MEMO

Quantifying Adult Trap Efficiency for Adult Winter Steelhead at Merwin Dam in Spring 2018

Prepared by PacifiCorp

February 2, 2018

Final

Background

At the January 11, 2018 Aquatics Coordination Committee (ACC) meeting, PacifiCorp presented the results from the third year (2017) of radio telemetry study at Merwin Dam evaluating Adult Trap Efficiency (ATE) of adult winter steelhead. The primary goal of this study was to continue to measure core passage metrics for fish that entered and transitioned through the tailrace and were eventually collected at the Merwin Fish Trap. In particular, the study was focused on assessing the general effectiveness of the new V-style fyke that was installed in the fish ladder between the 2016 and 2017 study years. Results of the 2017 study indicated that the fyke was effective in preventing fish from exiting the trap and increased the overall rate of collection from previous years (Appendix A). While these results are encouraging, the estimated ATE (76%; 70-84%) remained below the target value of 98% or greater, which was the agreed upon performance standard.

Following the presentation, a discussion occurred regarding the possibility of study biases associated with using trap non-naïve fish (i.e., fish collected and tagged at Merwin Trap and then release back downstream) and not accounting for natural straying rates. Both of these factors have not previously been accounted for in the Lewis River studies, and may have resulted in a more conservative estimate of ATE. In addition, these factors may be violating one or more of the key study assumptions outlined in the M&E Plan. It was recommended that a fourth year of study be conducted using winter steelhead, and that consideration be made for these possible influences.

Proposed Study Methods – 2018 Winter Steelhead

Overview

All aspects of the original study design and intent that were approved in the 2016 M&E Plan will remain. The primary goal of the 2018 evaluation will continue to measure core passage metrics for winter steelhead that entered and transitioned through the tailrace and were eventually collected at the Merwin Fish Trap. However, an emphasis will be made on collecting and radio tagging a portion of the test fish in the North Fork Lewis River downstream of Merwin Dam. These fish will then be considered trap-naïve when they transition upstream and enter the dam tailrace. Similar to previous years, a portion of fish will be also collected from the Merwin Trap and will be radio tagged and released just below the Merwin Bridge. These fish will be considered trap non-naïve when they transition back upstream and enter the tailrace. All passage metrics outlined in the M&E plan (e.g. trap entrance efficiency - P_{EE}, Adult Trap Efficiency - ATE_{test}, and trap inefficiency - T_i) will be calculated for each group separately and compared for statistical difference.

Study Objectives

Similar to previous studies, the specific study objectives include:

1) Determine trap effectiveness based on the ATE metric defined in the M&E plan for winter steelhead, and then compare those estimates to the specified ATE performance standard of 98 percent;
2) Determine if winter steelhead show directed movement to the trap entrance, and if some fish do not, what are the behavior patterns for those specific fish in the tailrace;
3) Determine if winter steelhead in the tailrace spend the majority of their time in the area in the entrance of the trap, and if some fish do not, are those fish holding in another location within the tailrace;
4) Determine the total time winter steelhead are present in the tailrace of Merwin Dam and compare that to ATE performance standards for safe, timely, and effective passage (see Attachment A for definitions);
5) Describe the movement and behavior of tagged winter steelhead that do not enter or choose to leave the Merwin Dam tailrace and move back downstream; and,
6) Determine the condition of winter steelhead that are captured by the trap, as a function of rates of descaling and injury.

Fish Collection, Tagging and Release

A target of 150 blank wire tagged (BWT) winter steelhead will comprise each test group. Tangle netting will be used to collect naïve fish downstream. This will be done in concert with NOR brood stock collection efforts already in place. Additional fish will be collected and tagged at the Merwin Trap similar to previous studies. Naïve fish that were radio tagged in the lower river and then captured at the trap may be re-released downstream just below Merwin Bridge to bolster trap non-naïve fish depending on overall run size and fish availability. All tagging efforts will begin mid-February and continue through April. Tangle netting in the lower river will be scheduled for two days per week initially and all fish collected will be tagged. The number of fish tagged at the Merwin Trap each week will be in proportion to the historic run timing curve similar to previous studies.

All test fish will be gastrically implanted with a tag similar to Lotek MCFT-3A digitally coded transmitters. Each tag will have a unique identifier code and set for 5 s burst rate (off-set by ½ second intervals to avoid tag collision). These tags are 16 mm in diameter, 46 mm in length and weigh 16 g in air and 6.7 g in water. Latex tubing will be added to reduce tag regurgitation for the gastric implants. All fish will be allowed to recover following the tagging procedure before being released. Fish collected downstream (trap-naïve) will be release at the spot of capture, whereas fish collected and tagged at Merwin Trap will be transported via truck and released directly into the river at the Merwin Dam boat launch approximately 0.6 km downstream from the trap entrance.

Monitoring Sites and Detection Array

Similar to earlier studies, 18 detection antennas will be deployed throughout the Merwin Dam tailrace and downstream (*for a detailed description of the detection array layout, please see the 2017 Annual Report*). Each antenna will be monitored using a radio receiver (Lotek SRX800), which will be range tested and verified. All sites will be downloaded weekly. In addition to the fixed detection arrays, manual tracking of the lower river will be conducted weekly by boat. Up to three aerial flights will also be conducted in April and May to scan for tags in the lower North Fork Lewis River and portions of the East Fork Lewis River, and Cedar Creek in combination with upper basin surveys. Detection information from fix receivers sites and manual tracking will be processed in the same manner as earlier studies.

Data Analysis

The analytical approach for each study objective will remain the same as previous studies (*for a detailed description of the analytical approach for each study objective, please see the 2017 Annual Report*). Estimates of the core passage metrics, descriptions of fish movement and condition will be developed for each test group (i.e., trap-naïve vs. trap non-naïve). Estimates of the core passage metrics will be compared statistically between groups and tested for differences. The actual statistical testing methods will be determined once data is collected and checked against data normality and dependence.

Revised Study Assumptions

- The tailrace, defined as the entire area of river upstream of the Merwin Dam access bridge, is the main location for fish that are migrating upstream to congregate;
- Fish initially collected at the Merwin Trap, tagged, and released downstream (i.e., trap non-naïve fish) are motivated to pass upstream;
- Tagging effects will be similar between test groups;
- Trap-naïve fish have not entered the trap prior to being tagged and released;
- All fish that are successfully captured at the Merwin Trap and are then subsequently released back downstream to pass a second time, will return upstream.

Appendix A: Table 1.

Core passage metrics for test fish released in 2015, 2016, and 2017. Adult Trap Efficiency (ATE_{TEST}) defined as the percentage of adults attempting to migrate above Merwin Dam that are successfully collected in the fish trap; Trap Entrance Efficiency (P_{EE}) defined as the proportion of fish entering the Merwin Dam Tailrace that successfully find and enter the entrance of the trap (includes fish that were trapped successfully and those that were not captured); and Trap Ineffectiveness (T_i) defined as the relative proportion of fish that were attracted to the trap entrance, but were not ultimately captured (i.e., greater T_i values equates to lower trap effectiveness).

2015 species-specific values for ATE_{test}, P_{EE}, and T_i.

Species	***N***	ATE_{test} ***(BCA 95% CI)***	P_{EE} ***(BCA 95% CI)***	T_i
Winter steelhead	146	61% (51-67%)	86% (79-90%)	29%
Spring Chinook	40	38%	90%	58%
Coho Salmon	35	9%	23%	61%

2016 species-specific values for ATE_{test}, P_{EE}, and T_i.

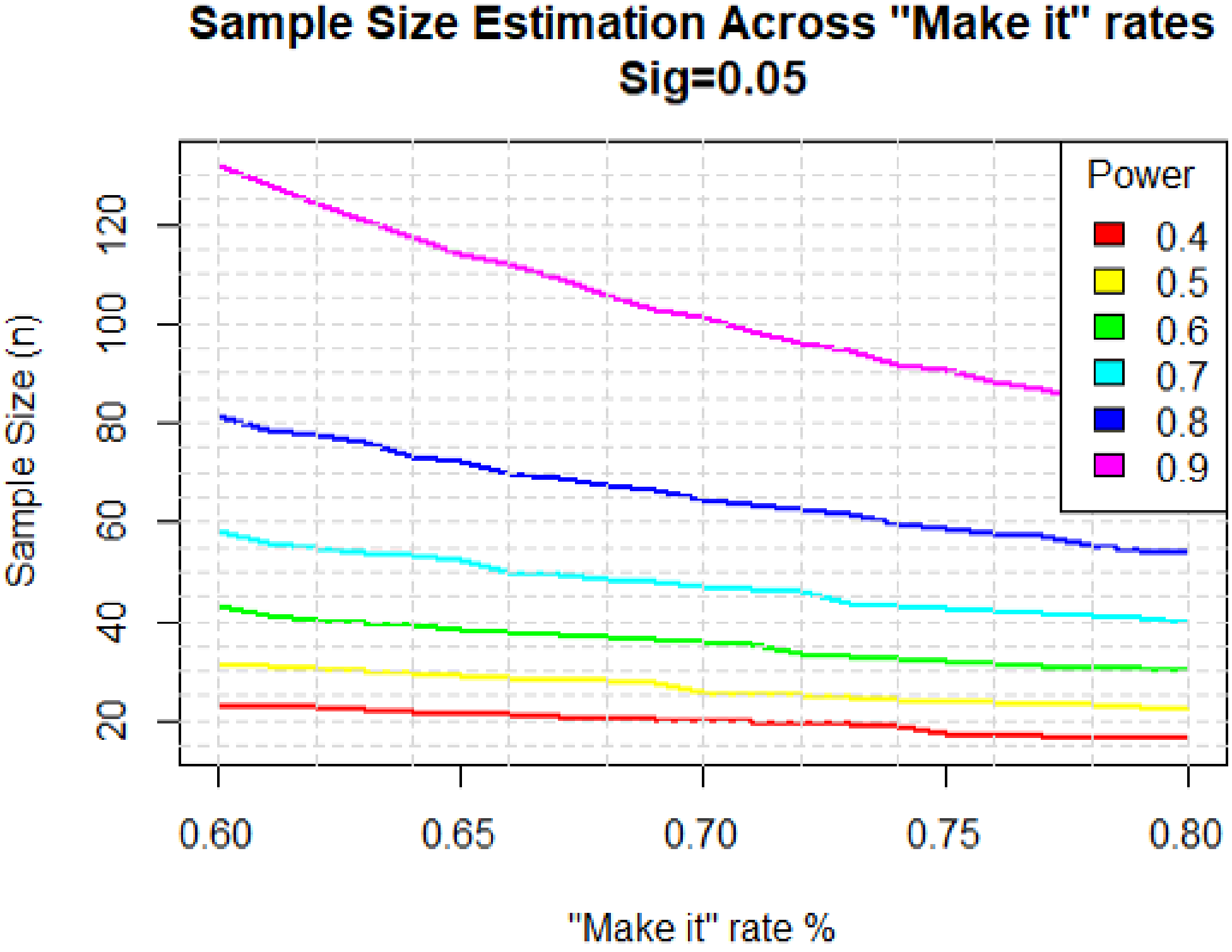
Species	***N***	ATE_{test} ***(BCA 95% CI)***	P_{EE} ***(BCA 95% CI)***	T_i
Winter steelhead	144	73% (65-80%)	93% (87-96%)	21%
Spring Chinook	*N/A*	*N/A*	*N/A*	*N/A*
Coho Salmon	*N/A*	*N/A*	*N/A*	*N/A*

2017 species-specific values for ATE_{test}, P_{EE}, and T_i.

Species	***N***	ATE_{test} ***(BCA 95% CI)***	P_{EE} ***(BCA 95% CI)***	T_i
Winter steelhead	150	83.5% (77-90%)	76.3% (70-84%)	8.6%
Spring Chinook	*N/A*	*N/A*	*N/A*	*N/A*
Coho Salmon	*N/A*	*N/A*	*N/A*	*N/A*

Responses to Comments Received on Quantifying Adult Trap Efficiency for Adult Winter Steelhead at Merwin Dam in Spring 2018 Memorandum - February 2, 2018

	Date	Commenter	Comment Number	Comment	Response
1	2/1/2018	Tom Wadsworth, WDFW	1	Steelhead caught in the lower river may not have the same re-sight probability (i.e., there may be fish in the lower river that were never destined for the Merwin trap and thus including them will artificially bias the efficiencies low). How will this effect be accounted for? For example, will naïve fish be censored in a similar manner as non-naïve fish (i.e., fish must enter the tail race to be included in the trap efficiency calculations)?	Yes, for calculating collection efficiency (ATE_{TEST}), trap naïve fish will be treated the same as non-naïve fish. ATE_{TEST} will be calculated for both groups as the proportion of fish entering the Merwin Dam tailrace that were ultimately captured at the trap. That is, only fish that enter the tailrace will be included in the calculation; fish that do not enter the tailrace will not.
2	2/1/2018	Tom Wadsworth, WDFW	2	Will there be any fish caught in the lower river that you would choose not to include in the study (e.g., non-chrome fish etc.)?	Likely not, unless they are found to be physically injured (e.g., sea lion injuries), in poor condition (e.g., presence of fungus) or have already spawned (Kelt), they will be included in the study. Fish's outward appearance/condition, sex, length, date of capture/tagging will be recorded as well as tissue samples taken as before. We also plan to incorporate two additional metrics this year to further understand possible mechanisms influencing fish passage behavior after release. Reflex action mortality predictors (RAMP) (Raby et al. 2012) will be assessed on both trap naïve and non-naïve fish prior to release to evaluate levels of acute stress from capture and handling procedures. Additionally, to understand how energetic reserves could influence fish behavior after release, somatic tissue lipid content (i.e. energetic state) will be estimated on fish using handheld microwave radio emitters (Distell Fatmeters, https://www.distell.com/). Raby, G.D., Donaldson, M.R., Hinch, S.G., Patterson, D.A., Lotto, A.G., Robichaud, D., English, K.K., Willmore, W.G., Farrell, A.P., Davis, M.W. and Cooke, S.J. (2012) Validation of reflex indicators for measuring vitality and predicting the delayed mortality of wild coho salmon bycatch released from fishing gears. Journal of Applied Ecology, 49(1), pp.90-98.
3	2/1/2018	Tom Wadsworth, WDFW	3	It would be good to know how many samples (tagged fish) are necessary to get a dependable efficiency estimate for naïve fish. Perhaps a power analysis could be done to assess this. However, without knowing how many fish tagged in the lower river will reach the trap it could be difficult to determine the number needed to tag. Therefore, tagging as many as possible seems like the best course of action (rather the 150 target). Once the proportion that reach the trap is determined, the sample size could be adjusted for future years.	A power analysis for a proportion test was run. Power was set to 0.8, a medium effect size was used, and assumed only 70% of released fish will "make it" (i.e., enter the tailrace). Results indicate that approximately 64 fish for each treatment group will need to be released. The attached figure shows the sample sizes needed across a range of “make it” rates (i.e., how many released fish will make it to the trailrace) and give different power levels. The take-home from this plot is that, given an power of 0.8, there is not a large difference in sample sizes needed between a 65% and 70% “make it” rate (only about 5 fish difference). This indicates that the sample size is relatively robust for a slight difference in the assumed “make it” rate of 70%. Of course, the benefit of using larger sample sizes is to buffer against lower “make it” rates. Agreed, once the proportion that reach the trap is determined, the sample size could be adjusted for future years if needed. For now, the conservative sample size selected appears to be robust.
4	2/1/2018	Tom Wadsworth, WDFW	4	For the data analysis, the memo says results for naïve and non-naïve fish will be compared, but it isn’t clear how the results would be used together to estimate overall Merwin trap efficiency. If the intention is just calculate separate estimates and they are found to be significantly different, would one group estimate be preferred over the other?	The intent is to calculate an estimate ATE_{TEST} for each group. Both estimates will be reported and presented to the ACC for discussion.
5	2/1/2018	Michelle Day, NOAA	5	Ed (Meyer) and I have reviewed the proposed 2018 ATE study. We agree with the proposal.	No additional response.


Sample Size Estimation Across "Make it" rates
Sig=0.05
Power
0.4
0.5
0.6
0.7
0.8
0.9
Sample Size (n)
20
40
60
80
100
120
0.60
0.65
0.70
0.75
0.80
"Make it" rate %