

Bridge-Seton Water Use Plan

Monitoring Program Terms of Reference

- BRGMON-7 Downton Reservoir Fish Habitat and Population Monitoring Terms of Reference

Addendum 1

May 8, 2015

A1 Addendum to BRGMON-7 Downton Reservoir Fish Habitat and Population Monitoring

A1.1 Addendum Rationale

During Bridge River WUP development process key information gaps pertaining to Downton Reservoir ecosystem were identified. These include: 1) the species composition, relative abundance, distribution and life history requirements of species of fish in the reservoir and adjacent tributaries, and, 2) the relationship between operating parameters of the reservoir (i.e., maximum/minimum elevation, filling schedule) and the fish population response. To resolve these data gaps and uncertainties the Bridge River Consultative Committee (BRG CC) recommended long term monitoring studies to obtain more comprehensive information on reservoir habitats and fish populations. To this end a set of management questions related to fisheries management goals and associated hypotheses regarding potential environment responses to the selected WUP operations were also defined.

However, after implementing the study for the first two years some key deficiencies in data collection methodologies, and issues with the testability of some of the hypotheses were identified. Further, recently proposed modifications to the Downton reservoir operation have necessitated revision to the original TOR. The identified issues are summarized as follows:

A1.1.1 Deficiencies in some of the original hypotheses:

Some of the hypotheses cannot be tested using the data collected under this monitor (e.g., fish stranding and fish entrainment) and data collection in general cannot be undertaken due to difficulties associated with access to sites around the reservoir. Impacts associated with stranding are addressed through operational procedures (reservoir drawdown rates) and entrainment impacts are addressed through offsetting measures being considered under Bridge-Seton Fish Entrainment Strategy Program.

A1.1.2 Deficiencies in methodological approaches to collecting sufficient sample size:

Some data collection approaches (e.g., mark-recapture methods) recommended in the original design are found to be ineffective in the Downton Reservoir situation. Specifically recapture rate on marked fish has been almost nil due to poor visibility and lack of information on fish distribution. Tributary spawner surveys are also found to be ineffective due to poor visibility and poor access to tributaries.

As the result of these concerns the TOR for this monitor needs to be revised in order to refine data collection approaches to improve study's ability to answer the management questions.

The changes made are outlined below.

1.2 Management Questions

The primary management questions addressed by the proposed monitoring program are:

1. What are the basic biological characteristics of fish populations in Downton and its tributaries?

This management question will be evaluated using fish population abundance or index of abundance, fish distribution and biological characteristics data.

2. Will the selected alternative (N2-2P) result in positive, negative or neutral impact on abundance or index of abundance and diversity of fish populations?

This management question will be evaluated using weight-of-evidence as exhibited by trends in fish population abundance and trends in their biological characteristics in conjunction with trends in reservoir operation. The underlining operational cause-effect relationship associated with any response may not be evident from this analysis. However, weight-of-evidence will be used to evaluate WUP operations impacts of reservoir rainbow trout population.

3. Which are the key habitat factors that contribute to reduced or improved productivity of Downton Reservoir fish populations?

This management question will be evaluated using basic habitat quality and quantity data collected in the reservoir in conjunction with reservoir operations data.

4. Is there a relationship between the minimum reservoir elevation and the relative productivity of fish populations?

This management question will be evaluated using combination of weight-of-evidence as exhibited by trends in fish population abundance and trends in their biological characteristics in conjunction with trends in reservoir operation.

5. Can refinements be made to the selected alternative, without significant impact to instream flow conditions in the Middle Bridge River, to improve habitat conditions or enhance fish populations in Downton Reservoir?

This management question will be evaluated based on insights gained from results under Management Questions 1-4.

1.3 Detailed Hypotheses about the Impacts of Downton Reservoir Operation on Fish Populations

The primary hypothesis (and sub-hypotheses) associated with these management questions have been updated as follows:

- H₁: The annual abundance index for rainbow trout in Downton Reservoir is stable over the monitoring period.
- H₂: The annual abundance index for rainbow trout is independent of minimum reservoir elevations observed over the period of monitoring.
 - H_{2a}: The annual abundance index for Age-1 rainbow trout is independent of a minimum reservoir elevation effect (sampling year minus 1).
 - H_{2b}: The annual abundance index for Age-2 rainbow trout is independent of a minimum reservoir elevation effect (sampling year minus 2).
- H₃: The annual abundance index for rainbow trout is independent of maximum reservoir elevations observed over the period of monitoring.
 - H_{3a}: The annual abundance index for Age-1 rainbow trout is independent of a maximum reservoir elevation effect (sampling year minus 1).

- H_{3b}: The annual abundance index for Age-2 rainbow trout is independent of a maximum reservoir elevation effect (sampling year minus 2).
- H₄: Operation of the reservoir restricts the amount of available effective spawning habitat in tributaries limiting the productivity of fish populations.
- H_{4A}: Rainbow trout spawning density in Downton Reservoir drawdown zone is minimal and therefore operations do not limit productivity of fish populations.
- H_{4B}: Operation of the reservoir restricts fish access to tributaries limiting the productivity of fish populations.
- H₅: Habitat availability in Downton Reservoir is independent of reservoir operation, i.e., habitat characteristics are not significantly different between minimum, maximum and modified maximum reservoir elevations.

These hypotheses will be tested using data from general fish population monitoring and habitat quality and quantity data. Weight-of-evidence will be used to assess potential WUP operations impacts on reservoir fish population. The range of operations across the years of monitoring should provide the operational contrast required to evaluate these hypotheses. They will be tested using inferences based on weight-of-evidence, rather than direct tests at specific sites.

2.2 Approach

The general approach to this monitoring program will be to collect a comprehensive long term data set on fish populations and habitat conditions in Downton Reservoir to resolve current data gaps about Downton Reservoir fish populations and scientific understanding about how drawdown influences fish population abundance and diversity. Through collection of coincidental information on reservoir operating parameters, habitat conditions and fish population information (age structure and abundance) it is possible to identify changes in natural or normal population structure, and changes over time can be used to develop and test hypotheses about the relationship of habitat conditions and population response. This will be accomplished by:

- a) Collecting time series information on the abundance and biological characteristics of resident fish populations and reservoir habitat conditions.
- b) Correlating abundance of younger ages of fish (recruitment) with reservoir operating parameters. For this step, it is important to understand the relative contribution of those younger ages that recruit from habitats that are not affected by operations (e.g., Upper Bridge River) and those habitats that are affected by operations (e.g., reservoir drawdown zone).
- c) Implementing a “stock synthesis” approach to estimating recruitment anomalies associated with operating impacts, which combines age composition and relative trend data collected during monitoring to better define recruitment changes.
- d) Examining trends in growth or distribution changes with operations. The advantage of this approach is that it provides an explicit method for linking habitat conditions created by implementation of reservoir operating parameters to response of fish populations.

2.3 **Methods**

General Fish Population Index Surveys

General fish population index surveys are proposed to provide information on seasonal and inter-annual variation in the relative abundance, distribution and growth rate of all species in the reservoir fish community. Single pass boat electrofishing at ca. 60 to 90 randomly selected sites (average ca. 300 m long) for a total sampling distance of ca. 18 to 27 km of shoreline will be conducted. This will be accomplished during one session (6-7 nights) per year at low reservoir elevation during spring (i.e., early June). Single season intensive sampling regimes were adopted based on lessons learned in the pilot years using a two season less intensive sampling frequency approach. Fish will be sampled for length, weight, and age structure. Spot turbidity and secchi disk measurements will also be taken as a general indicator of sampling conditions.

Habitat Surveys

Habitat surveys are proposed to document habitat availability in the reservoir and tributaries. Habitat surveys involve:

- a) Habitat mapping – This includes characterizing and mapping the entire shoreline of Downton Reservoir according to the following general habitat types (tributary mouth, fluvial fan, shallow <15% slope, steep >15% slope). This will be completed by boat and geo-referenced.
- b) Quantifying spawning habitat quality and quantity within and outside of the Downton Reservoir drawdown zone. This includes measurement of habitat sizes in and out of drawdown zone and substrate types as indices for habitat quality.
- c) Habitat measurement – This includes measuring bank slope, substrate size and embeddedness at a sub-set of the fish sampling locations. Measurements will be taken at observed minimum, maximum, and modified maximum reservoir operations (related to LaJoie seismic risk mitigation).
- d) Habitat/water quality measurement – In order to investigate the impacts of reservoir operation on fish populations' supplemental habitat, information will be collected during the fish sampling surveys. This includes but may not be limited to:
 - 1) installation and maintenance of thermographs in key reservoir tributaries;
 - 2) systematic monitoring of suspended sediment concentration from key tributaries;
 - 3) seasonal limnological surveys to document temperature/oxygen profiles and light penetration/water clarity.

Rainbow Trout PIT Tagging

PIT tagging of rainbow trout will be completed to assess use of drawdown area by rainbow trout. Data collection will involve angling in creek mouths prior to the rainbow trout spawning period. In the first year following this addendum two PIT aeriels will be installed in key tributaries that are particularly affected by the drawdown and in a couple of tributaries that are much larger and suspected to provide spawning habitat that is unaffected by drawdown (e.g., Upper Bridge River). Selection of these tributaries will be completed using spawning activity information from the two pilot years of this study. If tributaries affected by the drawdown are found to be utilized for spawning, in subsequent years installation of multiple arrays bounding the drawdown zone will be completed to determine if they spawn in areas that will be inundated.

2.3.3 Task 3 Laboratory Analysis

Laboratory analysis will be conducted to assess the age of specimens and allow development of relationships between size and age of fish. These data allow estimation of average growth rates of the different life stages and species of fish in the reservoir and gain better understanding of how different habitats or reservoir operating strategies influence fish growth rate.

2.6 Budget

Total Revised Program Cost: \$975,492.