Columbia River Project Water Use Plan

Monitoring Program Terms of Reference

- **CLBMON-18 Middle Columbia River Adult Fish Habitat use**

Addendum 2

March 12, 2015

A1 Addendum to CLBMON-18 – Middle Columbia River Adult Fish Habitat Use

A1.1 Addendum Rationale

The principal objective of this monitoring program is to assess how movement patterns and activities (and hence habitat use) of Bull Trout (Salvelinus confluentus) and Mountain Whitefish (Prosopium williamsoni) are affected by flow releases from Revelstoke Dam.

The schedule for this Terms of Reference (TOR) originally encompassed two periods, for a total of six years: a) three years of monitoring activity of Bull Trout and Mountain Whitefish in function of discharge during pre-minimum flow release and Revelstoke Unit 5 (REV5) entry in operation (the two coincided) in December, 2010 (termed pre-flow change phase), and b) an additional three years of monitoring post-minimum flow release and REV5 entry in operation (termed new flow regime).

The three years of the pre-flow change phase concluded in November, 2010, during which time Bull Trout and Mountain Whitefish were tracked downstream of Revelstoke Dam and their movements and energetic expenditures recorded through electromyogram telemetry.

These results suggest that the biological significance of the overall effects of discharge on Bull Trout and Mountain Whitefish is unknown. There is the potential that the range of discharges experienced by the two species during the pre-flow change phase generated in-river velocities encompassed by those likely to occur during most of the new flow regime.[1] In particular, the analyses showed that:

- There was no evidence of upstream or downstream displacement of tracked Bull Trout during periods of high or changing river discharge[2]. The fish appeared capable of maintaining their longitudinal position across the magnitude of discharges they experienced. (Taylor et al. 2014b); the same study also reported that the odds of movements decreased as discharge increased.
- Tracked Bull Trout spent most of their time stationary and could maintain their position without beating their tails, and this over a large range of discharge (0 to 1045 cms); moreover there was no relation between the swimming speed of these fish and within-hour changes in discharge (Taylor et al. 2014a)[3] ; and,
- Whitefish blood cortisol levels were positively related to discharge; however, levels over the range of discharges observed (0-1770cms) were always lower than those found in experimental studies of acute stress responses in other salmonids (e.g., Barton et al. 2002); this, coupled to their low blood lactate concentrations, suggested that fish were not swimming exhaustively at high flows and that discharge was not a stressor (Taylor et al. 2012).

[1] The addition of a fifth unit was predicted to increase average channel velocity under maximum flow conditions by up to 0.7 m/s at the tailrace and by 0.1 m/s near the airport (BC Hydro 2006).

[2] Transverse displacement could not however be measured.

[3] A possible interpretation is that fish held position to conserve energy (i.e., the bioenergetics consequences of holding position with increased discharge). This was not addressed by Taylor et al. (2014), who interpreted the results as suggesting that Bull Trout were not excluded from their macro-scale (100 m) habitat.

The predicted maximum discharges resulting from REV5 were rarely experienced by the fish during the pre-flow change phase, and Taylor et al (2014a) highlighted the need to focus on the effects of maximum discharge magnitude when considering the energetic consequences of altered flow regimes on these species. The present addendum proposes to use the data so far collected to model the energetic expenditures of these two species at high discharges rates, frequencies, and magnitudes.

If the modelling exercise indicates that there is no relationship between flows which would persist in post-REV5 operations and Bull Trout and Whitefish energetics response and movement patterns, then a technical review committee (c.f. Task 4 below) would evaluate whether there would be any benefit for post-flow monitoring. If the modelling however indicates that there are potentially biologically significant effects of the post-REV5 operations discharges on fish energetics and that there are benefits to track additional fishes for bioenergetics expenditures, the originally planned three years of monitoring may be implemented.

A1.2 Methods – Task 1 Literature Review on Fish Bioenergetics

An extensive literature review will be conducted on fish bioenergetics prior to implementation of the modelling. It will specifically review the effects of hydropeaking on fish energetics and body condition of Bull Trout and Mountain Whitefish, and identify energetics models which can be parametrized using available data.

The objective of this literature review is to ensure that the data available (either from the three years of this study alone – c.f. Task 2 below – or with the addition of peer reviewed or grey literature data) can provide the basis for a suitable model to predict the effects of the new flow regime on Bull Trout and Mountain Whitefish energy expenses.

The literature review will recommend a course of action; possibilities include extension, cancellation, or modification of the current study. It will also highlight the variables most likely to be affected, and on whose an effect is most likely to be detected, by the new flow regime. A power analysis (cf. Task 2) may also be required should the review recommend extension or modification of the current study.

A1.3 Methods – Task 2 Bioenergetics Modelling

The selection of the modeller will be subject to a review jointly conducted by BC Hydro, agencies and First Nations.

The objectives of the model are to make predictions about changes in Bull Trout and Mountain Whitefish swimming activity and their associated energetic costs under conditions of high discharge amplitude (2124 cms and higher) and diel variation in discharge representative of hydropeaking. The model will also generate energy expenditures and probability of movement under flows under and above 142 cms in order to compare them with those expected under the minimum flow regime.

The data collected in Years 1-3 of the program (Taylor and Lewis 2011) will be accessible from BC Hydro and will be used to model Bull Trout and Mountain Whitefish energetics. Other datasets (e.g., ADCP or HEC-RAS results from concurrent studies in the area; or other datasets deemed suitable by the literature review) may also be used and will be provided as needed. A sensitivity analysis will be included in the deliverables to assess the level of accuracy of the model.

The task will also generate a power analysis to estimate the sample size (fish, sessions) required to determine various effect sizes from field observations. In the event that the level of effort required to detect the effect size is unrealistic, this will be interpreted as that the effects of the new flow regime on Bull Trout and Mountain Whitefish energetics cannot be detected with the present technology within the budget.

A1.4 Methods – Task 3 Fish Sampling and Habitat Data (Conditional)

Pending the preliminary results of the modelling, additional data may be required to improve the model. Such data may be additional fish tracking or habitat data (e.g., water velocity). The fish tracking may include strategic tracking and monitoring of fish locations and daily activity patterns in relation to flows using either EMG and/or locational telemetry.

Any additional field sampling will require thorough justification in a detailed progress report and may be submitted to the technical review committee for evaluation before approval.

Should fish capture be required, budget from Year 5 associated with this task would be advanced; however, efforts will be made to coordinate the capture and tagging of suitable individuals from the fish population indexing study (CLBMON-16), as long as sampling methods do not affect behaviour and health of fish.

A1.5 Methods – Task 4 Technical Review Committee

A Technical Review Committee composed of representatives from BC Hydro, First Nations and agencies will:

a. Assess the conclusions of the literature review (Task 1 above); should the literature review conclude that a bioenergetics model is unlikely to yield conclusive results about the effects of the new flow regime on fish energetics, the Committee, in conjunction with the chosen contractor, will agree on the effect size most likely to be detected by the available technology during the additional three years of field work.

b. Review the conclusions of the bioenergetics modelling, pending a positive conclusion of the literature review. The objective of this technical review will be to determine, in view of the modeling's predictions and sensitivity analysis, whether the original TOR's three years of field work are required to determine the effects of the new flow regime on Mountain Whitefish and Bull Trout energetics.

A1.6 Budget

Total Revised Program Cost: $899,713.

A1.7 References

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