Columbia River Water Use Plan

Monitoring Program Terms of Reference

- **CLBMON-39 - Arrow Lakes Reservoirs Neotropical Migrant Use of the Drawdown Zone**

Revision 1
April 30, 2015

Columbia River Water Use Plan
Monitoring Program Terms of Reference Revision
CLBMON-39 Arrow Lakes Reservoirs Neotropical Migrant Use of the Drawdown Zone

1.0 Revision Overview

In 2014, a multi-year data analysis of CLBMON-39 (CBA 2013) was conducted which included a review of the Terms of Reference (TOR), the methods applied in the field and evaluation of the Management Questions. The review found that the Management Questions, hypotheses and objectives in the original Terms of Reference (2008) in some cases lack clarity, and the methods initially proposed limit the program's ability to address a key Management Question. These shortcomings are addressed in this revision.

The objective of this revision is to improve the study's capacity to address the original requirements defined by the Consultative Committee, and to address shortcomings in the framing of the initial Management Questions. This revision includes refining or removing some of the Management Questions which were originally either formulated in a way that was not possible to answer, or was too general to effectively address the Consultative Committee's specific concerns.

1.1 Rationale and Summary of Key Revisions

The main changes to the original TOR (2008) that are included in this revision are as follows:

- Addition of a new Objective (Objective 5) and a related Management Question ("MQ"; MQ 9) and Management Hypothesis ("MH"; MH 3) to document the availability and utilization of stopover habitat in the drawdown zone by neotropical migrant songbirds. This information is fundamental to address the questions posed by the Consultative Committee.
- Removal of MQ 7, which addressed the ability of revegetation and wildlife physical works to mitigate impacts of reservoir operations on neotropical migrants. This Management Question was removed because no wildlife physical works projects designed specifically for migrant songbirds have been implemented to date. The original MQ 7 was replaced with a new Management Question, MQ 8, which addresses whether the revegetation projects that have been undertaken are effective in enhancing habitat for neotropical migrants. MH 4 was added, consistent with the new MQ 8.
- Refined methodology to better address MQ 2: "Which habitats within the drawdown zone in Revelstoke Reach are utilized by neotropical migrants and what are their characteristics?"
- The physiological health monitoring methodology was discontinued because the research for this component of the study has been successfully completed and the relevant Management Question (MQ 6) has been answered.
- The vegetation and habitat sampling methodology was discontinued because all necessary habitat data are being collected in conjunction with other Water

Licence Requirements projects such as CLBMON-36, or are available from existing GIS mapping data.

- Approaches and methodology were revised to reflect the current stage of the project.

Please refer to Table 39-3 for a summary of the changes and the rationale for their inclusion in this TOR revision.

2.0 Monitoring Program Rationale

2.1 Background

The Columbia Basin is located along an important corridor for neotropical migrant1 songbirds that migrate between breeding grounds in Alaska, the Yukon and British Columbia and wintering grounds in the southern US, Mexico, and Central and South America. Valley bottom riparian and wetland areas in the Columbia Basin provide essential stopover sites for many of the neotropical migrants traveling along this flyway. Migratory songbirds use riparian areas for both shelter and foraging allowing them to refuel before they continue along their migration route.

Early research on the decline of migratory songbirds focused on the fragmentation of breeding habitat and destruction of tropical forests on wintering grounds. More recently, attention has turned to the importance of stopover habitat use during migration (e.g., Skagen et al. 2004). Research has demonstrated that mortality rates during migration are 15 times higher than mortality rates on breeding or wintering grounds (Sillett & Holmes 2002), but the extent to which mortality is affected by loss of suitable stopover habitat is unknown. Reductions in the availability of stopover habitat may lead to increased competition for limited food resources, thereby increasing stress levels or reducing the ability of migratory birds to gain the weight necessary to continue along their migration route. Both increased stress and reduced refueling rates have the potential to increase mortality during migration, resulting in a negative impact to migratory songbird populations (Alerstram & Hedenstrom 1998).

The Columbia River Revelstoke Migration Monitoring Station on Machete Island, at the north end of the Arrow Lakes Reservoir (Revelstoke Reach) near Revelstoke, BC has recorded over 60 species of neotropical migrants during fall migration (Jarvis 2001). In fall, neotropical migrant songbirds migrate through the station from mid-July to the end of October with migration peaking in late August (CBA 2011). Populations of many of these species appear to be exhibiting long-term decline (Campbell 2001; DeSante & George 1994).

During the Columbia River Water Use Planning Process (WUP), the Consultative Committee (CC) recognized that data on the relative abundance, distribution, and seasonal patterns of habitat use were needed to assess the impact of the operations of the Arrow Lakes Reservoir on neotropical migrants and provide information with respect to mitigation strategies.

[1] Neotropical Migrants are birds that breed in North America and spend the winter south of the Tropic of Cancer. The majority of Neotropical Migrants are songbirds but this group also includes some raptors, many shorebirds, and several species of waterfowl. As raptors, shorebirds, and waterfowl are monitored separately by BC Hydro under CLBMON-40, we restrict the term “Neotropical Migrants” to refer to neotropical migrant songbirds only.

To address the impacts on migrating neotropical birds and a multitude of other environmental and social objectives, the WUP may consider a number of operating alternatives ("soft constraints") that BC Hydro can implement within the Columbia River Treaty ("CRT") and the BC Hydro portion of the non-treaty storage. These "soft constraints" include the daily operational use of water (e.g., timing, and rate of release), swapping water between Kinbasket and Arrow Reservoirs, minimum and maximum reservoir levels within the constraints of the CRT, ramping rates, and incremental use of the BC Hydro portion of the Non-Treaty storage. Specifically, the "soft operating" constraint relating to songbird migration states:

> Ensure that the availability of migratory bird habitat in the fall is as good as or better than that which has been provided on average over recent history (1984 to 1999). Draft the reservoir quickly after full pool is reached, targeting a reservoir level of 438 m (1437 ft) or lower by August 7.

The CC therefore recommended that monitoring be conducted to determine how reservoir operations and the implementation of the soft constraints affect the abundance and diversity (species richness) of neotropical migrants in Revelstoke Reach during fall migration, by building on data from the long-term migration monitoring station established on Machete Island. The CLBMON-39 monitoring program was initiated in 2008 to accomplish this.

Note that while spring songbird monitoring studies complement this fall songbird study, they are governed by a separate Terms of Reference (CLBMON-11B-2).

3.0 Management Questions

The knowledge gaps to be addressed by this study are:

1) What is the seasonal and annual variation in the abundance and species richness of neotropical migrants in Revelstoke Reach during fall migration?
2) Which habitats within the drawdown zone in Revelstoke Reach are utilized by neotropical migrants and what are their characteristics?
3) Do reservoir operations influence the species richness or abundance of neotropical migrants using habitat in the drawdown zone during fall migration? If so, how do reservoir operations influence species richness or abundance?
4) Which neotropical migrants are most affected by reservoir operations?
5) Do reservoir operations affect the fattening rates of neotropical migrants using the drawdown zone during fall migration?
6) Can operational adjustments be made to reduce impacts on neotropical migrants during fall migration or are mitigation measures required to minimize the loss of stopover habitat?
7) *Original question 7 deleted*[2] because *no relevant physical works have been implemented to date.*
8) *New question:* Are the ongoing revegetation projects effective at improving utilization of the treated habitat in the drawdown zone by neotropical migrants?

[2] The original MQ 7 was: "Can physical works or revegetation mitigate adverse impacts on neotropical migrants resulting from reservoir operation?"

9) *New question*: Does the operation of Arrow Lakes Reservoir impact the availability or quality of stopover habitat in Revelstoke Reach for neotropical migrants?

To address these Management Questions it will be necessary to determine whether the abundance, species richness, or fattening rates of neotropical migrants in Revelstoke Reach are being impacted; and if so, if they are impacted by reservoir operations or by other negative effects.

4.0 Management Hypotheses

The primary hypotheses to be tested by this study include:

H_1: Annual and seasonal variation in reservoir levels do not influence neotropical migrant abundance or species richness in habitats in the drawdown zone of Revelstoke Reach during fall migration.

- H_{1A}: Changes in the diversity (species richness) of neotropical migrants in Revelstoke Reach are not attributable to reservoir operations.
- H_{1B}: Changes in the abundance of neotropical migrants in Revelstoke Reach are not attributable to reservoir operations.

H_2: Annual and seasonal variation in reservoir levels do not influence fattening rates of neotropical migrants in Revelstoke Reach during fall migration.

- H_{2A}: *Original sub-hypothesis H_{2A} deleted[3] as it has been answered.*
- H_{2B}: *Original sub-hypothesis H_{2B} deleted[4] as it has been answered.*

H_3: *New Hypothesis:* Annual and seasonal variation in reservoir levels do not influence the availability or quality of habitat for neotropical migrants.

H_4: *New Hypothesis:* Revegetation does not affect utilization of the area by neotropical immigrants as measured by migrant species richness or abundance.

5.0 Key Water Use Decision Affected

The key water use plan decision that will be influenced by the results of this monitoring program is the selection of an operating regime of the Arrow Lakes Reservoir that balances ecological health with recreational opportunities, flood control and power generation.

Implementing this monitoring program will provide information required to support future decisions around the operating regime of the Arrow Lakes Reservoir to protect migratory bird populations during spring and fall migration.

Information from the monitoring program will help to guide recommendations with respect to reservoir operations and revegetation to enhance habitat for neotropical migrants.

[3] The original sub-hypothesis H_{2A} was: "Corticosterone levels in neotropical migrants are not influenced by reservoir operations."

[4] The original sub-hypothesis H_{2B} was: "Plasma metabolite levels in neotropical migrants are not influenced by reservoir operations."

6.0 Monitoring Program Proposal

6.1 Objectives and Scope

The objectives of this monitoring program are to:

1) Determine the migration patterns of neotropical migrants in Revelstoke Reach over time (within season, across seasons, and across years).
2) Assess whether reservoir operations affect populations of neotropical migrants that use the area as a stopover site.
    a) Examine the effects of reservoir operation on the abundance, diversity, habitat availability, and fattening rate of neotropical migrants in Revelstoke Reach.
    b) Identify species that have a higher likelihood of being affected by reservoir operations.
3) Determine whether there are specific times during the migratory season when minor adjustments to flow rates or water levels will enhance the ability of the drawdown area to support neotropical migrants.
4) Provide information with respect to how wildlife physical works or revegetation can increase utilization of treated riparian habitat by neotropical migrants.
5) *New Objective:* Determine habitat use by neotropical migrants in the drawdown zone of Revelstoke Reach over time (within season, across seasons, and across years) and the impacts of reservoir operations on habitat availability and quality.

This monitoring program was designed to occur annually over a 10-year period in order to provide a long-term dataset on how reservoir operations affect fall migrating songbirds.The program was initiated in 2008 (Year 1). In 2012 (Year 5), an interim review of the data and progress took place, consisting of a complete initial examination of the first five years of data. During the final years of the program, monitoring will continue, and multi-year analyses will be refined. Final results from this study (2017, Year 10), and related studies, will be evaluated to assess the impacts of reservoir operations, the implementation of soft constraints and the effectiveness of revegetation to meet the wildlife objectives set by the Consultative Committee.

6.2 Approach

The approach and methods of this monitoring program have been revised from those presented in the original Terms of Reference (TOR) in 2008.

The overall approach of this monitoring program will entail: 1) monitoring fall migrating songbirds at the Columbia River Revelstoke(CRR) migration monitoring station at Machete Island and other banding stations within Revelstoke Reach, 2) monitoring neotropical migrants on permanent plots to assess the effects of reservoir water levels, 3) monitoring neotropical migrants on random plots to assess habitat use and preferences, and 4) monitoring neotropical migrants on effectiveness monitoring plots to assess the effectiveness of revegetation. The physiological health monitoring approach was successfully completed and the relevant MQ (MQ 5) has been answered.

1 Constant Effort Mist Netting

Monitoring the pattern of neotropical migrant abundance and diversity and the effect of reservoir operations requires systematic sampling of areas where relatively large numbers of fall migrants can be sampled for an extended period of time. For this reason, the study will capitalize on the CRR migration monitoring station located on Machete Island in the Upper Arrow Lakes Reservoir, Revelstoke B.C. The monitoring station was established in 1998 with the cooperation of the Canadian Wildlife Service (CWS), Parks Canada, and Friends of Mount Revelstoke and Glacier Parks.

During fall migration, songbirds will be monitored at the CRR station on a daily basis using capture-banding techniques. Capture-banding involves capturing songbirds using mist-nets to determine songbird diversity and absolute abundance (Bibby et al. 2002; Hussel & Ralph 2005). In addition to the main effort at the CRR banding station in fall, capture-banding monitoring will also be conducted at the two satellite banding stations situated at different elevations both in and outside of the drawdown zone.

Data from the migration monitoring stations will be used to determine the migration patterns of neotropical migrants in Revelstoke Reach (MQ 1) and to assess how reservoir operations affect neotropical migrants that use these areas as stopover sites(MQ 3 and MQ 4).

2 Monitoring Plot Sampling

Monitoring at the banding stations provides a comprehensive sample of migrating neotropical songbirds over the course of the fall migration period. However, because sampling is confined to a few sites with limited habitat diversity, this approach does not provide a means of assessing habitat use within the drawdown zone including the use of areas subject to revegetation treatments. Consequently, this limits the study's ability to draw conclusions regarding the importance of the habitats used by migrants and what impacts reservoir operations and mitigation measures have on migratory populations outside of banding station areas. Additional sampling is therefore required to answer the management questions concerned with habitat and habitat enhancement (MQ's 2, 8 and 9).

2.1 Permanent plot sampling

A permanent plot survey approach is primarily used to determine the effect of water levels (reservoir operations) on songbird stopover habitat availability and quality (MQ 9). Data from permanent plots, combined with data from the constant effort mist netting surveys, will also be used to assess the effect of reservoir operations on neotropical migrants (MQ 3 and MQ 4). Progress towards answering relevant management questions will be reviewed annually, and once they have been addressed, this sampling will be discontinued and additional effort will be put elsewhere.

2.2 Random Plot sampling

The goal of this component is to determine habitat preferences and habitat use by neotropical migrants in the drawdown zone. Analyses will examine what habitats in the drawdown zone are utilized by neotropical migrants and how plant species composition and vegetation structure influence utilization of the drawdown zone habitats by these species. This will address Management Questions 2, 9 and also inform Management Questions 3, 4, and 6. Progress towards answering relevant

Management Questions will be reviewed annually, and once they have been satisfactorily addressed this sampling will be discontinued and additional effort will be put elsewhere.

2.3 Revegetation Effectiveness Monitoring

This approach will be used to monitor the response of neotropical migrants to revegetation treatments using before-after-control-impact design (BACI). Analyses will evaluate whether revegetation with cottonwood stakes in Revelstoke Reach has enhanced habitat for neotropical migrants (MQ 8).

6.3 Methods

Task 1: Project Coordination

Project coordination involves the general administration and technical oversight of the program, which will include, but may not be limited to: 1) budget management, 2) program team management, 3) logistics coordination including safety, 4) technical oversight in field and analysis components, 5) facilitation of data transfer among other investigations associated with the Arrow Reservoir Operations Management Plan, 6) permit applications, and 7) liaison with regulatory agencies, as required.

The necessary research permits will be obtained from the Ministry of Environment and Canadian Wildlife Service. Protocols will be updated and submitted along with future permit requests and will be made available for review by animal care committees.

A safety plan must be developed and submitted to BC Hydro for all aspects of the study involving field work, in accordance with BC Hydro procedures and guidelines. Specific safety training may be required (e.g. first aid, small boat operation).

Task 2: Constant Effort Mist Netting

In Years 8 - 10 of this project, constant effort mist-netting will be conducted at the CRR migration monitoring station from late July to the end of September. Surveys will be conducted daily and will follow a strict protocol as the validity and accuracy of the capture data depend on the sampling effort and the sampling timing being equal during all periods and all years. Ten to 14 mist-nets will be opened 30 minutes prior to sunrise and operated for exactly six hours, if possible. Captured songbirds will be carefully extracted from nets, identified (species, age, sex), banded, and measured (weight, fat, wing length, molt). The animals will be handled in compliance with provincial animal handling protocols (Resources Inventory Committee 1998). Environmental conditions (e.g., weather) and survey and capture efforts will be recorded. Guidelines and considerations for using mist-nets can be found in Ralph *et al*. (2004) and DeSante *et al.* (2007).

During fall migration, constant effort mist netting at a low elevation site in the drawdown zone (Airport Islands) and a control site outside of the drawdown zone (Jordan River) will be conducted once per week following the same strict protocol as the Machete Island (CRR) station.

Task 3: Permanent Plot Sampling

Because monitoring of the same permanent plots over multiple years is essential to this study's design, a set of fall permanent plots established in 2011 and revised in

2012 (CBA 2014) will be surveyed. Progress towards addressing the relevant management questions will be reviewed annually and changes to the permanent plot sampling approach will be assessed as needed.

Plots will be surveyed once per week during fall migration and sampling will be conducted during the first six hours after sunrise, if possible. At each plot, an experienced observer will document bird occurrence and behavior for at least ten minutes or until Census Saturation Time (CST; the shortest time interval in which the observer is able to count all birds on the plot) is reached. If the plot is completely underwater and no vegetation is visible, the observer will record general plot survey data and survey the plot for at least one minute or until CST is reached.

For each bird observation the following data will be recorded: time since the beginning of the survey, CST, bird detections before and after CST, bird species, number, sex, age, migratory status, behavior and location (on plot, off plot, overhead), bird detections based on visual confirmation, bird detections based on flushing from the vegetation, substrate type being used, and height from the ground when the bird was first detected. For each bird observation, the distance from the observer will also be estimated. See CBA (2014) for a detailed permanent plot sampling protocol and permanent plot layout.

Task 4: Random Plot Sampling

In Years 8-10, random plot sampling will focus on sampling different habitats within the drawdown zone of Revelstoke Reach so that all relevant habitat types are sufficiently sampled to allow for a robust analysis. Random plots will be temporary and only surveyed once. Sampling will follow the same procedures used for the permanent plot sampling except that surveys will be conducted for 30 minutes. After the survey is completed, habitat and vegetation data will be collected at each plot. For the detailed monitoring protocol see CBA (2014).

Task 5: Effectiveness Monitoring Sampling

To assess the effectiveness of revegetation treatments with cottonwood stakes in Revelstoke Reach, a set of effectiveness monitoring plots established in 2010 and revised in 2013 (CBA 2014) will be surveyed. Sampling of effectiveness monitoring plots will follow the same protocols used for the permanent plot sampling. During the survey period, all treatment and control plots will be surveyed once per week. All effectiveness monitoring plots will be surveyed on the same day, if possible. See CBA (2014) for the study site layout and the detailed monitoring protocol.

Task 6: Data Analysis

A brief summary of the data collected during each year will be provided in an annual progress report. This will include a summary of sampling effort expended and an overview of the data collected. The intent of the data summary is to provide a synopsis of the sampling effort and results and to ensure the data is QA'd on an annual basis.

Detailed data analyses will be conducted iteratively each year, building towards an overall analysis at Year 10 in conjunction with the final comprehensive report. A range of analyses and statistical methods are expected to be required. The choice of statistical methods must be clearly stated and justified.

Task 7: Reporting

Annual Reporting:

A progress report will be prepared each year to summarize the methods employed and data obtained. Annual reports will provide two types of information: 1) a brief account of the annual results and, 2) a brief review of the multi-year progress including recommendations as appropriate. The report will include:

- A summary of survey effort and the numbers and species of birds captured or recaptured at the migration monitoring stations;
- A summary of survey effort and the numbers and species of birds recorded during permanent plot surveys;
- A summary of survey effort and the numbers and species of birds recorded during random plot surveys of the different habitats of the study area;
- A summary of survey effort and the numbers and species of birds recorded during effectiveness monitoring plot surveys;
- A brief descriptive analysis of multi-year data to date, to enable learning and modifications in future years.

Digital deliverables will include:

- A database that includes capture-banding data from the migration monitoring stations;
- A database that includes permanent, random and effectiveness monitoring plot data.

Capture-banding data from the CRR migration monitoring station will be submitted annually to the Canadian Wildlife Service/Bird Studies Canada in the appropriate format (MS Excel) as part of the Canadian Migration Monitoring Network. All bird observations will be submitted to the MoE Wildlife Species Inventory (WSI) in the required format. Species at Risk observations will be submitted to the BC Conservation Data Centre.

The detailed monitoring protocol will be updated annually.

10 Year Final Reporting:

A detailed technical report will be prepared at the conclusion of the study in Year 10. The report will include:

- an executive summary;
- a description of the methods employed;
- a data summary;
- a comparison of results between years;
- a detailed summary of the findings as they relate to the management hypotheses and management questions; and
- recommendations for (i) modifying the operating parameters of the Upper Arrow Reservoir to reduce negative effects on migratory songbirds and their habitat and (ii) or management efforts that could mitigate any negative effects of operating regimes currently in use.

A digital appendix with data from all years including:

- A database that includes the census and capture-banding data;
- A database that includes permanent, random and effectiveness monitoring plot data;
- A database that includes blood metabolite data and feather isotope data;
- A database of vegetation and habitat measurements.

Report Format:

Reports will follow the standard format for WUP monitoring projects. 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.

6.4 Interpretation of Results

A key result of this monitoring program will be to determine how the operating regime for Arrow Lakes Reservoir influences the abundance, species richness, and fattening rates of neotropical migrants during fall migration. The level of risk imposed by different reservoir operations will then be assessed by determining the extent to which water levels and the availability of riparian habitat affect the diversity, abundance or fattening rates of neotropical migrants after controlling for seasonal effects. This study will also provide an assessment of the effectiveness of the revegetation to mitigate the impacts caused by reservoir operations.

6.5 Study Design Limitations

Monitoring changes in wildlife populations and habitats can be complicated by numerous factors and limitations in study design or sampling strategy. Despite efforts to reduce these limitations, this monitoring program has several constraints. First, reservoir operations (water levels, filling and drafting rates) vary between seasons and between years, which may reduce the ability to correlate specific reservoir conditions to the abundance and diversity of neotropical migrants. This may be further complicated by the implementation of soft constraints over the course of the monitoring program. Second, as habitats may take several years or even decades to change, the duration of the monitoring program may not be sufficient to detect changes in the response of neotropical migrants to habitat enhancement initiatives such as revegetation.

6.6 Schedule

This monitoring program is being implemented over the first ten years of the Columbia River Water Use Plan from 2008 to 2017. During each year, fieldwork will be conducted between July and September. The annual schedule for each task is presented in Table 39-1.

6.7 Budget

Total Program Cost: $1,961,060.00 (unchanged from original TOR).

7.0 References

Alerstram, T., and A. Hedenstrom. 1998. The development of bird migration theory. Journal of Avian Biology 29:343-369.

Bibby, C.J., N.D. Burgess, D.A. Hill and S.H. Mustoe, 2002. Bird Census Techniques. Academic Press, London.

Campbell, R. W., N.K. Dawe, I. McTaggart-Cowan, J.M. Cooper, G.W. Kaiser, A.C. Stewart and M.C.E. McNall 2001. The Birds of British Columbia. Vol. 4. Passerines: wood-warblers through Old World sparrows. UBC Press, Univ. British Columbia, Vancouver, B.C.

Cooper Beauchesne and Associates Ltd (CBA). 2011. CLBMON39: Arrow Lakes Reservoir neotropic migrant use of the drawdown zone, Year 3, 2010. BC Hydro Water Licence Requirements, Castlegar, B.C.

Cooper Beauchesne and Associates Ltd (CBA). 2012. CLBMON39: Arrow Lakes Reservoir neotropic migrant use of the drawdown zone, Year 4, 2011. BC Hydro Water Licence Requirements, Castlegar, B.C.

Cooper Beauchesne and Associates Ltd (CBA). 2013. CLBMON39: Arrow Lakes Reservoir neotropic migrant use of the drawdown zone, 5-Year Interim Review Report.BC Hydro Water Licence Requirements, Castlegar, B.C.

Cooper Beauchesne and Associates Ltd (CBA). 2014. CLBMON39: Arrow Lakes Reservoir neotropic migrant use of the drawdown zone: monitoring protocols: monitoring protocols, Year 7, 2014. BC Hydro Water Licence Requirements, Castlegar, B.C.

DeSante, D. F., K. M. Burton, P. Velez, D. Froehlich, and D. Kaschube. 2007. MAPS Manual 2007 protocol: instructions for the establishment and operation of constant-effort bird-banding stations as part of the Monitoring Avian Productivity and Survivorship program. The Institute for Bird Populations. Point eyes Station, CA.

DeSante, D. F., and T. L. George. 1994. Population trends in the landbirds of western North America. Pages 173-190 in J. J.R. Jehl, and N. K. Johnson, editors. Avifaunal Change in Western North America. Studies in Avian Biology 15.

Hussel, D. J. T., and C. J. Ralph. 2005. Recommended method for monitoring change in landbird populations by counting and capturing migrants. North American Bird Bander 30:6-20.

Jarvis, J. 2001. Columbia River Revelstoke Bird monitoring station final banding Report. Unpublished Report.

Ralph, C. J., E. H. Dunn, W. J. Peach, and C. M. Handel. 2004. Recommendations for the use of mist nets for inventory and monitoring of bird populations. Studies in Avian Biology 29:187-196.

Resources Inventory Committee. 1998. Live animal capture and handling guidelines for wild mammals, birds, amphibians and reptiles. Standardized Inventory Methodologies for Components of British Columbia's Biodiversity. Ministry of Environment, Lands and Parks, Government of British Columbia. Victoria, BC. 47 pp.

Resources Inventory Committee. 1999. Inventory methods for forest and grassland of songbirds: No. 15. Standardized Inventory Methodologies for Components of

British Columbia's Biodiversity. Ministry of Environment, Lands and Parks, Government of British Columbia. Victoria, B.C.

Sillett, T. S., and R. T. Holmes. 2002. Variation in survivorship of a migratory songbird throughout its annual light cycle. Journal of Animal Ecology 71:296-306.

Skagen, S. K., C. P. Melcher, and R. Hazelwood. 2004. Migration stopover ecology a western avian populations: a southwestern migration workshop. USGS Open File Report 2004-1452. Reston, Virginia

Table 39-1: CLBMON-39 Schedule of Tasks

Tasks	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1. Project Coordination	√	√	√	√	√	√	√	√	√	√	√	√
2. Constant Effort Mist Netting			√	√	√							
3. Permanent Plot Sampling				√	√							
4. Random Plot Sampling				√	√							
5. Revegetation Effectiveness Plot Sampling				√	√							
6. Data analysis								√	√			
7. Reporting									√	√		

Table 39-3: CLBMON-39 Key TOR Changes and Rationale for their Inclusion

CLBMON-39 TOR		
Section	**Change**	**Rationale**
Overall	Intermittent editing	To improve clarity and consistency
Background	Minor changes to wording; updated	To improve clarity
Management Questions	Removed Original Question 7: Can physical works or revegetation mitigate adverse impacts on neotropical migrants resulting from reservoir operation?	This question's reference to physical works was not relevant. No relevant physical works have been implemented to date. Replaced with Question 8
Management Questions	Added Question 8: Are the ongoing revegetation projects effective at improving utilization of the treated habitat in the drawdown zone by neotropical migrants?	To focus on the effectiveness of ongoing revegetation projects
Management Questions	Added Question 9: Does the operation of Arrow Lakes Reservoir impact the availability or quality of stopover habitat in Revelstoke Reach for neotropical migrants?	To address the availability and utilization of stopover habitat in the drawdown zone by neotropical migrants
Management Hypotheses	Reworded H1 (including sub-hypotheses)	To improve clarity
Management Hypotheses	Reworded H2 and removed both sub-hypotheses	To improve clarity and accord with altered methodologies/sampling design
Management Hypotheses	Added H3: Annual and seasonal variation in reservoir levels do not influence the availability or quality of habitat for neotropical migrants.	To capture information central to addressing Management Question 9
Management Hypotheses	Added H4: Revegetation does not affect utilization of the area by neotropical migrants as measured by migrant species richness or abundance.	To capture information central to addressing Management Question 8
Objectives and Scope	Added Objective 5: Determine habitat use by neotropical migrants in the drawdown zone of Revelstoke Reach over time (within season, across seasons, and across years) and the impacts of reservoir operations on habitat availability and quality.	To document the availability and utilization of stopover habitat in the drawdown zone by neotropical migrant songbirds
Approach	Modified constant effort mist netting section	To reflect current stage of the project and goals for Years 8-10
Approach	Added monitoring plot sampling of permanent, random, and revegetation effectiveness plots	To assess neotropical migrants' habitat use and preferences, effectiveness of revegetation and the effects of reservoir water levels

CLBMON-39 TOR		
Section	**Change**	**Rationale**
Approach	Removed physiological health monitoring	The relevant management question (MQ 5) has already been successfully addressed
Approach	Removed Vegetation and Habitat Sampling	No additional vegetation monitoring is needed to address MQs or hypotheses
Methods ALL	Modification	To reflect the current methodologies, consistent with current MQs and MHs
Methods - Reporting	Modification	To reflect new approach, methods and data collected
Interpretation of results	Modification	To reflect the changes to methods and approach
Study design limitations	Modification	To reflect the changes to methods and approach