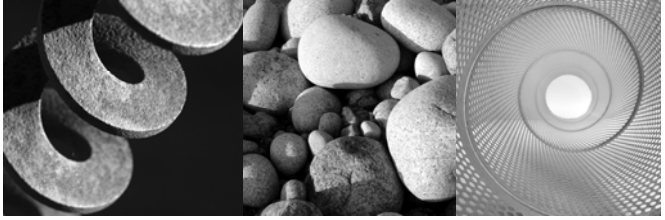

GEI Consultants

Geotechnical
Water Resources
Environmental and
Ecological Services

Results of 2006 Fish Telemetry Study Thompson Falls Dam

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May 2007
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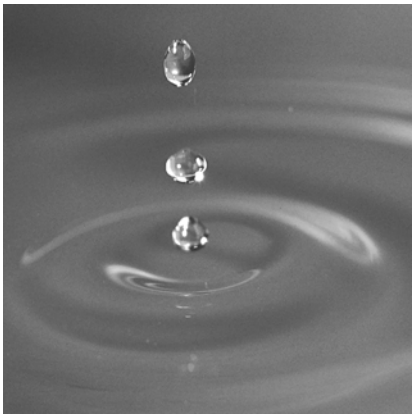

Ginger Gillin
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Executive Summary

PPL Montana is owner and operator of the Thompson Falls Dam, located on the Clark Fork River near Thompson Falls, Montana. The current Federal Energy Regulatory Commission (FERC) license was issued to Montana Power Company (now PPL Montana) in 1979 and is scheduled to expire on December 31, 2025. In 1998, the bull trout (*Salvelinus confluentus*) was federally listed under the Endangered Species Act (ESA) as a threatened species (Federal Register, 1998); and critical habitat was designated in 2005 (Federal Register, 2005). Because bull trout are present within the project area, a biological evaluation (BE) was prepared for the Thompson Falls project and submitted to the U.S Fish and Wildlife Service (USFWS) and FERC in 2003. The BE concluded that the Thompson Falls project was likely to adversely affect bull trout.

As a result of these findings, an informal consultation between PPL Montana and the USFWS identified the need to assess the means to implement adult, upstream fish passage at the Thompson Falls Dam for bull trout and potentially other trout species. Consequently, PPL Montana submitted a long-term plan to develop adult fish passage at Thompson Falls Dam to the USFWS. The long-term plan identified the need for additional fish behavior, primarily bull trout, and project operations data prior to the development of a permanent fish passage facility at Thompson Falls Dam.

PPL Montana, in consultation with GEI Consultants, Inc. (GEI), developed a study plan for 2004, 2005, and 2006 to evaluate fish behavior and potential locations for a new upstream passage facility. The fisheries work for PPL Montana's tailrace fish behavior study was planned and implemented in cooperation with the USFWS, Montana Fish, Wildlife and Parks (MFWP), Avista Corporation, NorthWestern Energy, and the Confederated Salish and Kootenai Tribes.

PPL Montana's tailrace fish behavior study was conducted over the course of three seasons (2004-2006). The overall goal was to establish a stationary radio telemetry receiver array and identify movement patterns of tagged fish. Analysis of fish behavior and movement would facilitate the understanding of where the ideal location for a permanent fish passage facility could be constructed. Data collected from 2004 was also used and analyzed as the baseline, from which revisions to the study design were implemented during the 2005 study. Telemetry data collected in 2005 was analyzed to distinguish fish movement and behavior related to the three main areas of the Thompson Falls project area (main channel dam, dry channel dam, and the powerhouse tailraces). Telemetry data analyzed from 2004 and 2005 indicated the main channel dam as the most likely location for a fish passage facility. In addition, the 2006 study plan monitored fish behavior and response to manipulating the flashboard operations at the main channel dam. In 2006, the study plan was fine-tuned to focus primarily on the main channel dam, which was represented by four antennae (left,

center, right, and right abutment). Telemetry data from 2006 further evaluates and defines the optimal location for an entrance to a fish passage facility at the main channel dam area. This report focuses on the findings in 2006 with some comparison to 2005 when relevant.

Although the fish that enter the project area do not remain in one location and appear to be searching and constantly on the move; fish in the project area were most frequently detected by the hilltop and main channel dam (main dam) antennas in 2005 and 2006. This study confirmed that trout enter the tailrace of Thompson Falls Dam in the early spring, beginning in March and April, and that arrival to the project area varied slightly by species. Rainbow trout arrived the earliest followed by brown and westslope cutthroat, and then bull trout.

In 2006, opening half of one spillway panel to create an attraction flow at the main channel dam prior to spill was successful in attracting fish to the main channel dam. There was a notable shift in location of fish to the main channel dam area in 2006 compared to 2005, when no attraction flow was released at the main channel dam.

An experiment was conducted to see if opening a half a panel on the right of the main channel dam, and then on the left, would cause fish to move in response. No discernable response was detected that could be directly attributable to the changing location of the attraction flow.

A spill schedule was developed to direct the opening of spill panels during the spill period. The purpose of this effort was to attract fish to the right bank during spill by providing an attraction flow and suitable holding water near the right bank and, at the same time, creating hydraulically violent conditions on the left bank. More fish spent more time on the right bank than near the left bank in 2006. This is in contrast to 2005, when spill was not "shaped" to attract fish to the right bank, and fish were more attracted to the left bank.

In summary, the 2006 telemetry results indicate that releasing a small amount of water at the main channel dam in the early spring prior to spill will attract fish to the main channel dam area. In addition, fish can be attracted to the right bank by modifying hydraulic conditions at the main channel dam.

These results were presented to an Interagency Technical Committee (the "Committee") in June and October 2005. In addition, results of the Thompson Falls fishway engineering feasibility study were also discussed at those meetings. The Committee concluded, based on the results of these two studies, that the best alternative to provide fish passage at the Thompson Falls project is a full height fish ladder at the right bank of the main channel dam.

The next steps in the process are to complete the design of the fish ladder, and to prepare the needed documentation for permitting construction.

1.0 Introduction

1.1 Background

PPL Montana is owner and operator of the Thompson Falls Dam, located on the Clark Fork River near Thompson Falls, Montana. The current Federal Energy Regulatory Commission (FERC) license was issued to Montana Power Company (now PPL Montana) in 1979 and is scheduled to expire on December 31, 2025. In 1998, the bull trout (*Salvelinus confluentus*) was federally listed under the Endangered Species Act (ESA) as a threatened species (Federal Register, 1998); and critical habitat was designated in 2005 (Federal Register, 2005). Because bull trout are present within the project area, a biological evaluation (BE) was prepared for the Thompson Falls project and submitted to the U.S Fish and Wildlife Service (USFWS) and FERC in 2003. The BE concluded that the Thompson Falls project was likely to adversely affect bull trout.

As a result of these findings, an informal consultation between PPL Montana and the USFWS identified the need to assess the means to implement adult, upstream fish passage at the Thompson Falls Dam for bull trout and potentially other trout species. Consequently, PPL Montana submitted a long-term plan to develop adult fish passage at Thompson Falls Dam to the USFWS. The long-term plan identified the need for additional fish behavior, primarily bull trout, and project operations data prior to the development of a permanent fish passage facility at Thompson Falls Dam.

Before the installation of any permanent fish passage facility, PPL Montana created a study plan (2004-2006) to gather additional data on the behavior of the target species as they enter the project area during their upstream migration. Knowledge of the target species movement patterns in the tailrace of Thompson Falls Dam is critical to understanding the ideal location of any future fish passage facility. In addition, understanding how fish behavior might change in relation to changing dam operations and varying river discharge is critical for determining the ideal location of a passage facility and how dam operations might be manipulated to improve passage. An understanding of these variables are especially important for the Thompson Falls project because of the complexity of the site, including two dams separated by an island, two powerhouses, a long wingwall between the powerhouses, and a large tributary (Prospect Creek) adjacent to the project.

PPL Montana, in consultation with GEI, developed a study plan for 2004, 2005, and 2006 to evaluate fish behavior and potential locations for a new upstream passage facility. Fisheries work included in this study plan included the collection of fish via trap and electrofishing, analysis of water quality data, and analysis of predator abundance upstream in Thompson Falls Reservoir via gill netting. The fisheries work for PPL Montana's tailrace fish behavior

study was planned and implemented in cooperation with the USFWS, Montana Fish, Wildlife and Parks (MFWP), Avista Corporation, NorthWestern Energy, and the Confederated Salish and Kootenai Tribes.

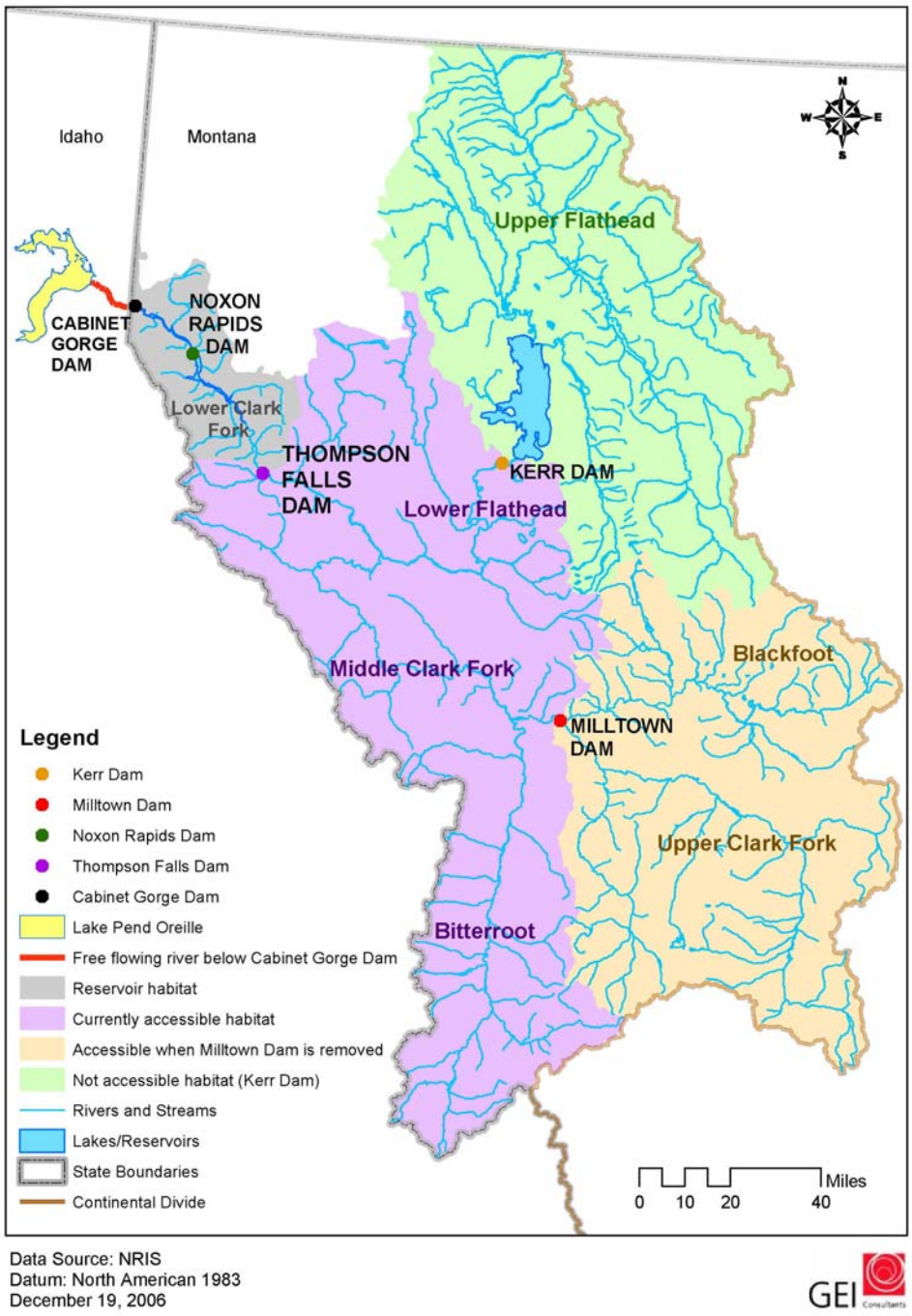

Figure 1: Map of the Clark Fork River Drainage and the location of Thompson Falls Dam

1.2 Project Description

The Thompson Falls Dam began operation in 1915 and is now a 92.6 megawatt (MW) hydropower facility that contains two powerhouses (Figure 2). FERC re-licensed the hydropower facility to the Montana Power Company (now PPL Montana) in 1979, and amended the license to include the new powerhouse in 1990. Currently, there is no upstream fish passage facility present at this facility.

The existing facilities enable water to be released from four major locations (two spillways, two powerhouses) (Figures 2 and 3). These flows change at different times of the day, season, and year; and are variable from year to year depending on runoff volume and snowmelt timing as well as power demands and tradeoffs between the two powerhouses. Additionally, flows emerge from Prospect Creek on the south (left) bank within a quarter-mile downstream of the dam. There are thus five sources of water that may provide attraction for upstream migrating fish depending on the time of year, species, and location of natal stream. Movements of fish into any specific area will be influenced by the volume and velocity of discharges in the river, the creek and the powerhouses (spill and generator operations).

In 2001, PPL Montana and MFWP installed a Denil fish ladder and trap box near the left bank of the lower Clark Fork River downstream of the main channel dam. This site was selected because fish had been observed in this area, jumping towards the dam. The trap has been successful at catching a variety of native and non-native fishes; therefore it is believed that at least some migratory fish that enter the project area head upstream into the vicinity of the main channel dam. However, the location and "success" of collecting fish in the trap does not equate to the best location for a permanent fishway. The percentage of fish that attempt to pass the dam that find their way into the existing trap is unknown. In addition, the length of time fish need to find this location is also unknown.

1.3 Study Objectives

PPL Montana's tailrace fish behavior study was conducted over the course of three seasons (2004-2006) (GEI, 2005 and 2006). The overall goal was to establish a stationary radio telemetry receiver array and identify movement patterns of tagged fish. Analysis of fish behavior and movement would facilitate the understanding of where the ideal location for a permanent fish passage facility could be constructed.

Data collected from 2004 was also used and analyzed as the baseline, from which revisions to the study design were implemented during the 2005 study (GEI, 2005). Telemetry data collected in 2005 was analyzed to distinguish fish movement and behavior related to varying spill regimes between the three main areas of the Thompson Falls project area (main channel

dam, dry channel dam, and the powerhouse tailraces) (GEI, 2006). Telemetry data analyzed from 2004 and 2005 indicated the main channel dam as the most likely location for a fish passage facility (GEI, 2005 and 2006). In addition, fish appeared to respond to varying spill regimes in 2005, thus the 2006 study plan monitored fish behavior and response to manipulating the flashboard operations at the main channel dam.

The 2006 study plan was fine-tuned to focus primarily on the main channel dam, which was represented by four antennae (left, center, right, and right abutment). PPL Montana's operations and flashboard data for Thompson Falls Dam were automatically downloaded to GEI's server allowing for simultaneous analysis of flow and fish telemetry data for each area of the project. This analysis will further evaluate and define the optimal location for an entrance to a fish passage facility at the main channel dam area.

In 2006, various fisheries research activities from 2004 and 2005 were continued at Thompson Falls Dam. These activities were a collaborative effort between PPL Montana, MFWP, and GEI and included: 1) the set up and use of stationary telemetry receivers; 2) radio tagging of salmonids using coded radio telemetry tags; 3) the use of the Thompson Falls fish trap,;4) electrofishing in the Clark Fork River, 4) gill netting in Thompson Falls Reservoir; and 5) manual and remote tracking of the movement of tagged fish below Thompson Falls Dam. All activities except gill netting were focused on fish behavior below Thompson Falls Dam. Gillnet data provided information regarding the abundance of large predators upstream in Thompson Falls Reservoir, thus the potential risk of predation for fish if passed upstream.

PPL Montana and the Avista Corporation continued their collaboration so that the remote telemetry stations at Thompson Falls could detect both PPL Montana and Avista-tagged bull trout if they migrated into the project area. Therefore, telemetry data from 2006 consists of both PPL Montana-tagged trout and any Avista-tagged bull trout that may have entered the project area.

This report summarizes all 2006 activities and provides further details regarding the results from the remote telemetry research, for the purpose of addressing the optimum location for a fish passage facility. This report focuses primarily on the findings in 2006 with some comparison to 2005 and 2004 when relevant.

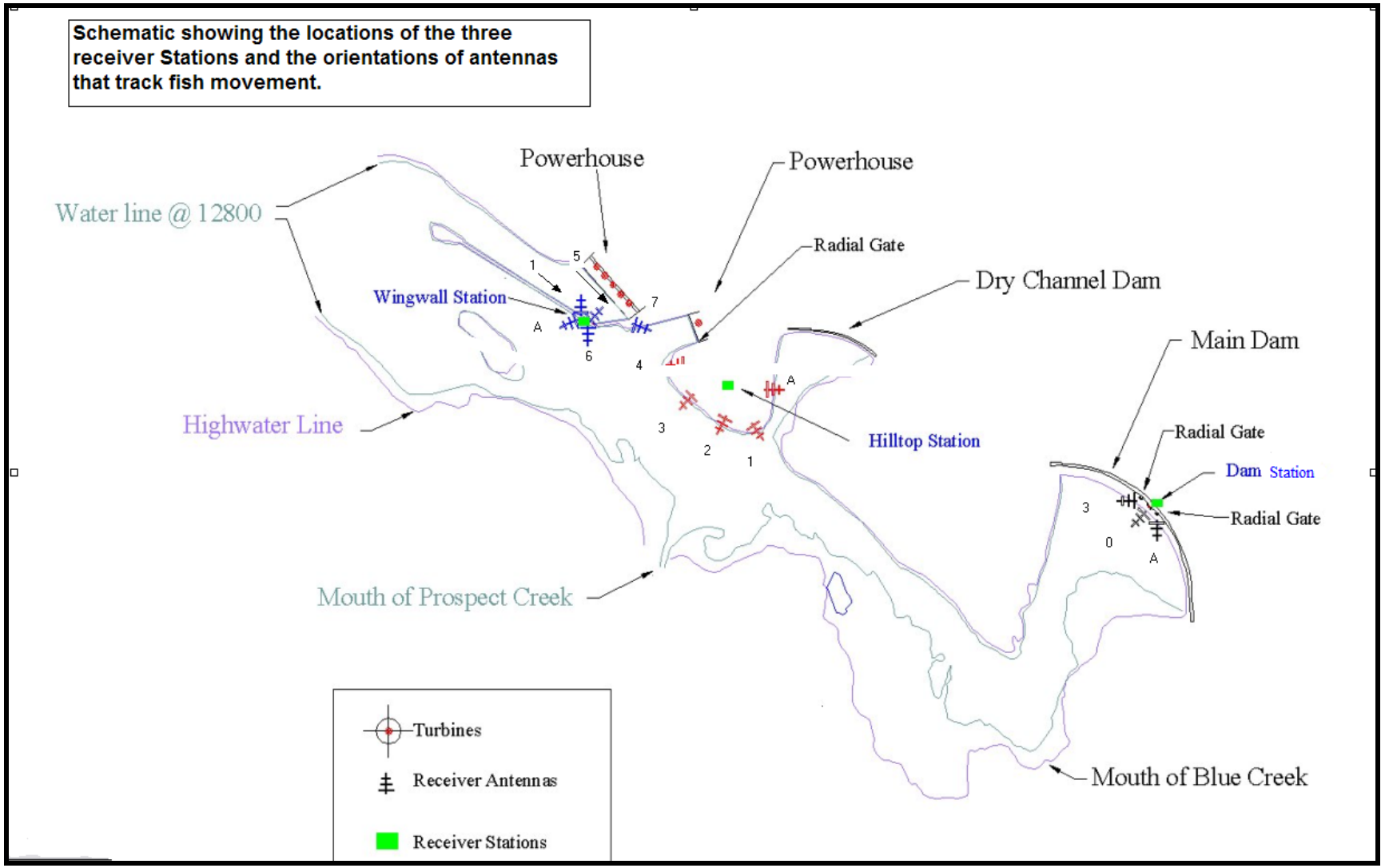

Figure 2: Schematic of Thompson Falls project area indicating the location of the two powerhouses, two dams, three radio telemetry stations, and the coverage direction of all antennas. New (2006) antenna along right abutment of the main channel dam is not represented in this schematic

Figure 3: Photo of Thompson Falls project looking upstream (east).

2.0 Methods

Methods utilized in 2006 were also implemented in 2005 (GEI, 2006). There was one additional antenna situated along the right abutment at the main channel dam in 2006 provided some new data not previously collected.

2.1 Fish Sampling

2.1.1 Thompson Falls Denil Fish Trap

River discharge was the main factor influencing when the trap was operational. During the spring freshet, the trap area becomes inaccessible due to spill at the dam. Trap dates for 2006 were March 24, 2006 to April 10, 2006 and July 26, 2006 to October 10, 2006.

Trapping and tagging ceases once the water temperature reached 16 degrees Celsius (˚C). This upper limit was set to reduce the amount of stress fish were exposed to during the ongoing fisheries monitoring activities.

2.1.2 Electrofishing

Night electrofishing in the Clark Fork River downstream of Thompson Falls Dam was conducted on 11 occasions in March, April, May, October, and November during 2006.

Each electrofishing effort began after sunset but lasted for a variable duration. Electrofishing using a jet boat mounted with an electrofishing unit was used in areas thought to hold salmonids. Since the objective was to catch salmonids for radio tagging, no catch per unit effort data was obtained.

2.1.3 Reservoir Gill Netting

On October 12, 2006, experimental mesh gill nets (n=10) were set in the Thompson Falls Reservoir to evaluate fish species composition. The nets were fished for an average of 18 hours. Nets were set perpendicular to the shore and fished from 0 ft to 30 ft in depth. On October 13, 2006, the nets were pulled in the morning, taken to shore where the fish were removed and data collected by MFWP, PPL Montana, and GEI personnel. Total lengths and weights were measured for all fish.

2.1.4 Angling

In contrast to 2004 or 2005, no angling was conducted in 2006.

2.1.5 Tagging Procedures

Salmonids tagged with radio telemetry transmitters during the 2006 season were captured using the Denil fish trap at Thompson Falls Dam, as well as electrofishing. Personnel followed protocol outlined in the *Study Plan: 2004 Thompson Falls Dam Fish Passage Studies* (GEI, 2004) for radio tagging all fish.

Bull trout, westslope cutthroat trout (*Oncorhynchus clarki lewisi*), rainbow trout (*O. mykiss*), and brown trout (*Salmo trutta*) were tagged with either coded or pulsed radio telemetry transmitters in 2006. Fish selected for radio tagging were placed in an anesthetic tank containing a minimal solution of MS-222. Once the fish were anesthetized, they were measured (total length) and weighed. The fish were then placed in a V-shaped trough with a clean towel to keep fish from sliding and to hold fish ventral side up. The gills were flushed with MS-222 water using a manual anesthetic infusion pump during the operation to maintain both oxygen and anesthetic to the gills. Prior to tagging, all surgical instruments and the operating area were disinfected. Radio tags weighing less than 2% of the fishes total weight were inserted into the fish through an incision made near the mid-ventral line and anterior to the pelvic girdle. Incision lengths were kept to a minimum, but varied depending on the size of radio tag being inserted. A cannula was used to insert the antenna through the body cavity musculature posterior to the pelvic girdle and was allowed to trail posteriorly. Between two and four surgical staples or sutures were used depending on the preference of the surgeon to close the incision. After surgery, fish were allowed to gain equilibrium in an aerated live well and were then transported either downstream or upstream to their release site.

Only fish that met the criteria outlined in the *Study Plan: 2004 Thompson Falls Dam Fish Passage Studies* (GEI, 2004) received radio tags. Fish were either released at the mouth of Squaw Creek or at Flatiron. Squaw Creek and Flatiron are located about seven miles downstream of the project in Noxon Reservoir.

In addition, all salmonids captured were scanned for previously implanted passive integrated transponder (PIT) tags. All bull trout, westslope cutthroat trout, and rainbow trout that did not have a PIT tag received one during the surgery. The PIT tags were placed in the body cavity next to the radio tag. Other trout (bull, brown, rainbow, and brown) not receiving radio tags were implanted with PIT tags using an injector into the same location. In addition to PIT tags, westslope cutthroat trout received an adipose fin clip for future identification.

Appendix A.1 has a listing of all fish collected with their length, weight, PIT tag number, and other specific sampling information.

Genetic samples were taken from all bull trout and westslope cutthroat trout captured during 2006. A small section of a rayed fin was clipped and placed in a container containing a 95 percent solution of ethanol. Westslope cutthroat trout genetic samples were then stored by MFWP and will be evaluated by a qualified laboratory at a future date. Bull trout genetic samples were analyzed by a U.S. Fish and Wildlife Service laboratory, results are in Table 3.1.1 .

2.2 Radio Telemetry Equipment

Digitally encoded radio transmitters (model MCFT-3FM and MCFT-3BM. Lotek Engineering, Newmarket, Ontario Canada) were used in the study and transmitted signals on one of three frequencies (148.300, 148.640, and 148.740 MHz). The two models of radio tags were cylindrical with a 300 millimeter (mm) whip antennae. Two sized tags were used during 2006. The MCFT-3FM weigh 10.0 grams (g) out of water, are 11 mm in diameter, 59 mm in length, and have an approximate operational life of 560 days at the set burst rate of 5 seconds. The smaller MCFT-3BM weigh 7.7 g out of water, are 11 mm in diameter, 43 mm in length, and have an approximate operating life of 278 days at the set burst rate of 5 seconds.

In all a total of six telemetry receivers were used at Thompson Falls Dam during 2006. Three were set to record the presence of PPL Montana's tagged fish and three were set to record the presence of Avista's tagged bull trout moved over Noxon Rapids Dam. The six receivers were manufactured by Lotek and were Model SRX_400. Each receiver was programmed with Code Log Version 4.2x W31 software and equipped with 64k data storage memory. Whenever a signal was detected, the receiver recorded the starting date and time, channel, code, antenna, power level, number of events, and stop date and time for that particular coded signal. The six receivers were kept in weatherproof enclosures and connected to a deep cycle 12 Volt battery (Sun Xtender Series, Concorde Battery Corporation) and an 80-Watt solar panel (Model SW90, SunWize® Technologies) with a solar controller (Model Sunsaver-10, Morningstar) (Figure 4). All receivers were connected to cellular modems allowing data to be downloaded from a distant location.

Figure 4: An example of the waterproof enclosure for the receiver

This receiver is located on the wingwall.

Nine-element and four-element Yagi antennae were used at the fixed monitoring locations. The antennae arrays were grouped together at the main channel dam and wingwall areas and separated at the hilltop (Figure 2). All antennae arrays were linked to two receivers and scanned sequentially. Antennas on the main channel dam and the wingwall were mounted on a stand built of 4"x 4" treated wood and bolted down into the concrete deck. The hilltop antennas were mounted using large wooden poles supported by plastic covered cable.

2.3 Telemetry Monitoring System Design

The movements of radio tagged salmonids released below Thompson Falls Dam were determined using three fixed monitoring stations. A monitoring station was established on the wingwall off the old powerhouse (Figure 5), the hilltop of the island between the new powerhouse (Figure 6) and the dry channel dam, and on the main channel dam (Figure 2). Each monitoring station consisted of two telemetry receivers (one for PPL Montana-tagged fish and one for Avista-tagged fish), which were connected to one antennae array. Dummy transmitters were used to validate the identification of transmitters in the desired areas at all stations. Occasionally more than one antenna identifies a transmitter at a given time. In this event, the power of the signal was used to identify what area a fish was residing in a specific area at a given time. Each antenna had a specific identifying number or letter to distinguish what specific antenna was receiving signals. A schematic of the Thompson Falls project area with the telemetry configuration is found in Figure 2. Note that in 2006 there was the addition of an antenna at the main channel dam (right abutment).

Figure 5: Telemetry monitoring station set up on the wingwall

The specific layout of the antenna arrays were as follows:

2.3.1.1 Wingwall

Five antennae were used to distinguish the location of fish from the wingwall receiver. The area specifically encompassed by the individual antennae and their identifiers were:

- Antenna 5. Right side of the wingwall (facing downstream) nearest to the east end of the old powerhouse.
- Antenna 1. Wingwall channel entrance (west side of wingwall channel).
- Antenna A. Clark Fork River downstream of the old powerhouse.
- Antenna 6. Main channel of the Clark Fork River adjacent (left side) to the wingwall.
- Antenna 7. New powerhouse tailrace.

2.3.1.2 Hilltop

Five antennae were used to distinguish the location of the fish from the hilltop receiver. The areas they specifically encompassed and their identifiers were:

- Antenna 4. Overseeing the new powerhouse tailrace and the mainstem Clark Fork River below island.
- Antenna 3. Mainstem Clark Fork River, just downstream of the mouth of Prospect Creek.

- Antenna 2. Mainstem Clark Fork River encompassing the mouth Prospect Creek.
- Antenna 1. Mainstem Clark Fork River, just upstream of the mouth of Prospect Creek.
- Antenna A. Dry channel dam tailrace.

Figure 6: Telemetry monitoring station set up on the hilltop

2.3.1.3 Main Channel Dam

Four (one additional antenna compared to 2004 and 2005) antennae were used to distinguish the location of fish from the dam receiver. The areas they specifically encompassed and their identifiers were:

- Antenna 3. Right side (facing downstream) of main channel dam tailrace.
- Antenna 7. Right side abutment (new antenna added in 2006).
- Antenna 0. Middle of main channel dam tailrace.
- Antenna A. Left side (facing downstream) of main channel dam tailrace.

Telemetry hits (presented in results section) only include fish that had multiple recordings on the telemetry arrays. In other words, fish that were only recorded for a brief time period were not analyzed due to the possibility that the receivers had in actuality recorded noise instead of an actual tagged fish. In addition, surgeries to install transmitters in fish collected in the trap were performed at the trap – within range of the antennae on the main channel dam. These detections were removed from the data set. In addition, telemetry results of westslope cutthroat x rainbow trout hybrids were classified as rainbow trout.

2.4 Spill Configuration

Once powerhouse capacity is exceeded, spill is initiated at the main channel dam. This feature is furthest upstream, and is located in the original river channel (immediately above the original falls) (Figure 3). The spillway has 36 spill bays, with 34 bays having six manually-operated spill panels (lift panels) each (Appendix D). Two large center-dam radial gates compose spill bays 16 and 17. They are each 41 ft wide, and a capacity of approximately 11,000 cubic feet per second (cfs). Their primary functions are to keep the forebay at a constant elevation at night during the spring (on the rising hydrograph), until operators can adjust the required lift panel numbers the next day; and, to maintain reserve emergency load-rejection capacity. Lift panels (4 ft wide and 8 ft high) are manually raised and lowered during daylight hours by a tracked lift. Each panel passes 233 cfs. The 10-12 panels to the right of the two radial gates are near the forebay trash boom tied to the dam, and are rarely opened (Appendix D). Project operators try to balance lift panel openings on each side of the trash shear boom, which minimizes excessive lateral hydraulic loading and limits boom problems.

Capacity of 192 spill panels is approximately 44,736 cfs. Flow from each lift panel spreads laterally as it passes down the spillway face and onto a concrete apron, before passing into the bedrock-lined tailrace channel (Appendix D).

Underneath the lift panels are eight, 1-ft high wood bulkheads. In years when total river discharge is expected to exceed 100,000 cfs during the spring freshet, there is a need to increase spillway capacity. A special operation removes bulkheads before the spill season, and they remain removed until after high runoff subsides. During normal and low runoff years, these bulkheads are not opened. Total main channel dam spill capacity, with all lift panels opened and without bulkheads opened, and including the two radial gates, is approximately 69,000 cfs. Currently, uncontrolled leakage of bulkheads varies, depending on the success of manual efforts to block leakage, and can total up to approximately 200 cfs.

A spillway operating schedule was developed for the 2006 tailrace fish behavior study, to determine whether tailrace hydraulic conditions could be manipulated to influence where fish hold in the main channel dam spillway tailrace. It was determined that this operating schedule was not detrimental to project operations. This spill schedule is a living document, and can be changed at any time to reflect additional appropriate fisheries or operational input (Appendix E). The principle is that three initial attraction lift panels are opened to attract fish to the right abutment tailrace area during low spill, then lift panels at the left abutment (starting at spill bay 36) are opened sequentially to the right – thereby creating a turbulent zone at the left spillway that pushes fish to the right (Appendix D). The most current spill schedule is in Appendix E.

2.5 Automated Data Collection (Telemetry & Flow)

Data from the receivers were automatically downloaded via cellular modems on a daily basis to a server computer in GEI's Bozeman, Montana office. All data were then entered into a database and post processed. The post processing consisted of using an algorithm to assign a signal to a specific antenna. Since many antennas at one station could receive an individual signal during an individual time interval, it was necessary to distinguish where the signal was the strongest. Therefore, the algorithm decided which antenna had the signal and which antenna had the strongest signal during a 15-minute interval. Thus, the signal is assigned to only one antenna for each 15-minute interval. This greatly helped with data analysis, since a multitude of data are generated when a signal is being read. Furthermore, making the decision of which antenna had the strongest signal in a given time period can be very laborious if conducted manually.

Additionally, PPL Montana's operations and flashboard data for Thompson Falls Dam were automatically downloaded to GEI's server. This allowed for simultaneous analysis of flow and fish data for each area of the project. For this analysis, flow was broken into three general areas, flow through the new and old powerhouses (wingwall), flow in the form of spill at the dry channel dam, and flow in the form of spill at the main channel dam (Figure 3). We also evaluated where spill was occurring at the main channel dam, allowing us to evaluate where fish were holding at the main channel dam concurrent with spill in 2006.

3.0 Results

3.1 General Tagging and Tracking Results

A total of 40 trout were radio tagged by PPL Montana in 2006; 13 were captured in the fish trap and 27 were captured via night electrofishing (Table 1). These fish included three bull trout, three brown trout, five westslope cutthroat trout, 17 rainbow trout, and 12 westslope cutthroat x rainbow trout hybrids. However, four of these fish (two rainbow and two westslope cutthroat x rainbow trout hybrids) were tagged in October and November. The results presented in this report only cover the 36 trout tagged in the spring. Trout tagged in the fall will be tracked over the 2006 – 2007 time period if they enter the project area.

During 2006, the Avista Corporation transported a total of 12 bull trout upstream over Noxon Rapids Dam (Figure 1). Of the 12 bull trout, eight were radio tagged. Of the radio tagged bull trout, two bull trout entered the project area, one in the spring (May/June) and the other in the fall (October/November), but later returned downstream to the Noxon Reservoir. As of December 2006, two of the eight radio tagged bull trout had died and five of the remaining six were located in Noxon Reservoir.

Of the 40 PPL Montana tagged fish, six fish were later located downstream of Noxon Rapids Dam in Cabinet Gorge Reservoir and 16 fish died or were presumed dead during the study season. As a result, only 18 fish are assumed to be alive and in the Noxon Reservoir area as of this writing (January 2007). These 18 fish are: one bull trout, one brown trout, 10 rainbow trout, two westslope cutthroat trout, and four westslope cutthroat x rainbow trout hybrids. However, many of the fish that died spent time in the project area after tagging but before death. Therefore, we were able to collect data on all but one of the fish that later died. The average length of time between tagging and assumed mortality was 90 days, with a range of 28 - 151 days.

In addition, data were collected on three of the fish that passed downstream of Noxon Dam when they entered the project area before migrating downstream.

A total of 52 individual fish were tracked in the project area in 2006 (through September 13, 2006). This includes fish tagged by PPL Montana in 2006, 2005, and also bull trout tagged by Avista Corporation. Of the 40 fish radio tagged by PPL Montana in 2006, 32 returned to the Thompson Falls Project area after tagging.

Table 1: Summary of all fish radio tagged, captured in Thompson Falls' Denil fish trap or via electrofishing, by PPL Montana in 2006. Yellow highlights represent fish that were detected in the project area at some point during 2006.

2006 PPL Radio Tagged Fish				Length (mm)	Weight (g)	Tag Life	Release Location	PIT #	Status
Species	Frequency	Code	Date						
BLT	148.300	87	4/6/06	341	560	250d	Squaw Cr	466C27584F	Dead
BLT	148.640	105	4/13/06	485	1115	455d	Flatiron	98512001987005	Presumed Alive
BLT	148.640	102	5/3/06	775	3941	455d	Flatiron	985120019717038	Dead
BRN	148.300	74	3/9/06	382	460	250d	Flatiron	466D14630F	Dead
BRN	148.640	111	3/9/06	412	550	455d	Flatiron	466C12525E	Presumed Alive
BRN	148.300	21	3/9/06	357	407	250d	Flatiron	466C28617F	Dead
RBT	148.640	99	3/9/06	456	865	455d	Flatiron	46692F3406	Presumed Alive
RBT	148.640	103	3/9/06	485	1045	455d	Flatiron	466B3A2F2A	Presumed Dead
RBT	148.640	112	3/9/06	525	1367	455d	Flatiron	46693E4377	Presumed Alive
RBT	148.640	109	3/9/06	422	716	455d	Flatiron	466B33543C	Presumed Alive
RBT	148.300	75	3/9/06	430	813	250d	Flatiron	985120019766203	Dead
RBT	148.640	101	3/13/06	450	434	455d	Flatiron	466B507866	Dead
RBT	148.640	113	3/13/06	536	1984	455d	Flatiron	46695E2D1	Cabinet Reservoir
RBT	148.640	110	3/13/06	460	1003	455d	Flatiron	466B4A7545	Presumed Dead
RBT	148.300	84	3/29/06	440	755	250d	Squaw Cr	466C0F0743	Presumed Alive
RBT	148.300	80	3/29/06	481	976	250d	Squaw Cr	4668792377	Presumed Alive
RBT	148.300	82	3/29/06	473	1009	250d	Squaw Cr	4669690148	Presumed Alive
RBT	148.300	81	3/29/06	460	1025	250d	Squaw Cr	4668781B58	Dead
RBT	148.300	83	3/29/06	471	945	250d	Squaw Cr	466B326358	Presumed Alive
RBT	148.300	77	3/31/06	475	894	250d	Squaw Cr	466C1E135F	Presumed Dead
RBT	148.300	95	10/31/06	348	440	250d	Flatiron	98512001976597	Presumed Alive
RBT	148.640	106	11/13/06	431	810	455d	Flatiron	985120019866297	Presumed Alive
RBT	148.300	90	11/13/06	410	594	250d	Flatiron	985120019750449	Presumed Alive
WCT	148.300	91	3/13/06	342	398	250d	Flatiron	466941233F	Presumed Dead
WCT	148.640	108	3/13/06	432	732	455d	Flatiron	46696B0F47	Cabinet Reservoir
WCT	148.640	100	3/13/06	377	569	455d	Flatiron	466C197663	Presumed Alive
WCT	148.300	88	4/4/06	395	593	250d	Squaw Cr	466B5E347F	Dead
WCT	148.640	104	4/4/06	415	699	455d	Squaw Cr	465B333A7B	Presumed Alive

2006 PPL Radio Tagged Fish				Length (mm)	Weight (g)	Tag Life	Release Location	PIT #	Status
Species	Frequency	Code	Date						
WRHY	148.640	97	3/9/06	579	1720	455d	Flatiron	4669283257	Cabinet Reservoir
WRHY	148.300	69	3/9/06	364	412	250d	Flatiron	465A58316	Cabinet Reservoir/ Presumed Dead
WRHY	148.640	107	3/13/06	423	763	455d	Flatiron	4669531F15	Dead
WRHY	148.300	95	3/13/06	367	459	250d	Flatiron	466879776A	Cabinet Reservoir
WRHY	148.640	114	3/13/06	432	839	455d	Flatiron	466C2D3E2B	Presumed Alive
WRHY	148.640	115	3/13/06	378	520	455d	Flatiron	4669312874	Presumed Alive
WRHY	148.640	116	3/13/06	375	537	455d	Flatiron	4669327800	Cabinet Res
WRHY	148.300	92	3/28/06	445	996	250d	Squaw Cr	466D00C5E	Presumed Dead
WRHY	148.300	76	3/30/06	469	986	250d	Squaw Cr	4669142427	Dead
WRHY	148.640	98	4/4/06	543	1496	455d	Squaw Cr	466B4B5A19	Dead
WRHY	148.300	86	4/4/06	485	1025	250d	Squaw Cr	466B4E7915	Presumed Alive
WRHY	148.300	89	10/20/06	360	455	250d	Flatiron	985120016417544	Presumed Alive

3.1.1 Bull trout collections in 2006

Table 3.1.1. Summary of bull trout handled in 2006.

In 2006, three bull trout were collected by electrofishing and one by trapping. Three bull trout were radio tagged by PPL Montana, and two of these fish later entered the project area and were detected by both stationary and mobile tracking. Two of these fish are currently believed to be dead. One carcass was retrieved from Graves Creek 151 days after tagging. The radio tag from the other fish was retrieved from Prospect Creek 137 days after tagging. The fate of the rest of the handled fish is unknown.

Avista radio tagged eight bull trout that were transported to Noxon Reservoir. All of those fish migrated up the Vermilion River (at least briefly) after being released into Noxon Reservoir. One Avista bull trout was detected in the Thompson Falls Dam area before migrating into the Vermilion River.

Date	Length (mm)	Weight (g)	PIT Tag No.	Radio Freq.	Radio Code	Tag Weight (g)	Genetic Assignments (Most Likely Population #1/#2)	Method	Current Status
3/9/2006	245	103	465D167759	n	n	n	Prospect Ck/Morris	Efish	unknown
4/6/2006	341	560	466C27584F	148.300	87	7.7	Fishtrap Ck/Cedar	Trap	8/21/2006 tag retrieved 12 km up Prospect Creek
4/13/2006	485	1115	985120019870005	148.640	105	10	Fishtrap Ck/ Grouse Ck	Efish	unknown Last detected 9/7/06 @ Graves Creek mouth
5/3/2006	775	3941	985120019717038	148.640	102	10	Fishtrap/Upper Rock	Efish	10/1/2006 Retrieved fish 1.2 km up Graves Creek

3.2 Fish Sampling

3.2.1 Denil Fish Trap

The trap captured fish between March 28 and April 7, 2006, and between August 1 and September 22, 2006. The fish trap captured a total of 54 individual fish which included 34 trout (Table 2). Of the 34 trout captured, a total of 13 fish received radio telemetry tags. This included one bull trout, two westslope cutthroat trout, six rainbow trout, and four westslope cutthroat x rainbow trout hybrids. All trout, with the exception of one westslope cutthroat trout caught August 1, were captured during the spring trapping season, prior to April 7, 2006.

Table 2: Summary of fish captured in the fish trap downstream of Thompson Falls Dam in 2006

Date(s)	Species	Total Trapped	Length (mm) Range	Weight (g) Range
4/6/2006	Bull trout	1	341	560
8/1 - 9/21/06	Northern pikeminnow	19	313-191	121-271
9/20/2006	Pumpkinseed	1	131	51
3/29 - 4/7/06	Rainbow trout	25	218-542	164-1407
4/4 & 8/1/06	Westslope cutthroat trout	3	395-415	593-699
3/28-4/4/06	Westslope cutthroat x rainbow trout hybrids	5	445-543	961-1496

Spring runoff and spill over the dam commenced in early April (Figure 7). Spill continued into early July. The trap was back in operation by late July and continued to trap 19 fish, primarily northern pikeminnow along with one westslope cutthroat trout, until late September.

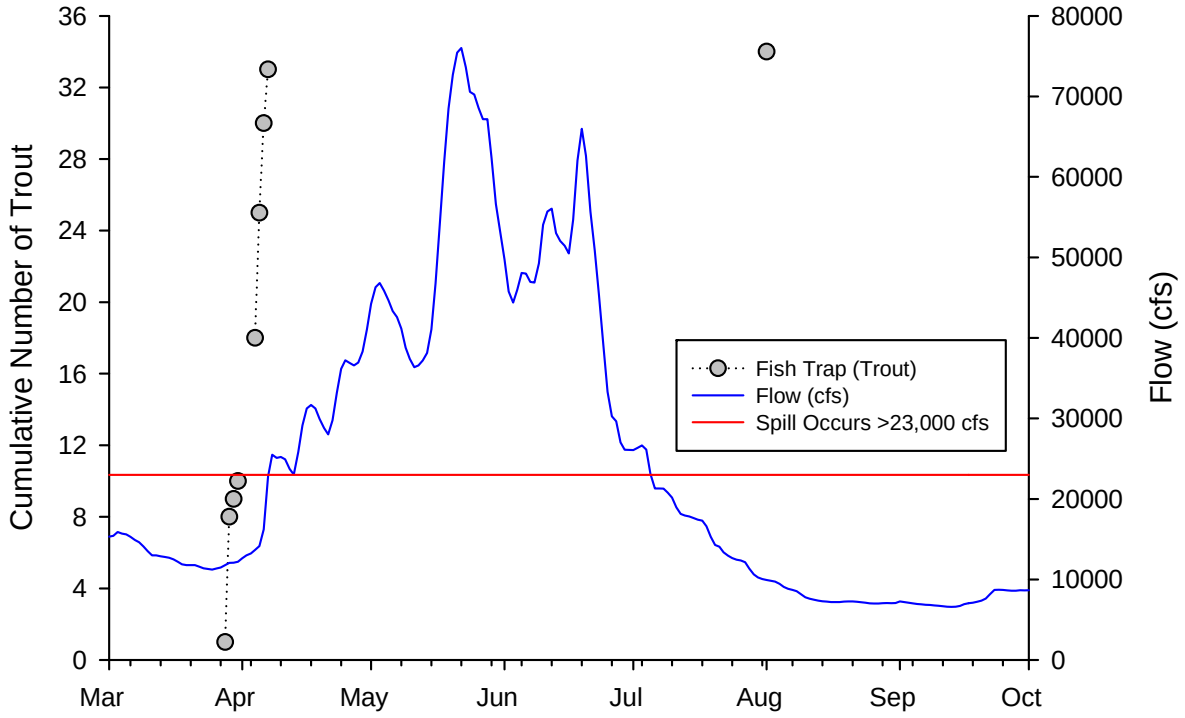

Figure 7: Cumulative number of combined trout (westslope cutthroat, rainbow, brown, and westslope cutthroat x rainbow trout hybrids) captured by date at the Thompson Falls Dam fish trap during 2006. Spill is the flow in excess of plant capacity which passed over the spillways, is indicated by red line (23,000 cfs). Flow represents combined flows measured at USGS gauge stations on the Clark Fork River in Plains, MT and the Thompson River, a tributary just upstream of Thompson Falls Dam

3.2.2 Electrofishing

Results from the 11 nights of electrofishing in 2006 are summarized in Table 3. A total of 93 fish were captured. Of the 93 fish, 78 were trout and the remaining 15 were either walleye, smallmouth bass, or northern pike. Of the 78 trout, we radio-tagged 27. The tagged fish included two bull trout, three brown trout, three westslope cutthroat trout, 11 rainbow trout, and eight westslope cutthroat x rainbow trout hybrids.

Table 3: Electrofishing data collected in March, April, May, October, and November 2006. BLT – bull trout, BRK – brook trout, BRN – brown trout, RBT – rainbow trout, NP – northern pike, WCT – westslope cutthroat trout, SMB – smallmouth bass, WE – walleye, WHRY – westslope cutthroat x rainbow trout hybrids

Species	Length (mm)		Weight (g)		Total
	Mean	Range	Mean	Range	
BLT	502	245-775	1720	103-3941	3
BRK		197		70	1
BRN	297	222-412	244	106-550	12
RBT	339	170-536	460	48-1984	41
WCT	296	183-423	297	48-732	10
WRHY	397	336-579	649	356-732	11
WE	534	426-623	1603	692-2480	6
SMB		313		386	1
NP	647	346-840	2347	237-4904	8

3.2.3 Gill Netting

A total of 10 gill nets were set in Thompson Falls Reservoir to identify fish species composition. Gill nets were set the night of October 12, 2006, and retrieved approximately 18 hours later during the morning of October 13, 2006. A total of 116 fish were captured representing seven species. The majority of fish were black bullhead (n=83) followed by northern pike (n=17) (Table 4). In previous years a few largemouth and smallmouth bass have been captured, however none were captured in 2006.

Table 4: Summary of fish composition from 10 gill nets retrieved from Thompson Falls Reservoir on October 13, 2006

2006	Length (mm)		Weight (g)		total n	# per net
	Mean	Range	Mean	Range		
Northern Pike	563	285-965	1814	162-7303	17	1.7
Yellow perch	189	*	8	*	1	0.1
Pumpkinseed	142	128-156	70.5	42-99	2	0.2
Northern pike minnow	459	395-482	949	575-1122	5	0.5
Largescale sucker	496	460-544	1271	954-1661	7	0.7
Peamouth	308	*	288	*	1	0.1
Black bullhead	208	149-306	145	46-285	83	8.3
Total					**116**	**11.6**

An overview of gill net data from 2004, 2005, and 2006 is provided in Appendix B. Overall, species composition has been similar among years with the exception of the increase in the number of black bullhead captured (Figure 8). The data indicate the abundance of predator species remains relatively consistent through the years (Figure 8).

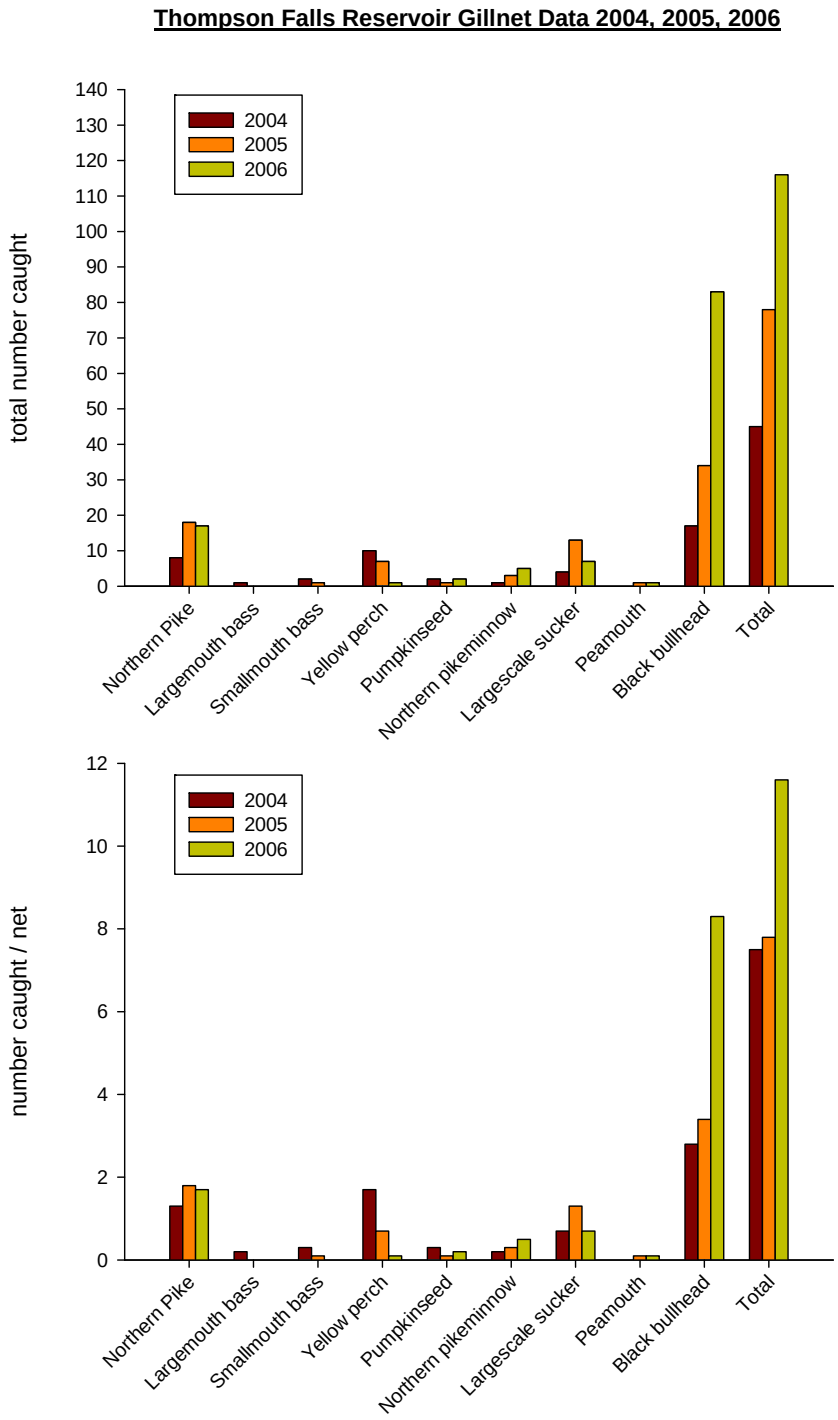

Figure 8: Above graphs summarize gill netting data from 2004, 2005, and 2006 at Thompson Falls Reservoir. The upper graph shows the total number of species captured each year. The lower graph shows the average number of species captured per net

3.3 Telemetry Results

3.3.1 Detection and Location

A total of 52 individual radio tagged fish were detected in the project area in 2006 (Table 5). This number exceeds the number tagged by PPL Montana because we also detected fish tagged in 2005 and fish tagged by Avista. Of the 52 fish detected, 46 were detected at the main channel dam, 45 were detected at the hilltop, and 39 were detected at the wingwall.

Table 5: Summary of fish detected at the Thompson Falls project, 2005 and 2006. MD = main channel dam

Metric	2006(a)	2005
# fish tagged by PPL	36	42
# of individual fish detected	52(b)	34
# fish detected at main channel dam	46	28
# fish detected at hilltop	45	34
# fish detected at wingwall	39	33
# of fish making forays to the MD-Right	44	26
# of fish making forays to the MD-Left	43	22
# of fish mostly at the MD—Right(c)	9	3
# of fish mostly at the MD—Left (c)	2	4

(a) As of September 13, 2006
(b) Includes two questionable bull trout, only detected very briefly
(c) Mostly is defined as at this location more than any other

The greatest activity of fish movement detected in the project area (telemetry hits) were recorded prior to the peak of spring runoff (between April and June). Telemetry data from March 1 to June 5 in 2005 and 2006 indicate trout tend to explore a large part of the project area, however, there are certain distinct areas where these fish spend most of their time. These areas include the hilltop and main channel dam. The hilltop antenna, specifically the one pointing upstream of the mouth of Prospect Creek received the highest number of hits in 2005 and 2006 (Figure 9). The main channel dam also received a large number of hits in both years, but with a substantial increase in 2006 (Figure 9). In 2005, between 50 – 70 percent of the fish detected in the project area made forays to the main channel dam. In 2006, this number increased to 80-90 percent of the fish in the project area (Figure 10). This is likely the result of providing attraction flow at the main channel dam in the pre-spill time period, and shaping the spill flow at the main channel dam to be more attractive to fish. In both years, the number of telemetry hits was fewest at the wingwall. Note that the main channel dam right abutment antennae was not installed until mid-spring 2006 after the majority of fish movement had been recorded, thus the data shown in Figures 9, 10, and 12 do not fully capture the presence of tagged fish visiting this area from March through June in 2006.

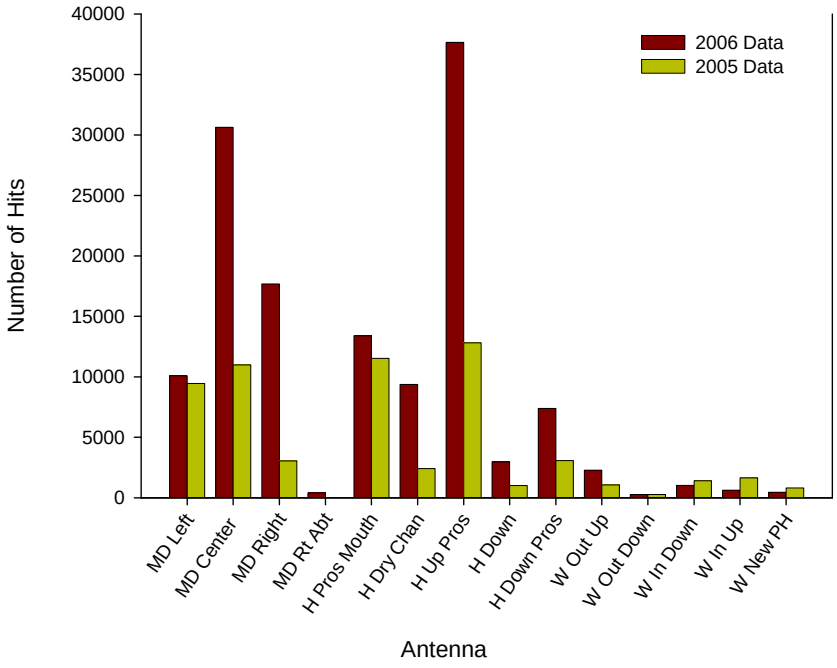

Figure 9: Number of hits on each antenna from March 1 through September 19 in 2005 and 2006

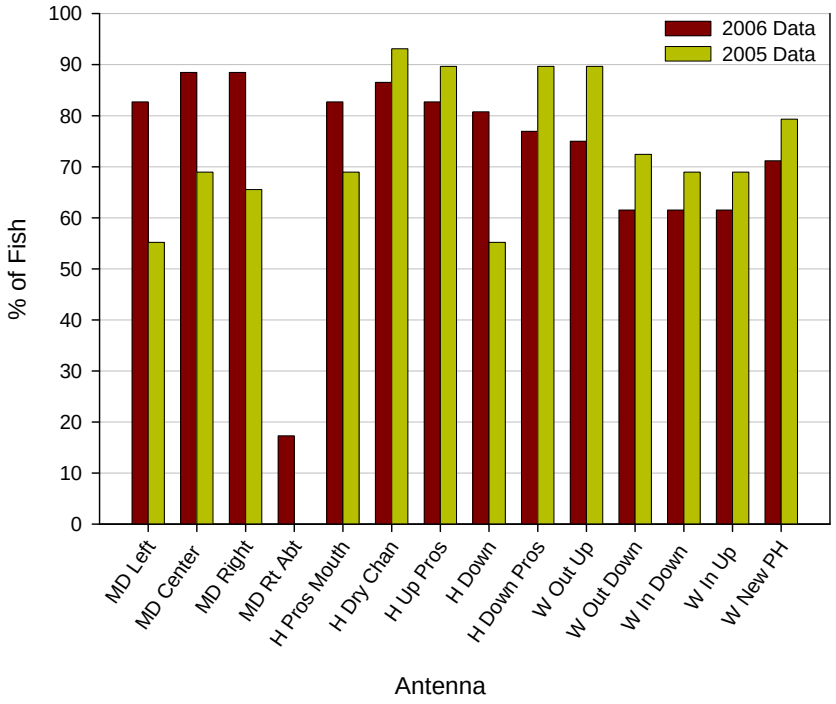

Figure 10: The percentage of total fish recorded in the project area at each antenna from March 1 through September 19 in 2005 and 2006. MD = main channel dam, H = hilltop, W = wingwall, Pros = Prospect, Abt=abutment, PH=powerhouse

As is apparent in Figure 10, most of the fish are detected at most of the receivers at least once. This indicates that fish move around in the tailrace area, possibly exploring for routes past the dam. However, as is clear from Figure 9, certain areas of the tailrace will attract fish for longer periods of time. Fish seem to briefly pass or explore the wingwall area, but do not hold there for extensive periods of time.

Figures 11 and 12 focus on bull and westslope cutthroat trout behavior in the project area in 2006. Bull trout were not detected in the project area in March. They made forays to the main dam in April and May. By June, they were primarily detected by the antenna pointing upstream of the mouth of Prospect Creek. Similarly, westslope cutthroat were rare in the project area in March and made forays to the main dam in April and May. For both species, most of the detections on the Main Dam right bank were made in May. However, westslope cutthroat were rarely detected in the project area after May.

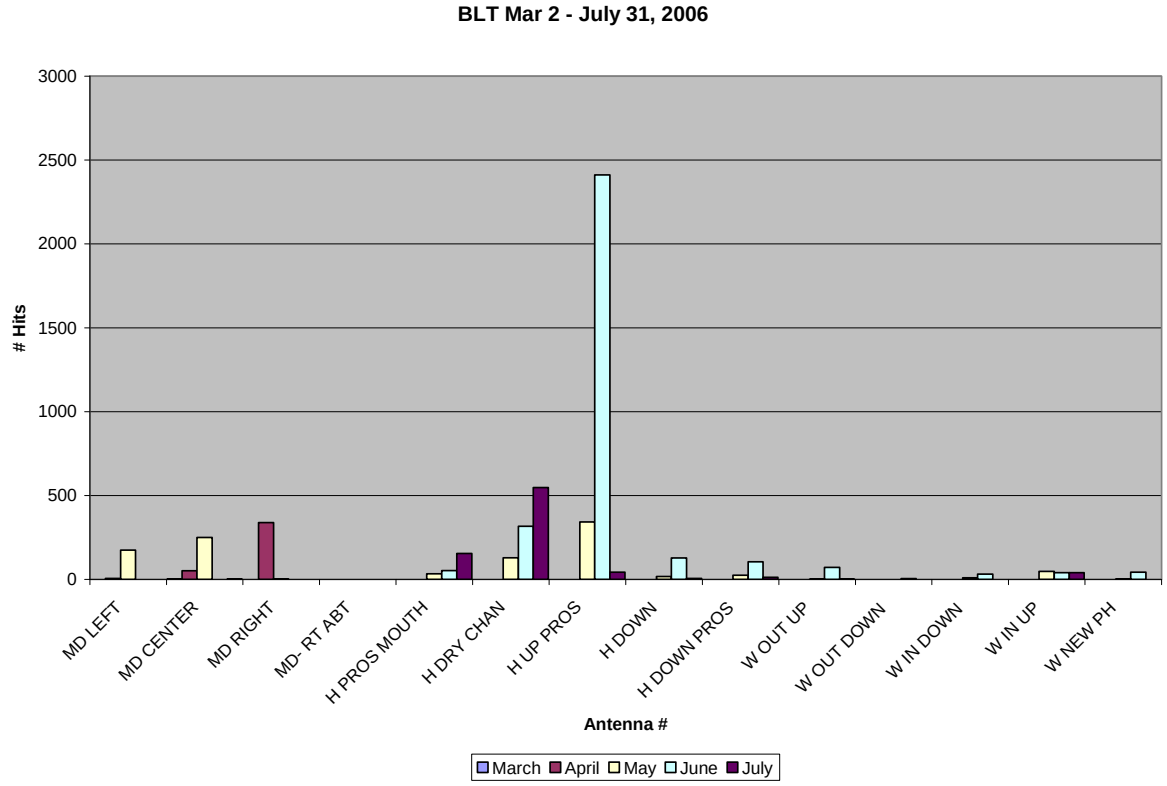

Figure 11. Bull trout distribution in the project area, by month, from March through July 2006.

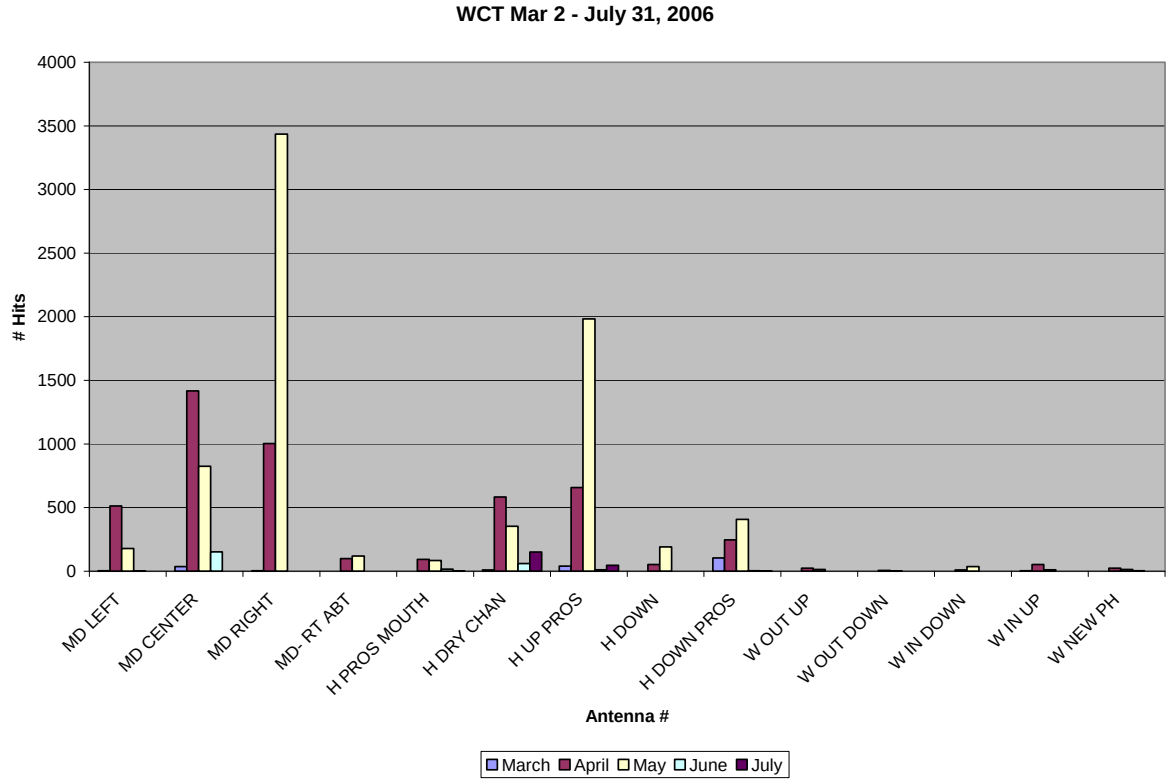

Figure 12. Westslope cutthroat trout distribution in the project area, March through July, 2006.

3.3.2 Flow Manipulation and Fish Response

3.3.1.1 Pre-Spill

In 2006, fish movement in response to changing the location of attraction flow was monitored as flashboards on the left and right of the main channel dam and at the dry channel dam were opened prior to spill. A single flashboard was partially lifted at the right side of the main channel dam for several days, then replaced and a flashboard lifted on the left, then one at the dry channel. This experiment was conducted from March 14 to April 11. The objective was to determine whether fish could be attracted to specific locations in the tailrace by providing attraction flow in these locations. The results were confounded by the fact that the number of radio tagged fish in the tailrace increased over time, and there was a general movement of fish upstream towards the main channel dam over time. To standardize the data, the percentage of telemetry hits is presented in Figure 11. The results indicate there was movement from the left, center, and right banks, and dry channel, however, these movements did not appear to be related or in response to the additional flow provided by the removal of specified flashboards. The results do not indicate any relationship between the

removal of flashboards at the main channel dam and movement of fish to the right or left bank pre-spill (Figure 11).

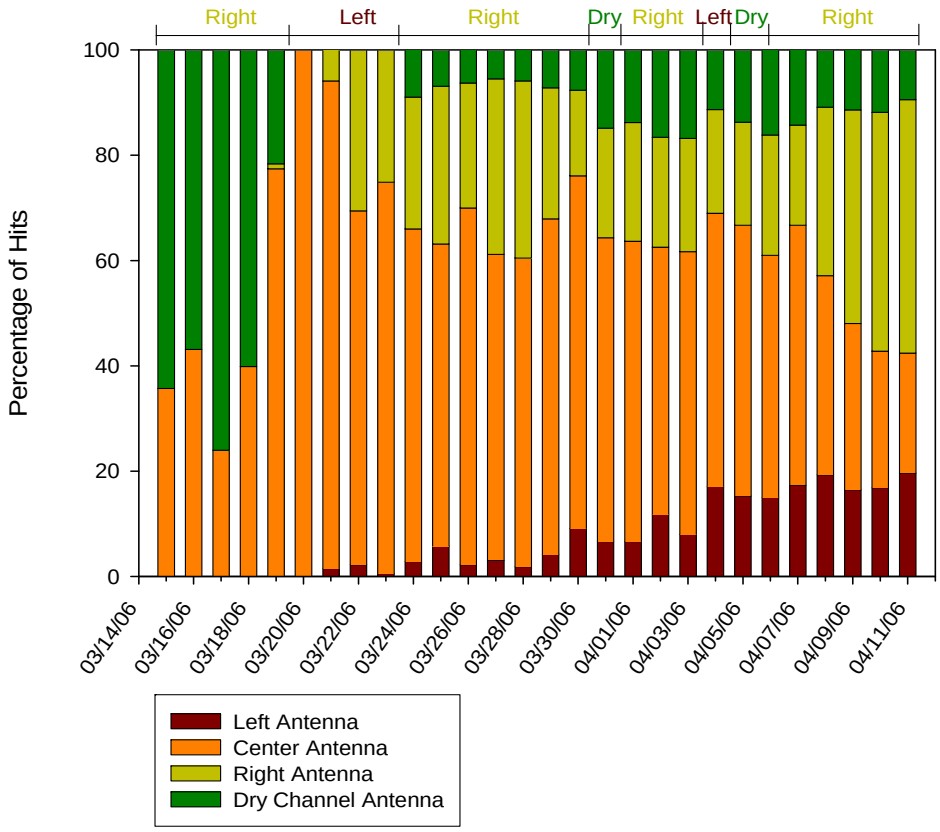

Figure 13: Percentage of total telemetry hits each day (March 15 through April 11, 2006) at each antenna (left, center, right, dry channel) in relation to flashboards opening. Text above the figure represent which flashboard was open (left, center, right, dry) and how long. Right refers to the right side when facing downstream

3.3.1.2 During Low Spill

In 2006, a spillway operating schedule (Appendix E) was developed to determine whether tailrace hydraulic conditions could be manipulated during spill to influence where fish hold in the main channel dam spillway tailrace. During this part of the study, three initial attraction lift panels were opened to attract fish to the right abutment tailrace area during low spill, then lift panels at the left abutment (starting at spill bay 36) were opened sequentially to the right – thereby creating a turbulent zone at the left spillway that pushes fish to the right. This operating schedule helped attract fish to the right abutment tailrace area (Figure 12), and was not detrimental to project operations.

In 2006, the radio telemetry data indicate a higher percentage of fish were detected at the main channel dam than in 2005. Additionally, behavior of the fish detected at the main channel dam appeared to change such that the majority of fish were detected at the main

channel dam right in 2006 versus main channel dam left in 2005. This was concluded to be a direct result of spill manipulation during low spill.

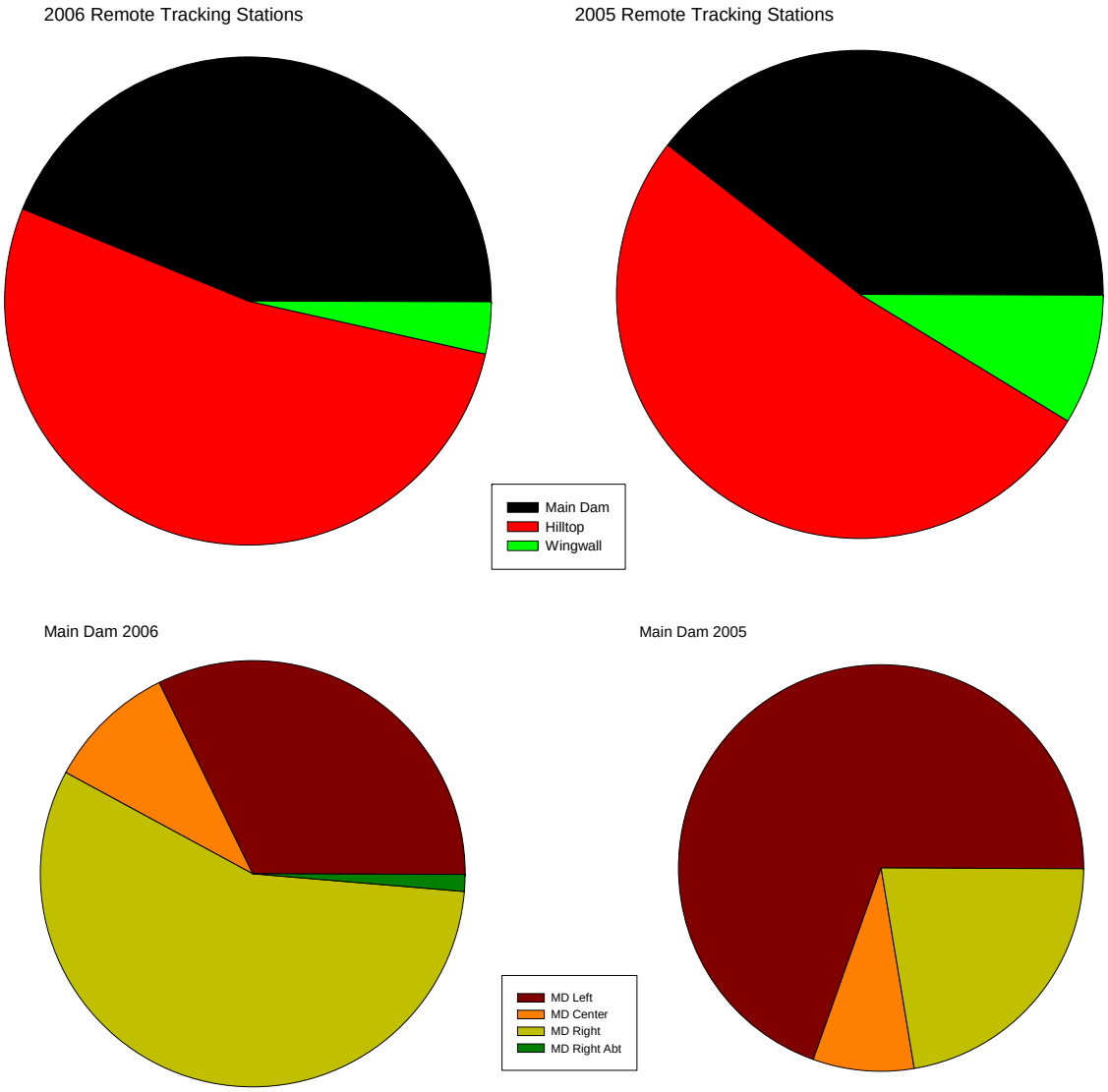

Figure 14: The percentage of total telemetry hits by proportion for the three remote telemetry stations (top two pie charts) and total telemetry hits by proportion for the four antennas at the Main channel dam (bottom two pie charts) at Thompson Falls. The data set for each pie graph represents telemetry hits that occurred between March 1 and June 5 in 2005 and 2006. MD = main channel dam, H = hilltop, W = wingwall, Pros = Prospect, Abt=abutment, PH=powerhouse

3.3.3 Timing

Timing of upstream fish migrations into the dam tailrace are available from two sources: the fish trap that has been in place, seasonally, at the main channel dam, since 2001 and the radio tracking study that has been on-going since 2004. The utility of the fish trap data is limited by the short season that the trap is operation. The trap is typically deployed in mid-March and then removed prior to spill. It can be reinstalled after spill, but at this time of the year water temperatures are generally too warm for safe daytime operation. Operating protocols for the trap call for limited trap operation, only under close supervision, when water temperature exceeds 16^{o}C (see 2006 Thompson Falls Study Plan). In 2006, water temperature climbed rapidly in late June, and consistently exceeded 16^{o}C after about June 20 through July at least (Figure 21). The radio telemetry study provides year-round data and monitors fish movement in a larger area covering the entire tailrace.

Telemetry data concurrent with flow data are presented in two formats: 1) total telemetry hits detected at each station (Figure 13) and by species (Figure 14); and 2) total number of fish detected at each station (Figure 15) and by species (Figure 16).

All of these figures (13-16) depict the peak movement of trout into the project area occurring March 26 through April 23, prior to the spring freshet in 2006. This was the same pattern observed in 2005. Total telemetry hits were most common at the hilltop and main channel dam stations (Figure 13).

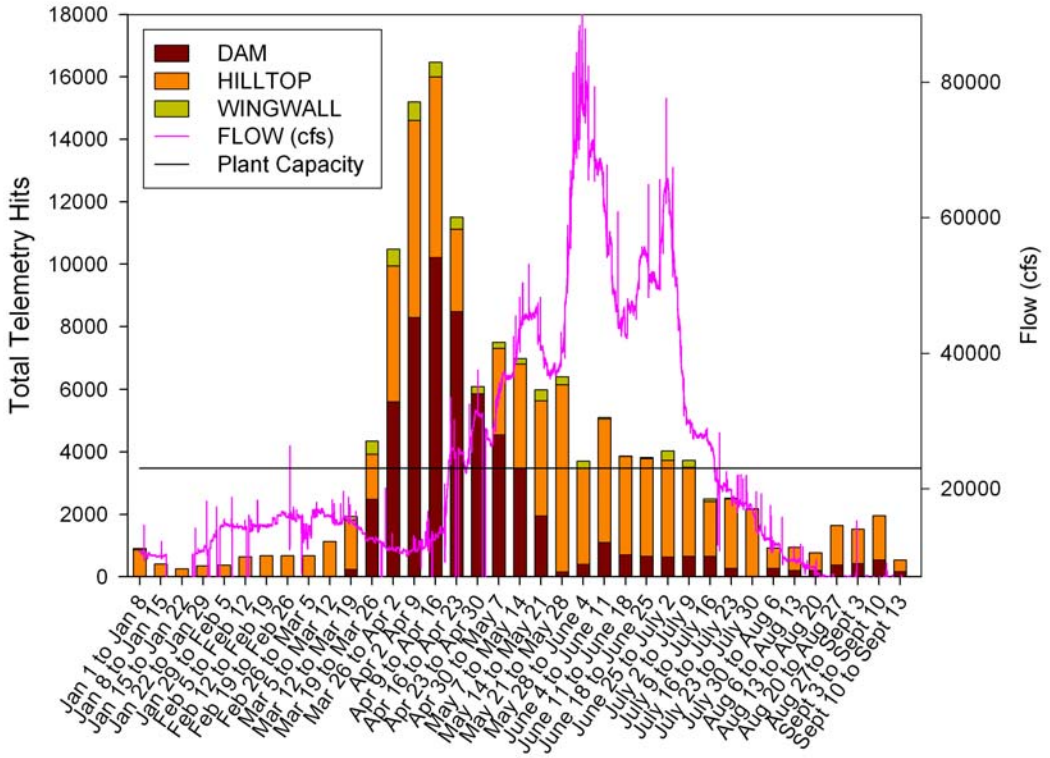

Figure 15: The total number of trout recorded by the remote telemetry receivers at the three remote stations (main channel dam, hilltop, and wingwall) at Thompson Falls Dam during 2006. River flows (cfs) as well as plant capacity (23,000 cfs) are also shown

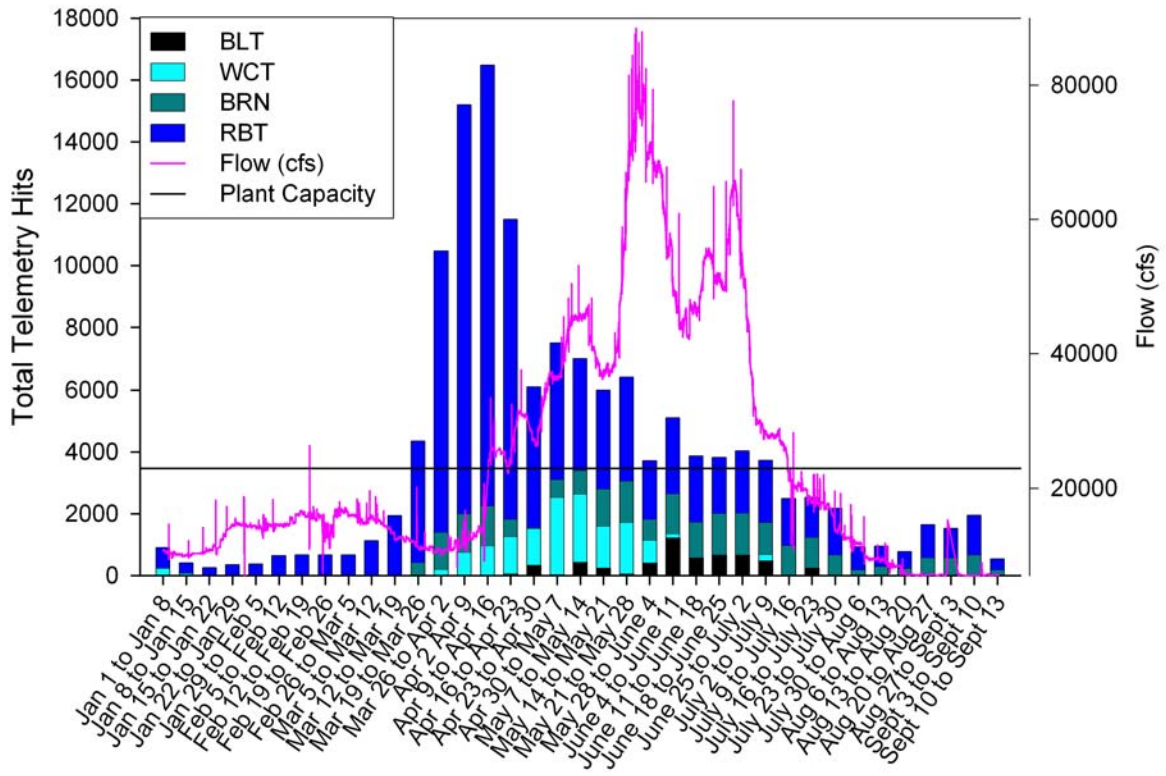

Figure 16: Total number of telemetry hits for each species (BLT = bull trout, WCT = westslope cutthroat trout, BRN = brown trout, RBT = rainbow trout) at all remote stations at Thompson Falls in 2006

Additionally, there have been more rainbow trout tagged during this study and present in the project area compared to other species at any time (Figure 14). Rainbow trout also appear to move into the project area, primarily to the main channel dam area, prior to the spring freshet (Figures 13 and 14).

The majority of fish movement and activity in the project area occurred prior to the spring freshet. At the peak number of fish detected in the project area (April 2-16, 2006), the fish were nearly equally distributed between all three stations (Figure 15). However, based on the previous graph (Figure 13), fish frequented and were detected more often (higher number of telemetry hits) at the main channel dam and hilltop during the period of time.

Although the greatest fish activity detected via telemetry data appeared to occur in early April, not all tagged trout species behaved in the same manner. Peak movement did vary among the tagged species (Figure 16). Rainbow trout were the first to enter the project area, followed by westslope cutthroat and brown trout, and then bull trout.

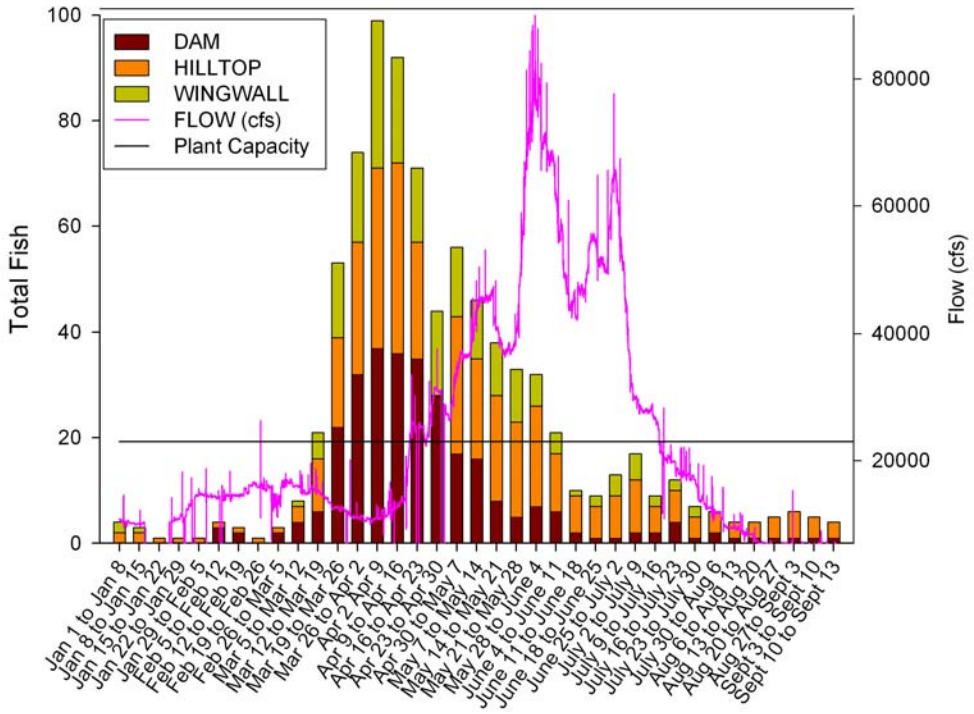

Figure 17: Total number of tagged fish (bull trout, westslope cutthroat trout, brown trout, rainbow trout) detected at each remote station (main channel dam, hilltop, wingwall) at Thompson Falls in 2006

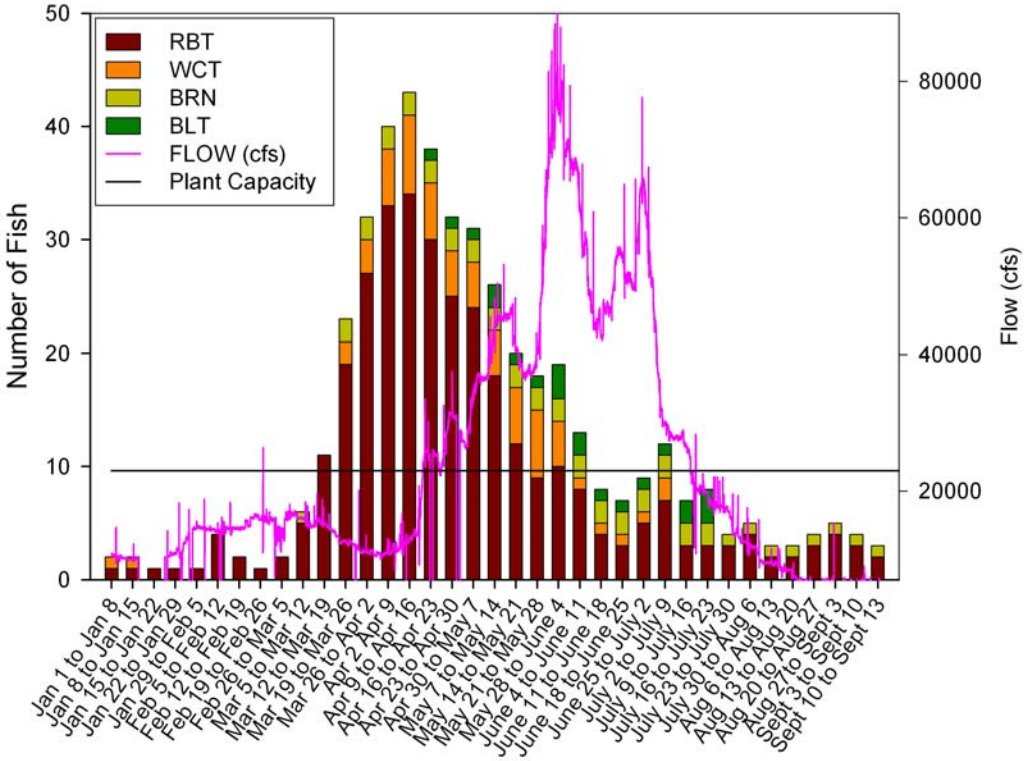

Figure 18: Total number of fish (BLT = bull trout, WCT = westslope cutthroat trout, BRN = brown trout, RBT = rainbow trout) detected at all remote stations at Thompson Falls in 2006

Flows in the project area vary by location as a result of project operations and project facilities. The highest flows were recorded around the main channel dam followed by the wingwall and then dry channel flow (Figure 17). Flow at the wingwall was relatively constant and remained below about 23,000 cfs. Flow in the dry channel was limited to the late April to early June time period. The greatest flows (>60,000 cfs) were recorded at the main channel dam. Here flows were more characteristic of a natural hydrograph with a peak in May representing spring runoff (Figure 17).

Peak activity was greatest around the main channel dam and hilltop prior to spill (Figure 17). Although fish activity declined significantly in main channel dam area, activity continued to be detected during spill. The majority of activity during peak flow season was detected by the hilltop station. There are relatively quiescent areas in this portion of the river that would be suitable holding habitat for trout during runoff. It is likely that many fish left the main channel area during spill to avoid turbulent and high velocity conditions (Figure 17).

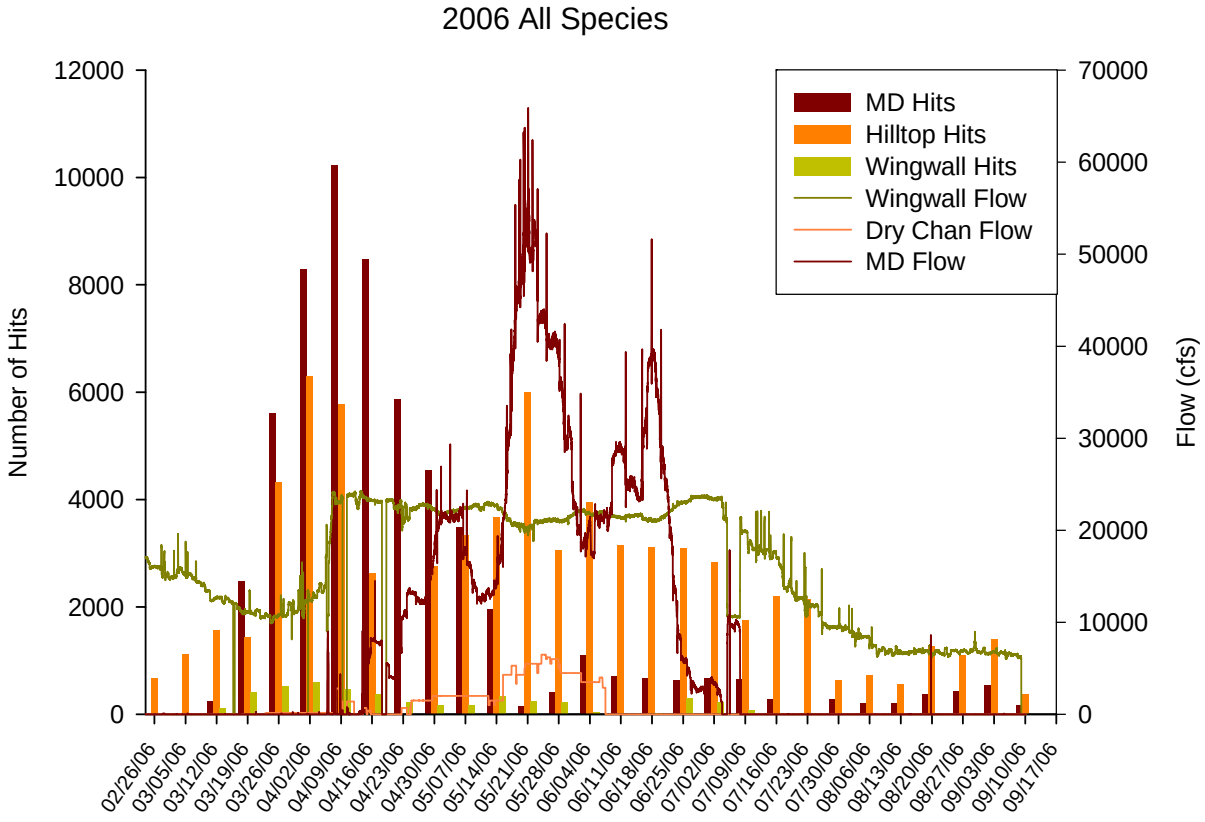

Figure 19: Number of telemetry hits for all species detected in 2006 at the three remote stations at Thompson Falls Dam (MD = main channel dam, hilltop, wingwall) and the vicinity where flow (wingwall flow, dry channel flow, MD Flow = main channel dam flow) occurring in the project area

Telemetry data from this study and in 2005 indicate movement of fish into the project area differed by species. In 2006, peak detection of rainbow trout occurred between March 26 and April 23, 2006, with the greatest detection early April (Figure 18). Rainbow trout were also most often detected at the main channel dam.

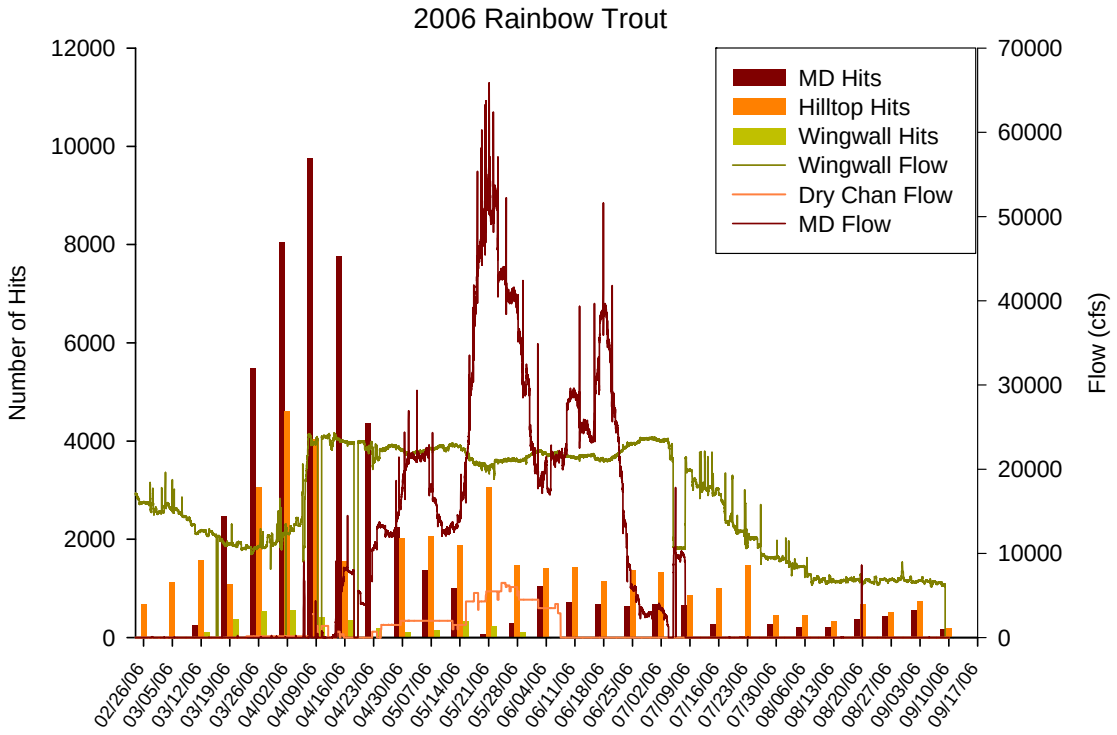

Figure 20: Total number of telemetry hits for rainbow trout (RBT) at each remote stations (MD= main channel dam, hilltop, and wingwall) along with flow data at the wingwall channel, dry channel (dry chan), and main channel dam (MD) at Thompson Falls in 2006

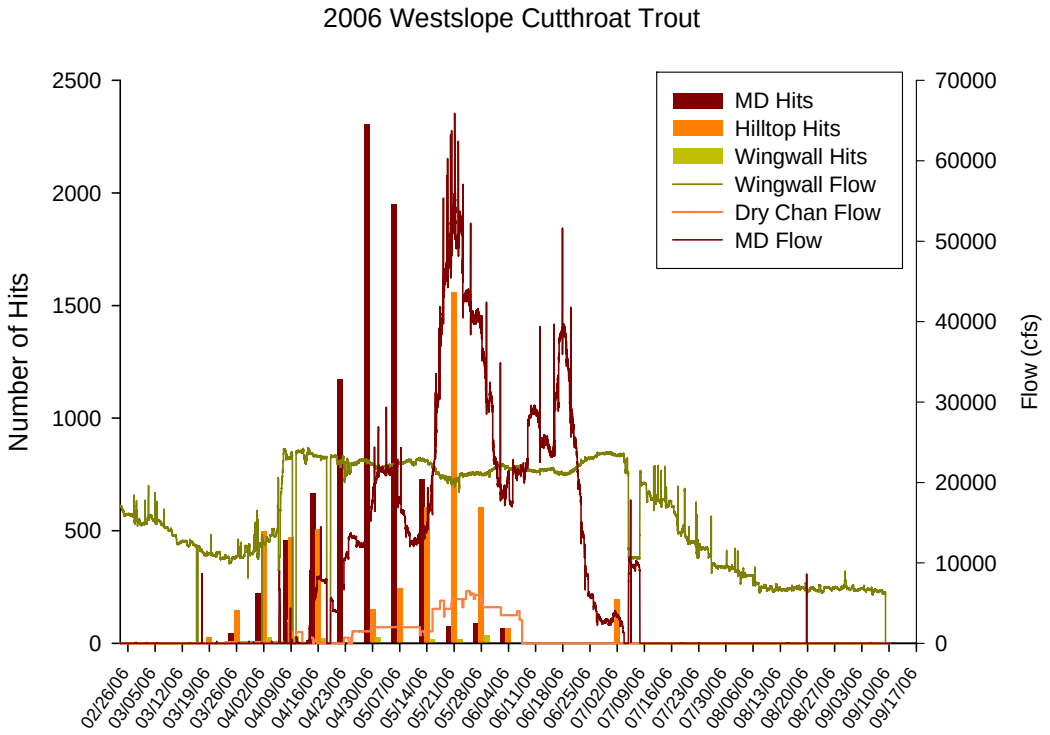

Figure 21: Total number of telemetry hits for westslope cutthroat (WCT) at each remote stations (MD= main channel dam, hilltop, and wingwall) along with flow data at the wingwall channel, dry channel (dry chan), and main channel dam (MD) at Thompson Falls in 2006

Peak detection of westslope cutthroat trout in the project area was in early May, about one month later than rainbow trout. Peak activity for westslope cutthroat trout in the project area began in April and lasted through June 6, 2006 (Figure 19). As with rainbow trout, the majority of westslope cutthroat trout detected were at the main channel dam.

Due to the limited number of tagged bull trout detected during 2006 in the project area, peak activity is less certain. Bull trout were detected in the project area later than rainbow and westslope cutthroat trout. The first bull trout detected in the area was near the end of April. The data also indicate bull trout activity (1 -2 fish detected occasionally at the hilltop station) continued through the end of July (Figure 17). There were sporadic detections of bull trout later in the season, including one bull trout that entered the project area (hilltop station) briefly from October 21 -22, 2006. This fish had been detected in the Vermilion River during the September spawning season (LaDana Hintz, Avista Corporation, personal communication, December 2006). The Vermilion River is a known bull trout spawning tributary to Noxon Reservoir located about 19 miles downstream of the Thompson Falls project area.

During 2006, a few brown trout were also tagged and monitored. Brown trout were detected in the project area from late March through June. There appeared to be two peaks in activity, one in early April peak and again in mid-May (Figure 17). One brown trout was detected at the hilltop station from September to mid-November.

3.3.4 Day vs. Night Activity

MFWP requested a review of fish behavior during the day and at night. We focused on the main channel dam area because this is the proposed location for the fish ladder. Fish location between day and night was evaluated from March to June 2006 (Figure 20). Some dates seem to indicate more fish in the main channel dam area in the daytime than at night, however, there is no consistent pattern throughout the time period evaluated. The majority of fish tagged were rainbow trout, thus there may be behavioral differences occurring in other species that was not observed in this study due to the limited numbers of tagged individuals representing the other species.

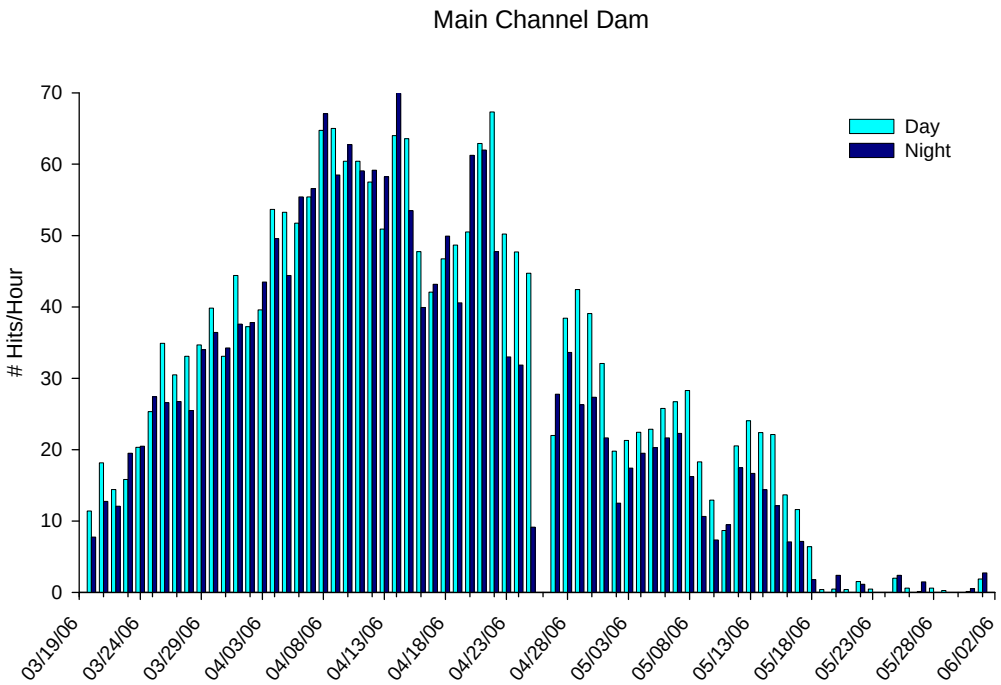

Figure 22: Telemetry results of day versus night detection of radio-tagged fish at the main channel dam in 2006. Results presented in average number of hits per hour since length of day and night changes are not equal throughout the year

3.4 Temperature

In 2006, temperature was monitoring using Hydrolabs in two locations; 1) downstream of the dam at Birdland Bay Bridge; and 2) above Thompson Falls Dam. The data are presented in Figure 21. Temperature data show water temperatures at the two sites are similar through the spring and early summer. Temperatures remained below 20˚C in both locations until July. The highest temperature recorded at the Birdland Bay Bridge (downstream of dam) was 22.4˚C on July 10, 2006. No temperature data was available above Thompson Falls Dam for July. Water temperature at both locations was nearly identical (Figure 21).

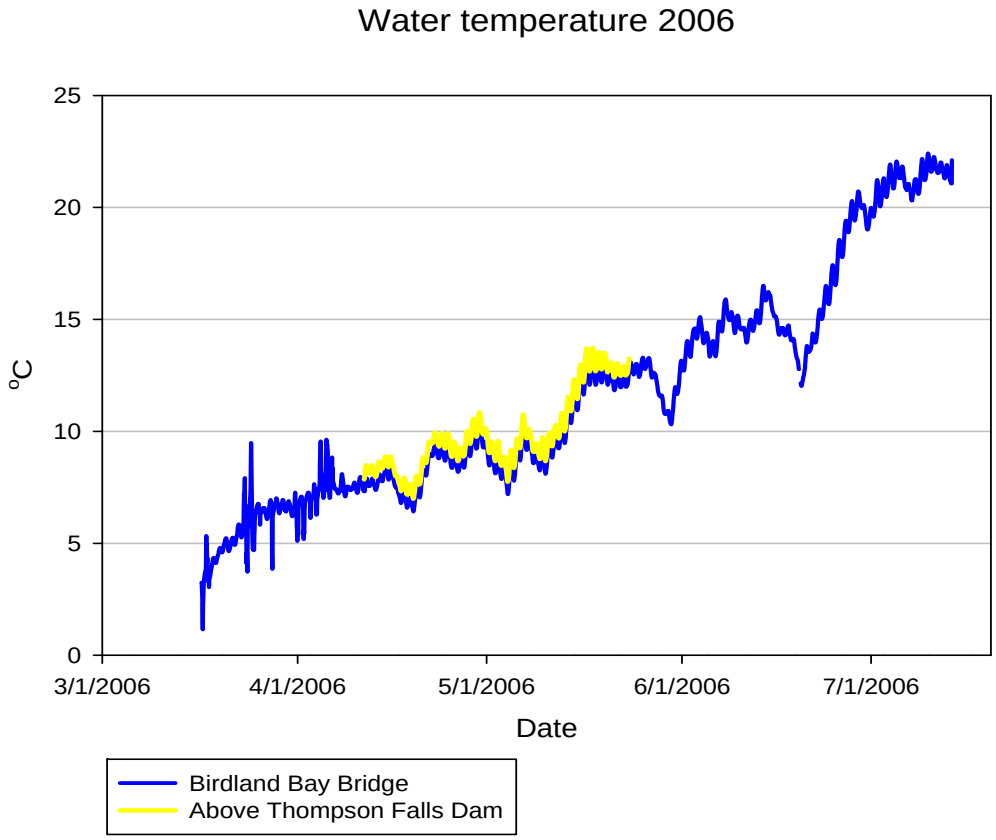

Figure 23: Continuous temperature measurements above Thompson Falls Dam from April 11 through June 27, 2006, and at the Birdland Bay Bridge (downstream of dam) from March 16 through July 13, 2006

A temperature profile in the reservoir was available for June 2001 (Figure 22). The profile data indicate no stratification occurring in the reservoir at this time with water temperatures varying only one-tenth of a degree from the surface to about 40 ft. No profile data representative of late summer conditions were available, however, reservoir retention time was calculated for the summer of 2005 and 2006.

Thompson Falls Reservoir is defined to be a "run-of-river" plant because the project can generate electricity using the water that flows down the river, without the need to store additional water supplies. Thus, retention time is assumed to be low and no stratification is expected to occur in the reservoir based on plant operations. To affirm this assumption, retention time was calculated by taking the storage capacity of Thompson Falls Reservoir, 8,300 acre-ft (362,000,000 cubic feet), divided by total flows through the project (PPL Montana flow records). Flow data was available from April 2005 through December 2006.

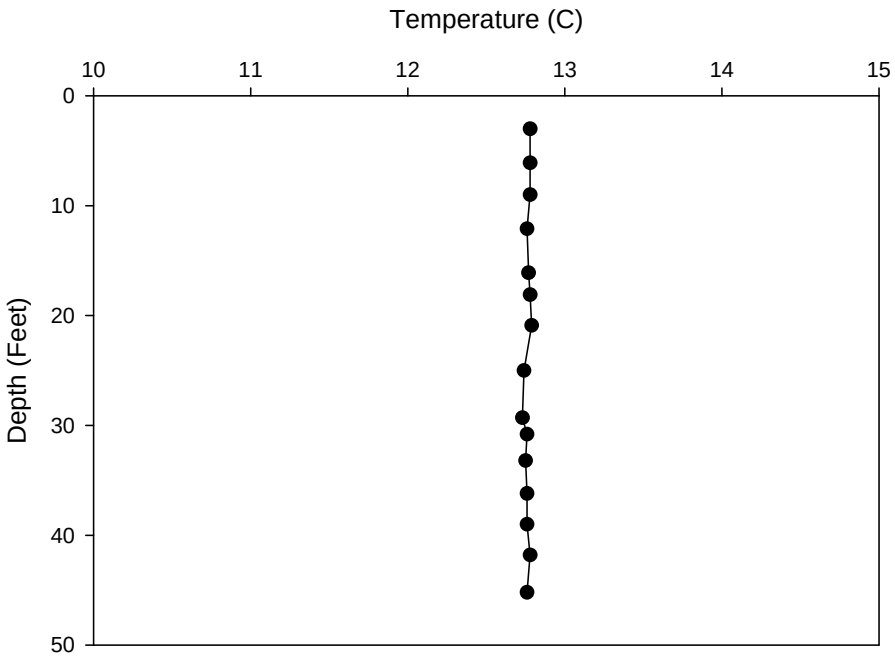

Figure 24: A temperature profile (°C) on June 14, 2001, at Thompson Falls Reservoir near the city boat ramp on the north side

Results indicate the mean annual retention time in 2005 and 2006 were less than half a day at 7.5 and 7.7 hours, respectively. These times support that the project is a "run-of-river" plant, which does not hold water for storage purposes thus preventing conditions for thermal stratification during low flows. Even though retention time increases when flows decrease, the retention time calculated in 2005 and 2006 generally remained less than 20 hours or one day. Mean, minimum, and maximum retention times for the months of June, July, August, and September illustrate how retention time increases when flows decrease, such that retention time is less in June when spill may still be occurring and more in September when flows are lower and spill has ceased (Table 6).

Table 6: Estimated mean, minimum, and maximum retention times (hours) in Thompson Falls reservoir during June, July, August, and September

2005	Mean	Min	Max	2006	Mean	Min	Max
Month	hours			Month	hours		
June	2.5	1.2	3.7	June	1.3	3.7	2.3
July	6.3	2.3	9.2	July	3.5	11.5	6.5
August	9.8	6.1	13.7	August	6.6	16.5	13.9
September	14.4	10.0	18.1	September	10.5	16.7	13.9

The results verify that stratification of the reservoir is highly unlikely due to the short retention time (less than one day) in the reservoir.

The lack of summer stratification is also true of Cabinet Gorge and Noxon reservoirs. Cabinet Gorge reservoir does not thermally stratify in the summer, although pockets of the cooler water are present where tributaries or groundwater enter the reservoir. The main body of Noxon Reservoir usually experiences limited areas of full stratification in only the deepest areas and weak stratification through the remainder of the main body of the reservoir (Land and Water Consulting, 2002). However, the bays in Noxon Reservoir do not stratify to any great degree even in low flow years.

These data support the conclusion that temperatures in the project area are unlikely to vary by location. Water temperature measured at the Birdland Bay Bridge or about Thompson Falls Dam likely represents the water temperatures found throughout the project area on any given day.

4.0 Discussion

The objective for the 2004-2006 tailrace fish behavior study at Thompson Falls Dam was to better understand and describe fish behavior in the tailrace, timing of migrations, location of fish moving upstream with respect to the dam, location of fish and relationship to the hydrograph, and whether fish behavior could be modified via manipulation of spill operations.

Telemetry monitoring commenced in 2004 with 31 PPL Montana-tagged fish. However there were a few glitches in the beginning such as power surges periodically interrupting the stationary receivers, which hampered the analysis of fish behavior and movement prior to the spring freshet. In 2005, an additional, 30 fish were radio-tagged and the glitches from the previous season had been alleviated. Telemetry results from 2005 concluded a large proportion of radio tagged fish that entered the Thompson Falls project area made their way to the main channel dam, and also appeared to migrate to the main channel dam area prior to spill. The main channel dam is the upstream most terminus a fish can currently navigate. Although the hilltop area had the greatest proportion of telemetry hits in 2005, these numbers may not be indicative of the number of fish attempting to navigate upstream via this route. Fish migrating upstream to or downstream from the main channel dam would likely be detected by the hilltop station. Additionally, fish entering Prospect Creek to spawn, or for a cool water refuge, would also be detected by the hilltop station. Thus, in 2005, the fish trap data along with telemetry data indicated the main channel dam was likely the most effective location for a fish passage facility.

In 2006, an additional 40 fish were radio-tagged by PPL Montana. Telemetry monitoring continued concurrent with the manipulation of spill operations at the main channel dam. Although the peak flow in 2006 was greater than in 2005, the shape of the hydrologic curves was similar and general fish behavior was similar. Fish moved throughout the project area, but with one notable change. When an attraction flow was released in the main channel dam area prior to spill, more fish were observed in the main channel dam area. In addition, the "shaping" of flow over the main channel dam during spill seemed to be successful in attracting fish to the right bank.

Although the fish that enter the project area do not remain in one location and appear to be searching and constantly on the move, fish in the project area were most frequently detected by the hilltop and main channel dam (main dam) antennas in 2005 and 2006. This study confirmed that trout enter the tailrace of Thompson Falls Dam in the early spring, beginning in March and April. Arrival to the project area varied slightly by species. Rainbow trout arrived the earliest followed by brown, westslope cutthroat, and then bull trout. Peak activity

was generally in April prior to the spring freshet. The number of fish located in the main channel dam area declined precipitously during peak runoff (mid- to late-May 2006). Concurrent with this decline of fish detected in the main channel, fish detected from the hilltop station increased. This is likely an indication that some of the fish previously in the main channel dam may have dropped back to the mouth of Prospect Creek in less turbulent waters or left the project area. During high flows fish generally leave the main channel dam area and project area. Fish activity in the project area remained at substantially lower levels post-spill than pre-spill.

4.1 Recommendations

GEI conducted an engineering feasibility study of upstream fishway alternatives at the Thompson Falls project concurrent with the fish behavior investigations (GEI, 2006a). The results of both studies were presented to the Thompson Falls Interagency Technical Advisory Committee in October 2006. The consensus decision of the Committee was that the right bank full height fish ladder at the main channel dam was the preferred alternative. Design work for the right bank fish ladder began in October 2006, and is expected to be substantially complete by December 2007.

5.0 References

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Appendix A

Fish Sampling 2006

A.1 2006 Thompson Falls Fish Capture Data-Recorded by MFWP

Appendix A.1

A.1 2006 Thompson Falls Fish Capture Data-Recorded by MFWP

Date	Time	H_2O Temp (C)	Species	Length (mm)	Wt (g)	Recap (y/n)	PITT Tag No.	Radio Freq.	Radio Code	Tag Wt (g)	Genetic Sample No.	Method	Collectors	Comments: (trap condition, spillway gates or boards....)
3/9/2006	1553	3	BRN	382	460	n	466D14630F	148.300	74	7.7g	n	EF	BM,JM,JS	upper, 3 staples, 2 min
3/9/2006	1601	3	WRHY	579	1720	n	4669283257	148.640	97	10g	n	EF	BM,JM,JS	upper, 3 staples, 2:30 min
3/9/2006	1609	3	RBT	456	865	n	46692F3406	148.640	99	10g	n	EF	BM,JM,JS	upper, 4 staples, 1:30 min
3/9/2006	1614	3	RBT	485	1045	n	466B3A2F2A	148.640	103	10g	n	EF	BM,JM,JS	upper, 3 staples, 1:30 min, some blood
3/9/2006	1617	3	RBT	525	1367	n	46693E4377	148.640	112	10g	n	EF	BM,JM,JS	upper, ripe female, 4 staples, 1:30 min
3/9/2006	1622	3	RBT	422	716	n	466B33543C	148.640	109	10g	n	EF	BM,JM,JS	upper, ripe female, 4 staples, 1:20 min
3/9/2006	1627	3	RBT	430	813	y	985120019766203	148.300	75	7.7g	n	EF	BM,JM,JS	upper, 3 staples, 1:15 min
3/9/2006	1631	3	RBT	265	169	n	985120019757304	n	n	n	n	EF	BM,JM,JS	
3/9/2006		3	RBT	275	199	n	466C4A0C6B	n	n	n	n	EF	BM,JM,JS	
3/9/2006		3	WCT	242	131	n	n	n	n	n	1	EF	BM,JM,JS	
3/9/2006		3	WCT	183	48	n	n	n	n	n	2	EF	BM,JM,JS	
3/9/2006	2200	3	BRN	412	550	n	466C12525E	148.640	111	10g	n	EF	BM,JM,JS	upper area, 4 staples, 2:45 min. little blood
3/9/2006	2200	3	WRHY	364	412	n	465A58316	148.300	69	7.7g	n	EF	BM,JM,JS	lower area, 3 staples, 2:25 min
3/9/2006	2200	3	BRN	357	407	n	466C28617F	148.300	21	7.7g	n	EF	BM,JM,JS	upper area, 3 staples, 2 min
3/9/2006	2200	3	RBT	289	325	n	46695A313D	n	n	n	n	EF	BM,JM,JS	

Date	Time	H_2O Temp (C)	Species	Length (mm)	Wt (g)	Recap (y/n)	PITT Tag No.	Radio Freq.	Radio Code	Tag Wt (g)	Genetic Sample No.	Method	Collectors	Comments: (trap condition, spillway gates or boards....)
3/9/2006	**2200**	**3**	**BLT**	**245**	**103**	**n**	**465D167759**	**n**	**n**	**n**	**Avista 14**	**EF**	**BM,JM,JS**	**upper area, bird wound. Genetic assignment to Prospect Ck/Morris Ck**
3/9/2006	2200	3	BRN	270	157	n	466B5E5308	n	n	n	n	EF	BM,JM,JS	upper area
3/9/2006	2200	3	BRN	247	124	n	466B3C0530	n	n	n	n	EF	BM,JM,JS	upper
3/9/2006	2200	3	RBT	227	114	n	466C220B47	n	n	n	n	EF	BM,JM,JS	upper
3/9/2006	2200	3	RBT	283	193	n	4669460759	n	n	n	n	EF	BM,JM,JS	lower
3/9/2006	2200	3	BRN	266	148	n	4669694977	n	n	n	n	EF	BM,JM,JS	lower
3/13/2006	1438	3	RBT	450	934	n	466B507866	148.640	101	10g	n	EF	BM,JM,JS	upper, 3 staples, 1:32 min
3/13/2006	1438	3	WRHY	423	763	n	4669531F15	148.640	107	10g	n	EF	BM,JM,JS	upper, 2 staples, 1:40 min
3/13/2006	1438	3	WRHY	367	459	n	466879776A	148.300	95	7.7g	n	EF	BM,JM,JS	upper, 3 staples, 1:50, little burn
3/13/2006	2000	3	RBT	190	69	n	985120019721651	n	n	n	n	EF	BM,JM,JS	old injury under
3/13/2006	2000	3	RBT	170	48	n	4669410431	n	n	n	n	EF	BM,JM,JS	
3/13/2006	2000	3	RBT	216	99	n	466B7E0318	n	n	n	n	EF	BM,JM,JS	
3/13/2006	2000	3	WCT	248	147	n	4669634438	n	n	n	3	EF	BM,JM,JS	bird wounds
3/13/2006	2000	3	BRK	197	70	n	n	n	n	n	n	EF	BM,JM,JS	
3/13/2006	2200	3	RBT	536	1984	n	46695E2D1	148.640	113	10g	n	EF	BM,JM,JS	lower, female, 5 staples, 1:20 min
3/13/2006	2200	3	RBT	460	1003	n	466B4A7545	148.640	110	10g	n	EF	BM,JM,JS	lower, ripe female, 4 staples, 1:15 min
3/13/2006	2200	3	WRHY	432	839	n	466C2D3E2B	148.640	114	10g	n	EF	BM,JM,JS	lower, 4 staples, 1:45 min
3/13/2006	2200	3	WRHY	378	520	n	4669312874	148.640	115	10g	n	EF	BM,JM,JS	lower, 3 staples, 1:30 min, little blood
3/13/2006	2200	3	WRHY	375	537	n	4669327800	148.640	116	10g	n	EF	BM,JM,JS	lower, 3 staples, 1:20 min
3/13/2006	2200	3	WCT	342	398	n	466941233F	148.300	91	7.7g	4	EF	BM,JM,JS	lower, 3 staples, 1:40 min
3/13/2006	2200	3	WCT	281	195	n	466D025E0A	n	n	n	5	EF	BM,JM,JS	

Date	Time	H_2O Temp (C)	Species	Length (mm)	Wt (g)	Recap (y/n)	PITT Tag No.	Radio Freq.	Radio Code	Tag Wt (g)	Genetic Sample No.	Method	Collectors	Comments: (trap condition, spillway gates or boards....)
3/13/2006	2200	3	WCT	423	732	n	46696B0F47	148.640	108	10g	6	EF	BM,JM,JS	lower, 3 staples, 1:10 min
3/13/2006	2200	3	WCT	377	569	n	466C197663	148.640	100	10g	7	EF	BM,JM,JS	lower, 4 staples, 1:50 min
3/13/2006	2200	3	BRN	n	n	y	466D14630F	148.300	74	10g	n	EF	BM,JM,JS	lower, tagged 3/9/06
3/13/2006	2200	3	RBT	360	425	n	46695C6365	n	n	n	n	EF	BM,JM,JS	
3/13/2006	2200	3	RBT	256	157	n	46690C6E17	n	n	n	n	EF	BM,JM,JS	
3/13/2006	2200	3	RBT	325	273	n	46692E484A	n	n	n	n	EF	BM,JM,JS	
3/13/2006	2200	3	RBT	369	500	n	466B630D53	n	n	n	n	EF	BM,JM,JS	
3/13/2006	2200	3	RBT	275	178	n	46687A5D68	n	n	n	n	EF	BM,JM,JS	
3/13/2006	2200	3	RBT	338	334	n	46690C2311	n	n	n	n	EF	BM,JM,JS	
3/13/2006	2200	3	RBT	301	241	n	46643727C	n	n	n	n	EF	BM,JM,JS	
3/13/2006	2200	3	RBT	269	160	n	466D201E03	n	n	n	n	EF	BM,JM,JS	
3/13/2006	2200	3	RBT	297	244	n	465A794C64	n	n	n	n	EF	BM,JM,JS	
3/13/2006	2200	3	BRN	297	208	n	n	n	n	n	n	EF	BM,JM,JS	
3/13/2006	2200	3	BRN	336	290	n	n	n	n	n	n	EF	BM,JM,JS	
3/28/2006	930	6	WRHY	445	996	n	466D000C5E	148.300	92	7.7g	n	T	JS,JM	4 staples, 2:30 min, release Squaw Cr 1017, H2O 6, left panel open
3/29/2006	1045	6	RBT	258	164	n	466B4C2D6F	n	n	n	n	T	JS,JM	
3/29/2006	1045	6	RBT	440	755	n	466C0F0743	148.300	84	7.7g	n	T	JS,JM	4 staples, 3:30 min, milt, some blood, release Squaw Cr 1236, H2O 6
3/29/2006	1045	6	RBT	481	976	n	4668792377	148.300	80	7.7g	n	T	JS,JM	3 staples, 3 min, release Squaw Cr 1236, H2O 6
3/29/2006	1045	6	RBT	473	1009	n	4669083240	148.300	82	7.7g	n	T	JS,JM	4 staples, 3 min, faint slash, release Squaw Cr 1236, H2O 6
3/29/2006	1045	6	RBT	335	374	n	4669690148	n	n	n	n	T	JS,JM	release Squaw Cr 1236, H2O 6

Date	Time	H_2O Temp (C)	Species	Length (mm)	Wt (g)	Recap (y/n)	PITT Tag No.	Radio Freq.	Radio Code	Tag Wt (g)	Genetic Sample No.	Method	Collectors	Comments: (trap condition, spillway gates or boards....)
3/29/2006	1045	6	RBT	460	1025	n	4668781B58	148.300	81	7.7g	n	T	JS,JM	4 staples, 2:30 min, release Squaw Cr 1236, H2O 6
3/29/2006	1045	6	RBT	471	945	n	466B326358	148.300	83	7.7g	n	T	JS,JM	4 staples, 2:15 min, scar on nose, release Squaw Cr 1236, H2O 6
3/30/2006	945	6	WRHY	469	986	n	4669142427	148.300	76	7.7g	n	T	JS,JM	4 staples, 2:30 min, faint slash, release Squaw Cr 1025, H2O 6
3/31/2006	950	6	RBT	475	894	n	466C1E135F	148.300	77	7.7g	n	T	JS,JM	4 staples, 2:30 min, blood, release Squaw Cr 1236, H2O 6
4/3/2006	942	6	NF	n	n	n	n	n	n	n	n	T	BM,JM,JS	open trap 4/2/06 0845, right dam panel open
4/4/2006	920	6.5	WRHY	450	961	y	466B675B76	n	n	n	n	T	JS,JM	no PIT in recap, left dam panel open
4/4/2006	920	6.5	RBT	449	1004	n	4669534754	n	n	n	n	T	JS,JM	
4/4/2006	920	6.5	RBT	359	484	n	466D1E3D50	n	n	n	n	T	JS,JM	
4/4/2006	920	6.5	RBT	414	618	n	466B4F7C38	n	n	n	n	T	JS,JM	
4/4/2006	920	6.5	WCT	395	593	n	466B5E347F	148.300	88	7.7g	8	T	JS,JM	3 staples, 1:45 min, release Squaw Cr 1236, H2O 8
4/4/2006	920	6.5	WCT	415	699	n	465B333A7B	148.640	104	10g	9	T	JS,JM	male/milt, 3 staples, 1:45 min, release Squaw Cr 1236, H2O 8
4/4/2006	920	6.5	WRHY	543	1496	n	466B4B5A19	148.640	98	10g	n	T	JS,JM	faint slash, 4 staples, 1:45 min, release Squaw Cr 1236, H2O 8

Date	Time	H_2O Temp (C)	Species	Length (mm)	Wt (g)	Recap (y/n)	PITT Tag No.	Radio Freq.	Radio Code	Tag Wt (g)	Genetic Sample No.	Method	Collectors	Comments: (trap condition, spillway gates or boards....)
4/4/2006	920	6.5	WRHY	485	1025	n	466B4E7915	148.300	86	7.7g	n	T	JS,JM	faint slash, 4 staples, 2:15 min, release Squaw Cr 1236, H2O 8
4/5/2006	935	8	RBT	394	679	n	466C072139	n	n	n	n	T	JS,JM	no spill from dam
4/5/2006	935	8	RBT	479	989	n	466C7A1F79	n	n	n	n	T	JS,JM	
4/5/2006	935	8	RBT	498	1285	n	466B41781E	n	n	n	n	T	JS,JM	
4/5/2006	935	8	RBT	475	1125	n	466B3B7C25	n	n	n	n	T	JS,JM	
4/5/2006	935	8	RBT	475	1094	n	465C55251C	n	n	n	n	T	JS,JM	
4/5/2006	935	8	RBT	218	358	n	466C0D7948	n	n	n	n	T	JS,JM	
4/5/2006	935	8	RBT	507	1137	n	466B450D2F	n	n	n	n	T	JS,JM	3 staples, 1:30 min, release Squaw Cr 1236, H2O 8
4/6/2006	**942**	**8**	**BLT**	**341**	**560**	**n**	**466C27584F**	**148.300**	**87**	**7.7g**	**Avista 15**	**T**	**JS,JM**	**release Squaw Cr 1100, H2O 8. Genetic assignment Fishtrap Ck/Cedar Ck**
4/6/2006	942	8	RBT	470	723	n	46687B1P05	n	n	n	n	T	JS,JM	release Squaw Cr 1100, H2O 8
4/6/2006	942	8	RBT	395	485	n	4669573051	n	n	n	n	T	JS,JM	release Squaw Cr 1100, H2O 8
4/6/2006	942	8	RBT	542	1407	n	466C111A12	n	n	n	n	T	JS,JM	release Squaw Cr 1100, H2O 8
4/6/2006	942	8	RBT	408	673	n	46695A613A	n	n	n	n	T	JS,JM	trap and sandbags blown out, take out trap box, release Squaw Cr 1236, H2O 8
4/7/2006	930	8	RBT	n	n	n	n	n	n	n	n	T	JS,JM	
4/7/2006	930	8	RBT	n	n	n	n	n	n	n	n	T	JS,JM	
4/7/2006	930	8	RBT	n	n	n	n	n	n	n	n	T	JS,JM	

Date	Time	H_2O Temp (C)	Species	Length (mm)	Wt (g)	Recap (y/n)	PITT Tag No.	Radio Freq.	Radio Code	Tag Wt (g)	Genetic Sample No.	Method	Collectors	Comments: (trap condition, spillway gates or boards....)
4/10/2006	1500-1700	8	WE	615	2480	n	floy 4-0700	n	n	n	n	EF	BM,JM,JS	take out all chute sections of trap, 6 panels open on right side
4/10/2006	1500-1700	8	WE	564	1970	n	floy 4-0699	n	n	n	n	EF	BM,JM,JS	
4/10/2006	1500-1700	8	WE	623	5.14 lbs	n	floy 4-0698	n	n	n	n	EF	BM,JM,JS	
4/10/2006	1500-1700	8	WE	532	1361	y	floy 4-0697	y	?	?	n	EF	BM,JM,JS	Avista radio tagged, no PIT
4/10/2006	1500-1700	8	WE	425	692	n	floy 4-0696	n	n	n	n	EF	BM,JM,JS	
4/10/2006	1500-1700	8	WE	442	781	n	floy 4-0695	n	n	n	n	EF	BM,JM,JS	
4/10/2006	1500-1700	8	NP	346	237	n	floy 4-0693	n	n	n	n	EF	BM,JM,JS	
4/10/2006	1500-1700	8	SMB	313	386	n	floy 4-0692	n	n	n	n	EF	BM,JM,JS	
4/10/2006	1500-1700	8	WRHY	336	356	n	n	n	n	n	n	EF	BM,JM,JS	
4/10/2006	1500-1700	8	RBT	256	156	n	n	n	n	n	n	EF	BM,JM,JS	
4/10/2006	1500-1700	8	WCT	281	244	n	466C225528	n	n	n	10	EF	BM,JM,JS	
4/10/2006	1500-1700	8	RBT	361	477	n	n	n	n	n	n	EF	BM,JM,JS	HSL
4/10/2006	1500-1700	8	RBT	257	165	n	n	n	n	n	n	EF	BM,JM,JS	
4/10/2006	1500-1700	8	RBT	312	275	n	n	n	n	n	n	EF	BM,JM,JS	
4/10/2006	1500-1700	8	RBT	336	352	n	n	n	n	n	n	EF	BM,JM,JS	
4/10/2006	1500-1700	8	RBT	322	281	n	n	n	n	n	n	EF	BM,JM,JS	
4/10/2006	1500-1700	8	RBT	473	1074	n	n	n	n	n	n	EF	BM,JM,JS	
4/10/2006	1500-1700	8	WRHY	395	642	n	n	n	n	n	n	EF	BM,JM,JS	HSL
4/10/2006	1500-1700	8	RBT	390	470	n	n	n	n	n	n	EF	BM,JM,JS	
4/10/2006	1500-1700	8	RBT	355	373	n	n	n	n	n	n	EF	BM,JM,JS	
4/10/2006	1500-1700	8	WRHY	355	437	n	n	n	n	n	n	EF	BM,JM,JS	
4/10/2006	1500-1700	8	RBT	297	236	n	n	n	n	n	n	EF	BM,JM,JS	
4/10/2006	1500-1700	8	BRN	222	106	n	n	n	n	n	n	EF	BM,JM,JS	
4/10/2006	1500-1700	8	BRN	241	112	n	n	n	n	n	n	EF	BM,JM,JS	
4/10/2006	1500-1700	8	BRN	241	121	n	n	n	n	n	n	EF	BM,JM,JS	
4/13/2006	**1642**	**7**	**BLT**	**485**	**1115**	**n**	**985120019870005**	**148.640**	**105**	**10g**	**Avista 16**	**EF**	**JM, BL**	**3 staples, 3 min. Genetic assignment**

Date	Time	H_2O Temp (C)	Species	Length (mm)	Wt (g)	Recap (y/n)	PITT Tag No.	Radio Freq.	Radio Code	Tag Wt (g)	Genetic Sample No.	Method	Collectors	Comments: (trap condition, spillway gates or boards....)
														Fishtrap Ck/Grouse Ck
4/27/2006	1730-1900	9	WCT	268	183	n	985120019744338	n	n	n	11	EF	BM,JS,TT	
4/27/2006	1730-1900	9	WCT	316	320	n	985120019842090	n	n	n	12	EF	BM,JS,TT	bird wound
4/27/2006	1730-1900	9	NP	840	4904	n	yellow floy 16678	n	n	n	n	EF	BM,JS,TT	
4/27/2006	1730-1900	9	NP	560	1134	n	yellow floy 16681	n	n	n	n	EF	BM,JS,TT	
4/27/2006	1730-1900	9	NP	600	1644	n	yellow floy 16677	n	n	n	n	EF	BM,JS,TT	
4/27/2006	1730-1900	9	NP	725	2750	n	yellow floy 16680	n	n	n	n	EF	BM,JS,TT	
4/27/2006	1730-1900	9	NP	590	1503	n	yellow floy 16682	n	n	n	n	EF	BM,JS,TT	
4/27/2006	1730-1900	9	NP	680	2381	n	yellow floy 16683	n	n	n	n	EF	BM,JS,TT	
4/27/2006	1730-1900	9	NP	831	4224	n	yellow floy 16676	n	n	n	n	EF	BM,JS,TT	
5/3/2006	**2130**	**9**	**BLT**	**775**	**3941**	**n**	**985120019717038**	**148.640**	**102**	**10g**	**Avista 17**	**EF**	**TT,JM,KD**	**4 staples, 3 min, lower@ Rimrock. Fishtrap Ck/Upper Rock Ck**
8/1/2006	900	20	WCT	n	n	n	n	n	n	n	n	T	BM,JM,JS	trap opened by public 7/30/06. Trap installed 7/26/06 H2O 22C
8/1/2006	900	20	NPM	n	n	n	n	n	n	n	n	T		
8/1/2006	900	20	NPM	n	n	n	n	n	n	n	n	T		
8/1/2006	900	20	NPM	n	n	n	n	n	n	n	n	T		
8/1/2006	900	20	NPM	n	n	n	n	n	n	n	n	T		
8/1/2006	900	20	NPM	n	n	n	n	n	n	n	n	T		
8/1/2006	900	20	NPM	n	n	n	n	n	n	n	n	T		
8/1/2006	900	20	NPM	n	n	n	n	n	n	n	n	T		
8/1/2006	900	20	NPM	n	n	n	n	n	n	n	n	T		
8/1/2006	900	20	NPM	n	n	n	n	n	n	n	n	T		
8/1/2006	900	20	NPM	n	n	n	n	n	n	n	n	T		
8/1/2006	900	20	NPM	n	n	n	n	n	n	n	n	T		

Date	Time	H_2O Temp (C)	Species	Length (mm)	Wt (g)	Recap (y/n)	PITT Tag No.	Radio Freq.	Radio Code	Tag Wt (g)	Genetic Sample No.	Method	Collectors	Comments: (trap condition, spillway gates or boards....)
9/20/2006	1015	14	NPM	191	121	n	n	n	n	n	n	T	JS,TT	
9/20/2006	1015	14	NPM	311	252	n	n	n	n	n	n	T	JS,TT	
9/20/2006	1015	14	PUM	131	51	n	n	n	n	n	n	T	JS,TT	
9/20/2006	1015	14	NPM	313	271	n	n	n	n	n	n	T	JS,TT	
9/21/2006	1030	14	NPM	n	n	n	n	n	n	n	n	T	JS,TT	
9/21/2006	1030	14	NPM	n	n	n	n	n	n	n	n	T	JS,TT	
9/21/2006	1030	14	NPM	n	n	n	n	n	n	n	n	T	JS,TT	
9/21/2006	1030	14	NPM	n	n	n	n	n	n	n	n	T	JS,TT	
9/22/2006	845	12	NF	n	n	n	n	n	n	n	n	T	JS,TT	close trap 845
10/20/2006	1225	11	WRHY	360	455	n	985120016417544	148.300	89	7.7g	n	EF	JS, BM	1min 25sec, 3 staples, release Flatiron
10/31/2006	1615	8	RBT	348	440	n	985120019768597	148.300	95	7.7g	n	EF	JS, BM	3min, 4 staples, release Flatiron
11/6/2006	1700	7	NF	n	n	n	n	n	n	n	n	EF	JS, BM	
11/13/2006	1500	6	RBT	295	225	n	n	n	n	n	n	EF	JS, BM	
11/13/2006	1500	6	RBT	318	319	n	n	n	n	n		EF	JS, BM	
11/13/2006	1500	6	RBT	256	159	n	n	n	n	n		EF	JS, BM	
11/13/2006	1500	6	RBT	431	810	n	985120019866297	148.640	106	10g		EF	JS, BM	3min 30sec, 5 staples
11/13/2006	1500	6	RBT	410	594	n	985120019750449	148.300	90	7.7g		EF	JS, BM	2min 30sec, 3 staples
11/20/2006	1430	5	NF	n	n	n	n	n	n	n		EF	JS, BM	

Appendix B

Gill Net Data 2004, 2005, 2006

Appendix B.1

B.1: 2006 Thompson Falls Reservoir gill netting, performed by MFWP and PPL Montana

Location#	Date set	Time set	H_2O temp (˚C)	Depth set (ft)	Date pulled	Time pulled	GPS location	Species	Length (mm)	Weight (g)
1a	10/12/2006	1451	11	1' - 16.5'	10/13/2006	900	N47.58852	NF		
							W115.33651			
1b	10/12/2006	1458	11	5' - 10'	10/13/2006	908	N47.58814	LSS	495	1257
1b	10/12/2006	1458	11	5' - 10'	10/13/2006	908	W115.33336	LSS	463	954
1b	10/12/2006	1458	11	5' - 10'	10/13/2006	908		LSS	518	1515
1b	10/12/2006	1458	11	5' - 10'	10/13/2006	908		NPM	482	937
1b	10/12/2006	1458	11	5' - 10'	10/13/2006	908		PUMP	156	99
2a	10/12/2006	1539	11	6' - 30'	10/13/2006	950	N47.57942	NP	628	1706
2a	10/12/2006	1539	11	6' - 30'	10/13/2006	950	W115.31928	NP	427	502
2a	10/12/2006	1539	11	6' - 30'	10/13/2006	950		NP	550	1233
2a	10/12/2006	1539	11	6' - 30'	10/13/2006	950		NP	590	1210
2a	10/12/2006	1539	11	6' - 30'	10/13/2006	950		NP	299	162
4a	10/12/2006	1547	11	2' - 25'	10/13/2006	935	N47.56812	NPM	470	1092
4a							W115.2957	PEA	308	288
6a	10/12/2006	1616	11	5' - 12'	10/13/2006	1020	N47.57809	NP	965	7,303
6a	10/12/2006	1616	11	5' - 12'	10/13/2006	1020	W115.22110	NPM	477	1122
6a	10/12/2006	1616	11	5' - 12'	10/13/2006	1020		NP	512	959
6a	10/12/2006	1616	11	5' - 12'	10/13/2006	1020		BBH	209	137
6a	10/12/2006	1616	11	5' - 12'	10/13/2006	1020		BBH	187	92
6a	10/12/2006	1616	11	5' - 12'	10/13/2006	1020		BBH	208	156
6a	10/12/2006	1616	11	5' - 12'	10/13/2006	1020		BBH	205	126

Location#	Date set	Time set	H_2O temp (˚C)	Depth set (ft)	Date pulled	Time pulled	GPS location	Species	Length (mm)	Weight (g)
6b	10/12/2006	1610	11	3.5' - 10'	10/13/2006	1015	N47.57753	NP	285	379
6b	10/12/2006	1610	11	3.5' - 10'	10/13/2006	1015	W115.22084	NP	838	5556
8a							N47.57173	NF		
							W115.25995			
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		LSS	544	1661
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923	N47.59103	NP	635	2700
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923	W115.32737	BBH	222	162
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	192	195
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	240	208
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	178	81
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	212	131
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	224	160
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	227	177
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	175	74
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	207	127
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	149	46
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	198	115
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	228	182
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	217	167
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	219	145
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	192	96
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	212	148
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	199	123
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	217	150
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	211	137
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	169	66
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	220	170
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	238	225
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	249	230
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	225	180
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	193	103

Location#	Date set	Time set	H_2O temp (˚C)	Depth set (ft)	Date pulled	Time pulled	GPS location	Species	Length (mm)	Weight (g)
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	171	83
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	213	176
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	185	82
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	225	168
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	220	161
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	173	81
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	204	127
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		BBH	183	102
9a	10/12/2006	1520	11	3.5' - 10'	10/13/2006	923		PUMP	128	42
9b	10/12/2006	1510	11	6' - 12'	10/13/2006	914	N47.59210	NP	562	1251
9b	10/12/2006	1510	11	6' - 12'	10/13/2006	914	W115.33022	NP	480	682
9b	10/12/2006	1510	11	6' - 12'	10/13/2006	914		NP	595	1512
9b	10/12/2006	1510	11	6' - 12'	10/13/2006	914		YP	189	81
9b	10/12/2006	1510	11	6' - 12'	10/13/2006	914		BBH	210	152
9b	10/12/2006	1510	11	6' - 12'	10/13/2006	914		BBH	190	106
9b	10/12/2006	1510	11	6' - 12'	10/13/2006	914		BBH	187	102
9b	10/12/2006	1510	11	6' - 12'	10/13/2006	914		BBH	194	110
9b	10/12/2006	1510	11	6' - 12'	10/13/2006	914		BBH	204	139
9b	10/12/2006	1510	11	6' - 12'	10/13/2006	914		BBH	205	130
9b	10/12/2006	1510	11	6' - 12'	10/13/2006	914		BBH	219	164
9b	10/12/2006	1510	11	6' - 12'	10/13/2006	914		BBH	176	85
9b	10/12/2006	1510	11	6' - 12'	10/13/2006	914		BBH	224	187
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931	N47.58753	LSS	525	1400
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931	W115.32697	LSS	460	969
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		LSS	465	1144
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		NPM	395	575
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		NP	413	508
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	250	271
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	230	178
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	219	175

Location#	Date set	Time set	H_2O temp (˚C)	Depth set (ft)	Date pulled	Time pulled	GPS location	Species	Length (mm)	Weight (g)
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	205	164
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	212	173
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	220	167
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	214	172
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	215	170
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	244	285
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	219	197
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	207	152
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	208	131
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	241	206
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	211	154
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	182	95
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	210	146
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	174	77
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	225	183
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	204	179
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	215	149
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	192	129
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	189	117
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	193	111
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	215	158
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	202	136
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	219	157
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	190	112
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	180	90
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	210	171
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	170	66
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	244	208
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	194	132
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	194	115
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	218	164
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	217	152

Location#	Date set	Time set	H_2O temp (˚C)	Depth set (ft)	Date pulled	Time pulled	GPS location	Species	Length (mm)	Weight (g)
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	190	102
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		BBH	306	245
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		NP	635	2106
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		NP	491	1004
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		NP	660	2062
10	10/12/2006	1532	11	0' - 12'	10/13/2006	931		NPM	470	1019

Appendix B.2

B.2: Summary of gill net data for Thompson Falls Reservoir, collected in October of 2004 - 2006

2004	Length (mm)		Weight (g)		total n	# per net
	Mean	Range	Mean	Range		
Northern Pike	566	298-767	1592.3	170-3629	8	1.3
Largemouth bass	150	*	44	*	1	0.2
Smallmouth bass	327	325-328	588	577-599	2	0.3
Yellow perch	213	149-332	168	37-537	10	1.7
Pumpkinseed	137	125-148	55	41-69	2	0.3
Northern pike minnow	496	*	1162	*	1	0.2
Large scale sucker	430	238-525	931	126-1326	4	0.7
Black bullhead	206	125-250	168.9	30-261	17	2.8
TOTAL					**45**	**7.5**

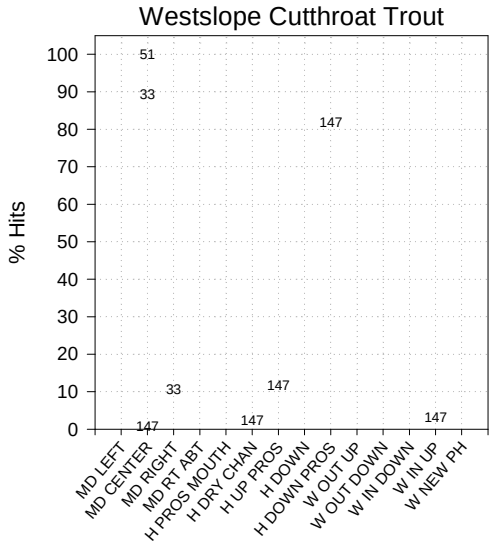
2005	Length (mm)		Weight (g)		total n	# per net
	Mean	Range	Mean	Range		
Northern Pike	544	275-755	1384	128-3502	18	1.8
Largemouth bass	*	*	*	*	0	0
Smallmouth bass	346	*	659	*	1	0.1
Yellow perch	222	150-256	146	42-246	7	0.7
Pumpkinseed	115	*	35	*	1	0.1
Northern pike minnow	383	210-498	694	76-1137	3	0.3
Largescale sucker	496	447-571	1296	1036-1740	13	1.3
Peamouth	361	*	486	*	1	0.1
Black bullhead	186	130-264	113	35-306	34	3.4
TOTAL					**78**	**7.8**

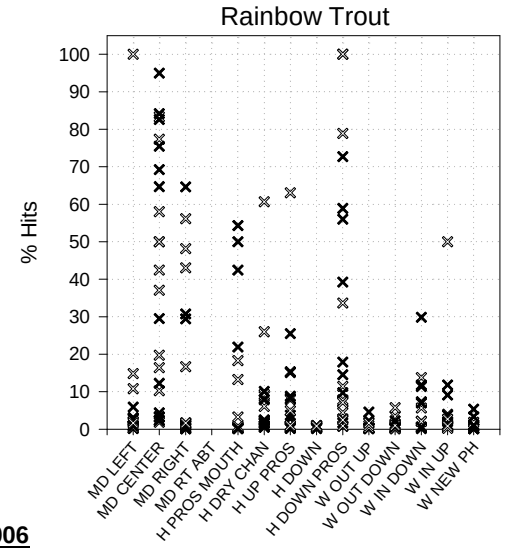
2006	Length (mm)		Weight (g)		total n	# per net
	Mean	Range	Mean	Range		
Northern Pike	563	285-965	1814	162-7303	17	1.7
Largemouth bass	*	*	*	*	0	0
Smallmouth bass	*	*	*	*	0	0
Yellow perch	189	*	8	*	1	0.1
Pumpkinseed	142	128-156	70.5	42-99	2	0.2
Northern pike minnow	459	395-482	949	575-1122	5	0.5
Largescale sucker	496	460-544	1271	954-1661	7	0.7
Peamouth	308	*	288	*	1	0.1
Black bullhead	208	149-306	145	46-285	83	8.3
TOTAL					**116**	**11.6**

Appendix C

Telemetry Data by Species

Telemetry hits presented by month from March through September for each species that has been tagged: bull trout, westslope cutthroat trout, rainbow trout, and brown trout. Each of the following graphs is set up in the same format. Each graph represents total telemetry hits for a specific species for one month. The y-axis depicts the percentage of hits of a single fish for a given month. Hits in the graphs are often depicted by a number, which represented an individual radio frequency number of a tagged fish. Due to the higher number hits, this number is replaced and shown as an **x** to reduce clutter in some of the graphs. The x-axis depicts the location of the hit. The abbreviations for the locations include: MD = main channel dam, H = hilltop, W = wingwall, PH = powerhouse, Pros = Prospect Creek, Rt Abut = right abutment, Chan = channel.


Westslope Cutthroat Trout
% Hits
MD LEFT
MD CENTER
MD RIGHT
MD RT ABT
H PROS MOUTH
H DRY CHAN
H UP PROS
H DOWN
H DOWN PROS
W OUT UP
W OUT DOWN
W IN DOWN
W IN UP
W NEW PH


Rainbow Trout
% Hits
MD LEFT
MD CENTER
MD RIGHT
MD RT ABT
H PROS MOUTH
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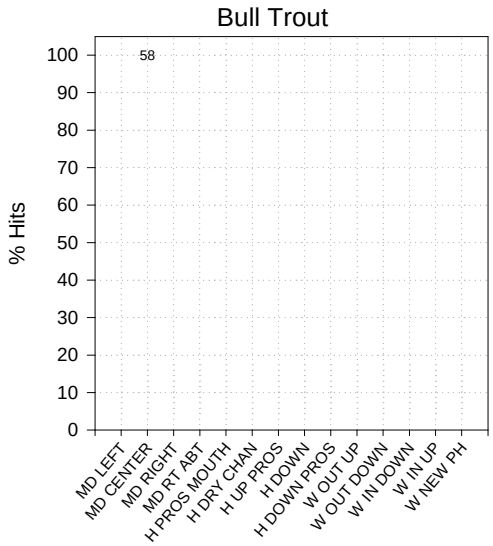
H UP PROS
H DOWN
H DOWN PROS
W OUT UP
W OUT DOWN
W IN DOWN
W IN UP
W NEW PH

March 2006


Bull Trout
% Hits
MD LEFT
MD CENTER
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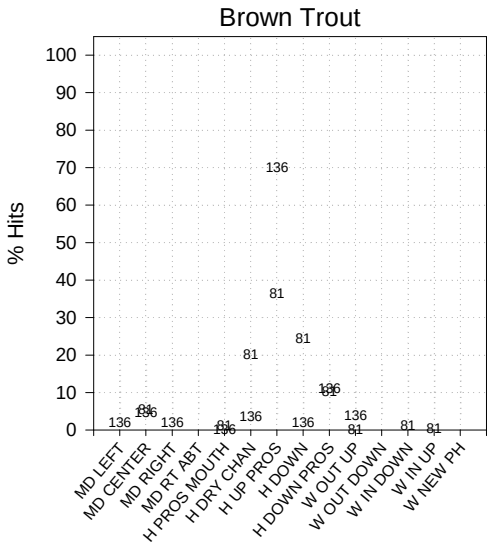
W OUT DOWN
W IN DOWN
W IN UP
W NEW PH


Brown Trout
% Hits
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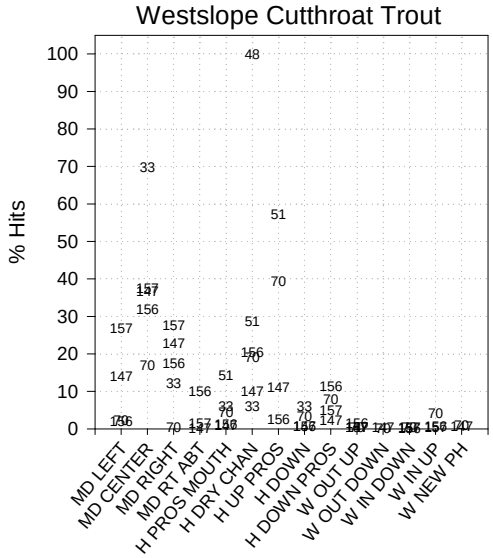
W IN UP
W NEW PH


Westslope Cutthroat Trout
% Hits
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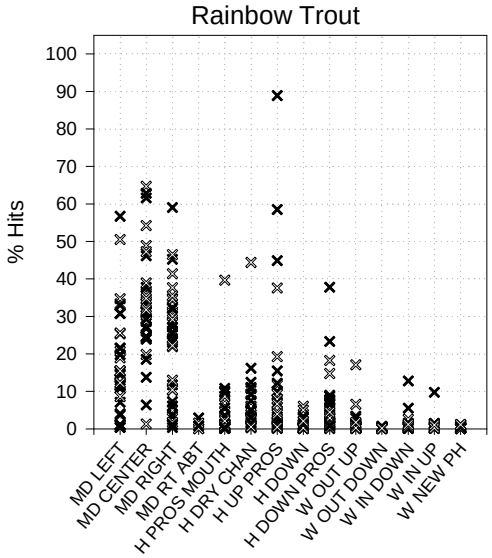
Rainbow Trout
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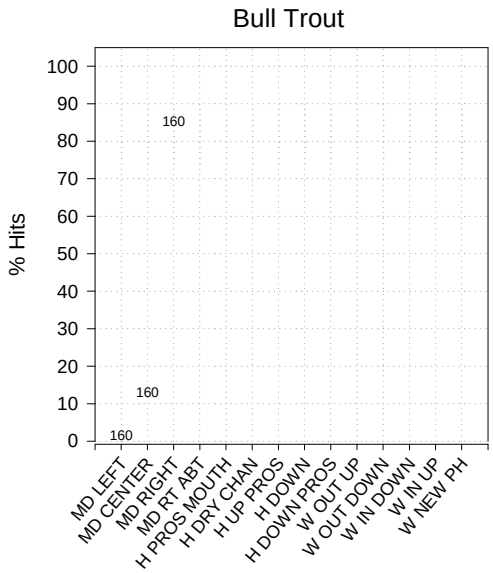
April 2006


Bull Trout
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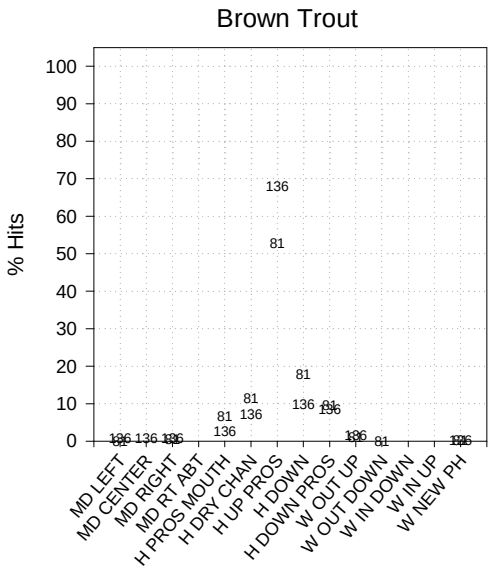
Brown Trout
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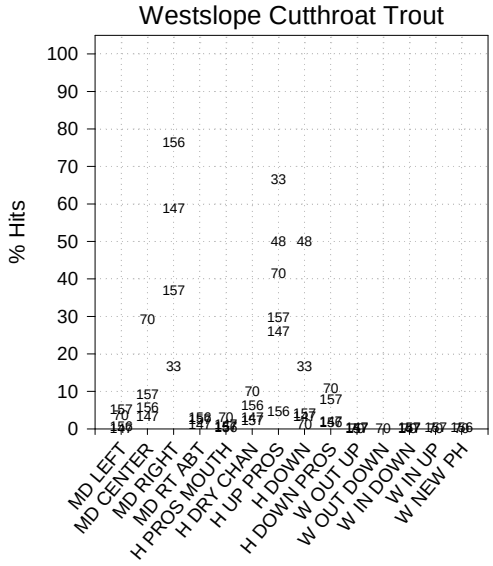
Westslope Cutthroat Trout
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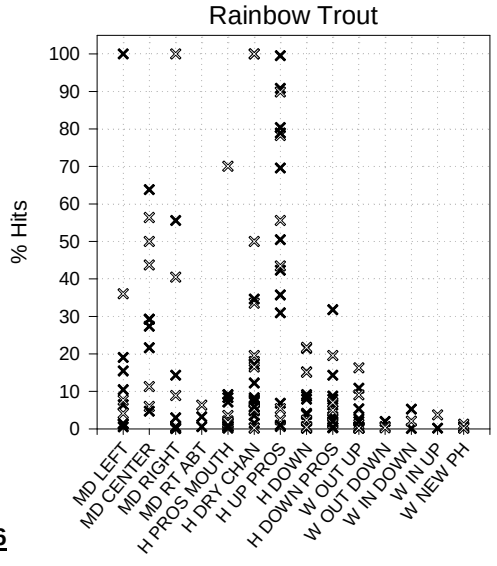
Rainbow Trout
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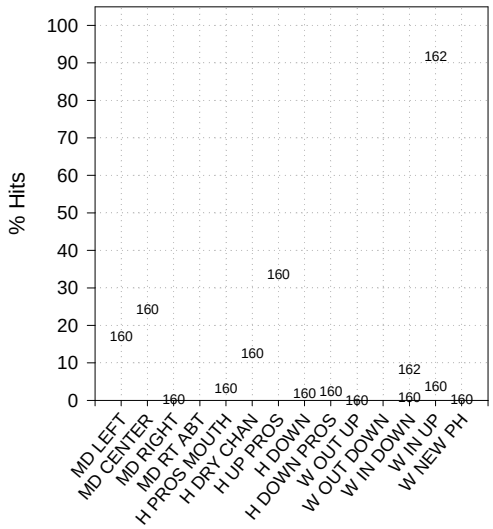
May 2006


Bull Trout
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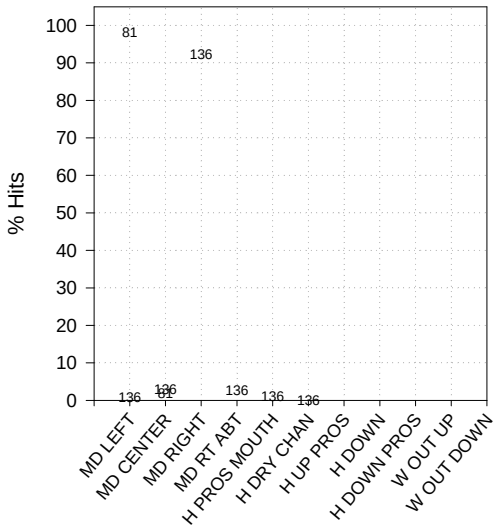
Brown Trout
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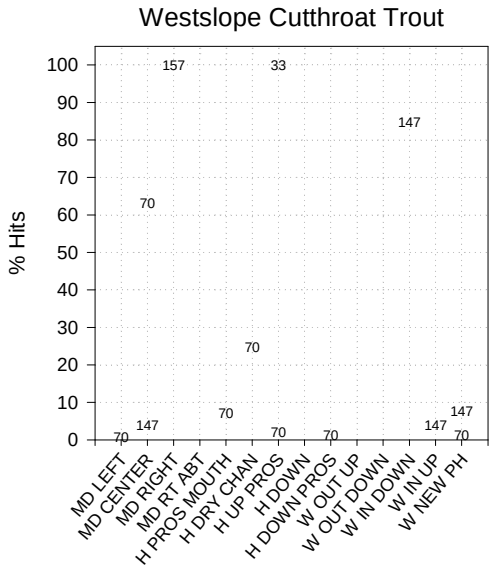
Westslope Cutthroat Trout
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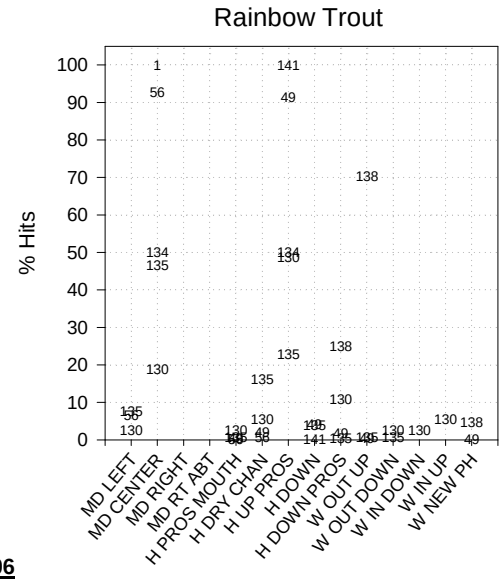
Rainbow Trout
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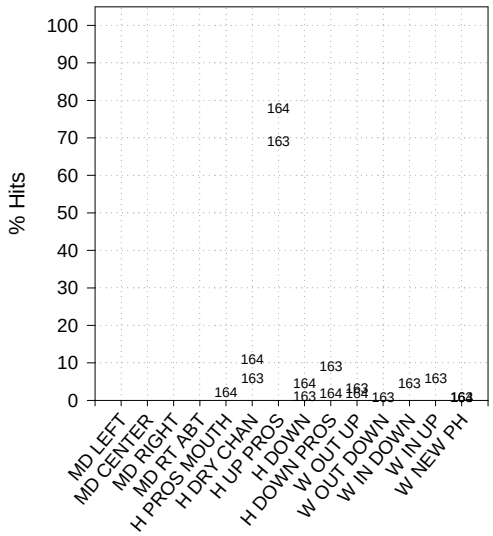
June 2006


Bull Trout
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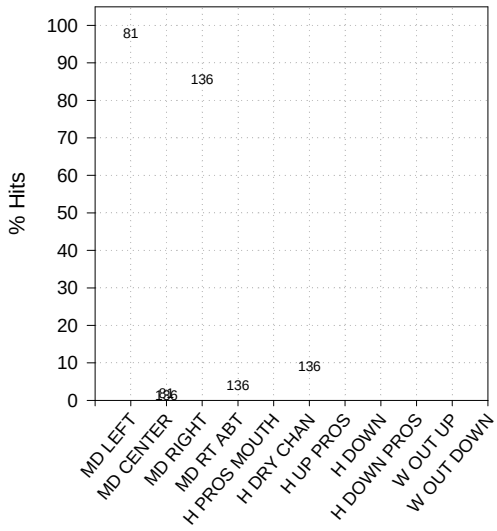
Brown Trout
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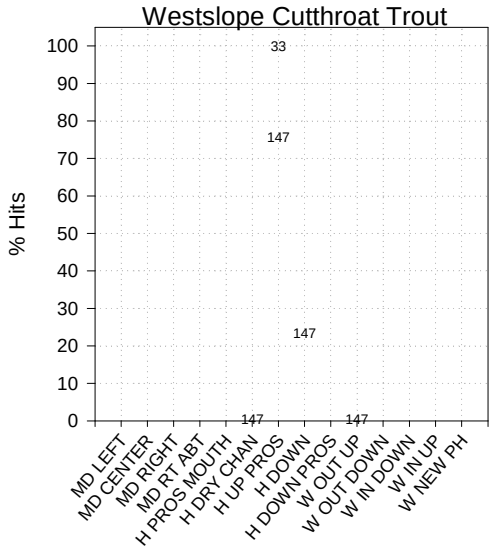
Westslope Cutthroat Trout
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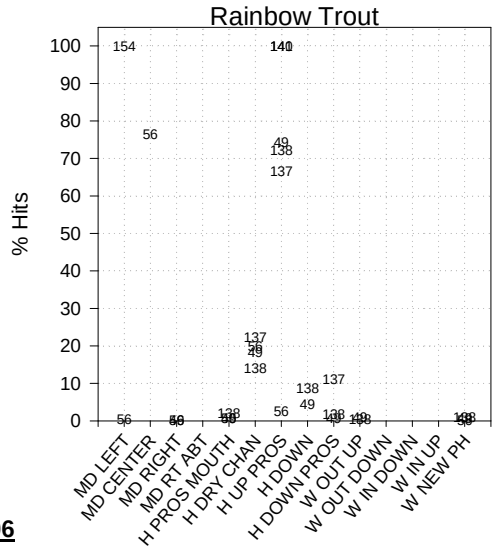
W NEW PH


Rainbow Trout
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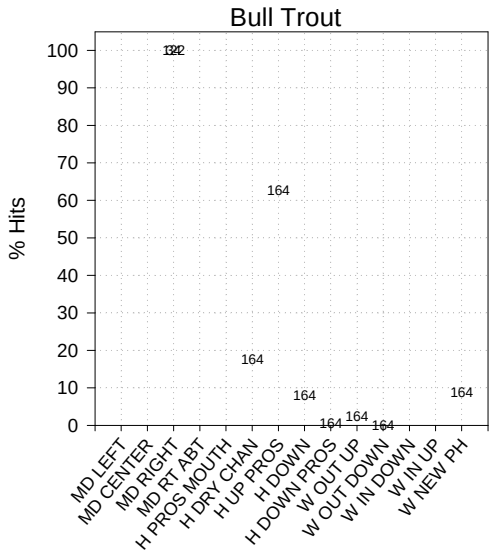
W IN UP
W NEW PH

July 2006


Bull Trout
% Hits
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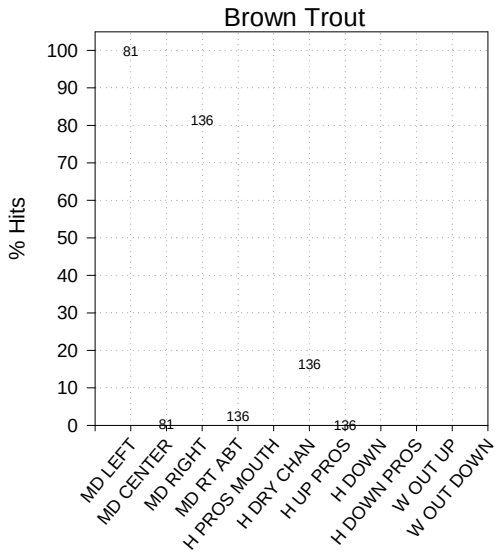
W NEW PH


Brown Trout
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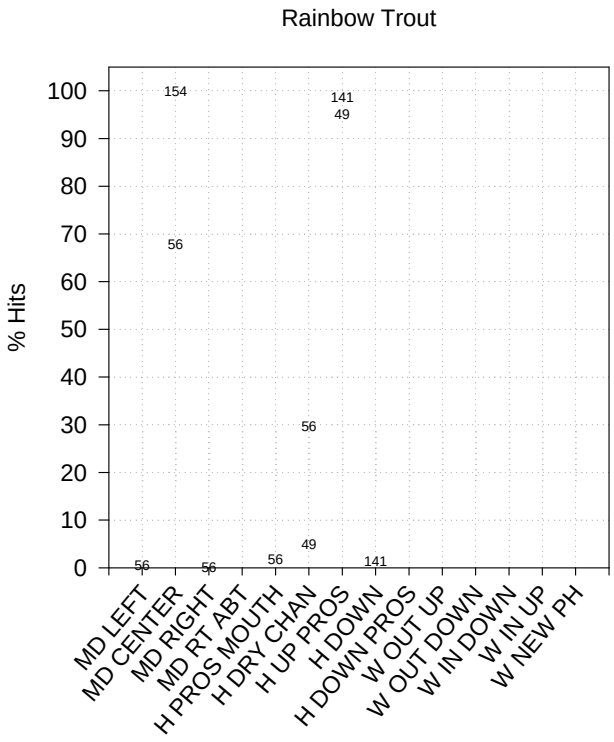
W OUT DOWN

August 2006


Rainbow Trout
% Hits
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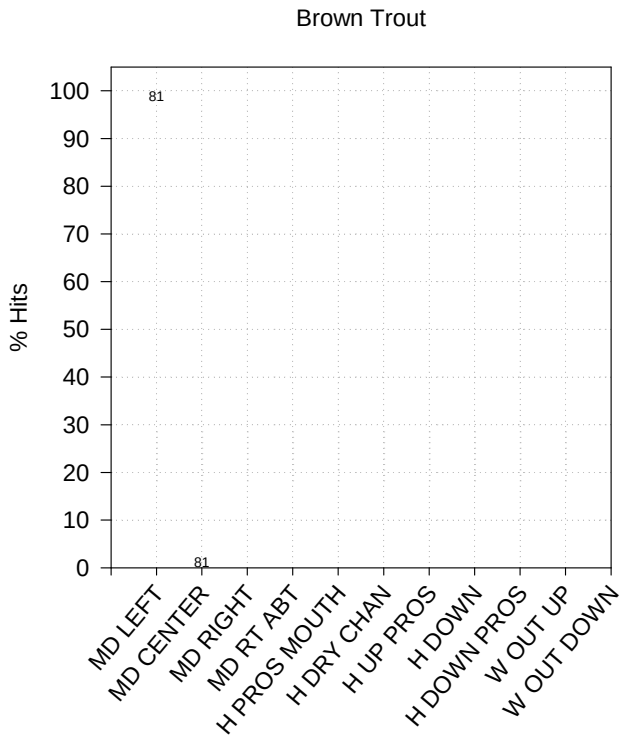
90
80
70
60
50
40
30
20
10
0
154
141
49
56
56
56
56
49
56
141
MD LEFT
MD CENTER
MD RIGHT
MD RT ABT
H PROS MOUTH
H DRY CHAN
H UP PROS
H DOWN
H DOWN PROS
W OUT UP
W OUT DOWN
W IN DOWN
W IN UP
W NEW PH


Brown Trout
% Hits
100
90
80
70
60
50
40
30
20
10
0
81
81
MD LEFT
MD CENTER
MD RIGHT
MD RT ABT
H PROS MOUTH
H DRY CHAN
H UP PROS
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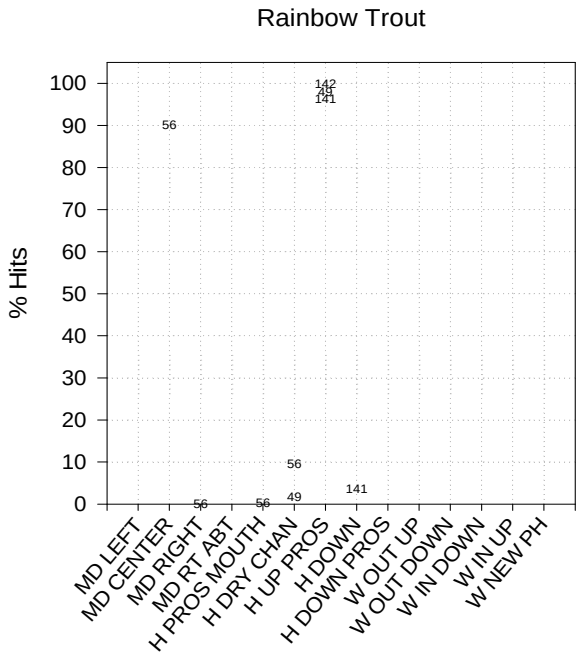
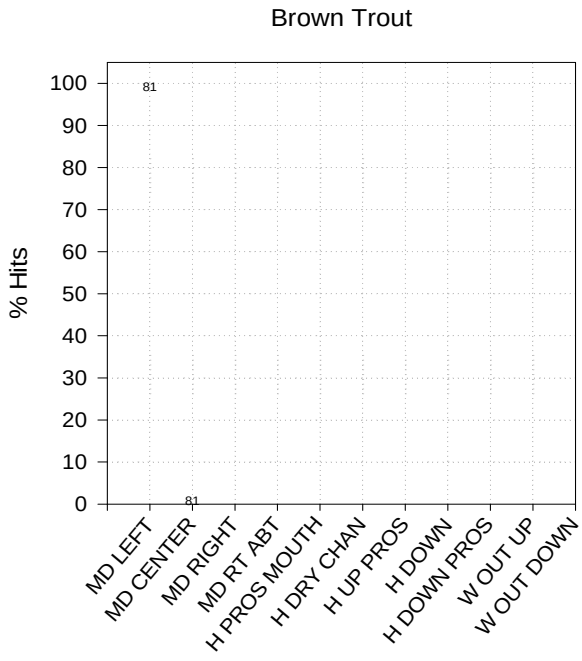
H DOWN PROS
W OUT UP
W OUT DOWN

September 2006 (9/1-9/13)

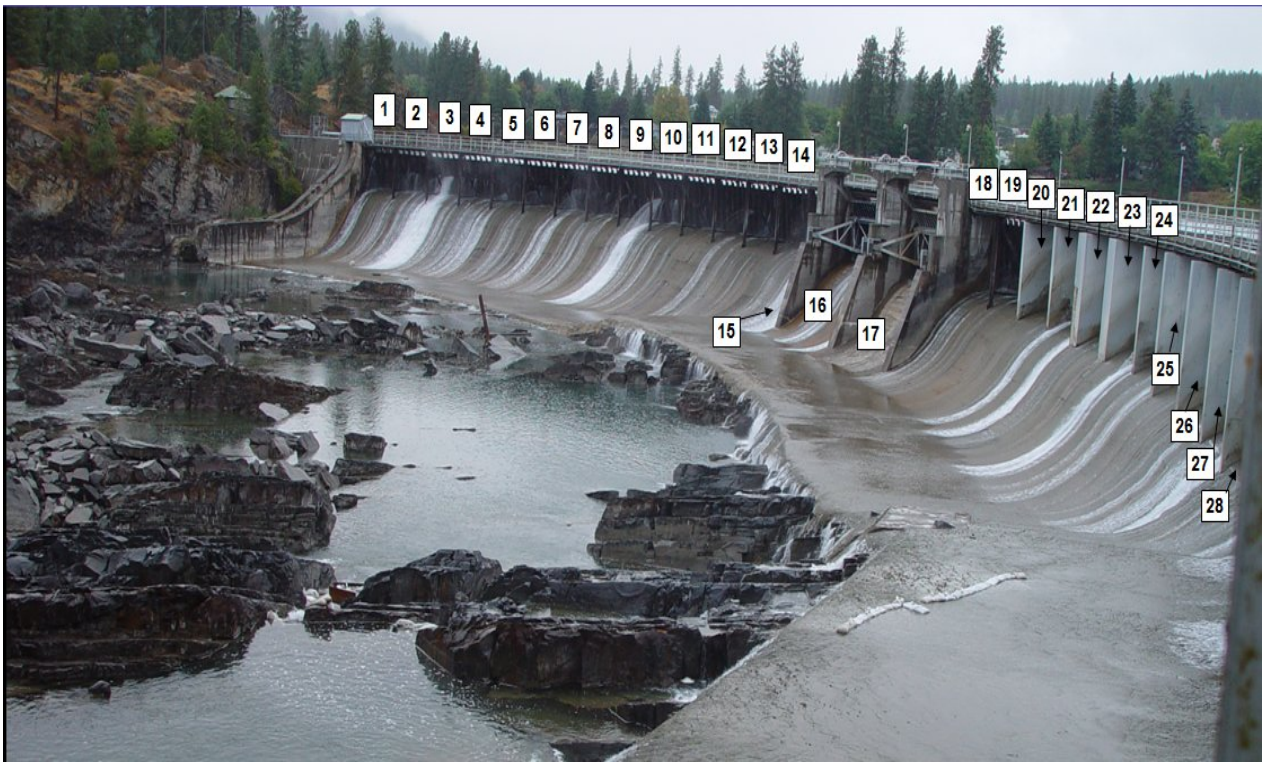




Appendix D

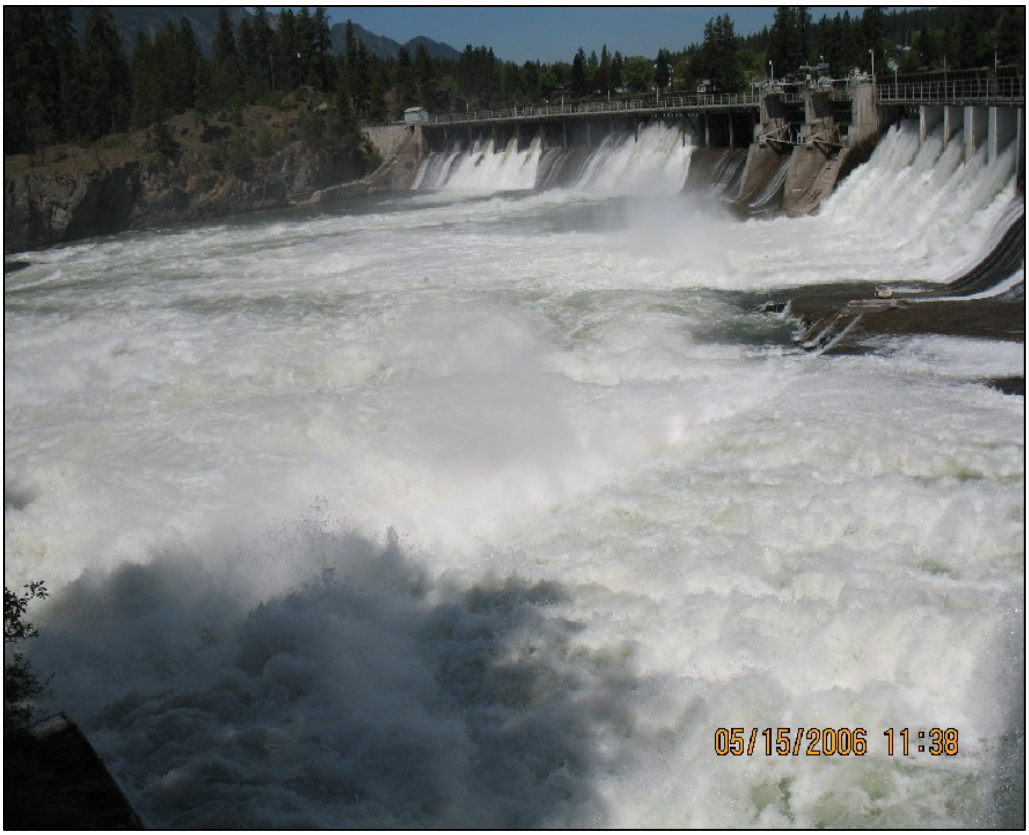
Thompson Fall's Spillway at the Main Channel Dam

Configuration of the spillway at the main channel dam at Thompson Falls with the spill bays numbered.




04/19/2006 09:02


04/24/2006 08:47



Various levels of spill during 2006 on April 19, April 24, May 15, and May 19. Spill bay 1 is on the far left side of each photo.

Appendix E

Main Channel Dam Operation Schedule

Thompson Falls Dam - Main Channel Dam Spill Operating Schedule for Fish Passage

Revised December 6, 2006

The following is a description of the spill gate opening sequence that appeared to be the best combination of fish and operational needs during 2006. Spill-reduction sequence to be in the opposite order. This spill schedule is a living document, and can be updated as appropriate, on the basis of new fish or operations information.

- Spill from 0 – 700 cfs: Open lift *panels 16, 22, and 28 (right to left), in spill bays 3-5* as attraction for fish to the right abutment, for rising spill… (up to a total of three lift panels opened, and total spill = 700 cfs) – 3 total panels

- Spill from 700 – 6,292 cfs: Open all lift panels, starting with #204 and (working to the *right*) extending to #181, in spill bays 36-33 as a deterrent to keep fish from the left abutment tailwater zone… (up to a subtotal of 24 lift panels, for a total of 5,592 cfs, plus 700 cfs attraction flow from spill bays 3-5, for a grand total of 6,292 cfs) – 27 total panels

- Spill from 6,292 – 11,884 cfs: Open lift panels, starting with #91 and extending (to the *left*) to #114, in spill bays 18 – 21… (subtotal of *24* lift panels, for a total of 5,592 cfs, for a grand total of 11,884 cfs) – 51 total panels

- Spill from 11,884 – 14,680 cfs : Open lift panels, starting with #66 and extending (to the *right*) to #55, in spill bay 11 and 10… (subtotal of 12 lift panels, for a total of 2,796 cfs, for a grand total of 14,680 cfs) – 63 total panels

- Spill from 14,680 – 17,476 cfs: Open lift panels, starting with #115 and extending (to the *left*) to #126, in spill bays 22 and 23… (subtotal of 12 lift panels, for a total of 2,796 cfs, for a grand total of 17,476 cfs) – 75 total panels

- Spill from 17,476 – 20,272 cfs: Open lift panels, starting with #180 and extending (to the *right*) to #169, in spill bays 32 and 31… (subtotal of 12 lift panels, for a total of 2,796 cfs, for a grand total of 20,272 cfs) – 87 total panels

- Spill from 20,272 – 23,068 cfs: Open lift panels, starting with #54 and extending (to the *right*) to #43, in spill bays 9 and 8… (subtotal of 12 lift panels, for a total of 2,796 cfs, for a grand total of 23,068 cfs) – 99 total panels

- Spill from 23,068– 27,262 cfs: Open lift panels, starting with #151 and extending (to the *left*) to #168, in spill bays 30 - 28… (subtotal of 18 lift panels, for a total of 4,194 cfs, for a grand total of 27,262 cfs) – 117 total panels

- Spill from 27,262– 30,058 cfs: Open lift panels, starting with #42 and extending (to the *right*) to #31, in spill bays 7 and 6… (subtotal of 12 lift panels, for a total of 2,796 cfs, for a grand total of 30,058 cfs) – 129 total panels

- Spill from 30,058– 36,650 cfs: Open lift panels, starting with #127 and extending (to the *left*) to #150, in spill bays 24 - 27… (subtotal of 24 lift panels, for a total of 5,592 cfs, for a grand total of 35,650 cfs) – 153 total panels

- Spill from 35,650– 52,426 cfs: Open dry channel lift panels, starting with Spill Bay 1 and extending to spill bay 12 (or in the reverse order, at operator's discretion), adding up to a total of 16,776 cfs, for a grand spill total of 52,456 cfs) – 153 total panels at main channel dam and 72 total panels at dry channel

- Spill from 52,426– 58,717 cfs: Sequentially open the remaining lift panels in spill bays 1 – 5 of the main channel dam (starting with lift panel #30, and extending to lift panel #1, for a total of 27 lift panels, for a total of 6,291 cfs, and a grand spill total of 58,747 cfs.) – 180 total panels at main channel dam and 72 total panels at dry channel

- Spill from 58,717 – 64,309 cfs: Sequentially open all remaining lift panels (spill bays 12-15, lift panels 67-90) – for a total spill of 5,592 cfs.

- Spill from 64,309 to 86,309 cfs: Open both radial gates (emergency only)

Note: It is assumed that all lift gates have a 233 cfs capacity.