Columbia River Project Water Use Plan
Kinbasket Fish and Wildlife Information Management Plan

Mica Tailrace Fish Indexing Study

Implementation Year 1

Reference: CLBMON-60

Columbia River Headpond Drawdon Impacts (Fish Stranding and Water Quality) Monitoring – Interim Report

Study Period: September 2012 to February 2013

Canadian Columbia River Inter-tribal Fisheries Commission (CCRIFC)
Poisson Consulting Ltd.
Applied Aquatic Research Ltd.

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Executive Summary

BC Hydro recently completed the Water Use Plan (WUP) for the Columbia River Mica Dam Hydroelectric Project. Subsequent to acceptance of the WUP, an Environmental Impact Assessment (EIA) was completed by BC Hydro for the proposed expansion of generating capacity and the installation of two new turbines (Mica 5 and 6). Two key concerns related to the expansion and associated headpond drawdown were identified:

1. Changes in distribution of ichthyofauna downstream of the tailrace; and
2. The effects of the addition of Mica 5 and 6 turbines on water temperatures downstream of the Mica Dam Tailrace (BC Hydro 2011).

The primary objectives of the monitoring program are to monitor the ichthyofauna and thermal regime in the Mica Dam tailrace during the two years before and the two years after the service date for full operations of Mica 5 and 6.

To address these objectives two field surveys were initiated in 2012. The first was an ichthyofauna survey of the section of Columbia River between the Mica Dam tailrace to the Blue Bridge approximately 2.5 km downstream. This survey was conducted in October 2012. Year Two will be sampled in October 2013, with the post-construction monitoring schedule still to be finalized but tentatively targeted for October 2016 and 2017. The second field program is a year-round temperature study. Temperature loggers were deployed in a vertical array in the Mica Dam forebay and downstream of Mica Dam on both banks to assess temperature effects of operations. The temperature loggers were deployed in September 2012, and data collection will continue until the end of the study in spring 2017 with 3-5 downloads per year.

Boat and backpack electrofishing were used to enumerate and characterize the ichthyofauna within the study area. A total of 204 fishes of four species were captured by boat, 34 were captured by backpack electrofishing and 541 fishes were observed using boat electrofishing. Sampling locations were the same as those sampled in 2008 by the previous indexing study in the same reach (Ford and Hildebrand 2008). Five sampling locations were sampled by boat electrofishing, and two with a Smith Root LR 24 backpack electrofisher. In the 2012 sampling window, only two of the four backpack sites (ES01 and ES02) could be sampled due to high daytime flow levels. Float electrofishing in the shallows with the boat shocker was also attempted in two locations that were suitable. Twenty-four hours prior to the boat electrofishing capture component, an initial pass with the boat electrofisher was completed to observe and record the species, size (to the nearest estimated 5 mm) and georeferenced location of fish within the study reach. The approach represents an extension of methods that were previously developed during snorkel surveys to boat electrofishing. The same range of settings on the boat electrofisher were used for the observation session as for the capture session. The trialling of the novel method of using night boat electroshocking to observe the fish was successful. The advantages of this method are: 1) it provides fine-scale spatial fish distribution information, 2) does not require fish to be handled, 3) the data are also less dependent on netter skill and non-selectivity and on the density of fish in an area. The ratio of observed: captured fish showed evidence of the increased effectiveness of fish observation relative to capture for this type of indexing program. However, fish observations from a boat at night are heavily reliant on highly

skilled observers since estimating length and determining species quickly and accurately are essential to its success. Its primary disadvantage is that it does not readily allow observer efficiencies to be estimated as would be possible with a mark-recapture program. Helmet mounted cameras were trialled as an attempt to calibrate the observer efficiency but were not successful.

The condition of adult mountain whitefish, fry kokanee and adult sculpins (all species aggregated) decreased since 2008, while the condition of juvenile mountain whitefish and adult bull trout increased since 2008. The largest decrease in average condition was for kokanee fry and the greatest increase in average condition since 2008 was for adult bull trout.

Obtaining the provision of flow levels low enough for efficient sampling and likely to be repeatable over all four years of field work was best achieved by dropping flows at 22:00h, waiting for 4-6 hours after the change was implemented and then sampling at that flow level from 03:00h until 07:00 in the late October period. In order to determine if other sampling times during daylight hours were possible, sampling the fish fauna was attempted during daylight hours. At 09:00h, site ES04 was sampled for 7 minutes, which covered approximately one third of the site; no fish responded during daytime to the electric current generated by the electrofishing boat. For comparison, in the first 7 minutes of sampling ES04 during night time sampling, 32 fish were observed. Results suggest that daytime sampling is not effective and that in future years the flows should be stable for 4-6 hours prior to night time sampling to ensure comparable efficiency.

While the results presented are preliminary for the first year of this monitoring program, they suggest that the proposed study will achieve the monitoring program requirements with the suggested modifications outlined.

Suggested Citation:

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Table of Contents

List of Tables

List of Figures

List of Appendices

1 Introduction

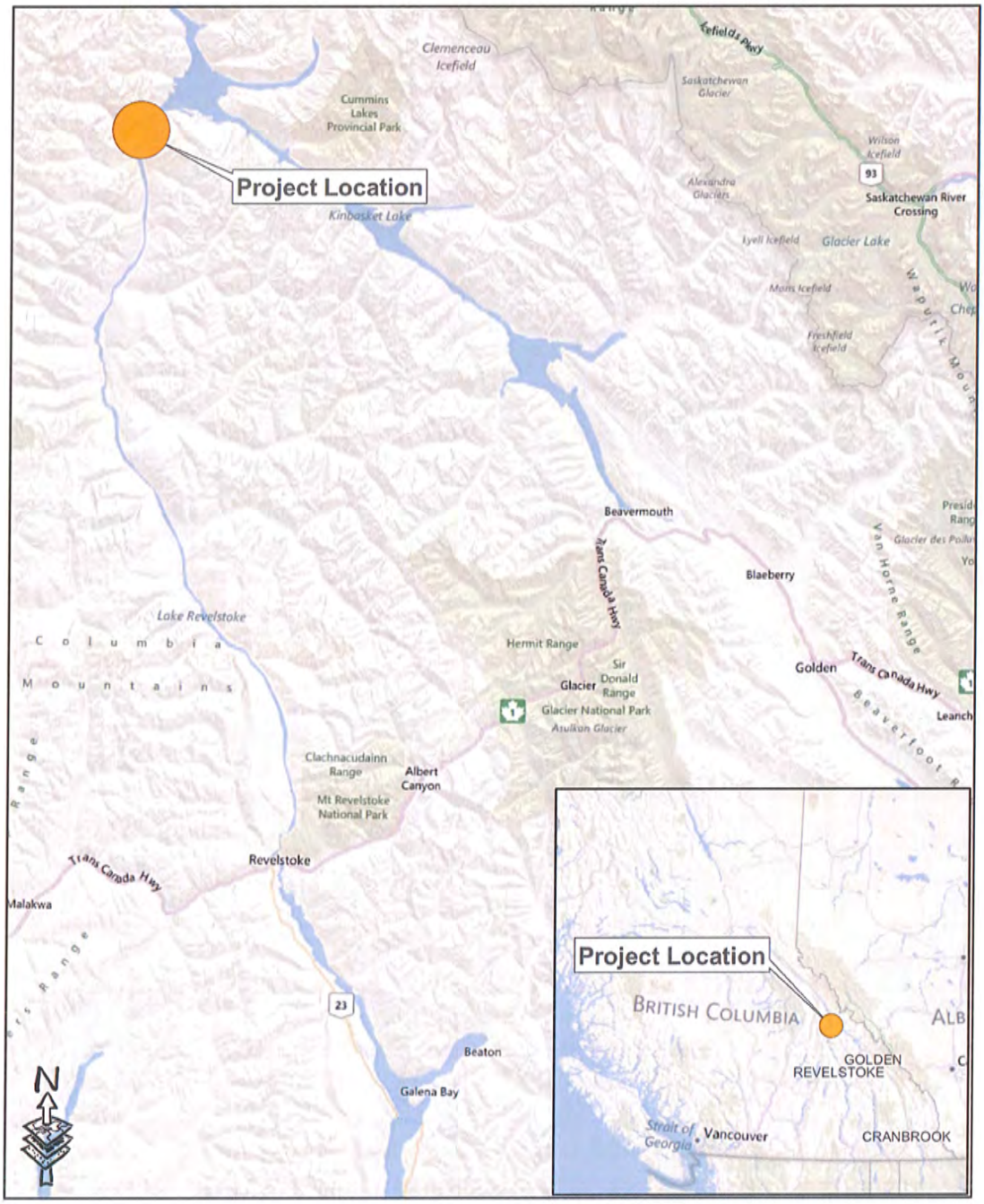
BC Hydro recently completed a Water Use Plan (WUP) for the Columbia River, along with the Kinbasket Reservoir Fish and Wildlife Information Plan, which outlined the Terms of Reference (TOR) for monitoring programs required through the WUP process (RL&L 2001; BC Hydro 2007; Kinbasket Reservoir Fish and Wildlife Monitoring Program TOR August 2011).

The WUP is a sustainable work practice that seeks to balance power generation with other water uses that provide social, environmental and economic benefits to British Columbians. The WUP process for the Columbia River was initiated in 2004 and completed in January 2007 based on recommendations from the Consultative Committee (BC Hydro 2004, BC Hydro, 2007). Subsequently, Monitoring Program TOR (BC Hydro, 20011a, 2011b) were developed to implement and assess recommendations from the WUP and the subsequent Environmental Impact Assessment, which was triggered by the proposed addition of two turbines (Mica 5/6). This particular study was designed to assess the impacts to fish and fish habitat in the Mica Dam Tailrace (CLBMON 60) as a result of the proposed expansion.

In 2009, in accordance with the BC Environmental Assessment Act, BC Hydro submitted two Environmental Assessment Certificate Applications (EACAs), one for each of the proposed Mica Unit 5 and Mica Unit 6 projects (BC Hydro 2011a). The potential effects of the operation of the proposed project on the downstream fish community in the Columbia River are unknown; one of the commitments of the project Environmental Assessment (EA) mitigation measures was the fish indexing and thermal regime monitoring program outlined in the TOR (KCP 2009 p. 4/5).

This report outlines the study design and results for Year One (1) of the ichthyofauna and water temperature monitoring program and how the management questions and key water use decisions affected by the operation of the proposed projects are addressed.

As stated in the Mica Tailrace Fish Indexing Study TOR (CLBMON 60) Request for Proposals (RFP) and monitoring program requirements (BC Hydro 2011b), "There are no management hypotheses associated with this program, as hypotheses are unlikely to be falsified within the time frame allocated for the project." "The primary objectives of the monitoring program are to monitor the ichthyofauna and thermal regime in the Mica Dam tailrace during the two summers before and the two summers after the service date for full operations of Mica 5 and 6" (cf. Schedule, section 2.5), as described in the RFP (BC Hydro 2011). The Mica Dam impounds the Columbia River. The release rates are determined by generation (operational) requirements and demand. The general project location is shown in Figure 1-1. The proposed study area, as described in the TOR (BC Hydro 2011a) is shown in Figure 1-2.



Study Area Overview Map - Kinbasket Reservoir (Mica Dam Headpond), Columbia River

0 12.5 25 50

Kilometers

1:800,000
UTM Zone 11 - NAD 83

Figure 1-1. General Project Location and Columbia River Study Area for the Mica Tailrace Fish Population Indexing Study, relative to the town of Revelstoke and Kinbasket Reservoir.

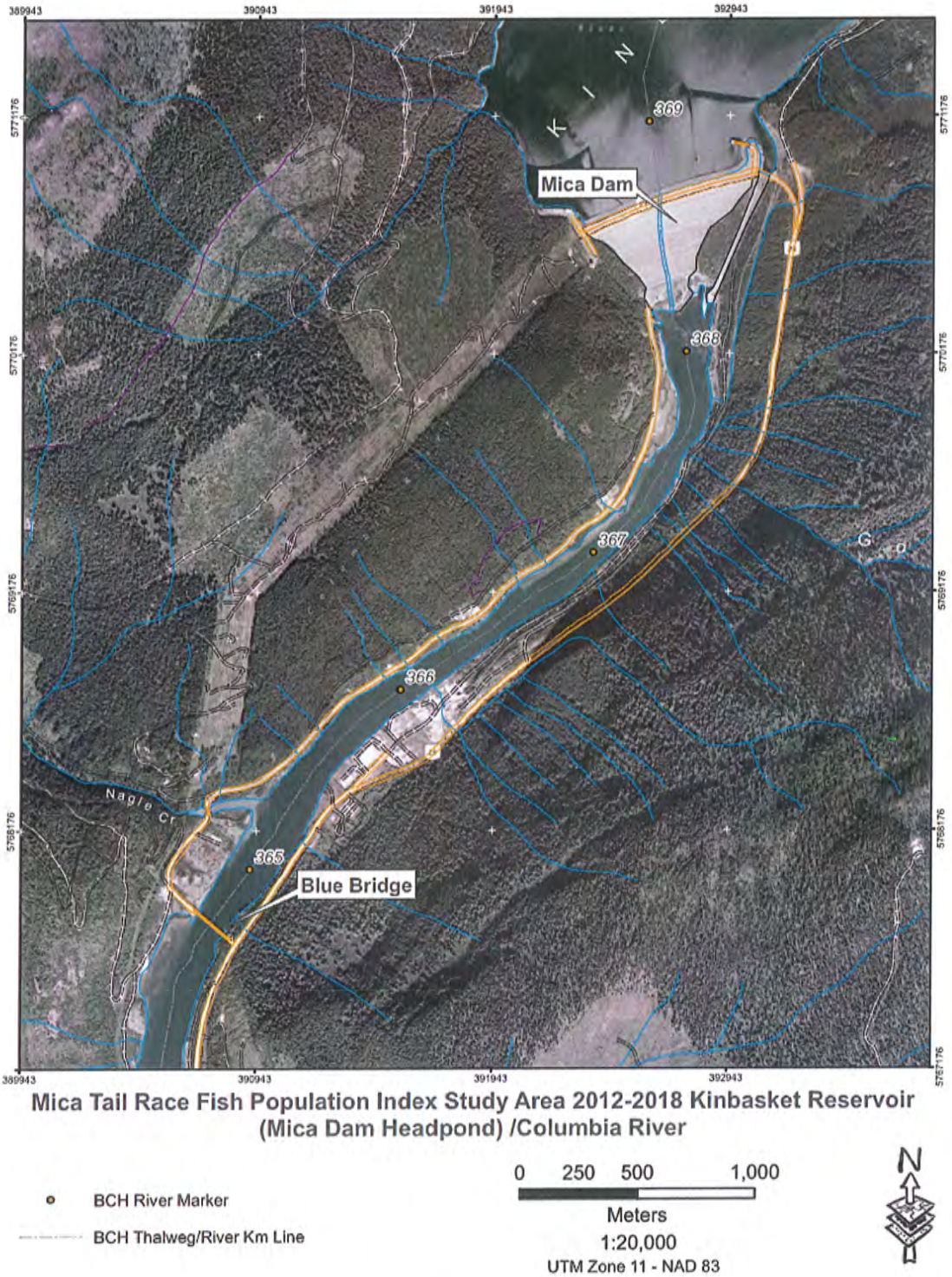


Figure 1-2. Detailed description of Mica Tailrace Fish Population Index Study Area 2012-2018.Locations of Mica Dam, Nagle Creek and the Blue Bridge shown for reference.

The proposed completion date for construction and operation of the two additional turbines is tentatively 2015. To fulfill the EA requirements for two years of study prior to and after turbine installation, studies are required in 2013, 2014 and in 2016 and 2017. The post-installation studies are required to assess the potential impacts of operation of turbines five (5) and six (6) on water temperatures and fish distribution within the zone of effect downstream of the Mica Dam, particularly in the ~2.5 km section between the tailrace and the Blue Bridge (Figure 1-1). Other studies have been and are currently being completed with respect to flows, temperature, fish habitat and fish distribution in the Kinbasket Reservoir and Columbia River downstream of the dam, including CLBMON-1 (Total Gas Pressure Monitoring), CLBMON-2 (Kokanee population monitoring), CLBMON-4 (Fish stranding assessment) and many others (BC Hydro 2013).

1.1 Background and Scope

Seasonal flow patterns in the Columbia River are typical of mountain streams in the area. As a result, a single snowmelt runoff dominates the hydrograph peak, while secondary rainfall events in the summer and fall also increase seasonal flow variation (KCB 2009). There are 2 currently operating Water Survey of Canada (WSC) gauging stations (WSC 08NE049, 08NB005) and several historic stations that provided baseline hydrology information. Poisson Consulting Ltd. (Poisson) have developed and maintain a database to consolidate flow, elevation and temperature data for WLR projects. There is also a continuous gauge above the Mica Dam at Donald operated by BC Hydro which characterises flow patterns and precipitation within the Columbia River. The WSC data showed that Columbia River is a snowmelt dominated system, with peak runoff/freshet conditions typically observed in late May through to early July and winter low flows from October to April. Low flow periods are typically observed in the late winter, when the dominant precipitation form occurs as snowfall. The annual peak monthly inflow for the period from 1940 to 1999 at Mica averaged 574.25 m^3s^{-1}, with winter low flows ranging from mean monthly inflows of 103 to 132 m^3s^{-1} (BC Hydro 2007).

This background data was used to develop hydrographs for Columbia River and inform hydrology studies. The hydrologic studies were then used to identify constraints and determine operational requirements for the facility, identify periods of low (i.e., critical) flows relative to fish habitat use and develop minimum flow requirements.

Previous fish studies suggest that the Columbia River below Mica Dam supports populations of Rainbow Trout (RBT), *Oncorhynchusmykiss*, Kokanee (*O. nerka*), Bull Trout (*Salvelinusconfluentus*) and Mountain Whitefish (*Prosopiumwilliamsoni*), all of which are salmonids, in addition to Slimy (*Cottuscognatus)*, Torrent (*C.rhotheus*) and Prickly sculpins (*C. asper*) as outlined in Table 1-1.

Table 1-1. Fish species documented in the Columbia River which may be observed downstream of the Mica Tailrace (Sources: RL&L 2001; Ford and Hildebrand 2008; BC Hydro 2007; BC Hydro 2011b)

Common Name	Scientific Name
Rainbow Trout	*Oncorhynchusmykiss*
Bull Trout	*Salvelinusconfluentus*
Kokanee	*O. nerka*
Mountain Whitefish	*Prosopiumwilliamsoni*
Slimy Sculpin	*Cottuscognatus*
Torrent Sculpin	*C. rhotheus*
Prickly Sculpin	*C. asper*
Burbot	*Lotalota*
Lake whitefish	*Coregonusclupeaformis*
Yellow perch	*Percaflavescens*
White sturgeon	*Acipensertransmontanus*
Pygmy Whitefish	*P. coulteri*
Cutthroat trout	*O. clarkii*
Lake Chub	*Couesiusplumbeus*
Bridgelip Sucker	*Catostomuscolumbianus*

1.2 Objectives

BC Hydro implemented the CLBMON-60 study as a four year monitoring program. The goal of the program is to evaluate potential impacts of the addition of two generating units to the Mica Dam Project (Mica 5 and 6) on the ichthyofauna and the thermal regime immediately below Mica Dam. The management questions are to detect whether the operations of Mica 5 and Mica 6 change the aquatic thermal regime and/or ichthyofauna in the tailrace. No management hypotheses were provided in the TOR as it was thought to be unlikely that the hypotheses could be falsified during the time span of the study. An additional stated objective was to collect opportunistic information about rare or invasive species.

The monitoring program goals are described in detail in the BC Hydro Columbia River Project Water Use Plan Monitoring Program Terms of Reference – Mica Units 5 and 6 Project Commitments -CLBMON-60 Mica Tailrace Fish Indexing Study (BC Hydro 2011a, 2011b). The methods section below describes how the CCRIFC/Poisson/Westslope/AAR project team implemented and will implement the monitoring program, including, field activities and monitoring, data analysis, interpretation and reporting for the period from project start-up (summer 2012) to completion (April 2018).

1.3 Study Area

The Columbia River Mica Dam hydroelectric project is part of BC Hydro's integrated generation system, and is located approximately 137 km north of Revelstoke on Highway 23 (Figure 1-1). The Mica Dam impounds the Columbia River and forms Kinbasket Lake. Mica Dam was

completed in 1973 as part of the Columbia River Treaty (1964) and is the furthest upstream dam on the Columbia River and the thirteenthhighest dam (244 m above bedrock to the crest) in the world. It reached a maximum full pool elevation of 754.71 m in August 2012, and 754.31 m in 2007. Minimum pool depth observed was 712.29 m in April 2002 for data ranging from 2001 – present. While the generating station contains four single-jet impulse turbines with a total capability of generating 1,805 megawatts (MW) of power, maximum generation capacity is limited by available flow (KCB 2009, BC Hydro 2007). The proposed expansion will take the facility from four to six turbines at completion for a total generating capacity of 2,805 MW.

The study area is the approximately 2.5 km of river from about 1 km downstream of the face of the dam to the Blue Bridge that has been studied in previous indexing work (Ford and Hildebrand 2008; Figure 1-2) and the thermal monitoring includes the forebay of the dam in Kinbasket Reservoir as well as the ~2.5 km of river (Figure 2-3).

2 Methods

The workplan for 2013 was developed and finalized in August and September 2012 through discussions with the project team and BC Hydro staff.

Initially, the temperature study and ichthyofauna survey was scheduled to start in July-August 2012. Record high water levels and freshet conditions precluded installation of Hobo tidbit data loggers until September 2012 and did not allow operations to provide flows suitable for fish sampling until early October.

Consultation between the CCRIFC/Poisson project team and BC Hydro staff between June and September 2012 resulted in changes to the fish sampling schedule. Ultimately, the October period was selected and agreed to as representing the most diverse fish communities, and the period where the stable target flows required for fish sampling could be consistently achieved over the four years of the study program.

Weather conditions and Columbia River water levels were monitored from late September to late October 2012 to identify a suitable time period for sampling to occur. Operational changes and restrictions (target flows of 400 to 800 cms) could most effectively be achieved between October 17 and November 5, 2012. The design flow requirement target was 600 cms for a period of 6 hours stable flow prior to the initiation of sampling. The post-daylight period (from approximately 19:00h PDT to 07:00h PDT) was identified as the preferred sampling period. Peak demand for this time of year typically occurs during weekdays from 07:00h PDT to 19:00h PDT. We were able to arrange for a weekend sampling period to conduct the fish population indexing from Saturday morning to Monday morning.

2.1 Discharge

It was considered critical to have stable discharge from the dam for as long as possible prior to sampling to allow any re-distribution of fishes in response to flow changes to occur before the onset of sampling. Provision of flow levels low enough for efficient sampling and likely

repeatable over all four years of field work was a challenge to achieve and was best met by dropping flows at 22:00h, waiting for 4-6 hours after the change was implemented and then sampling at that flow level from 03:00h until 07:00 in the late October period. This is the planned approach for the future three years of the program as well.

In order to determine if other sampling times during daylight hours were possible, sampling the fish fauna was attempted during daylight hours on October 22, 2012. At 09:00h, site ES04 was sampled for 7 minutes, which covered approximately 1/3 of the site, and no fish responded to the electric current generated by the electrofishing boat. This was in stark contrast to the high numbers of fishes responding to the electricity in the dusk to dawn hours in that same section of river where 32 fishes were observed in the first 7 minutes of sampling and 97 observed in the entire site, so further daylight sampling was not attempted and is not recommended for future years of the program. We considered the lack of observed fish representative of fish susceptibility to sampling in daytime.

Communication with on site staff as well as the project authority and the Pacific Operations Centre (PSOSE) was key to determining the exact daily timing of the flow reductions and for providing an additional measure of safety for the crews on the water. The field crew was provided with a VHF radio programmed with the Mica frequencies by the on-shift operator and the crew radioed the Mica Dam operator upon entering and exiting the river below the dam.

The field crew also contacted PSOSE prior to the scheduled flow reduction post – peak demand period prior to sampling, and upon completion of sampling prior to the morning ramp up to meet increased power demands, to ensure crew safety and meet BCH operational considerations and safety requirements.

2.2 Fish Observations

Boat electrofishing was used to enumerate and characterize the ichthyofauna within the study area. The five sites demarcated for indexing work by Golder within the study reach were used to define the sampling for both capture and observation of the fish fauna (Ford and Hildebrand 2008). Twenty-four hours prior to the fish capture phase of the fieldwork, an initial pass with the boat electrofisher was completed to observe and record the species, size (to the nearest 5 mm) andgeoreferenced location of fish within the study reach. The approach represents an extension of methods previously developed during snorkel surveys to boat electrofishing. Data were grouped by sampling site. During this pass, the same range of settings on the boat electrofisher was used as for the capture session. The boat proceeded in a downstream direction at approximately 4-5km/hr with spotlights and headlights directed towards the anode netting area. The start time was noted once the generator was operational and the observers were prepared and observers pulsed the power (7 seconds on and 3 seconds off) to prevent fish being herded in front of the boat's lighting range by the electrical current.

Two observers were stationed in standard netting positions and each observer was paired with a recorder who had a watch synchronized to the GPS time and the standardized data sheets on a clipboard. Each recorder noted the fish data (species and length to the nearest 5mm) as well

as the exact time of the observation. In order to assess observer efficiency of this relatively novel method, it was proposed that cameras be used to also view the fish and to verify the efficiency of each observer. The observers each mounted a Contour Roam Model 1600 1080p HD 170 Degree Wide camera to a swiftwater helmet in order to provide this secondary assessment of fish numbers and sizes.

Two GPS units (Garmin 62S) ran track logs during the sampling session. One was on the console of the electrofishing vessel (the distance from the console GPS to the midpoint of the anode and boom when extended was 6.2 m) and the other was in a backpack with an external antenna and was carried by one of the observers. This was done to have redundancy in spatial data. The GPS data from the unit on the console was utilized in the analysis and corrected for the distance from the console to the end of the anode boom.

2.3 Fish Capture

The same range of settings and the same electrofishing boat and crews were used to capture fish on the subsequent two nights of field study after the observation work was completed. Fish of all species present were captured, transferred to the live well and at the end of each sampling site, were recorded for length, weight, species, and sex (if possible). Comments were noted about exceptional characteristics for individual fish, and crews were aware of the study program's stated objective to collect opportunistic information about rare or invasive species.

Small bodied fishes were captured using a Smith-Root 24 backpack electrofisher. The four sites demarcated for backpack electrofishing work by Golder within the study reach were replicated as shown in Figure 2-1 (Ford and Hildebrand 2008). Habitat where backpack electrofishing could be done effectively was minimal in the study area in general and was very limited in 2012 due to daytime river stage. In the 2012 sampling window, only two of the four sites (ES01 and ES02) could be sampled due to the flow levels. Float electrofishing in the shallows with the boat shocker was also attempted in two locations that were suitable. Two netters in waterproof waders wearing linesman's gloves walked ahead of the boat and the anodes trailed into the water providing current to roll the fish.

The only methods to be certain of a fish's sex is through internal examination of the gonads, expression of gametes (eggs from females, or milt from males) or DNA. However, secondary sexual characteristics (i.e., enlarged kype, nuptial tubercles, etc.) can be used to determine the putative sex of a fish, depending on the reproductive period and fish condition. During this sampling period, three of the salmonids sampled were near or just past their peak spawning activity – kokanee, bull trout (post-spawn) and mountain whitefish (actively spawning). Obvious sexual characteristics were present and used where possible to identify the sex of individuals for each species, with internal examination. Despite this, there were a number of fish that were indeterminate (potentially juveniles not ready to spawn, or alternate-year spawners such as bull trout and were subsequently recorded as unknown.

Figure 2-1. Detailed description of Electrofishing Locations for the Mica Tailrace Fish Index Study 2012.

2.4 Habitat

Habitat information was not collected at the fish sampling locations in 2012. The mesohabitat variables as assessed by Ford and Hildebrand (2008) were used to group fish by habitat type. In 2013, additional habitat variables will be assessed as appropriate to answer the management questions.

2.5 Temperature

The original study design stated that 28 temperature loggers would be deployed in the study area, as follows : 16 in the forebay of Mica Dam, spaced at 2m vertical intervals; and 12 downstream of the dam in the ~2km study reach. The arrays downstream were to be deployed in pairs, with 3 arrays on opposite banks (total of 6) with duplicate loggers at each array.Two of the paired arrays would be located on opposite banks downstream of the inflow of Nagle Creek, the main tributary to the study reach on the right downstream bank. The download interval was to be every 2 months.

Six water temperature loggers were installed in the study reach below Mica Dam on October 10th, 2012. Loggers were deployed across from each other on left and right banks in three locations, as shown in Figure 2-3. When the field crew went to the location where the DFO forebay array was meant to be to deploy additional loggers on October 24, 2012 the array could not be found. An entirely new deployment was therefore carried out and loggers were deployed from 40 m below the surface to 12 m below the surface at 2 m intervals. This was only a partial forebay array that was deployed on October 24, 2012 since it was going to be in addition to the DFO loggers which were unable to be found. Additional loggers were added on January 26, 2013 at depths from 41 m to 45 m at 1m intervals only due to lack of rope.

Tidbits downstream of the tailrace were deployed at depths of 2.2m to 5.8m initially. Two sets of Tidbits were deployed below Nagle Creek near the Blue Bridge on April 3, 2013 at depths of 11.3m and 15.1m respectively. Each logger was anchored to shore with 1/8" diameter braided, coated cable. The loggers were anchored inside of decorative 12"x12"x12" concrete blocks (standard concrete blocks decay over time) to ensure that loggers were maintained as close to or on the river bottom and the loggers themselves were protected from damage. Loggers in the headpond were arranged from top to bottom as illustrated in Figure 2-2. shows the location of temperature logger deployment in the headpond as well as below the tailrace between the dam and the blue bridge.

The data from the loggers installed in the fall 2012 season were downloaded on January 27, 2013 for the first time. Twenty-six loggers' data were downloaded. Due to either hardware or field crew errors, 10 had no data recorded and 1 logger ceased downloading on December 17, 2012. Of the 15 that logged continuously throughout the 3.5 month period and were downloaded correctly, 13 were recording in the forebay and 3 in the downstream study reach. The logger that ceased downloading in December was in the downstream study reach and the incomplete

data from that logger were used. Recommendations for improvement of this portion of the study program are provided in the discussion section.

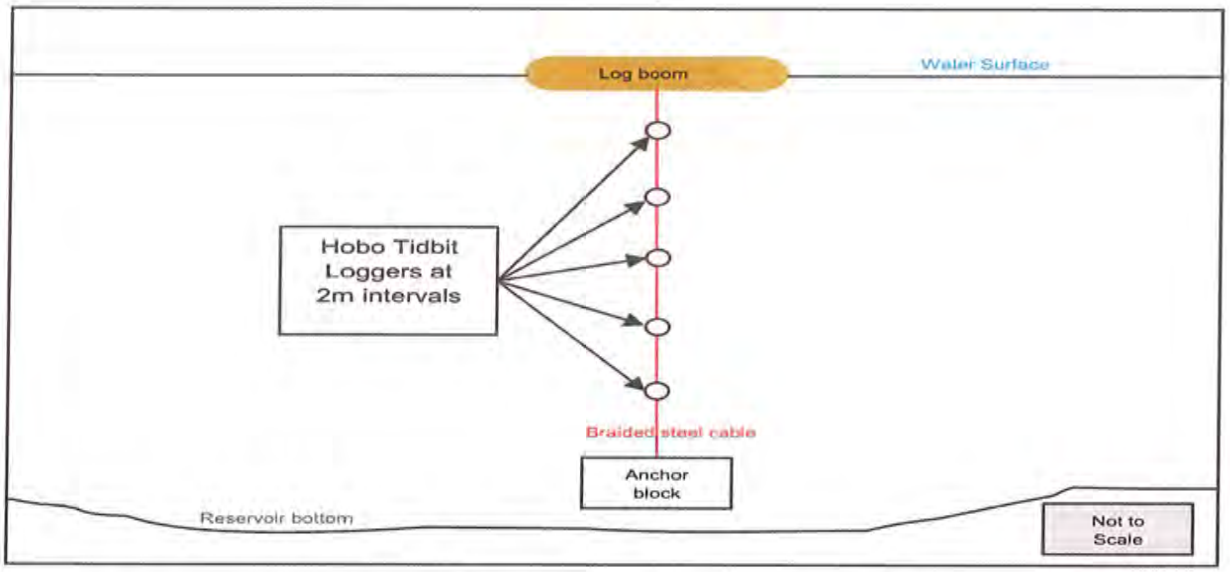


Figure 2-2. Diagrammatic sketch of Headpond Data Logger Setup and Deployment.

Historical water temperature data were available for the forebay and two downstream sites within the study area. A vertical array of temperature loggers deployed by DFO was in place in the Mica Dam forebay and the historical data from May, 2011 until March, 2012 was provided and imported into the temperature database (G. Martel, BC Hydro, pers. comm.). Downstream of the dam, water temperature data were obtained from Golder Associates Ltd. for the March – November, 2008 time period from a temperature logger that was installed mid-channel on the Blue Bridge at the downstream end of the study area. These data were not plotted in the current report. Data were also obtained from a water temperature logger installed just below the tailrace of the dam on the right downstream bank from a study running from 2001 - 2004 conducted by Karen Bray, BC Hydro. All historical water temperature data were incorporated into the CLBMON-60 water temperature database.

Data loggers were subsequently downloaded again on April 3 and 4, 2013. All loggers were re-set to record at 15 minute intervals. Battery levels on all loggers were checked to ensure that more than 80% battery life remained. The next download is expected to occur in early June 2013. For each of the downstream locations, an additional logger was added to the location to obtain duplicate loggers as outlined in the study plan. In the headpond, the depths were adjusted to 0 (surface), 2, 4, 6, 8, 12, 14, 16, 18, 20, 22, 24, 26, 30, 34 and 38m respectively to provide greater depth of coverage. The current headpond array extends from the surface to a depth of 38m.

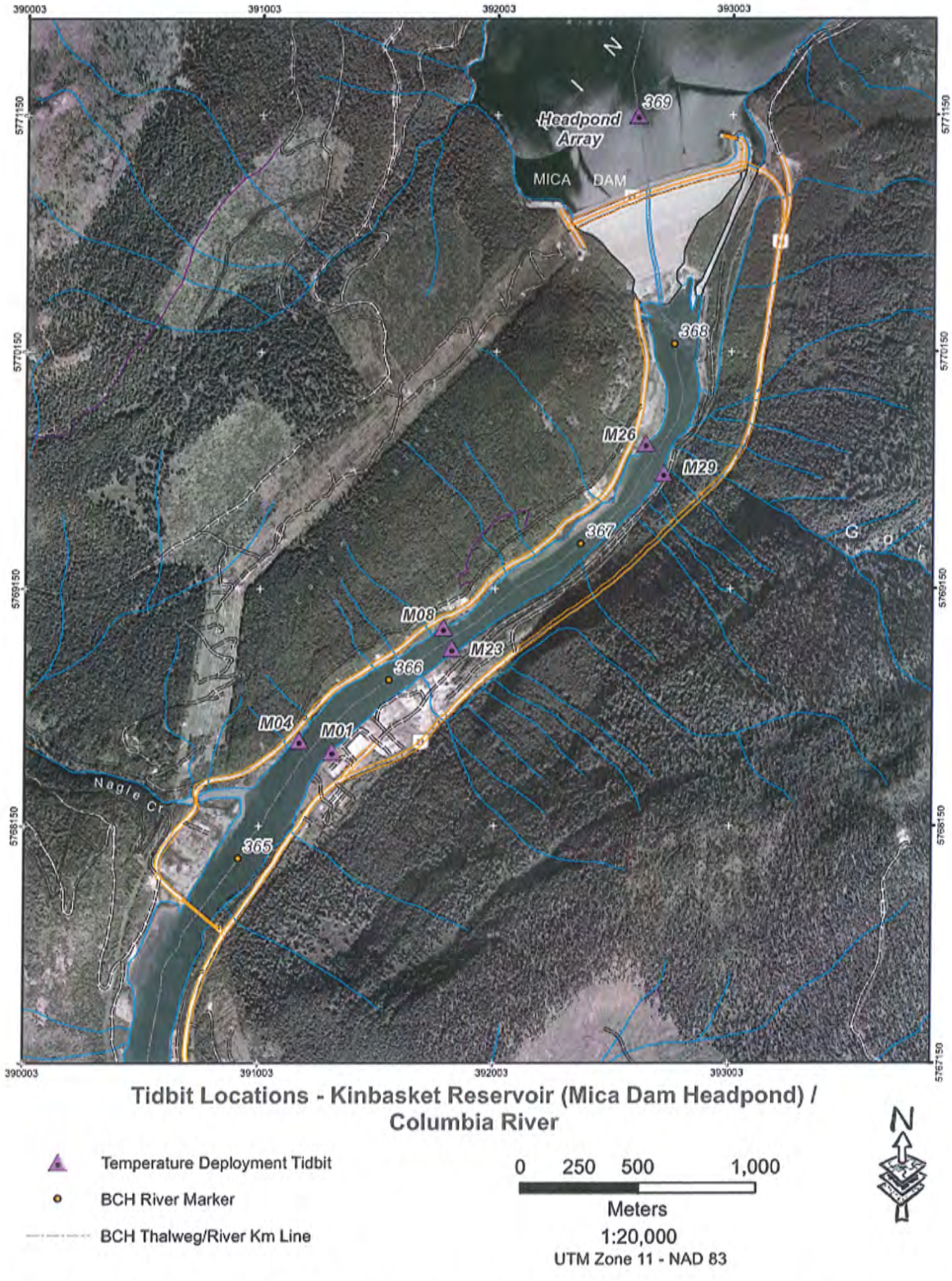


Figure 2-3. Tidbit deployment locations in the Kinbasket Reservoir (Mica Dam Headpond) and Columbia River from October 2012 to April 2013.

2.6 Data

Data were entered into Excel spreadsheets and imported into customized Access databases. Four databases were employed in the analysis. The historical indexing information was obtained from a database produced by Golder Associates Ltd. for the 2008 study in the Mica Dam tailrace. The current program's (CLBMON-60) fish sampling and biological information were placed into a separate database since the methods used and the structure of the data were so different from the previous work. The information about temperature loggers' deployment, individual logger's identification and locations as well as all downloaded temperature data from both historical programs in the area and the current program were in a customized Access database. The discharge and elevation information for Kinbasket and Revelstoke Reservoirs were extracted from the Poisson Consulting Ltd. database containing Power Records data for the Columbia River system.

Spatial data from the Garmin 62S GPS units were downloaded after each night's survey into Garmin BaseCamp software and were saved as .gpx files for import into other GIS software. A shape file provided by Karen Bray of BC Hydro provided a line down the thalweg of the river and river kilometer references that will be common to all Water License Requirement projects on the Columbia River (K. Bray, pers. comm.). The observations of individual fish were spatially located by taking the exact time of the recorded observation from the data sheet and matching that to the spatial point on the time referenced .gpx file to give a UTM coordinate in the river for that fish. The specific locations were then assigned a river kilometer by drawing a perpendicular line from the fish's location to the provided thalweg line and assessing where on the line it was located. Each river km and bank is associated with a particular habitat type as defined in Ford and Hildebrand (2008) so assigning each fish's location to a river km allowed each fish to also be affiliated with a habitat type as well as providing the distribution of the fish in linear as well as Cartesian space.

Prior to analysis, the data were checked for data entry errors, with 10% of the data checked completely with additional random checks to ensure accuracy. The data were then plotted to look for errors and outliers.

2.7 Analysis

As per the terms of reference (BC Hydro 2011), the following variables were assessed from the fish observation and capture data: relative abundance, condition, and spatial distribution throughout the study area.

Species richness and a modified Shannon diversity index were also assessed for the study area by site. Species richness (R) is simply the number of species observed or captured by boat electrofishing or backpack shocking.

The Shannon diversity index (H') is calculated by:

$$H' = -\sum_{i=1}^{R} p_i \ln p_i$$

where R is the richness and p_i is the proportion of individuals belonging to the ith species. It is modified in this case as each life history stage and species combination were considered an individual 'species' in order to assess the diversity of life stages and species using each sampling site throughout the study area.

Weight-length and length frequency relationships were assessed by species where sufficient data were available. A generalized linear model assuming a Poisson distribution was fitted to the fish count data from the observation survey where site was modeled as a random effect. The model predicted observed density, which is defined as the expected counts per km by boat electrofishing site.

Body condition which is the weight of a fish relative to its length was estimated using a mass-length model (He et al. 2008). The estimated changes in body condition were expressed in terms of the expected percent change in body weight of a representative length fish relative to 2008. The representative lengths by species and life history for those categories that had sufficient data were: 300mm for an adult mountain whitefish, 175mm for a juvenile mountain whitefish, 600mm for an adult bull trout, 60mm for a kokanee fry and 60mm for an adult sculpin.

The analysis of the temperature data from the forebay and within the 2.5km of the study area will assess the rate of change in water temperature and water temperatures associated with different operational strategies and the spatial structure and variability in temperature changes throughout the study reach. The latter objective will focus particularly on where the waters from the dam and from the main tributary of Nagle Creek mix as well as whether there are detectable differences between banks. Trends in fish relative abundance and distribution will be assessed in conjunction with the thermal regime study results and the operations of Mica Dam where possible given the available data. The analysis of the preliminary water temperature assessed any indications of differences in water temperature between banks and the reservoir's thermal structure in the October-January period. For the 2012 study year, 4 loggers below the dam collected water temperature data from October 2012 until the end of January 2013. The two additional loggers deployed below the dam did not successfully obtain data for this time period. These data gaps were remedied by the addition of temperature loggers in April, 2013 including duplicate loggers downstream of the dam and the redistribution of the loggers throughout the water column in the forebay array. This will allow the modelling and understanding of any stratification and the effects of operations on temperatures in the forebay and the downstream study area.

A hierarchical Bayesian approach was used to model the data using R Version 2.15.2 (R Development Core Team 2012) and the JAGS library and plotting was done with the ggplot2 library (Plummer 2003, Wickham 2009). The full descriptions and code for all modeling efforts are provided in the Analytic Appendix to this report.

3 Results

The results of the Year 1 study are provided in the following sections. Subsequent annual reports will follow a similar format to this one. A final project completion report will incorporate and integrate observations and synthesize data and analysis from all years. The project completion report (target spring 2017) will synthesize data from the four study years (as well as from other relevant projects) and provide a detailed description of the changes in fish distribution and water temperatures observed.

3.1 Discharge

Kinbasket Reservoir fills during May and June with a flush every 12 hours to prevent the build up of dissolved gases. The rest of the year Mica Dam operates through its four turbines in a typical year. The year 2012 was an exceptional year for snowmelt and spring precipitation and was the first year in many in which spill discharge had to be used as an operational strategy. The discharge through Mica Dam's turbines and spill throughout the year are summarized in Figure 3-1 and plotted in comparison to the previous years from 2008 in Figure 3-2. In 2012, there was continuous spill from July 16th until August 30th and brief spill episodes on the 17th of September, the 9th of October, the 14th of November and the 10th of December (Figure 3-1). Flows during the four day sampling period are summarized in Figure 3-3. The sampling window was delayed from the planned August time period to the third week in October to avoid the spill period and to obtain stable flows within the range previously sampled in the 2008 indexing study (Ford and Hildebrand 2008). The first two nights, the sampling took place at flows of 484 m^3/s and the third night the sampling occurred at 830 m^3/s; both discharge levels were within the range sampled by the 2008 study (Figure 3-3).

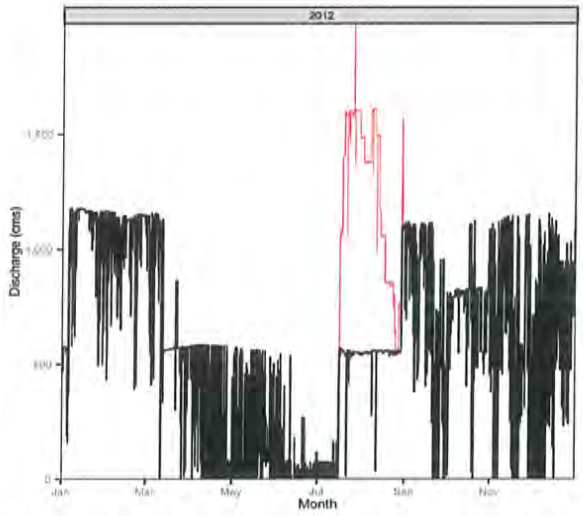


Figure 3-1. Hourly discharge from Mica Dam for 2012 with spill shown in red and turbine flow in black.

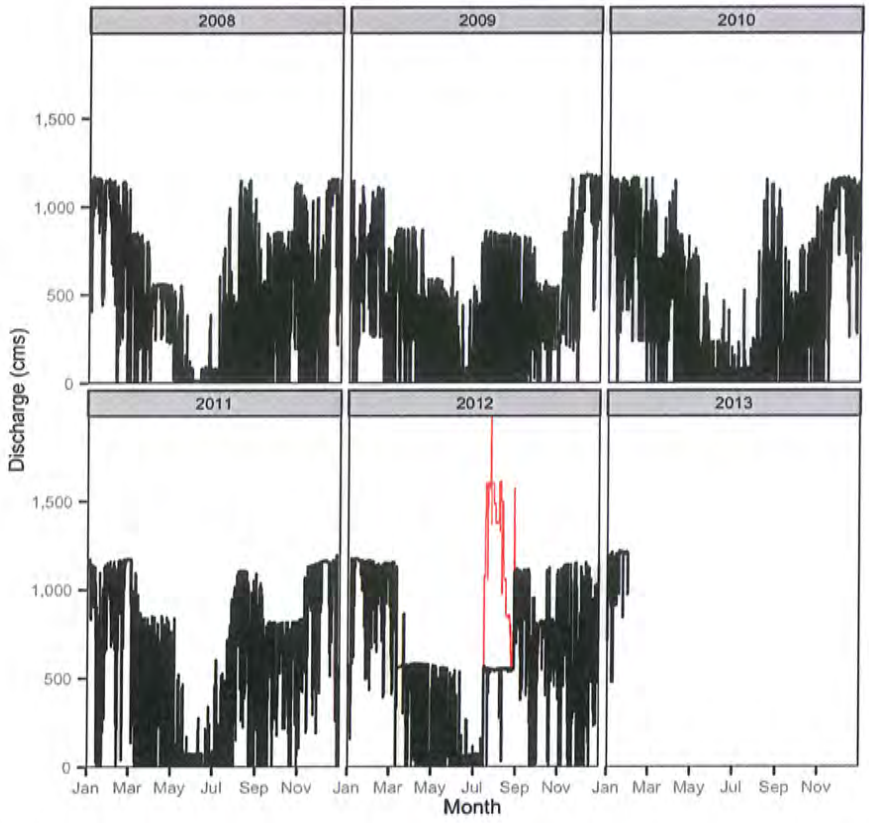


Figure 3-2. Hourly discharge through Mica Dam from 2008 until January 31, 2013. Spill through the dam is shown in red, turbine flow in black.

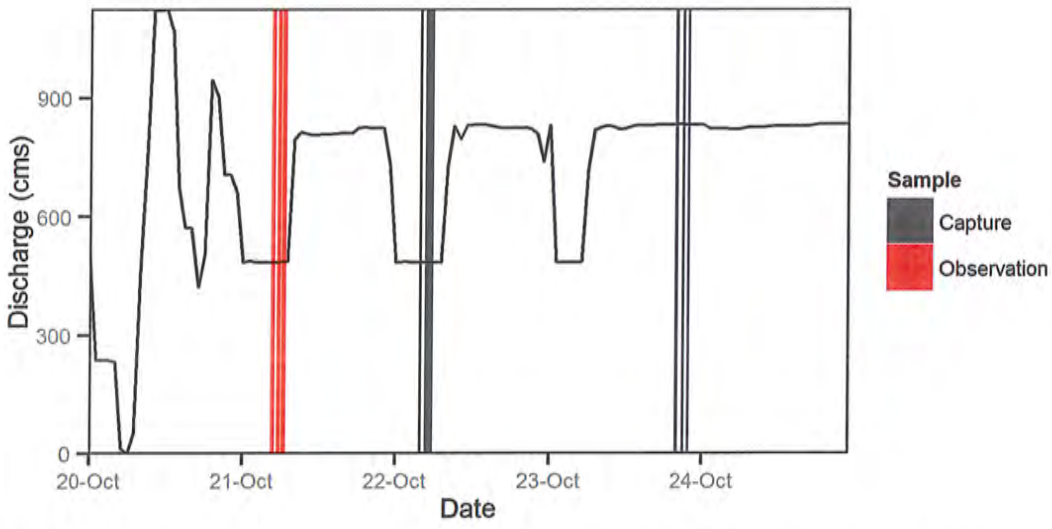


Figure 3-3. Hourly discharge through Mica Dam during the sampling window from October 20-24, 2012. Observation sampling is marked with red vertical lines and capture sampling with grey vertical lines.

3.2 Fish Observations

The five sampling sites were sampled in one night on October 22, 2012 using the observation methods. Sampling began at 04:33h and continued until 06:34h. Over all five sites, 451 fishes were observed. The trial of the video backup of the observation of fishes was unsuccessful likely due to the movement of each observer's head while communicating to the data recorders. Further trials of the utility of the video camera will be considered for the 2013 field season with an independent videographer or a stationary mount on the railing of the electrofishing boat. The length frequency data for the four salmonid species noted by observers are plotted with juvenile and adult length cut-off values plotted with vertical lines (Figure 3-4). For mountain whitefish, fry were defined as fish less than 120mm, juveniles as those between 120-249mm and adults as those 250 mm or larger, for bull trout, fry were those fish less than 120mm, juveniles between 120-399mm and adults were 400 mm or greater. For rainbow trout, fry were considered those less than 120mm, juveniles from 120-249 mm and adults those fish greater than 249 mm. For kokanee the demarcations were fry less than 100mm, juveniles from 100-174mm and adults greater than 174mm (Figure 3-4).

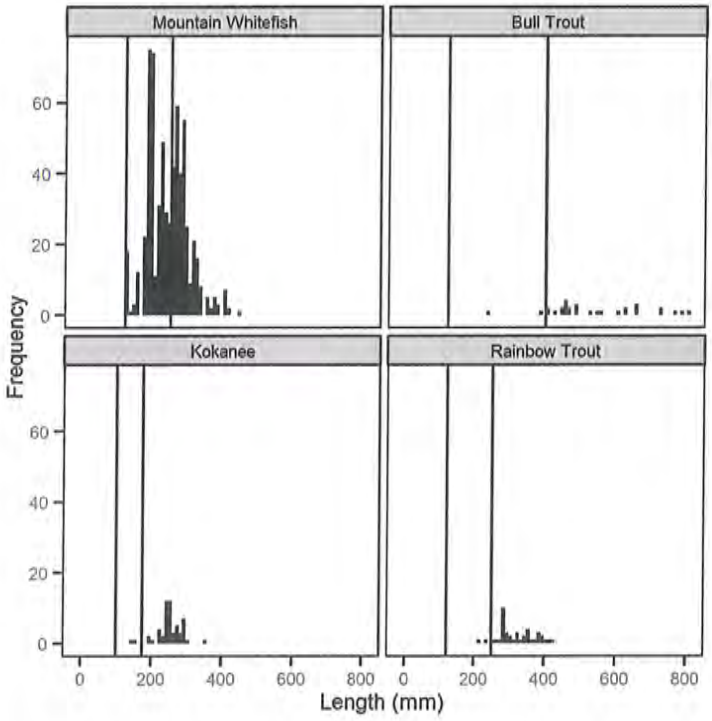


Figure 3-4. Lengths of the four salmonid species observed in 2012 boat electroshocking. The juvenile and adult length cut-offs are represented by the vertical lines on each plot.

Mountain Whitefish were the most numerous fish observed in all five of the boat electroshocking sites (Figure 3-5). Adult Rainbow trout were observed in all five sites, but had very low densities and Bull Trout were only seen in abundance in ES01 and ES02 and in low numbers in ES04 and ES05 (Figure 3-5).

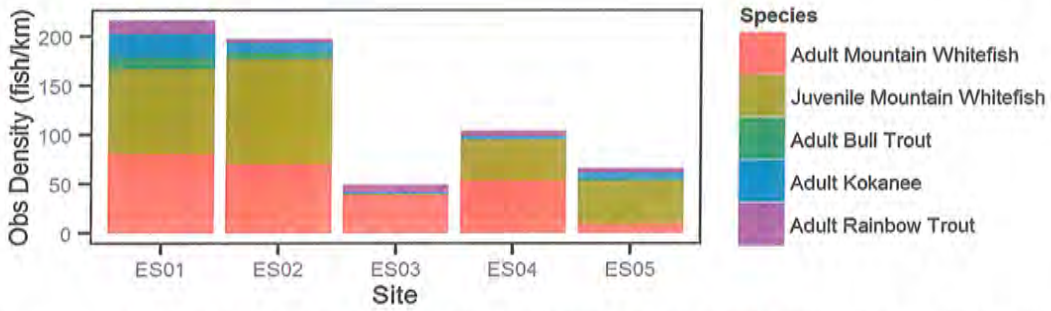


Figure 3-5. The density of the four salmonid species and life stage by site as observed in 2012 boat electroshocking.

The density of fish by site and river km was modelled for each species and life stage with sufficient data (Fugure 3-6 –Figure 3-10). The general trend was for higher densities of fish to occur on the sites located along the left downstream bank. Juvenile mountain whitefish densities were the highest of all species and life stages observed and ranged from 1.3 fish/km in site ES03 to 106 fish/km in ES02 (Figure 3-7). Adult bull trout densities were strongly correlated with kokanee densities (Figure 3-11) and very low numbers or zero counts of both species were found in sites ES03, ES04 and ES05. Numbers of observed rainbow trout were quite low overall. Rainbow trout densities were highest in site ES01 with a modeled density of 13.5 fish/km (Figure 3-10). Adult Rainbow Trout displayed higher densities on the left downstream bank for the upper three sites and not for the two most downstream sites.

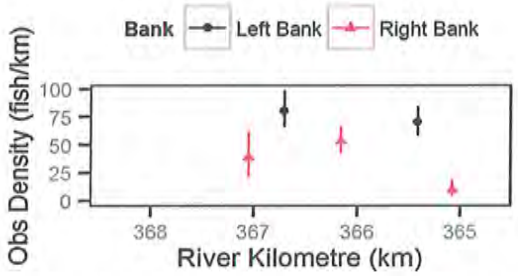


Figure 3-6. Modeled observer fish density (fish/km) for adult mountain whitefish by site. The dam is represented by the left side of the graph and the bottom of the study reach at the blue bridge is represented by the right side of the graph box. 95% credibility intervals are plotted around each estimated density.

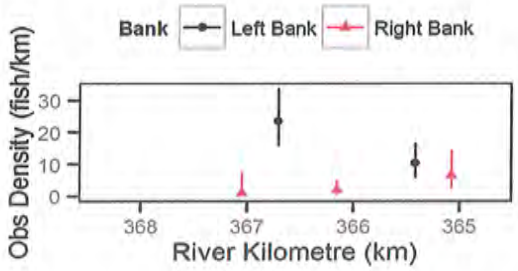


Figure 3-7. **Modeled observer fish density (fish/km) for juvenile mountain whitefish by site. The dam is represented by the left side of the graph and the bottom of the study reach at the blue bridge is represented by the right side of the graph box. 95% credibility intervals are plotted around each estimated density.**

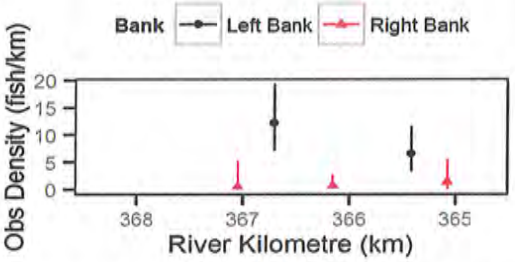


Figure 3-8. **Modeled observer fish density (fish/km) for adult bull trout by site. The dam is represented by the left side of the graph and the bottom of the study reach at the blue bridge is represented by the right side of the graph box. 95% credibility intervals are plotted around each estimated density.**

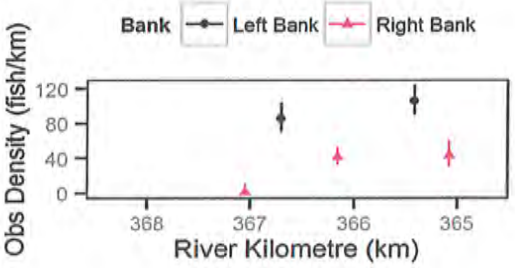


Figure 3-9. **Modeled observer fish density (fish/km) for adult kokanee by site. The dam is represented by the left side of the graph and the bottom of the study reach at the blue bridge is represented by the right side of the graph box. 95% credibility intervals are plotted around each estimated density.**

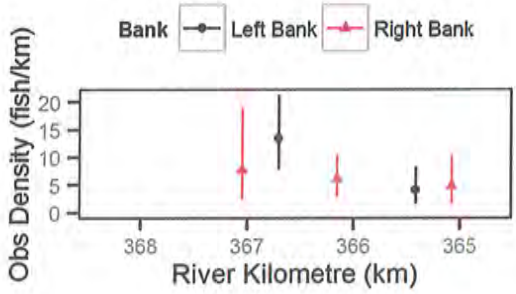


Figure 3-10. Modeled observer fish density (fish/km) for adult rainbow trout by site. The dam is represented by the left side of the graph and the bottom of the study reach at the blue bridge is represented by the right side of the graph box. 95% credibility intervals are plotted around each estimated density.

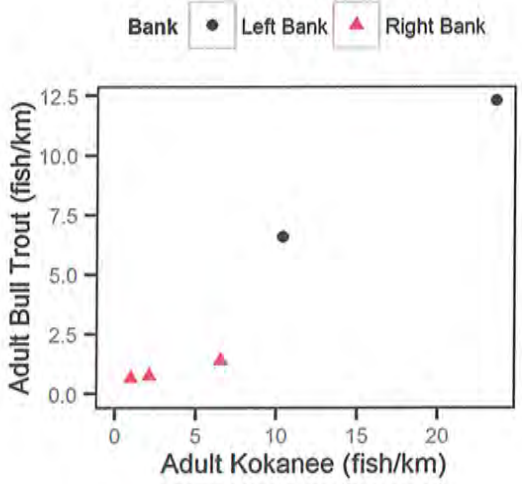


Figure 3-11. Modeled observer fish density (fish/km) for adult Bull Trout vs. adult Kokanee.

3.3 Fish Captures

In the two nights of boat electroshocking where netting was done, 204 fishes were captured, measured, weighed and sexed if possible. The majority of the fishes were Mountain Whitefish with three other salmonid species netted: Bull Trout, Rainbow Trout and Kokanee. Most of the

kokanee were in spawning colours and starting to show post-spawning degradation though a few silver kokanee were captured. Exceptional characteristics were noted for individual fishes and no rare or invasive species were observed or captured during the 2012 sampling season.

Fishes were separated into juvenile and adult categories using the information from the length frequency plots and from previous indexing work completed on Revelstoke reservoir in the Middle Columbia River (Ford et al. 2011).The fish length-density plot of captured and observed fish shows that the observer estimates were quite accurate with some 'heaping' of lengths noted in Mountain Whitefishfor the observed data (Figure 3-12).

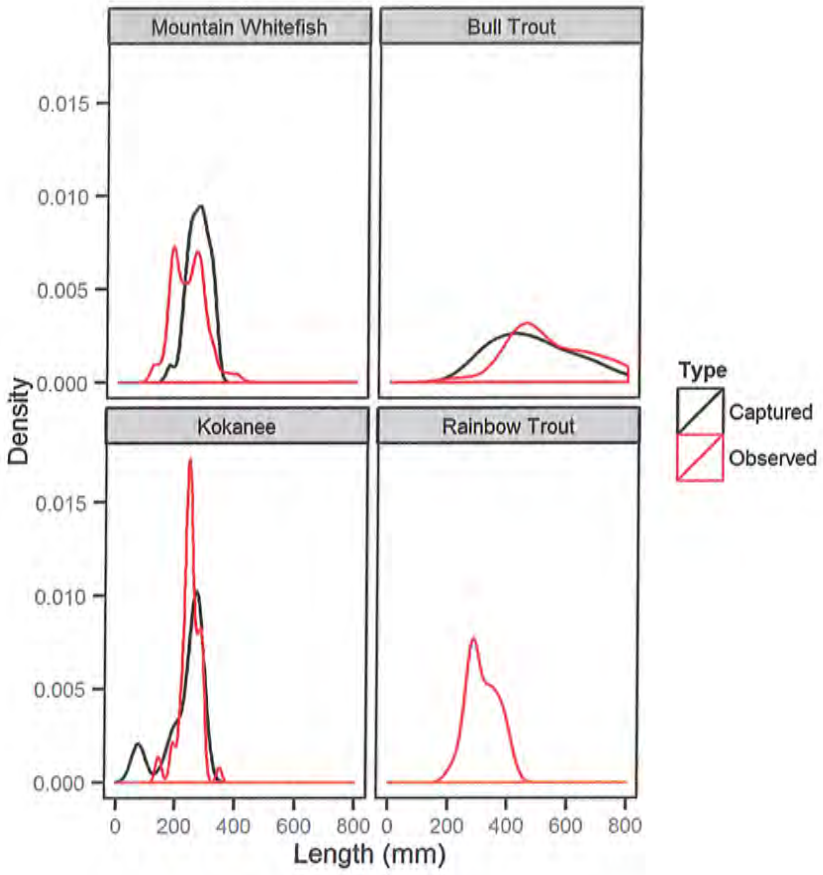


Figure 3-12. Relative density plot of fish lengths for captured and observed data for the four salmonid species captured in 2008 and 2012 boat electroshocking.

The use of the observation method was implemented because netting efficiency limits the number of fishes that can be assessed in a session and is particularly limiting when there are high densities of fish. Since the management questions ask what the relative abundance and the spatial distribution of the fishes are, observation was used as the theoretically more efficient method. The data from observed fish and captured (netted) were used to calculate a ratio and both types of data from the 2008 and 2012 study were plotted to test this assumption of

relatively improved efficiency for observation (Figure 3-13). The observed fish count data from 2008 was obtained using a different method where at the end of each site the fish observed by each netter during the site were noted from memory, whereas in 2012 the fish were observed in actual time. The 1:1 line indicates the relative efficiency: any data point on the line indicates that netting and observation are identical with respect to efficiency, data below the line indicate that netting is more efficient at estimating the fish numbers, and data above the line indicate observation is more efficient (Figure 3-13). The data show that observation is much more efficient at sampling the fish in the study reach than capture, particularly when the densities increase. This is especially apparent in the MW panel of the plot where the ratio goes as high as 24 fish observed for every fish netted (Figure 3-13).

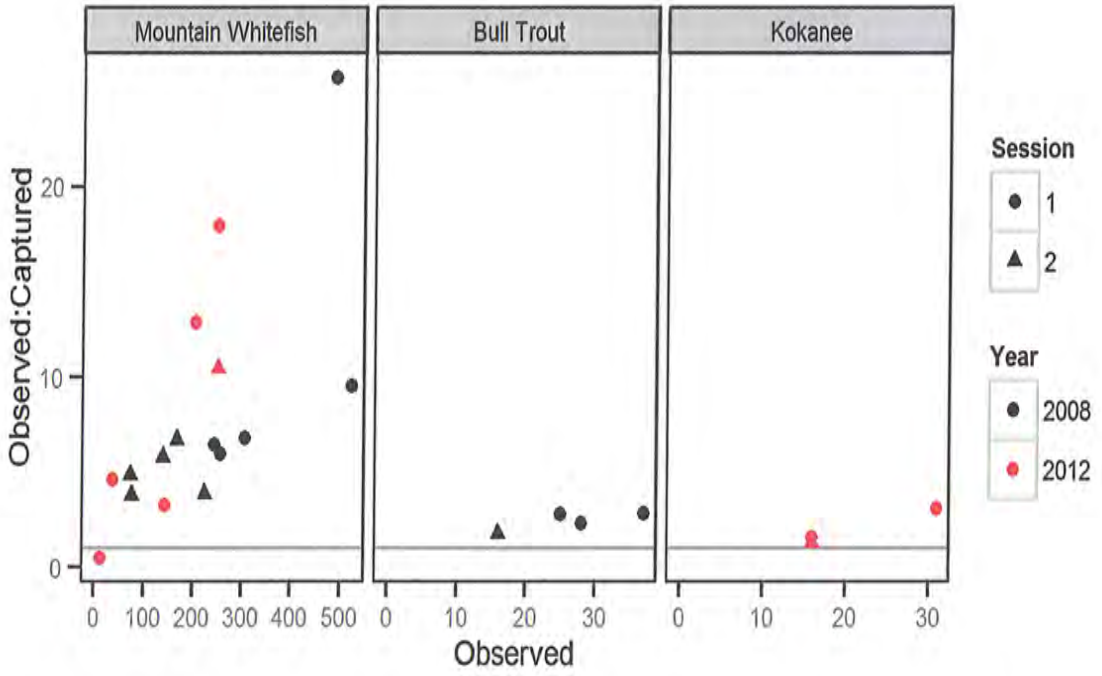


Figure 3-13. Ratio of observed to captured fishes for the previous indexing program (2008) and the current study program (2012) separated by sampling session. The horizontal line is the 1:1 line, where data points below the line indicate that netting is more efficient, and data points above the line indicate observation is more efficient.

Two of the four backpack sites demarcated by Golder in 2008 (sites ES01 and ES02) had available and suitable habitat for backpack sampling in 2012 (Figure 3-14).

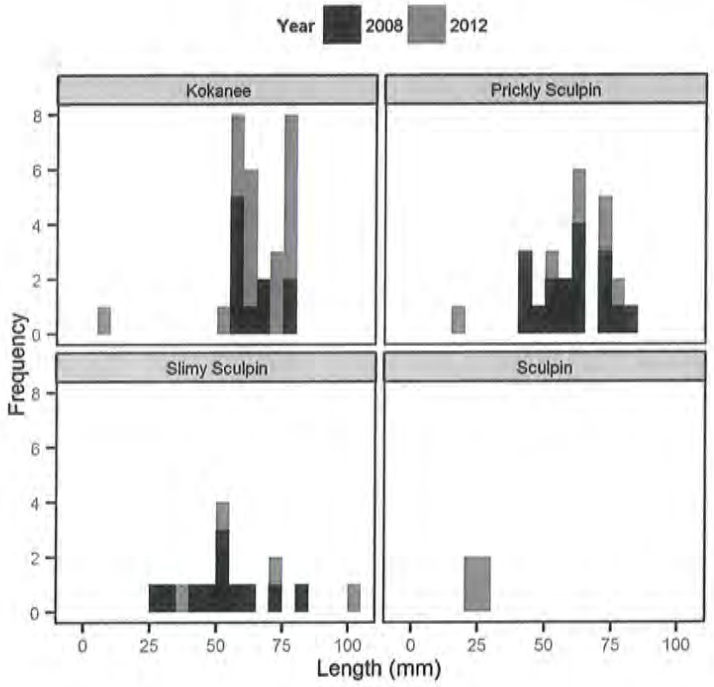


Figure 3-14. Length frequency plots by fish species captured with backpack electrofishing in 2008 and 2012.

Fish condition was estimated for 2012 and compared to the 2008 data for the same species and life stage to show how the method for assessing fish condition before and after the turbine installation will be used after the installation of Mica 5 & 6. The condition of adult mountain whitefish, fry kokanee and adult sculpin (percent change in weight of an average length fish, all species aggregated) decreased since 2008 (**Figure 3-15**),while the condition of juvenile mountain whitefish and adult bull trout increased since 2008 (**Figure 3-15**). The largest decrease in average condition was for kokanee fry and the greatest increase in average condition since 2008 was for adult bull trout (**Figure 3-15**). There are no credibility intervals around the 2008 data because there is no uncertainty in the percent change in weight of an average length fish in 2008 relative to 2008.

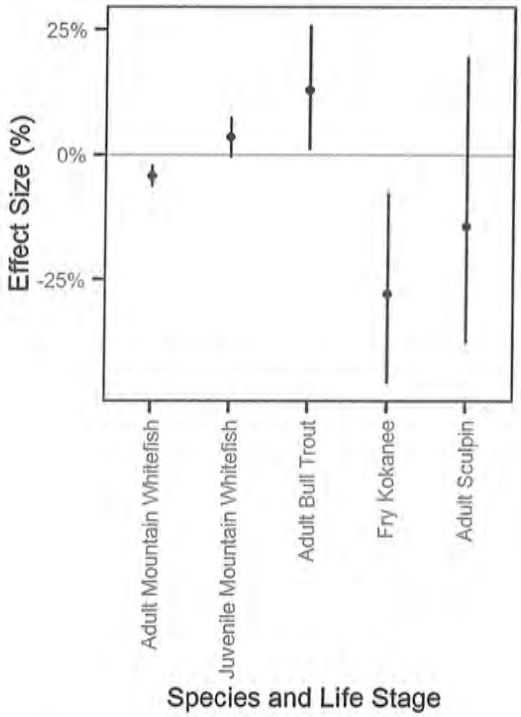


Figure 3-15. Modeled percent change in weight of adult and juvenile Mountain Whitefish, adult Bull Trout, Kokanee fry and adult Sculpin from 2008 to 2012.

The modified Shannon diversity index was calculated from the model results for apparent fish densities from observer data by site for all fishes observed. The highest diversity was at site ES01 on the left bank (1.3) and the lowest diversity (0.72) at site ES03 on the right downstream bank (Figure 3-16).

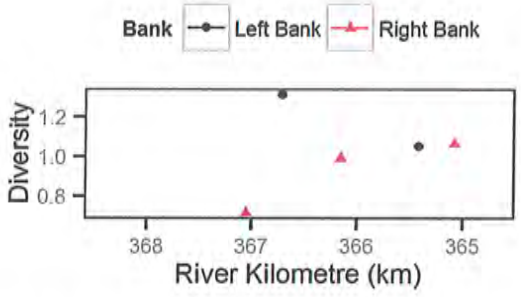


Figure 3-16. Shannon diversity index values by site plotted by river kilometer within the Mica indexing study area for 2012 sampling.

3.4 Temperature

All loggers installed in October 2012 were downloaded on January 27, 2013 and the historical data and the current program's loggers' data are presented here.

The forebay water temperatures show stratification of the reservoir occurring in July – September and breaking down in October (Figure 3-17). Water temperatures in the surface water logger (0.2m below surface) range from a high of 19.8°C to a low of 4.03°C (**Figure 3-17**). The range at the reservoir bottom (62.6m from surface) is much narrower with a high temperature of 7.4°C and a low of 3.7°C (Figure 3-17).

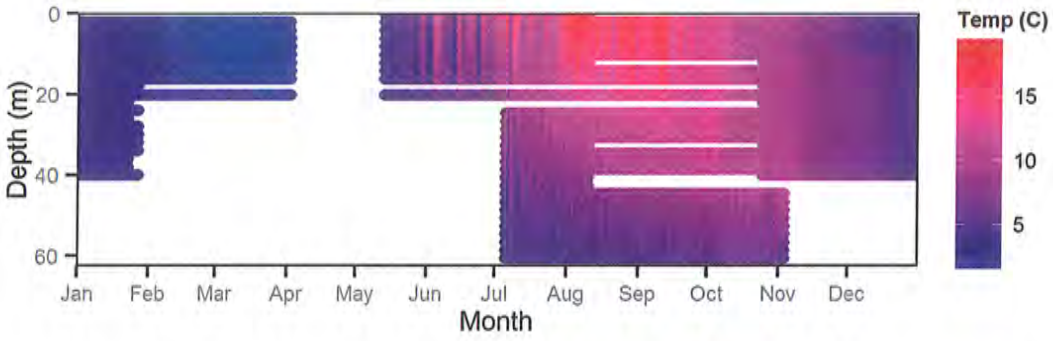


Figure 3-17. Water temperature in the forebay of Mica Dam plotted by depth vs. time for 2011 and 2012 data combined from the DFO array in 2011 –April 2012 and for the CLBMON-60 array from October, 2012 to January, 2012.

Historical water temperature recorded on the right downstream bank immediately below the tailrace from 2001 to 2004 give a strong indication of the annual patterns of water temperature with four turbines operating at Mica Dam (Figure 3-18).

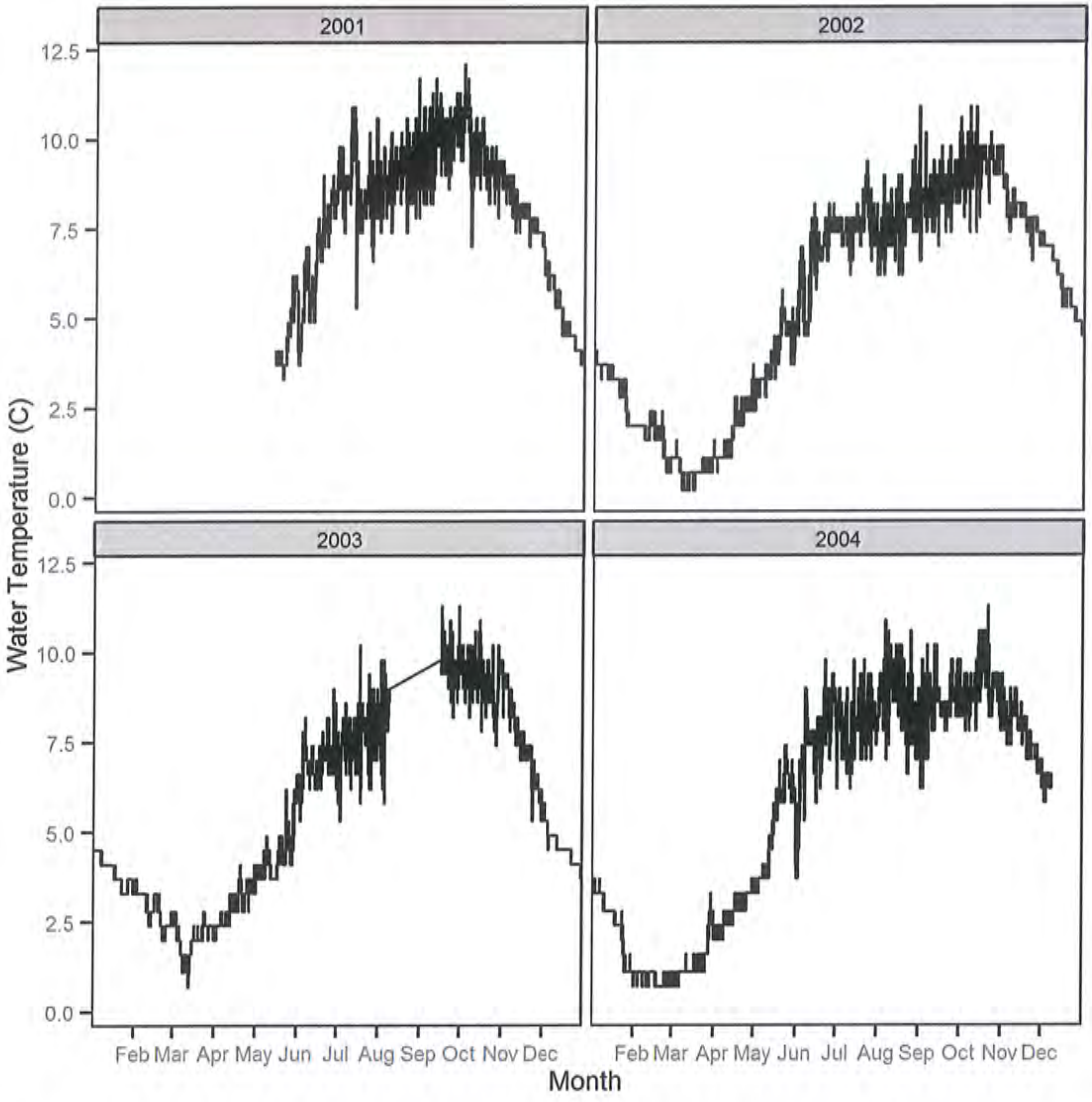


Figure 3-18. Historical water temperature through time for the data logger installed on the right downstream bank just down from Mica Dam for the period from 2001-2004.

Water temperature loggers installed October 10, 2012 show the gradual decrease in water temperature over the onset of winter and during the early winter months. The loggers at river km 365.6 appears to have been dewatered in January with the temperatures dropping below 0°C (Figure 3-19).

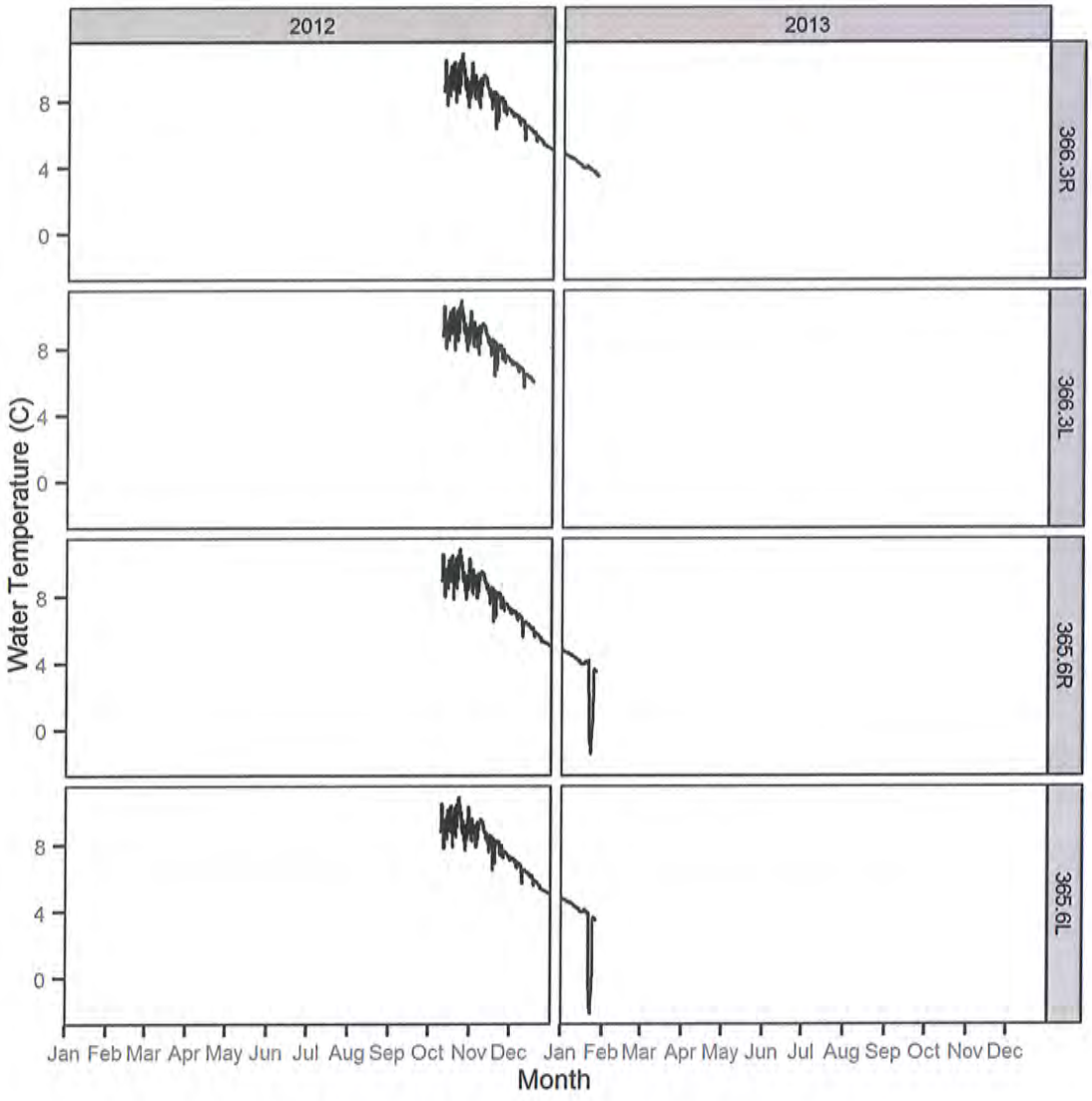


Figure 3-19. Water temperature through time plotted by river km and site for the four loggers downstream of Mica Dam. The dam is at river km ~369 and the blue bridge at ~365.

The differences between the left and right bank most upstream loggers at river km 366.3 indicate that the left bank was slightly warmer than the right bank until November when the difference largely subsides (Figure 3-20).

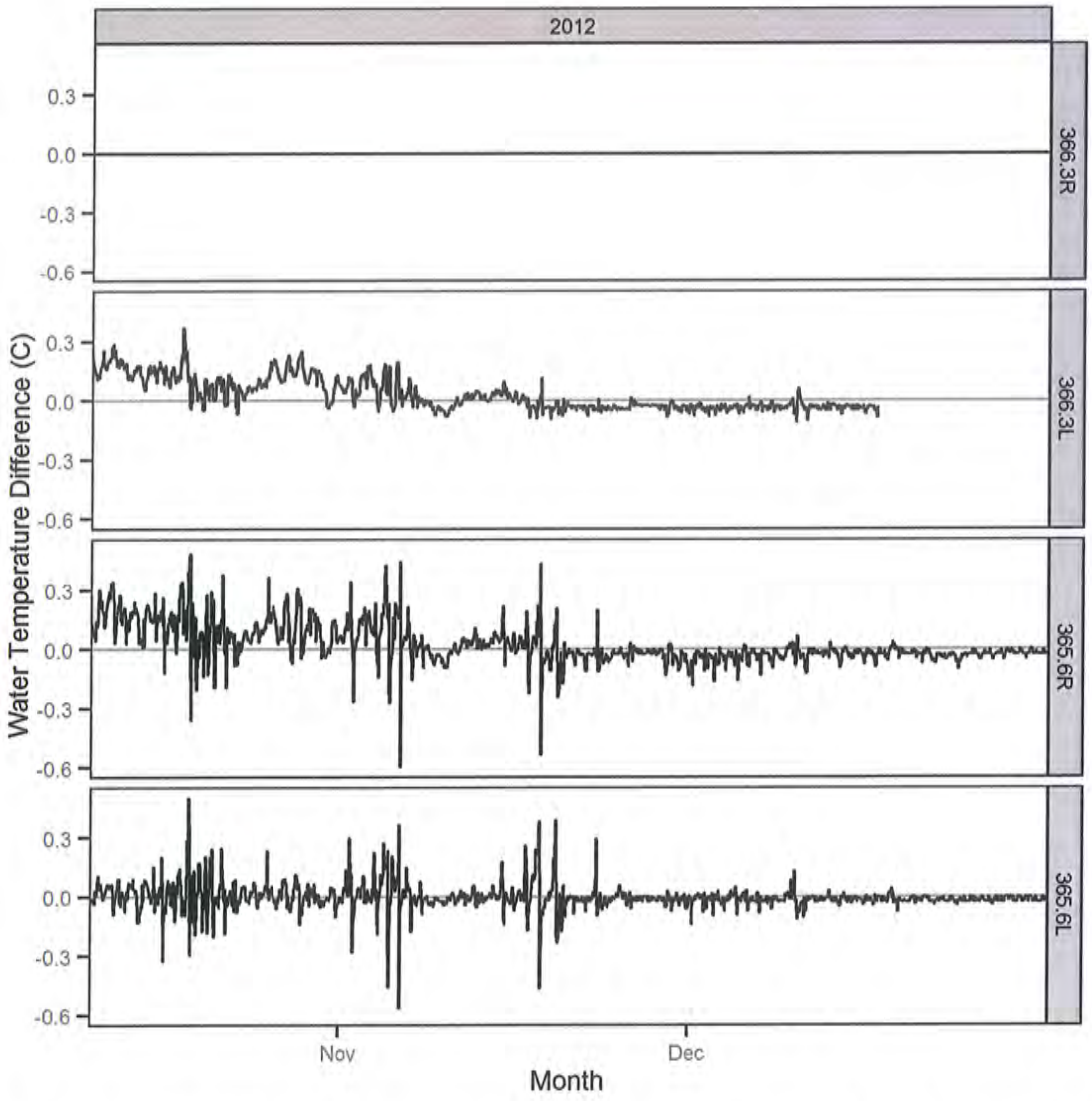


Figure 3-20. Water temperature difference between right and left bank loggers at each location relative to the the furthest upstream logger location at river km 366.3.

The reservoir elevation fluctuates throughout the year following predictable operational patterns as well as being affected by within year fluctuations due to extreme water events. In 2012, the lowest elevation occurred in late April with an elevation of 721.9m and the highest elevation occurred in early September with an elevation of 753.6m for an annual change of 31.7m (Figure 3-21).

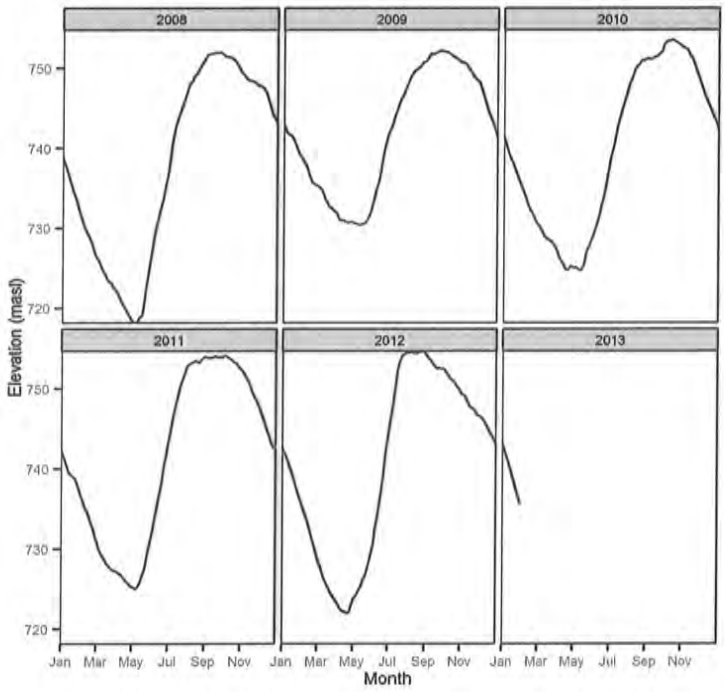


Figure 3-21. Kinbasket Reservoir hourly elevation in metres at the Mica Dam Forebay recording station for the time period of January 1, 2008 – January 31, 2013.

4 Discussion

The addition of Mica 5& 6 is predicted to result in average monthly changes in reservoir elevations of -0.1 to 0.2m (BC Hydro 2011 TOR). Water velocities in the Mica tailrace are expected to increase to maximal levels of 1.5-2.4m/s during peak demand periods and these daily flows could alter the water temperature (BC Hydro 2011). Changes in water temperature resulting from the operational changes from the two additional units are predicted to be small and not distinguishable from the existing variability (BC Hydro 2011). The effect these potential changes may have on the fish community is unclear and part of the reason for the implementation of CLBMON-60.

In the first field season of CLBMON-60, a new method for fish indexing using fish observation aided by the use of boat electroshocking to draw the fish in at night was successfully tried. The advantages of utilizing the fish observation method rather than capture for determining relative fish abundance as well as fish distribution throughout the study area are that it provides fine-scale spatial fish distribution information and does not require fishes to be handled. The data are also less dependent on netter skill and non-selectivity and on the density of fish in an area. The ratio of observed: captured fish showed evidence of the increased effectiveness for indexing the fish in a sample site as compared to netting with a boat electrofisher. However, fish observation from a boat at night is heavily reliant on highly skilled technicians and biologists working as observers since estimating length and determining species quickly and accurately is

essential to its success. Its primary disadvantage is that it does not readily allow observer efficiencies to be estimated. Ensuring that future surveys are undertaken under similar conditions and with the same crew where possible will minimize the differences in observer efficiencies. This will make it reasonable to assume that the observer efficiencies do not change significantly through time. Where it isn't possible to keep observers consistent, the effect of observers can be modelled in the density estimation model in order to account for the differences. Observer efficiency will also be kept as consistent as possible in future by keeping as many factors constant as possible (e.g., boat operation speed and EF settings) and crew training if new crew are utilized, and a defined observer area from the midline of the boat to either port or starboard for a set distance demarcated by lighting. The trial of helmet cameras to verify the data collected by each observer was not successful due to camera movement, however additional trials will be conducted in the 2013 field season to assess if the method can be used successfully. The fish capture program that was also conducted allowed the assessment of fish condition which could be related to changes in flow and temperature by looking at the percent change in condition from year to year as was demonstrated in this year's analysis. The exertion of more effort with increased flows from the two additional turbines may show changes in fish condition factor even for transient salmonids and this will be tested after the construction is completed. With the addition of 2013 capture data, there will be three years of pre-Mica 5 & 6 data from which to estimate the variability by species for the condition and these values will be compared to the condition after the turbines' installation to determine if there is an effect. Species diversity was estimated using the Shannon diversity index ranged from 0.73-1.3 by site. These values will be useful for comparison among and between years as the study program progresses.

The second component of the study is the monitoring of the changes in temperature in relation to alterations in operations at Mica Dam resulting from the addition of two turbine units. The temperature data collected so far shows some indication of differences between left and right banks of the study area and stratification of the reservoir at least in the 2011 season. The detection of patterns between the banks was obstructed by only 4 of the 6 loggers providing useable data for the October 2012 – January 2013 period. The deployment patterns for the reservoir and the downstream study area were not considered adequate to analyse and detect patterns of difference and change. Therefore, the forebay temperature logger array was redeployed in April 2013 with greater distance between each logger to ensure coverage of the entire depth of the reservoir so that temperature stratification (if it occurs) can be captured in 2013. In addition, duplicate loggers downstream of the dam were installed in April, 2013 to ensure a full comparison of the left and right bank in relation to operations can be conducted next year. An additional pair of loggers was installed in April, 2013 below the inflow from Nagle Creek so that the influence of that major tributary can be modeled separately from the influence of the dam's operations. The trend for the left downstream bank of the river to be warmer than the right downstream bank was observed at one pair of loggers and reversed at the second pair of loggers for which data were available. This seems unlikely and may be due to a logger installation error (i.e., the wrong logger serial number being attributed to a UTM). The additional loggers and 2013 data will provide adequate data to assess whether this trend is an artefact or genuine.

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Appendix 1. Fish Distribution Maps – Mica Tailrace Fish Indexing Study

Figure 5-1. Observed Juvenile and Adult Bull Trout Distribution – Mica Dam Tailrace October 2012.

Figure 5-2. Observed Juvenile and Adult Rainbow Trout Distribution – Mica Dam Tailrace October 2012.

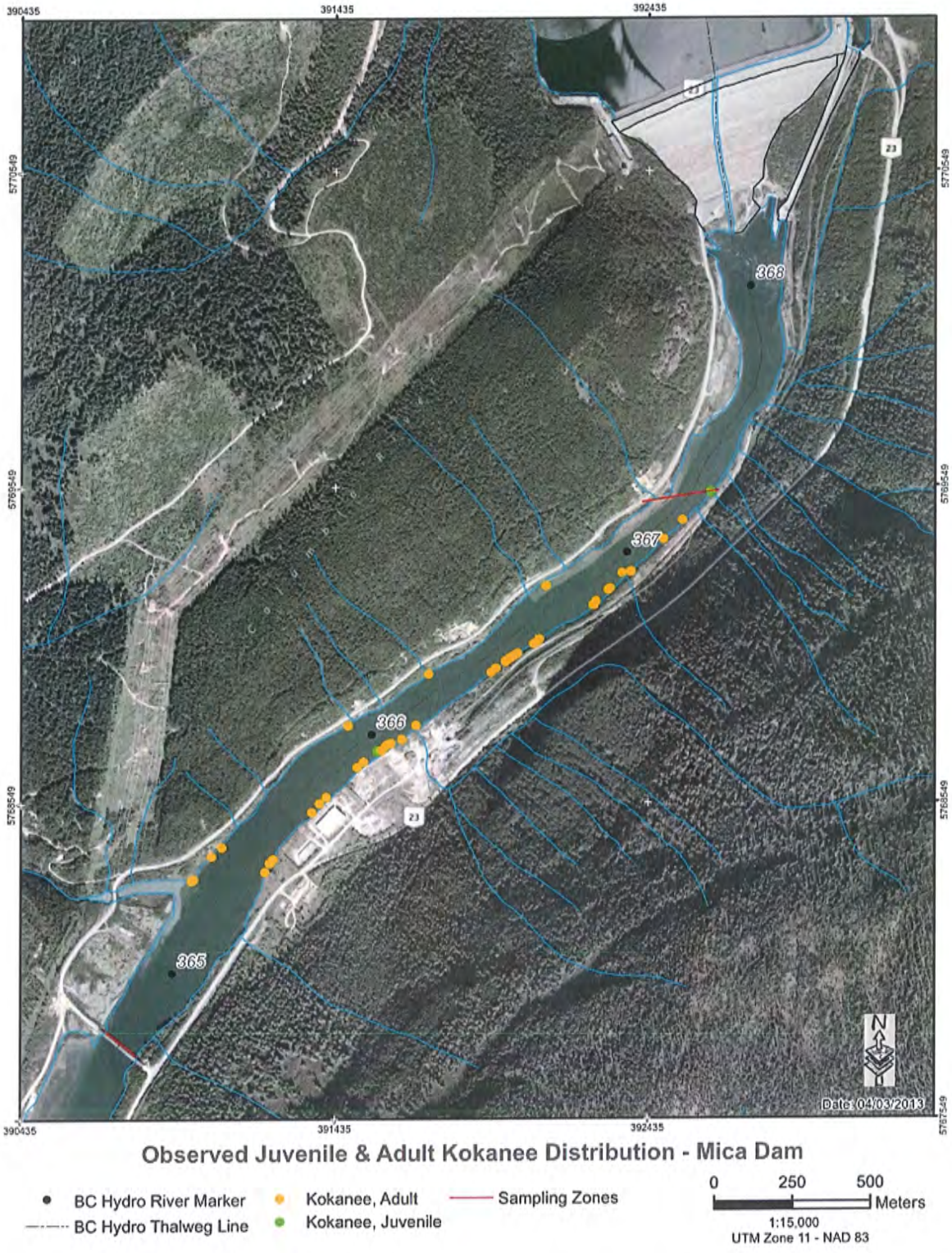


Figure 5-3. Observed Juvenile and Adult Kokanee Distribution – Mica Dam Tailrace October 2012.

Figure 5-4. Observed Juvenile Mountain Whitefish Distribution – Mica Dam Tailrace October 2012.

Figure 5-5. Observed Adult Mountain Whitefish Distribution – Mica Dam Tailrace October 2012.

Appendix 2. Digital Data –Electrofishing, Temperature Data

Table 5-1. Mica Boat Electrofishing Data Sheet - Mica Tailrace Fish Population Index Study

Year		Month	Day	Site		Efer	Net1	Net2	Sheet
									of
Temp	Cond	Vis	Hours	Mins	HourF	MinF	Volts	Freg	Pulse
No.	Spp.	L(mm)	W(g)	Count	Comments		Unwell	Injured	Scaled

Comments:

Table 5-2. Mica Backpack Electrofishing Datasheet - Boat Observation Datasheet – Mica Tailrace Fish Population Index Study

Year		Month	Day	Site		Efer	Netter	Pass	Sheet
								of	of
Pulse	Cond	Vis	Hours	Mins	EFsecs	Volts	Freq	Pulse	Model
No.	Spp.	L(mm)	W(g)	Count	Comments		Unwell	Injured	Scaled

Comments:

Table 5-3. Boat Observation Datasheet – Mica Tailrace Fish Population Index Study

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs - Port	Obs – Star	Recorder
2012	10	21	MICA	ES -03	JB	JC	JF

Wtemp ©	Cond (uS)	Vix (m)	Boat Model	Volts (v)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153		225 AAL				TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
4	33	10		start						
4			JB	325						
4			JB	320						
4			JB				280			
4			JB				280			
4			JB				280			
4			JB	285						
4			JB	285						
4			JB	285						
4			JB	285						
4			JB	285						
4			JB	285						
4			JB	260						
4	36	24	JB	320						
4	38	29	JB	325						
4	39	0	JB	290						
4			JB							
4	39		JB		END TIME					

Table 5-4. Boat Observation Datasheet – Mica Tailrace Fish Population Index Study

TEMPERATURE LOGGER DEPLOYMENT

Year	Month	Day	Project	Site
2012	10	24	MICA	FB

Wtemp (c)	Cond (uS)	Vis (m)	MODEL	Volts (V)
8.74	0.153		VR24	

Start Hour	Start Min	End Hour	End Min	EF Seconds
15	17:32	16	1:32	

Number	Species	Depth	Launch Time	Comments
	deepest	40	1648 MDT	M2 - 10171277
		38	1646	M3 - 10171286
		36	1644	M5 - 10171283
		34	1643	M6 - 10171279
		32	1642	M7 - 10170919
		30	1641	M9 - 10171280
		28	1640	M 10 - 10170918
		26	1637	M 12 - 10170917
		24	1636	M 13 - 10170922
		22	1633	M 14 - 10171281
		20	1634	M 15 - 10171276
		12	1615	M 19 - 10170925

From Zap Strap 2 m between every tid bit

New Location

UTM N:392339 E:5771014

Appendix 3. Field Notes – Temperature Study

TEMPERATURE LOGGER DEPLOYMENT

MICA Fish Indexing ~~Backpack Electrofishing~~ BOAT Datasheet

Year	Month	Day	Project	Site	Operator	~~Netter~~ Crew	Recorder
2012	10	24	MICA	~~EF~~ FB	TB	JF/JC/	RI

DFO UTM N: 5771003 E: 392347.9 (will fluctuate as boom moves.)

surface

WTemp (C)	Cond (uS)	Vis (m)	Model	~~Volts (V)~~	~~Freq (Hz)~~	~~Pulse (%)~~
8.74	0.153	NA	VR24	NA	NA	NA

EW LOCATION :392339 :5771014 (HOPEFULLY THE SAME AS DFO ... BLE)

(PDT) Deployed@ PDT

Start Hour	Start Min	End Hour	End Min	EF Seconds
15:	17:32	16	01:32	~~[illegible]~~

DFO DESCRI... – attached at the end of the sec... ... of the log b... from red anchor ...

– Tidbits launched in MDT on Oct... for D/S units + in reservoir

Number	Species	~~Length~~ Depth from Surface	~~Weight~~ LAUNCH TIME (TZ)	~~Healthy~~	Comments – From zapstrap.
	DEEPEST	40	1648	MDT	M2 – 10171277 } 2m between every tidbit
	↓	38	1646	↓	M3 – 10171286
		36	1644		M5 – 10171283
		34	1643		M6 – 10171279 (Experiment)
		32	1642		M7 – 10170919
		30	1641		M9 – 10171280
		28	1640		M10 – 10170918
		26	1637		M12 – 10170917
		24	1636		M13 – 10170922
		22	1635		M14 – 10171281
		20	1634		M15 – 10171276
		18	1633		M17 – 10170920
		16	1632		M18 – 10170921
	↓	14	1628	↓	M11 – 10171275
	SHALLOW	12	1625	MDT	M19 – 10170925

Sheet __ of __

Record the length and weight of every netted fish and if healthy i.e. no disease and uninjured

4°C		12:29	MT	Jan. 27/13	
1	M14	12:36		79%. Battery	
2	M11	12:33		93%. Battery	
3	M18	12:36 RL	12:37	93%.	
4	M17	12:37	RL 12:39	86%.	
5	M15	12:39	12:41 RL	79%.	
6	M14 Pulled	12:41	12:43 RL	86%.	
7	M13	12:44	12:45	79%.	
8	M12	12:46	12:47	79%.	
9	M10	12:49	12:50	79%.	
10	M9	12:49	12:52	86%.	
11	M7	12:49	12:54	73%.	
12	M6	12:49	12:56	79%.	
13	M5	12:56 Am	12:58	79%.	
14	M3	12:59	1:01	86%.	
15	M2	1:02	1:03	79%.	
TAILRACE		PULL PST	LAUNCH PST	H2O TEMP	BATT
16	NOT SCANNING M26	3:22	3:30	4.5°C	93%
17	NOT BEING M29	3:48	3:53		86%
*	COMPUTER READ 5 MICA 28				
*	TID BIT READ 1 MICA 29				
18	M8	3:59	4:02		79%

READS EXPERIMENT ① Hobo on computer

#1				
2012	10	/ 10	JF, JC	
M29	12:31	PT	H390717E	
			5769663N	
#2				
2012	10	/ 10	JF, JC.	
M26	12:56	PT	H392641E	
#3			5769765N	
2012	10	/ 10		
M9			H391775E	
M8	13:18	PT	5769012N	
#4				
M16	2012	10 / 10	H391207E	
	13:35	PT	5768886.3N	
#5				
M4	2012	10 / 10	JF JC	
			H391181E	
	14:00	PT	5768534N	
#6				
M1	2012	10	10 JC	
	14:12	PT	H391515E	
			5768[illegible]3N	

done in Oct. 2012

River km Closer

) 367.460

) 367.517

) 366.325

) 366.220

) 365.590

) 365.620

		PULL	LAUNCH	BATT
(19)	M16	407	4:09	93%
(20)	M4	4:20	4:23	86%
	READS MILL TAIL RACE HOBO ON COMPUTER, READS M4 ANTIDOT			
(21)	M1	4:28	4:29	79%

Jose's help

headpond - 369.

392600

5771151

Camera.	Site.
#2	Parkwood on broadwater ride @ Dobson across from saw mill.
#4	CPR. X-ing @ Castleton W/side 300 ft upstream.
#3	Oasis in White Pine.
#6	Brilliant bridge in creas S side.

* M19 light was off
don't know if data
was collected.
* M11 good
* M18 not flashing concerned
65 thousand bytes of
data it reads
* M17 light flashing
41 thousand bytes for
ones with lights on
* M15 light flashing
* M14 light not flashing
* M13 light ✓ *M12 no light flash
M10 ✓ M9 ✓ M7 ✓ M6 ✓ all bunched
together all lights flashing
*M6 Experiment
*M5 not blinking. *M3 not blinkin
* M3 Hobo M2 ✓

* M19 light was off
don't know if data
was collected
* M11 good
* M18 not flashing concerned
65 thousand bytes of
data it reads
* M17 light flashing
41 thousand bytes for
ones with lights on
* M15 light flashing
* M14 light not flashing
* M13 light ✓ *M12 no light flash
M10✓ M9✓ M7✓ M16✓ all blinking
together all lights flashing
2b Experiment
M5 not blinking *M13 not blinking
M3 Hobo M2✓

Camera. Site.
\#2 Parkwood on broadwater rd @ Dobson
across from saw mill.

\#4 CPL X-ing @ Castlegar
W side 300 ft upstream.

\#3 Oasis in White Pines.

\#6 Brilliant bridge on creeks
S. side.

		PULL	LAUNCH		BATT
19	M16.	4:07	4:09		93%
20	M4	4:20	4:23		86%
	READS	MICA TALL MAKES USER ON			
	COMPUTER.	READS M4 ANTENNAS			
21	M1	4:25	4:29		79%

base is help

headpond - 369.
392 600
577 11 51

#1

20:12	10 / 10		JF, JC
M29	12:31	PT	#392717 E
			5769663 N
#2			
2012	10 / 10		JF, JC.
M26	12:56	PT	#392641E
#3			5769765N
2012	10 / 10		
			#391775E
M8	13:18	PT	5769012 N
#4			
M16	2012 10 / 10		#391807E
	13:35	PT	5768853N
#5			
M4	2012	10 / 10	JF JC
			#391181E
	14:08 PT		5768534N
#6			
M1	2012	10	10 JC
	14:12	PT	#391212E
			5768248N

done in Oct. 2012

4°C	12:29	MT	Jan. 27/13		
①	M19	12:36		79%	Battery
②	M11	12:33		93%	Battery
③	M18	12:36 RL	12:37	93%	
④	M17	12:37	RL 12:39	86%	
⑤	M15	12:39	12:41 RL	79%	
⑥	M14	12:41	12:43 RL	86%	
⑦	M13	12:44	12:45	79%	
⑧	M12	12:46	12:47	79%	
⑨	M10	12:49	12:50	79%	
⑩	M9	12:49	12:52	86%	
⑪	M7	12:49	12:54	73%	
⑫	M6	12:49	12:56	79%	
⑬	M5	12:56	12:58	79%	
⑭	M3	12:59	1:01	86%	
⑮	M2	1:02	1:03	79%	
TAG	RACE	RUN PST	LAUNCH PST	THOTEMP	BATT
⑯	NOT SUBMITTED M26	3:32	3:30	4.5°C	93%
⑰	NOT BEING M29	3:48	3:53		86%
*	COMPUTER RESET	5 MIN	28		
	TID BIT READ	MIN	29		
⑱	M8	3:59	4:02		79%

READS EXPERIMENT ⑨ Hobo on computer

River Km. Times

① 367.460

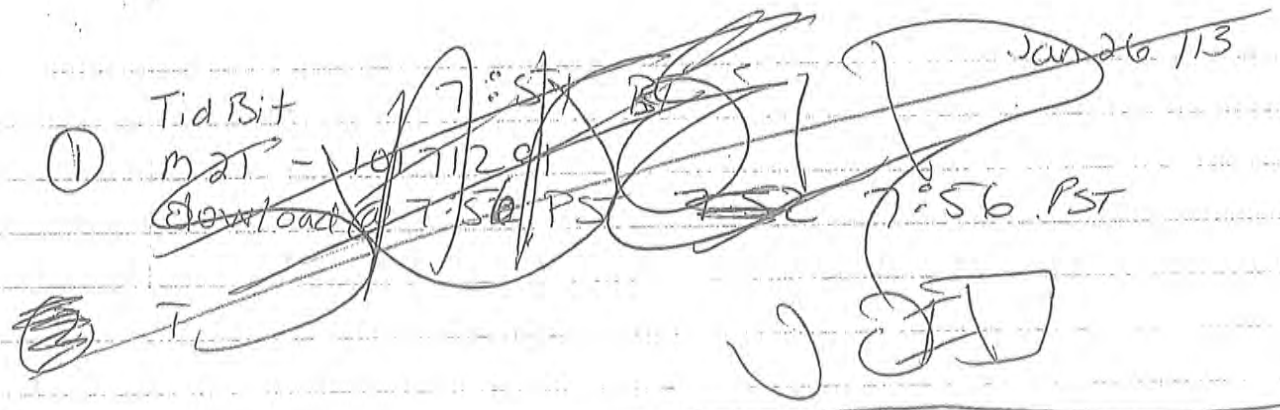
② 367.317

③ 366.325

④ 366.220

⑤ 365.590

⑥ 365.620



TIDBIT deployed Jan 27/13 Jan 26/13

(1) M21 - 10171291
DL Time. Start 7:57 PST

(2) M22 - 10171290 8:48 PST

(3) M25 - 10171287 Launch Start - 8:49 PST

(4) M20 - 10170923 Launch Start - 8:51 PST

(5) M23 - 10170914 Launch Start - 8:52 PST

Serial #

M6 = 10171279 - Experiment

M29 = 10171282

M8 = 10170919

M4 = 10171284

M1 = 10171285

tab - Backfish

Backup of pg 1 of 4 - jf - excel

		PULL	LAUNCH		BATT
(19)	M16	4:07	4:09		93%
(20)	M4	4:20	4:23		86%
	READS MILA TAIL RACE HS620 ON COMPUTER, READS M4 ANTIDOTE				
(21)	M1	4:28	4:29		79%

base is help

head panel - 369.
292.6030
577 1151

*	M19 light was off dont know if data was collected.
¥	M11 good
¥	M13 not flashing concerned 65 thousand bytes of data it reads
¥	M17 light flashing 41 thousand bytes for ones with lights on
¥	M15 light flashing
¥	M14 light not flashing
¥	M13 light ✓ *M12 no light flash M10 ✓ M9 ✓ M7 ✓ M6 ✓ all blinked together all lights flashing
*M6 Experiment	
*M5 not blinking. *M3 not blinkin	
¥ M3 Hobo M2 ✓	

J. L. DARLING CORP. TACOMA, WA 98424-1017
www.RileintheRain.com
No. 312

4°C 12:29 MT Jan. 27/13

1	M19	12:38		79%	Battery
2	M11	12:33		93%	Battery
3	M18 *	12:36 RL	12:37		93%
4	M17	12:37	RL 12:39		86%
5	M15	12:39	12:41 RL		79%
6	M14 Retrieved	12:41	12:43 RL		86%
7	M13	12:44	12:45		79%
8	M12	12:46	12:47		79%
9	M10	12:49	12:50		79%
10	M9	12:49	12:52		86%
11	M7	12:49	12:54		73%
12	M6	12:49	12:56		79%
13	M5	12:56 Am	12:58		79%
14	M3	12:59	1:01		86%
15	M2	1:02	1:03		79%

TAIL	RACE	PULL PST	LAUNCH PST	H2O TEMP	BATT
16	NOT SUBMERGED M26	3:22	330	4.5°C	93%
17	NOT BLINK M29	3:48	353		86%
*	COMPUTER READS MICA 28				
*	TID BIT READS MICA 29				
18	M8	3:59	4:02		79%

READS EXPERIMENT D. Hobo on computer
READS M8, N TIDBIT

#1				
2012	10	/ 10	JF, JC	
M29	12:31	PT	1139271 7E	
			5769663 N	
#2				
2012	10	/ 10	JF, JC.	
M26	12:56	PT	1139241E	
#3			5769765N	
2012	10	/ 10		
[illegible]			1139177 5E	
M6	13:18	PT	5769012 N	
#4				
M16	2012	10 / 10	1139180 7E	
	13:35	PT	5768860.3N	
#5				
M4	2012	10 / 10	JF JC	
			1139118 1E	
	14:00 PT		5768534N	
#6				
M1	2012	10	10 JC	
	14:12	PT	1139131 2E	
			5768493N	

Mica Temperature Location Datasheet

Year	Month	Day		Crew1	Crew2		Sheet
2013	04	03		JF	JC		1 of
Location	Easting*	Northing*	Description				
			Head Braun				
HP	392348	5719014	Depth = 23.3				
			WATER TEMP = 3.4				

Pulled @ 11:23 AD PST

HP only has 38 mtrs cable.

Comments: TID BIT m1 from surface is 2.2 m

1 = m14 lights not blinkin
2 = m11 " " "
3 = m16 " " "
4 = m17 light is blinkin
5 = m15 " " "
6 = m14 " " "
7 = m13 " " "
8 = m12 " " "
9 = m10 } All Blinking but broadcast together
10 = m9 }
11 = m7 }
12 = m6 }

13 = m5 = OK
14 = m3 = OK
15 = m2 = OK
16 = m22 = OK
17 = m25 = OK
18 = m23 = OK
19 = m21 = OK
20 = m20 = OK

April 5/13

1 - M19 surface

2 = M11 22

3 = M18 4/m

4 = M17 6

dropped in water @ 12:00 BT.

5 = M15 [illegible]

= M14 2 readouts 1 test 0

7 = M13

8 = M12

1 = M10

0 = M9

= M7

= M6

= M5

= M3

= M2 corrupt = changed to remote shutter

= M22 corrupt = 100% 10:55 PST 2.2

= M25 = corrupt 13% 10:53 PT

= M23 = SPA 86% battery

= M21 = SN 20 100% 10:51

Image header is available / retrieved.

Mica Temperature Location Datasheet

Water Depth 0.0
Temp. 3.6

Year	Month	Day		Crew1	Crew2		Sheet
2013	04	03		JF	JC		of

Location	Easting*	Northing*	Description
			pulled. 1:38pm mica M26 serial #10171289
392638	5769764	11°C	added M24 serial # 10170916 Depth 4.8
			13°C outside
			pulled @ 2:20 m#29 3.6 water temp. 3.7 oust
(2)	392715	5769640	added M25 #10171287
			pulled @ 240pm # m8 3.4 water air temp 14°C
(3) 240	391781	5768980	added M20 10170923 depth 5.8
			m 23 added # 10170914 water temp 3.4 air temp. 12°C
(4)	391799	5768860	3.2
			pulled @ 3:07 PST # m4 3.4 water temp 3.5 depth
(5)	391170	5768512	added M28 #10171288
			* max depth 10 m. outdoor temp 15°C
(6)	391309	5768465	pulled @ 3:17 m#1 water temp 3.4 °C depth 2.2 m
			added M27 #10170915 air temp 14°C

*GPS should be set to [illegible] NAD83

Mica Bridge 1 Donald 2010 # 2391458 86%. mica Blue Bridge 1

Comments: M21 serial # 10171291 3.7 water temp. outside temp 12°C depth

m depth

#2 Sullivan 1 # 9709742 3:44 dropped Mica Blue Bridge 2

air temp 12°C 15.1 m

M30 # 10170924 water temp 3.6 3:58 dropped

11.3 m depth

recently added near bridge

Appendix 4. Field Notes –Electrofishing Data

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs – Port	Obs – Star	Recorder
2012	10	20	MICA	ES 01	JB	JC	JF

WTemp (C)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
04	43	51	JB		STABLE					
							380			
					160					
	44	44		320						
				160						
				180						
	45	20		120						
	46	37	6X	180						
						450				
				410						
	46	04		320						
				410						
	46	31	6X	180						
	47	43	5X	210						
				230						
				210						
	46	55		310						
			7X	310						
	47	23		220						
	47	53	6X	150						
	48			180						
				190						
	48	25		190						
		20				380				
		37					310			
				320						
	48	57	5X	180						
5					280					
					280					
	52	38								
			6X	390						
						450				
				150						
	53	25		130						
	53	18		150						
				320						
					250					
					250					
	53	42	6X	190						
				280						
	54	00		150						
	54	16		180						
	54	32	8X	190						
			18	190						
					280					
				190						
				180						
			8X	190						
			7X	190						
	55	02	6X	190						
			7X	220						
				180						
	55	51		160						

Sheet __ of __

Record all observed fish by time, observer and species – if possible record estimated individual lengths

Done

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs – Port	Obs – Star	Recorder
			MICA	ES 01			

WTemp (C)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
4	58	35	JB		Start					
				180						
							400			
				2X	190					
	59			320						
						600				
					240					
5	00			350						
	00	14			250					
			[illegible]	400						
					240					
					230					100
	1	12							200	
	1	32		180						
	1	38		150						
				280						
			2X	370						
			1	320						
	2	34	6X	330						
				[illegible]					240	
	3	24		330						
	3	49		190						
			5X	170						
	4	13		280						
	4	27		240						
	4	54		320						
	60					630				
					240					
	5	48								

long nose suck

wws

Sheet __ of __

Record all observed fish by time, observer and species – if possible record estimated individual lengths

2

done

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs – Port	Obs – Star	Recorder
2019	10	20	MICA	ES 02	JB	JC	JE

WTemp (C)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
							TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
5	23	10	JB	95	FRT					
				180						
			2Y	180						
	24	44								
			3Y	180						
				180						
			4Y	180						
					250					
			2Y	280						
			2Y	181						
			15Y	181-310						
				320						
					240					
			2Y	250						
					230					
			1	190						
					260					
			4Y	250						
	26	10			293					
			2	X280						
					140					
			2Y	250						
	29	18		280						
			3Y	221-260						
			3	270						
									350	
	29	26		290						
	30	21	4Y	310						
				180						
				210						
6	32	29		280						
	32	49		300						
	33	00		320						
				130						
			2Y	180					195	
	33	40	10Y	190					190	
			8	220						
			10	170						
					310					
5	34	12		200						
	34	32	5Y	195						
			4Y	220						
				190						
			7Y	180						
			2Y	150						
	36	09	4Y	190						
			1	120						
			3Y	170						
	37	19		150						
				220						
	39	50	TB			320				

Sheet__ of__

Record all observed fish by time, observer and species – if possible record estimated individual lengths

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs – Port	Obs – Star	Recorder
			MICA	ES			

WTemp (C)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
			JB	200						
				320						
5	39	51		290						
5	40	00		3X 190						
				130						
				120						
	40	38				650				
			TB			320				
			JB 3X 190							
5	42	03	END							
5	42	32	JB	3X 190						
				180						
	49	33		3X 190				100		
							6	100		
							8	110		
	50	31		160						
	51	00		130						
				210						
				210						
	5	20		210						
5	51	210	3X	190-210						
				310						
	52	10		310						
	52	19		340						
	53	33		180						
	53	49		240						
	54	35		290						
	54	40				360				
	56	50		280						
	58	11				380				
	58	11								
5	59	17		END						

Sheet__ of__

Record all observed fish by time, observer and species – if possible record estimated individual lengths

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs – Port	Obs – Star	Recorder
2012	10	20	MICA	ES 04	JB	JC	JF

WTemp (C)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
							TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
6	08	51	START							
			JB							
			3X	180						
	9	36		010						
				170						
				320						
				240						
	9	56		240						
			10X	190-200						
			7X	100						
				240						
				240						
				140						
	10	28		240						
			3X	260						
	10	55		300						
				320						
	11	13		300						
						500				
	11	37	8X	300-320						
			6X	240-260						
	11	440		300						
				240						
				170						
	12	01		180						
			10X	180-200						
	14	10		320						
			5X	170						
	14	28	9X	260						
	16	33	2X	170						
				220						
				180						
			3X	210						
	19	30	3X	220						
	19	50		170						
	20	08				680				
	20	15				660				
			TB	217						
	20	37	TB	230						
			JB			620				
	22	00		220						
				240						
	22	28		240						
	23	03	2X	290						
	22	40	2X	290						
				240						
	24	05		240						
	24	44		280						
				220						
	25	42		210						
	230	18		170						
	28	28		210					LNS	
	30	40							320	
	29	42		210						

Sheet __ of __

Record all observed fish by time, observer and species – if possible record estimated individual lengths

05

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs – Port	Obs – Star	Recorder
2012	10	20	MICA	ES 04	JB	JC	JF

WTemp (C)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
							TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
10	28	05	JB	280						
	25	17	JB	260						
	28	44	\	320						
	29	06		260						
	29	54		180						
	30	01		260						
	30	11		190						
	32	00		220						
	32	14		220						
	33	33		210						
10	34	08		END						

Sheet __ of __

Record all observed fish by time, observer and species – if possible record estimated individual lengths

done

(6)

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs – Port	Obs – Star	Recorder
2012	10	20	MICA	ES 05	JB	JC	JF

WTemp (C)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
							TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
6	36	27		START						
			JB	240						
	37	00		240						
			S	210						
			S	210						
	41	07		220						
			S	220						
	41	27			240					
	41	43					240			
	45	210		200						
			2X	220						
	46	09		220						
	46	37		250						
	48	17		180						
	48	28					280			110
	49	00					270			
10	49	18	END							

Sheet __ of __

Record all observed fish by time, observer and species – if possible record estimated individual lengths

7

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs – Port	Obs – Star	Recorder
2012	10	21	MICA	ES 03	JB	JC	JF

WTemp (C)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153		225 AAL				TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	Sculpin CC	SU	Other
4	53	10		START						
			JB	325						
				310			280			
							280			
							280			
				285						
				285						
				285						
				285						
				285						
				285						
				260						
				320						
4	36	24		320						
4	38	29		325						
	38			290						
		429	END TIME							

4:38 PM

Sheet 1 of _

Record all observed fish by time, observer and species – if possible record estimated individual lengths

(1a)

Boat Observation Data Sheet

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	21	MICA	ES TEST	JB	JC	RI

D/S of BP
River Right

WTemp (C)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4	22.5' AAL Marathon		30		TB

2-1.2 Amps

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
04	08	44			START					
							320			
12	24	36			END					

Sheet 1 of 9

If possible record the length of individual fish – if too many fish just record the number.

Year	Month	Day	Project	Site	Obs – Port	Obs – Star	Recorder
2012	10	21	MICA	ES 03	JB	JC	RL

WTemp (C)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4 yds	22.5 AAL				TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
04	33	10				START				
		44			350					
					350					
		54		350	~~350~~					
	34	00			210					
				360	~~360~~					
				350	~~350~~					
	34	13		360	~~360~~					
				111	~~111~~					
	34	28		350	~~350~~					
		48		270						
		56		2			220			
	35	06		240						
	35	06		240						
				111-11	250-270					
	35	29		270						
	35	29		270						
							330			
				250						
				250						
	35	50					250			
					230					
	38	21					350			
		38			200					
	39	16					350			
	39	25		220						
4	39	43			END					

Sheet 1 of 4

If possible record the length of individual fish – if too many fish just record the number.

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs – Port	Obs – Star	Recorder
2012	10	21	MICA	ES 01	TB	JC	RJ

WTemp (C)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4m	22.5 AAL				TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
04	42	51	[illegible]		ST	A R	T			
			TB				320			
	45	11	JC	220						
	45	17	|	300						
	46	35	|				210			
		[illegible]	|	410						
		59	|		220					
	46	05	|	200						
	46	28	|				270			
	46		|				250			
	46	51	|	400						
	46	28	|	350						
	47	03	|		290					
	|		JC				240			
	|		TB	[illegible]			410			
	47	58	JC	111 - 230-290						
	48		|	210						
	48	26	|				350			
	|	35	|	250						
	|	39	|				250			
	|		|	270						
	46	52	|	270						
	49	01	|				390			
	49	33	|	IIIII - 250-310						
	48	00	V			620				
	52	09	TB			410				
			JC		290					
	52	24	|			550				
	92	31	|				580			
	|		|	250						
	|		|	250						
	53	06	|			450				
	53	20	|				330			
	|		|	280						
	|	21	|			445				
	|		|			450				
	|		|				250			
	54	42	3?	290						
	54	69	|	270						
	|		|	270						
	|		|		350					
	|	24	|		290					
	|		TR	250-330						
	54	50	TR	250-330						
			TR	250-330						
			|	290						
	55	35	V	330						
	55	410	TB			485				
			JC	290						
	56	00	TB			460				
	59	03	JC		390					
		50	TB		[illegible]	625				
5	00	02	JC			470				
	00	07		210						

Sheet 3 of 3

Record all observed fish by time, observer and species – if possible record estimated individual lengths

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs – Port	Obs – Star	Recorder
2012	10	21	MICA	ES 01	JB	JC	RI

WTemp (C)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7°	0.153	4	22.5 AAL				TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
5	00	30	JC				4x280-850			
				230						
					270					
		43			290					
		58			4x240	-290				
				240						
	01	31			270					
	01	48			290					
	02	00		290						
				280						
		28		3x280						
		29		220						
	04	15	√				380			
1	04	32	TB			540				
1	05	34	TB			280				
5	05	40			END					

Sheet 1 of 1

Record all observed fish by time, observer and species – if possible record estimated individual lengths

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs – Port	Obs – Star	Recorder
2012	10	21	MICA	ES 02	JB	JC	RI

WTemp (C)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4m	22.5 AAL		30	40	TB

High Range 24.

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
05	23	16				START				
	24	46	JC	220						
	24		JC	210						
	24	57	TB	320						
	25	00	JC			480				
	25	08		3x 270-280						
				3x 270						
		21		5x 260						
	25	30		8x 220-280						
		32		4x 220-260						
				3x 220						
				230						
		46		245						
				280						
	26	05		250						
	26	11			220					
	28	46					280			
	28	56			270					
	28	56			240					
	29	19			290					
	29	48		240						
	29	55		280						
	30	34		260						
	30	24		260						
	32	29				Restart	after	gen.	died	
	32	17				800				
				5x 270-280						
	33	31	TB			600				
			JC	270						
					270					
	33	46		4x 350-380						
	33	51		260						
		56	↓	260						
	34	00	TB			460				
	34	13	JC	270						
	34	13		270						
		19		270						
		29		280						
		32			240					
		39		260						
	34	42		270						
	36	01				Restart	after	gen	died.	
		18		310						
		35		290						
		39	↓	300						
		39	TB	300						
		39	TB	260						
		47	JC	270						
	36	42	JC		230					
	36	50					280			
	36	54		210						
	37	04		310						
		22					350			
	37	50		330						

incubator cooldown.

generator

Sheet 5 of 7

Record all observed fish by time, observer and species – if possible record estimated individual lengths

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs – Port	Obs – Star	Recorder
2017	10	21	MICA	ES 02	JB	JC	RI

WTemp (C)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4m	22.5 AAL				TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
5	38	49	—	—	Restart after generator					—
	39	01	JB	290						
	39	09	JB 4m	260						
	39	58	JC	380						
	40	01	JC		300					
		15			220					
		30		280						
		35		250						
	40	40	↓4m	220-250						
		48	TB			720				
		49	JC		220					
		57		260						
	41	08		260						
↓	41	59	↓	270						
-5	42	03	—	—	—	END	—	—	—	— pulse alarm site continue
5	48	32		Restart						
	49	39	JC	240						
	50	13					410			
		35								440 - Cyprinid UNK
		40					340			
	50	49		7x220-290						
		48		210						
		50		220						
	51	00		220-						
	51	06		280						
	51	20		310						
	51	24		330						
	51	31		290						
	53	07		260						
		12		210						
		23		230						
		27		310						
		41		3x 310-330						
		42		280						
		47	↓	220						
	56	03	TB			650				
5	59	17	—	—	—	END	—	—	—	— 30m short of end.

Sheet 6 of 7

Record all observed fish by time, observer and species – if possible record estimated individual lengths

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs – Port	Obs – Star	Recorder
2012	10	21	MICA	ES 04	JB	JC	RJ

WTemp (C)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4m	22.5				

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
6	08	57				Start				
	09	42	JC	220						
				210						
		59		230						
	10	00		180						
	10	10		5X 220-280						
	10	20		5X 210-250						
	10	30		2X 260, 280						
	10	36		280						
	10	46		280						
		48		280						
		50		250						
		52		7X 220-280						
		58		260						
	11	09		250						
	11	11		5X 250-270						
				260						
				270						
	11	26		3X 230-250						
		34		6X 230-280						
		40		5X 230-280						
		48		10X 220-290						
	11			260						
				3X 230-280						
	12	01		3X 230-250						
generator brake	12	08		8X 220-290						
	14	05			230					
		10		220						
		19		1X 250						
	14	14		260						
		23		7X 220-280						
		34		230						
orchestrating gen. break		36		280						
	16	14				Restart				
	16	48	↓	260						
	17	00	TB 3X	260						
	17	57	JC	260						
	18	18		280						
		45					290			
	19	10		260						
	19	20	↓				290			
	19	28	TB	180						
	19	36	JC	190						
	20	14					260			
	20	30	TB	230						
	20	40	JC	260						
	21	15		300						
				260						
				280						
							280			
	21	24		250						
				280						
			TB	180						
↓	22	15	JC	210						

Record all observed fish by time, observer and species – if possible record estimated individual lengths

done

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs – Port	Obs – Star	Recorder
2012	10	21	MICA	ES 04	JR	JC	RJ

WTemp (C)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4m	22.5 AAL	See other sheets.			TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
6	22	00	JC	290						
				280						
		20			240					
	22	31		260						
		35		260						
		50					290			
	22	54		210						
			TB				320			
	23	10	JC	260						
	23	21		260						
		33		240						
		40		180						
		44		210						
		44		230						
	24	10					290			
	24	12		170						
	24	41		240						
	24	43		260						
		52		280						
	26	18					360			
	26	18		190						
	26	40	TB	230						
	26	40	JC		200					
	27	50	JB	220						
	28	00	JB	300						
	28	35	JC	210						
		40		260						
		43					260			
	29	55	TB	230						
	30	01	TB	120						
	30	08	TB	180						
	30	24	JC	280						
	30	30		220						
	31	22		220						
	31	52				450				
	32	00		230						
	32	11		260						
	33	14					280			
		27		220						
				220						
			TB	260						
		42	JC	260						
						230				
	33	55		220						
	34	01		140						
6	34	08				END				

Record all observed fish by time, observer and species – if possible record estimated individual lengths

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs – Port	Obs – Star	Recorder
2012	10	21	MICA	ES 05	JB	JC	RI

WTemp (C)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.155	4m			See other sheet		TB

3201 secs over all 5 sites

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
6	35	27				start				
	36	13	JC	260						
					270					
		39		230						
		44					280			
	37	05			240					
	37	14		230						
	37	30				480				
gear restart	39	50				re start				
	41	07		3x 220-270						
			JC	260						
			RI				230			
			JC	3x 220-250						
		30			260					
	41	33			240					
	42	05		260						50-UNK
	45	17								30-UNK
	46	09		180						
	46	20	"	180						
	46	30	TB	220						
	47	10	JC	170						
	49	00	JC	260						
6	49	18				END				

Record all observed fish by time, observer and species – if possible record estimated individual lengths

MICA Fish Indexing Boat Electrofishing Datasheet

Year	Month	Day	Project	Site	Net – Port	Net – Star	Recorder
2012	10	22	MICA	ES 08	JP/JB	RI	

WTemp (C)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator	Seconds	
6.7	01153	3.5	22' AM		30	42	TB	497	1 AMP

Start Hour	Start Min	End Hour	End Min
03	39	4	00

Number	Species	Fork Length	Weight	Healthy	Comments
1	MW	258	196	Y	
2	MW	305	314		
3	MW	270	251		
4	MW	224	117		
5	MW	258	195		
6	MW	264	207		
7	MW	285	182		Spent male
8	MW	287	296		Female, hard
9	BT	320	335		Unknown sex
10	MW	295	287		Ripe female, green
11	MW	315	421		Female hard V
12	MW	270	222		Female, hard
13	MW	320	332		Female, hard.
14	BT	463	1190		Female
15	KO	199	88	Y	Juvenile
16	MW	183	56		
17	MW	266	227		
18	MW	224	127		UNK SEX
19	MW	288	230		Female, possibly spent
20	KO	209	94	N	
21	KO	187	73	N	
22	MW	265	192		Probably female
23	MW	249	190		
24	BT	330	424		Immature.
25	KO	265	182		spent ♀, Lacking Caudal
26	MW	300	304		Hard green
27	BT	520	16688		Probable Female.
28	MW	228	125		Immature
29	MW	300	282		Hard female
30	MW	290	271		Male
31	BT	530	1536		Spawned female, Wear on caudal
32	BT	570	2048		Male
33	MW	330	394		Female
34	MW	338	417		Hard female
35	MW	300	294		Green Female
36	MW	290	311		Female Hard.

BT	KO	MW
6	4	26

✓ RI

Record the length and weight of every netted fish and if healthy i.e. no disease and uninjured

MICA Fish Indexing Boat Electrofishing Datasheet

Year	Month	Day	Project	Site	Net – Port	Net – Star	Recorder
2012	10	22	MICA	ES 01	JF/JB	~~JB~~ JC	RI

WTemp (C)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
				See data sheet			TB

Effort 815

Start Hour	Start Min	End Hour	End Min
09	31	4	58

Number	Species	Length	Weight	Healthy	Comments
1	KO	268	180	N	Female Spent
2	KO	250	134		" "
3	KO	270	167		" "
4	MW	305	278	Y	Male Tubercles
5	MW	248	157		" "
6	BT	338	441		
7	BT	414	681		
8	BT	378	498		
9	MW	320	323		Female Hard
10	MW	310	301		" "
11	KO	265	144		Female
12	MW	250	177		Female ~~BSD~~
13	MW	315	327		Female
14	MW	280	229		Male Tubercles
15	MW	280	253		Female hard
16	KO	265	161	N	Female Spent
17	KO	77	3	~~Y~~	
18	KO	265	187	N	~~Female~~
19	MW	250	153	Y	
20	BT	269	201	Y	
21	KO	270	179	N	Female
22	MW	260	191	Y	Female
23	KO	~~175~~	4	~~Y~~	
24	MW	236	171	Y	♀
25	BT	370	512	Y	
26	MW	309	294	Y	♀ hard
27	MW	244	141	Y	Male
28	MW	248	~~168~~	Y	♀
29	KO	264	174	N	♀
30	MW	329	391	Y	♀, Fat
31	MW	285	236	Y	Male, hard

MW	KO	BT
16	10	.5

RI

Sheet 2 of 3

Record the length and weight of every netted fish and if healthy i.e. no disease and uninjured

MICA Fish Indexing Boat Electrofishing Datasheet

Year	Month	Day	Project	Site	Net – Port	Net – Star	Recorder
2012	10	22	MICA	ES 02	R1	JC / JF	R1

WTemp (C)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
—	—	See	Other Boat	—	—	—	R1

Effort
50 sec

Start Hour	Start Min	End Hour	End Min
4	46	5	48

Number	Species	Length	Weight	Healthy	Comments
1	KO	280	211	N	Female
2	KO	267	172	N	"
3	KO	290	293	N	Male
4	MW	330	132	N	Mortality, Male
5	MW	270	226	Y	Male
6	MW	249	180	Y	Female
7	KO	280	201	N	Female
8	MW	270	259	Y	Female, Hard
9	MW	238	161	Y	Female
10	MW	253	197	Y	Female
11	MW	258	195	Y	F Hard
12	KO	200	69	Y	~~Unk Sex~~ Juvenile
13	MW	272	212	Y	Male
14	KO	235	139	Y	UNK, silver
15	KO	70	3	Y	JUV
16	MW	329	385	Y	Female
17	MW	329	384	Y	Female
18	KO	285	259	N	Female
19	KO	262	169	N	"
20	MW	310	363	Y	Female
21	BT	479	2920	Y	Female (supposed)
22	MW	259	146	Y	Male
23	KO	263	180	N	Female
24	MW	275	237	Y	Male
25	MW	283	242	Y	Male

KO	BT	MW
10	1	14

✓ R1

Record the length and weight of every netted fish and if healthy i.e. no disease and uninjured

MICA Fish Indexing Boat Electrofishing Datasheet

Year	Month	Day	Project	Site	Net – Port	Net – Star	Recorder
2012	10	23	MICA	ES 04	JB	RJ	RV/JT

WTemp (C)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
5.67	0.153	4	22' AAR		30-60	30-42	TB

Amps 2.0

Start Hour	Start Min	End Hour	End Min
19	42	20	12

1942 START TIME
2012 End Time

Number	Species	Length	Weight	Healthy	Comments
1	KO	267	145		
2	MW	224	136		
3	MW	284	230		
4	MW	228	127		Tubercles
5	MW	208	107		
6	MW	228	157		Fiesty
7	MW	328	427		Fat & ripe
8	MW	168	34		(F)
9	MW	266	206		
10	MW	311	376		(M)
11	MW	263	243		
12	MW	280	279		
13	MW	252	187		
14	MW	238	147		
15	MW	304	280		
16	MW	323	416		
17	MW	176	60		
18	MW	298	289	✓	
19	MW	261	166		
20	MW	283	307		
21	MW	303	255		
22	MW	300	330		
23	KO	191	79		SILVER
24	KO	216	89		NOT RED BUT PINKISH OUT
25	MW	312	273		
26	MW	320	395		
27	KO	187	81		
28	KO	197	85		SILVER
29	MW	278	269		
30	MW	299	247		
31	MW	280	283		
32	MW	267	217		
33	MW	277	270		
34	MW	240	167		(M)
35	MW	289	290		1 Pectoral torn
36	KO	82	6		
37	MW	207	102		
38	MW	291	290		
39	MW	175	53		
40	MW	240	152		
41	MW	262	210		
42	MW	253	184		
43	MW	312	314		
44	MW	275	239		Tubercle
45	MW	246	182		
46	KO	69	3.5 g		
47	MW	266	197		
48	KO	86	10		
49	MW	313	349		
50	MW	213	103		
51	MW	257	171		Tubercles

Record the length and weight of every netted fish and if healthy i.e. no disease and uninjured

MICA Fish Indexing Boat Electrofishing Datasheet

Year	Month	Day	Project	Site	Net – Port	Net – Star	Recorder
2012	10	23	MICA	ES04	SP	R1	AF

WTemp (C)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
	See	flw	sheet				TB

Start Hour	Start Min	End Hour	End Min
19	42	20	12

Number	Species	Length	Weight	Healthy	Comments
2	MW	238	166		
3	BT	610	2940		
4	BT	595	2450		
5	BT	449	930		
6	BT	417	660		
7	BT	485	1158		

JRI

Record the length and weight of every netted fish and if healthy i.e. no disease and uninjured

MICA Fish Indexing Boat Electrofishing Datasheet

Year	Month	Day	Project	Site	Net – Port	Net – Star	Recorder
2012	10	23	MICA	ES 05	JB	RI	JF

WTemp (C)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
5.67	0.153	4m	22'	Jump	30	42	TB

Start Hour	Start Min	End Hour	End Min
8	49	21	13

Number	Species	Length	Weight	Healthy	Comments
1	KO	280	369	N	Male
2	KO	275	161	N	Female
3	KO	265	151	N	Female
4	KO	278	235	Y	Not red, hard female
5	MW	273	850	Y	
6	MW	253	138	Y	Male
7	MW	223	119	Y	Male
8	MW	225	123	Y	
9	CAS	70m	5	Y	
10	MW	214	102	Y	
11	MW	230	141	Y	Male
12	MW	215	236	Y	Male, tubercles
13	RT	643	2394	Y	Male, torn dorsal
14	RT	760	~5450	Y	(>5kg, more than scale can weigh); Male = chipe
15	MW	250	177		Female

VR1

Record the length and weight of every netted fish and if healthy i.e. no disease and uninjured

MICA Fish Indexing Boat Electrofishing Datasheet

Year	Month	Day	Project	Site	Net – Port	Net – Star	Recorder
2012	10	23	MICA	ES 02	JB	JP	RI

WTemp (C)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
5.67	0.153	4m	22' AAR	2amps	30	42	TB

Effort from whole night
2313s.

Start Hour	Start Min	End Hour	End Min
21	39	22	04

BT	KO	MW
5	12	2

Number	Species	Length	Weight	Healthy	Comments
1	KO	285	214	N	Female
2	KO	278	214	N	Female
3	KO	283	205	N	Female
4	KO	266	168	N	Female
5	KO	288	240	N	Female
6	~~MW~~	305	331	Y	Male
7	KO	260	142	N	Female
8	KO	235	123	N	Female
9	MW	250	197	Y	Female
10	MW	280	232	Y	"
11	MW	238	146	Y	"
12	MW	220	126	Y	"
13	MW	240	144	Y	Male
14	MW	285	278	Y	Female, losing scales, ripe
15	KO	265	182	N	Male
16	MW	249	172	Y	Female
17	KO	152	37	Y	Smolt
18	MW	218	115	Y	Female
19	MW	320	382	Y	"
20	MW	285	215	Y	"
21	MW	238	143	Y	Male
22	MW	238	135	Y	Female
23	KO	298	306	N	Male
24	MW	235	149	Y	Female
25	MW	279	227	Y	Male
26	MW	228	206	Y	Female, hard
27	MW	327	383	Y	Female,
28	MW	242	161	Y	Male
29	MW	298	345	Y	"
30	MW	275	232	Y	Female
31	KO	248	134	N	Female
32	MW	285	239	Y	Male
33	MW	250	166	Y	Female
34	BT	618	2982	Y	~~UNK SEX~~ FEMALE
35	BT	315	320	Y	UNK SEX
36	MW	310	394	Y	Female
37	KO	275	214	N	Female
38	BT	560	1814	Y	MALE, wear on caudal peduncle
39	MW	320	336	Y	Male
40	BT	423	888	Y	Male
41	BT	695	6800	Y	Female, deep.

RI ✓

Sheet 4 of 4

Record the length and weight of every netted fish and if healthy i.e. no disease and uninjured

done

+BOAT FLOAT

MICA Fish Indexing Backpack Electrofishing Datasheet

Year	Month	Day	Project	Site	Operator	Netter	Recorder
2012	10	23	MICA	EF 01	TB	RI/JB	JF

US of

WTemp (C)	Cond (uS)	Vis (m)	Model	Volts (V)	Freq (Hz)	Pulse (%)
5.67	0.154	3m	VR24	225	30	25

Start Hour	Start Min	End Hour	End Min	EF Seconds
10	06	10	40	253 Backpack EF01 107 Boat EF01

Total

Effort

EF02

Number	Species	Length	Weight	Healthy	Comments
1	CAS	62	2.7	V	
2	CAS	71	3.6	V	
3	CC	27	.2	V	
4	KO	78			27.6 - 17.9
5	KO				24.9 - 14.10
6	KO	78	2.8		21.6 - 19
7	KO	79	3.9		22.9 - 19
8	KO	71	2.3		21.3 - 19
9	KO	64	.9		20.9 - 19
10	KO	56	.5		19.9 - 19
11	KO	71	2.4		21.4 - 19
12	KO	68	1.3		20.3 - 19
13	KO	64	1.4		20.4 - 19
14	KO	63	1.1		20.1 - 19
15	KO	53	.8		19.9 - 19
16	KO	59	.8		19.9 - 19
17	KO	59	1.1		20.1 - 19
18	KO	72			20.6 - 19
19	KO	64	.9		19.9 - 19
20	CAS	16.	.2		
					EF02 START
1	11:25 START				
2	11:31 END				
1	KO	M265	205		
2	KO	308	1401	1.14.2	Mint not to dock
6					
7					
8					
17					

Sheet 1 of _

Record the length and weight of every netted fish and if healthy i.e. no disease and uninjured

MICA Fish Indexing Backpack Electrofishing Datasheet

Year	Month	Day	Project	Site	Operator	Netter	Recorder
2012	10	24	MICA	EF 01	TB	RI	JF

WTemp (C)	Cond (uS)	Vis (m)	Model	Volts (V)	Freq (Hz)	Pulse (%)	Intervals
5.67	0.153	3	VR24	275	35	—	5 mls

Start Hour	Start Min	End Hour	End Min	EF Seconds
9	46	10	23	1016

Also fished U/S and D/S of EFO Tracked log to area.

Number	Species	Length	Weight	Healthy	Comments
1	KO	98	4.1		
2	KO	79	4.6		Fiesty
3	CCA	72	est 5		slimy sculpin
4	KO	76	3.7		
5	CCA	100	10.5		slimy no black dot on dorsal
6	CAS	79	5.2		prickly sculpin
7	CAS	70	3.1		
8	CAS	53	1.5		
9	CAS	61	2.2		
10	CCA	51	1		
11	CCA	37	.6		
12	CC	29	.3		unidentified
13	CC	21	.1		
14	CC	22	.1		

Sheet __ of __

Record the length and weight of every netted fish and if healthy i.e. no disease and uninjured

Appendix 5. Digital Data –Electrofishing, Temperature Data

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	20	MICA	ES - 01	JB	JC	JF

Wtemp ℃	Cond (uS)	Vix (m)	Boat Model	Volts (v)	Freq (Hz)	Pulse (%)	Operator
							TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
4	43	51			START					
			JB				310			
			JB		150					
4	44	44	JB	320						
			JB	180						
			JB	180						
4	45	20	JB	120						
4	45	35	JB	6X100						
			JB			450				
			JB		410					
4	46	4	JB	320						
			JB	410						
4	46	31	JB	6X180						
4	46	43	JB	5X210						
			JB	250						
			JB	310						
4	46	55	JB	80						
			JB	7X310						
4	47	23	JB	220						
4	47	57	JB	6X180						
			JB	180						
			JB	180						
4	48	5	JB	170						
4	48	20	JB			330				
4	48	31	JB				310			
			JB	320						
4	48	55	JB	5X180						
			JB		280					
			JB		280					
4	52	28	JB	6	390					
			JB				420			
			JB		180					
4	53	5	JB		170					
4	53	18	JB		170					
			JB		250					
			JB			210				
			JB			210				

MICA Fish Indexing Boat Datasheet

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	24	MICA	ES - 03	JB	JC	JF

Wtemp	Cond(uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153		225 AAL				TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
4	53	10			Start					
4			JB	325						
4			JB	320						
4			JB				280			
4			JB				280			
4			JB				280			
4			JB	285						
4			JB	285						
4			JB	285						
4			JB	285						
4			JB	285						
4			JB	285						
4			JB	260						
4			JB	320						
4	36	24	JB	320						
4	38	29	JB	325						
4	39		JB	290						
4	39				END TIME					

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	21	MICA	ES -03	JB	JC	JF

Wtemp ©	Cond (uS)	Vix (m)	Boat Mode	Volts (v)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153		225 AAL				TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
4	33	10		start						
4			JB	325						
4			JB	320						
4			JB				280			
4			JB				280			
4			JB				280			
4			JB	285						
4			JB	285						
4			JB	285						
4			JB	285						
4			JB	285						
4			JB	285						
4			JB	260						
4	36	24	JB	320						
4	38	29	JB	325						
4	39	0	JB	290						
4			JB							
4	39		JB		END TIME					

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	21	MICA	ES-04	JB	JC	RI

Wtemp (c)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4 M	22.5 AAL				TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
6	8	57	START							
6	9	42	JC	220						
6	9	42	JC	210						
6	9	59	JC	230						
6	10	0	JC	180						
6	10	10	JC	5X220-280						
6	10	20	JC	5X210-250						
6	10	30	JC	2X260-280						
6	10	36	JC	280						
6	10	46	JC	280						
6	10	48	JC	260						
6	10	50	JC	250						
6	10	52	JC	7X220-280						
6	10	58	JC	260						
6	11	9	JC	250						
6	11	11	JC	5X250-270						
6	11		JC	260						
6	11		JC	270						
6	11	26	JC	3X230-250						
6	11	34	JC	6X230-280						
6	11	40	JC	5X230-280						
6	11	48	JC	10X220-290						
6	11		JC	260						
6	11		JC	3X230-280						
6	12	1	JC	3X220-250						
6	12	8	JC	8X220-290						
6	14	5	JC		230					
6	14	10	JC	220						
6	14	14	JC	250						
6	14	14	JC	260						
6	14	23	JC	7X220-280						
6	14	34	JC	230						
6	14	36	JC	280						
6	16	14	JC	RESTART						
6	16	48	JC	260						

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	21	MICA	ES-04	JB	JC	RI

Wtemp (c)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4 M	22.5 AAL				TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
6	17	0	TB	3X260						
6	17	57	JC	260						
6	18	18	JC	280						
6	18	45	JC				390			
6	19	10	JC	260						
6	19	20	JC				290			
6	19	28	TB	180						
6	19	36	JC	170						
6	20	14	JC				260			
6	20	30	TB	230						
6	20	40	JC	260						
6	21	15	JC	300						
6	21	15	JC	260						
6	21		JC	280						
6	21		JC				280			
6	21	24	JC	250						
6	21		JC	280						
6			TB	180						
6	22	15	JC	210						

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	20	MICA	ES-04	JB	JC	JF

Wtemp (c)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
							TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC
CONT	FROM	PAGE	5	ES-04				
6	28	5	JB	280				
6	28	17	JB	260				
6	28	44	JB	320				
6	29	6	JB	260				
6	29	54	JB	180				
6	30	1	JB	260				
6	30	11	JB	190				
6	32	0	JB	220				
6	32	14	JB	220				
6	33	33	JB	210				
6	34	8	END					

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	20	MICA	ES - 05	JB	JC	JF

Wtemp (c)	Cond (uS)	Vis (m)	Boat Mode	Volts (V)	Freq (Hz)	Pulse (%)	Operator
							TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC
6	35	27	START					
6	37		JB	240				
			JB	5X210				
			JB	5X210				
6	41	7	JB	220				
			JB	3X220				
6	41	27	JB		240			
6	41	43	JB				340	
6	45	26	JB	200				
			JB	2X220				
6	46	9	JB	220				
6	46	37	JB	200				
6	48	17	JB	180				
6	48	30	JB					
6	49		JB				370	
6	49	18	END					

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	21	MICA	ES - 01	JB	JC	RI

Wtemp (c)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4 M	22.5 AAL				TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
4	53		JC	380						
4	53		JC			440				
4	53		JC			450				
4	53		JC				280			
4	53	42	JC	3X270						
4	54	8	JC	270						
4	54		JC	270						
4	54		JC		350					
4	54	24	JC		290					
4	54		JC	17X250-330						
4	54	50	JC	7X250-330						
4	54		JC	7X250-330						
4			JC	290						
4	55	35	JC	330						
4	55	46	TB			485				
4			JC	290						
4	56		TB			460				
4	59	7	JC		280					
4	59	50	TB			625				
5		2	JC			420				
5		2	JC	210						

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	21	MICA	ES - 01	JB	JC	RI

Wtemp (c)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4 M	22.5 AAL				TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
4	53		JC	380						
4	53		JC			440				
4	53		JC			450				
4	53		JC				280			
4	53	42	JC	3X270						
4	54	8	JC	270						
4	54		JC	270						
4	54		JC		350					
4	54	24	JC		290					
4	54		JC	17X250-330						
4	54	50	JC	7X250-330						
4	54		JC	7X250-330						
4			JC	290						
4	55	35	JC	330						
4	55	46	TB			485				
4			JC	290						
4	56		TB			460				
4	59	7	JC		280					
4	59	50	TB			625				
5		2	JC			420				
5		2	JC	210						

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	21	MICA	ES-04	JB	JC	RI

Wtemp (c)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4 M	22.5 AAL				TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
6	8	57	START							
6	9	42	JC	220						
6	9	42	JC	210						
6	9	59	JC	230						
6	10	0	JC	180						
6	10	10	JC	5X220-280						
6	10	20	JC	5X210-250						
6	10	30	JC	2X260-280						
6	10	36	JC	280						
6	10	46	JC	280						
6	10	48	JC	260						
6	10	50	JC	250						
6	10	52	JC	7X220-280						
6	10	58	JC	260						
6	11	9	JC	250						
6	11	11	JC	5X250-270						
6	11		JC	260						
6	11		JC	270						
6	11	26	JC	3X230-250						
6	11	34	JC	6X230-280						
6	11	40	JC	5X230-280						
6	11	48	JC	10X220-290						
6	11		JC	260						
6	11		JC	3X230-280						
6	12	1	JC	3X220-250						
6	12	8	JC	8X220-290						
6	14	5	JC		230					
6	14	10	JC	220						
6	14	14	JC	250						
6	14	14	JC	260						
6	14	23	JC	7X220-280						
6	14	34	JC	230						
6	14	36	JC	280						
6	16	14	JC	RESTART						
6	16	48	JC	260						

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	21	MICA	ES-04	JB	JC	RI

Wtemp (c)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4 M	22.5 AAL				TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
6	17	0	TB	3X260						
6	17	57	JC	260						
6	18	18	JC	280						
6	18	45	JC				390			
6	19	10	JC	260						
6	19	20	JC				290			
6	19	28	TB	180						
6	19	36	JC	170						
6	20	14	JC				260			
6	20	30	TB	230						
6	20	40	JC	260						
6	21	15	JC	300						
6	21	15	JC	260						
6	21		JC	280						
6	21		JC				280			
6	21	24	JC	250						
6	21		JC	280						
6			TB	180						
6	22	15	JC	210						

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	21	MICA	ES - 02	JB	JC	RI

Wtemp (c)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4 M	22.5 AAL		30	40	TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
5	23	16	START							
5	24	46	JC	220						
5	24		JC	210						
5	24	57	TB	220						
5	25	8	JC			480				
5	25	8	JC	3X270-350						
5	25		JC	3X270						
5	25	21	JC	260						
5	25	30	JC	8X220-280						
5	25	32	JC	4X220-280						
5	25		JC	220						
				230						
5	25	46	JC	245						
5	25		JC	280						
5	26	5	JC	250						
5	26	11	JC		220					GENERATOR COOLDOWN
5	28	46	JC				280			
5	28	56	JC		240					
5	28	56	JC		240					
5	29	19	JC		290					
5	29	48	JC	240						
5	29	55	JC	280						
5	30	24	JC	260						
5	30	24	JC	260						
5	32	25	restart after cool down of generator							
5	33	17	JC			800				

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	21	MICA	ES - 02	JB	JC	RI

Wtemp (c)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4 M	22.5 AAL		30	40	TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
5	33		JC	5x270-290						
5	33	31	TB			600				
5	33		JC	270						
5	33		JC		270					
5	33	46	JC	4X350-380						
5	33	51	JC	260						
5	33	55	JC	260						
5	34	0	TB			460				
5	34	13	JC	270						
5	34	13	JC	270						
5	34	19	JC	270						
5	34	29	JC	280						
5	34	32	JC		240					
5	34	39	JC	260						
5	34	42	JC	270						
5	36	1	restart after cool down of generator							
5	36									
5	36	18	JC	310						
5	36	35	JC	290						
5	36	39	JC	300						
5	36	39	TB	300						
5	36	39	TB	250						
5	36	42	JC	270						
5	36	42	JC	270						
5	36	50	JC				280			
5	36	54	JC	210						
5	37	4	JC	310						
5	37	22	JC				350			
5	37	50	JC	330						

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	21	MICA	ES - 02	JB	JC	RI

Wtemp (c)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4 M	22.5 AAL		30	40	TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	21	MICA	ES-04	JB	JC	RI

Wtemp (c)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4 M	22.5 AAL				TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
6	8	57	START							
6	9	42	JC	220						
6	9	42	JC	210						
6	9	59	JC	230						
6	10	0	JC	180						
6	10	10	JC	5X220-280						
6	10	20	JC	5X210-250						
6	10	30	JC	2X260-280						
6	10	36	JC	280						
6	10	46	JC	280						
6	10	48	JC	260						
6	10	50	JC	250						
6	10	52	JC	7X220-280						
6	10	58	JC	260						
6	11	9	JC	250						
6	11	11	JC	5X250-270						
6	11		JC	260						
6	11		JC	270						
6	11	26	JC	3X230-250						
6	11	34	JC	6X230-280						
6	11	40	JC	5X230-280						
6	11	48	JC	10X220-290						
6	11		JC	260						
6	11		JC	3X230-280						
6	12	1	JC	3X220-250						
6	12	8	JC	8X220-290						
6	14	5	JC		230					
6	14	10	JC	220						
6	14	14	JC	250						
6	14	14	JC	260						
6	14	23	JC	7X220-280						
6	14	34	JC	230						
6	14	36	JC	280						
6	16	14	JC	RESTART						
6	16	48	JC	260						

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	21	MICA	ES-04	JB	JC	RI

Wtemp (c)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4 M	22.5 AAL				TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
6	17	0	TB	3X260						
6	17	57	JC	260						
6	18	18	JC	280						
6	18	45	JC				390			
6	19	10	JC	260						
6	19	20	JC				290			
6	19	28	TB	180						
6	19	36	JC	170						
6	20	14	JC				260			
6	20	30	TB	230						
6	20	40	JC	260						
6	21	15	JC	300						
6	21	15	JC	260						
6	21		JC	280						
6	21		JC				280			
6	21	24	JC	250						
6	21		JC	280						
6			TB	180						
6	22	15	JC	210						

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	21	MICA	ES - 01	JB	JC	RI

Wtemp (c)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4 M	22.5 AAL				TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
4	53		JC	380						
4	53		JC			440				
4	53		JC			450				
4	53		JC				280			
4	53	42	JC	3X270						
4	54	8	JC	270						
4	54		JC	270						
4	54		JC		350					
4	54	24	JC		290					
4	54		JC	17X250-330						
4	54	50	JC	7X250-330						
4	54		JC	7X250-330						
4			JC	290						
4	55	35	JC	330						
4	55	46	TB			485				
4			JC	290						
4	56		TB			460				
4	59	7	JC		280					
4	59	50	TB			625				
5		2	JC			420				
5		2	JC	210						

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	21	MICA	ES-04	JB	JC	RI

Wtemp (c)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4 M	22.5 AAL				TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
6	8	57	START							
6	9	42	JC	220						
6	9	42	JC	210						
6	9	59	JC	230						
6	10	0	JC	180						
6	10	10	JC	5X220-280						
6	10	20	JC	5X210-250						
6	10	30	JC	2X260-280						
6	10	36	JC	280						
6	10	46	JC	280						
6	10	48	JC	260						
6	10	50	JC	250						
6	10	52	JC	7X220-280						
6	10	58	JC	260						
6	11	9	JC	250						
6	11	11	JC	5X250-270						
6	11		JC	260						
6	11		JC	270						
6	11	26	JC	3X230-250						
6	11	34	JC	6X230-280						
6	11	40	JC	5X230-280						
6	11	48	JC	10X220-290						
6	11		JC	260						
6	11		JC	3X230-280						
6	12	1	JC	3X220-250						
6	12	8	JC	8X220-290						
6	14	5	JC		230					
6	14	10	JC	220						
6	14	14	JC	250						
6	14	14	JC	260						
6	14	23	JC	7X220-280						
6	14	34	JC	230						
6	14	36	JC	280						
6	16	14	JC	RESTART						
6	16	48	JC	260						

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	21	MICA	ES-04	JB	JC	RI

Wtemp (c)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4 M	22.5 AAL				TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
6	17	0	TB	3X260						
6	17	57	JC	260						
6	18	18	JC	280						
6	18	45	JC				390			
6	19	10	JC	260						
6	19	20	JC				290			
6	19	28	TB	180						
6	19	36	JC	170						
6	20	14	JC				260			
6	20	30	TB	230						
6	20	40	JC	260						
6	21	15	JC	300						
6	21	15	JC	260						
6	21		JC	280						
6	21		JC				280			
6	21	24	JC	250						
6	21		JC	280						
6			TB	180						
6	22	15	JC	210						

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	21	MICA	ES - 02	JB	JC	RI

Wtemp (c)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4 M	22.5 AAL		30	40	TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
5	23	16	START							
5	24	46	JC	220						
5	24		JC	210						
5	24	57	TB	220						
5	25	8	JC			480				
5	25	8	JC	3X270-350						
5	25		JC	3X270						
5	25	21	JC	260						
5	25	30	JC	8X220-280						
5	25	32	JC	4X220-280						
5	25		JC	220						
				230						
5	25	46	JC	245						
5	25		JC	280						
5	26	5	JC	250						
5	26	11	JC		220					GENERATOR COOLDOWN
5	28	46	JC				280			
5	28	56	JC		240					
5	28	56	JC		240					
5	29	19	JC		290					
5	29	48	JC	240						
5	29	55	JC	280						
5	30	24	JC	260						
5	30	24	JC	260						
5	32	25	restart after cool down of generator							
5	33	17	JC			800				

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	21	MICA	ES - 02	JB	JC	RI

Wtemp (c)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4 M	22.5 AAL		30	40	TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
5	33		JC	5x270-290						
5	33	31	TB			600				
5	33		JC	270						
5	33		JC		270					
5	33	46	JC	4X350-380						
5	33	51	JC	260						
5	33	55	JC	260						
5	34	0	TB			460				
5	34	13	JC	270						
5	34	13	JC	270						
5	34	19	JC	270						
5	34	29	JC	280						
5	34	32	JC		240					
5	34	39	JC	260						
5	34	42	JC	270						
5	36	1	restart after cool down of generator							
5	36									
5	36	18	JC	310						
5	36	35	JC	290						
5	36	39	JC	300						
5	36	39	TB	300						
5	36	39	TB	250						
5	36	42	JC	270						
5	36	42	JC	270						
5	36	50	JC				280			
5	36	54	JC	210						
5	37	4	JC	310						
5	37	22	JC				350			
5	37	50	JC	330						

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	21	MICA	ES - 02	JB	JC	RI

Wtemp (c)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4 M	22.5 AAL		30	40	TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	21	MICA	ES-04	JB	JC	RI

Wtemp (c)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4 M	22.5 AAL				TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
6	8	57	START							
6	9	42	JC	220						
6	9	42	JC	210						
6	9	59	JC	230						
6	10	0	JC	180						
6	10	10	JC	5X220-280						
6	10	20	JC	5X210-250						
6	10	30	JC	2X260-280						
6	10	36	JC	280						
6	10	46	JC	280						
6	10	48	JC	260						
6	10	50	JC	250						
6	10	52	JC	7X220-280						
6	10	58	JC	260						
6	11	9	JC	250						
6	11	11	JC	5X250-270						
6	11		JC	260						
6	11		JC	270						
6	11	26	JC	3X230-250						
6	11	34	JC	6X230-280						
6	11	40	JC	5X230-280						
6	11	48	JC	10X220-290						
6	11		JC	260						
6	11		JC	3X230-280						
6	12	1	JC	3X220-250						
6	12	8	JC	8X220-290						
6	14	5	JC		230					
6	14	10	JC	220						
6	14	14	JC	250						
6	14	14	JC	260						
6	14	23	JC	7X220-280						
6	14	34	JC	230						
6	14	36	JC	280						
6	16	14	JC	RESTART						
6	16	48	JC	260						

MICA Fish Indexing Boat Observation Datasheet

Year	Month	Day	Project	Site	Obs - Port	Obs - Star	Recorder
2012	10	21	MICA	ES-04	JB	JC	RI

Wtemp (c)	Cond (uS)	Vis (m)	Boat Model	Volts (V)	Freq (Hz)	Pulse (%)	Operator
6.7	0.153	4 M	22.5 AAL				TB

Hour	Min	Sec	Obs	MW	KO	BT	RB	CC	SU	Other
6	17	0	TB	3X260						
6	17	57	JC	260						
6	18	18	JC	280						
6	18	45	JC				390			
6	19	10	JC	260						
6	19	20	JC				290			
6	19	28	TB	180						
6	19	36	JC	170						
6	20	14	JC				260			
6	20	30	TB	230						
6	20	40	JC	260						
6	21	15	JC	300						
6	21	15	JC	260						
6	21		JC	280						
6	21		JC				280			
6	21	24	JC	250						
6	21		JC	280						
6			TB	180						
6	22	15	JC	210						

Species	Stage	Length	UTMEastin	UTMNorthing
Bull Trout	Adult	400	392359.2	5769267
Bull Trout	Adult	650	391219.4	5768341
Bull Trout	Adult	650	391008.5	5767973
Bull Trout	Adult	720	391187.6	5768273
Bull Trout	Adult	450	392347.1	5769248
Bull Trout	Adult	760	390987.1	5767948
Bull Trout	Adult	440	392311.5	5769227
Bull Trout	Adult	450	392306.9	5769223
Bull Trout	Adult	540	391762.8	5768841
Bull Trout	Juvenile	380	392410.9	5769314
Bull Trout	Adult	450	391176.1	5768524
Bull Trout	Adult	450	392569.2	5769467
Bull Trout	Adult	485	392194.1	5769131
Bull Trout	Adult	400	392075.9	5769056
Bull Trout	Adult	460	392158.1	5769116
Bull Trout	Adult	625	392037.1	5769039
Bull Trout	Adult	480	391021.7	5768378
Bull Trout	Adult	440	392378.4	5769286
Bull Trout	Adult	520	391262.1	5768428
Bull Trout	Adult	720	391213.7	5768333
Bull Trout	Adult	620	392432.4	5769330
Bull Trout	Adult	420	392026.1	5769029
Bull Trout	Adult	460	391389.5	5768554
Bull Trout	Juvenile	230	391103.5	5768441
Bull Trout	Adult	650	391697.9	5768799
Bull Trout	Adult	780	391698.5	5768799
Bull Trout	Adult	480	391638.3	5768747
Bull Trout	Adult	800	391427.6	5768584
Bull Trout	Adult	550	392371.1	5769275
Bull Trout	Adult	600	391416.6	5768575
Kokanee	Adult	250	391649.5	5768752
Kokanee	Adult	220	392543.3	5769444
Kokanee	Adult	350	392268.3	5769187
Kokanee	Adult	290	392377.8	5769281
Kokanee	Adult	240	390978.9	5768306
Kokanee	Adult	240	391043.2	5768383
Kokanee	Adult	240	391385.4	5768549
Kokanee	Adult	230	392004.7	5769014
Kokanee	Adult	290	392261.8	5769178
Kokanee	Adult	290	391505.9	5768664
Kokanee	Adult	250	391604.2	5768736
Kokanee	Adult	290	391935.3	5768963
Kokanee	Adult	260	390982.7	5768308
Kokanee	Adult	280	392082.6	5769059
Kokanee	Adult	270	391075.2	5768412
Kokanee	Adult	257	391981.5	5768998

Kokanee	Adult	250	392260.7	5769175
Kokanee	Adult	240	391526.3	5768680
Kokanee	Adult	240	392009.4	5769016
Kokanee	Adult	270	391951.1	5768976
Kokanee	Adult	290	392483.6	5769384
Kokanee	Juvenile	140	391570.5	5768715
Kokanee	Adult	220	391227.6	5768362
Kokanee	Adult	250	392306.9	5769223
Kokanee	Adult	220	391212.9	5768333
Kokanee	Adult	190	392088	5769068
Kokanee	Adult	280	392350.7	5769277
Kokanee	Adult	240	391526.3	5768680
Kokanee	Adult	240	391362.2	5768522
Kokanee	Adult	250	391585.4	5768717
Kokanee	Adult	240	392070.6	5769054
Kokanee	Adult	270	391996.8	5769009
Kokanee	Adult	290	391995	5769006
Kokanee	Juvenile	150	392633.4	5769533
Kokanee	Adult	230	392110.2	5769236
Kokanee	Adult	280	392380.5	5769282
Kokanee	Adult	190	392088	5769068
Kokanee	Adult	270	391407.7	5768569
Kokanee	Adult	260	391614.1	5768739
Kokanee	Adult	250	392019.1	5769023
Kokanee	Adult	240	391981.5	5768998
Kokanee	Adult	273	391981.5	5768998
Kokanee	Adult	290	391981.5	5768998
Kokanee	Adult	240	390986.3	5768310
Kokanee	Adult	260	391596.7	5768730
Kokanee	Adult	300	391238.5	5768373
Kokanee	Adult	240	391736.9	5768958
Kokanee	Adult	200	391477.3	5768794
Kokanee	Adult	220	391584.4	5768717
Kokanee	Adult	250	392312.7	5769227
Kokanee	Adult	250	392260.7	5769175
Kokanee	Adult	250	392260.7	5769175
Kokanee	Adult	240	391695.4	5768796
Kokanee	Adult	250	392260.7	5769175
Kokanee	Adult	250	392260.7	5769175
Mountain \	Juvenile	120	391393.7	5768558
Mountain \	Juvenile	190	391407.7	5768569
Mountain \	Juvenile	190	391407.7	5768569
Mountain \	Juvenile	190	391407.7	5768569
Mountain \	Juvenile	190	391407.7	5768569
Mountain \	Juvenile	190	391407.7	5768569
Mountain \	Adult	270	391379	5768541
Mountain \	Adult	260	392035.2	5769185

Mountain \ Adult	260	392035.2	5769185
Mountain \ Adult	260	392035.2	5769185
Mountain \ Juvenile	220	391402.7	5768566
Mountain \ Juvenile	220	391402.7	5768566
Mountain \ Adult	270	391373.4	5768535
Mountain \ Adult	260	391990.6	5769142
Mountain \ Juvenile	120	391393.7	5768558
Mountain \ Juvenile	120	391393.7	5768558
Mountain \ Juvenile	120	391393.7	5768558
Mountain \ Juvenile	120	391393.7	5768558
Mountain \ Juvenile	120	391393.7	5768558
Mountain \ Juvenile	120	391393.7	5768558
Mountain \ Juvenile	120	391393.7	5768558
Mountain \ Juvenile	120	391393.7	5768558
Mountain \ Juvenile	120	391393.7	5768558
Mountain \ Adult	280	391364.9	5768524
Mountain \ Adult	280	391973.8	5769115
Mountain \ Juvenile	190	392299.2	5769215
Mountain \ Juvenile	190	392299.2	5769215
Mountain \ Juvenile	190	392299.2	5769215
Mountain \ Juvenile	190	392299.2	5769215
Mountain \ Juvenile	190	392299.2	5769215
Mountain \ Juvenile	190	392299.2	5769215
Mountain \ Juvenile	190	392299.2	5769215
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Mountain \ Juvenile	190	392299.2	5769215
Mountain \ Juvenile	190	392299.2	5769215
Mountain \ Adult	270	392299.2	5769215
Mountain \ Adult	270	392299.2	5769215
Mountain \ Adult	270	392299.2	5769215
Mountain \ Adult	280	392289.6	5769200
Mountain \ Adult	270	392275.2	5769193
Mountain \ Juvenile	220	391380	5768542
Mountain \ Adult	260	391356.2	5768516
Mountain \ Adult	260	391926.5	5769065
Mountain \ Juvenile	150	392284.3	5769196
Mountain \ Adult	270	392272.7	5769191
Mountain \ Juvenile	190	391371.1	5768532
Mountain \ Juvenile	190	391371.1	5768532
Mountain \ Juvenile	190	391371.1	5768532
Mountain \ Adult	270	391354	5768513
Mountain \ Juvenile	180	392270.2	5769190
Mountain \ Adult	250	392242.3	5769169
Mountain \ Adult	263	392242.3	5769169
Mountain \ Adult	277	392242.3	5769169
Mountain \ Adult	290	392242.3	5769169
Mountain \ Adult	303	392242.3	5769169

Mountain \ Adult	317	392242.3	5769169
Mountain \ Adult	330	392242.3	5769169
Mountain \ Juvenile	150	391352.8	5768524
Mountain \ Juvenile	150	391352.8	5768524
Mountain \ Adult	300	391324.2	5768496
Mountain \ Juvenile	230	391858.7	5769013
Mountain \ Juvenile	180	392258.9	5769172
Mountain \ Adult	250	392238.5	5769169
Mountain \ Adult	263	392238.5	5769169
Mountain \ Adult	277	392238.5	5769169
Mountain \ Adult	290	392238.5	5769169
Mountain \ Adult	303	392238.5	5769169
Mountain \ Adult	317	392238.5	5769169
Mountain \ Adult	330	392238.5	5769169
Mountain \ Juvenile	170	391324.2	5768496
Mountain \ Juvenile	170	391324.2	5768496
Mountain \ Juvenile	170	391324.2	5768496
Mountain \ Juvenile	170	391324.2	5768496
Mountain \ Adult	250	391324.2	5768496
Mountain \ Adult	260	391851.8	5769009
Mountain \ Juvenile	180	392253.4	5769168
Mountain \ Juvenile	180	392253.4	5769168
Mountain \ Adult	290	392212.2	5769140
Mountain \ Juvenile	120	391318.2	5768490
Mountain \ Adult	270	391320.8	5768493
Mountain \ Adult	300	391811.3	5768995
Mountain \ Juvenile	190	392246.7	5769168
Mountain \ Juvenile	190	392246.7	5769168
Mountain \ Juvenile	190	392246.7	5769168
Mountain \ Juvenile	190	392246.7	5769168
Mountain \ Juvenile	190	392246.7	5769168
Mountain \ Juvenile	190	392246.7	5769168
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Mountain \ Juvenile	190	392246.7	5769168
Mountain \ Adult	330	392206.5	5769137
Mountain \ Juvenile	170	391304.5	5768477
Mountain \ Juvenile	170	391304.5	5768477
Mountain \ Juvenile	170	391304.5	5768477
Mountain \ Adult	270	391320.8	5768493
Mountain \ Adult	260	391811.3	5768995
Mountain \ Juvenile	190	392232.7	5769165
Mountain \ Juvenile	190	392232.7	5769165
Mountain \ Juvenile	190	392232.7	5769165
Mountain \ Juvenile	190	392232.7	5769165
Mountain \ Juvenile	190	392232.7	5769165
Mountain \ Juvenile	190	392232.7	5769165
Mountain \ Juvenile	150	391287.8	5768459

Mountain \ Adult	280	391807.8	5768994
Mountain \ Juvenile	220	392220.6	5769152
Mountain \ Juvenile	220	392220.6	5769152
Mountain \ Adult	260	391727.8	5768946
Mountain \ Adult	350	392023.9	5769027
Mountain \ Juvenile	200	391223.2	5768345
Mountain \ Adult	260	391723.1	5768943
Mountain \ Adult	260	391677	5768913
Mountain \ Juvenile	180	391950.3	5768975
Mountain \ Adult	280	391906.6	5768946
Mountain \ Juvenile	140	391112.5	5768128
Mountain \ Adult	260	391196.3	5768327
Mountain \ Juvenile	240	391663.2	5768906
Mountain \ Juvenile	150	391945.2	5768970
Mountain \ Adult	280	391892.6	5768937
Mountain \ Adult	280	391892.6	5768937
Mountain \ Adult	280	391892.6	5768937
Mountain \ Juvenile	130	391109.6	5768122
Mountain \ Adult	270	391188.2	5768274
Mountain \ Juvenile	180	391658.2	5768902
Mountain \ Adult	280	391938.6	5768966
Mountain \ Juvenile	220	391891.6	5768936
Mountain \ Juvenile	210	391106.3	5768116
Mountain \ Juvenile	240	391151.8	5768201
Mountain \ Juvenile	210	391656.8	5768900
Mountain \ Adult	270	391932.9	5768962
Mountain \ Adult	270	391932.9	5768962
Mountain \ Juvenile	210	391103.6	5768110
Mountain \ Juvenile	230	391656.8	5768900
Mountain \ Adult	320	391900.9	5768943
Mountain \ Juvenile	210	391095	5768092
Mountain \ Adult	280	391883.6	5768930
Mountain \ Adult	280	391883.6	5768930
Mountain \ Adult	280	391883.6	5768930
Mountain \ Adult	280	391883.6	5768930
Mountain \ Adult	280	391883.6	5768930
Mountain \ Adult	280	391883.6	5768930
Mountain \ Juvenile	190	391089.4	5768104
Mountain \ Juvenile	194	391089.4	5768104
Mountain \ Juvenile	199	391089.4	5768104
Mountain \ Juvenile	203	391089.4	5768104
Mountain \ Juvenile	230	391477.3	5768794
Mountain \ Juvenile	180	391653.2	5768753
Mountain \ Juvenile	180	391653.2	5768753
Mountain \ Juvenile	180	391653.2	5768753
Mountain \ Juvenile	240	392241.8	5769294
Mountain \ Adult	280	391641.1	5768748

Mountain \ Adult	285	392482.7	5769481
Mountain \ Juvenile	190	391600.1	5768733
Mountain \ Juvenile	150	392449	5769346
Mountain \ Juvenile	150	392449	5769346
Mountain \ Juvenile	220	392276.7	5769328
Mountain \ Adult	260	392160.1	5769247
Mountain \ Juvenile	230	392131.4	5769231
Mountain \ Adult	255	392131.4	5769231
Mountain \ Adult	280	392131.4	5769231
Mountain \ Juvenile	220	390996.6	5768322
Mountain \ Juvenile	220	390996.6	5768322
Mountain \ Juvenile	220	392122	5769226
Mountain \ Juvenile	235	392122	5769226
Mountain \ Adult	250	392122	5769226
Mountain \ Juvenile	240	392111.5	5769221
Mountain \ Adult	260	392111.5	5769221
Mountain \ Juvenile	180	392385.5	5769287
Mountain \ Juvenile	180	392385.5	5769287
Mountain \ Adult	260	391397.4	5768561
Mountain \ Juvenile	220	392086	5769229
Mountain \ Juvenile	180	391681.2	5768787
Mountain \ Juvenile	220	391655.2	5768755
Mountain \ Adult	325	392527.1	5769518
Mountain \ Juvenile	240	391045.9	5768388
Mountain \ Adult	260	391082.6	5768429
Mountain \ Juvenile	150	392355	5769259
Mountain \ Juvenile	220	392597.6	5769488
Mountain \ Juvenile	180	391670.4	5768795
Mountain \ Juvenile	180	391670.4	5768795
Mountain \ Juvenile	210	391653.2	5768753
Mountain \ Adult	320	392524.8	5769517
Mountain \ Juvenile	210	392276.7	5769328
Mountain \ Juvenile	210	391034.3	5768373
Mountain \ Juvenile	210	391034.3	5768373
Mountain \ Juvenile	210	391034.3	5768373
Mountain \ Juvenile	210	391034.3	5768373
Mountain \ Juvenile	210	391034.3	5768373
Mountain \ Juvenile	180	391428	5768585
Mountain \ Adult	320	392615.9	5769512
Mountain \ Adult	300	392592.9	5769484
Mountain \ Juvenile	180	391655.5	5768757
Mountain \ Juvenile	180	391655.5	5768757
Mountain \ Juvenile	180	391655.5	5768757
Mountain \ Juvenile	220	391647.9	5768751
Mountain \ Juvenile	190	391407.7	5768569
Mountain \ Juvenile	230	392259.4	5769319
Mountain \ Juvenile	210	391034	5768374

Mountain \ Juvenile	210	391034	5768374
Mountain \ Juvenile	210	391034	5768374
Mountain \ Juvenile	210	391034	5768374
Mountain \ Juvenile	210	391034	5768374
Mountain \ Juvenile	230	391066.2	5768404
Mountain \ Juvenile	180	392606.7	5769502
Mountain \ Juvenile	180	391655.5	5768756
Mountain \ Adult	310	391083.6	5768085
Mountain \ Juvenile	180	392258.3	5769319
Mountain \ Juvenile	220	391004.2	5768328
Mountain \ Juvenile	180	392602.8	5769497
Mountain \ Adult	440	392552.1	5769450
Mountain \ Juvenile	180	391653.2	5768753
Mountain \ Juvenile	180	391653.2	5768753
Mountain \ Juvenile	180	391653.2	5768753
Mountain \ Adult	270	391638.3	5768747
Mountain \ Adult	310	391638.3	5768747
Mountain \ Adult	350	391638.3	5768747
Mountain \ Juvenile	220	392247.5	5769308
Mountain \ Juvenile	235	392247.5	5769308
Mountain \ Adult	250	392247.5	5769308
Mountain \ Adult	265	392247.5	5769308
Mountain \ Adult	280	392247.5	5769308
Mountain \ Juvenile	220	390996.6	5768322
Mountain \ Adult	320	392403.9	5769420
Mountain \ Juvenile	120	392590.2	5769482
Mountain \ Adult	250	392241.8	5769294
Mountain \ Juvenile	230	391034.2	5768375
Mountain \ Juvenile	180	392570.6	5769468
Mountain \ Juvenile	180	392570.6	5769468
Mountain \ Juvenile	180	392570.6	5769468
Mountain \ Juvenile	180	392570.6	5769468
Mountain \ Juvenile	180	392570.6	5769468
Mountain \ Juvenile	180	392570.6	5769468
Mountain \ Juvenile	200	392538	5769439
Mountain \ Adult	280	391641.1	5768748
Mountain \ Adult	260	391628.8	5768742
Mountain \ Adult	260	392232.7	5769287
Mountain \ Adult	280	392232.7	5769287
Mountain \ Juvenile	220	391364	5768523
Mountain \ Juvenile	190	392261.8	5769178
Mountain \ Juvenile	181	391633.1	5768744
Mountain \ Juvenile	181	391633.1	5768744
Mountain \ Juvenile	220	391619.8	5768740
Mountain \ Juvenile	229	391619.8	5768740
Mountain \ Juvenile	237	391619.8	5768740
Mountain \ Juvenile	246	391619.8	5768740

Mountain \ Adult	254	391619.8	5768740
Mountain \ Adult	263	391619.8	5768740
Mountain \ Adult	271	391619.8	5768740
Mountain \ Adult	280	391619.8	5768740
Mountain \ Adult	285	392463.2	5769468
Mountain \ Adult	280	392225.8	5769283
Mountain \ Juvenile	200	390865.6	5768114
Mountain \ Juvenile	220	391004.2	5768328
Mountain \ Juvenile	245	391004.2	5768328
Mountain \ Adult	270	391004.2	5768328
Mountain \ Adult	410	392568	5769466
Mountain \ Juvenile	190	392261.2	5769177
Mountain \ Juvenile	180	391625.3	5768742
Mountain \ Juvenile	182	391625.3	5768742
Mountain \ Juvenile	184	391625.3	5768742
Mountain \ Adult	250	392086	5769229
Mountain \ Adult	260	392205.9	5769274
Mountain \ Adult	270	392205.9	5769274
Mountain \ Adult	280	392205.9	5769274
Mountain \ Juvenile	180	390742.9	5767917
Mountain \ Juvenile	120	392496.5	5769398
Mountain \ Juvenile	120	392496.5	5769398
Mountain \ Juvenile	120	392496.5	5769398
Mountain \ Juvenile	120	392496.5	5769398
Mountain \ Juvenile	120	392496.5	5769398
Mountain \ Adult	280	391600.1	5768733
Mountain \ Adult	260	392199.1	5769270
Mountain \ Juvenile	210	392494.6	5769396
Mountain \ Juvenile	190	391600.1	5768733
Mountain \ Adult	250	391589.5	5768722
Mountain \ Adult	320	392381.5	5769399
Mountain \ Adult	250	392185.1	5769261
Mountain \ Adult	260	390938.2	5768306
Mountain \ Adult	310	392491.3	5769392
Mountain \ Adult	250	392434.7	5769331
Mountain \ Adult	270	392434.7	5769331
Mountain \ Adult	290	392434.7	5769331
Mountain \ Juvenile	180	392219.1	5769148
Mountain \ Adult	325	392367.8	5769395
Mountain \ Adult	250	392183	5769260
Mountain \ Adult	255	392183	5769260
Mountain \ Adult	260	392183	5769260
Mountain \ Adult	265	392183	5769260
Mountain \ Adult	270	392183	5769260
Mountain \ Adult	280	391795.3	5768986
Mountain \ Adult	310	392488.4	5769388
Mountain \ Juvenile	210	392433.5	5769331

Mountain \ Juvenile	240	391589.5	5768722
Mountain \ Juvenile	240	391589.5	5768722
Mountain \ Juvenile	240	391589.5	5768722
Mountain \ Juvenile	240	391589.5	5768722
Mountain \ Adult	290	392338.8	5769371
Mountain \ Adult	260	392179.2	5769259
Mountain \ Juvenile	180	390834.4	5768072
Mountain \ Adult	310	392469.9	5769374
Mountain \ Adult	310	392469.9	5769374
Mountain \ Adult	310	392469.9	5769374
Mountain \ Adult	310	392469.9	5769374
Mountain \ Adult	310	392469.9	5769374
Mountain \ Adult	310	392469.9	5769374
Mountain \ Adult	310	392469.9	5769374
Mountain \ Adult	260	391261.1	5768422
Mountain \ Adult	260	391261.1	5768422
Mountain \ Adult	260	391261.1	5768422
Mountain \ Adult	270	392173.8	5769257
Mountain \ Juvenile	180	390825.8	5768061
Mountain \ Adult	320	392460.3	5769365
Mountain \ Adult	250	392395.7	5769305
Mountain \ Adult	280	391581.1	5768716
Mountain \ Adult	280	391581.1	5768716
Mountain \ Juvenile	170	391231.7	5768366
Mountain \ Juvenile	230	392167.7	5769254
Mountain \ Juvenile	240	392167.7	5769254
Mountain \ Adult	250	392167.7	5769254
Mountain \ Juvenile	220	390820.7	5768048
Mountain \ Juvenile	150	392449	5769346
Mountain \ Juvenile	150	392449	5769346
Mountain \ Juvenile	150	392449	5769346
Mountain \ Juvenile	220	391124.7	5768142
Mountain \ Juvenile	150	392449	5769346
Mountain \ Juvenile	230	392086	5769229
Mountain \ Juvenile	240	392086	5769229
Mountain \ Juvenile	180	391342.7	5768517
Mountain \ Adult	260	392086	5769229
Mountain \ Juvenile	230	392160.1	5769247
Mountain \ Juvenile	240	392160.1	5769247
Mountain \ Adult	250	392160.1	5769247
Mountain \ Adult	270	392160.1	5769247
Mountain \ Adult	280	392160.1	5769247
Mountain \ Adult	260	390712.7	5767864
Mountain \ Juvenile	190	392442.5	5769337
Mountain \ Adult	270	392386.6	5769290
Mountain \ Adult	280	391506.8	5768665
Mountain \ Adult	280	391476.5	5768635

Mountain \ Juvenile	220	392140.5	5769239
Mountain \ Juvenile	228	392140.5	5769239
Mountain \ Juvenile	236	392140.5	5769239
Mountain \ Juvenile	243	392140.5	5769239
Mountain \ Adult	251	392140.5	5769239
Mountain \ Adult	259	392140.5	5769239
Mountain \ Adult	267	392140.5	5769239
Mountain \ Adult	274	392140.5	5769239
Mountain \ Adult	282	392140.5	5769239
Mountain \ Adult	290	392140.5	5769239
Mountain \ Juvenile	170	392426.1	5769327
Mountain \ Juvenile	180	391140.7	5768185
Mountain \ Adult	250	391501.2	5768658
Mountain \ Adult	265	391501.2	5768658
Mountain \ Adult	280	391501.2	5768658
Mountain \ Adult	260	391469.1	5768627
Mountain \ Adult	260	392137.6	5769237
Mountain \ Adult	250	392360.3	5769269
Mountain \ Adult	260	392360.3	5769269
Mountain \ Adult	270	392360.3	5769269
Mountain \ Adult	280	392360.3	5769269
Mountain \ Adult	290	392360.3	5769269
Mountain \ Adult	300	392360.3	5769269
Mountain \ Adult	310	392360.3	5769269
Mountain \ Adult	250	391496.8	5768654
Mountain \ Adult	250	391496.8	5768654
Mountain \ Adult	250	391496.8	5768654
Mountain \ Adult	260	391469.1	5768627
Mountain \ Adult	260	391206	5768329
Mountain \ Adult	260	391106.3	5768444
Mountain \ Adult	310	391114.1	5768117
Mountain \ Adult	320	392488.4	5769388
Mountain \ Adult	350	391489.5	5768648
Mountain \ Adult	270	391422.6	5768578
Mountain \ Adult	275	391422.6	5768578
Mountain \ Adult	280	391422.6	5768578
Mountain \ Adult	285	391422.6	5768578
Mountain \ Adult	290	391422.6	5768578
Mountain \ Juvenile	220	392111.5	5769221
Mountain \ Juvenile	230	392111.5	5769221
Mountain \ Adult	250	392111.5	5769221
Mountain \ Adult	270	392111.5	5769221
Mountain \ Adult	280	392111.5	5769221
Mountain \ Adult	290	392111.5	5769221
Mountain \ Juvenile	180	392385.5	5769287
Mountain \ Juvenile	180	392385.5	5769287
Mountain \ Juvenile	180	392385.5	5769287

Mountain \ Adult	370	391470	5768629
Mountain \ Adult	370	391470	5768629
Mountain \ Adult	370	391470	5768629
Mountain \ Adult	370	391470	5768629
Mountain \ Juvenile	190	392261.8	5769178
Mountain \ Juvenile	190	392261.8	5769178
Mountain \ Juvenile	190	391462.1	5768620
Mountain \ Juvenile	207	391089.4	5768104
Mountain \ Juvenile	211	391089.4	5768104
Mountain \ Juvenile	216	391089.4	5768104
Mountain \ Juvenile	220	391089.4	5768104
Mountain \ Juvenile	210	391456.3	5768613
Mountain \ Juvenile	170	391631.7	5768877
Mountain \ Adult	270	391863.9	5768917
Mountain \ Juvenile	220	391127.1	5768146
Mountain \ Juvenile	232	391127.1	5768146
Mountain \ Juvenile	243	391127.1	5768146
Mountain \ Adult	255	391127.1	5768146
Mountain \ Adult	267	391127.1	5768146
Mountain \ Adult	278	391127.1	5768146
Mountain \ Adult	290	391127.1	5768146
Mountain \ Juvenile	240	391601.4	5768856
Mountain \ Adult	330	391827.9	5768896
Mountain \ Adult	250	392355	5769259
Mountain \ Adult	360	391451.3	5768610
Mountain \ Adult	317	392258	5769171
Mountain \ Adult	280	391591	5768852
Mountain \ Juvenile	180	391342.7	5768517
Mountain \ Juvenile	180	391342.7	5768517
Mountain \ Juvenile	170	391794.9	5768869
Mountain \ Juvenile	180	391342.7	5768517
Mountain \ Adult	270	392086	5769229
Mountain \ Adult	280	392086	5769229
Mountain \ Juvenile	220	391117.2	5768133
Mountain \ Adult	300	391324.2	5768496
Mountain \ Adult	320	391434	5768594
Mountain \ Adult	260	391393.7	5768558
Mountain \ Juvenile	230	392073.5	5769222
Mountain \ Juvenile	170	392341.8	5769245
Mountain \ Juvenile	240	391756.6	5768838
Mountain \ Juvenile	170	391430.5	5768588
Mountain \ Adult	280	392070.8	5769221
Mountain \ Juvenile	170	392327.4	5769237
Mountain \ Adult	380	392306.9	5769223
Mountain \ Juvenile	180	391428	5768585
Mountain \ Adult	270	391379	5768541
Mountain \ Adult	260	392046.4	5769192

Mountain \ Adult	250	392318.8	5769230
Mountain \ Juvenile	170	391895.7	5769046
Mountain \ Juvenile	190	391407.7	5768569
Mountain \ Juvenile	190	391407.7	5768569
Mountain \ Juvenile	190	391407.7	5768569
Mountain \ Juvenile	190	391407.7	5768569
Mountain \ Adult	260	391355.5	5768725
Mountain \ Juvenile	230	391282	5768651
Mountain \ Juvenile	220	391074.5	5768082
Mountain \ Juvenile	180	391269.9	5768636
Mountain \ Juvenile	190	392261.8	5769178
Mountain \ Juvenile	220	391091.8	5768432
Mountain \ Juvenile	180	391351.2	5768512
Mountain \ Adult	290	391328.9	5768500
Mountain \ Adult	400	392014.7	5769019
Mountain \ Juvenile	190	392261.2	5769177
Mountain \ Juvenile	210	392241.8	5769294
Mountain \ Juvenile	220	392241.8	5769294
Mountain \ Juvenile	230	392241.8	5769294
Mountain \ Juvenile	210	391310	5768482
Mountain \ Juvenile	200	391253.4	5768426
Mountain \ Juvenile	170	391794.9	5768869
Mountain \ Juvenile	180	392083.2	5769071
Mountain \ Juvenile	220	391364	5768523
Mountain \ Adult	310	391350.2	5768510
Mountain \ Juvenile	180	391904.2	5769048
Mountain \ Adult	290	391244.5	5768378
Mountain \ Adult	290	391267.2	5768430
Mountain \ Juvenile	190	392261.8	5769178
Mountain \ Juvenile	190	392261.8	5769178
Mountain \ Adult	400	392490.4	5769391
Mountain \ Juvenile	190	392261.8	5769178
Mountain \ Juvenile	190	392261.8	5769178
Mountain \ Adult	260	392210.5	5769276
Mountain \ Juvenile	220	390834.4	5768072
Mountain \ Adult	260	391261.1	5768422
Mountain \ Adult	410	392521.7	5769415
Mountain \ Juvenile	190	392261.2	5769177
Mountain \ Juvenile	190	392261.2	5769177
Mountain \ Juvenile	190	392261.2	5769177
Mountain \ Juvenile	190	392261.2	5769177
Mountain \ Juvenile	190	392261.2	5769177
Mountain \ Juvenile	190	392261.2	5769177
Mountain \ Juvenile	190	392261.2	5769177
Mountain \ Juvenile	190	392261.2	5769177
Mountain \ Adult	250	392258	5769171
Mountain \ Adult	263	392258	5769171

Mountain \ Adult	277	392258	5769171
Mountain \ Adult	290	392258	5769171
Mountain \ Adult	303	392258	5769171
Mountain \ Juvenile	210	391088.2	5768089
Mountain \ Adult	330	392258	5769171
Mountain \ Juvenile	170	391794.9	5768869
Mountain \ Juvenile	180	391342.7	5768517
Mountain \ Juvenile	180	391342.7	5768517
Mountain \ Juvenile	180	391342.7	5768517
Mountain \ Juvenile	220	390854.9	5768094
Mountain \ Adult	260	391001.4	5768325
Mountain \ Adult	320	392538.9	5769440
Mountain \ Adult	320	391619.8	5768740
Mountain \ Juvenile	220	391614.1	5768739
Mountain \ Adult	285	392437.9	5769450
Mountain \ Juvenile	140	391086	5768427
Mountain \ Juvenile	190	391235	5768369
Mountain \ Adult	400	392014.7	5769019
Mountain \ Adult	350	392486.8	5769387
Mountain \ Juvenile	240	391963.5	5768987
Mountain \ Juvenile	230	391608.7	5768739
Mountain \ Adult	285	392427.9	5769442
Mountain \ Adult	250	392208.1	5769275
Mountain \ Juvenile	200	390818.1	5768037
Mountain \ Juvenile	220	390992.3	5768317
Mountain \ Juvenile	235	390992.3	5768317
Mountain \ Adult	250	390992.3	5768317
Mountain \ Juvenile	180	391140.7	5768185
Mountain \ Juvenile	199	391625.3	5768742
Mountain \ Juvenile	230	391170.1	5768520
Mountain \ Adult	260	391169.7	5768514
Mountain \ Juvenile	220	391116.2	5768460
Mountain \ Juvenile	210	392026.1	5769029
Mountain \ Juvenile	190	391235	5768369
Mountain \ Juvenile	190	391235	5768369
Mountain \ Adult	400	392014.7	5769019
Mountain \ Adult	290	391760.2	5768970
Mountain \ Adult	285	392489.8	5769488
Mountain \ Juvenile	220	392220.6	5769152
Mountain \ Adult	290	392188.6	5769128
Mountain \ Juvenile	220	391274.3	5768444
Mountain \ Adult	270	392000.7	5769011
Mountain \ Juvenile	170	391799.1	5768875
Mountain \ Adult	310	391300.1	5768474
Mountain \ Adult	250	391801.8	5768990
Mountain \ Juvenile	140	392187.7	5769127
Mountain \ Juvenile	170	391794.9	5768869

Mountain \ Adult	320	391256	5768435
Mountain \ Adult	330	391262.1	5768428
Mountain \ Juvenile	180	391777.6	5768975
Mountain \ Juvenile	170	390794.5	5767999
Mountain \ Juvenile	210	391741.3	5768963
Mountain \ Juvenile	190	391184	5768267
Mountain \ Juvenile	190	391184	5768267
Mountain \ Adult	250	391221.3	5768343
Mountain \ Juvenile	230	392152.4	5769243
Mountain \ Adult	400	392014.7	5769019
Mountain \ Adult	400	392014.7	5769019
Mountain \ Adult	400	392014.7	5769019
Mountain \ Adult	320	392084	5769059
Mountain \ Adult	290	392367.4	5769273
Mountain \ Adult	290	392367.4	5769273
Mountain \ Adult	250	392359.2	5769267
Mountain \ Adult	280	391472	5768629
Mountain \ Adult	380	391241.9	5768374
Mountain \ Adult	280	391741.3	5768963
Mountain \ Juvenile	180	391140.7	5768185
Mountain \ Juvenile	170	391223.6	5768350
Mountain \ Adult	260	391352.3	5768723
Mountain \ Juvenile	195	391625.3	5768742
Mountain \ Juvenile	120	391276.3	5768644
Mountain \ Juvenile	170	391794.9	5768869
Mountain \ Juvenile	220	392205.9	5769274
Mountain \ Juvenile	180	391079.3	5768083
Mountain \ Juvenile	210	391625.3	5768742
Mountain \ Adult	280	391782.7	5768854
Mountain \ Juvenile	240	391046.2	5768048
Mountain \ Adult	280	391111.7	5768126
Mountain \ Juvenile	180	392445.8	5769340
Mountain \ Juvenile	190	391184	5768267
Mountain \ Adult	260	391112.3	5768451
Mountain \ Adult	270	391412.3	5768573
Mountain \ Juvenile	220	392104.7	5769234
Mountain \ Adult	250	392098.7	5769232
Mountain \ Adult	290	392367.4	5769273
Mountain \ Juvenile	180	391156.1	5768207
Mountain \ Juvenile	220	391218.5	5768339
Mountain \ Juvenile	230	391218.5	5768339
Mountain \ Juvenile	240	391218.5	5768339
Mountain \ Adult	250	391218.5	5768339
Mountain \ Juvenile	210	391702.2	5768927
Mountain \ Juvenile	210	391113.6	5768115
Mountain \ Juvenile	210	391360.8	5768727
Mountain \ Juvenile	180	391140.7	5768185

Mountain \ Juvenile	180	391140.7	5768185
Mountain \ Adult	260	391599.7	5768856
Mountain \ Juvenile	180	392513.6	5769410
Mountain \ Juvenile	180	391140.7	5768185
Mountain \ Juvenile	180	391140.7	5768185
Mountain \ Juvenile	180	391140.7	5768185
Mountain \ Juvenile	197	391625.3	5768742
Mountain \ Adult	280	391082.2	5768085
Mountain \ Adult	260	392412.6	5769426
Mountain \ Juvenile	230	392205.9	5769274
Mountain \ Adult	280	391203.3	5768555
Mountain \ Adult	260	391689.3	5768917
Mountain \ Juvenile	220	391205	5768558
Mountain \ Adult	290	391921.4	5768955
Mountain \ Adult	285	392457.1	5769463
Mountain \ Juvenile	190	391501.6	5768809
Mountain \ Juvenile	220	391116.2	5768460
Mountain \ Adult	290	391013.6	5767981
Mountain \ Adult	250	391580.7	5768718
Mountain \ Juvenile	230	391477.3	5768794
Mountain \ Juvenile	230	391477.3	5768794
Mountain \ Juvenile	240	391480.7	5768641
Mountain \ Juvenile	242	392152.4	5769243
Mountain \ Adult	268	392152.4	5769243
Mountain \ Adult	290	392367.4	5769273
Mountain \ Adult	270	391633.1	5768744
Mountain \ Adult	270	391633.1	5768744
Mountain \ Adult	270	391633.1	5768744
Mountain \ Juvenile	220	391403.3	5768753
Mountain \ Adult	360	391401.6	5768565
Mountain \ Adult	310	391110.7	5768106
Mountain \ Juvenile	210	391125.1	5768144
Mountain \ Adult	310	391100.4	5768098
Mountain \ Adult	250	391608.7	5768739
Mountain \ Adult	310	391103.6	5768110
Mountain \ Juvenile	201	391625.3	5768742
Mountain \ Juvenile	245	391603.2	5768735
Mountain \ Adult	280	391617.3	5768740
Mountain \ Adult	290	392367.4	5769273
Mountain \ Adult	270	392389.5	5769296
Mountain \ Adult	350	391401.6	5768565
Mountain \ Juvenile	230	391105.6	5768101
Mountain \ Adult	290	392367.4	5769273
Mountain \ Adult	330	391083.6	5768085
Mountain \ Adult	260	391115	5768120
Mountain \ Adult	290	391097.6	5768098
Mountain \ Juvenile	204	391625.3	5768742

Mountain \ Juvenile	206	391625.3	5768742
Mountain \ Juvenile	240	392205.9	5769274
Mountain \ Juvenile	180	392513.6	5769410
Mountain \ Juvenile	180	392513.6	5769410
Mountain \ Adult	280	392152.4	5769243
Mountain \ Juvenile	193	391625.3	5768742
Mountain \ Juvenile	220	390854.9	5768094
Mountain \ Juvenile	180	392513.6	5769410
Mountain \ Adult	250	391608.7	5768739
Mountain \ Adult	250	391580.7	5768718
Mountain \ Juvenile	220	391617.3	5768740
Mountain \ Adult	260	391617.3	5768740
Mountain \ Adult	280	392212.4	5769278
Mountain \ Adult	330	391101.9	5768106
Mountain \ Adult	280	390900	5767876
Mountain \ Adult	300	391392.2	5768746
Mountain \ Adult	320	391738.3	5768824
Mountain \ Adult	255	392152.4	5769243
Mountain \ Juvenile	240	391617.3	5768740
Mountain \ Adult	320	391083.6	5768085
Mountain \ Adult	260	392098.7	5769232
Mountain \ Juvenile	186	391625.3	5768742
Mountain \ Juvenile	208	391625.3	5768742
Mountain \ Juvenile	191	391625.3	5768742
Mountain \ Juvenile	230	391477.3	5768794
Mountain \ Juvenile	180	392513.6	5769410
Mountain \ Juvenile	220	391250.1	5768610
Mountain \ Juvenile	189	391625.3	5768742
Mountain \ Adult	250	392205.9	5769274
Mountain \ Adult	380	391401.6	5768565
Mountain \ Juvenile	180	392513.6	5769410
Mountain \ Adult	370	391401.6	5768565
Rainbow Tr Adult	420	392449.9	5769348
Rainbow Tr Adult	290	391707	5768930
Rainbow Tr Adult	320	391698.3	5768923
Rainbow Tr Adult	380	392363.8	5769271
Rainbow Tr Adult	280	391538.2	5768687
Rainbow Tr Adult	280	392303.3	5769220
Rainbow Tr Adult	350	392392.7	5769302
Rainbow Tr Adult	290	391915	5769055
Rainbow Tr Adult	390	391944.5	5769084
Rainbow Tr Adult	327	392004.7	5769014
Rainbow Tr Adult	410	391143	5768171
Rainbow Tr Adult	280	391126.8	5768472
Rainbow Tr Adult	280	392503.6	5769498
Rainbow Tr Adult	380	391781.2	5768853
Rainbow Tr Adult	290	391634.1	5768878

Rainbow Tr Adult	330	392325.3	5769235
Rainbow Tr Adult	350	392004.7	5769014
Rainbow Tr Adult	310	392513.6	5769410
Rainbow Tr Adult	350	391285.8	5768456
Rainbow Tr Adult	250	392494.6	5769396
Rainbow Tr Adult	270	392512	5769409
Rainbow Tr Adult	280	391314	5768486
Rainbow Tr Adult	320	392620.7	5769530
Rainbow Tr Adult	280	391059.7	5768401
Rainbow Tr Adult	300	392469.9	5769374
Rainbow Tr Adult	280	392004.7	5769014
Rainbow Tr Juvenile	210	392570.6	5769468
Rainbow Tr Adult	340	390965.2	5768303
Rainbow Tr Adult	400	392085.9	5769070
Rainbow Tr Adult	350	392405.3	5769311
Rainbow Tr Adult	370	390712.7	5767864
Rainbow Tr Adult	303	392004.7	5769014
Rainbow Tr Adult	280	391805.7	5768993
Rainbow Tr Adult	380	392620.7	5769530
Rainbow Tr Adult	260	391874	5769024
Rainbow Tr Adult	390	392382.5	5769284
Rainbow Tr Adult	280	392514	5769506
Rainbow Tr Adult	280	392518.7	5769509
Rainbow Tr Juvenile	230	390996.6	5768322
Rainbow Tr Adult	340	391129.4	5768150
Rainbow Tr Adult	360	391501.6	5768809

Appendix 6. Analytic Appendix

Hierarchical Bayesian Analysis

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5 March 2013

1 General Approach

Hierarchical Bayesian models were fitted to the fish indexing data below Mica Dam using the software packages R 2.15.2[8] and JAGS 3.3.0[6] which interfaced with each other via the jaggernaut R package. The models assumed low information uniform or normal prior distributions. The posterior distributions were estimated from a minimum of 1,000 samples thinned from the second halves of three Gibbs sampling chains. Model convergence was confirmed by ensuring that R-hat (the Gelman-Rubin-Brooks potential scale reduction factor) was less than 1.1 for each of the parameters in the model[2, 4, 3].

Following Bradford et al. (2005)[1], the influence of particular variables was, where informative, expressed in terms of the effect size (i.e., percent change in the response variable) with 95% credibility intervals. When the variable was considered a random effect, the percent change in the response was quantified with respect to the typical value, i.e., the expected value of the underlying distribution from which the observed values represent random draws. Plots were produced using the ggplot2 R package [9].

2 JAGS Distributions, Functions and Operators

JAGS distributions, functions and operators are defined in the following two tables. For additional information on the JAGS language, which is a dialect of the BUGS language, see the JAGS User Manual[7].

JAGS Distribution	Description
dlnorm(mu, sd^-2)	Log-normal distribution
dnorm(mu, sd^-2)	Normal distribution
dpois(lambda)	Poisson distribution
dunif(a, b)	Uniform distribution

JAGS Function or Operator	Description
<-	Deterministic relationship
~	Stochastic relationship
1:n	Vector of integers from 1 to n
a[1:n]	Subset of first n values in a
for (i in 1:n) {...}	Repeat ... for 1 to n times incrementing i each time
log(x)	Log of x
x^y	Power where x is raised to the power of y

3 JAGS Models

The following section provides the variable and parameter definitions and JAGS model code for the analyses.

3.1 Condition

Condition was estimated via an analysis of body weight conditional on body length [5].

3.1.1 Condition Model - Variables and Parameters

Variable/Parameter	Description
bLength	Effect of log length on log weight
bYear[yr]	Effect of yrth year on log weight
eLogWeight[i]	Expected log weight of ith fish
LogLength[i]	Log length of ith fish
bIntercept	Log weight intercept
sWeight	SD of residual variation in log weight
Weight[i]	Weight of ith fish
Year[i]	Year the ith fish was encountered

3.1.2 Condition Model - JAGS Code

```
model {
  sWeight ~ dunif(0, 5)

  bIntercept ~ dnorm(5, 5^-2)
  bLength ~ dnorm(0, 5^-2)

  bYear[1] <- 0
  for(yr in 2:nYear) {
    bYear[yr] ~ dnorm(0, 2^-2)
  }

  for(i in 1:nrow) {
    eLogWeight[i] <- bIntercept + bLength * LogLength[i] + bYear[Year[i]]
    Weight[i] ~ dlnorm(eLogWeight[i], sWeight^-2)
  }
}
```

3.2 Relative Abundance

Apparent lineal density was estimated via an analysis of the observer counts.

3.2.1 Relative Abundance - Variables and Parameters

Variable/Parameter	Description
Count[i]	Count for ith visit
bIntercept	Count intercept
bSite[st]	Effect of stth site on count
eFish[i]	Expected apparent abundance for ith visit
eDensity[i]	Expected apparent lineal density for ith visit
LengthSite[i]	Length of site for ith visit
sSite	SD of effect of site on count
Site[i]	Site for ith visit

3.2.2 Relative Abundance - JAGS Code

```
model {

  sSite~dunif(0, 5)

  bIntercept~dnorm(0,5^-2)

  for(st in 1:nSite) {
    bSite[st]~dnorm(0, sSite^-2)
  }

  for (i in 1:nrow) {
    log(eDensity[i]) <- bIntercept + bSite[Site[i]]
    eFish[i] <- eDensity[i] * LengthSite[i]
    Count[i] ~ dpois(eFish[i])
  }
}
```

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Appendix 7. Columbia River Database