

Columbia River Project Water Use Plan
Monitoring Program Terms of Reference
KINBASKET RESERVOIR
FISH AND WILDLIFE INFORMATION PLAN

- **CLBMON-5 Kinbasket Reservoir Burbot Life History and Habitat Use Assessment**

24 October 2007

Terms of Reference for the Columbia River Project Water Use Plan Monitoring Programs Kinbasket Reservoir Fish and Wildlife Information Plan

1.0 OVERVIEW

This document presents Terms of Reference for monitoring programs under the Kinbasket Reservoir Fish and Wildlife Information Plan (Table 1). These programs will evaluate the potential effects of Mica Dam and Kinbasket Reservoir operations on fish habitat and fish populations, wildlife habitat and wildlife populations.

This document provides detailed Terms of Reference for the following programs:

- 1) CLBMON-1 Mica Dam Total Gas Pressure Monitoring and Abatement Program: a 2-year study to determine dissolved gas supersaturation with synchronous condense operation of Units 3 and 4 in relation to Units 1 and 2, which have been previously monitored.
- 2) CLBMON-2 Kinbasket and Revelstoke Reservoirs Kokanee Population Monitoring: a 12-year program to monitor trends in the biological characteristics, distribution and abundance of kokanee populations in Kinbasket and Revelstoke reservoirs, and provide information required to link the effects of reservoir operation to population levels.
- 3) CLBMON-3 Kinbasket and Revelstoke Reservoirs Ecological Productivity Monitoring Program: a 12-year study to define the trophic web mechanisms and dynamics of Kinbasket and Revelstoke reservoirs, and determine if changes in pelagic productivity are associated with reservoir operations.
- 4) CLBMON-4 Kinbasket Reservoir Fish Stranding Assessment: a 3-year study to qualitatively evaluate the extent of fish stranding caused by the annual drawdown of Kinbasket Reservoir.
- 5) CLBMON-5 Kinbasket Reservoir Burbot Life History and Habitat Use Assessment: a 3-year study to obtain baseline data on the biological characteristics of burbot populations in Kinbasket Reservoir, and provide information to evaluate potential effects of reservoir operation on burbot population productivity
- 6) CLBMON-6 Kinbasket Reservoir Bull Trout Life History and Habitat Use Assessment: a 3-year study to obtain baseline data on the life history and habitat characteristics of juvenile bull trout in Kinbasket Reservoir, and provide preliminary information to determine if reservoir operations could have an effect on bull trout populations.
- 7) CLBMON-7 Kinbasket Reservoir Rainbow Trout Life History and Habitat Use Assessment: a 3-year study to obtain baseline data on the biological characteristics of rainbow trout in Kinbasket Reservoir, and provide the information required to evaluate the impacts of reservoir water levels on the productivity of rainbow trout populations.
- 8) CLBMON-8 Kinbasket Reservoir Monitoring of the Valemount Peatland: a 3-year monitoring program to address key uncertainties regarding the relative contribution and importance of the current reservoir operating regime to the erosion processes affecting the

wetland, obtain an inventory of plant and wildlife species, and determine whether the long-term viability of the wetland, and associated plant and animal species, are being affected by erosion processes related to reservoir operations, and how these effects may be mitigated.

Table 1 Kinbasket Reservoir Fish and Wildlife Information Plan Monitoring Program Terms of Reference Submission Information

Name of Monitoring Program	Order Clause Fulfilled	Submitted with this Package	Previously Submitted To CWR	Submission Date	Leave to Commence
CLBMON-1 Mica Dam Total Gas Pressure Monitoring and Abatement Program	Schedule A: 5.a	Yes	No	24 October 2007	No
CLBMON-2 Kinbasket and Revelstoke Reservoirs Kokanee Population Monitoring	Schedule A: 5.b Schedule B: 1.a	Yes	No	24 October 2007	No
CLBMON-3 Kinbasket and Revelstoke Reservoirs Ecological Productivity Monitoring Program	Schedule A: 5.c Schedule B: 1.b	Yes	No	24 October 2007	No
CLBMON-4 Kinbasket Reservoir Fish Stranding Assessment	Schedule A: 5.d	Yes	No	24 October 2007	No
CLBMON-5 Kinbasket Reservoir Burbot Life History and Habitat Use Assessment	Schedule A: 5.e	Yes	No	24 October 2007	No
CLBMON-6 Kinbasket Reservoir Bull Trout Life History and Habitat Use Assessment	Schedule A: 5.f	Yes	No	24 October 2007	No
CLBMON-7 Kinbasket Reservoir Rainbow Trout Life History and Habitat Use Assessment	Schedule A: 5.g	Yes	No	24 October 2007	No
CLBMON-8 Kinbasket Reservoir Monitoring of the Valemount Peatland	Schedule A: 5.h	Yes	No	24 October 2007	No

2.0 MONITORING PROGRAM RATIONALE

Early on in the Columbia River Water Use planning (WUP) process, the WUP Consultative Committee (WUP CC) recognized that there was a great deal of uncertainty regarding whether the lack of constraints on operation of Kinbasket Reservoir was having a significant impact on fish and wildlife and associated habitat. A number of key hypothesized impacts were identified during the issue scoping phase (e.g., entrainment at Mica Dam, and interruption of natural sturgeon recruitment processes).

However, a general lack of data on the relative abundance, distribution, life history and seasonal patterns of habitat use and supporting ecosystem processes in the upper Columbia River and Kinbasket Reservoir, precluded incorporation of these concerns into Water Use Plan assessments.

The WUP CC explored alternative ways of operating Kinbasket Reservoir to provide benefits to fish and wildlife by imposing minimum elevation constraints. However, the ability to track the performance of the alternatives was limited to use of habitat-based measures (pelagic productivity), which were developed based on limited site-specific data and professional judgment. Initial modeling results showed that some improvements to pelagic productivity could be achieved through a minimum elevation constraint, but that this constraint would incur a high cost in foregone power generation. While the WUP CC agreed to stop exploring water management options for Kinbasket Reservoir for more cost-effective non-operational works, it was acknowledged that this decision was based on a number of uncertain assumptions about reservoir ecology and the influence of reservoir operations. The WUP CC underscored the need for better information to support future decision-making as a key outcome of the Columbia River Water Use planning process.

The operational link for many of the proposed monitoring studies, developed to address current data gaps, was considered tenuous given that there were no operational changes being considered for Kinbasket Reservoir. However, the WUP CC recognized that a large obstacle to recommending operational or physical works for the reservoir was the lack of quantitative data on fish and wildlife populations. Therefore, the proposed monitoring studies were accepted as meeting the Water Use Plan monitoring criteria, because they are the only tool available to validate the assumptions made by the WUP CC when deciding on operational changes.

Although no operating changes were considered for Revelstoke Reservoir, the WUP CC recommended that some of the fish-related studies in Kinbasket be linked to studies in Revelstoke to provide a comparison of trends to inform on operational impacts.

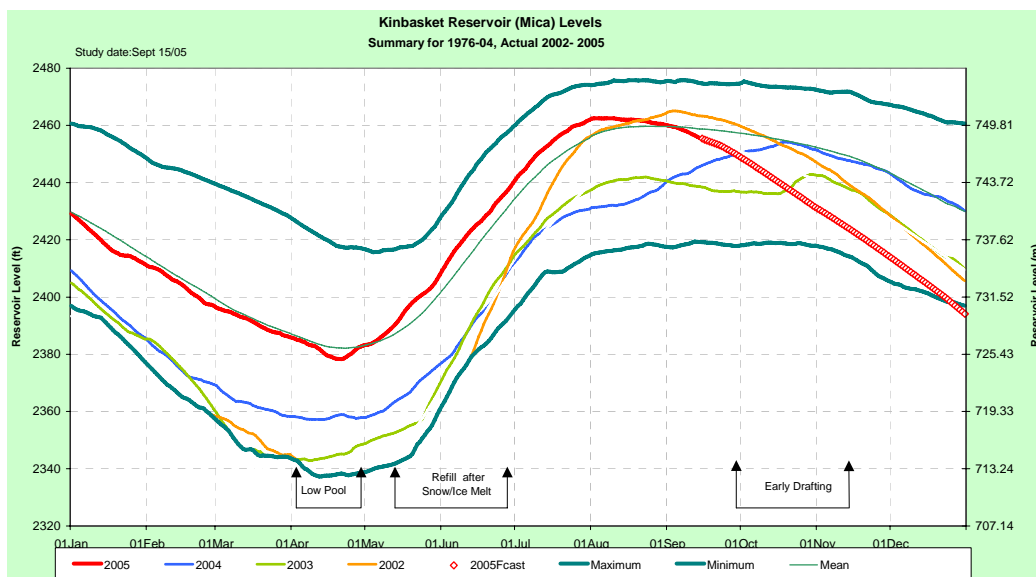


Figure 1 Seasonal pattern of water level drawdown and refill for Kinbasket Reservoir

Monitoring Study No. CLBMON-5

Kinbasket Reservoir Burbot Life History and Habitat Use Assessment

1.0 MONITORING PROGRAM RATIONALE

1.1 Background

Burbot were identified by the Columbia River Water Use Plan Consultative Committee (WUP CC) as a key fish species of concern in Kinbasket Reservoir because of their importance to the sport fishery, because of the potential for links between reservoir operations and burbot population productivity, and due to the dearth of information regarding burbot biology in the reservoir. This species has long been a valued sport fish in the Columbia River system and remains locally abundant in the reservoir (Prince 2001). To date, little information has been collected on the status of these populations in Kinbasket Reservoir. Sampling efforts undertaken on the reservoir have been limited to gill net surveys conducted between 1985 and 1993, and setline sampling in 1995 (RL&L 2001).

The WUP CC hypothesized that the greatest potential impact of reservoir operations on burbot populations may be the dewatering effect of winter drawdown on spawning success and egg survival in sites along the shoreline and in lower sections of tributaries. While burbot spawning time and locations in Kinbasket Reservoir have not been documented, this species typically spawns between late January and late February, either in shallow lake habitats or in low velocity stream habitats, and has an egg incubation period of about 1.5 months (McPhail 1997; Taylor and McPhail 2000). It can be expected that spawning and egg incubation in the Kinbasket system likely occur between January and April, which coincides with the period when reservoir water levels decline by an average of 4.3 m/month (Figure 1).

There is also concern that winter drawdown could affect burbot spawning habitat in tributary streams of Kinbasket Reservoir. In a radio telemetry study of adult burbot in Duncan Reservoir, the extent of spawning migration into the upper Duncan River appeared to be influenced by reservoir water levels, back-flooding and stream velocity (Spence and Neufeld 2002). As back-flooding from Duncan Reservoir declined, burbot tended to move downstream into areas with lower water velocities than the locations they had abandoned. Since stream spawning burbot tend to spawn in low velocity stream habitats (McPhail 1997), the burbot may have been moving downstream to more suitable lower velocity spawning sites.

To address these concerns, the WUP CC recommended that a life history and habitat use assessment be undertaken in Kinbasket Reservoir to gain a better understanding of how the current operating regime might be affecting burbot populations. The objectives of the monitoring program are to: 1) collect information on general population characteristics (distribution, growth and age structure), 2) focus on identification of spawning habitat and use within the drawdown zone; and 3) determine potential links between effects of reservoir operation and populations.

Concern was also expressed that winter drawdown of Kinbasket Reservoir may also reduce the productivity of burbot populations by stranding of juvenile fish. This issue will

be addressed in a fish stranding risk assessment conducted as part of the Kinbasket Reservoir Fish and Wildlife Information Plan (refer to CLBMON-4).

1.2 Management Questions

The fundamental management questions to be addressed by the burbot life history and habitat use assessment are:

- 1) What are some basic biological characteristics of burbot populations in Kinbasket Reservoir (e.g., distribution, abundance, growth and age structure)?
- 2) Does winter drawdown of Kinbasket Reservoir cause the dewatering of burbot spawning habitat and affect spawning success?
- 3) Can modifications be made to the operation of Kinbasket Reservoir to protect or enhance spawning success of these burbot populations?

The monitoring program will provide a qualitative baseline dataset to establish basic biological characteristics of the burbot populations in Kinbasket Reservoir. It will provide information on the current status of these populations (e.g., growth rate, condition, age structure and density), and possible factors affecting burbot productivity. Specifically, the assessment will address uncertainty regarding the extent to which winter drawdown of the reservoir affects burbot spawning potential and, therefore, reproductive success.

1.3 Management Hypothesis

The primary aim of this monitoring program is to provide baseline information on burbot populations in Kinbasket Reservoir to better inform on the relationship between reservoir operations and current population levels. It is designed to specifically test the following management hypothesis²:

H₁: Winter drawdown of Kinbasket Reservoir causes dewatering of burbot spawning habitat, which reduces egg survival and burbot spawning success.

H₂: Winter drawdown of Kinbasket Reservoir causes dewatering of access to burbot spawning habitat in some years.

1.4 Key Water Use Decision Affected

Implementation of the proposed monitoring program will provide information to support more informed decision making with respect to the need to balance storage in Kinbasket Reservoir with impacts on fish populations in the reservoir. Specifically, it will provide the information that is required to support future decisions around maintaining the current operating regime or modifying operations to protect reservoir burbot populations.

² For clarity, the hypotheses are stated as alternative hypotheses to the null hypotheses of no effect or difference.

2.0 MONITORING PROGRAM PROPOSAL

2.1 Objectives and Scope

The primary objectives of this assessment are to obtain baseline data on the biological characteristics of burbot populations in Kinbasket Reservoir, and to provide information to evaluate potential effects of reservoir operation on burbot population productivity. Initiated in Year 5 (2012) and conducted over a 3-year period, this program will focus on reservoir burbot populations (i.e., not fluvial populations restricted to tributaries). The delayed implementation will allow for learnings gained from CLBMON-31 Arrow Burbot Life History to be transferred to work on Kinbasket Reservoir.

2.2 Approach

Burbot life history and habitat use will be assessed using a combination of trapping and radio telemetry methods. Basic biological characteristics, such as age, size and maturity, will be assessed for trap-captured burbot. Since mean catch rates of burbot in traps have been found to be well correlated with changes in burbot abundance (Bernard et al. 1993), trap catch rates should also provide an estimate of relative burbot abundance. A sub-sample of burbot captured in the traps will be implanted with radio telemetry tags and tracked during their spawning season using aerial surveys. If potential burbot spawning locations are identified during the aerial surveys, boat-based surveys will be conducted to confirm the presence of burbot spawning activity. The location and habitat conditions of confirmed burbot spawning locations will be thoroughly documented.

2.3 Tasks

2.3.1 Task 1: Project Coordination

Project co-ordination will involve the general administration and technical oversight of the assessment study, which will include, but not be limited to: 1) budget management; 2) study team selection; 3) logistics co-ordination; 4) technical oversight in field and analysis components; and 5) facilitation of data transfer among relevant projects.

A safety plan must be developed and submitted to the BC Hydro contact, for all aspects of the study involving field work, in accordance with BC Hydro procedures and guidelines. Specific safety training may be required.

2.3.2 Task 2: Field Studies

A field sampling program will be initiated to identify burbot spawning areas that may be affected by reservoir drawdown and determine if reservoir operation is affecting egg survival. Additional information on size, age structure, growth, distributions, obtained through trapping or tagging programs, for example, will be collected. The following methodologies are suggested only as possibilities and have been used as the basis for establishing the budget. Alternative methodologies may be proposed during the contracting process.

Trapping

During the fall period, trapping will be employed to sample burbot from Kinbasket Reservoir. Trapping methods will be similar to those used in past (and ongoing) burbot studies in British Columbia lakes (e.g., Spence 1999; Spence and Neufeld 2002; Neufeld 2005; Arndt and Baxter, 2006).

To obtain results that are broadly applicable to burbot populations in Kinbasket Reservoir, the spatial coverage of the trap sampling program should be as extensive as possible, and should include at least the two main reaches of the reservoir (i.e., the Columbia and Canoe reaches). At the same time, sampling effort may also be focused in areas of suspected high burbot abundance (i.e., hotspots) as suggested by local knowledge or past studies (e.g., Prince 2001).

Biological Sampling and Tagging

The primary source of movement data will be from radio telemetry. Surgical methods will be consistent with previous burbot studies (e.g., Spence and Neufeld 2002; Arndt and Baxter, in prep.). Burbot selected for telemetry tagging should come from as wide a geographic area as possible (e.g., both the Canoe and Columbia reaches), and should not show significant signs of decompression trauma at the time of tagging. Any fish suffering severe decompression trauma will be euthanized and the otoliths taken for ageing. Sexual maturity will be assessed for radio tagged and sacrificed burbot.

Aerial Telemetry Tracking and Spawning Habitat Surveys

Radio telemetry tracking and ground reconnaissance will be undertaken during the typical burbot spawning and egg incubation period of each study year (January through April). Locations of tracked burbot will be mapped, and photographed.

Ground reconnaissance surveys will be conducted to verify and examine potential burbot spawning sites identified during aerial tracking surveys and assess changes in habitat characteristics at known burbot spawning locations after reservoir water levels have dropped.

2.3.3 Task 3: Data Analysis and Reporting

Data analysis will include the following parameters:

- Length and age frequency distributions, length-weight relationships, and size at age data (i.e., growth pattern);
- Trap catch rates, with variation in mean catch rates versus sampling areas, water depth and sampling year;
- Telemetry data and summary tracking statistics for individual fish; and
- Data from spawning habitat surveys (e.g. chemical and physical mean habitat characteristics).

Brief technical reports will be prepared after Year 1 and 2 of the monitoring program. These reports will summarize trap catch rates for burbot, biological characteristics of trap-caught burbot (e.g., size, age, and maturity), movement patterns of telemetry tracked burbot, and physical characteristics of burbot spawning habitats.

A final technical report will be prepared at the conclusion of Year 3 of the study, which will include:

- (a) an executive summary;
- (b) a description of the methods employed;
- (c) a data summary;
- (d) a comparison of results between years; and
- (e) a detailed summary of the findings as they relate to the ecological hypothesis and the key management questions.

Reports will follow the standard format that is being developed for WUP monitoring programs. All reports will be provided in hard copy and as Microsoft Word and Adobe Acrobat (*.pdf) format, and all maps and figures will be provided either as embedded objects in the Word file or as separate files.

2.4 Interpretation of Monitoring Program Results

The monitoring program will provide valuable information to address two specific categories of uncertainty related to the operational impacts of Kinbasket Reservoir on burbot populations:

- 1) This program will provide a baseline dataset on the basic biological characteristics of burbot populations in Kinbasket Reservoir. This baseline dataset will allow for better assessment of factors affecting burbot productivity and the response of burbot populations to potential future changes in reservoir operations; and
- 2) Identifying burbot spawning times and locations will enable an assessment of whether reservoir operations have the potential to affect burbot spawning success and, thereby, population productivity. If there is convincing evidence for such an effect, mitigation measures will be discussed (e.g., operation changes or physical works). If the findings are inconclusive, future research needs will be outlined.

2.5 Schedule

The study will be conducted over a 3-year period, and will be initiated in Year 5 of implementation of the Columbia River Water Use Plan (2012). Depending on capture and tagging success, it may be necessary to extend the period of study to include an additional year of tracking. It is unknown if enough mature burbot will be tagged and tracked to spawning locations in three years, and methods may require some refinement following the first year of study.

Note that conditions on and around Kinbasket Reservoir can be dangerous and unpredictable, and the sampling program may be altered, interrupted, or curtailed in any given year.

2.6 Budget

The total annual budget for the burbot life history and habitat use assessment is estimated at \$ 122,853 (in 2004 dollars). The budget breakdown by task and year is provided below in Table CLBMON-5-1.

3.0 REFERENCES

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