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MEMORANDUM

TO: Michele DeHart

FROM: Jerry McCann

DATE: September 25, 2000

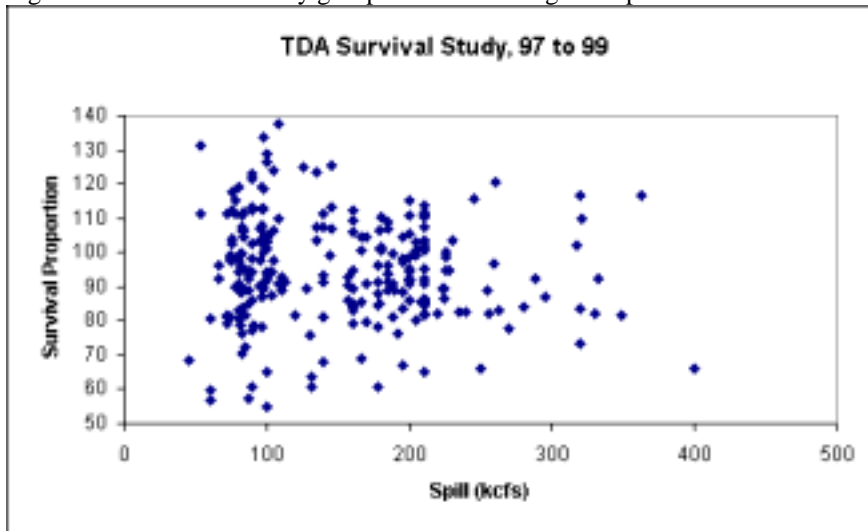RE: NMFS Survival Study at The Dalles

Comments for BiOp 2000 regarding NMFS Survival Study at The Dalles

According to the study results, NMFS finds no significant difference in survival of fish released at 30% spill versus fish released at 64% spill. In fact NMFS shows a slightly lower, though statistically insignificant difference in survival for juvenile salmon released in the forebay of the dam versus reference release groups in the tailwater. From this study result NMFS has recommended decreasing spill at the dam. We have done a detailed analysis of the NMFS data and we have found some areas of concern in both the study design and the analysis.

The Dalles survival study was reviewed by the ISAB, who stated in their summary response "The studies of 1997-1999 did not include all relevant factors influencing the mortality of juvenile salmon…". They were not critical of the conduct of the study, but their description agreed with our finding, that there was a great deal of variability in the survival data when compared to physical conditions at the dam (Figure 1). Such a high level of variability brings into question any interpretation of the data with regard to those parameters the study has tested, namely proportion spilled at release (of test groups), and time of day of release.

We set out to independently review some of the NMFS research at The Dalles because of the importance NMFS is placing upon this data in managing the hydrosystem. We confined detailed analysis to 1999 data and in particular the spring chinook and coho data, because we did not have time or resources for more thorough analysis. We found several sources of variability in the data that may not be accounted for in neither the

Figure 1. Plot of Survival by group 1997 to 1999 against spill volume at time of release.

analyses nor the study design. We found travel time differences between released PIT-tag fish and run at large fish that suggest PIT-tag groups may not be representative of active migrants. Operations at Bonneville were found to affect recapture proportion based on time of day of release at The Dalles. We also found that 3 day grouped releases may have inherent bias that may be due to handling.
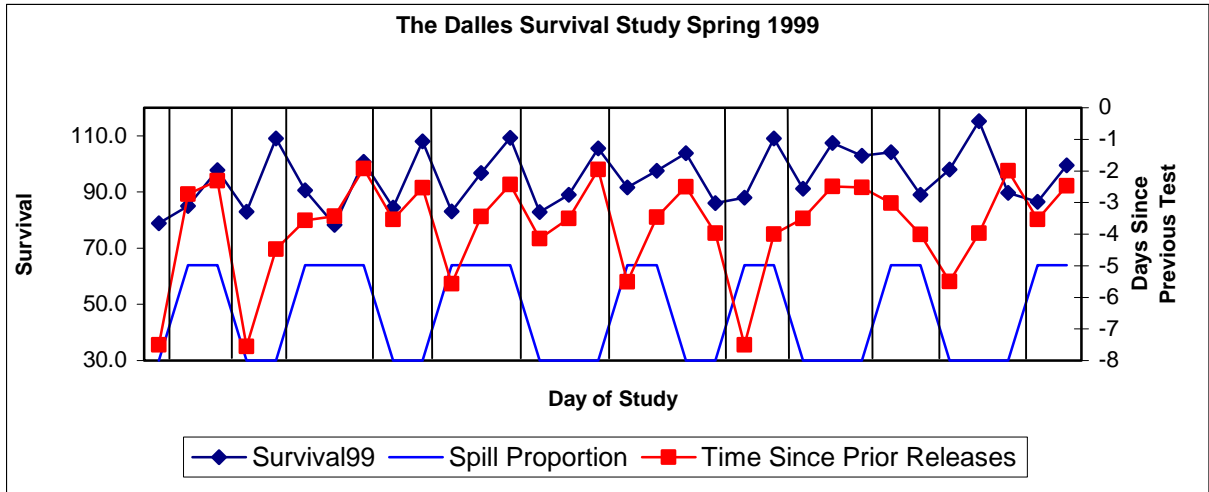
We find it troubling that this study design is being used to develop data for NMFS SIMPAS model, especially when such data is represented as a point value in lieu of the highly variable quality of the data. We would expect that the power of study results to provide a statistically significant result would be quite poor. And that given this problem, any comparisons of that data that were not significant could not be used to determine real differences. We present data that brings into question how representative the experimental fish were in determining survival through spill at the project.

Detailed Analysis of Spring 1999 data

We did a detailed analysis of spring 1999 PIT-tag release data and compiled data for each release group, including number released, and number recaptured at Bonneville Dam as well as at the NMFS estuary trawl. We did not include recaptures from Rice Island, because at the time of our analysis, June 2000, those data from 1999 were not available on PTAGIS.

We plotted survival data over the season and compared these data to spill and time of day of release (Figure 2). NMFS blocked three releases over a two-day period (For example on day 1 there might have been a day-time release, then a night-time release followed by a night-time release a day later). In these blocks, it was apparent that survival for the first release group was lowest, followed by intermediate survival for second release and finally highest for third release.

Figure 2. Plot of survival of spring chinook and coho during spring 1999. Vertical bars separate release blocks (usually 3 release periods over two days grouped for a single spill volume). Time since prior release is the number of days since the last releases were done.

This odd pattern could be an artifact of fish handling, such that those fish given longer recovery periods are better able to survive after release In any case, this is a troubling pattern that could seriously bias study results.

We calculated recapture proportions of all release groups. It was apparent that there was a consistently higher recapture proportion for daytime releases than nighttime release groups. This did not show up in differences in survival calculations because this pattern was true for both forebay (test) and tailwater (control) release groups. When we compared arrival time of these groups at Bonneville Dam, it appeared that a large proportion of fish from day-time release groups arrived at Bonneville Dam during the following day, when the project was spilling a lower volume, while night-time releases arrived at night during higher spill and that this probably accounted for the difference in detection probability (Figure 3 and Figure 4). Because of this difference between day and night releases we felt it necessary, when doing other analyses on recapture data to analyze these releases separately. Also, this difference pointed out the importance of operations at Bonneville, and time of arrival (based on time of detection) in determining recapture proportion. And consequently, the potential for operations at Bonneville to affect survival estimates of release groups where arrival times of test and control fish differed.

Figure 3. Plot of detections and Spill at Bonneville for a daytime release at The Dalles.
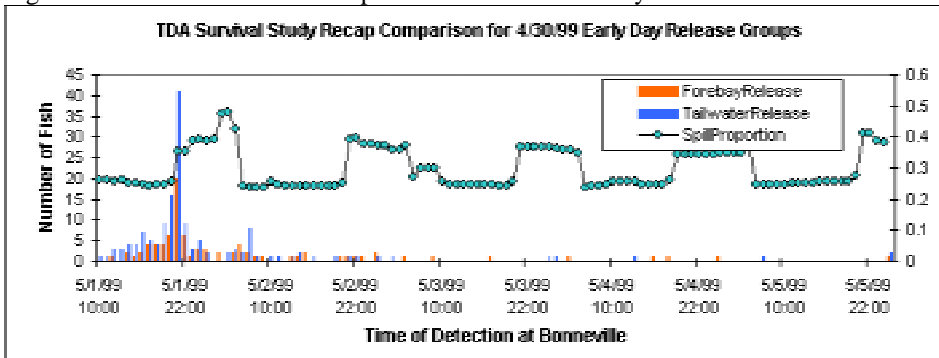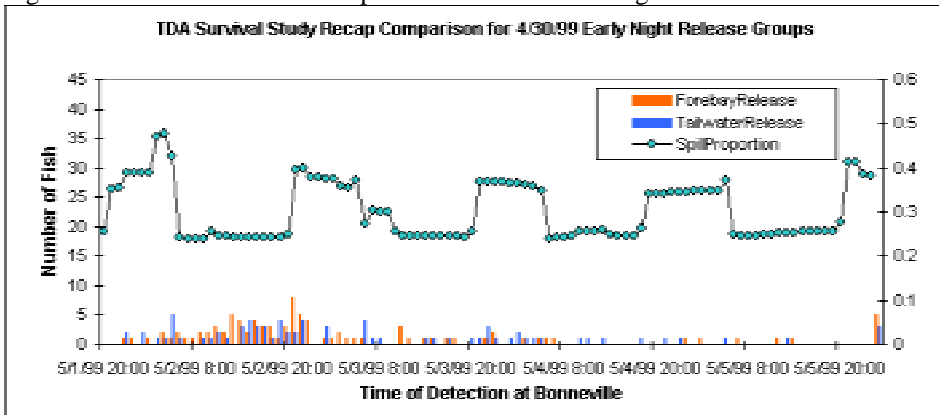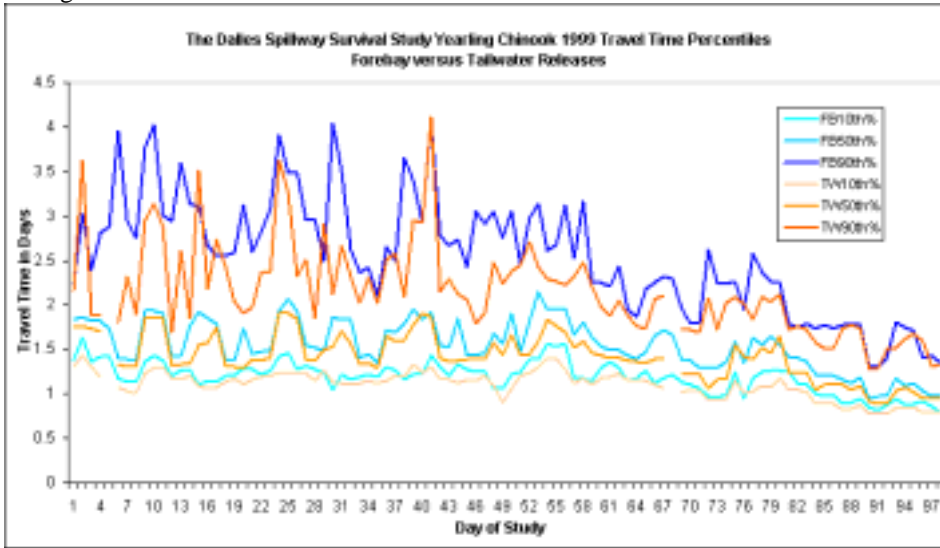

Figure 4. Plot of detections and Spill at Bonneville for a Nighttime release at The Dalles.

We compared arrival times of paired release groups, forebay and tailwater, based on time of release. On any given date, three groups of fish were released in the forebay, over a 30-minute period, followed by three tailwater releases two hours later. Generally, the 50th percentile of these tailwater and forebay release group pairs arrived at a similar time at Bonneville Dam despite the two-hour delay in release of tailwater groups, after tests groups had been released in the forebay. However, the 90th percentile of the test fish were almost always later in arriving than the control fish by anywhere from six hours to a day (Figure 5). It is difficult to say what result this would have on survival estimates. But two possible problems could result. First, their protracted arrival at the downstream dam could affect overall detection probability at Bonneville Dam, simply due to different spill proportions at that project when test and control groups arrive there. Second, it does demonstrate a significant delay in at least a portion of the forebay release groups, since on top of the two hour earlier start than tailwater release groups a portion of these fish are further delayed.

Figure 5. Plot of Arriving Percentiles of Release Groups; comparing forebay and tailwater group arrival timing.

Also, it appeared that, species such as coho and chinook, which are known to have differing collection rates at dams, that these species might show differing recapture proportions in the study. Since detection rate is in part dependent upon operations at Bonneville, it also follows that coho and chinook might show differing recapture proportions as well. We ran a factorial analysis of detection proportion of individual releases (forebay separate from tailwater) grouped by time of day of release and species. The factorial analysis showed no study test variables to be significant (e.g. Time of release, Spill proportion although spill proportion is only marginally insignificant) but Species was significant and two interaction variables ReleaseTime*Species and ReleaseTime*SpillProportion were significant.

Table 1. Analysis of Variance of Forebay Release Groups RecapRatio as dependent variable (arc-sine transformed).

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Time of Day	0.001	1	0.001	0.098	0.755
Spill Proportion	0.042	1	0.042	3.780	0.054
Species	0.516	1	0.516	46.317	0.000
Release Group	0.037	2	0.018	1.652	0.195
Time of Day*Spill Proportion	0.059	1	0.059	5.296	0.023
Time of Day*Species	0.041	1	0.041	3.705	0.056
Time of Day*Release Group	0.004	2	0.002	0.158	0.854
Spill Proportion*Species	0.018	1	0.018	1.580	0.211
Spill Proportion*Release Group	0.020	2	0.010	0.916	0.402
Species*Release Group	0.031	2	0.016	1.401	0.249
Time of Day*Spill Proportion*Species	0.019	1	0.019	1.719	0.192
Time of Day*Spill Proportion*Release Group	0.031	2	0.015	1.372	0.256
Time of Day*Species*Release Group	0.019	2	0.010	0.867	0.422
Spill Proportion*Species*Release Group	0.018	2	0.009	0.822	0.441
Time of Day*Spill Proportion$*Species$*Release Group	0.031	2	0.016	1.411	0.247
Error	1.893	170	0.011		

N: 194   Multiple R: 0.567   Squared multiple R: 0.321

We then decided to step back from regression analysis of survival versus flow conditions during tests and focused on comparing component groups. First, we looked at recapture ratio of forebay release groups within blocks of study. In other words, day versus night, chinook versus coho. We found significant differences in recapture probability of chinook versus coho for both forebay and tailwater release groups when groups were broken down into day and night release groups. Comparisons of forebay release groups in which species were analyzed separately showed significant differences in recapture probability for chinook in day versus night releases, while coho showed no significant differences between day and night releases. Unlike forebay releases, in tailwater releases both species showed significantly different recapture ratios for day versus night release groups.

Coho and Chinook were grouped together in release groups and analysis by NMFS. And yet their recapture probabilities were significantly different, especially when time of day of release was taken into consideration. Given that recapture proportion affects survival estimate, species composition of release groups would affect survival comparisons. And differences among species used as tests and controls would violate the basic assumption of the survival estimate; equal recapture probability. This is important because the proportion of coho used in each group varied seasonally (with generally low numbers early in season, higher numbers as coho increased then declined again as coho numbers decreased). Also, relative proportion of coho varied between forebay and tailwater release groups within a given release date.

We also found differences in detection probability between chinook and coho, when we analyzed day and night releases separately. This required further sub-dividing the data into chinook-day, chinook-night, coho-day and coho-night release groups for testing against flow parameters. When we did this we still found a high degree of variability in the resulting survival versus flow analyses and consequently no factors were significant in regression models.

Differences in detection probability by species, time of day of release and release location would warrant separate analyses for species, by time of release. Since location is being tested it would be appropriate to make this comparison, but it would have to account for differences by time of day and species.

Travel Time Comparisons between Run-at-Large and TDA test release groups

Finally, we were curious about the effect of handling the fish might have upon the study. Are these test fish representative of actively migrating fish. To test this we looked at one the travel time of these experimental fish versus run-at-large fish migrating downriver during the same time period. We compared travel time of run-at-large fish detected at both John Day and Bonneville dams to test fish released in the forebay of The Dalles Dam and recaptured at Bonneville Dam. Generally the forebay release groups were found to travel slower than would be expected for run-at-large fish traveling through the same reach (Table 1 and Figure 7). Indeed, during most weeks of the study, we calculated a 6h
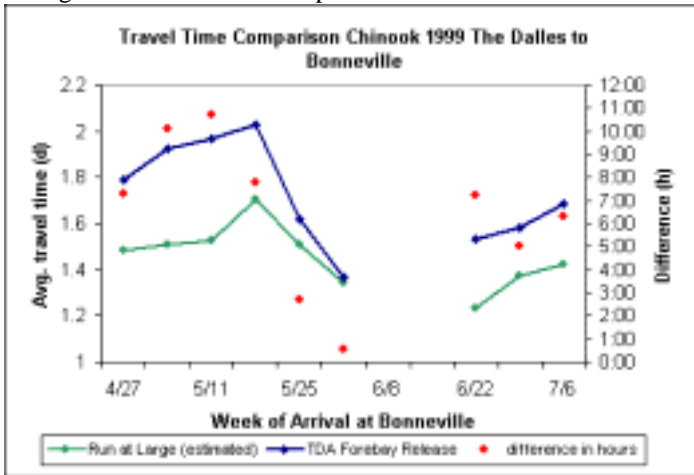
to 10h longer mean travel time for test fish through this reach than we would expect for run-at-large fish traveling the same reach.

Table 2. Travel Time Comparison for TDA to BON Reach for
Yearling Chinook Spring of 1999 expressed in days.

Date	Run-at-Large [a] (In days)	TDA Forebay (in days)	Difference (hh:mm)
4/27/99	1.4846171	1.78718	7:15
5/4/99	1.5051228	1.925909	10:05
5/11/99	1.5236087	1.969761	10:42
5/18/99	1.7030245	2.027243	7:46
5/25/99	1.5056328	1.61904	2:43
6/1/99	1.3420798	1.364717	0:32
6/8/99			
6/15/99			
6/22/99	1.2355957	1.535634	7:12
6/29/99	1.3721167	1.5814	5:01
7/6/99	1.4231462	1.685389	6:17
7/13/99		1.948398	
7/20/99		1.835628	
7/27/99		2.303995	

[a] Run-at-Large estimated based on JDA to BON travel time * 0.65 (proportion of distance that TDA to BON reach is of JDA to BON.

to Figure 7. Travel time comparison between test releases and run-at-large fish in the TDA BON reach.

Given a travel time of 36 hours, this represents a 12 to 20% increase in mean travel time for test fish versus active migrants. This difference in travel time suggests the test fish may not behave in a way that is indicative of migrating fish. Indeed, coupled with their relative difference in travel time to control fish (we.e. two hour delayed release), it suggests there is some delay in their travel time through the reach that is unrelated to the conditions being tested (spill proportion, day or night release). This delay, could significantly bias the study. Especially if predation is the main source of mortality, as has been proposed by NMFS researchers. If test fish are delayed after release due to disorientation or stress, and are then exposed to high predation pressure during that

recovery period, these test fish could be much more vulnerable to predation than active migrants. In turn their survival would only reflect the relative survival of fish released in the forebay of the dam and would not be representative of downstream migrants.

Conclusions

Differences in travel time of study fish compared to run-at-large migrants suggest that test fish are not representative of run-at-large migrants and thus results of research can not be used to extrapolate a cost or benefit to overall population of operational changes evaluated in that research.

Grouping of chinook and coho could bias results as unequal proportions are used in test and control groups.

Large differences in recapture probabilities between day and night release groups demonstrate the importance of arrival time at Bonneville in calculation of survival. Differences in arrival timing at Bonneville of test and control fish could affect their recapture probability and therefore survival estimates may be biased by this.

Variability of data suggests no power to detect differences in survival given operational changes at the dam. This could lead to a false acceptance of hypothesis that there is no difference between 40% and 64% spill. Coupled with biases and questions we have regarding the study, we find this study useless in determining small differences in survival at The Dalles.

Research to date does not justify reducing spill. NMFS BiOp states that spill is the preferred route of passage and bases this statement on a good deal of research conducted in the last 30 years. However, NMFS has made an exception to this rule at The Dalles and based it upon PIT-tag research that we find seriously flawed. Without a definitive result from that research showing that the benefits of 40% spill outweigh those of 64% spill NMFS should choose that management alternative that is most protective of the fish. At The Dalles that means providing the higher spill level.

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