. (2009) reflect conditions of high spill levels and cannot be used to extrapolate survival estimates at lower flow and spill volumes.

BON 2010- Ploskey et al. 2011

The purpose of this study was to estimate concrete survival and other performance testing metrics, although not an actual compliance test. Juveniles were collected in the juvenile bypass at John Day Dam, tagged, and then transported and released at multiple sites above Bonneville Dam. Only single-release estimates were generated. Operations in 2010 are not comparable to current procedures at Bonneville due to a number of issues, including problems with the functioning of sluiceway gates and the closure of Unit 11 and the Corner Collector. For this reason, results from this study should only be considered for Compass with extreme reservations.

The rejection rate for Bonneville testing in 2010 is reported as an overall 16%. This number is not broken down by species, so it is impossible to compare rejection rates between yearling Chinook, steelhead, and subyearing Chinook. However, this rejection rate is higher than other studies, and shows that a large percentage of the run-at-large is not included in the test. The rejection of injured or diseased fish least likely to survive dam passage will inflate survival estimates over the actual conditions.

The spring testing period was from April 27th to June 1st. The percentage of the yearling Chinook and steelhead runs represented by tagging is not reported. It is impossible to determine how applicable results are to the run-at-large.

BON 2011- Ploskey et al. 2013

The purpose of this study was to estimate concrete survival and other performance testing metrics. Juveniles were collected in the juvenile bypass at John Day Dam, tagged, and then transported and released at a number of upstream sites. The virtual-paired release design was used, with a single virtual release in the forebay of Bonneville Dam and two control releases downstream of the dam. The use of the third release group as a second control, may artificially inflate dam survival estimates. This upward bias in survival estimates may be caused by differential mortality between groups due to random sampling effects or environmental factors such as predation.

The tagging rejection rate due to condition was 11.9% for yearling Chinook and 16.4% for steelhead. These are high rejection rates in comparison to other studies, and prompted the revision of tagging criteria to be more representative of the run-at-large. With such a large portion of the run not included in survival estimates due to exclusion from tagging, the results from this performance test should not be considered representative of the run-at-large.

The spring study dates ran from April 27th through May 31st. The final 1.4% of the yearling Chinook run and 8.6% of the steelhead runs were not included in tagging. However, the percentage of the run that had passed by the start of tagging is not included. If tagging misses large portions of the run, it will not be representative of the migration conditions and genetic diversity of the run-at-large.

The flow and spill operations at Bonneville Dam in 2011 are not representative of a standard water year. The average spill during the entire tagging study was 160 Kcfs. Spill from April 27th to May 12th was held to the objective 100 Kcfs, as outlined in the Fish Passage Plan. However, from May 13th to the end of the study on May 31st, the average daily spill was 242 Kcfs, more than double the planned operations. If future operations at Bonneville are to include 100 Kcfs of spring spill, survivals generated by Ploskey et al. (2013) should not be considered representative.

The Dalles Dam

TDA 2010- Johnson et al. 2011

The purpose of this study was to estimate concrete survival and other performance testing metrics. Juveniles were collected in the juvenile bypass at John Day Dam, tagged, and then transported and released at a number of upstream sites. The virtual-paired release design was used, with a single virtual release in the forebay of The Dalles Dam and two control releases downstream of the dam. The use of the third release group as a second control, may artificially inflate dam survival estimates. This upward bias in survival estimates may be caused by differential mortality between groups due to random sampling effects or environmental factors such as predation.

The rejection rate for testing at The Dalles Dam in 2010 is reported as an overall 16%. This number is not broken down by species, so it is impossible to compare rejection rates between yearling Chinook, steelhead, and subyearing Chinook. However, this rejection rate is higher than other studies, and shows that a large percentage of the run-at-large is not included in the test. The rejection of injured or diseased fish least likely to survive dam passage will inflate survival estimates over the actual conditions.

The spring testing period was from April 28th to June 1st. The percentage of the yearling Chinook and steelhead runs represented by tagging is not reported. Without this information, it is difficult to determine how applicable results are to the run-at-large.

TDA 2011- Skalski et al. 2012

The purpose of this study was to estimate concrete survival and other performance testing metrics. Juveniles were collected in the juvenile bypass at John Day Dam, tagged, and then transported and released at a number of upstream sites. The virtual-paired release design was used, with a single virtual release in the forebay of The Dalles Dam and two control releases downstream of the dam. The use of the third release group as a second control, may artificially inflate dam survival estimates. This upward bias in survival estimates may be caused by differential mortality between groups due to random sampling effects or environmental factors such as predation.

The tagging rejection rate due to condition was 11.9% for yearling Chinook and 16.4% for steelhead. These are high rejection rates in comparison to other studies, and prompted the revision of tagging criteria to be more representative of the run-at-large. With such a large portion of the run not included in survival estimates due to exclusion from tagging, the results from this performance test should not be considered representative of the run-at-large.

The spring study dates ran from April 29th through May 30st. The final 13% of the yearling Chinook run and 9% of the steelhead runs were not included in tagging. However, the percentage of the run that had passed by the start of tagging is not included. If tagging misses large portions of the run, it will not be representative of the migration conditions and genetic diversity of the run-at-large. The exclusion of this information makes it difficult to assess the usefulness of the data presented in the report.

John Day Dam

JDA 2010- Weiland et al. 2013

The purpose of this study was to estimate concrete survival and other performance testing metrics, as well as evaluating the top-spill weir prototype. Juveniles were collected in the juvenile bypass at John Day Dam, tagged, and then transported and released at a number of upstream and downstream sites. The virtual-paired release design was used, with a single virtual release in the forebay of John Day Dam and two control releases downstream of the dam. The use of the third release group as a second control, may artificially inflate dam survival estimates. This upward bias in survival estimates may be caused by differential mortality between groups due to random sampling effects or environmental factors such as predation.

The tagging rejection rate due to condition was 7.3% for yearling Chinook and 12.1% for steelhead. The tagging period was from April 28th to June 12th, which covered 78% of the yearling Chinook run and 73% of the steelhead run. The proportion of smolts not included in tagging will affect the applicability of study results. The high rejection rates and proportion of the run excluded for timing may significantly bias survival estimates compared to the run-at-large.

JDA 2011- Weiland et al. 2013

The purpose of this study was to estimate concrete survival and other performance testing metrics, as well as evaluating the top-spill weir prototype. Juveniles were collected in the juvenile bypass at John Day Dam, tagged, and then transported and released at a number of upstream and downstream sites. The virtual-paired release design was used, with a single virtual release in the forebay of John Day Dam and two control releases downstream of the dam. The use of the third release group as a second control, may artificially inflate dam survival estimates. This upward bias in survival estimates may be caused by differential mortality between groups due to random sampling effects or environmental factors such as predation.

The tagging rejection rate due to condition was 11.0% for yearling Chinook and 15.3% for steelhead. The tagging period was from April 27th to May 29th. The actual percentage of the run covered by these dates is not included, but it is stated in Appendix H that all of most of the yearling Chinook and all of the steelhead testing dates occur within the middle 80% of the run, indicating that approximately 20% of the run is not represented by the testing dates. The proportion of smolts not included in tagging will affect the applicability of study results. The high rejection rates and proportion of the run excluded for timing may significantly bias survival estimates compared to the run-at-large.

The Fish Passage Plan requires alternating 2-day blocks of 30% and 40% spill at John Day Dam. During 2011, high flows necessitated cancelling the planned spill blocks for the second half of the study. Therefore, survivals from the early season reflect future operations, while the later part of the season is indicative of higher spill levels. The results from this study should not be used to extrapolate survivals at lower spill levels.

JDA 2012- Skalski et al. 2013

The purpose of this study was to estimate concrete survival and other performance testing metrics. Juveniles were collected in the juvenile bypass at John Day Dam, tagged, and then transported and released at a number of upstream sites. The virtual-paired release design was used, with a single virtual release in the forebay of John Day Dam and two control releases downstream of the dam. The use of the third release group as a second control, may artificially inflate dam survival estimates. This upward bias in survival estimates may be caused by differential mortality between groups due to random sampling effects or environmental factors such as predation.

The tagging rejection rate due to condition was 3.7% for yearling Chinook and 7.0% for steelhead. The tagging period was from April 30th to June 2nd, which covered 89.7% of the yearling Chinook run and 65.2% of the steelhead run. The proportion of smolts not included in tagging will affect the applicability of study results. Because 35% of the steelhead run was not included in tagging, and an additional 7% of steelhead rejected from tagging due to condition, survival estimates may be significantly biased compared to the actual survival of the run-at-large.

The Fish Passage Plan requires alternating 2-day blocks of 30% and 40% spill at John Day Dam. During 2012, high flows necessitated cancelling the planned spill blocks for the second half of the study. Therefore, survivals from the early season reflect future operations, while the later part of the season is indicative of higher spill levels. The results from this study should not be used to extrapolate survivals at lower spill levels.

McNary Dam

MCN 2012- Skalski et al. 2012

The purpose of this study was to estimate concrete survival and other performance testing metrics. Juveniles were collected in the juvenile bypass at John Day Dam, tagged, and then transported and released upstream of McNary Dam. The virtual-paired release design was used, with a single virtual group detected in the forebay of McNary Dam and two control releases downstream of the dam. The use of the third release group as a second control, may artificially inflate dam survival estimates. This upward bias in survival estimates may be caused by differential mortality between groups due to random sampling effects or environmental factors such as predation.

As stated above, differential mortality in the control groups may artificially inflate the survival estimate. At McNary Dam in 2012, the single release estimate of yearling Chinook survival was 91.7%, and increased to a final estimate of 96.2% due to low survival in the first downstream release group. The single release estimate of steelhead survival was 91.4%, and increased to a final estimate of 99.1%, also due to low survival in the first downstream release group. High mortality in the control groups indicate that the single release estimates may more accurately reflect smolt survival at the dam and the virtual-paired release estimates should not be used.

The tagging rejection rate due to condition was 3.7% for yearling Chinook and 7.0% for steelhead. The tagging period was from April 27th to May 30th, which covered 91% of the yearling Chinook run and 75% of the steelhead run. The proportion of smolts not included in tagging will affect the applicability of study results. Because 25% of the steelhead run was not included in tagging, and an additional 7% of steelhead rejected from tagging due to condition, survival estimates may be significantly biased compared to the actual survival of the run-at-large.

Spill levels at McNary Dam are set at 40% in the Fish Passage Plan. In 2012, actual spill levels during the study period ranged from 40% to 73%, with an average of 54%. The survival estimates generated by this study can only be used to describe survivals at spill levels far above an average water year.

MCN 2014- Weiland et al. 2014

The purpose of this study was to estimate concrete survival and other performance testing metrics. Juveniles were collected in the juvenile bypass at John Day Dam, tagged, and then transported and released upstream of McNary Dam. The virtual-paired release design was used, with a single virtual group detected in the forebay of McNary Dam and two control releases downstream of the dam. The use of the third release group as a second control, may artificially inflate dam survival estimates. This upward bias in survival estimates may be caused by differential mortality between groups due to random sampling effects or environmental factors such as predation.

The rejection rate due to condition was 2% for yearling Chinook and 3.2% for steelhead. However, the rejection rate of smolts due to small size (<95mm) was not reported. In the draft report, histograms indicated a potentially significant number of size-related rejections for yearling Chinook (Joint Technical Staff Memo January 27, 2015). These graphical representations were removed from the final report and not replaced with a data table, despite the specific request of FPAC and SRWG members (Joint Technical Staff Memo September 17, 2015). Without data regarding the proportion of the run not included in tagging, these survival estimates cannot be assumed to represent migration conditions for the run-at-large.

Weiland et al. (2014) also does not report the percentage of the run represented by tagging dates between April 27th and May 30th in 2014. If a large percentage of the run is not included in the tagging effort, the applicability of the study cannot be evaluated and results should only be accepted with reservations.

As in 2012 at McNary Dam, spill levels far exceeded those outlined in the Fish Passage Plan. Although a spill level of 40% is the planned operation at McNary, actual spill levels in 2014 ranged from 42% to 62% with an average of 52%. The survival estimates generated by this study can only be used to describe survivals at spill levels far above an average water year and should not be used as a description for the planned operations at McNary Dam.

Ice Harbor

ICE 2006- Axel et al. 2007

The purpose of this study was to estimate juvenile survival with surface passage under two spill operations. Juveniles were collected in the juvenile bypass at Lower Monumental Dam, tagged, and then transported and released in the Lower Monumental forebay and downstream sites. Survivals were calculated with a paired release, in contrast to the virtual-paired release used in later performance testing. This study design is susceptible to inflation of survival estimates caused by mortality in the tailrace release groups.

Spill levels during the study were too high to keep to the planned operations of alternating 2-day blocks for much of the test period of May 3rd through May 31st. Survivals generated during high spill events cannot be used to extrapolate survivals during normal operations.

Smolts are usually rejected from tagging due to a number of conditions, including size, descaling, disease, and deformity. However, the rejection rates are not reported in this study. The minimum size of tagged fish is reported to be 120 mm, much larger than the 95mm minimum used in performance testing. Larger tags with a larger minimum tag size can be assumed to have higher rejection rates than smaller, less invasive tags. Without knowing the actual rejection rates due to size and condition, it is impossible to determine how representative the study is of the run-at-large and if survival estimates are inflated due to the rejection of smaller or injured fish.

The tagging dates in Axel et al. (2007) covered 83% of the yearling Chinook run and 77% of the steelhead run. The majority of the run not included in the study passed prior to the start of tagging. If sampling does not include the entire run, particular runs representing genetic stock, and timing involving particular outmigration conditions, will not be included in the study and make results inapplicable to the overall passage experience.

ICE 2006- Axel et al. 2008

The purpose of this study was to estimate juvenile survival with surface passage under two spill operations. Juveniles were collected in the juvenile bypass at Lower Monumental Dam, tagged, and then transported and released in the Lower Monumental forebay and downstream sites. Survivals were calculated with a paired release, in contrast to the virtual-paired release used in later performance testing. This study design is susceptible to inflation of survival estimates caused by mortality in the tailrace release groups.

Smolts are usually rejected from tagging due to a number of conditions, including size, descaling, disease, and deformity. However, the rejection rates are not reported in this study. The minimum size of tagged fish is reported to be 115 mm, much larger than the 95mm minimum used in performance testing. Larger tags with a larger minimum tag size can be assumed to have higher rejection rates than smaller, less invasive tags. Without knowing the actual rejection rates due to size and condition, it is impossible to determine how representative the study is of the run-at-large and if survival estimates are inflated due to the rejection of smaller or injured fish.

The tagging dates in Axel et al. (2007) covered 92% of the yearling Chinook run and 94% of the steelhead run. The majority of the run not included in the study passed after the conclusion of tagging. If sampling does not include the entire run, particular runs representing genetic stock, and timing involving particular outmigration conditions, will not be included in the study and make results inapplicable to the overall passage experience.

Lower Monumental

LMN 2012- Skalski et al. 2013

The purpose of this study was to estimate concrete survival and other performance testing metrics. Juveniles were collected in the juvenile bypass at Lower Monumental Dam, tagged, and then transported and released in the Little Goose forebay. The virtual-paired release design was used, with a single release above Little Goose Dam and two control releases downstream of the dam. The use of the third release group as a second control, may artificially inflate dam survival estimates. This upward bias in survival estimates may be caused by differential mortality between groups due to random sampling effects or environmental factors such as predation.

Spill levels during the performance test, from April 30th through May 28th, ranged from 24% to 90%, and averaged above the 110/115% gas cap spill level required by the Biological Opinion. Spill exceeded the gas cap on 16 out of 32 test days. Spill exceeded the 120% gas cap on five out of 32 test days. Survivals generated during high spill events cannot be used to extrapolate survivals during normal operations.

Smolts were rejected from tagging due to a number of conditions, including descaling, disease, and deformity. Of yearling Chinook, 4.8% were excluded, and 6.6% of steelhead were rejected, primarily due to descaling. These rejection rates mean that of the Chinook and steelhead runs, only 95.2% and 93.4% were represented by the study. By not including fish with lower survival probabilities, the study artificially inflates survival estimates when compared to survival of the run-at-large.

The tagging dates in Skalski et al. (2013) covered 96.1% of the yearling Chinook run and 89.7% of the steelhead run. The graphical representation indicates that most of the yearling Chinook run not represented by tagging passed prior to the start of tagging, while steelhead passage occurred both before and after tagging. If sampling does not include the entire run, particular runs representing genetic stock, and timing involving particular outmigration conditions, will not be included in the study and make results inapplicable to the overall passage experience.

Little Goose

LGS 2009- Beeman et al. 2010

The purpose of this study was to estimate dam passage and survival, especially with regards to the installation of surface passage at Little Goose Dam. Juveniles were collected at Little Goose Dam, tagged, and released at sites upstream and downstream of Little Goose Dam. Survivals were calculated with a paired release, in contrast to the virtual-paired release used in later performance testing. This study design is susceptible to inflation of survival estimates caused by mortality in the tailrace release groups.

The number of smolts rejected from tagging is not included in the report. However, a rejection rate of 13% for yearling Chinook due to size is included. This rejection rate for size is much higher than other reports, and with rejections due to disease or injury, the rejection rates can be assumed to be much higher. However, this is impossible to determine as the rejection criteria due to condition was not included in the report. This study cannot be considered representative of the run at large due to high rejection rates.

LGS 2012- Skalski et al. 2013

The purpose of this study was to estimate concrete survival and other performance testing metrics. Juveniles were collected in the juvenile bypass at Lower Monumental Dam, tagged, and then transported and released in the Little Goose forebay. The virtual-paired release design was used, with a single release above Little Goose Dam and two control releases downstream of the dam. The use of the third release group as a second control, may artificially inflate dam survival estimates. This upward bias in survival estimates may be caused by differential mortality between groups due to random sampling effects or environmental factors such as predation.

Spill levels during the performance test, from April 24th through May 25th, ranged from 26% to 46%, and averaged above the 30% spill level required by the Biological Opinion. During ten days of the test, spill levels reached the 115/120% gas cap. On five test days, spill levels reached the 120% gas cap, and the 125% gas cap on two test days. These are not conditions that can be expected to be replicated on a routine basis in the hydrosystem. The survival estimates generated in Skalski et al. (2013) reflect conditions of high spill levels and cannot be used to extrapolate survival estimates at lower flow and spill volumes.

Smolts were rejected from tagging due to a number of conditions, including descaling, disease, and deformity. Of yearling Chinook, 4.8% were excluded, and 6.6% of steelhead were rejected, primarily due to descaling. These rejection rates mean that of the Chinook and steelhead runs, only 95.2% and 93.4% were represented by the study. By not including fish with lower survival probabilities, the study artificially inflates survival estimates when compared to survival of the run-at-large.

The tagging dates in Skalski et al. (2013) covered 87.3% of the yearling Chinook run and 70.7% of the steelhead run. The graphical representation indicates that most of the yearling Chinook run not represented by tagging passed prior to the start of tagging, while steelhead passage occurred both before and after tagging. If sampling does not include the entire run, particular runs representing genetic stock, and timing involving particular outmigration conditions, will not be included in the study and make results inapplicable to the overall passage experience.

Lower Granite

LGR 2006- Beeman et al. 2008

The purpose of this study was to study the effects of the Behavioral Guidance Structure (BGS) on hatchery yearling Chinook and hatchery steelhead survival. The BGS was deployed and removed in a randomized block pattern. Although results are presented for both test conditions as well as an average of both conditions, results from when the BGS was not deployed should not be considered for inclusion in COMPASS, as those conditions do not reflect current operations at Lower Granite Dam.

The timing of survival studies is critical to represent the run-at-large. In Beeman et al. (2008), the spring study period is April 16th through June 13th. Collection and tagging, however, occurred only from April 16th through May 24th. The report states that 95% of the yearling Chinook and steelhead runs were represented by the study time period, but this includes 20 days when the run-at-large was not sampled at all. If sampling does not include the entire run, particular runs representing genetic stock, and timing involving particular outmigration conditions, will not be included in the study and make results inapplicable to the overall passage experience.

Although few fish were rejected from the study due to small size, the tag burden for fish was as high as 5%, exceeding the recommended limit in the Columbia River Basin (Winter 1983, 1996, 2000, and Zale 2005). High tag burdens can affect the swimming ability of smolts, which will influence their route of passage, probability of survival through the dam, and overall survival estimates.

The report states that fish were not included in the study if they showed signs of gas bubble trauma, descaling, or other abnormalities. However, the number of smolts rejected from the study for these reasons was not reported. When fish are rejected for injury, deformity, or other maladies, only the healthiest fish are included in the study, thereby artificially inflating estimates of survival. The results do not represent the run-at-large and have limited applicability to management applications. The fact that rejection rates are not reported in Beeman et al. (2008) is concerning, because it is impossible to assess how the results can be used when estimating overall dam passage survival.

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