Entrainment risk of burbot (*Lota lota*) and bull trout (*Salvelinus confluentus*) in a large hydropower reservoir: mapping entrainment zones and linking fish movement to forebay flow hydraulics

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Rationale: Fish using habitats near dams are vulnerable to being non-volitionally displaced from reservoirs (i.e. entrained) when water is diverted through turbines for the generation of electricity. However, little is known on how entrainment of non-anadromous adult fish in hydropower reservoirs is influenced by biotic (e.g. sex, size, population, species) and abiotic (e.g. temperature, flow, season, turbine operational modes) factors.

Description*:* In this study, we will use a telemetry system capable of positioning fish with sub-meter accuracy to study the fine-scale movement of acoustically-tagged burbot (*Lota lota*) and bull trout (*Salvelinus confluentus*) in the forebay of a large hydropower reservoir (Kinbasket Lake, Mica Dam) in the upper Columbia River, British Columbia. We will first use the fine-scale movement data to map the fish entrainment zone (FEZ) inside the forebay, where FEZ is defined as the volume immediately upstream of turbine intakes where the movement of fish toward the turbines is greater than a given probability (e.g. 90%). Secondly, we will analyze the fine-scale movement data in relation to flow hydraulics in the forebay to investigate the biotic and abiotic characteristics that lead to fish entrainment under different turbine operational modes.

Outcomes

- Markov chain model defining fish entrainment zones in the forebay.
- State-space model linking the fish movement data with the forebay flow field (calculated with a computational fluid dynamics model).

Benefits from this research

The outcomes of this study should be useful in the development of turbine operational guidelines to reduce entrainment risk of non-anadromous adult fish in hydropower reservoirs. In addition, a detailed understanding of fish behaviour in the vicinity of the forebay should be helpful in developing and evaluating mitigative measures.