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MEMORANDUM

TO: Erick VanDyke, ODFW

FROM: Fish Passage Center Staff

DATE: August 24, 2016

SUBJECT: Request for Review of Publications Used to Support Draft Change Form 17LGS002 – SW Close Criteria

You requested that we review the following publication: “Li X, Deng ZD, Brown RS, Fu T, Martinez JJ, McMichael GA, Skalski JR, Townsend RL, Trumbo BA, Ahmann ML, Renholds JF, 2015. Migration depth and residence time of juvenile salmonids in the forebays of hydropower dams prior to passage through turbines or juvenile bypass systems: implications for turbine-passage survival. *Conserv Physiol* 3: doi:10.1093/conphys/cou064”. Migration depths from this paper are cited as justification in the Draft Change Form 17LGS002 to conclude that the benefit of the RSW for subyearling Chinook passage is reduced when temperatures exceed 20°C. The Corps of Engineers also cites a second paper in their justification: “Tiffan K.F., T.J. Kock, W.P. Connor, R.K. Steinhorst, and D.W. Rondorf, 2009. Behavioural thermoregulation by subyearling fall (autumn) Chinook salmon *Oncorhynchus tshawytscha* in a reservoir. *Journal of Fish Biology* 74, 1562–1579”. We have also reviewed Tiffan et al. (2009) for its application to the statements in the Draft Change Form.

Based on our review of the two papers referenced in the Draft Change Form justification we have concluded that:

- **Li et al. (2015) is not an appropriate reference for information relative to the depth of fish that ultimately pass Little Goose Dam via the spillway.**
- **Neither Li et al., (2015) nor Tiffan et al., (2009) present information relative to subyearling migrants seeking an optimal temperature range, or limiting their exposure to temperatures above 20°C, in the Little Goose Dam forebay.**

- **Neither of the papers provides the specific information needed to justify that closing the RSW at Little Goose Dam is beneficial to subyearling migrants.**
- **The Draft Change Form justification should be rewritten to accurately portray that there is no direct information that quantifies the risk to subyearling migrants associated with closing the RSW at Little Goose Dam.**

Li et al. (2015) is not an appropriate reference for information relative to the depth of fish that ultimately pass via the Little Goose Dam spillway.

The objectives of Li et al. (2015) were to investigate the forebay depth distributions of fish that subsequently passed through the powerhouse and to determine whether there were differences in depth distributions between fish that pass through the JBS versus the turbines. Because the objectives of this study focused on powerhouse passage, Li et al. (2015) does not present any data about the depth distributions of fish that passed through the spillways at Little Goose Dam. As it is currently written, it is not accurate for the proposed Draft Change Form to cite Li et al. (2015) as a reference for a proposed operational change that affects spillway passing fish at Little Goose Dam.

Neither Li et al., (2015) nor Tiffan et al., 2009 present information relative to subyearling migrants seeking an optimal temperature range, or limiting their exposure to temperatures above 20°C, in the Little Goose Dam forebay.

In their study, Li et al. (2015) chose to use mode depth to define acclimation depth. Mode depth was the depth where a fish spent most of its time in a data set, with the assumption that fish were neutrally buoyant at this depth (hence the most energy saving). The authors employed bootstrapping procedures to 1) estimate standard errors of mode depths, and 2) conduct Kolmogorov-Smirnov (KS) test for equal distributions. From the standard errors of mode depths the authors obtained interval estimates of fish acclimation depth. From the Kolmogorov-Smirnov (KS) test for equal distributions the authors compared mode depths and depth distributions of different fish groups based on variables of their choice (passage type, year, diel period, location, and species/age group). If the KS statistic between two fish groups was shown to be extreme, based on the bootstrapping procedures, then the test indicated that particular variable was influential to fish swimming depth.

The Li et al. (2015) analysis showed that variables such as year, diel period, location, and species/age group could have influenced the swimming depths of juvenile salmonids in this study; however, the authors made no assumptions that extended beyond the scope of their study. For example, temperatures at different water depths were not investigated as a variable in this study, so one should not cite this study to conclude that water temperature was influential to fish swimming depth. The authors only hypothesized in their paper that temperature might be one of the latent variables that drives the differences in fish swimming depths but provided no analyses to investigate this hypothesis.

The proposed change form also directly cites Tiffan et al. (2009) as a source confirming that "...subyearlings likely migrate deeper in the water column to stay in an optimal temperature range and limit their exposure to temperatures above 20°C.". It is true that Tiffan et al. (2009) found that subyearling Chinook selected a depth and temperature combination that increased their exposure to 16-20°C. However, Tiffan et al. (2009) relied on fish that were captured and tagged at Lower Granite Dam, held for 24-36 hours, and released into the Snake River, 0.6 km upstream of the confluence of the Clearwater River (i.e., ~51 km above Lower Granite Dam). These fish were then tracked for up approximately 24.5 km as they migrated back downstream towards Lower Granite Dam. Therefore, Tiffan et al. (2009) does not provide data on behavioral thermoregulation of subyearling Chinook at the Little Goose Dam forebay.

Neither of the papers provides the specific information needed to justify that closing the RSW at Little Goose Dam is beneficial to subyearling migrants.

The two papers cited in the Draft Change Form do not provide a justification for the removal of the RSW as avoiding or minimizing risk to subyearling migrants. Presumably, depth distribution data for fish passing via the spillway at LGS are available from the same performance studies that Li et al. (2015) relied on to describe the depth distribution for powerhouse passed migrants.

However, the Draft Change Order should recognize that even the use of JSATS tagging for these studies is limited since the study cannot represent the run at large. This is recognized by the authors when they state: "Additional analysis may help to explain further some of the results presented. Investigation of the influence of telemetry tags on the depth distributions of fish would allow better comparisons to run-of-the-river untagged populations." The performance tests associated with Li et al. (2015) had some of the highest rejection rates of JSATS tagging in the hydrosystem. With almost 20% of subyearling Chinook excluded from the study due to size and condition, extrapolation of results of behavioral studies to the run at large should be done with extreme caution.

- In 2012, the rejection rate of subyearling Chinook for performance testing was 6.3%. In 2013, the rejection rate of subyearling Chinook was 18.8%. These fish were rejected due to size (13.6% in 2013) or condition (5.2% in 2013). For comparison, after a 12.6% rejection rate at The Dalles Dam in 2010, SRWG members revised the rejection criteria to reduce rejection rates in future studies.
- Median-sized fish are overrepresented in these studies, eliminating a large portion of the run-at large. If migration behavior and depth vary with smolt size, these JSATS tags cannot be used to adequately represent the passage experience for subyearling Chinook. Results should be used with caution when applying to management decisions.

With recognition of the application of the JSATS data it would be more informative if the Draft Change Form presented similar analyses for fish that passed via the spillway as justification for the proposed operation than to simply cite Li et al. (2015).

The Draft Change Form justification should be rewritten to accurately portray that there is no direct information that quantifies the risk to subyearling migrants associated with closing the RSW at Little Goose Dam.

Until there is additional information available to inform this Draft Change Form, it would be advisable to rewrite the existing justification to accurately reflect the state of knowledge regarding this recommendation.

Li et al. (2015) does not present any data that links temperatures to the depth distribution of fish passing through the powerhouse. Therefore, it is misleading for the proposed change form to cite Li et al. (2015) as a reference for the statement: “As the river warms, subyearlings likely migrate deeper in the water column to stay in an optimal temperature range and limit their exposure to temperatures above 20°C.

In its current state, the statement in the proposed Draft Change Form that cites Tiffan et al. (2009) is misleading and should be rewritten to clarify what data Tiffan et al. (2009) used and the limitations of applying these data to the proposed operation at Little Goose Dam.