BULL TROUT LIFE HISTORY INVESTIGATIONS IN THE NORTH FORK CLEARWATER RIVER BASIN

REGIONAL FISHERIES MANAGEMENT INVESTIGATIONS NORTH FORK CLEARWATER RIVER BULL TROUT

FINAL REPORT
Period Covered: 2000 – 2006

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ABSTRACT

Above Dworshak Dam, on the North Fork Clearwater River 1,283 bull trout *Salvelinus confluentus* were captured and implanted with passive integrated transponder (PIT) tags, and 706 implanted with telemetry tags from 2000 to 2006. Sampling occurred during the spring and summer near the slack/flowing water interface in Dworshak Reservoir. Total length of all captured bull trout ranged from 105 – 692 mm and weight ranged from 50 – 3,400 g. Bull trout average total length increased from 2000 to 2006. Mean growth rate was estimated from recaptured bull trout at 0.109 mm per day. Adult pre-spawn population estimates indicate a general increase in population size from 2002 to 2005. Current adult pre- spawn population estimates are around 1900 (1514-2312, 95%CI) adult fish. Diet samples collected from bull trout during the spring and fall indicate a switch in prey items between the two seasons from primarily rainbow trout and fish eggs in the spring and then kokanee during the fall. We attributed this to spatial overlap between bull trout and their prey for these times. Most tagged adult bull trout migrated out of the reservoir during May and June in route to the upper North Fork (NFC) or Little North Fork Clearwater Rivers (LNF) or associated tributaries to spawn. Mean upstream migration distance, from tagging location, was 67.5 km with the farthest being 237.2 km. Spawning took place between August and October in the fluvial habitat. Key production watersheds as determined by numbers of tagged fish are Headwaters NFCR, Long Creek, Middle LNF, and Upper LNF. Post spawn survival rates were near 80% from 2002 to 2005 when sample sizes were greater than 45 spawning fish. Eighty percent of bull trout exhibited repeat year spawning behavior and 20% alternate year or longer spawning. Upon spawning bull trout returned to Dworshak Reservoir and overwintered here from November through April. Mean over winter (6 months) distance traveled, within Dworshak Reservoir, was 56.7 km. Based on spatial distribution project operations are most likely to have an effect on adult bull trout during the winter when greater concentrations of fish are in the reservoir. Bull trout entrainment is identified as a risk and the conditions that present the greatest risk are a combination of high water discharges through the dam and bull trout proximity to the dam. These conditions are most likely to occur during March, and based on fish depth use entrainment through the turbines is the probable avenue. Through the rest of the winter most bull trout are located farther upstream in the reservoir and not at risk of entrainment. Only two of 706 tagged bull trout were documented being entrained through the six year study and project operations of the dam appear to have little overall effect on the bull trout population above Dworshak Dam.

Below Dworshak Dam twenty bull trout were implanted with radio tags from 2003 – 2005. Total length of all bull trout captured within the North Fork Clearwater River below the dam (NFBD) ranged from 310 mm to 664 mm (mean 475.7 mm) and weight ranged from 300 g to 4,080 g (mean 1,374.8 g). Nine fish remained in the vicinity of their tagging locations, only migrating a mean distance of 3.3 km (range = 1.3 – 5.7 km). This group of tagged bull trout stayed in the NFBD or within 5.0 km of the confluence with the Clearwater River (CLW). The remaining nine fish were detected migrating farther than 5 km from the confluence of the CLW and NFBD (Figure 8). This group had a mean total migration distance of 83.3 km (range = 6.8 – 371.6 km). Five fish, within this group, migrated greater than 20 km; three moved upstream into the Lochsa River, one upstream near Lawyer Creek, and one downstream 20 km. This study documents bull trout traveling between the NFBD, CLW, and Lochsa Rivers and documents bull trout in these areas during spawning time. It is not known if these tagged bull trout attempted to spawn or not. Additional investigation is needed to identify unknown areas mature bull trout are using to reproduce and the effects of cool water releases from Dworshak Dam on bull trout.

PART I: BULL TROUT NORTH FORK CLEARWATER RIVER ABOVE DWORSHAK DAM

INTRODUCTION

Historical observations document bull trout *Salvelinus confluentus* throughout the North Fork Clearwater River (NFC). Bull trout were found in the basin prior to construction of Dworshak Dam (Cannon 1970) and are still found in the NFC, many of its tributaries and Dworshak Reservoir (Lindland 1987, Statler 1988, Schriever and Cochnauer 1996, Weigel and Cross 1997, Weigel and Zakrajsek 1998, Schriever and Schiff 2002, Schiff and Schriever 2004, Schiff 2004). However, measuring changes in bull trout population abundance and distribution in the basin is difficult because of the lack of pre- and post-dam data. There is also a lack of information on bull trout populations in basins without dam and reservoir influences to use as comparable controls. As a result, direct assessment of the change in bull trout population dynamics due to the construction of Dworshak Dam is likely not feasible. However, assessment of the status and structure of the current bull trout population remaining in the NFC basin is possible. Determining whether their viability and movements are affected by operations of Dworshak Dam and its physical attributes can also be determined. The investigation of these issues will help provide the information necessary to assess the need for, and determination of strategies to protect and perpetuate viable populations of bull trout in the NFC basin.

Although bull trout have been observed and collected throughout the basin before this study, little quantitative information was available on their life history, distribution, and abundance. Other than documenting presence or absence, no information is available regarding the role Dworshak Reservoir plays in the life history, distribution and abundance of bull trout in the NFC.

Bull trout populations are susceptible to habitat disruption and fragmentation (Rieman and McIntyre 1993). Dworshak Dam has possibly isolated bull trout population(s) in the NFC from genetic exchange with other populations in the Clearwater River basin. The impact(s) of severing the connectivity between the NFC bull trout populations and other Clearwater River populations may be crucial in sustaining a viable bull trout population upstream of Dworshak Dam, relative to Dworshak Dam. Additional threats to bull trout upstream of Dworshak Dam include the risk of entrainment. Understanding the spatial and temporal distribution of bull trout will help in managing dam operations to decrease risks of entrainment.

This study was designed to document and describe bull trout life history and temporal and spatial distribution within the NFC drainage and the effects of Dworshak Dam operation on bull trout. This information will be used to develop and implement strategies to protect and perpetuate bull trout populations in the NFC drainage with regards to the operation of Dworshak Dam and project area.

STUDY SITE

The NFC is a fourth order stream located in north central Idaho. It has a total drainage area of 739,982 ha with the headwaters extending into the Bitterroot Mountains and forming the western border of Montana. The majority of the drainage is under public ownership by the U.S. Forest Service, Clearwater and Panhandle National Forests. The major tributaries of the NFC are Little North Fork Clearwater River (LNF), Kelly, Cayuse, Skull, Quartz, Orogrande, and Weitas creeks (Figure 1).

Dworshak Dam was constructed in 1971 near the mouth of the NFC. The 218 m tall structure inundated over 100 km of stream habitat on the NFC. The authorized purpose of the dam is to provide flood control, power, and navigation, while providing recreation and fishing opportunities.

At full pool (487 msl) Dworshak Reservoir is 86.2 km long and has 295 km of steep shoreline. It has a total volume of 4.28×10^9 m^3 that corresponds to a maximum depth of 194 m, mean depth at full pool of 56 m, and a surface area of 6,644 ha (Maiolie and Elam 1994). The main arms of the reservoir are Elk Creek, the LNF, and the NFC. Adjacent land cover to Dworshak Reservoir belongs to the Army Corp of Engineers.

Water levels in Dworshak Reservoir are primarily controlled by water releases at Dworshak Dam. These releases are generally governed by flood control rule curves and the 2001 Biological Opinion. Depending on reservoir elevation and snow pack, water releases can vary. Generally water releases usually begin, around April 1 with discharges approaching 566 cms (20,000 cfs). Spring augmentation is normally 30 days, before releases are reduced in an attempt to fill Dworshak pool by June 30. Starting in early July reservoir elevation begins to recede until September when pool elevation reaches a low (440 msl) and is maintained near this level through the winter. High discharges occur during spring run-off and in summer, when cool water is released for anadromous fish flows.

Fluctuating water levels in Dworshak Reservoir vary where the start of the fluvial habitat begins. At low pool an additional 6.4 km of river, that was reservoir, is exposed compared to when water levels are near full pool. Annual pool level fluctuations in excess of 40 m are common. Because of fluctuating water levels the shore surrounding Dworshak Reservoir (below 1600 msl) has little vegetation growth and banks are easily eroded.

Overall in the last 30 years there has been little change in reservoir clarity or chlorophyll A concentrations, but a marked decline in nutrients such as nitrates and orthophosphates. Total zooplankton densities have also seen reductions since initial assessments in 1974 (Stark 2006). Generally Dworshak Reservoir is thermally stratified starting in April-May, and has a strong thermocline through the summer.

Native resident salmonids found within the drainage include bull trout, westslope cutthroat trout *Oncorhynchus clarkii lewisi*, rainbow trout *O. mykiss* and mountain whitefish *Prosopium williamsoni*. Anadromous fish have been eliminated from the system since the construction of Dworshak Dam. Prior to that time, Chinook salmon O*. tshawytscha and* steelhead *O. mykiss* where found throughout the drainage. The system has been stocked with kokanee *O. nerka*, rainbow trout, brook trout *Salvelinus fontinalis,* westslope cutthroat trout, bull trout, smallmouth bass *Micropterus dolomieui*, and largemouth bass *M. salmoides*.

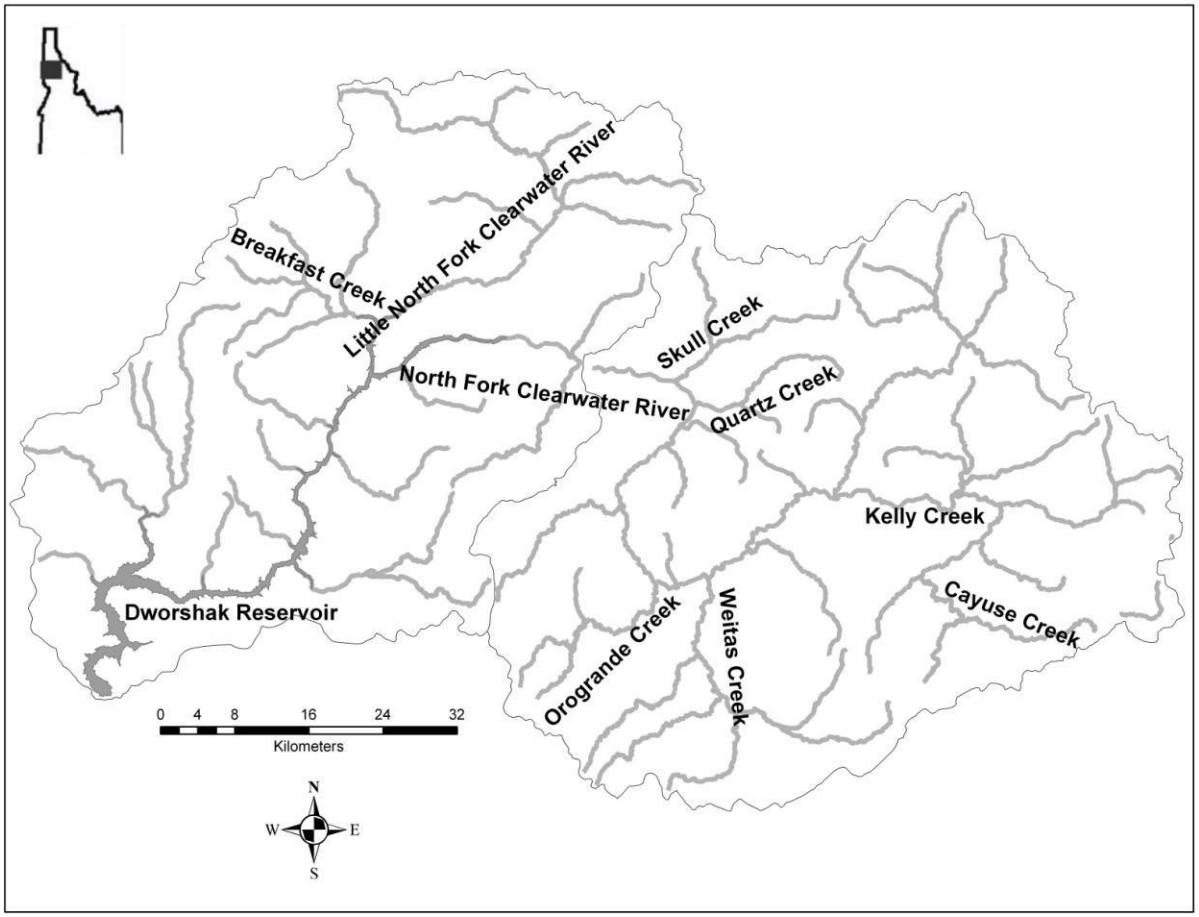

Figure 1. Study area. North Fork Clearwater River, including Dworshak Reservoir and major tributaries.

OBJECTIVES

1. Characterize the biology and life history of bull trout in the NFC drainage.

2. Determine bull trout temporal and spatial distributions within Dworshak Reservoir and the NFC drainage.

3. Obtain information on the timing and extent of migration into the North Fork and Little North Fork Clearwater rivers and tributaries, and identify spawning sites.

4. Evaluate the effects of project operation on bull trout.

METHODS

Tagging

Bull trout were captured by hook and line techniques and gill nets in Dworshak Reservoir from 2000 to 2006. Sampling was conducted near the slack/flowing water interface where bull trout concentrate in early spring. Experimental gill nets were used; they consisted of six 7.6 m long panels. Each panel was one of six mesh sizes. The mesh sizes were 19 mm, 25 mm, 32 mm, 38 mm, 51 mm, and 64 mm. Sampling was conducted in the NFC arm between rkm 74.1 and rkm 85.8 (NFC area), in the LNF arm 5.5-8.0 km above the confluence of the LNF and NFC (LNF area), and in a 3 km area near the slack-water interface in Breakfast Creek (BFC area). Additional bull trout were collected in Dworshak Reservoir between Elk Creek (rkm 20.1) and Grandad Bridge (rkm 64.4) (DWR area) (Figure 2).

In the fall of 2001-2006 sampling was conducted in the LNF and NFC areas and in the mainstem NFC from Isabella Creek (rkm 91.9) to Pete Ott Creek (rkm 171.6). This sampling was conducted to tag post-spawn bull trout returning from upstream migrations and increase the number or tagged bull trout in the reservoir during the winter.

Tagging was conducted on Dworshak Reservoir by a four person crew and volunteers on eight day rotating shifts from 04/17/00-05/26/00, 04/09/01-06/14/01, 10/17/01-10/23/01, 04//17/02-07/01/02, 10/04/02-10/22/02, 04/13/03-06/16/03, 10/02/03-10/30/03, 04/16/04-06/26/04,10/15/04-11/14/04, 04/18/05-06/04/05,09/29/05-11/19/05 and 05/09/06-05/24/06.

Individual bull trout were anesthetized in a 60-80 mg/l solution of tricaine methanesulphonate (MS-222). All fish, including recaptures, were weighed (g) and total and fork lengths (mm) measured. Fish were scanned for Passive Integrated Transponder (PIT) tags. If fish were not previously PIT tagged a 134 kHz PIT tag was inserted in the opercula muscle using a 14 gauge hypodermic needle. Also, an adipose fin clip was removed for genetic sampling and stored in a 95% ethanol solution. If the fish were previously pit tagged the number was recorded and marked as a recapture event. In 2003 to 2005 the first pelvic fin ray on the left fin was removed for age analysis. Aging was completed by the University of Idaho.

Bull trout weighing greater than 190 g were candidates for surgical transmitter implantation. The surgical procedure is an adaptation of the shielded-needle technique as described by Schill et al. (1994). All individuals were allowed to recover in fresh circulating water for a minimum of 15 minutes prior to release. Radio transmitters used were Lotek Nano tags (NTC-6-2) and Micro tags (MCFT-3EM, MCFT-3FM, MCFT-3BM MCFT-3A). Combination radio/acoustic transmitters were used in 2001 (Lotek CART 14-1) and acoustic tags in 2002 and 2003 (Lotek CAFT 11-4). Lotek MAP transmitters (MA-TP11-25, MA-TP16-25, MA-TP11-25) were used in 2004 and 2005 (Table 1). Multiple size tags were used to keep the tag weight below 2% of the fish's body weight.

Radio and acoustic tags were used to record the position of a fish at an unknown depth within the watershed. Unlike radio transmitters, MAP transmitters are digitally encoded acoustic transmitters that do not have the depth limitations associated with radio transmitters, and therefore are more effective at finding fish in the reservoir at deeper levels. These transmitters were designed to detect and transmit the fish's depth and temperature in the water. To increase the probability that MAP-tagged bull trout would inhabit the reservoir we only implanted MAP

transmitters into bull trout caught in October and November. We assumed bull trout caught at this time period were returning to the reservoir to over winter.

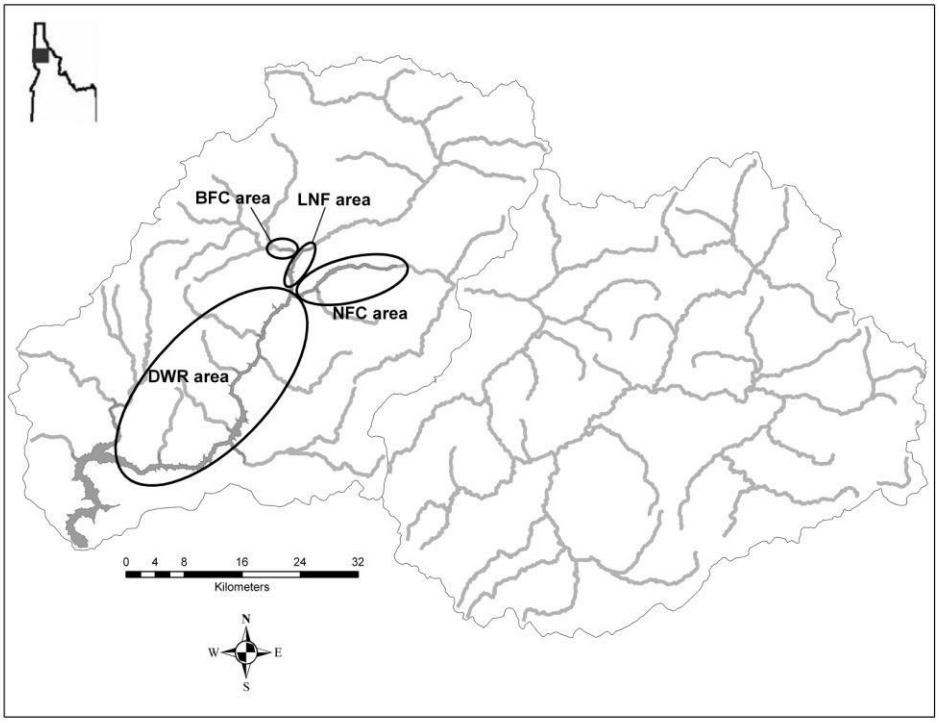

Figure 2. Bull trout tagging areas above Dworshak Dam.

Beginning in October of 2002, fish with transmitters surgically implanted were also subject to maturity and sex determination. An otoscope was used to visually determine gender and maturity. The instrument was inserted into the incision created for transmitter implantation to observe reproductive organs. If no reproductive organs were initially observed, the otoscope followed the body wall dorsally and anteriorly toward the head, following the kidney. Immature reproductive organs were generally found lying along the body wall posterior to the kidney. If no reproductive organs were observed, it was recorded as unknown. A female was determined to be mature if large ripe eggs (greater than one mm in diameter) were observed and immature if small eggs (less than one mm in diameter) were observed. Males were identified as mature if large gonads were observed or immature if gonads were small.

Diet samples from bull trout were collected by gastric lavage in 2001- 2004 similar to methods used by Underwood et al (1995). During April samples were collected in all years except 2001, in May samples were collected every year, in June during 2002 through 2004. Diet samples were also taken in October and November during 2003 and 2004. Diet samples came primarily from bull trout in the NFC and LNF tagging areas, although limited samples were collected from fish captured in other areas. Prey items were divided into eight categories; aquatic invertebrates, terrestrial invertebrates, fish (including fish eggs), zooplankton, amphibians, mammals, non-food (plants, rocks), and unknown. These categories were further broken down by attempting to identify diet items to species level, particular in the fish category.

Table 1. Model and associated information of transmitters used during the study.

Lotek Wireless Transmitters	Type	Pulse Rate (seconds)	Weight (g)	Estimated Life (days)	Tag Depth Sensor Range	Years used
NTC-6-2 (NANO)	Radio	5	4.5	213		2001 & 2002
MCFT-3EM (MICRO)	Radio	5	8.9	353		2000 & 2005
MCFT-3FM (MICRO)	Radio	5	10.0	504		2004 & 2005
MCFT-3BM (MICRO	Radio	5	7.7	251		2004 & 2005
MCFT-3A (MICRO)	Radio	5	16.0	685		2003
CART14-1	Acoustic/Radio	5	21.6	175		2001
CAFT11-4	Acoustic	5	10.0	327		2002 & 2003
MA-TP11-25	MAP	7	10.0	139	0 to 102 m	2004
MA-TP16-25	MAP	5	23.0	273	0 to 33 m	2005
MA-TP11-25	MAP	5	10.0	103	0 to 33 m	2005

Tracking and Distribution

Boat and fixed-wing aircraft were utilized biweekly to monitor fish in the study area. Tracking in riverine sections of the study area was completed using automobiles, fixed-wing aircraft and hiking. All mobile tracking was conducted using a Lotek SRX 400 receiver. In addition to mobile tracking we established stationary radio and/or acoustic receiving sites. All radio fixed sites were equipped with data logging Lotek SRX 400 receivers. In 2000, riverine fixed sites were established on the NFC at the US Forest Service Canyon Work Center (CWC) (rkm 96.6), and at Kelly Fork Ranger Station (KFR) (rkm 166.5). In 2001 and 2002, the survey area extended into the Little North Fork of the Clearwater River (LNF) and Breakfast Creek (BFC). Along with the site at CWC, a fixed site was established 10.0 km from the confluence of the LNF and NFC, approximately 1 km above Dworshak Reservoir at full pool. In 2003 the CWC fixed site on the NFC was moved to rkm 91.5, approximately 400 m downstream from the mouth of Isabella Creek (Figure 3). The fixed site was moved closer to the slack-water interface of Dworshak Reservoir to detect the fish that migrated into Isabella and Beaver creeks that would be missed by the receiver upriver of the tributaries at the CWC fixed site. All riverine fixed sites were removed every fall to avoid freezing temperatures and were redeployed as soon as sites were accessible in the spring; usually during April or early May. Radio-tagged fish may have moved above or below fixed site locations and were not detected due to when fixed sites were installed or removed. Radio-tagged bull trout were determined to leave or enter the reservoir when they were initially detected on the CWC, NFC, or LNF receivers on their upstream or downstream migrations.

Five radio telemetry fixed sites were located in Dworshak Reservoir from 2003 to 2006. These sites were located across from Big Eddy Marina (rkm 4.7), downstream of Cranberry Creek (rkm 30.0), downstream of Gold Creek (rkm 58.9), at the LNF/NFC confluence (rkm 66.5), and above Benton Creek (rkm 72.6) (Figure 4). Additionally, five acoustic wireless hydrophones (WHS 3000) were deployed near these sites from 2003 to 2005 to detect fish tagged with acoustic transmitters (CART, CAFT). Three Lotek submersible data loggers (SDL's)

with wireless hydrophones were deployed in the fall of 2005 to detect MAP-transmitters. SDL's recorded the code, pressure, and temperature of each detected fish. The SDL's were programmed to receive data for 35 seconds out of each minute to sustain battery life through the winter of 2005/2006.

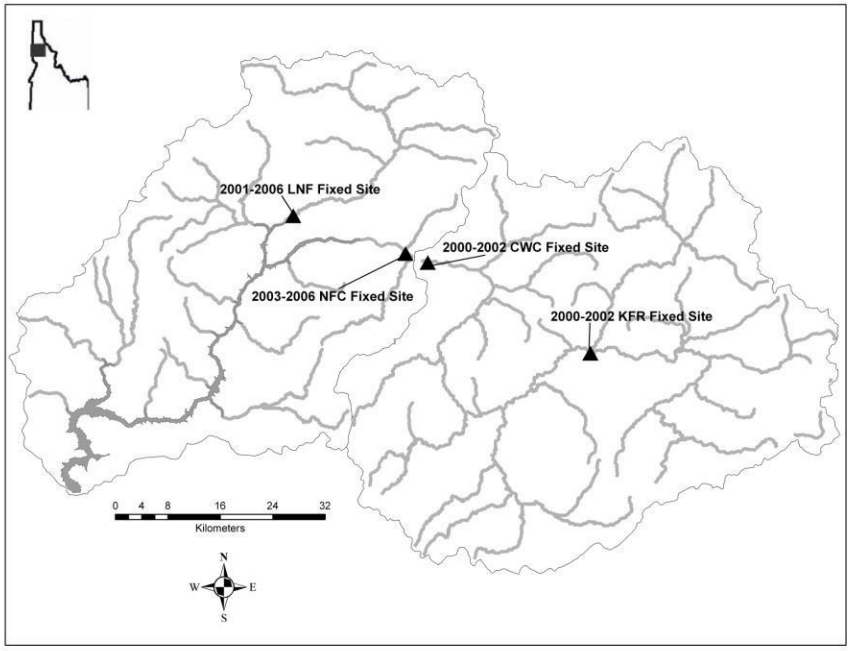

Figure 3. Location of stationary telemetry river receivers and years they were deployed.

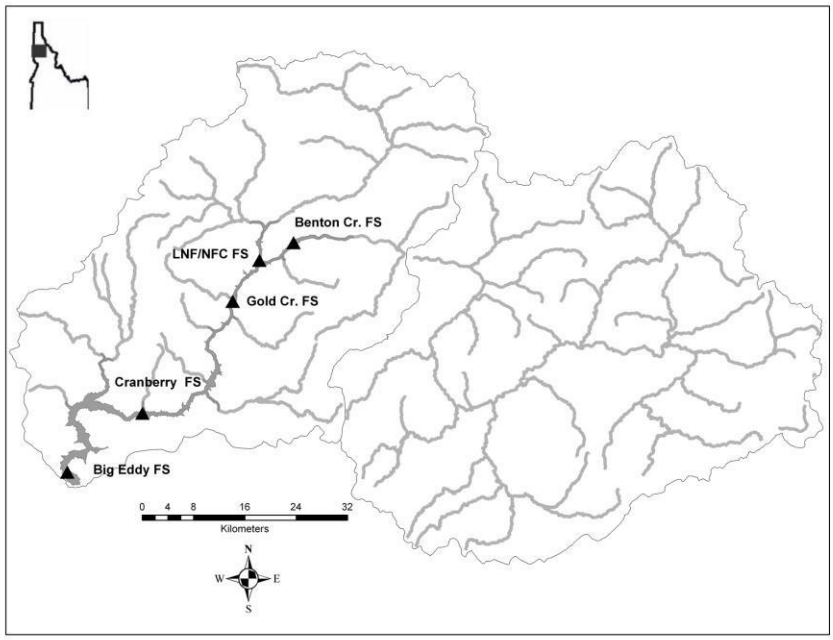

Figure 4. Location of stationary telemetry receivers on Dworshak Reservoir.

From November 2005 through 27 March 2006 two of the SDL's were located within 200 m of Dworshak Dam on the left and right floats directly in front of the dam (rkm 3.13), and one was suspended in front of the Big Eddy Marina (rkm 4.7). These were positioned to detect the possibility of MAP tagged fish being entrained. After 27 March 2006 the right SDL and Big Eddy SDL were relocated to positions higher in the reservoir. One was located at Swamp Creek (rkm 42.83) until 25 May 2006 and the other at the confluence of the LNF and NFC arms (rkm 66.5) until 20 June 2006 (Figure 5). Repositioning the SDL's allowed an increased number of fish depth and temperature detections throughout the reservoir.

Fish tagged with MAP-transmitters were also tracked bi-weekly throughout the reservoir from November through April in both 2004/2005 and 2005/2006. Real-time tracking was conducted by boat utilizing a dual hydrophone system and a Lotek MAP 600 RT receiver. Tracking the length of the reservoir took two to three days. When a fish was located GPS coordinates, fish temperature, fish depth, surface water temperature, water depth at detection, and position related to shoreline was recorded. We conducted intensive tracking during the winter of 2004/2005 where a single tagged fish was followed for multiple hours and we marked its location every 10 to 15 minutes.

Temporal and spatial distribution of radio and acoustic tagged fish was grouped into three time periods based on bull trout life history patterns and the different habitats that are used during these time periods. The three time periods are: May through July (migration), August through October (spawning) and November through April (over winter). ArcGIS 9.1 was utilized to analyze the spatial and temporal distributions of bull trout migrations. Over winter movement of bull trout in the reservoir was measured as the distance between locations every two weeks from November through April. During 2004 and 2005 intensive tracks were used to calculate hourly movement of bull trout. Intensive tracks consisted of following one fish for at least one hour and recording its position every 10 to 15 minutes. The distance moved was divided by the number of hours tracked to obtain a distance moved per hour and then extrapolated to a distance moved per day by multiplying km/hr by 24 hours.

To further define reservoir use, Dworshak Reservoir was divided into five sections. The sections are defined as follows: Section 1, Dworshak Dam (rkm 3.1) upstream to Dent Bridge (rkm 24.0); Section 2, Dent Bridge to Evans Creek (rkm 45.4); Section 3, Evans Creek to Grandad Bridge (rkm 66.4); Section 4, the NFC arm of the reservoir (rkm 66.5 – 89.5); and Section 5, the LNF arm of the reservoir (rkm 66.5 – 74.3) (Figure 6).

Throughout the study period acoustic tagged fish were only tracked in Dworshak Reservoir because it was impossible to track the acoustic signals in the riverine environment. The assumption is that radio and acoustic tagged fish behave in similar manners and would display similar patterns, but due to the limitations of the transmitter type are not detected equally in the reservoir and river habitats. For example, more acoustic transmitter detections are recorded in Dworshak Reservoir during the over wintering period because fish inhabit deeper depths where the fish with radio transmitters are not detectable. We assume there are radio- tagged fish distributed at a similar frequency but not detected. The same assumption is made in the riverine environment regarding the distribution of acoustic tagged fish even though they are not detected. We used the 5th field Hydrologic Unit Code (HUC) described by the USGS (1982) to define geographical areas of local spawning populations. These HUC's were used because they were the best geographical representation of these spawning groups. Radio-tagged bull trout were delineated into these HUC's based on their furthest documented upstream location or their location near the time of spawning.

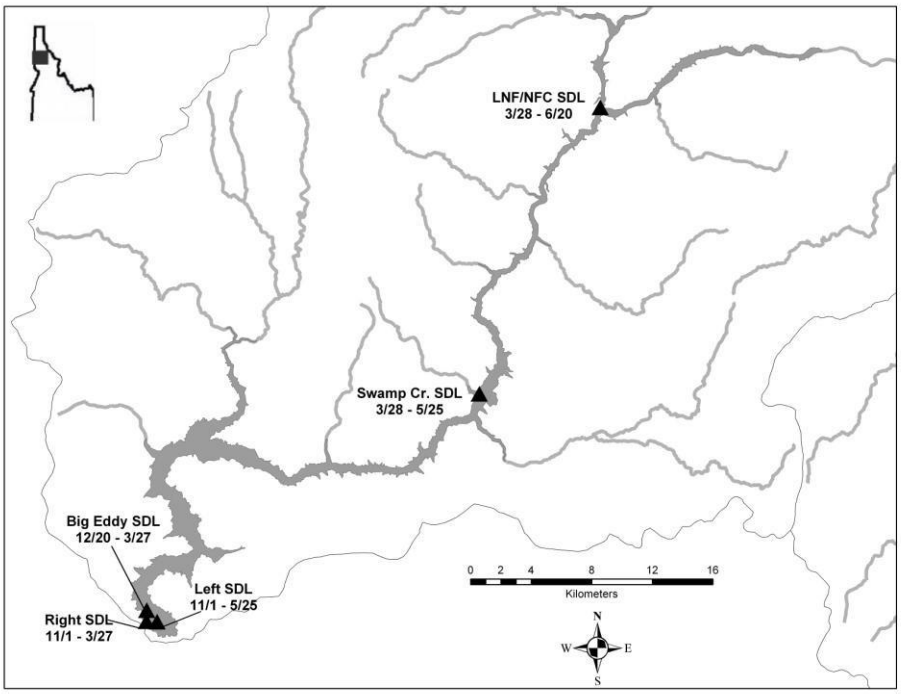

Figure 5. Location of Submersible Data Loggers and dates deployed at these locations during 2005/2006.

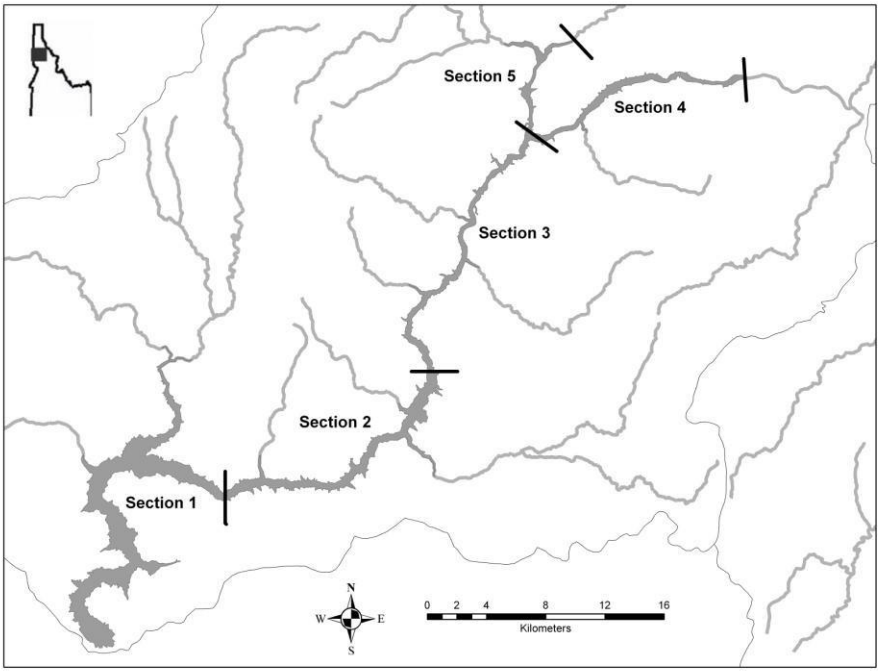

Figure 6. Dworshak Reservoir divided into sections.

Population Estimate

Population estimates of adult spawning bull trout were conducted when the fish were in pre-spawning aggregates located in riverine habitat. Population estimates were conducted using a random sampling design that incorporates radio tracking and snorkeling techniques. A section of stream was tracked to identify the location of radio-tagged bull trout. The GPS coordinates were recorded when a radio transmitter was detected. A field crew would then locate the GPS coordinates on the ground within one to six days after the flight. Through triangulation methods, the transmitter's position would be pinpointed to within a 10 m section of stream. A primary 100 m transect was established that included the 10 m section of stream containing the radio transmitter(s). This primary transect would be snorkeled, beginning and ending at natural habitat breaks. Snorkel surveys were completed using one to six people depending on the width and visibility of the stream at the transect location. Snorkelers would enter the river downstream of the transect, form a straight line perpendicular to the flow, and proceed upstream to the top of the transect. Snorkelers identified all fish observed. Species and total lengths (to the nearest inch) were recorded. Bull trout observed were recorded as being radio-tagged, adipose clipped or neither. Special notation was made when a bull trout was observed but total length, presence of radio transmitter or fin clip were not confirmed. When a radio-tagged bull trout was not observed in the transect, the area was searched further to determine if the transmitter was still in a live fish that was missed by snorkelers, or if the signal was from a transmitter only. When we found a transmitter no longer associated with a fish, we noted the location of the transmitter and any indication of cause of mortality.

Secondary, randomly chosen transects, were snorkeled in addition to primary transects. The secondary transects were sampled to determine the bias of selecting locations known to have radio-tagged fish in them. The length of each stream containing radio-tagged fish was measured using MAPTECH Terrain Navigator 2002. The stream length was used as the bounds in Microsoft Excel's random number generator software to select the secondary transects. For example, Isabella Creek had radio-tagged fish in it from its mouth upstream 6.5 km. Therefore, the range set in Excel would be 0.0 to 6.5. If the random number selected was 3.2, the transect snorkeled would start within the second 100 m of the third km. All stream calculations were completed in an upstream direction. The secondary transect was snorkeled and fish recorded in the same manner as the primary transect, but telemetry was not used to locate radio-tagged fish.

The number of adult bull trout (those > 350 mm) was estimated using the ratio of radio-tagged and non radio-tagged bull trout observed in a 100 m transect. The following equations were used to generate a population estimate in areas where documented pre-spawning aggregates of bull trout occur. The length of these stream reaches was estimated using MAPTECH Terrain Navigator 2002. The ratio estimate equation used for a simple random sample of transects was (Schaeffer et. al. 1996):

$$\hat{R} = \frac{\sum_{i=1}^{n} y_i}{\sum_{i=1}^{n} x_i}$$

where:

y_i = the number of non-radio-tagged bull trout observed in the i^{th} 100 m transect

x_i = the number of radio-tagged bull trout observed in the i^{th} 100 m transect

The variance of the ratio estimate was:

$$\hat{V}\left(\hat{R}\right) = \frac{1}{n\bar{x}^2}\left(\frac{N-n}{N}\right)\left(\frac{\sum_{i=1}^{n}\left(y_i - \hat{R}x_i\right)^2}{n-1}\right)$$

where

n = the number of 100 m transects completed

N = the number of 100 m transects in the spawning aggregate areas.

The equation for the ratio estimator of the population total was:

$$\hat{\tau}_y = \hat{R}\hat{\tau}_x$$

The variance of the estimator for the total was:

$$\hat{V}\left(\hat{\tau}_y\right) = \tau_x^2 \hat{V}\left(\hat{R}\right)$$

In addition to population estimates, fish densities (fish/100m^2) were calculated for each stream that contained snorkel transects. For each of the transects, the mean of three random width measurements were multiplied by the transect length to estimate the area.

Redd Surveys

Redd surveys were conducted from the last week of August until the end of September from 2000 to 2005. Tributaries to be surveyed were selected based on occurrence of radio-tagged bull trout either in the tributary or in the mainstem near a tributary mouth. Observers walked stream reaches and identified redds while recording their physical attributes and GPS locations. Occurrence of bull trout on a redd or in the stream was also recorded. Redd survey monitoring areas were established to determine trends in redd counts for multiple years.

Since 2000 surveys on the NFC have been conducted on Black Canyon, Bostonian, Boundary, Collins, Goose, Hidden, Isabella, Kelly, Little Moose, Long, Moose, Niagara Gulch, Osier, Placer, Pollock, Quartz, Ruby, Skull, Swamp, Upper NF, Vanderbilt Gulch, Weitas, Orogrande, Slate, and in the NFC from Meadow creek to Vanderbilt Gulch. In the Breakfast Creek drainage Floodwood, Glover, and Stony creeks were surveyed. Within the LNF drainage redd surveys were completed on Buck, Canyon, Butte, Rutledge, Rocky Run, Lund, Little Lost Lake, and Lost Lake creeks. Redd counts in the mainstem LNF were completed in four sections as well. Instituting these index areas will allow for consistent monitoring of redd count trends for the future. Descriptions of redd survey transects are included in Appendix A; Table 1.

RESULTS

From 2000 to 2006 1,283 bull trout were captured above Dworshak Dam in the NFC system, all of these fish were marked with PIT tags. Of this sample 706 were implanted with telemetry transmitters; 146 in 2005, 135 in 2004, 192 in 2003, 114 in 2002, 98 in 2001, and 21 in 2000. Sixty seven bull trout were identified as being recaptured due to PIT tag detection, through the duration of the study.

Total length of all captured bull trout ranged from 105 – 692 mm and total length averaged 411.6 mm (Figure 7, Table 2); weight averaged 737.5 g and ranged from 50 – 3400 g (Figure 8, Table 2). Bull trout captured have a length-weight relationship, log weight (g) = 3.3205 log total length (mm) – 5.8997 (Figure 9). Distribution of length classes varied between years. The length class containing the largest number of fish each year ranged from the 300 – 349 mm class in 2000 to 450 – 499 mm in 2006. Bull trout average total length increased from 2000 to 2006 (Figure 10).

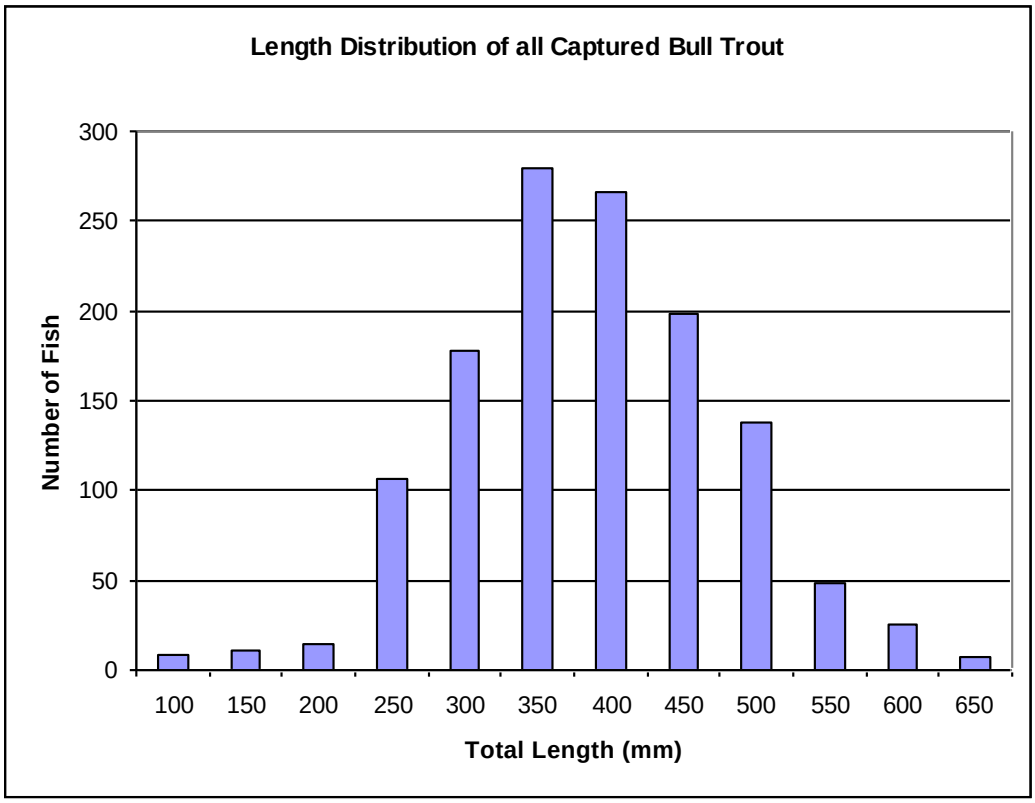

Figure 7. Total length distribution of captured bull trout for all years combined, 2000-2006.

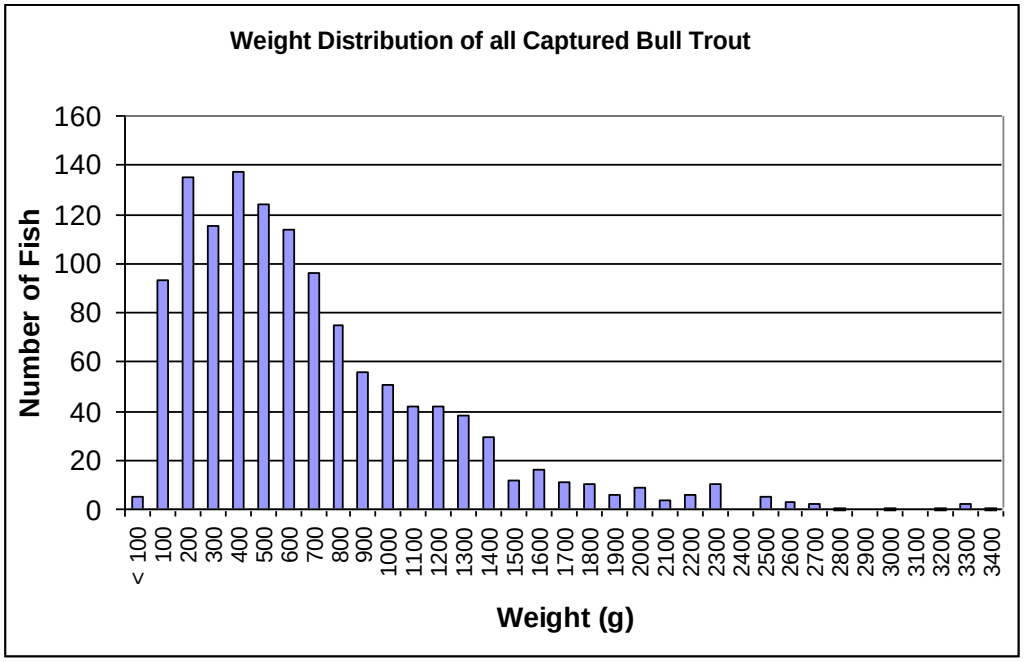

Figure 8. Weight distribution of captured bull trout for all years combined, 2000-2006.

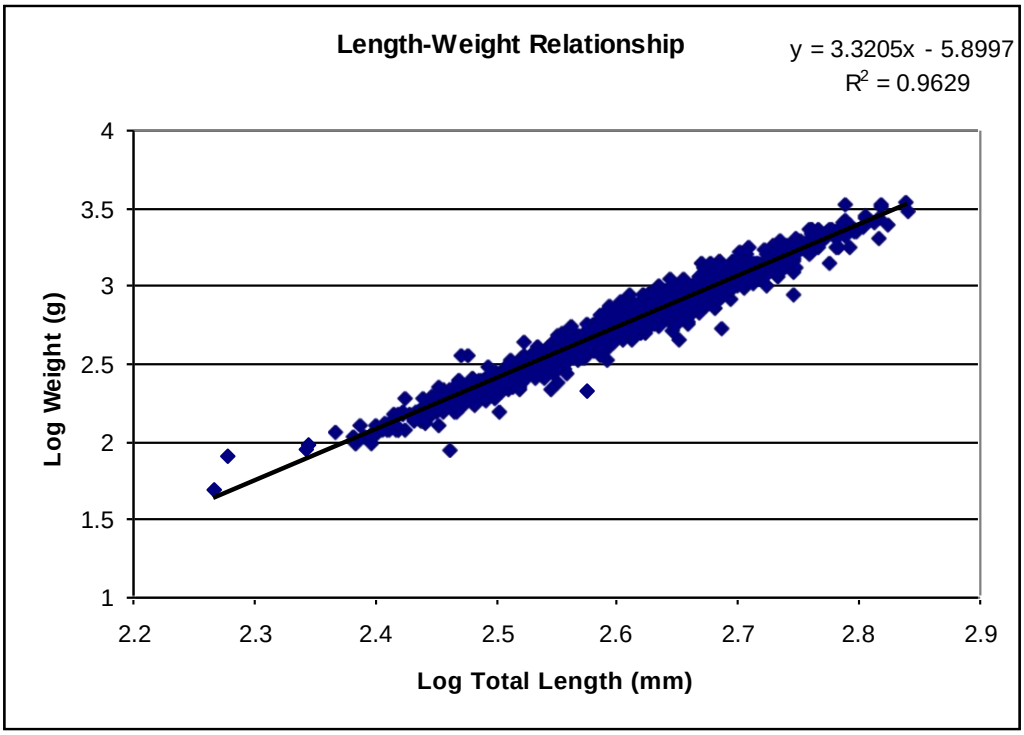

Figure 9. Log length-weight relationship for bull trout captured in the study area, 2000-2006.

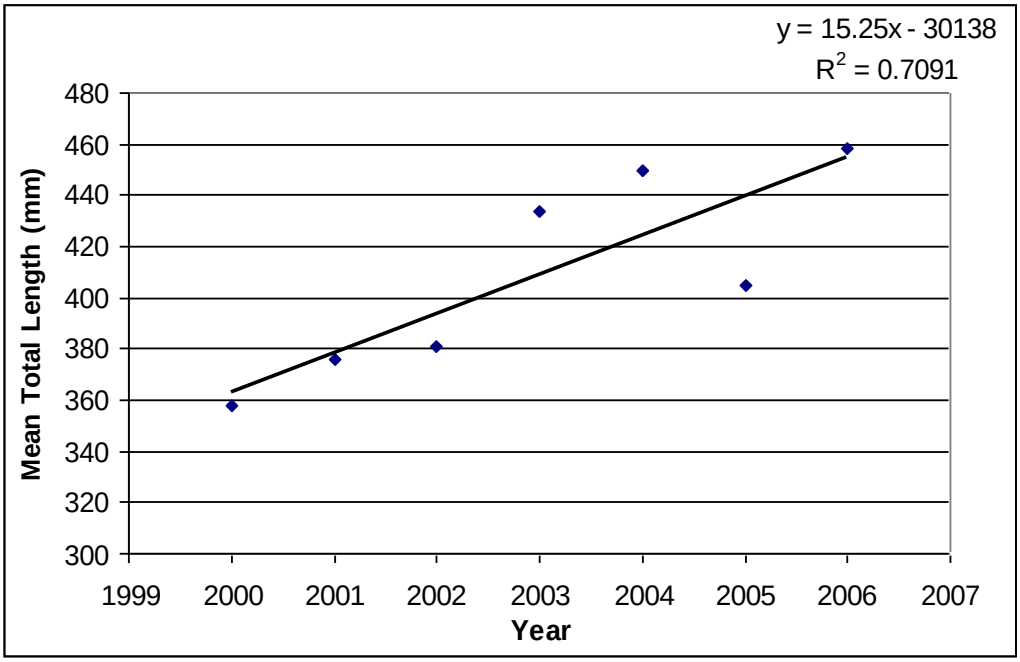

Figure 10. Annual mean total length of captured bull trout from 2000 to 2006.

Table 2. Total length and weight statistics for all captured bull trout above Dworshak Dam.

	Total Length (mm)	Weight (g)
Mean	411.6	737.5
Median	407	610
Mode	431	450
Standard Deviation	91.2	522.0
Range	587	3,350
Minimum	105	50
Maximum	692	3,400
Sample Size	1,279	1,253

Sex Ratio/Maturity

Sex determination from 347 bull trout were 196 females and 151 males, resulting in an overall ratio of 1.3 females to males. The highest ratio of females to males, 2:1, occurred in 2002 and 2004. The lowest ratio of females to males, 0.85:1, was documented in 2005. The ratio females to males in 2003 was 1.2:1. Mean total length of females was 432.1 mm and 428.4 mm for males, significant differences were not detected in total lengths between males and females. From our determinations it appears that all bull trout captured that were less than 300 mm and over 650 mm total length were males (Figure 11).

Maturity was determined in 319 bull trout, 24 fish were immature and 295 bull trout were mature. We did not determine maturity in 107 fish, this includes those fish that inspection was inconclusive and fish that were not examined for maturity.

Age Structure

One hundred thirty three bull trout were collected and aged from pelvic rays in 2003. Sixty percent of fish collected for age analyses were ages four and five. Mean lengths at age ranged from 124 mm for age one fish up to 650 mm for age thirteen fish. The equation describing the relationship of mean length at age is; mean length= 151.01*Ln(age)+169.31 (Figure 12).

Growth/Recaptures

Sixty seven bull trout were recaptured and PIT tag identified from 2001 to 2006. Mean growth rate was 0.109 mm per day. Yearly mean growth was estimated at 40 mm/year. Six recaptured fish were not included in analysis due to suspected measurement errors. Upon closer inspection of the data it appeared that smaller fish grew at different rates than larger fish. Total lengths were therefore separated by 75 mm length classes starting with fish at 300 mm. Bull trout with an initial capture length from 300 – 374 mm grew 0.182 mm/day, 375 – 449 mm grew 0.161 mm/day, 450 – 524 mm grew 0.095 mm/day, 525 – 599 grew 0.053 mm/day, and 600+ mm at 0.038 mm/day (Figure 13).

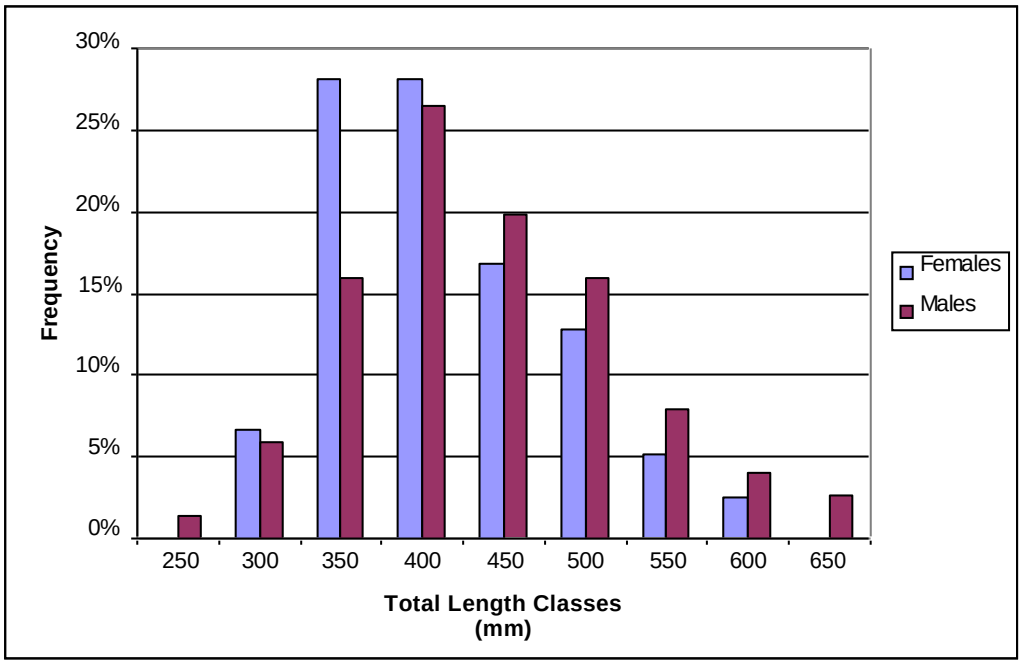

Figure 11. Total length frequency of captured males and females, 2000-2006.

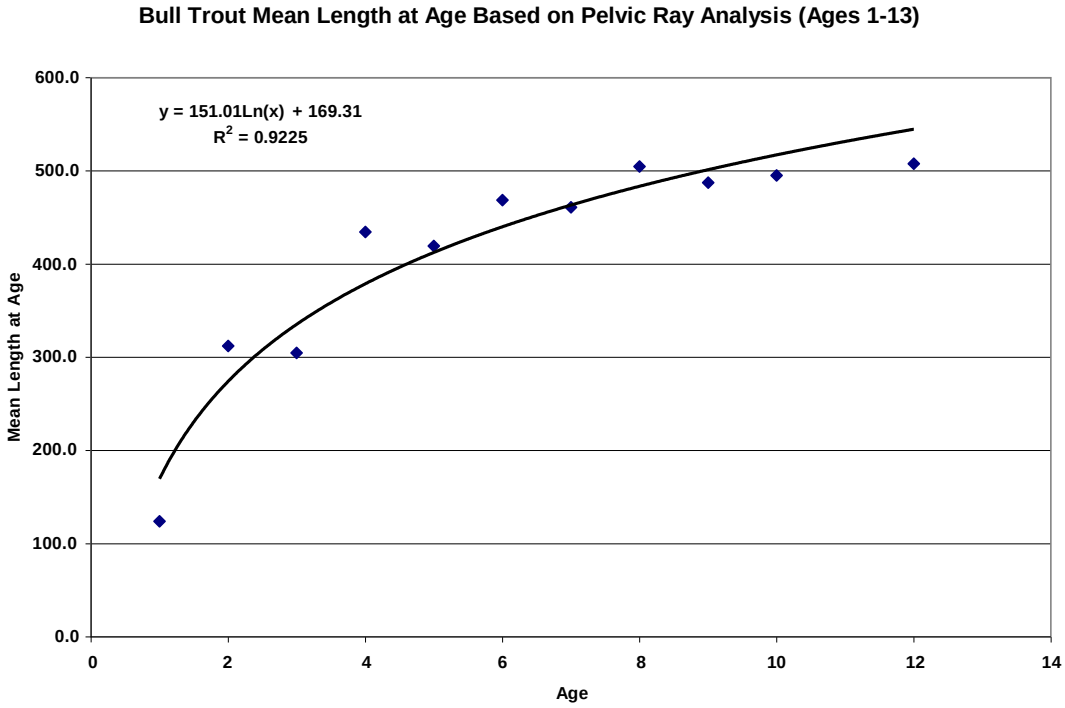

Figure 12. Bull trout mean length at age, based on pelvic ray analysis.

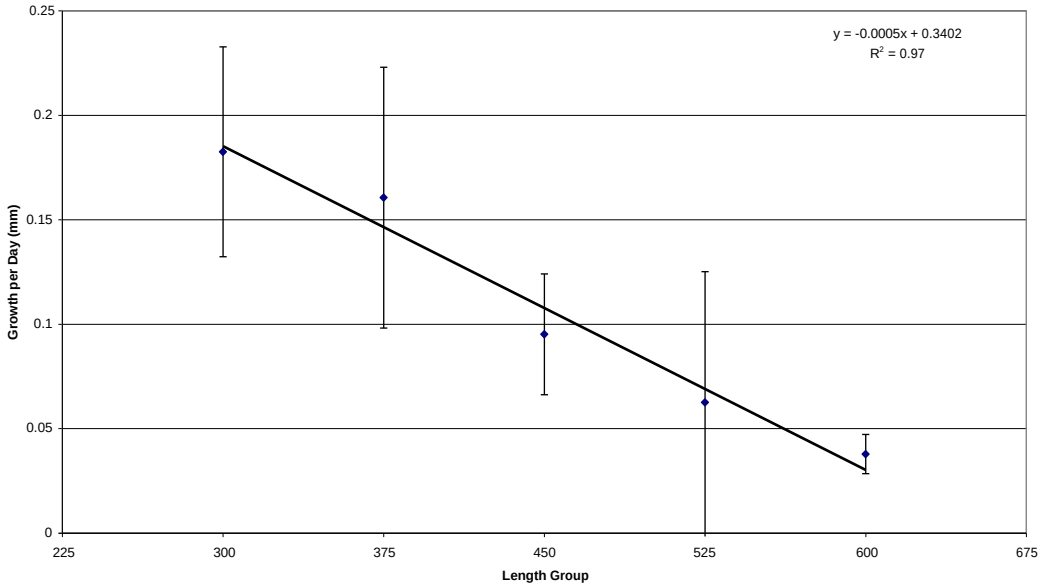

Figure 13. Bull trout mean yearly growth rate separated by 75 mm length groups. Mean yearly growth rate is based on recaptured fish within length groups.

Movement or location of recaptured bull trout within the study area did not appear to considerably effect growth. However it was observed that many recaptured bull trout with growth rates less than the mean growth rate of 0.109 mm/day were; found migrating farther up tributary streams compared to fish with greater growth rates, there were twice as many with growth rates less than 0.109 mm/day found in section one (8) as compared to fish with daily growth rates greater than 0.109 mm/day, and there were more fish with slower growth rates found below reservoir section three. Generally recaptured bull trout that stayed in the upper reservoir sections grew more rapidly than those that ventured to lower reservoir sections.

Diet

In April 51.5% of bull trout diet by weight was fish, in June fish consisted of 66.5% of diet samples, and 99.4% and 96% in October and November (Figure 14). During May the predominate prey item, by weight, (63%) was mammal, followed by fish at 26%. During all the years only one mammal was found in diet samples, a gopher *spp*. ingested by a bull trout during 2004. Without including this mammal fish would have made up 70.2% of the diet during May. Fish or fish eggs was the only prey category found in diet samples for all months sampled. Amphibians were found only in April and zooplankton only in October.

Composition of bull trout stomach samples by number of items show that in all months except October aquatic invertebrates were most commonly consumed (Figure 15). Fish were most frequently preyed upon by numbers during October, 65.4%.

When possible, prey fish in diets were identified to the species level. Seven species of fishes were discovered in diet analysis; cutthroat trout, bull trout, rainbow trout, redside shiner, slimy sculpin, mountain whitefish, and kokanee. Fish eggs and unidentified parts were also

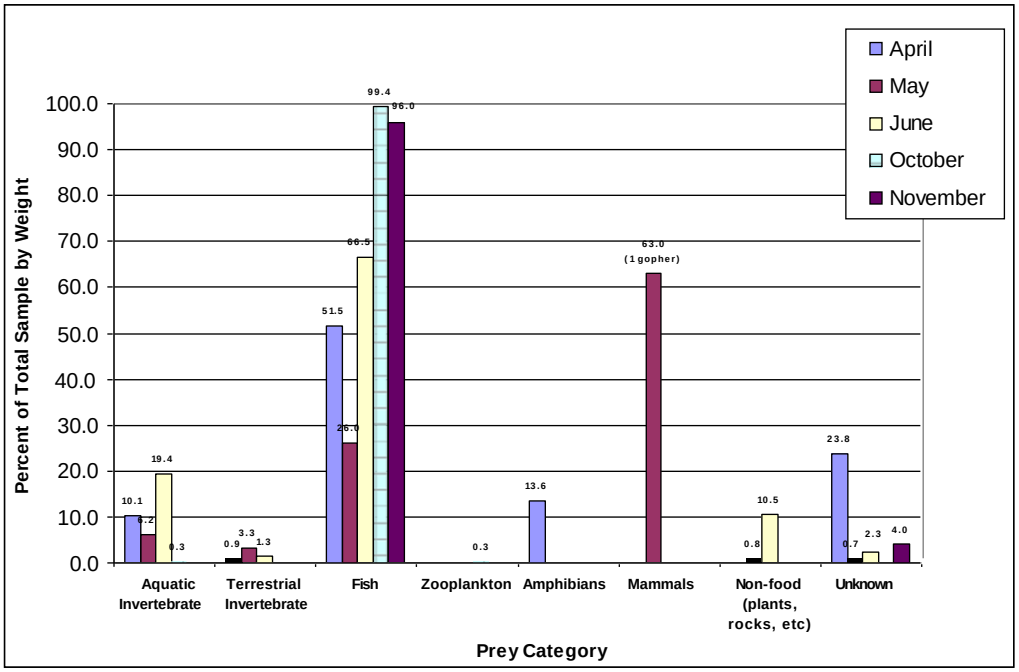

Figure 14. Composition of bull trout stomach analysis by weight for April, May, June, October, and November, 2001-2005.

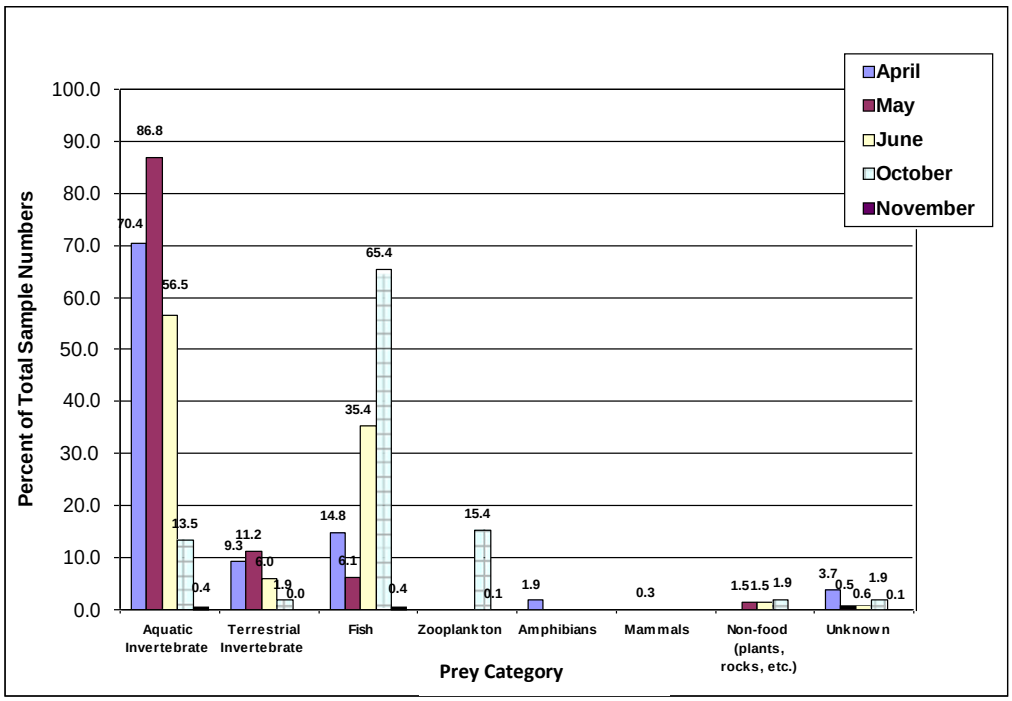

Figure 15. Composition of bull trout stomach analysis by total numbers of prey items for April, May, June, October, and November, 2001-2005.

found. Rainbow trout made up the majority of species (26.6%), followed by kokanee (19.2%) then mountain whitefish (11.6%). Fish eggs consumed during the spring made up 20.6% of the total fish sample (Figure 16). Comparison between years is difficult due to sampling during differing seasons.

A shift in diet between fish species was apparent between the spring and fall months. During the spring (April, May, June) rainbow trout were most commonly consumed, followed by fish eggs. In the fall (October and November) kokanee were selected 60% of the time compared to other fish species, followed by cutthroat trout 34.8% (Figure 17).

Population

Relative abundance of bull trout was calculated in twenty six different watersheds from 2002 to 2005. A total of 364 transects were snorkeled for the four years and densities of bull trout per transect ranged from 0 - 5.27/100m² (Appendix A; Table 2). On average bull trout <350 mm were found at densities of 0.16/100m², and bull trout >350 mm at densities of 0.18/100m². For combined watersheds and years bull trout were observed at a mean density of 0.34/100m².

Thirty six streams or sections of streams were surveyed, mean densities of observed bull trout in each watershed for combined years ranged from 0.00 – 2.16/100m² (Table 3). Trends in densities between years are difficult to assess due to the varying number of transects snorkeled each year and additional years worth of data needed. It is apparent there is a wide degree of annual density variation in watersheds. Watersheds that had mean densities over 0.70/100m² included; Bostonian Creek, Long Creek, Upper NFC, Vanderbilt Gulch, Niagara Creek, and Rocky Run Creek. These streams were all sampled for more than one year and contained at least three transects (Table 3).

Population estimates for pre-spawn adult migratory bull trout populations were calculated throughout areas surveyed in the North Fork Clearwater River drainage from 2002 to 2005. The areas surveyed were restricted to areas that were known to contain radio-tagged bull trout. Population estimates were not calculated in 2000 and 2001 due to lack of information on pre-spawn locations during this time period of the study. In 2002 the population estimate was 1057 (649-1465, 95%CI) while the survey area was 803 rkm. In 2003 the population estimate was greater in total numbers, 1587 (1139-2035, 95%CI), however nearly twice as much area was surveyed; 1506 km (Schiff et al. 2003). The 2004 population estimate was slightly higher at 1977 (1252-2702, 95%CI) with 1471 river km surveyed (Schiff et al. 2005). The 2005 estimate was calculated at 1913 (1514-2312, 95%CI) with 1240 river kilometers surveyed (Figure 18).

Redd Surveys

Bull trout redd surveys were conducted in multiple tributaries during the study period. The highest number of redds documented in the NFC drainage was 112 in 2005. Similarly the highest number of reds in the LNF drainage was in 2005, with 52 redds. Since 2000, 405 redds have been observed in the NFC basin and 276 in the LNF basin (Table 4).

Beginning in 2000 there has been a general increase in the number of redds counted in the NFC. The exception to this is in 2004 when redd counts were less than half of those observed in 2003 and in 2005.

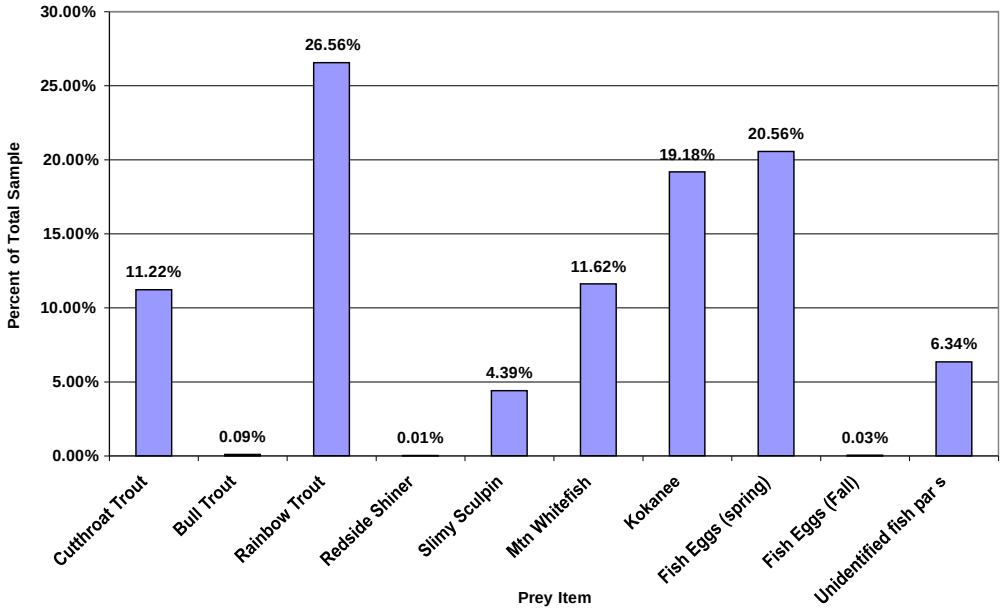

Figure 16. Percent of fish species in bull trout stomach analysis by weight.

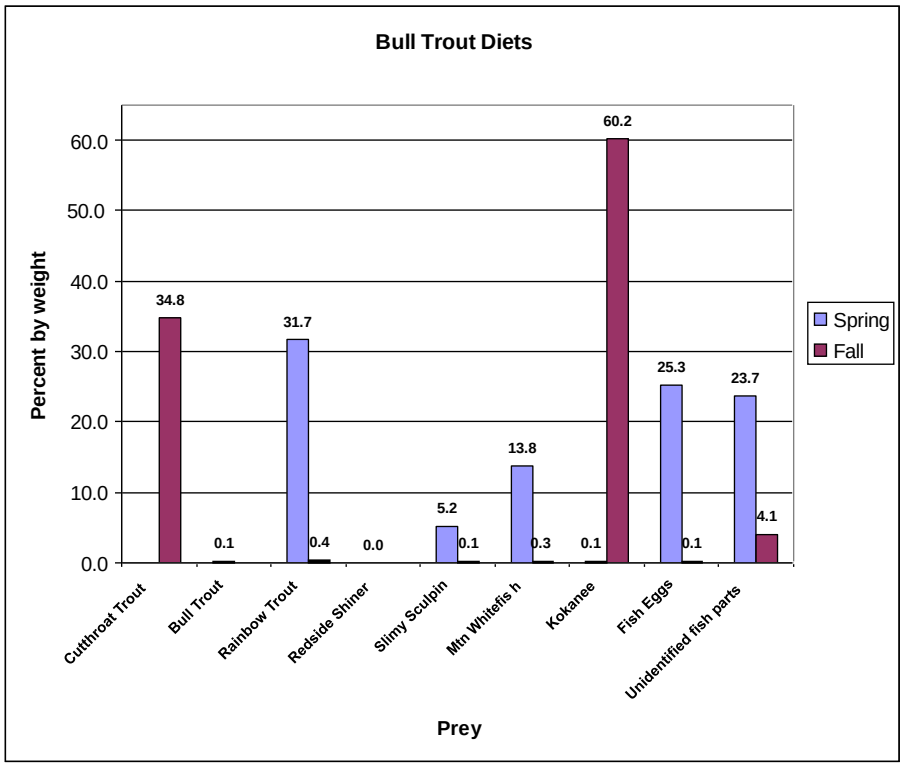

Figure 17. Fish species consumed by weight during the spring and fall periods. Spring period includes April, May and June. Fall period includes October and November, 2001-2005.

Table 3. Mean density of bull trout per 100 $m^{2.}$

Year	Beaver Creek	N.F. Black Canyon	Bostonia Creek	Breakfast Creek	Breakfast Creek	Floodwood Creek	Foehl Creek	French Creek	Glover Creek	Goose Creek	Isabella Creek	Lake Creek
2005	0.00	0.21		0.08	0.0	0.06		0.00	0.00	0.42	0.19	
2004	0.07	0.11	2.29		0.00	0.03	0.10	0.00			0.25	0.14
2003	0.16	0.14	0.88			0.08	0.27		0.16	0.66	0.18	0.35
2002		0.07									0.29	
Total Mean	0.08	0.14	1.35	0.08	0.00	0.06	0.19	0.00	0.08	0.38	0.22	0.24
# of Transects	11	28	3	1	8	12	2	6	2	5	27	8

	Long Creek	Little Lost Lake Creek	Little Moose Creek	Kelly Creek	Stoney Creek	Weitas Creek	Upper NFC	Vanderbilt Gulch	W.F. Floodwood Creek	Rutledge Creek	Placer Creek
2005	0.97	0.23	0.79					1.19			
2004					0.06		0.52	5.27	0.32		
2003	0.59	3		0.19		0	2.41	0.32		0.30	2.16
2002	0.27			0.01							
Total Mean	0.72	1.62	0.79	0.12	0.06	0.00	1.28	1.06	0.32	0.30	2.16
# of Transects	10	2	3	10	2	4	5	9	1	2	1

	Little North Fork	Lund Creek	Moose Creek	N.F. Above Cedars	Niagra Creek	Orogrande Creek	Quartz Creek	Rocky Run Creek	Ruby Creek	Sawtooth Creek	Skull Creek	Swamp Creek
2005	0.46	1.22	0.22	1.03		0.04	0.10	0.90	0.00		0.11	0.26
2004	0.24	0.41		1.19	4.88	0.00	0.08	0.67		0.00	0.04	
2003	0.28		0.13	0.10	1.06		0.06				0.19	
2002	0.29						0.17				0.28	0.08
Total Mean	0.30	0.68	0.19	0.61	2.02	0.03	0.09	0.79	0.00	0.00	0.16	0.17
# of Transects	108	3	3	27	4	6	8	4	1	1	25	4

Table 4. Number of redds counted from 2000 to 2005 in the NFC, LNF, and BFC drainages.

STREAM SURVEYED	2000	2001	2002	2003	2004	2005	Mean
North Fork Clearwater River							
Black Canyon	--	--	1	--	--		1
Bostonia Creek	1	1	1	18	12	15	8
Boundary Creek	--	--	--	2	3	10	5
Collins Creek	--	0	--	--	--	--	0
Goose Creek	--	1	0	2	1	12	3
Hidden Creek	--	--	1	0	--	--	1
Isabella Creek	--	--	1	1	0	0	1
Kelly Creek - North Fork	--	14	--	--	--	--	14
Lake Creek	19	7	20	14	5	2	11
Little Moose Creek	--	0	--	--	--	--	0
Long Creek	--	--	5	0	8	10	6
Moose Creek	0	0	0	0	--	--	0
Niagra Gulch	2	5	6	10	3	4	5
Osier Creek	3	0	2	0	--	--	1
Placer Creek	4	2	4	6	2	3	4
Pollock Creek	--	--	--	1	--	--	1
Quartz Creek	--	4	0	0	0	0	1
Ruby Creek	0	--	--	--	--	--	0
Skull Creek	--	--	0	6	5	3	4
Swamp Creek	2	0	1	0	0	2	1
Upper NF	--	--	--	7	3	6	5
Vanderbilt Gulch	--	24	18	13	12	41	22
Weitas Creek	1	--	--	--	--	--	1
Orogrande Creek	--	--	--	--	--	0	0
Slate Creek	--	--	--	--	--	3	3
NFC meadow to VG	--	--	--	--	--	1	1
Breakfast Creek							
Floodwood Creek	--	--	4	0	0	0	1
Glover Creek	--	--	--	1	0	0	0
Stony Creek	--	--	4	0	0	--	1
Total Per Year	**32**	**58**	**68**	**81**	**54**	**112**	**68**
Mean Per Year	**4**	**4**	**4**	**4**	**3**	**6**	**3**
Little North Fork Clearwater River	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**Mean**
Buck Creek	--	--	--	5	--	--	5
Canyon Creek	--	--	--	0	--	--	0
Butte Creek	--	5	0	--	--	--	3
Rutledge Creek	--	--	--	1	1	6	3
Rocky Run Creek	--	--	5	1	3	19	7
Lund Creek	13	5	7	7	5	7	7
Little Lost Lake Creek	1	--	6	7	16	1	6
Lost Lake Creek	--	--	0	--	1	--	1
Little North Fork Clearwater River Ranges							
1268 Bridge to Lund Cr.	--	17	6	13	8	--	11
Lund Cr. to Lost Lake Cr.	3	12	7	7	5	--	6
Lost Lake Cr. to Headwaters	1		5	6	5	11	6
301 Bridge to 760 Bridge	--	--	--	--	--	8	8
Total Per Year	**18**	**39**	**36**	**47**	**44**	**52**	**40**
Mean Per Year	**4**	**7**	**5**	**5**	**6**	**9**	**5**

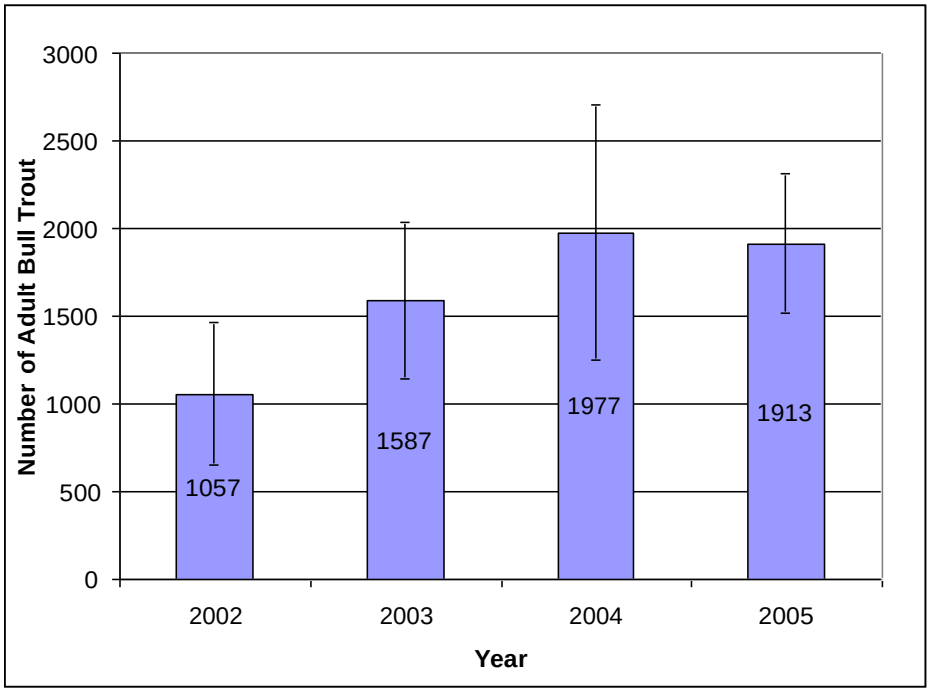

Figure 18. Population estimate of adult pre-spawn aggregate bull trout, 2001-2005.

Migration Timing and Patterns

Tagged bull trout were observed migrating upstream from the reservoir from May through August by fixed radio receivers. From 2000 to 2006, 548 radio-tagged fish were detected moving past the LNF and NFC fixed sites. Three hundred fifty one detections recorded fish moving upstream and 197 as tagged bull trout moved downstream into the reservoir.

Annual upstream migration primarily took place between 27 May and 30 June, with 83.5% passing the fixed sites within this time period (Figure 19). Peak migration for 2002, 2004, and 2005 was the week of 17 – 23 of June. Peak migration for 2001 was between 8 – 14 of July and from 10 – 16 of June during 2003. By 1 July 80.6% (283/351) of bull trout that would migrate out of the reservoir had moved above the fixed sites and into the riverine habitat. Detected radio-tagged bull trout that migrated upstream reached their furthest upstream location by 19 September for all years. Spawning was thought to occur sometime during August and September as most fish were located at their furthest upstream location during these months.

Following spawning, radio-tagged fish moved out of tributaries and back to the NFC, LNF or to Dworshak Reservoir. Fifty five percent (94/172) of radio-tagged fish moved downstream past the fixed sites between 7 October and 5 November. Peak downstream migration past fixed sites for all years combined was the week of 29 October to 5 November (Figure 19). The earliest downstream migrating bull trout, thought to have spawned, was documented passing a fixed site 6 September. Timing of out migration in the LNF and NFC reservoir arms was different in that by November most tagged bull trout left the LNF, whereas a greater proportion resided longer in the NFC (Figure 20).

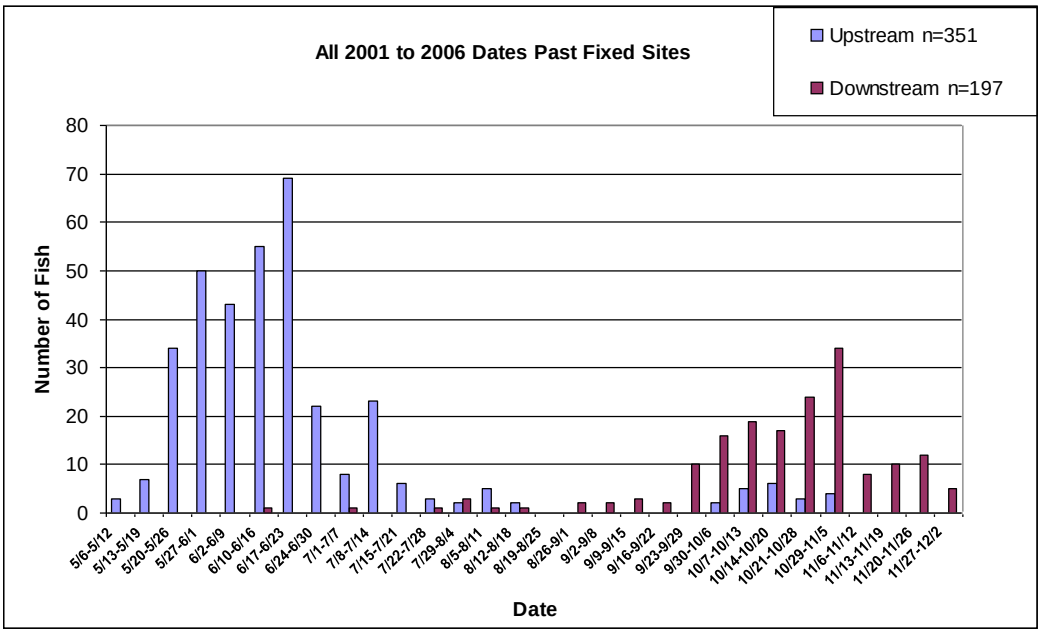

Figure 19. Upstream and downstream timing of radio tagged bull trout past the NFC or LNF fixed site, 2001-2006.

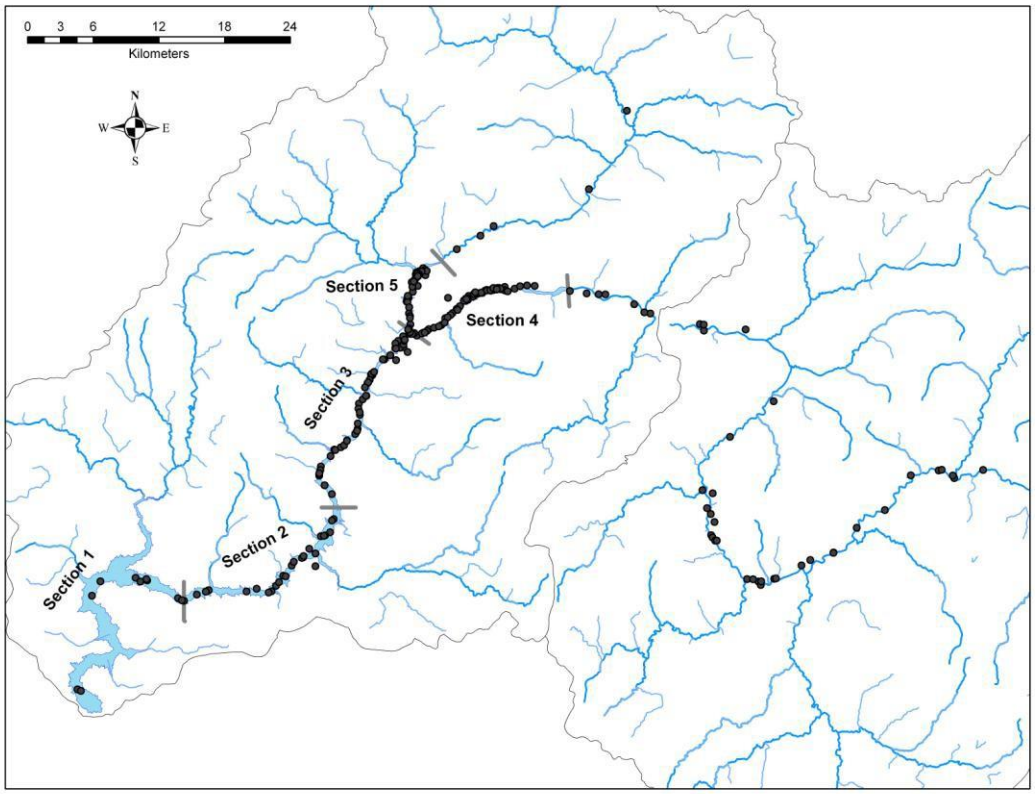

Figure 20. Radio tagged bull trout distribution during November. Note the higher proportion of bull trout in section four and the NFC river compared to section five and the LNF river.

River discharge was measured by a USGS gauging station in the NFC at rkm 91.6, 161 m above the mouth of Beaver Creek. Stream flow measurements are not available in the LNF but flow patterns are thought to be similar due to the proximity to the NFC drainage and like physical characteristics. Generally, discharge at the gauging station the first two weeks of May was around 225 m^3/s. After 20 May discharge began decreasing and then leveled off during the summer. 2002 was an exception, discharge on 30 May was 620 m^3/s, and did not reach 225 m^3/s until 1 July 2002. Upstream migrations recorded by fixed sites generally occurred during the descending limb of the hydrograph (Figure 21).

River discharge during October and November, when most radio-tagged fish moved downstream, averaged 25 m^3/s, yet values ranged from 13 m^3/s to 147 m^3/s (Figure 21). All recorded downstream migrations occurred when flows were less than 75 m^3/s. It did not appear that weekly variations in the hydrograph had an effect on downstream migration past fixed sites.

From 2001 to 2005 252 bull trout were radio-tagged during the spring in the NFC area; of these 240 were detected after initial tag implantation. 206 (86%) migrated above the fixed site on the NFC, 20 (8%) moved above the fixed site on the LNF, and 14 (6%) moved into Dworshak Reservoir (Table 5).

In the spring of all years 115 bull trout were radio-tagged in the LNF area, of these 107 were detected after initial tag implantation. Eight (7%) moved past the NFC fixed site, 97 (91%) migrated upstream of the LNF fixed site, and one of each (1%) moved downstream into Dworshak Reservoir and into Breakfast Creek (BFC) (Table 5). The majority of bull trout tagged in the NFC and LNF (area 1 and 2) tagging areas migrated into the tributary associated with the tagging area.

Seventy seven bull trout were tagged during the spring in multiple years in the BFC area, of these 76 were detected after initial tag implantation. 14 (7%) migrated into the NFC drainage, 36 (47%) moved above the LNF fixed site, 8 (11%) moved downstream into Dworshak Reservoir, and 18 (24%) moved into the BFC drainage (Table 5). This is the only tagging area where more fish migrate to alternate locations than ascended the tributary associated with tagging.

Forty eight fish were radio-tagged in the DWR area, of these 41 were detected after implantation. 17 (41%) migrated above the NFC fixed site, 13 (32%) above the LNF fixed site, 9 (22%) stayed within Dworshak Reservoir, and 2 (5%) were found in BFC. Bull trout radio-tagged in this area primarily migrated above fixed stations in the LNF and NFC (Table 5).

Radio-tagged bull trout migrated extensive distances from tagging locations to spawning locations. The longest documented migration from a tagging area to furthest upstream location was 237.2 km and averaged 67.5 km for all years. The mean migration distance for 2001 was 42.6 km, 58.7 km in 2002, 71.8 km in 2003, 67.4 in 2004, and 76.3 km in 2005 (Appendix A; Table 3).

The majority of migrations included adult, radio-tagged bull trout that moved either up the NFC or LNF arm of Dworshak Reservoir and continued their travels in these respected arms to spawning tributaries. However, some made initial migrations up one drainage, turned around, and then traveled up the other drainage. It is not known whether these fish spawned during their first migration, during the second, or not at all (Appendix A; Figure 1).

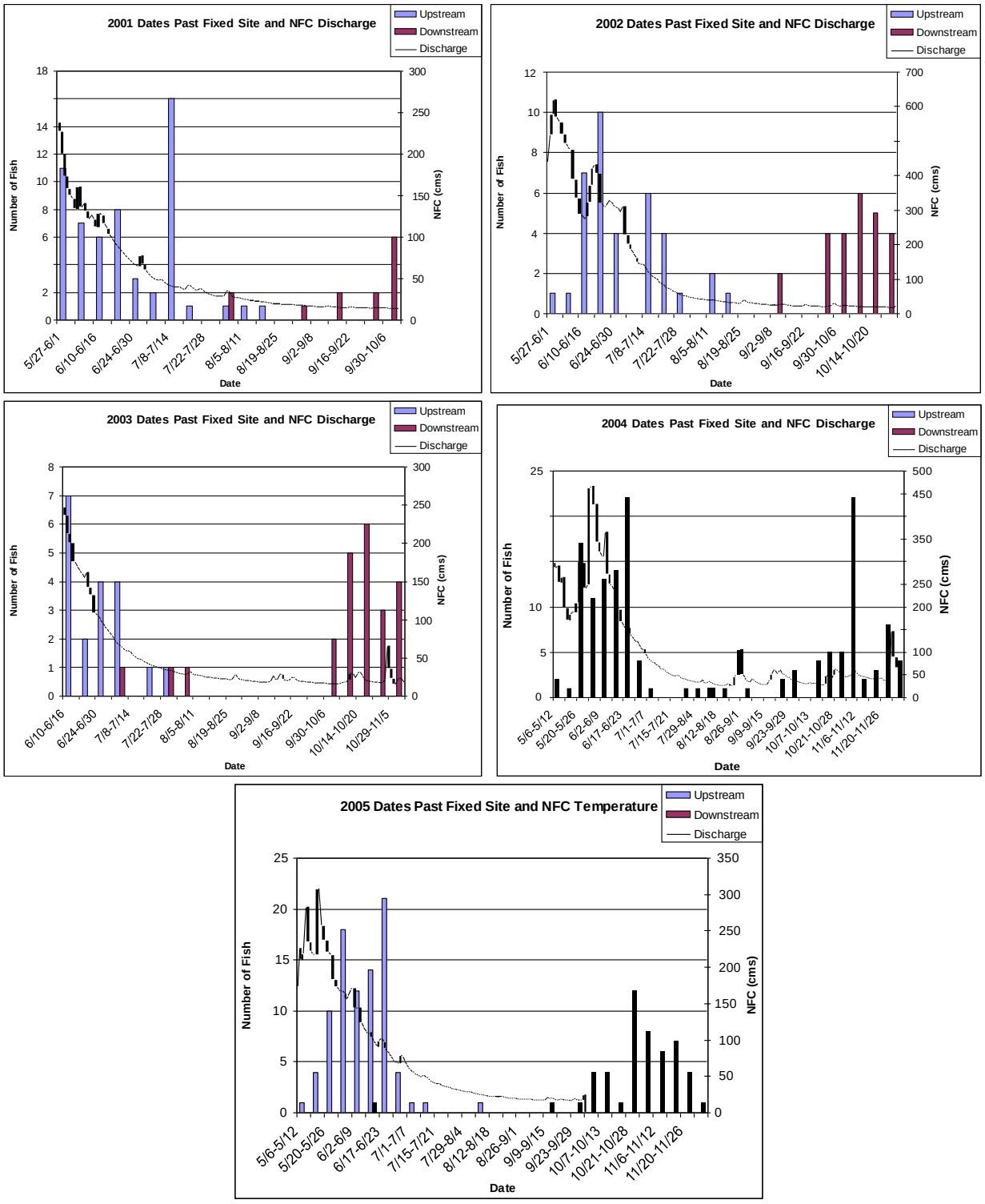

Figure 21. Upstream and downstream timing of radio tagged bull trout past the NFC or LNF fixed site for 2001 through 2005, and NFC discharge.

Table 5. Number of radio-tagged bull trout and associated tagging areas and migration watersheds

Migration Area	Tagging Area NFC	Tagging Area LNF	Tagging Area BFC	Tagging Area DWR
NFC	206	8	14	17
LNF	20	97	36	13
DWR	14	1	8	9
BFC	0	1	18	2
Not detected	12	8	1	7
Total Tagged	252	115	77	48

Temporal and Spatial Distribution

Distribution of bull trout was grouped into three periods: migration, May through July; spawning, August through October; and over winter, November through April. Within the periods, spatial variations between months were also examined to document key times in bull trout distribution, at a smaller scale.

Migration Period

For all years a total of 4,440 detections were recorded during the migration period. 33.6% (1,494/4,440) of locations were within the full pool height of Dworshak Reservoir and 66.4% (2,946/4,440) in riverine habitat. Broken down by month 56% of detections during May were in the reservoir, 17% in June were in the reservoir, and 9% in July. During May tagged bull trout in the reservoir were found congregated in the slack water interface below the NFC and LNF riverine habitat (Figure 22). As the spring period progressed into June 83% of tagged fish moved into the riverine habitat above full pool (Figure 23), and by July the majority (91%) were found in the upper LNF river, upper NFC river and in BFC (Figure 24). Tagged fish were found distributed from Dworshak Dam to the upper reaches of the LNF and NFC rivers, and associated tributaries.

During May tagged bull trout were in the reservoir, or the mainstem NFC, LNF or lower BFC. No fish were found in tributaries during May. Tagged bull trout first entered tributaries to the mainstem LNF, NFC, or BFC starting in June. By July multiple fish were found in tributaries and in the upper LNF, NFC, and BFC drainages.

Distribution of bull trout in the reservoir through the migration period show that 35% of fish tracked in the slack water of the reservoir inhabited section five, 32% in section four, 19% were found in section three at some time, 8% in section two, and 2% in section one. Fish were primarily found in the upper sections of the slack water, and only 8/395 tagged bull trout were found in section one (closest to Dworshak Dam). Distribution patterns were similar between all years during the migration period.

During May of all years 20% (57/288) of fish tracked in the reservoir were located in multiple reservoir sections. Movement between reservoir sections decreased during June to

10% (12/123), and again to 2% (1/54) during July. Bull trout did move within sections during this time for all months, but between reservoir section movement was limited.

Spawning Period

For the duration of the spawning period the majority of tagged fish and 88% (2,435/2,755) of radio detections were located in riverine habitat (Figure 25). Radio-tagged bull trout were distributed in 23 watershed groups throughout the study area. The watershed groups within the NFC subbasin were, Beaver, Cayuse, Cold Springs, Collins, Headwaters NFC, Isabella, Kelly, Larson, Long, Lost Pete, Osier, Quartz, Scofield, Upper Kelly, Upper Weitas, and Middle Fork Kelly. Watershed groups within the LNF included Canyon, Floodwood, Stony, Middle LNF, and Upper LNF. Radio-tagged bull trout were found with differing frequencies within these watershed groups. The majority of tagged fish (26.2%) were found in the Upper LNF for all years, then Long Creek (13.1%), Headwaters NFC (11.7%), and Middle LNF (8.2%) (Table 6). Compared to other 5th Field HUC's, tagged bull trout were consistently located here in high numbers during all years. Distribution within other 5th Field HUC groups varied depending on the year (Table 6).

Some radio-tagged bull trout were detected in Dworshak Reservoir during the spawning period. In August fish tracked in the reservoir were distributed rather evenly in sections 2, 3, 4, and 5. Only 1/53 (2%) tagged bull trout was detected in section 1 during August. During September and October nearly 50% of fish in Dworshak Reservoir were in section 5 (Table 7). Distribution during the spawning period for all years indicates that most tagged adult bull trout inhabit the river habitat. When fish were tracked in the reservoir during this time, the majority of bull trout were found in the upper sections (3, 4, 5) and few fish found below section 3.

Movement between reservoir sections during the spawn time was limited. Less than 11% of fish for all years, and the three months, were detected moving between sections. This does not indicate fish in Dworshak Reservoir were necessarily inactive during this time, but long range movements between reservoir sections were not commonly observed. Tagged bull trout did move within individual sections during this time.

Alternate and repeat year spawning bull trout were documented from 2001 to 2005. Combined for these five years battery life in 60 radio-tags allowed tracking of fish to continue in excess of one year and allowed us to determine alternate or repeat year spawning bull trout. Eighty percent (48/60) of this sample exhibited repeat year spawning behavior, and 20% (12/60) alternate year, or longer, spawning. Separated by individual years the proportion of repeat and alternate year spawning fish varied considerably because of low sample sizes (Table 8). In both 2002 and 2004 the HUC 5 watershed that contained the most consecutive returning radio-tagged fish was the Upper LNF watershed.

Mortality and survival following spawning were calculated from 2001 to 2005 by the number of suspected radio-tagged bull trout that spawned, and then were confirmed mortalities or did not move from a location for multiple months. Post spawn survival varied little between most years with survival estimates at 80% in 2005, 75% in 2004, 80% in 2003, 76% in 2002, and 40% in 2001. Post spawn survival estimates from 2002 to 2005 contained sample sizes greater than 45 spawning fish, whereas the sample from 2001 contained 15 spawning bull trout.

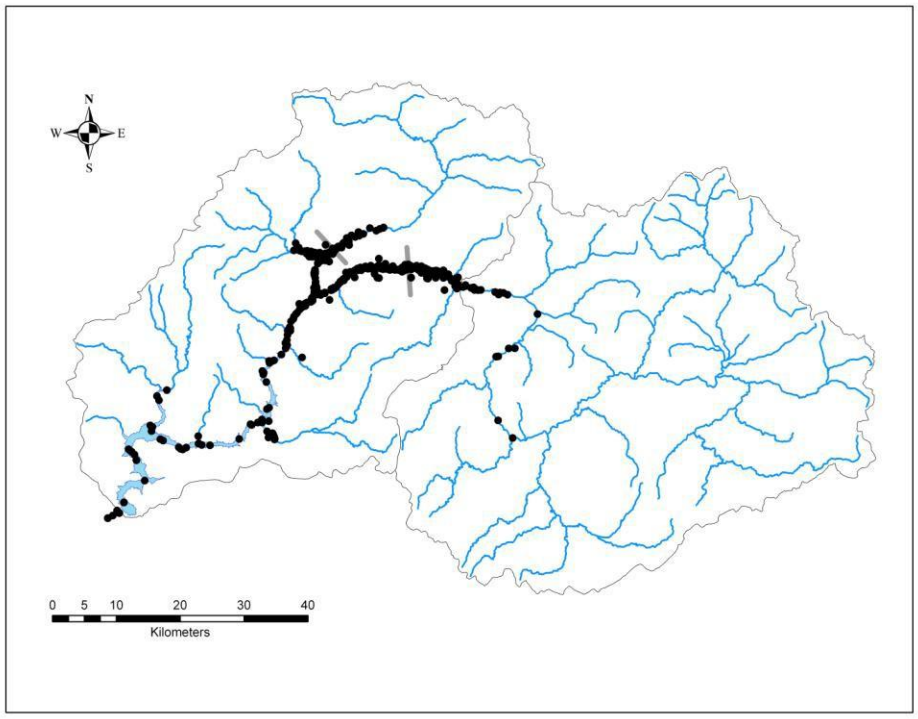

Figure 22. Radio-tagged bull trout detections during May for 2000-2006.

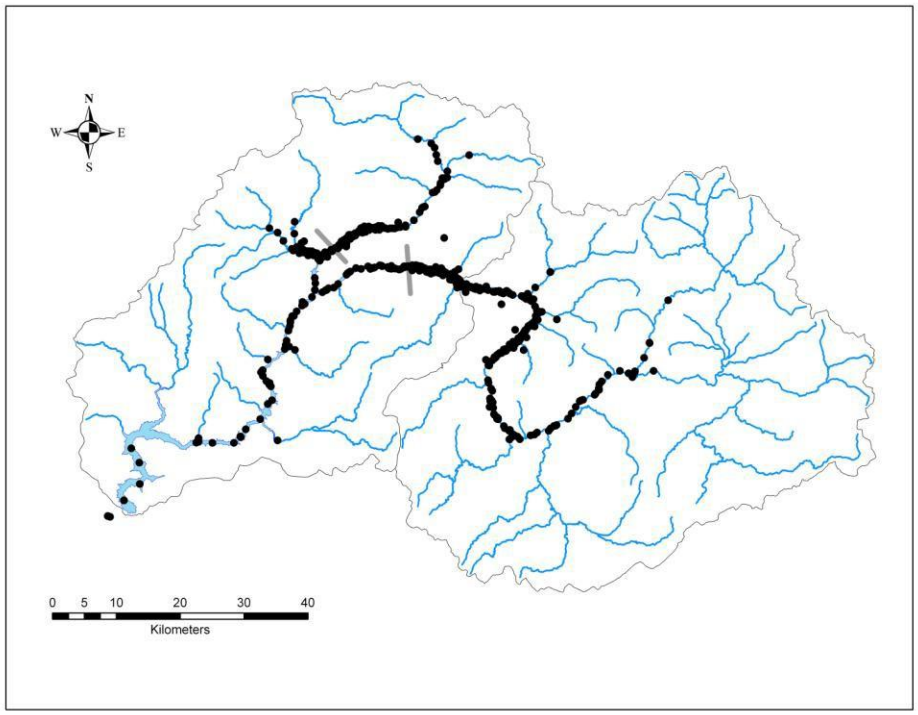

Figure 23. Radio-tagged bull trout detections during June for 2000-2006.

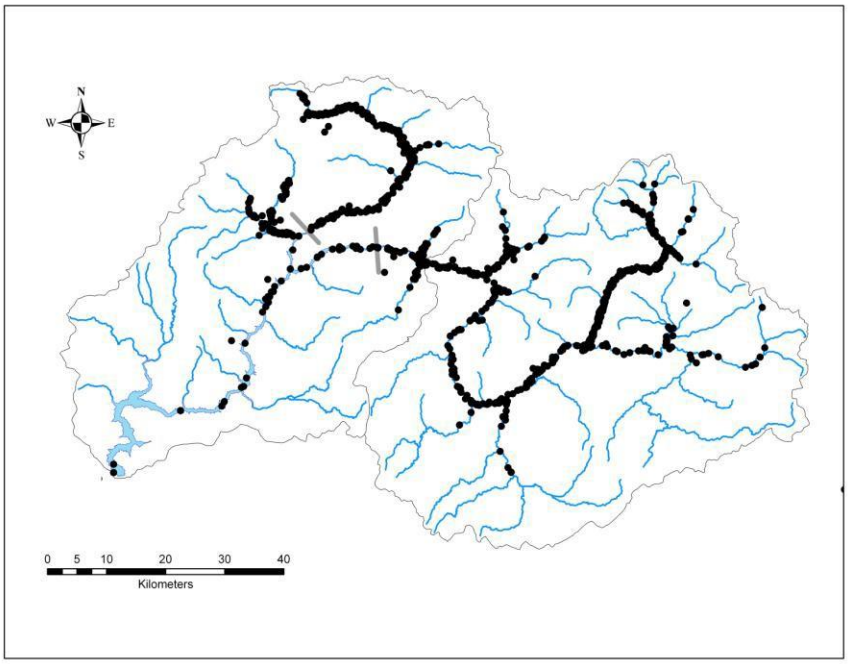

Figure 24. Radio-tagged bull trout detections during July for 2000-2006.

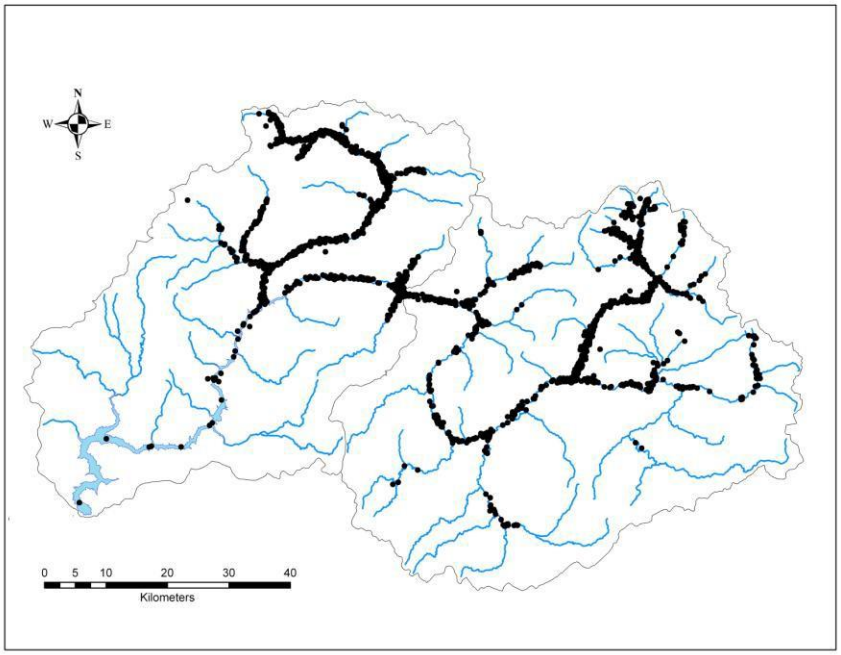

Figure 25. Radio-tagged bull trout distribution from 2000 to 2006, during the spawning time period; August – October.

Table 6. Watershed groups (5th field HUC) and number of radio-tagged bull trout that presumably spawned in that location. Key production areas are highlighted.

Subbasin	Watershed Group (5th Field HUC)	Number Of Bull Trout 2000	Number Of Bull Trout 2001	Number Of Bull Trout 2002	Number Of Bull Trout 2003	Number Of Bull Trout 2004	Number Of Bull Trout 2005	Total Frequency of Occurrence
NFC	Beaver Creek	1	1		2	3		1.4%
	Cayuse Creek					1		0.2%
	Cold Springs Creek	1	2	5	5	1	3	3.5%
	Collins Creek		1	3	6	9	2	4.3%
	Headwaters NFCR	3	5	2	21	21	5	10.1%
	Isabella Creek			1	8	3		2.5%
	Kelly Creek	2		3	2	1	1	1.8%
	Larson Creek		1		1			0.4%
	Long Creek	4	6	12	13	10	19	13.1%
	Lost Pete Creek	3	2	2	2	3	1	2.7%
	Osier Creek	1	2	2		3	2	2.0%
	Quartz Creek		2	1	2	1	1	1.4%
	Schofield Creek		2		2	1		1.0%
	Upper Kelly Creek				7	2		1.8%
	Upper Weitas Creek	1	1		2		1	1.0%
	French Creek						1	0.2%
	Lower Weitas Creek						2	0.4%
	Middle Fork Kelly Creek						4	0.8%
LNF	Canyon Creek		3				3	1.2%
	Floodwood Creek		5	1	8	1	2	3.5%
	Stony Creek		2	2	2	1	1	1.6%
	Middle LNF		7	8	15	10		8.2%
	Upper LNF		19	15	40	22	32	26.2%
Unknown	Detected At Fixed Site Only	2	3					1.0%
Unknown	Not Detected After Tagging		26	10	3			8.0%

Table 7. Distribution of tracked bull trout in Dworshak Reservoir during the spawning period.

Sections	August Total per Section	August % per Section	September Total per Section	September % per Section	October Total per Section	October % per Section
Dworshak Reservior						
Section 1: Dam to Dent Bridge	1	2%	0	0%	5	3%
Section 2: Dent Bridge to Evans Creek	11	20%	1	3%	4	3%
Section 3: Evans Creek to Grandad Bridge	17	31%	7	21%	37	26%
Section 4: NFC Arm	12	22%	11	32%	25	17%
Section 5: LNF Arm	13	24%	15	44%	68	48%
Grandad Fixed Site Only		0%		0%	4	3%
Total Bull Trout Detected per Month	54		34		143	

Table 8. Frequency and numbers of repeat and alternate year radio-tagged spawning bull trout.

	YEAR 2001	2002	2003	2004	2005
Frequency Repeat	50%	67%	91%	95%	83%
Frequency Alternate	50%	33%	9%	5%	17%
Number Repeat	3	12	10	18	5
Number Alternate	3	6	1	1	1

Winter Distribution

From November through April 96.7% of bull trout detections were in located in Dworshak Reservoir. The remaining detections were located in riverine habitat in the mainstem LNF or NFC (Figure 26). During November most tagged fish were located in section four of Dworshak Reservoir, followed by section three. In November tagged bull trout were still in the process of moving down into the reservoir and out of the riverine habitat (Figure 20). In December fish were most commonly found in section three and then section four (Figure 27). More fish were distributed in section two and one, 33% combined, than during November. As time progressed into January the highest percentage of fish, 35%, were in section two followed by section three and section one (Figure 28). In February 44% of detected bull trout occupied section two, followed by 19% in section one (Figure 29). In March, the highest percentage of tagged fish were found in section one, followed by section two and three, respectively (Figure 30). For April, tagged bull trout began to disperse more evenly in the reservoir, being more uniformly distributed from section one to section five (Figure 31 and Table 9).

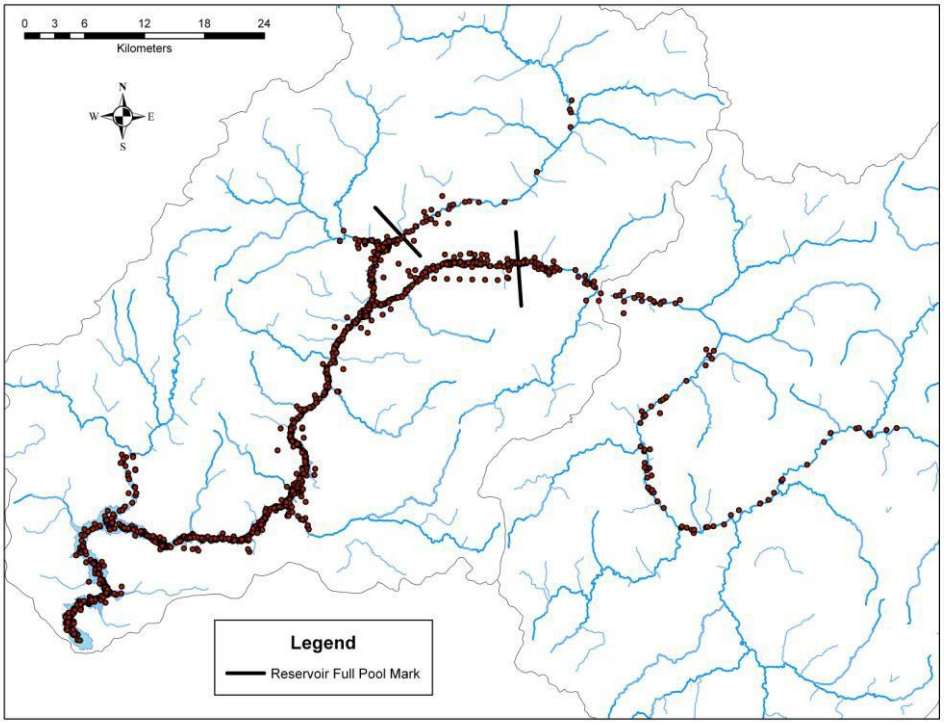

Figure 26. Tagged bull trout detections from 2000 to 2006, during the overwinter time period; November – April, in the NFCR upstream of Dworshak Dam.

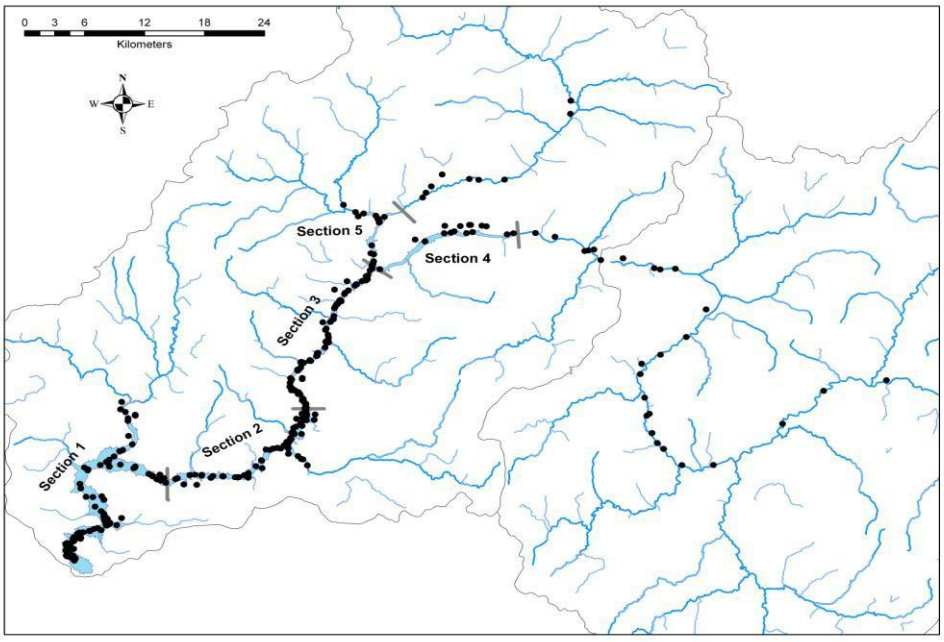

Figure 27. Distribution of tagged bull trout in the NFCR upstream of Dworshak Dam during December, from 2000 to 2005.

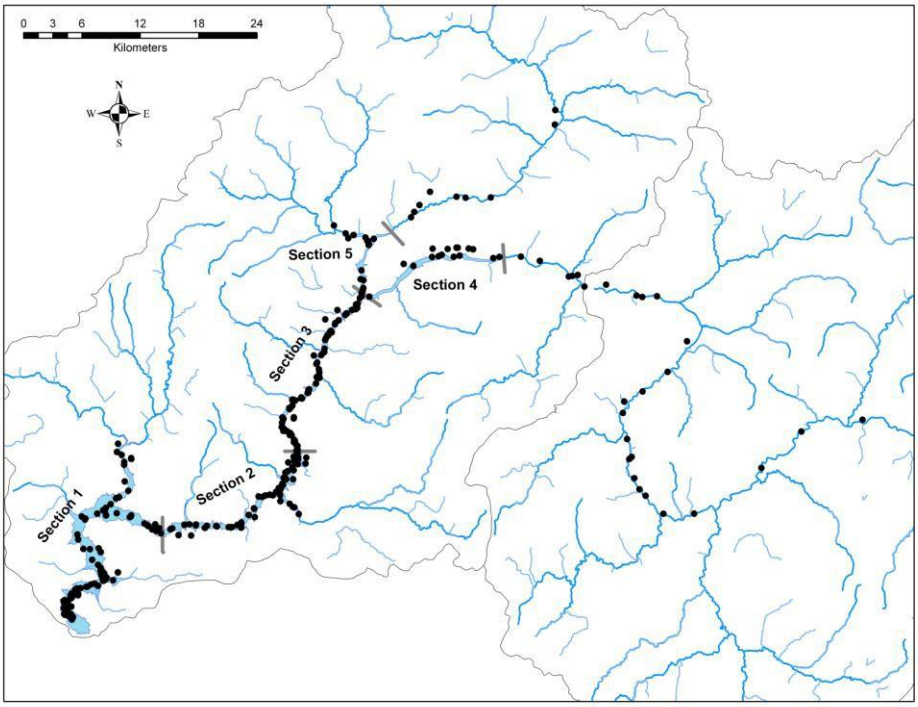

Figure 28. Distribution of tagged bull trout in the NFCR upstream of Dworshak Dam during January, from 2001 to 2006.

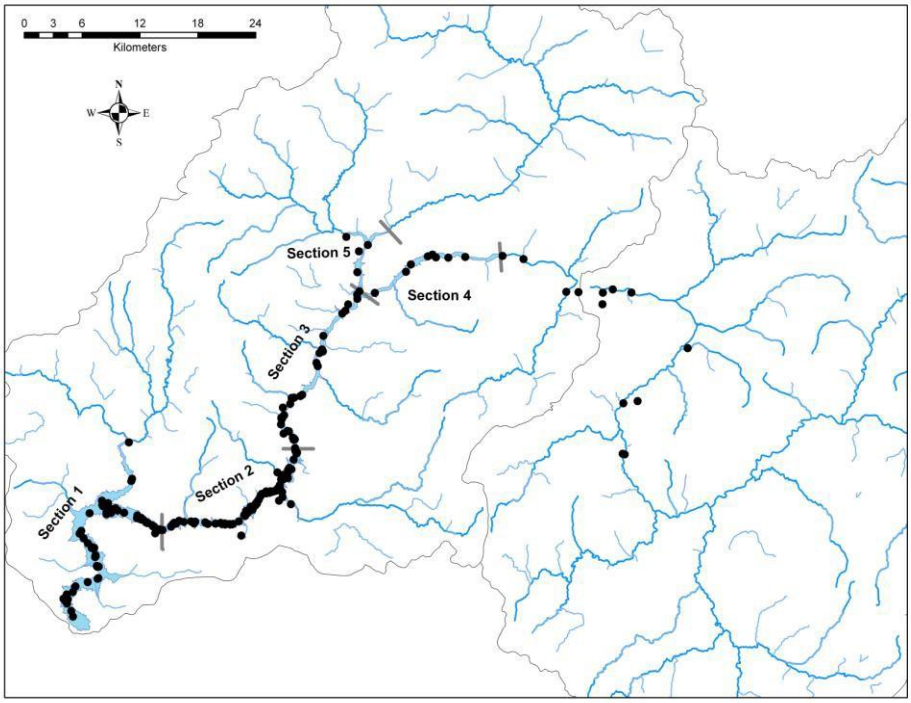

Figure 29. Distribution of tagged bull trout in the NFCR upstream of Dworshak Dam during February, from 2001 to 2006.

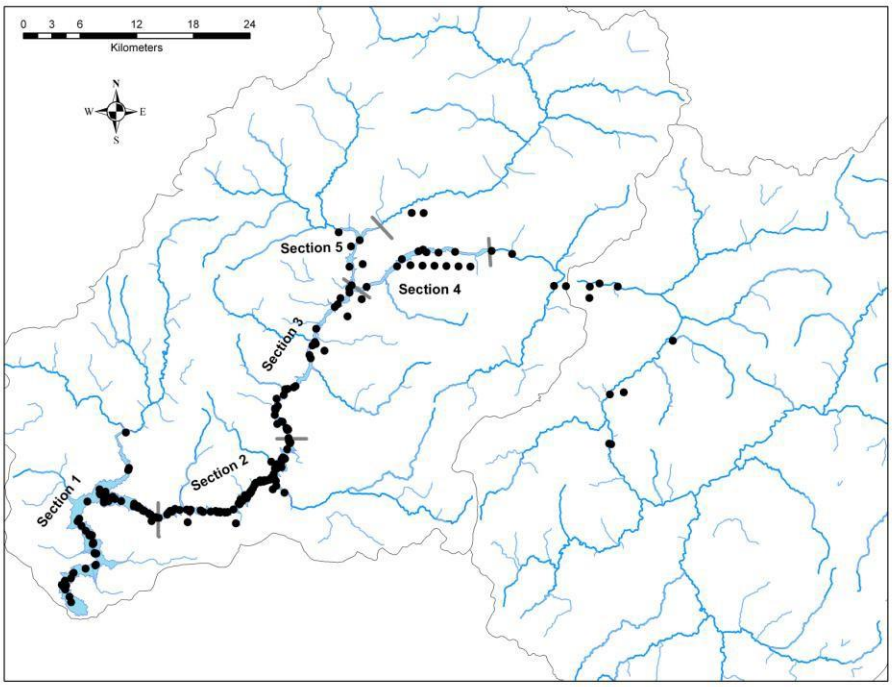

Figure 30. Distribution of tagged bull trout in the NFCR upstream of Dworshak Dam during March, from 2000 to 2006.

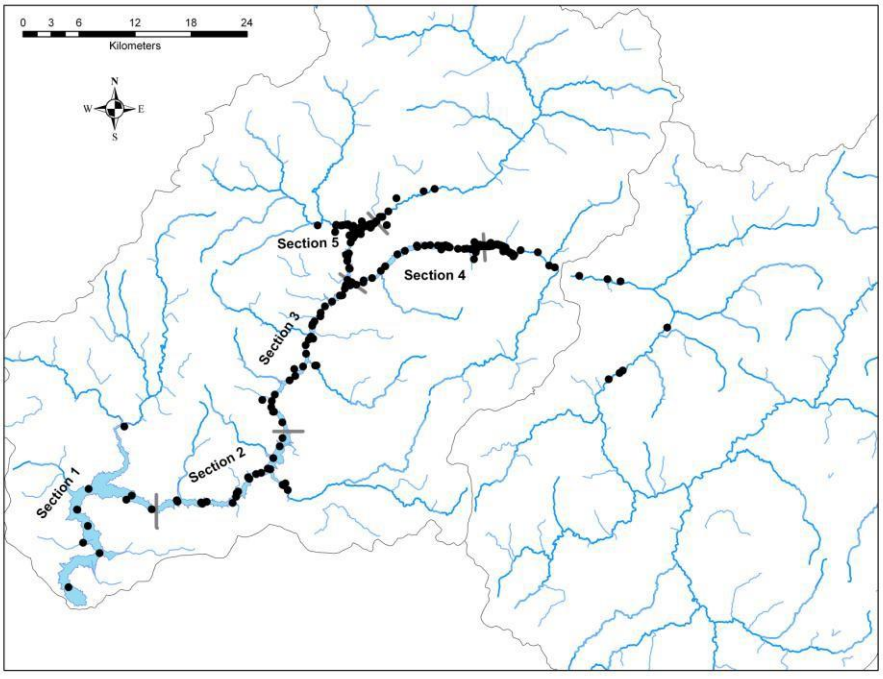

Figure 31. Distribution of tagged bull trout in the NFCR upstream of Dworshak Dam during April, from 2000 to 2006.

Table 9. Distribution of telemetry tagged bull trout in Dworshak Reservoir during the winter period, 2001-2006.

	November		December		January	
Section	# per Section	% per Section	# per Section	% per Section	# per Section	% per Section
Dworshak Reservoir						
Section 1: Dam to Dent Bridge	23	6%	54	15%	64	19%
Section 2: Dent Bridge to Evans Creek	42	11%	63	18%	121	35%
Section 3: Evans Creek to Grandad Bridge	89	23%	82	23%	71	21%
Section 4: NF Arm	96	25%	69	20%	20	6%
Section 5: LNF Arm	46	12%	24	7%	15	4%
Grandad Fixed Site Only	37	10%	45	13%	17	5%
LNF Riverine	6	2%	3	1%	9	3%
NFC Riverine	50	13%	10	3%	24	7%
Total Number of Fish Detected	**389**		**350**		**341**	

	February		March		April	
Section	# per Section	% per Section	# per Section	% per Section	# per Section	% per Section
Dworshak Reservoir						
Section 1: Dam to Dent Bridge	42	19%	42	24%	28	12%
Section 2: Dent Bridge to Evans Creek	98	44%	35	20%	34	14%
Section 3: Evans Creek to Grandad Bridge	37	17%	35	20%	52	22%
Section 4: NF Arm	16	7%	14	8%	41	17%
Section 5: LNF Arm	4	2%	12	7%	30	13%
Grandad Fixed Site Only	13	6%	31	18%	22	9%
LNF Riverine	1	0%	1	1%	8	3%
NFC Riverine	11	5%	2	1%	20	9%
Total Number of Fish Detected	**222**		**172**		**235**	

Entrainment Risk

We classified fish as being at risk of entrainment only if they were within section one (closest to Dworshak Dam). We also considered that risk of entrainment for fish in section one increased with discharge at Dworshak Dam. We documented a marked increase in the number of fish found in section one beginning in December. From May to October the average number of fish found in section one was four (range 0 – 12). From November through April the average number of fish found in section one was 42 (range 23 – 64). Starting in November tagged bull trout progressively moved farther downstream near section one through March. More fish were found in the lower reservoir during this time than any other. As April began there is a decrease in the number of tagged bull trout in section one and two, and an increase of fish in upper sections, indicating bull trout are beginning to migrate to the upper reservoir and into lower riverine habitat.

MAP Tagged Fish

A total of 83 bull trout were tagged with MAP transmitters; 41 in 2004 and 42 in 2005. MAP fish were tagged in the upper reservoir from 30 September to 30 November (Figure 32). Total length ranged from 355 – 619 mm, with an average of 446.3 mm, average weight was 878 g and ranged from 340 – 2,320 g. Deploying MAP tags increased the number of bull trout that could be consistently located and tracked compared to radio transmitters that had depth limitations. Fish tagged with MAP transmitters greatly added to our understanding of movement within the reservoir.

Bull trout tagged in the fall from all three tagging areas exhibited three patterns of winter movement. Bull trout either stayed high in the LNF or NFC arms not moving below Grandad, progressively moved down reservoir and then often traveling back up reservoir in April, or fish tagged in the respective reservoir arm traveled downstream to Grandad and then up the other arm in late October and November only to move down reservoir later. Fish tagged in the LNF showed a higher propensity (33%) to move into the NFC arm than fish tagged in other areas; only 13% of tagged bull trout in the NFC moved into the LNF arm after tagging.

Throughout the winter time period MAP tagged bull trout were found in all reservoir sections at one time or another. Human access to sections three, four, and five during January and February was limited because of ice cover, and complete tracking of the sections was not always possible. Beginning in November MAP tagged bull trout progressively moved farther downstream, into the next lower section, until March. For example, in November most fish were found in sections four and five, and then in December the majority found in sections four and three, until February and March when the majority of fish were in sections two and one. Although most fish during March were in sections one and two, they were more evenly spread out in the reservoir, and by April most MAP tagged bull trout had traveled up reservoir and were found in upper reservoir sections (Figure 33).

The mean over winter distance traveled was 56.7 km and ranged from 1.19 – 218.7 km. This is an estimate of the minimum distance traveled over these six months, within Dworshak Reservoir. Significant differences in movement between fish tagged in 2004 and in 2005 were not observed. Intensive track data showed a mean movement of 0.71 km/hr with a range of 0.08 to 3.23 km/hr. If extrapolated into one 24 hour period MAP tagged bull trout moved on average 16.94 km/day and ranged from 1.80 – 77.57 km/day (Appendix A; Table 2). Significant differences were not detected between night and day periods.

Bull trout depths were recorded when mobile tracking by boat, and SDL's when fish were within detectable range. The mean depth inhabited by bull trout for all years combined was 5.96 m and ranged from 0 – 33.3 m. The mean depth in the 2004/2005 winter tracking interval (interval one) was 2.60 m and the average depth in 2005/2006 (interval two) was 6.08 m. A significant difference ($p<0.001$) was detected in average depth between the two tracking periods.

Mean fish depth by month varied from 0.50 m in April 2005 to 13.9 m in February 2006 (Appendix A; Table 4). In every month the interval two mean fish depth was significantly different than the interval one tracking period. Bull trout were found at deeper depths during the second interval in every month. When divided by reservoir section the same pattern was observed, with fish in the 2005/2006 interval being at greater depths than in the 2004/2005 period.

Diel depth use was measured by SDL's when MAP tagged fish were within detection range for a prolonged period. In reservoir section one, the three SDL's detected four fish between 3 November 2005 to 16 March 2006. On average tagged fish occupied depths below 6 m from 1800 to 0500 and from 0600 to 1700 mean depth use ranged from 8.7 m to 23.3 m (Figure 34). In section two, at Swamp Creek the SDL detected 14 MAP tagged fish from 30 March through 25 May 2006. Fish detected at this site were on average shallower than those fish detected in section one. From 1800 to 0500 tagged bull trout mean depth ranged from 1.3 m to 3.6 m. During the day from 0600 to 1700 mean depth use was slightly deeper and ranged from 2.5 m to 4.9 m (Figure 35). At the confluence of the LNF and NFC arms, in reservoir section three the SDL detected 17 MAP tagged fish from 30 March to 3 June 2006. At night from 1800 to 0500 mean depth ranged from 0.2 m to 3.1 m. During the day from 0600 to 1700 mean depth use ranged from 1.8 m to 6.6 m (Figure 36).

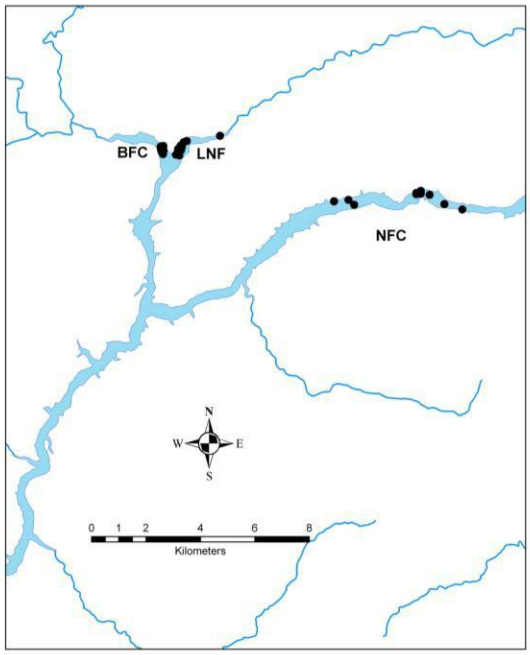

Figure 32. Tagging locations of MAP tagged fish in the fall of 2004 and fall 2005.

Combined depth detections exhibited a similar pattern of shallower detections during the night with the majority being less than 15 m. During the day depth detections were more spread out ranging from 0 m to 33 m. (Figure 37). Tagged bull trout occupied a much broader range of depths during the day, venturing nearly two times as deep as they did during the night. Fish made many of their depth transitions very quickly covering up to 9.5 m of depth in less than one minute (Appendix A; Figure 2). When elevations of MAP fish within the forebay area are plotted with the elevation of the regulating outlets and turbines on Dworshak Dam one can see which structures are most likely to entrain bull trout. Most tag elevations at risk of entrainment, during the day, were located between the top and bottom of the turbines located from 429.2 msl to 437.4 msl (Figure 38).

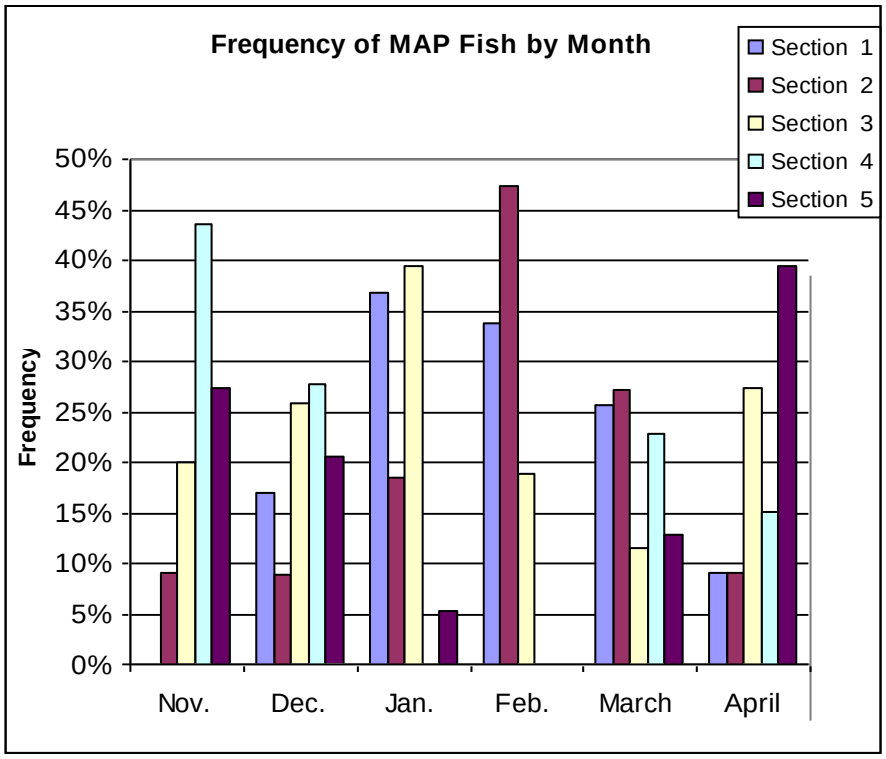

Figure 33. Reservoir distribution of MAP tagged fish by month and section, during 2004 and 2005 from November - April.

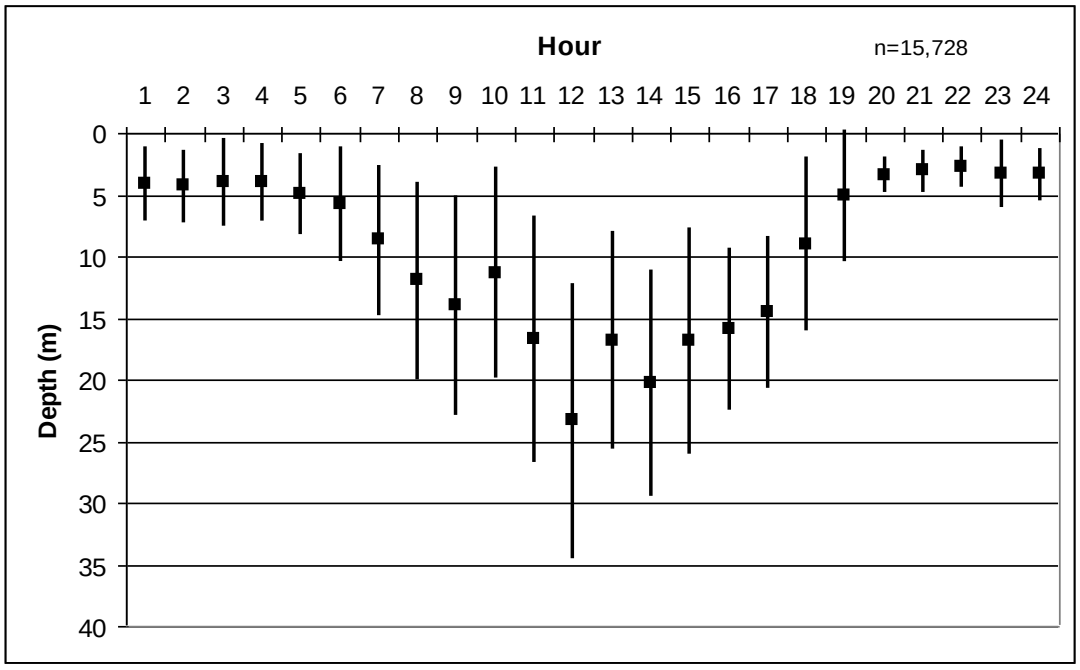

Figure 34. Mean and standard deviation of MAP tagged bull trout depths, by hour. Detections by SDL's in reservoir section one from 3 November to 16 March 2005/2006.

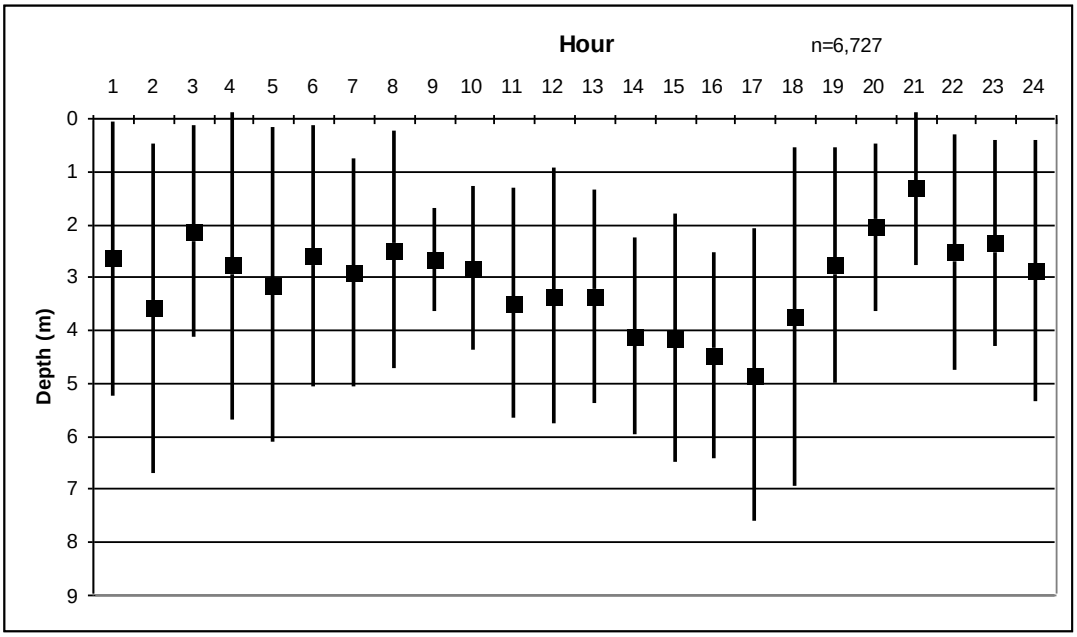

Figure 35. Mean and standard deviation of MAP tagged bull trout depths, by hour. Detections by SDL's in reservoir section two from 30 March to 25 May 2006.

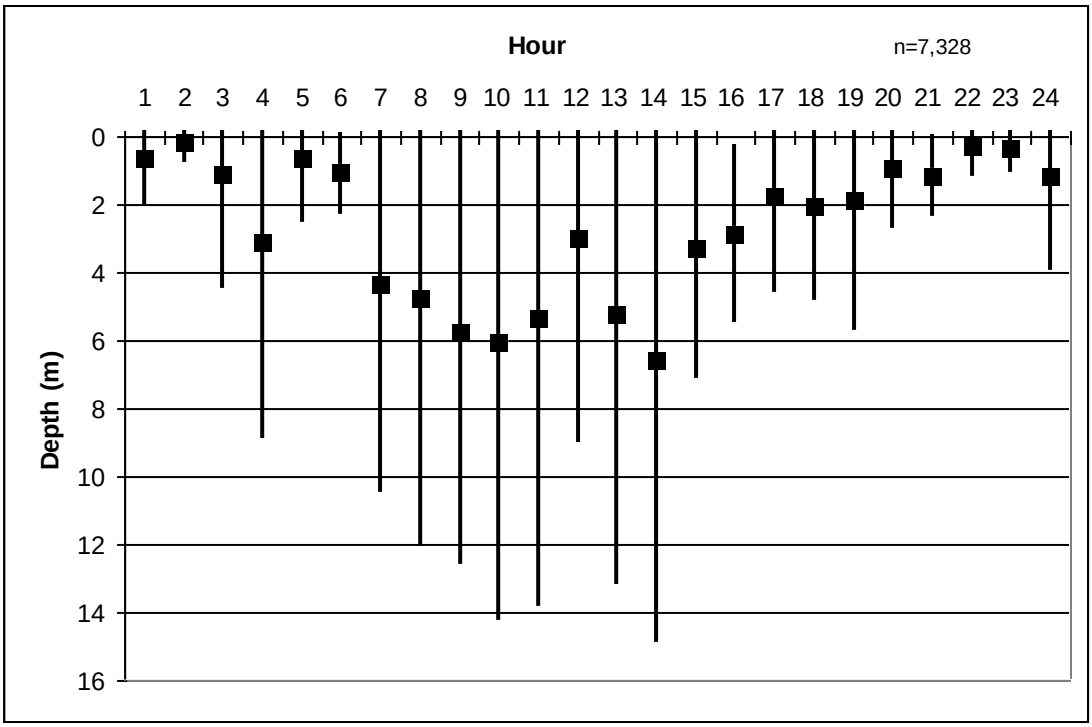

Figure 36. Mean and standard deviation of MAP tagged bull trout depths, by hour. Detections by SDL's in reservoir section three from 30 March to 3 June 2006.

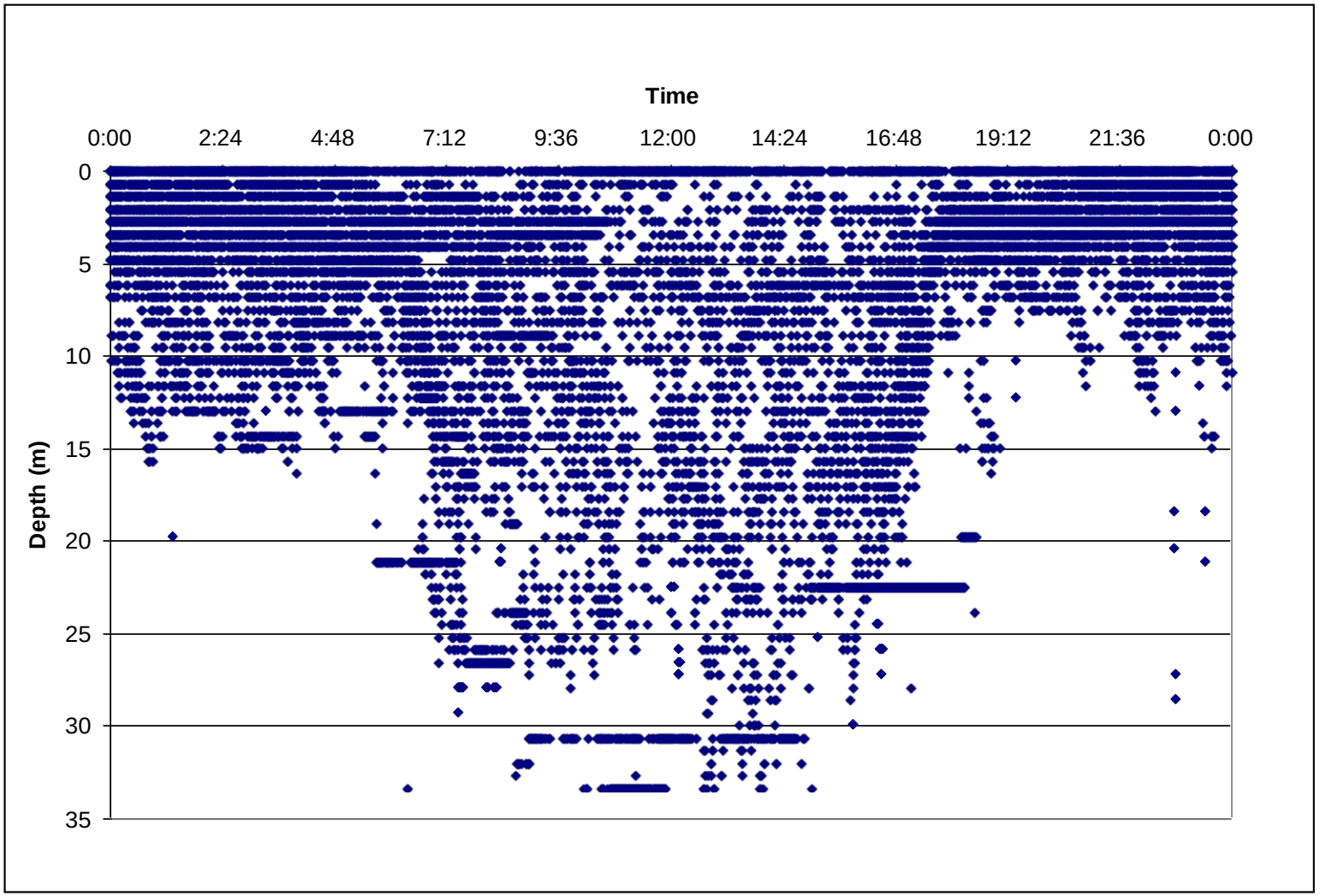

Figure 37. All depth detections for MAP tagged bull trout in winter 2004/2005 and 2005/2006. N=23,071.

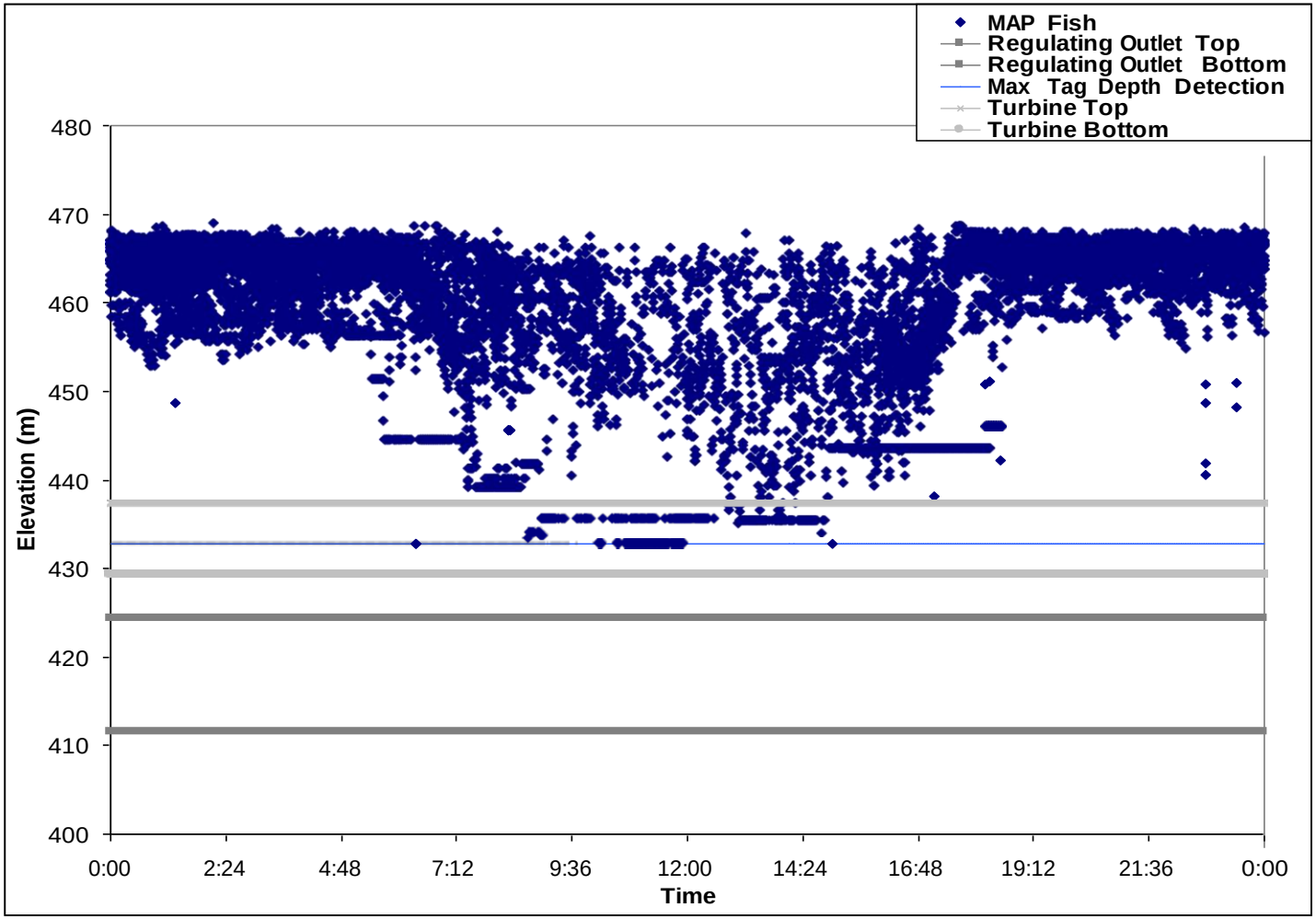

Figure 38. Elevation of MAP tagged bull trout in the forebay area and elevations of top and bottom of outlet structures.

Temperature

Average MAP tagged bull trout temperature for both tracking intervals combined was 5.22º C. Fish temperature ranged from 0.4 to 10.4º C from November to April for both years. Mean temperature measured by MAP tags was significantly different ($p<0.001$) between the two tracking periods. In interval one the mean fish temperature was 5.49º C., during interval two the mean fish temperature was 4.97º C. Fish temperatures in November and December of interval two were warmer than those in interval one, but from January through April interval two had temperatures near two degrees cooler than during interval one (Appendix A; Table 6). Water surface temperature in interval two was colder than interval one by approximately two degrees as well.

Rapid changes in fish temperature were difficult to assess as bull trout moved quickly between depths. The time it took bull trout body temperature to mirror water temperature and the speed at which the temperature sensor changed was unknown. Water temperature did not appear to limit bull trout movement in Dworshak Reservoir from November through June.

Sub Adults & Alternate Year Spawners

We documented 18% (7/40) of tagged bull trout under 350 mm TL migrating above fixed sites during the length of the study. The remaining 82% (33/40) were not detected leaving the reservoir whereas, 81% (400/492) of radio-tagged fish greater than 350 mm TL were detected moving above fixed stations. During implanting of radio tags only three fish less than 350 mm were confirmed as being mature, two females and one male. Out of 14 visually confirmed immature bull trout, eight fish were over 350 mm respectively. The largest of these fish was 61 mm larger than our set mark of 350 mm. Only one confirmed immature fish, greater than 350 mm, was documented migrating to a known spawning area.

Since one would expect comparable proportions of fish greater and less than 350 mm to emigrate from the reservoir at the same frequency, we classified sub adults as less than 350 mm and adults greater than 350 mm.

Although the majority of fish <350 mm were tagged with NANO tags they were handled in the same manner as MICRO-tagged fish and we would not expect their mortality/tag loss to be significantly different. This indicates that sub adult bull trout use the reservoir more during the summer months when spawning adults are in streams.

Within reservoir movement of sub adult (<350 mm) bull trout is difficult to characterize due to radio tag limitations in deep water. Few locations of sub adults in the reservoir were attained through the study, but sub adults were found in every section of Dworshak Reservoir. Within the reservoir, detections were distributed as follows; 53% (40/76) were in sections four and five, 36% (27/76) in section three, 9% (7/76) in section two and 3% (2/76) in section one. Only two sub adults were identified as being at risk of entrainment due to their distribution below Dent Bridge. These fish occupied reservoir section one during April and May.

Entrained Fish

During the six year study, two radio-tagged bull trout were documented being entrained through Dworshak Dam. In 2003, the first radio-tagged fish was entrained through Dworshak Dam. This fish exhibited a typical migration pattern for bull trout in the study area; it moved upstream into the LNF during the migration period, was found farthest upstream during the spawning period, and then returned to the reservoir during the over winter period (Figure 39). In March the tagged fish was first found in section one, and was initially detected after entrainment on 14 May 2003.

The other radio-tagged bull trout documented being entrained was in 2006. This fish also migrated and presumably spawned up the LNF, then traveled down to the LNF and NFC confluence during October and November, went upstream into the NFC arm, and then moved down into the lower reservoir and was first detected in section one in December 2005 (Figure 40). This fish was entrained through the dam sometime between 17 April 2006 and the first detection date below the dam on 26 April 2006.

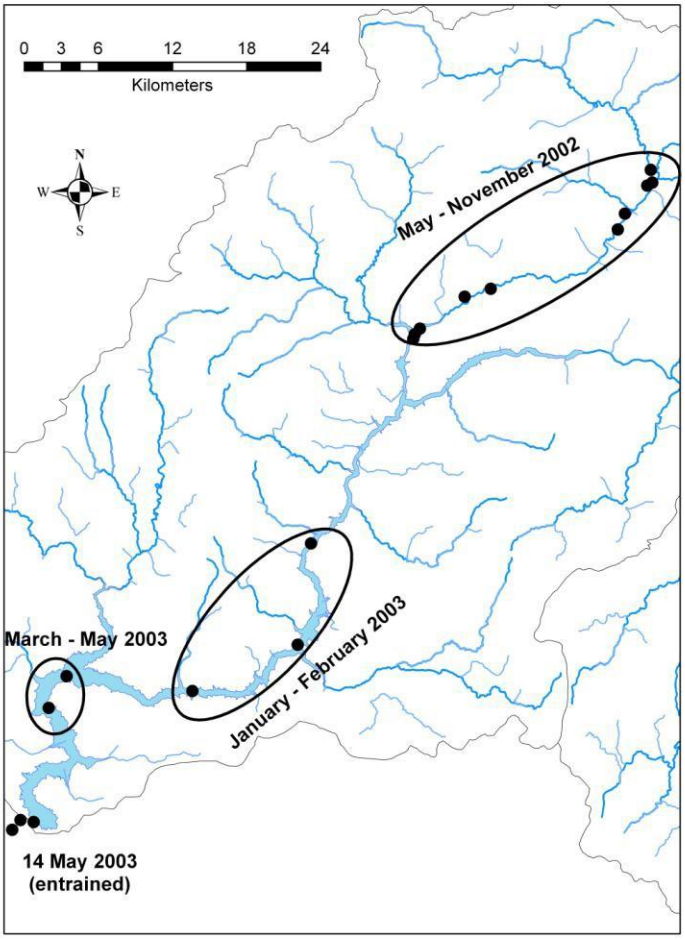

Figure 39. Movement of radio-tagged fish entrained through Dworshak Dam in 2003.

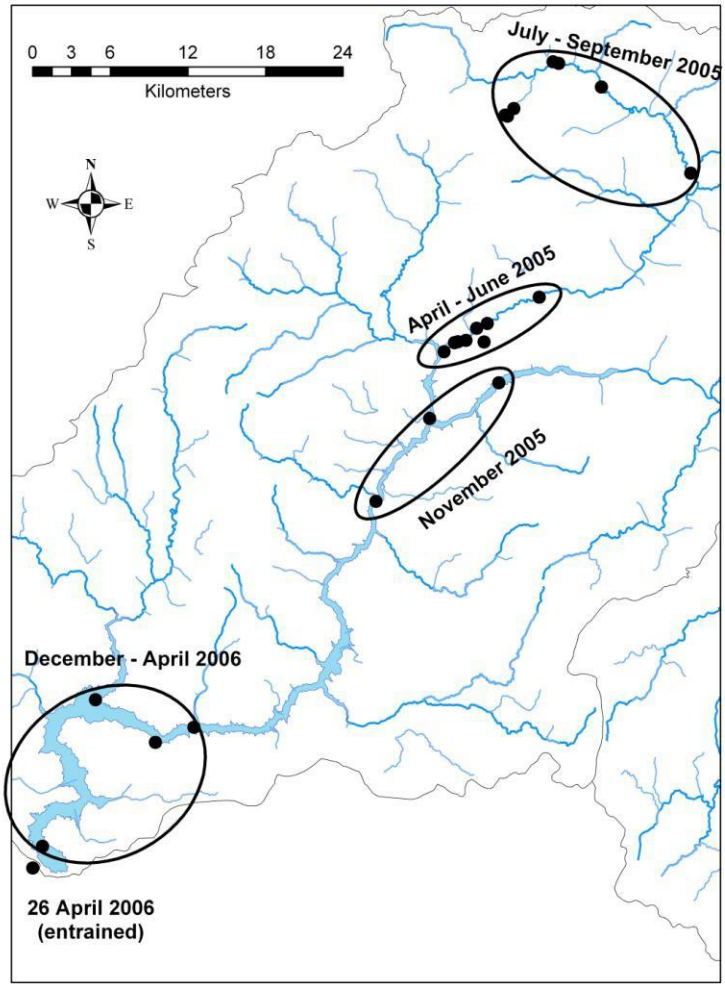

Figure 40. Movement of radio-tagged fish entrained through Dworshak Dam in 2006.

DISCUSSION

We documented an increase in the size structure of bull trout from 2000 to 2006. We surveyed the same or similar areas, during the same time, and for the same duration were surveyed every year. Hook and line, and gill nets or trap nets were used each year. Angling would have biased the sample somewhat since larger fish were targeted by anglers, but the use of nets should have reduced the bias of capturing fish by angling and would have selected a representative sample of the population. Consequently, the occurrence of increasingly older, larger bull trout represents an increase in annual survival. It is not uncommon for fish to increase in age and size following the closure of a sport fishery. Bull trout have a slow growth rate and mature relatively late making them susceptible to over fishing even at low harvest rates. Before 1994, when the bull trout fishery was open, even little mortality due to angling could have suppressed the numbers of larger fish, subsequently, the bull trout population would increase following reductions in mortality rates.

Coincident in time with the bull trout fishery closure was a change in operations at the Dworshak project. Prior to 1993 the majority of discharge at Dworshak Dam occurred from

September through April with frequent flood control releases occurring in January through March. These winter-time releases coincide with temporal and spatial distribution of bull trout identified by this study as predisposing them for higher risk of entrainment through Dworshak Dam.

Maturity was determined in 319 bull trout, 24 were immature and 295 were mature. Sampling was biased since most sampling was conducted where known adult migrants stage in the reservoir before entering the river on a migration run. Mature fish are also larger than immature fish and more susceptible to angling as described above. Bull trout life history characteristics also contribute to fewer immature fish at sample sites. Immature fish stay in their natal streams and the fluvial habitat for at least three years before moving into the reservoir, where most sampling took place.

Growth

Estimated average annual growth rates for the NFC bull trout population were considerably greater than in other systems. In Trestle Creek, Idaho, Downs et al. reported average growth rates of 28 mm and 20 mm. NFC growth rates averaged 40 mm/yr. It was expected that bull trout with smaller initial capture lengths grew at greater rates than larger fish. Some trends were apparent when examining growth rates of radio-tagged fish that were less than the mean daily rate of 0.109 mm/day. Bull trout with slower growth rates were more likely to travel greater distances upstream and were found farther downstream in Dworshak Reservoir. The farther a fish travels on either a spawning migration (upstream) or a winter migration (downstream) the more energy that fish expends as compared to a bull trout with a smaller range. It may be beneficial for some adult bull trout to deposit their eggs farther up a tributary, if there are fewer predators or more suitable habitat. The substitution between growing faster or larger and eggs or fry having a higher probability of survival is worth this trade-off.

Movement differences within the reservoir may reflect prey availability and concentrations. Fish that traveled into reservoir sections one or two generally grew at slower rates than bull trout that stayed above section two. These fish traveled greater distances from the riverine habitat to the lower reservoir expending more energy

Diet Analysis

Bull trout diet composition varied between months. Most commonly fish or fish eggs were found during every month except May, when one gopher was ingested. Other items consumed by bull trout included aquatic and terrestrial invertebrates, zooplankton, and amphibians. Bull trout are known opportunistic feeders and with increasing size are able to prey upon larger items. The one mammal (gopher spp.) ingested by a bull trout and a few amphibians that were found, probably do not make up a critical component of a bull trout's diet, but do show that they are occasionally consumed. On the other hand, fish and fish eggs are a critical element of bull trout's diet during the spring and fall.

When separated by fish species there is a clear difference between fish selection during the two seasons. In the spring rainbow trout and fish eggs made up a combined 57% of bull trout diets, during the fall kokanee consisted of 60.2% of the diet and cutthroat trout 34.8%. Other studies have also documented shifts in bull trout diets during the span of a year. At Lake Billy Chinook in Oregon, Beauchamp and Van Tassel documented bull trout greater than 450 mm feeding primarily on kokanee in the autumn and secondarily in winter-spring. Predation on salmonids other than kokanee was more prevalent during winter-spring (2001). We associated

shifts in diet mainly due to distribution of bull trout and distribution of prey species. During the spring, bull trout are located in the upper reservoir and lower fluvial habitat, beginning to migrate upstream. At this time rainbow trout are also in this area moving upstream to spawn. This overlap in spatial distribution makes rainbow trout more susceptible to predation. Fish eggs were also consumed heavily during the spring. Although eggs could not be identified to a species level a number of possible spring spawning species may have been consumed, these include rainbow trout, cutthroat trout, bridgelip sucker *Catostomus columbianus*, and largescale sucker *Catostomus macrocheilus*. Fish eggs are high in nutrients and little energy is expended in capturing these.

During October and November adult bull trout are migrating downstream from spawning locations high in the drainage, concurrently during this time kokanee are spawning in tributaries to the NFC. Kokanee abundance estimates from 2000 to 2004 range from 1,150,222 to 3,919,956 (Stark 2006) making them an abundant prey species. With a large number of kokanee in the upper reservoir and lower NFC river bull trout can take advantage of this prey concentration. Kokanee distribution in the NFC arm and river may affect the movement patterns of bull trout during this time period. Bull trout migrations out of the NFC riverine habitat are slower than those in the LNF, bull trout tend to stay longer during the fall in the NFC arm and riverine habitat. In the LNF 33% of bull trout tagged during the fall moved out of the LNF and into the NFC arm during October and November, presumably to feed on kokanee in this area. The abundant kokanee prey during the fall in the NFC delays the downstream migration of bull trout into the lower reservoir, and draws bull trout from the LNF arm to the NFC.

Limitations of diet analysis are important to consider for this study. Sampling occurred in a relatively small area when considering the overall size of the study site. Diets were solely collected in the upper reservoir near the slack water/flowing water interface and in the river, no farther than one kilometer from the reservoir. Additionally diets during the summer and winter were not collected from the reservoir because of the inability to capture bull trout. In the reservoir, during the summer and winter, bull trout were more scattered throughout the reservoir and difficult to efficiently capture. If sample locations in the reservoir were spread from the dam up to the slack/flowing water interface, we hypothesize we would see an increased number of kokanee in diets, for all seasons, due to their high abundance and distribution throughout the reservoir. Even though the region we did sample was relatively small, the importance of the area is clear, especially during the fall and spring when high concentrations of bull trout occupy this zone.

Population

Trends in densities are highly variable between years within streams. For example mean yearly densities in Vanderbilt Gulch ranged from 0.32/100m² to 5.27/100m² over a three year period. Extreme differences like these are most likely due to the timing and locations of surveys in this area. During the pre-spawn period bull trout could be observed in extremely high densities in a select few, small pools. Up to 70 bull trout may be viewed by snorkeling one deep pool. If a random or marked transect included one of these concentrations of bull trout one year, and then did not the next year the annual density would be dramatically different between the two years, due to chance. The majority of yearly variation is not to the degree of that in Vanderbilt Gulch, and yearly differences do not show a consistent increase or decrease in densities over numerous years.

Key production areas identified by radio-tagged bull trout occupying 5th field HUC's during the spawning time are the NFCR Headwaters, Long Creek, Middle LNF and Upper LNF. The importance of these areas is clear since such a large proportion (59.2% combined) of radio-

tagged bull trout presumably spawned in these locations. Protection of habitat and sustaining connectivity to these locations will assure that bull trout continue to inhabit these areas during the spawning time. It should also be noted that other 5th field HUC's may be just as important to spawning bull trout as the ones mentioned above. Collection of bull trout, to radio tag, nearly exclusively occurred in the upper reservoir in either the LNF or NFC arm, and there may be more of a natural tendency for fish that congregate here, to spawn in on of these areas. We assume a portion of the population inhabits areas where collection did not occur, and may spawn in watershed groups not documented in this study, or at greater frequencies within other HUC 5 watershed groups

The population estimates for adult, pre-spawn, fluvial bull trout increased from 2002 to 2004 and decreased from 2004 to 2005. However, the confidence bounds between the estimates overlap indicating that they are not substantially different between years. Additionally, the population estimates calculated likely represent a minimum estimate because there are areas known to contain pre-spawning fish that we were unable to survey or use in this estimate. These areas were not surveyed due to remoteness of the location and the time required to access them.

We know pre-spawning aggregates of bull trout are not uniformly distributed across the landscape. We determined areas where pre-spawn aggregates occurred based on the presence of radio-tagged bull trout. The total area actually encompassed by each pre-spawning aggregate may be larger than we delineated because radio-tagged bull trout may not have been distributed at the maximum distribution of the aggregate. It is unrealistic to believe we have identified all potential locations where aggregates of pre-spawning bull trout may occur. Therefore, further identification and inclusion of these areas would increase the adult population estimate. To more accurately determine the total population size, additional effort is going to be required to determine bull trout habitat preference during pre-spawn aggregation, the amount and availability of these habitat types and additional areas in the watershed where these habitats are located. Also since population estimates were completed when fish were in the river, before spawning, estimates would not include any alternate year spawning bull trout and would underestimate the true adult migrating population. Bull trout less than 350 mm were also not included in estimates, although mature resident fish may be in this size range and able to reproduce.

Redd Counts

Trends in redd surveys have generally been increasing since 2000. The exception to this is in 2004 when counts were nearly half of those observed in 2003 and 2005. Average stream discharge in the NFC during 2004 for August and September was 40.2 cms, discharge in other years for the same period ranged from 18.9 cms in 2001 to 29.4 cms in 2002. The increased discharge in 2004 may have hampered surveyors ability to detect redds. Another possibility is that with the increased water flow bull trout were able to migrate farther upstream than in other years and constructed redds outside annual monitoring transects. The adult bull trout population estimate in 2004 did not indicate the same 50% drop as the redd count data, supporting our theory of lower detection as the probable cause for the low number of redds.

Redd surveys were conducted on the annual transects as well as additional surveys based on locations of radio-tagged bull trout during the spawning time. Surveys on Orogrande, Slate, and Pollock creeks were completed because of tagged bull trout entering these tributaries for specific years. The yearly counts should continue to be monitored at the index sites to monitor long term bull trout redd trends.

Post Spawn Survival & Repeat/Alternate Spawners

Post spawn survival estimates were similar for all years except in 2001 when estimates were nearly half of other years. The average survival for 2002 to 2005 was 78% and in 2001 was 40%. This is likely due to sample size effects; in other years there were at least 45 spawning fish tagged and only 15 in 2001.

The average estimate of 80% for bull trout exhibiting repeat year spawning is within the range of 66 – 80% documented by Elle et al. (1994) in Rapid River, Idaho. A comparison between years is not feasible due to the erratic number and few radio tags that could be tracked for multiple spawning years. Boundaries on tag size and battery life limited our ability to track the majority of bull trout for the length of time it took to determine spawning frequency.

Movement

This multi-year study documents sub adult and non-spawning bull trout utilizing Dworshak Reservoir throughout the year. During April and May, adult spawning bull trout congregate in the upper reservoir at the flowing/slack-water interfaces. Bull trout then leave the reservoir passing fixed sites primarily during June on the descending limb of the hydrograph, and return starting in September. Bull trout begin to enter spawning tributaries from early July to late August and were found at their furthest upstream location during August and September. Most surviving fish then move downstream and over winter in Dworshak Reservoir. Prior to Dworshak Dam two life forms of bull trout likely existed in the NFC drainage, fluvial and resident. It is not known how far downstream the fluvial form over wintered. Since Dworshak Reservoir was created it now appears that the fluvial form of bull trout are using the reservoir as an over wintering habitat in lieu of the lower 50 miles of their traditional habitat in the lower North Fork Clearwater; exhibiting more of an ad-fluvial type life history.

Other studies, including this one, document the correlation between bull trout movement upstream and the descending limb of the hydrograph (Swanberg 1997). Another factor to include in a reservoir is water level. The operations of Dworshak Dam control water levels throughout the reservoir by either increasing or decreasing water elevation. Near the slack/flowing water interface this fluctuating water level varies where the start of the riverine habitat begins and the slack water ends. This is a rather arbitrary definition since water in the reservoir is still flowing downstream, but at a much reduced rate because of the impoundment. The effect of the reservoir being at full pool is an additional 6.4 km of slow moving reservoir water compared to the low pool elevation where water velocity is greater. Bull trout can move farther upstream near the mouth of the riverine habitat and expend less energy when reservoir water levels are higher. Upstream migrations past fixed sites began to occur when water elevations in the reservoir were greater than 465 m. Peak timing for upstream migrations was near maximum water elevations. Known bull trout cues for migrating upstream include river discharge, temperature, and length of day. It is difficult to assess to what degree reservoir water levels affect movement with so many other factors involved, although higher water levels make the initial 6.4 km of lower river/upper reservoir easier to travel with additional slower moving water.

We feel that the conditions that present the greatest risk of entrainment for bull trout in Dworshak reservoir is a combination of high water discharges and bull trout proximity to the dam. High discharges can occur at any time but are most common during the spring, March – May, during the fall, and during late summer. Bull trout distribution is likely the most important of the two factors as entrainment can occur with any amount of discharge. The increased discharge simply increases the chance of entrainment if fish are near the dam.

Susceptibility to entrainment for adult bull trout during the migration period is low because during the migration period most adult bull trout are in the riverine habitat and those that are in the reservoir are not within section one. From May through July adult spawning bull trout leave the reservoir, and migrate upstream to spawning locations. Alternate year spawning bull trout and juveniles that inhabit the reservoir during this period were primarily found far from Dworshak Dam and had little risk of entrainment. Only 2% (8/395) of fish tracked in the reservoir during this period were found in section one. Outflow from Dworshak Dam during the migration period can be highly variable. In general the water level is rising, but high water discharges can occur due to spring run-off. Although discharges can be high during this period, bull trout spatial distribution infers a low chance of entrainment.

From August through October bull trout are primarily found outside of the reservoir in riverine habitat. Operation of Dworshak Dam does not have an effect on bull trout that are high in the river and tributaries during this period, however sub adult and alternate year spawning bull trout inhabit the reservoir at this time. Spatial distribution during this period also infers a low chance of entrainment. Out of 231 bull trout detected over these months, within the reservoir, only six were located in section one, most bull trout inhabited sections three four and five during this time. On average outflow from Dworshak Dam during August and September is near 10 – 15 kcfs (Figure 42), but spatial distribution of bull trout shows a low probability of entrainment.

From November through April 96.7% of bull trout detections were located within Dworshak Reservoir. Bull trout are most susceptible to entrainment during this time due to their distribution in the reservoir, especially section one. The month with the highest frequency of tagged bull trout inhabiting section one was March (24%), followed by January and February (19% each). Based on spatial distribution alone bull trout are most likely to be entrained from December through April. Mean outflow from Dworshak Dam is variable during this time period. From November through the first part of January the mean ten year outflow is around 2 kcfs, with periodic increases and decreases around this mean. Beginning in January outflow has a general trend of increasing until May, with much fluctuation around the mean (Figure 41). Discharge is greatest during March and April in this period, and bull trout are most at risk of entrainment during March when the greatest percentage of fish were in section one. The combination of high discharge events and distribution of bull trout near the dam makes March a particular vulnerable time for bull trout entrainment.

Out of 706 bull trout implanted with telemetry tags from 2000 to 2006 only two fish were documented being entrained, this is 0.28% of tagged bull trout. One fish was entrained during 2003 sometime between March and 14 May, the other fish was entrained in 2006 between 17 April and 26 April. Both of these fish were detected below the dam after peak water discharges from the project. Discharges ranged from 371 m^3/s to 453 m^3/s and lasted over 40 days. We believe both fish were flushed through the project during high water discharges. These two events strengthen our argument that the combination of high water discharges and an increased number of fish being in the area during March is the time when the bull trout population is most susceptible to entrainment. Currently there is not a total population estimate for bull trout in the reservoir; therefore we can not extrapolate the total numbers of bull trout annually lost due to entrainment.

Most tagged fish were greater than 350 mm TL, and were classified as adult fish, although spatial distribution from limited numbers of sub-adult bull trout <350 mm TL was also evaluated. Sub-adult and alternate year spawners were documented to remain in the reservoir throughout the year; but did not frequently inhabit section one. During the migration and spawning period very few fish were detected within section one. Sub-adult and alternate year spawners inhabit the reservoir more often, yet they were rarely found below Dent Bridge. Based on spatial distribution in the reservoir, their risk of entrainment during the spring and summer is

not of concern. It may be however that when sub-adult or juvenile fish do occupy the forebay area they are more likely to be entrained at lower discharges, because smaller, juvenile fish, have lower critical swimming velocities compared to adult size fish (Mesa et al. 2004).

To gain further details on bull trout entrainment during the winter and spring MAP tags were deployed that recorded depths of bull trout. By analyzing depth use during the winter, when bull trout are most susceptible to entrainment, we could attempt to identify which structures on Dworshak Dam are most likely to entrain fish. Depth distribution of MAP tagged bull trout for both years indicates that fish were not found at the same elevation as the regulating outlets, but depth use did overlap between the bottom and the top of the turbines (Figure 38). The other potential avenue for entrainment is over the spill way, as bull trout were found at the surface, but the spill way is rarely used during the winter when most bull trout are spatially at risk for entrainment. The structures most likely to be responsible for entrainment during the winter and spring are the three turbines. Survival of fish that are entrained is variable. Out of the two documented fish that were entrained one survived and was found moving within the NFC below the dam, and the other fish was a suspected mortality since it did not move for multiple months.

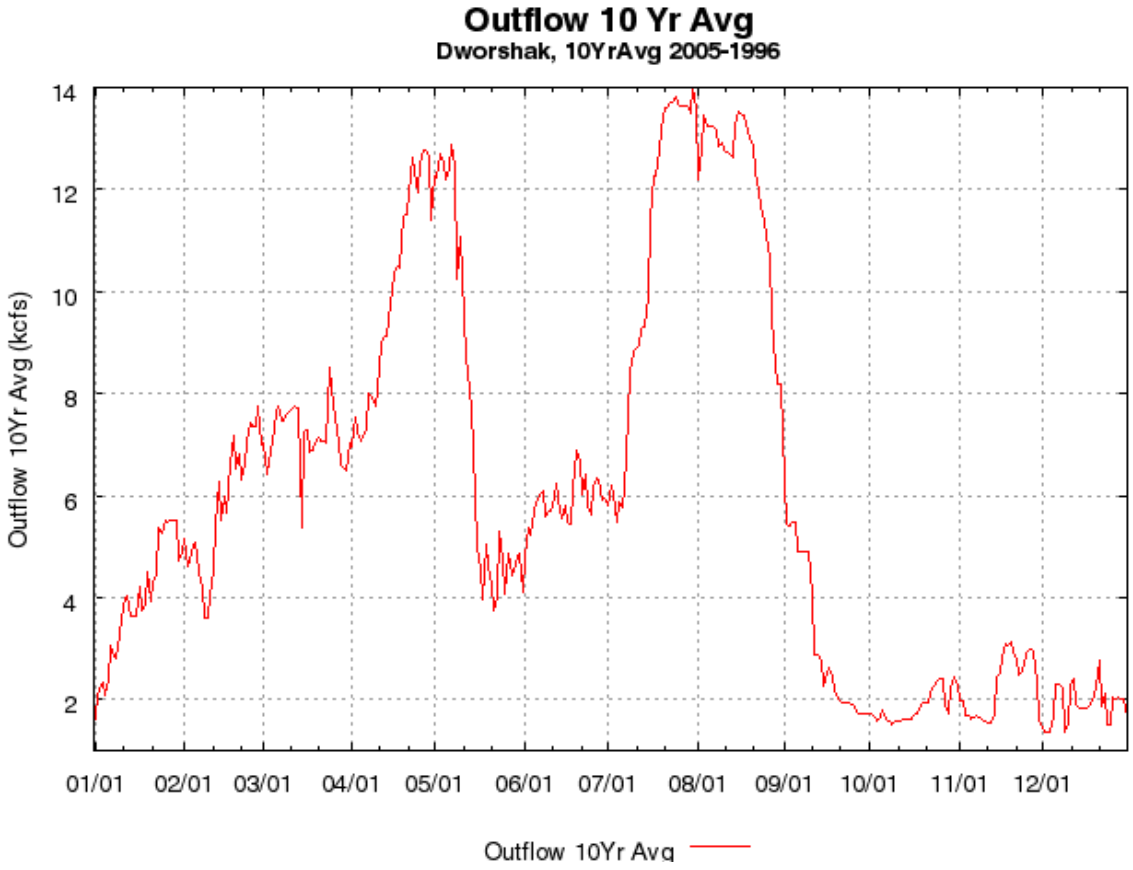

Figure 41. Mean outflow from Dworshak Reservoir from 1995-2005. Graph from DART River Environment Dataset.

We feel patterns in bull trout depth distribution during the winter are closely tied with feeding habits within the reservoir. Bull trout primarily eat kokanee during the fall and winter, as they are the primary piscivorous prey item in Dworshak. Investigation of kokanee depths in 1994 and 1995 by Maiolie and Elam determined night and day depth use of kokanee using hydroacoustic equipment. Their findings from 1995 suggest that during the winter period, in the day fish were mostly located at a depth of 50 - 75 m, with a second group of fish located at 20 – 25 m. At night most kokanee (70% of the distribution) were in a narrow band 10 – 20 m wide. The depth of this band was usually above 15 m in depth except during January when fish were deeper. Findings in 1994 were similar, although depths used were deeper by 10 to 20 m. Diel depth use by bull trout is similar with a strong pattern of most fish staying above 15 m during the night and then ranging from 33 m to the surface during the day. Fish may have ventured farther than 33 m but tag depth was limited to a maximum of 33 m in 2005/2006. During the day bull trout depth range was much broader than at night, and fish often made rapid vertical transitions traveling 10 m in a couple minutes. Bull trout may be pursuing kokanee at these different depths either chasing one group that is changing depths, or switching between groups of fish occupying two depth layers.

The reason for significant differences between the two intervals in mean fish depth is not clear. The MAP transmitters used for each period were slightly different in the maximum depth they could record, and fish were only found at this maximum tag depth during the second interval when bull trout were on average found deeper than in interval one. Transmitter depth accuracy between the two tags does not explain this difference as it was +/- 1.4 m for interval one and +/- 0.68 m for interval two. Also sample sizes were comparable between the two intervals, and observation times of the day were similar. Additional winter tracking would be necessary to determine factors that contribute to yearly differences in mean depths occupied.

Water temperatures during the two years were similar and within two degrees of each other. It may be this slight difference in water surface temperature that accounts for the significant difference of mean temperature between the two tracking intervals.

Other studies have shown that in stream and river systems bull trout movement during the winter is limited (Jakober et. al 1998, Muhlfeld et. al 2003, Hanson and Schriever 2006). In the reservoir, bull trout were found to move extensive distances, up to 218.7 km from November through April. This is a minimum estimate as locations were recorded once every two weeks over the winter. Daily movement was estimated at an average of 16.94 km/day based on continuous tracking for at least two hours. Bull trout within the NFC system not only travel long distances between spawning and over wintering areas, but also during the winter within the reservoir. Fluctuating water levels and temperatures are not inhibiting bull trout movement during this time as they freely move about the reservoir. During other times of the year when sub-adult and alternate year spawning bull trout are in the reservoir, temperature or water levels do not appear to inhibit movement; as radio-tagged bull trout were documented moving throughout the reservoir. Surface water temperature during the summer often exceeds 20º C which is near bull trout lethal limits (Selong et. al 2001), but the reservoir is thermally stratified allowing bull trout to chose temperatures ranging from around 4º C to +20º C (Maiolie and Elam 1996, Maiolie and Elam 1997).

Conclusions

Bull trout movement above Dworshak Dam follow a seasonal pattern with spawning adult fish congregating in the upper reservoir in May. From May through July fish begin migrating into river habitat on an upstream migration to spawning grounds. Fish moved extensive distances traveling up to 237.2 km from tagging locations to spawning areas. Spawning occurs during August through October in tributary streams and near the headwaters of the LNF or NFC mainstem. Upon spawning adfluvial adult fish migrate downriver into Dworshak Reservoir. From November to April fish are located in the reservoir, and are distributed from section one to sections four and five in the upper reservoir. During the winter, project operations are likely to have little effect on bull trout based on their distribution within the reservoir. Entrainment is identified as a risk to bull trout below Dent Bridge in section one, and is most probable to occur during March based on spatial distribution and high discharges from the dam. Minimizing high discharge events near this time would further lessen entrainment chances. We feel even though entrainment was documented in this study (two times in six years), risks to the overall bull trout population are minor. Spatial distribution throughout the year infers that, when in the reservoir, the majority of fish inhabit the area above Dent Bridge.

Sub-adult and alternate year spawning bull trout are found in Dworshak Reservoir throughout the year. Distribution patterns of sub-adult and alternate spawning fish infer that they primarily occupy reservoir sections three, four and five during the summer. Only three percent (2/76) of sub-adult bull trout in the reservoir were located in section one.

Biological characteristics were examined for bull trout above Dworshak Dam as well. Through the duration of this study there was an increasing number of larger fish and older individuals contributing to the population, presumably due to the closure of the bull trout fishery in 1994 and changes in Dworshak operations that reduced bull trout entrainment potential. Based on recapture data growth rates of fish differed based on size classes, with smaller fish growing at greater rates and larger fish at slower rates. Overall the average growth rate for all fish was calculated at 0.109 mm/day. Key prey identified consisted primarily of fish although invertebrates, amphibians, mammals, and zooplankton were identified. During the spring adult bull trout fed primarily on rainbow trout and fish eggs then switched to mainly kokanee, and cutthroat trout in the fall. We attributed this change in diets, between the two seasons, to an overlapping spatial distribution between bull trout and their prey.

Population estimates of pre-spawn, adult bull trout show a general increasing trend since 2002, although confidence intervals overlap for all years. Current estimates are around 1,900 individuals, compared to 1,057 in 2002. Post spawn survival varied little between years, averaging 78%, with the exception of 2001 when survival was estimated at 40%. The low post spawn survival documented in 2001 was likely due to few radio-tagged fish that were documented spawning, resulting in a low sample size.

This study has shed significant light on the population of bull trout utilizing Dworshak Reservoir. Project operations of the dam appear to have little overall effect on the population. We did identify entrainment occurring during the six years but the overall risk of entrainment was very low and we only documented 2 of 706 tagged bull trout being entrained.

RECOMMENDATIONS

1. Avoid high discharges through the dam during the winter, when most adult bull trout are in the reservoir. March is particularly important as it is when the highest numbers of bull trout are distributed nearest the dam, and are at the greatest risk of entrainment.

2. Continue pre-spawning population trends, and develop a methodology to determine population estimates of bull trout in Dworshak Reservoir.

3. Protect critical watersheds where bull trout densities are the highest. These streams include Bostonian, Long, Upper NFC, Vanderbilt Gulch, Niagara and Rocky Run creeks.

4. Conduct annual redd counts on index areas developed by this study.

5. Consider sport fishing regulations that adequately protect bull trout population survival rates.

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PART II: BULL TROUT NORTH FORK CLEARWATER RIVER BELOW DWORSHAK DAM

INTRODUCTION

Bull trout studies conducted in Dworshak Reservoir and the North Fork Clearwater River (NFC) have documented fish being entrained through Dworshak Dam (Schiff and Schriever 2004). After fish were documented being entrained IDFG began studying the bull trout found in the North Fork Clearwater River below Dworshak Dam (NFBD) and the lower Clearwater River (CLW).

OBJECTIVES

1. Obtain basic biological and life history information on bull trout in the North Fork Clearwater River below Dworshak Dam and the Clearwater River.

2. Determine migration patterns of bull trout present in the North Fork Clearwater River below Dworshak Dam

STUDY AREA

The CLW is a seventh order stream located in north-central Idaho. The CLW extends form its confluence with the Snake River, at Lewiston, Idaho, east to its confluence with the South Fork Clearwater River (SFC) at Kooskia, Idaho. Major tributaries to the CLW include the North Fork Clearwater River (NFC) (rkm 64.8) and the SFC (rkm 119.5). In this document, river kilometers are calculated from 0.0 rkm at the Snake and CLW river confluence. The NFC extends east 3.1 km to the base of Dworshak Dam. Dworshak Dam was constructed in 1971 without fish passage facilities, and is a permanent upstream migration barrier. Upstream of Dworshak Dam is Dworshak Reservoir and the remainder of the NFC. Dworshak and the NFC is a seventh order stream with a total drainage area of 739,982 ha. The MFC extends from Kooskia, Idaho (rkm 119.5), and east to the confluence of the Lochsa and Selway rivers (rkm 156.2) at Lowell, Idaho.

METHODS

Tagging

Bull trout were captured by boat electrofishing techniques in the NFBD. Sampling was conducted in the 3.1 km stretch with a three person crew during the nights of 06/29, 06/30 of 2003, 05/20, 06/22, 06/24, and 06/30 of 2004, and 07/08, 07/09 of 2005. All fish were handled and tagged as described in Part I of this report.

Tracking and Distribution

IDFG and University of Idaho coordinated tracking efforts in 2003 - 2005. Automobiles and fixed-wing aircraft were utilized on a monthly basis to monitor fish in the Lochsa, MFC, NFBD, and CLW rivers. In addition to mobile tracking we utilized three established stationary radio-receiving sites, maintained and operated by the University of Idaho. The Lochsa fixed site was located at rkm 156.2, at Lowell, Idaho. The South Fork fixed site was located at rkm 6.2 on the SFC at Stites, Idaho. The Lewiston fixed site was located at rkm 6.7, approximately 3.0 km upstream of Lewiston, Idaho (Figure 42).

RESULTS

Tagging

Twenty bull trout were captured and implanted with radio tags over the three years (Figure 43). During 2003 eight fish were tagged, seven in 2004, and five in 2005. Total length of all bull trout captured within the NFBD ranged from 310 mm to 664 mm (mean 475.7 mm) and weight ranged from 300 g to 4080 g (mean 1374.8 g) (Figure 44) (Figure 45). Bull trout captured in the NFBD have a length weight relationship of log weight (g) = 3.0435 log total length (mm) – 5.058 (mm) (Figure 46).Two fish in all the years were recaptures; one was recaptured two days after being tagged in the same area, the other fish that was recaptured in the NFBD was radio tagged thirteen days earlier in the Lochsa River in a concurrent study.

Maturity was determined in 16 fish with 15/16 (94%) being mature. Sex was also determined in 15 fish that resulted in a sex ratio of 1.17 males per female. There were seven males and six females.

Diets were collected in 2003 on 29 and 30 June from five bull trout captured NFBD. Samples consisted entirely of fish or fish eggs (Figure 47).

Migration

All bull trout radio-tagged in the NFBD were detected after being released. Two fish were not included in migration analysis due to mortality or lack of detections. Fish 148.48.008 was illegally harvested within two months after tagging and the angler turned in the transmitter. It is unknown the exact date the fish was captured and detections after August occurred while the transmitter was at Dworshak National Fish Hatchery prior to being deactivated. Fish 149.34.119 was located only one time after being tagged near its capture location.

Nine fish remained in the vicinity of their tagging locations, only migrating a mean distance of 3.3 km (range = 1.3 – 5.7 km). This group of tagged bull trout stayed in the NFBD or within 5.0 km of the confluence with the CLW (Figure 48). The remaining nine fish were detected migrating farther than 5 km from the confluence of the CLW and NFBD (Figure 50). This group had a mean total migration distance of 83.3 km (range = 6.8 – 371.6 km). Five fish, within this group, migrated greater than 20 km; three moved upstream into the Lochsa River, one upstream near Lawyer Creek, and one downstream 20 km.

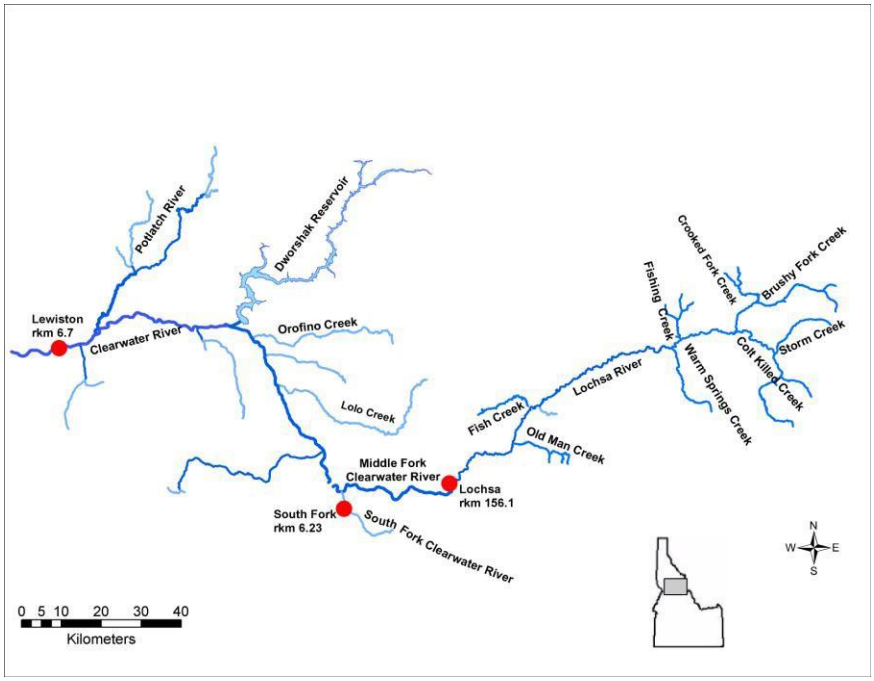

Figure 42. Overview map of the Clearwater, South Fork Clearwater, and Lochsa River drainages including major tributaries. Fixed telemetry site locations are indicated by a solid circle, they are located at the following rkm: Lewiston 6.7 (CWR), Stites 6.23 (SFC) and Lochsa 156.1 (MFC).

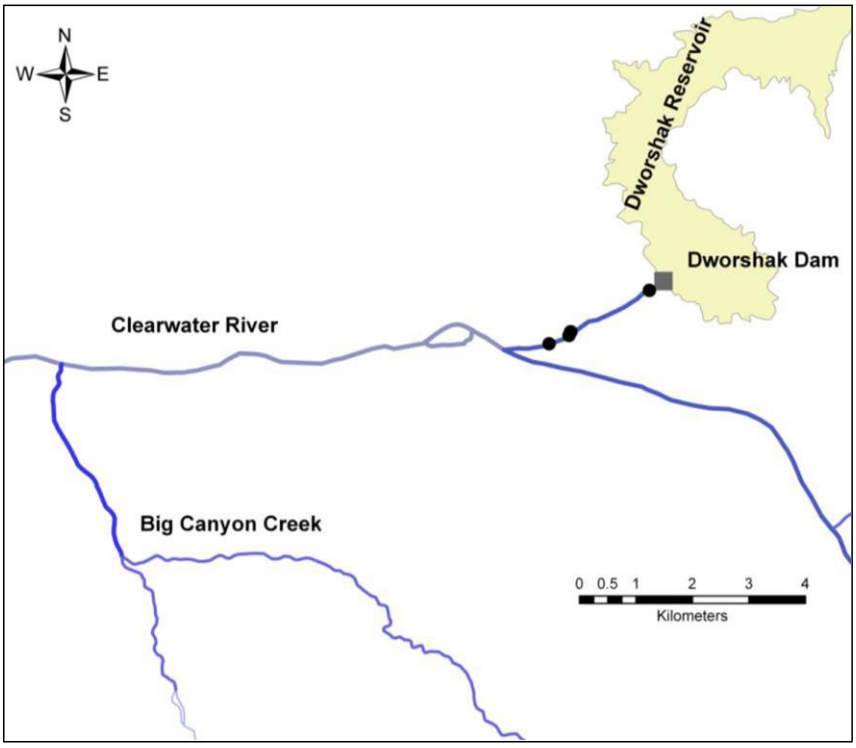

Figure 43. Capture locations of bull trout in the North Fork Clearwater River, below Dworshak Dam, 2003 -2005.

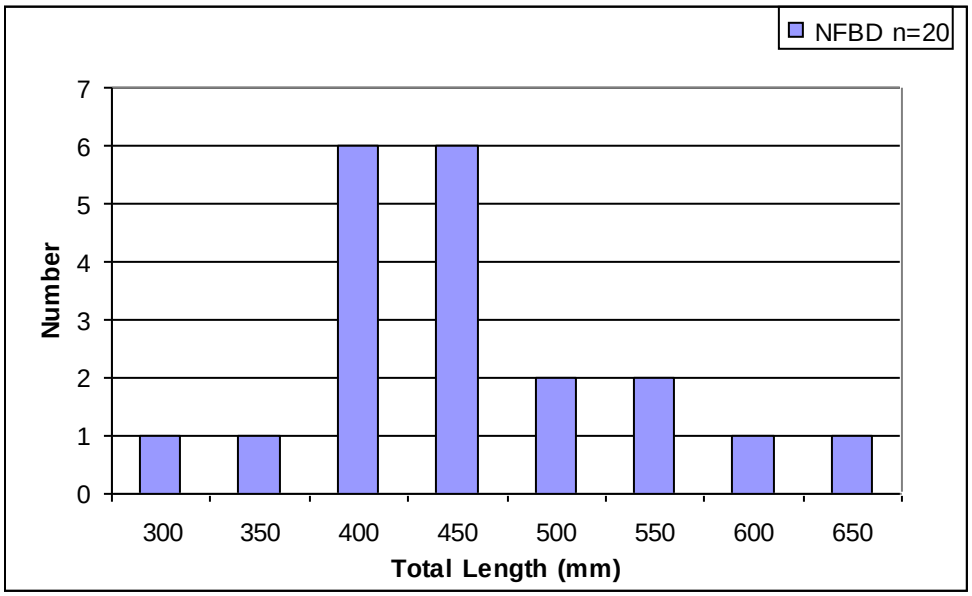

Figure 44. Total length classes of bull trout captured NFBD, 2003-2005.

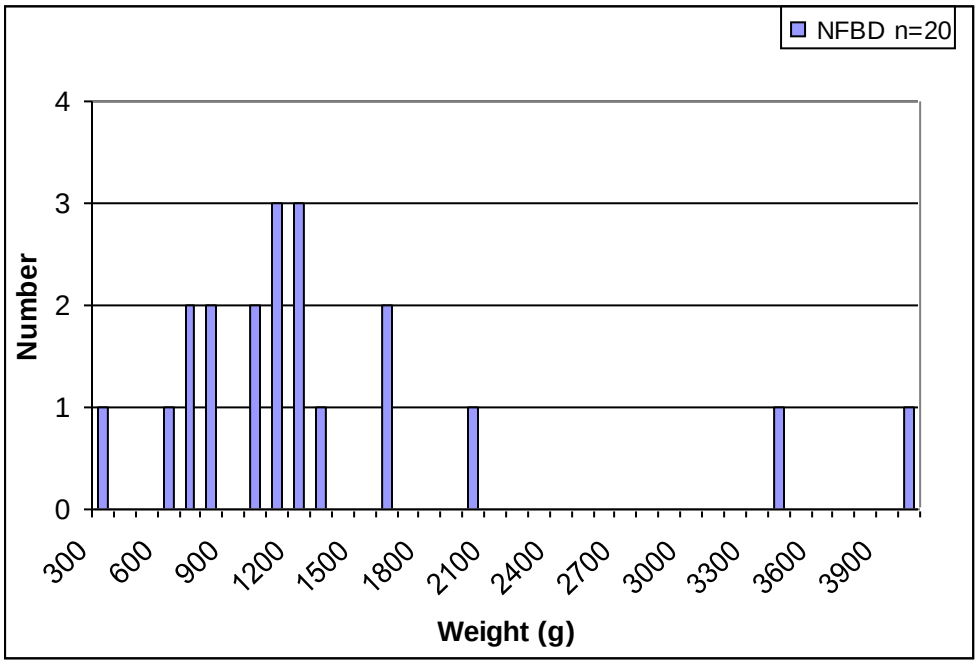

Figure 45. Weight classes of bull trout captured NFBD, 2003-2005.

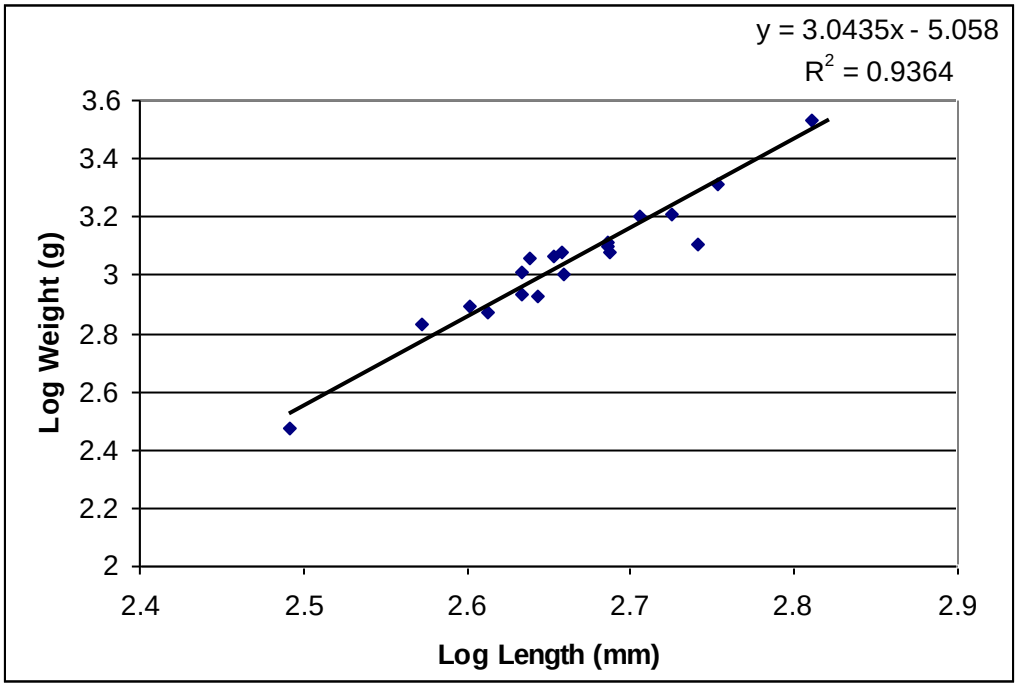

Figure 46. Length-weight relationship of bull trout captured NFBD, 2003-2005.

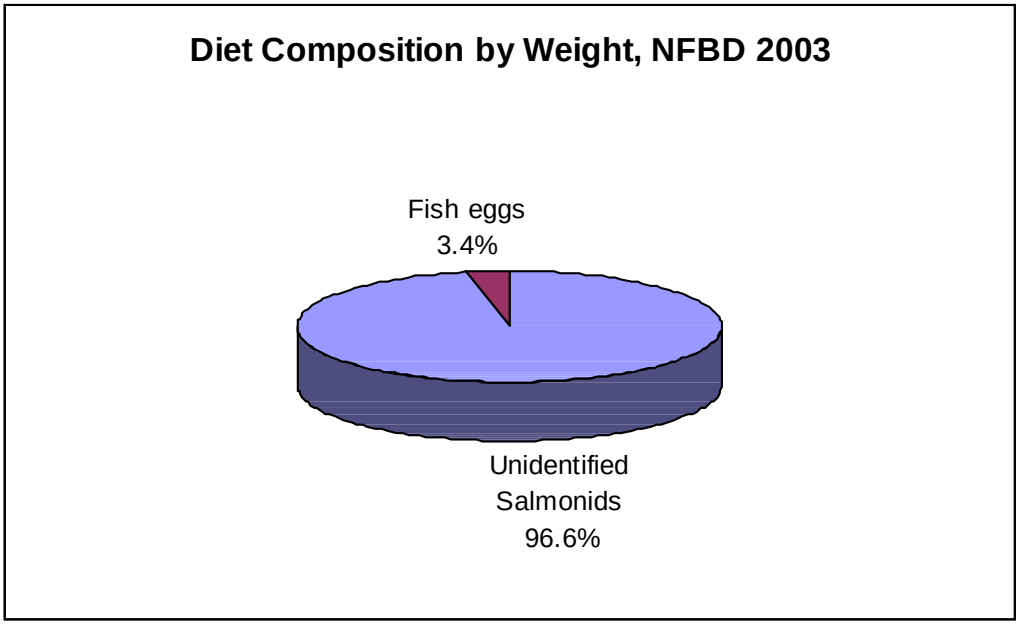

Figure 47. Results of diet analysis from five bull trout captured NFBD during 2003.

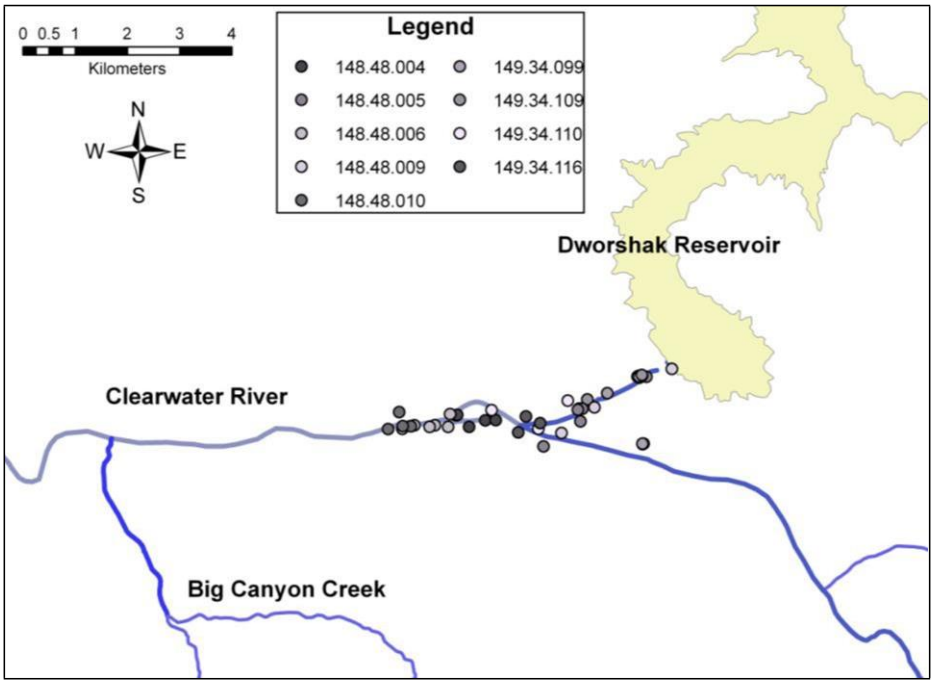

Figure 48. Radio-tagged fish within 5 km of NFBD, 2003-2005.

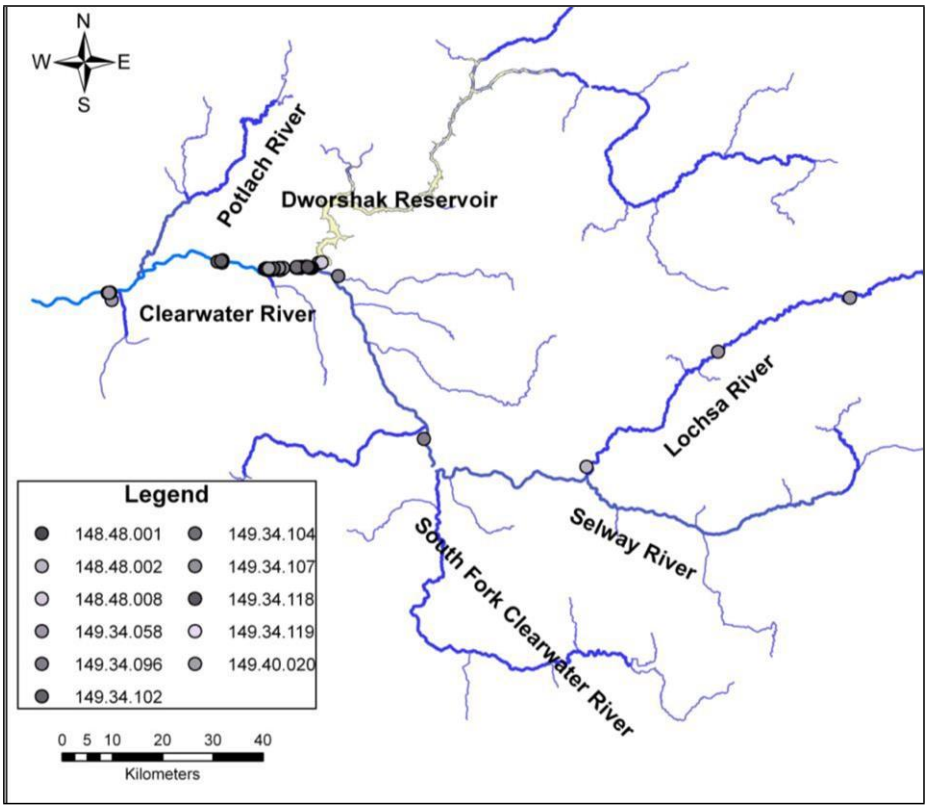

Figure 49. Radio-tagged fish venturing farther than 5 km from NFBD, 2003-2005.

Radio-tagged bull trout 149.34.058 migrated 371.6 km between 17 August 2005 and 19 December 2005. This fish migrated from the NFBD to the Lochsa River, 3.5 km below Warm Springs Creek, and then down into the CLW near Potlatch River (Figure 51). It is unknown if this fish spawned, but it was located during the spawning time in the upper Lochsa River, where known spawning of bull trout occurs. This fish was documented moving farther than all other fish radio-tagged in the NFBD.

Seventy percent (143/203) of all radio-tagged bull trout detections were in the NFBD or within 5 km of the confluence with the Clearwater River. The remaining detections were distributed as follows; 20% (41/203) greater than 5 km downstream from the confluence with the NFBD in the CLW, 0.49% (1/203) between 5 km upstream from the confluence with the NFBD to the Lochsa River, and 9% (18/203) in the Lochsa River.

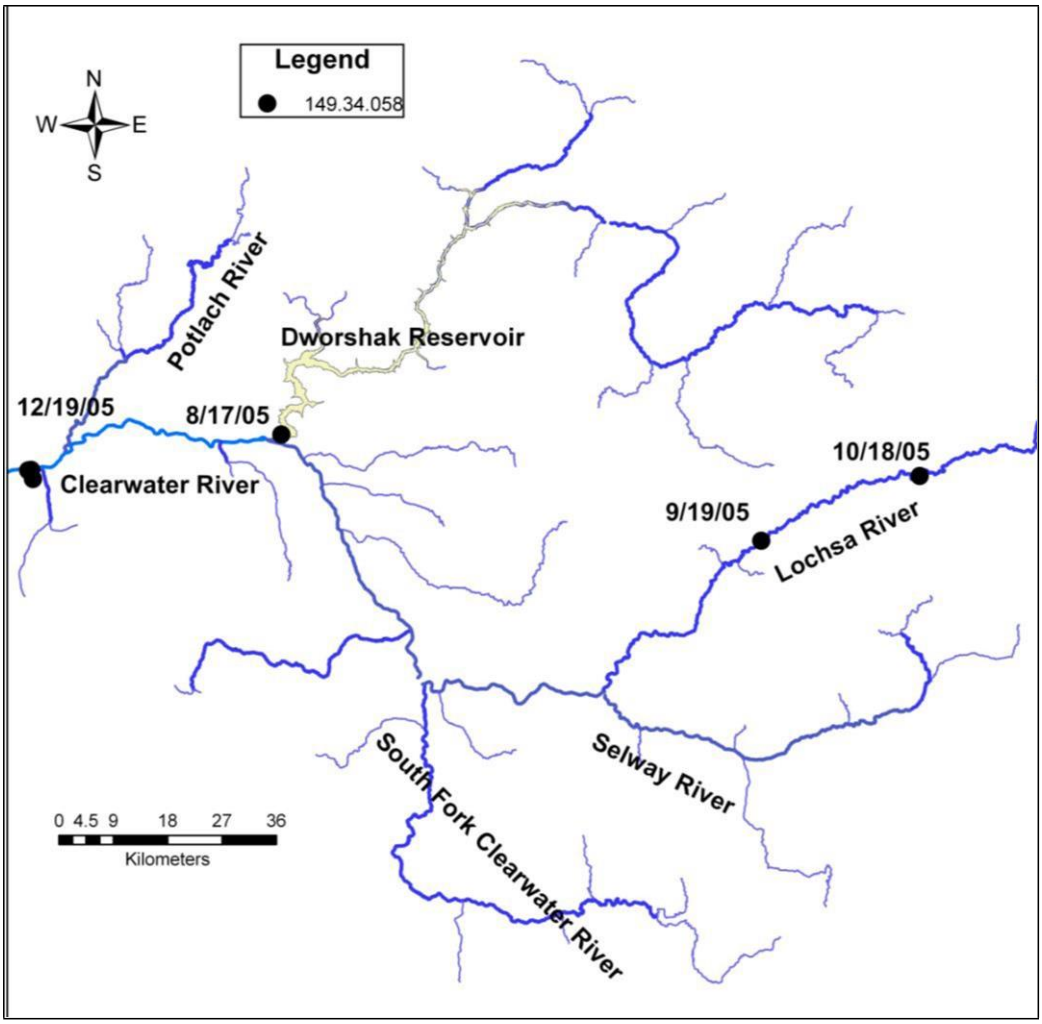

Figure 50. Migration of bull trout 149.34.058 within the NFBD, CLW and Lochsa Rivers.

DISCUSSION

Most bull trout tagged in the NFBD remained in the area around the NFC/CLW confluence for at least part of the year. Half of the tagged fish were never found farther than 5 km from the NFBD and most of these were known mature individuals were detected in an area with no known spawning habitat. It is not known if these tagged bull trout attempted to spawn or not. The three fish that migrated into the Lochsa River were all mature fish, and in the Lochsa drainage during the spawning time period. Although few detections were recorded while these bull trout were in this area there is a high probability that these fish were making a spawning migration. The Lochsa drainage is known to contain multiple tributaries that have local bull trout populations and an area that bull trout utilize for spawning (Schiff et al. 2005, Hanson and Schriever 2006, US Fish and Wildlife Service, Chapter 16 2002).

A concurrent study radio tagging bull trout in the Lochsa River demonstrated that, in addition to fish tagged NFBD moving into the Lochsa, a bull trout tagged in the Lochsa River moved downstream into the NFBD (Schiff et al. 2005). The particular fish in this study was tagged in the Lochsa River and moved downstream into the lower CLW and NFBD. One possible reason for this fish having an unusual migration could be that it was previously entrained through Dworshak Dam and was attempting to return to its natal stream. Another possibility could be that it was returning to the lower reaches of the CLW to forage.

In many instances fish would be found in the same small area for three or four months and then suddenly not found again. It is possible these fish moved outside of the study area, were harvested by anglers or other predators, or radio tag battery failed.

Difficulties associated with this study are that there are gaps in the tracking. These may be due to lack of aerial tracking, car tracking being less efficient, the inability to track the entire system every time from the CLW to the Lochsa River, or if bull trout moved into the Selway River or any minor tributary of the CLW or Lochsa Rivers. Covering all the possible locations radio-tagged fish could move was not feasible due to the number of river kilometers and tributaries linked with the study area and employee work effort concentrated on projects above Dworshak Dam. Additional tracking effort and radio fixed sites would be required to more effectively cover the area.

Increasing the number of tagged bull trout below Dworshak Dam would help determine migration patterns and life history characteristics of bull trout in the NFBD and CLW Rivers. Although this study sheds some light on bull trout movement below the dam, additional numbers of transmitters are necessary to assist in identifying unknown areas mature bull trout are using to reproduce. Documenting if fish actively attempt to or successfully construct redds in the mainstem Clearwater River or NFBD should be a high priority.

This and previous investigations have shown that mature bull trout radio-tagged in the Lochsa River and NFBD are known to travel between the Clearwater River, North Fork Clearwater River, and Lochsa River (Schiff et al. 2005, Hanson and Schriever 2006). The summer operation of Dworshak Dam is generally operated to benefit salmonid out-migrants by increasing flows and decreasing water temperatures. The operations have altered the natural temperature regime by reducing temperatures in the Lower Clearwater River. These cool water releases have the potential to disrupt natural cues for bull trout to migrate to spawning locations. It is unknown how the thermal changes from Dworshak Dam affect spawning migrations of bull trout in the CLW, NFBD, and Lochsa Rivers.

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APPENDICIES

Appendix A; Table 1. Bull Trout Redd Survey Site Descriptors.

North Fork Clearwater

Boundary Creek and Upper North Fork Clearwater (Graves Cr.)

DIRECTIONS: Take USFS road #250 north up Long Creek until you reach USFS road #5428 to the west. Road #5428 is gated, park the pickup there and unload the motorcycles. Proceed up road #5428 approximately 7.5 miles and trail #94 will drop off to the west. Proceed down trail #94, about 200-300 yards down trail #94 it will fork, stay to the right (the fork is before you begin the steep decent). Approximately 1.5 miles down the trail you will approach a saddle with large open/brush fields and the trail will start to fade in and out of existence, park the motorcycles here and mark their location with a GPS unit so you can find them on your return. From this point you will be able to see where the Boundary Creek drainage comes in from the east and dumps into the upper North Fork Clearwater River (flowing to the south). From here you hike down a little creek to the north about a quarter mile until you come to an old trail, take the trail to the west (left) about a half mile until you reach a sharp ridge that will take you directly to the confluence of the upper NF and Boundary Creek. See map of area with route indicated below.

SPECIAL REQUIREMENTS: Special Use Permit required from USFS to ride motorbikes on road #5428. Technical trail riding skills with motorcycle. Detailed map of area. Best to send two people and have one do Boundry Creek and the other do Upper NFC.

AREA TO BE SURVEYED: Boundry Creek – From mouth upstream about 1 mile. Upper North Fork (Graves Cr.) – From mouth of Boundry Creek upstream about 1 mile.

Goose Creek

DIRECTIONS: Take USFS road #295 east to the mouth of Goose Creek.
SPECIAL REQUIREMENTS: None.
AREA TO BE SURVEYED: From the mouth of Goose Creek upstream to the barrier, approximately 4 miles. Barrier at GPS coordinates N: 46.53.26.9, W: 114.57.40.0. Below Goose Creek suitable spawning gravels are sparse. Not productive to complete.

Lake Creek

DIRECTIONS: Take USFS road #295 east to the mouth of Goose Creek.
SPECIAL REQUIREMENTS: None
AREA TO BE SURVEYED: From the mouth of Goose Creek upstream to the mouth of Jap Creek, approximately 3-3.5 miles. Follow Jap Creek to trail on north side of Lake Creek, return to trailhead via this trail.

Long Creek

DIRECTIONS: Take USFS road #250 to where it crosses over Slate Creek.
SPECIAL REQUIREMENTS: None.
AREA TO BE SURVEYED: From the mouth of Slate Creek upstream approximately 2 miles. Survey at same time as Slate Creek.

Appendix A, Table 1, Continued

Slate Creek
DIRECTIONS: Take USFS road #250 to where it crosses over Slate Creek.
SPECIAL REQUIREMENTS: None
AREA TO BE SURVEYED: From the mouth of Slate Creek upstream to the culvert under road #250 (about 200 meters). Survey at same time as Long Creek.

Vanderbilt Gulch
DIRECTIONS: Take USFS road #250 to the Cedars Campground. Park the pickup there and unload the motorcycle. Take the motorcycle up trail #373 paralleling the North Fork Clearwater going upstream approximately 5 or 5.5 miles to where the trail crosses the North Fork. Cross the North Fork and continue up trail #379 which takes you upstream on Vanderbilt Gulch about 1.5 miles to where the terrain starts to open up and the creek runs through a meadow (where Chamberlain Creek dumps in from the southwest). Park the motorcycle off the trail and hike down to Vanderbilt Gulch/Chamberlain Creek confluence.
SPECIAL REQUIREMENTS: Technical trail riding skills with motorcycle, including river crossing.
AREA TO BE SURVEYED: From the mouth of Chamberlain Creek upstream approximately2.5 miles to the mouth of Fall Creek.

Quartz Creek
DIRECTIONS: Take USFS road #247 to the mouth of Quartz Creek.
SPECIAL REQUIREMENTS: None
AREA TO BE SURVEYED: From the Mouth of Quartz Creek upstream approximately 1 mile to the barrier (huge landslide).

Skull Creek
DIRECTIONS: Take USFS road #247 to the mouth of Skull Creek, turn northeast onto USFS road #252, continue up road #252 until you reach the outfitters camp (about 7 or 8 miles) and park the pickup. At the outfitters camp go north on trail #288 down to Skull Creek (about ¾ mile). Cross Skull Creek and continue northeast up trail #286 upstream on Skull Creek about ¾ mile until you reach the mouth of Roaring Creek. FYI trail #286 continues up Roaring Creek not Skull Creek as the USFS map indicates.
SPECIAL REQUIREMENTS: None
AREA TO BE SURVEYED: From the mouth of Roaring Creek upstream approximately 2 miles to the barrier (large rock/log jam) near the mouth of Copper Creek. Barrier GPS coordinates N: 46.53.18.9, W: 115.19.33.5.

Isabella Creek
DIRECTIONS: Take USFS road #700 upstream on Isabella Creek to the mouth of Dog Creek.
SPECIAL REQUIREMENTS: None
AREA TO BE SURVEYED: From the mouth of Dog Creek upstream approximately 2.5 miles to the believed migration barrier (log jam). GPS coordinates of the barrier are N: 46.53.35.4, W: 115.35.37.1

Appendix A, Table 1, Continued

Little North Fork Clearwater

Upper Little North Fork
DIRECTIONS: Take USFS road #760 to the bridge over Little Lost Lake Creek, hike down Little Lost Lake Creek about 250 meters to where it dumps into the Little North Fork.
SPECIAL REQUIREMENTS: None.
AREA TO BE SURVEYED: From the mouth of Little Lost Lake Creek upstream about 3 miles, to a point approximately 1 mile above the road crossing on the Little North Fork.

Little North Fork/Lost Lake Creek (301 campground through Lost Lake Creek)
DIRECTIONS: Take USFS road #301 to the campground where the 301 crosses the Little North Fork.
SPECIAL REQUIREMENTS: None
AREA TO BE SURVEYED: From the 301 bridge upstream about 4.1 miles to the mouth of Lost Lake Creek, then up Lost Lake Creek about 1 mile.

Little Lost Lake Creek
DIRECTIONS: Take USFS road #760 to the bridge over Little Lost Lake Creek, hike down Little Lost Lake Creek about 250 meters to where it dumps into the Little North Fork.
SPECIAL REQUIREMENTS: None
AREA TO BE SURVEYED: From the mouth upstream about 2 miles.

Lund Creek
DIRECTIONS: Take USFS road #760 to the mouth of Lund Creek.
SPECIAL REQUIREMENTS: None
AREA TO BE SURVEYED: From the mouth upstream about 1.62 miles to the migration barrier (large cliff and waterfall 15-20 feet high) at GPS coordinates: N 47.03.13.2 W 115.54.20.2.

Rocky Run
DIRECTIONS: Take USFS road #1268 to where it crosses the Little North Fork, and have someone drop you off. Then hike upstream on the Little North Fork to the mouth of Rocky Run.
SPECIAL REQUIREMENTS: Operate motorcycle on dirt road.
AREA TO BE SURVEYED: From the mouth upstream about 2.9 miles to the barrier (rock and waterfall 6 foot and 8 foot consecutive), about 700 meters above road #787 crossing.

Rutledge Creek
DIRECTIONS: Take USFS road #28 to the Trail 50 trailhead. Unload the motorcycle at the trailhead and take trail 50 east about 3 miles to where it crosses Rutledge Creek.
SPECIAL REQUIREMENTS: Operate motorcycle on single track trail.
AREA TO BE SURVEYED: From the trail 50 crossing upstream about 1.5 miles to where the road crosses Rutledge Creek.

Appendix A, Table 1, Continued

Butte Creek

DIRECTIONS: Take USFS road #28 to the Trail 50 trailhead. Unload the motorcycle at the trailhead and take trail 50 east about 6.25 Miles until you see a sign saying Butte Creek pointing to the south. Park the motorcycle and hike down to the Little North Fork, follow the LNF downstream to the mouth of Butte Creek.

SPECIAL REQUIREMENTS: Operate motorcycle on single track trail.

AREA TO BE SURVEYED: From the mouth of Butte Creek upstream about 2 miles to a large fork, proceed about 200 meters up each fork.

Appendix A; Table 2. Rainbow, cutthroat, and bull trout densities observed in snorkel transects, 2002-2005.

Year	Stream	Transect	Area (m^2)	Rainbow Trout			Cutthroat Trout			Bull Trout		
				<305 mm	>305 mm	Total	<305 mm	>305 mm	Total	<350 mm	>350 mm	Total
2002	Little North Fork Clearwater	129-6-A	1317	0.08	0.00	0.08	1.29	0.00	1.29	0.00	0.15	0.15
2002	Little North Fork Clearwater	129-6-B	1309	1.07	0.08	1.15	0.46	0.08	0.53	0.00	0.00	0.00
2002	Little North Fork Clearwater	129-6-A	1331	0.00	0.00	0.00	3.53	0.30	3.83	0.08	0.23	0.30
2002	Little North Fork Clearwater	129-6-B	1485	0.34	0.07	0.40	1.55	0.00	1.55	0.07	0.00	0.07
2002	Little North Fork Clearwater	142-25-A	1498	0.13	0.00	0.13	1.54	0.07	1.60	0.07	0.00	0.07
2002	Little North Fork Clearwater	142-25-B	997	0.20	0.00	0.20	1.10	0.00	1.10	0.30	0.20	0.50
2002	Little North Fork Clearwater	151-25-A	1526	0.07	0.07	0.13	0.72	0.39	1.11	0.00	0.07	0.07
2002	Little North Fork Clearwater	151-25-B	1272	0.00	0.00	0.00	0.71	0.39	1.10	0.08	0.31	0.39
2002	Little North Fork Clearwater	13-24-A	1335	0.07	0.00	0.07	1.35	0.15	1.50	0.00	0.07	0.07
2002	Little North Fork Clearwater	13-24-B	1136	0.53	0.00	0.53	0.70	0.00	0.70	0.00	0.00	0.00
2002	Little North Fork Clearwater	67-7-A	1650	0.06	0.00	0.06	1.33	0.06	1.39	0.06	0.12	0.18
2002	Little North Fork Clearwater	67-7-B	1602	0.25	0.00	0.25	2.56	0.00	2.56	0.00	0.00	0.00
2002	Little North Fork Clearwater	13-25-A	1417	0.00	0.00	0.00	1.76	0.07	1.84	0.07	0.14	0.21
2002	Little North Fork Clearwater	13-25-B	867	0.58	0.12	0.69	3.92	0.23	4.15	0.46	0.00	0.46
2002	Little North Fork Clearwater	140-25-A	1250	0.72	0.00	0.72	0.40	0.00	0.40	0.16	0.32	0.48
2002	Little North Fork Clearwater	140-25-B	1183	0.08	0.00	0.08	3.30	0.17	3.47	0.00	0.00	0.00
2002	Little North Fork Clearwater	75-7-A	889	0.22	0.00	0.22	2.47	0.00	2.47	0.34	0.22	0.56
2002	Little North Fork Clearwater	75-7-B	790	0.00	0.00	0.00	3.42	0.00	3.42	0.38	0.25	0.63
2002	Little North Fork Clearwater	137-25-A	980	0.31	0.00	0.31	1.12	0.10	1.22	0.41	0.10	0.51
2002	Little North Fork Clearwater	137-25-B	923	0.00	0.00	0.00	1.62	0.00	1.62	0.43	0.00	0.43
2002	Little North Fork Clearwater	139-25-A	1246	0.00	0.00	0.00	0.80	0.00	0.80	0.24	0.08	0.32
2002	Little North Fork Clearwater	139-25-B	1102	0.09	0.00	0.09	0.54	0.00	0.54	0.00	0.09	0.09
2002	Little North Fork Clearwater	10-25-A	1604	0.69	0.00	0.69	5.74	0.31	6.05	0.12	0.12	0.25
2002	Little North Fork Clearwater	10-25-B	1509	1.19	0.00	1.19	1.79	0.07	1.86	0.00	0.00	0.00
2002	Little North Fork Clearwater	141-25-A	1598	0.25	0.00	0.25	1.94	0.06	2.00	0.06	0.06	0.13
2002	Little North Fork Clearwater	141-25-B	2684	0.04	0.00	0.04	0.67	0.00	0.67	0.00	0.00	0.00
2002	Little North Fork Clearwater	4-25-A	1459	0.89	0.00	0.89	1.85	0.21	2.06	0.14	0.00	0.14

Appendix A, Table 2, Continued

	Stream	Transect	Area (m^2)	Rainbow Trout <305 mm	Rainbow Trout >305 mm	Rainbow Trout Total	Cutthroat Trout <305 mm	Cutthroat Trout >305 mm	Cutthroat Trout Total	Bull Trout <350 mm	Bull Trout >350 mm	Bull Trout Total
2002	Little North Fork Clearwater	4-25-B	1719	0.17	0.06	0.23	2.97	0.06	3.02	0.00	0.00	0.00
2002	Little North Fork Clearwater	22-22-A	750	0.00	0.00	0.00	2.40	0.00	2.40	0.53	0.27	0.80
2002	Little North Fork Clearwater	22-22-B	909	0.11	0.00	0.11	1.98	0.00	1.98	0.22	0.55	0.77
2002	Little North Fork Clearwater	7-25-A/13-23-A	714	0.00	0.00	0.00	1.40	0.00	1.40	0.14	1.54	1.68
2002	Little North Fork Clearwater	7-25-B/13-23-B	845	0.00	0.00	0.00	3.08	0.12	3.20	0.12	0.24	0.36
2002	Little North Fork Clearwater	7-25-C/13-23-C	714	0.00	0.00	0.00	3.92	0.00	3.92	0.00	0.00	0.00
2002	Skull Creek	113-6-A	1159	0.60	0.00	0.60	2.59	0.09	2.67	0.52	0.09	0.60
2002	Skull Creek	113-6-B	1968	0.97	0.00	0.97	0.66	0.05	0.71	0.05	0.00	0.05
2002	Skull Creek	122-6-A	1247	1.20	0.00	1.20	5.77	0.32	6.09	0.08	0.24	0.32
2002	Skull Creek	122-6-B	1262	1.11	0.00	1.11	3.72	0.55	4.28	0.08	0.08	0.16
2002	Long Creek	148-25-A	667	0.00	0.00	0.00	0.90	0.00	0.90	0.30	0.00	0.30
2002	Long Creek	148-25-B	848	0.00	0.00	0.00	0.71	0.00	0.71	0.24	0.00	0.24
2002	Quartz Creek	2-24-A	790	6.08	0.00	6.08	5.70	0.13	5.83	0.00	0.25	0.25
2002	Quartz Creek	2-24-B	1050	2.09	0.00	2.09	6.76	0.19	6.95	0.00	0.10	0.10
2002	Moose Creek	4-24-A	620	0.48	0.00	0.48	1.94	0.48	2.42	0.00	0.00	0.00
2002	Moose Creek	4-24-B	605	0.50	0.00	0.50	1.65	0.33	1.99	0.00	0.00	0.00
2002	Swamp Creek	154-25-A	622	0.96	0.00	0.96	0.32	0.32	0.64	0.00	0.16	0.16
2002	Swamp Creek	154-25-B	722	0.14	0.00	0.14	0.55	0.83	1.38	0.00	0.00	0.00
2002	Kelly Creek	1-24-A	2413	0.00	0.00	0.00	0.50	0.66	1.16	0.00	0.00	0.00
2002	Kelly Creek	1-24-B	2601	0.00	0.00	0.00	0.00	0.12	0.12	0.00	0.00	0.00
2002	Kelly Creek	131-6-A	4099	0.00	0.00	0.00	0.05	0.66	0.71	0.00	0.02	0.02
2002	Kelly Creek	131-6-B	2592	0.00	0.00	0.00	0.15	0.31	0.46	0.00	0.00	0.00
2002	NF Black Canyon	117-6-A	2567	0.04	0.04	0.08	0.70	0.39	1.09	0.04	0.08	0.12
2002	NF Black Canyon	117-6-B	2411	0.00	0.00	0.00	0.66	0.08	0.75	0.00	0.00	0.00
2002	NF Black Canyon	119-6-A	1722	0.75	0.06	0.81	0.64	0.41	1.05	0.12	0.06	0.17
2002	NF Black Canyon	119-6-B	1233	1.22	0.08	1.30	0.49	0.49	0.97	0.00	0.00	0.00
2002	Isabella Creek	145-25A	1020	3.14	0.00	3.14	2.16	0.20	2.35	0.00	0.78	0.78

Appendix A, Table 2, Continued

Year	Stream	Transect	Area (m^2)	Rainbow Trout			Cutthroat Trout			Bull Trout		
				<305 mm	>305 mm	Total	<305 mm	>305 mm	Total	<350 mm	>350 mm	Total
2002	Isabella Creek	145-25B	900	1.33	0.00	1.33	4.33	0.00	4.33	0.00	0.11	0.11
2002	Isabella Creek	??A	1067	0.28	0.00	0.28	0.66	0.09	0.75	0.09	0.19	0.28
2002	Isabella Creek	??B	1067	0.28	0.00	0.28	1.59	0.00	1.59	0.00	0.00	0.00
2003	Beaver Creek	37-24	983	1.53	0.00	1.53	1.83	0.00	1.83	0.10	0.10	0.20
2003	Beaver Creek	41-21 / 8-20	751	3.66	0.00	3.66	0.71	0.40	1.11	0.00	0.27	0.27
2003	Beaver Creek	Random 1.9	1107	0.81	0.00	0.81	3.36	0.09	3.45	0.00	0.00	0.00
2003	Bostonia Creek	39-20	646	0.00	0.00	0.00	1.02	0.00	1.02	0.46	0.15	0.62
2003	Bostonia Creek	Random BSA 3.3	265	0.00	0.00	0.00	1.12	0.00	1.12	0.75	0.38	1.13
2003	Niagara Gulch	46-21	307	0.00	0.00	0.00	0.92	0.00	0.92	0.98	0.33	1.30
2003	Niagara Gulch	Random CDA 0.1	425	0.00	0.00	0.00	0.51	0.00	0.51	1.88	0.00	1.88
2003	Niagara Gulch	Random CDA 1.1	470	0.00	0.00	0.00	1.63	0.00	1.63	0.00	0.00	0.00
2003	Collins Creek	Random CLS 4.3	1020	3.25	0.20	3.45	7.53	0.20	7.72	0.00	0.00	0.00
2003	Floodwood Creek	35-24	1233	0.81	0.08	0.89	3.86	0.00	3.86	0.00	0.08	0.08
2003	Floodwood Creek	39-24	767	0.20	0.00	0.20	4.17	0.39	4.56	0.00	0.00	0.00
2003	Floodwood Creek	6-24	1312	0.00	0.00	0.00	1.73	0.23	1.96	0.00	0.15	0.15
2003	Floodwood Creek	7-24	1100	0.20	0.00	0.20	3.97	0.18	4.15	0.00	0.09	0.09
2003	Floodwood Creek	Random FLD 10.8	1246	0.10	0.00	0.10	1.42	0.08	1.50	0.08	0.00	0.08
2003	Foehl Creek	40-20	733	3.46	0.55	4.00	1.63	0.27	1.90	0.00	0.27	0.27
2003	Glover Creek	21-24	640	0.20	0.00	0.20	3.66	0.00	3.66	0.00	0.16	0.16
2003	Goose Creek	48-20	910	0.10	0.00	0.10	1.12	0.00	1.12	0.44	0.22	0.66
2003	Isabella Creek	17-20	996	0.31	0.00	0.31	8.14	0.00	8.14	0.00	0.10	0.10
2003	Isabella Creek	18-20	806	1.53	0.12	1.65	4.58	0.37	4.95	0.12	0.25	0.37
2003	Isabella Creek	3-21 / 5-20	1134	1.02	0.00	1.02	2.95	0.00	2.95	0.00	0.18	0.18
2003	Isabella Creek	36-20	1545	3.15	0.06	3.22	4.88	0.13	5.01	0.00	0.13	0.13
2003	Isabella Creek	41-21	1053	3.25	0.00	3.25	2.95	0.09	3.04	0.00	0.19	0.19
2003	Isabella Creek	44-24	1111	0.92	0.00	0.92	4.07	0.18	4.25	0.09	0.18	0.27
2003	Isabella Creek	Random	1023	1.02	0.00	1.02	4.98	0.20	5.18	0.00	0.00	0.00

Appendix A, Table 2, Continued

Year	Stream	Transect	Area (m^2)	Rainbow Trout			Cutthroat Trout			Bull Trout		
				<305 mm	>305 mm	Total	<305 mm	>305 mm	Total	<350 mm	>350 mm	Total
2003	Kelly Creek	34-24 / Random KLY 22.4	833	0.71	0.00	0.71	1.32	0.36	1.68	0.00	0.12	0.12
2003	Kelly Creek	43-24	1082	0.41	0.00	0.41	1.32	0.09	1.41	0.00	0.09	0.09
2003	Kelly Creek	Random KLY 19.7	1233	0.61	0.16	0.77	0.41	0.08	0.49	0.00	0.00	0.00
2003	Kelly Creek	39-21	841	0.20	0.00	0.20	2.03	0.71	2.75	0.12	0.59	0.71
2003	Kelly Creek	20-20	1013	0.31	0.00	0.31	1.22	0.10	1.32	0.00	0.10	0.10
2003	Kelly Creek	7-21	909	0.10	0.00	0.10	0.71	0.33	1.04	0.11	0.00	0.11
2003	Lake Creek	22-21	1209	0.61	0.00	0.61	2.14	0.17	2.30	0.08	0.25	0.33
2003	Lake Creek	29-24	644	0.00	0.00	0.00	1.12	0.00	1.12	0.47	0.62	1.09
2003	Lake Creek	Random 3.6	1200	0.41	0.00	0.41	1.53	0.00	1.53	0.00	0.00	0.00
2003	Lake Creek	Random 8.1	980	0.10	0.00	0.10	0.61	0.00	0.61	0.00	0.00	0.00
2003	Little North Fork Clearwater	12-20	2000	0.71	0.05	0.76	2.03	0.65	2.68	0.00	0.15	0.15
2003	Little North Fork Clearwater	139-25 / 49-21	1188	0.71	0.00	0.71	0.92	0.00	0.92	0.08	0.08	0.17
2003	Little North Fork Clearwater	139-25 A	1083	0.10	0.00	0.10	1.02	0.18	1.20	0.18	0.18	0.37
2003	Little North Fork Clearwater	142-25	1040	0.81	0.00	0.81	0.92	0.00	0.92	0.00	0.19	0.19
2003	Little North Fork Clearwater	142-25	710	0.00	0.00	0.00	1.73	0.00	1.73	0.00	0.56	0.56
2003	Little North Fork Clearwater	18-21	1387	0.41	0.07	0.48	2.75	1.23	3.97	0.07	0.07	0.14
2003	Little North Fork Clearwater	19-21	800	0.10	0.00	0.10	3.25	0.13	3.38	0.13	0.13	0.25
2003	Little North Fork Clearwater	20-21	1297	0.41	0.00	0.41	0.92	0.23	1.15	0.08	0.23	0.31
2003	Little North Fork Clearwater	25-20	1110	0.31	0.09	0.40	1.42	0.36	1.78	0.18	0.09	0.27
2003	Little North Fork Clearwater	28-20	850	0.31	0.00	0.31	1.83	0.00	1.83	0.24	0.12	0.35
2003	Little North Fork Clearwater	28-20	583	0.31	0.00	0.31	3.36	0.00	3.36	0.17	0.51	0.69
2003	Little North Fork Clearwater	31-24	1678	0.61	0.00	0.61	0.81	0.48	1.29	0.00	0.06	0.06
2003	Little North Fork Clearwater	32-21	1751	0.00	0.00	0.00	0.51	0.17	0.68	0.06	0.11	0.17
2003	Little North Fork Clearwater	33-21	1470	0.31	0.00	0.31	0.51	0.00	0.51	0.00	0.34	0.34
2003	Little North Fork Clearwater	38-21	733	0.61	0.14	0.75	2.54	1.77	4.32	0.55	0.14	0.68
2003	Little North Fork Clearwater	40-21	957	0.10	0.00	0.10	1.53	0.00	1.53	0.31	0.21	0.52
2003	Little North Fork Clearwater	4-20	686	0.00	0.00	0.00	1.53	0.00	1.53	0.15	0.00	0.15

Appendix A, Table 2, Continued

Year	Stream	Transect	Area (m^2)	Rainbow Trout <305 mm	Rainbow Trout >305 mm	Rainbow Trout Total	Cutthroat Trout <305 mm	Cutthroat Trout >305 mm	Cutthroat Trout Total	Bull Trout <350 mm	Bull Trout >350 mm	Bull Trout Total
2003	Little North Fork Clearwater	42-20	387	0.31	0.00	0.31	2.54	0.00	2.54	0.78	0.00	0.78
2003	Little North Fork Clearwater	43-20 A	1068	0.20	0.00	0.20	1.53	0.00	1.53	0.00	0.28	0.28
2003	Little North Fork Clearwater	50-20	2133	0.51	0.00	0.51	2.14	0.47	2.60	0.19	0.14	0.33
2003	Little North Fork Clearwater	50-24	1768	0.10	0.00	0.10	0.41	0.17	0.58	0.06	0.06	0.11
2003	Little North Fork Clearwater	5-21	1083	0.00	0.00	0.00	1.93	0.18	2.12	0.00	0.00	0.00
2003	Little North Fork Clearwater	5-21	758	0.51	0.00	0.51	1.22	0.00	1.22	0.00	0.00	0.00
2003	Little North Fork Clearwater	Random 14	1216	0.00	0.00	0.00	0.71	0.08	0.79	0.00	0.00	0.00
2003	Little North Fork Clearwater	Random 16	1568	0.31	0.00	0.31	0.61	0.06	0.67	0.00	0.00	0.00
2003	Little North Fork Clearwater	Random 18	1515	0.10	0.00	0.10	0.71	0.00	0.71	0.40	0.07	0.46
2003	Little North Fork Clearwater	Random LNF 2.5	2584	0.61	0.08	0.69	1.22	0.08	1.30	0.19	0.08	0.27
2003	Long Creek	10-21	666	0.00	0.00	0.00	2.64	0.00	2.64	1.50	0.00	1.50
2003	Long Creek	134-25	725	0.00	0.00	0.00	0.81	0.14	0.95	0.00	0.28	0.28
2003	Long Creek	Random LNG 5.2	755	0.20	0.00	0.20	2.03	0.00	2.03	0.00	0.00	0.00
2003	Little Lost Lake Creek	137-25	233	0.20	0.00	0.20	2.34	0.00	2.34	0.00	3.00	3.00
2003	Moose Creek	Random MSC 2.2	1533	0.00	0.00	0.00	1.32	0.20	1.52	0.00	0.13	0.13
2003	NF Black Canyon	18-24	1962	0.00	0.00	0.00	0.31	0.51	0.81	0.05	0.15	0.20
2003	NF Black Canyon	24-20	1867	0.00	0.05	0.05	1.63	0.86	2.48	0.00	0.21	0.21
2003	NF Black Canyon	22-20	4133	0.71	0.02	0.74	0.61	0.12	0.73	0.02	0.00	0.02
2003	NF Black Canyon	29-21 A	2167	0.00	0.00	0.00	0.81	0.37	1.18	0.00	0.05	0.05
2003	NF Black Canyon	73-7	2033	0.20	0.05	0.25	2.03	0.25	2.28	0.05	0.20	0.25
2003	NF Black Canyon	Random 10.7	3605	0.20	0.00	0.20	0.51	0.33	0.84	0.17	0.06	0.22
2003	NF Black Canyon	Random 11.3	3600	0.00	0.00	0.00	0.61	0.58	1.19	0.03	0.03	0.06
2003	NFCW	11-21	2390	0.00	0.00	0.00	1.12	0.13	1.24	0.00	0.08	0.08
2003	NFCW	18-24	2424	0.20	0.00	0.20	1.12	0.12	1.24	0.12	0.04	0.17
2003	NFCW	27-20	1986	0.20	0.00	0.20	0.00	0.15	0.15	0.00	0.05	0.05
2003	NFCW	30-20	2424	0.20	0.00	0.20	1.22	0.29	1.51	0.00	0.12	0.12
2003	NFCW	34-21	2000	0.00	0.00	0.00	0.41	0.25	0.66	0.00	0.25	0.25

Appendix A, Table 2, Continued

Year	Stream	Transect	Area (m^2)	Rainbow Trout			Cutthroat Trout			Bull Trout		
				<305 mm	>305 mm	Total	<305 mm	>305 mm	Total	<350 mm	>350 mm	Total
2003	NFCW	38-24	1867	0.10	0.00	0.10	1.22	1.02	2.24	0.00	0.16	0.16
2003	NFCW	39-20	1500	0.00	0.00	0.00	0.41	0.13	0.54	0.07	0.27	0.33
2003	NFCW	4-21/34-21	2170	0.51	0.00	0.51	0.61	0.18	0.79	0.00	0.05	0.05
2003	NFCW	44-21	2167	0.00	0.00	0.00	0.10	0.05	0.15	0.00	0.14	0.14
2003	NFCW	46-20	2278	0.00	0.09	0.09	0.81	0.44	1.25	0.00	0.00	0.00
2003	NFCW	64-7	3467	0.10	0.03	0.13	0.31	0.06	0.36	0.00	0.00	0.00
2003	NFCW	8-21	1633	0.10	0.00	0.10	1.02	0.06	1.08	0.00	0.00	0.00
2003	NFCW	Random NF 5.5	2700	0.00	0.00	0.00	0.31	0.00	0.31	0.00	0.00	0.00
2003	Placer Creek	47-20	277	0.00	0.00	0.00	0.20	0.00	0.20	2.16	0.00	2.16
2003	Quartz Creek	23-20	7979	0.31	0.00	0.31	1.93	0.06	1.99	0.01	0.00	0.01
2003	Quartz Creek	49-24	986	3.05	0.10	3.15	5.69	0.10	5.80	0.00	0.10	0.10
2003	Rutledge Creek	13-20	761	0.00	0.00	0.00	0.92	0.00	0.92	0.00	0.39	0.39
2003	Rutledge Creek	Random Rutledge 0.1	501	0.00	0.00	0.00	0.81	0.00	0.81	0.00	0.20	0.20
2003	Skull Creek	15-21	1309	0.20	0.00	0.20	1.53	0.38	1.91	0.00	0.00	0.00
2003	Skull Creek	15-21/40-21	1470	0.31	0.00	0.31	4.37	0.41	4.78	0.00	0.14	0.14
2003	Skull Creek	16-21	750	0.61	0.00	0.61	0.92	1.33	2.25	0.00	0.27	0.27
2003	Skull Creek	20-24	1392	2.44	0.00	2.44	0.71	0.07	0.78	0.00	0.07	0.07
2003	Skull Creek	20-24	1503	0.61	0.00	0.61	2.95	0.33	3.28	0.00	0.07	0.07
2003	Skull Creek	43-21	1267	0.31	0.00	0.31	3.66	0.32	3.98	0.00	0.00	0.00
2003	Skull Creek	45-20	1666	0.71	0.00	0.71	3.97	0.06	4.03	0.06	0.06	0.12
2003	Skull Creek	48-21	1467	4.07	0.20	4.27	1.63	0.75	2.38	0.00	0.07	0.07
2003	Skull Creek	48-21	1600	0.61	0.00	0.61	4.58	0.00	4.58	0.00	0.00	0.00
2003	Skull Creek	Random SKL 14.9	737	0.71	0.14	0.85	1.83	0.14	1.97	0.00	0.00	0.00
2003	Skull Creek	Random SKL 15.3	654	1.83	0.15	1.98	2.64	0.00	2.64	1.22	0.15	1.38
2003	Upper NFC	8-21	575	0.00	0.00	0.00	0.61	0.00	0.61	2.09	1.04	3.13
2003	Upper NFC	Random UNF 5.8 / 11-21	832	0.00	0.00	0.00	0.61	0.00	0.61	0.72	0.96	1.68
2003	Vanderbilt Gulch	23-21	869	0.00	0.00	0.00	1.22	0.00	1.22	0.46	0.35	0.81

Appendix A, Table 2, Continued

Year	Stream	Transect	Area (m^2)	Rainbow Trout			Cutthroat Trout			Bull Trout		
				<305 mm	>305 mm	Total	<305 mm	>305 mm	Total	<350 mm	>350 mm	Total
2003	Vanderbilt Gulch	30-20	983	0.00	0.00	0.00	0.81	0.00	0.81	0.51	0.10	0.61
2003	Vanderbilt Gulch	3-20 / 34-20	810	0.00	0.00	0.00	0.51	0.00	0.51	0.00	0.25	0.25
2003	Vanderbilt Gulch	4-21	847	0.00	0.00	0.00	1.22	0.00	1.22	0.00	0.24	0.24
2003	Vanderbilt Gulch	46-20	719	0.00	0.00	0.00	1.53	0.00	1.53	0.00	0.00	0.00
2003	Vanderbilt Gulch	Random VG 8.6	1020	0.00	0.00	0.00	0.20	0.00	0.20	0.00	0.00	0.00
2003	Weitas Creek	2-20	1760	0.20	0.00	0.20	0.00	1.02	1.02	0.00	0.00	0.00
2003	Weitas Creek	37-20	1472	0.10	0.07	0.17	0.51	1.97	2.48	0.00	0.00	0.00
2003	Weitas Creek	Random	653	0.00	0.00	0.00	0.00	0.77	0.77	0.00	0.00	0.00
2003	Weitas Creek	Random 10.1	1536	0.10	0.00	0.10	0.41	0.20	0.60	0.00	0.00	0.00
2004	Beaver Creek	27:15	1339	3.43	0.00	3.43	0.67	0.07	0.75	0.00	0.07	0.07
2004	Beaver Creek	124:16	887	4.06	0.00	4.06	3.38	0.00	3.38	0.00	0.11	0.11
2004	Beaver Creek	BC-1	132	12.08	0.00	12.08	0.00	0.00	0.00	0.00	0.00	0.00
2004	Beaver Creek	BC-1-M	132	12.08	0.00	12.08	0.00	0.00	0.00	0.00	0.00	0.00
2004	Beaver Creek	BC-2	168	6.56	0.00	6.56	1.19	0.00	1.19	0.00	0.00	0.00
2004	Beaver Creek	Random 2.0	947	4.43	0.00	4.43	2.53	0.00	2.53	0.11	0.11	0.21
2004	Black Canyon	1:15	2933	0.24	0.00	0.24	0.31	0.10	0.41	0.00	0.07	0.07
2004	Black Canyon	9:21	2880	0.42	0.07	0.49	0.35	0.45	0.80	0.17	0.00	0.17
2004	Black Canyon	31:15	1972	0.35	0.00	0.35	1.37	0.25	1.62	0.00	0.10	0.10
2004	Black Canyon	48:15	2091	0.67	0.00	0.67	1.10	0.38	1.48	0.10	0.05	0.14
2004	Black Canyon	100:16	2640	0.27	0.04	0.30	0.95	0.30	1.25	0.08	0.08	0.15
2004	Black Canyon	108:16	2414	0.29	0.00	0.29	0.83	0.33	1.16	0.04	0.08	0.12
2004	Black Canyon	135:16	1895	1.11	0.05	1.16	0.48	0.26	0.74	0.00	0.05	0.05
2004	Black Canyon	089:15	1938	0.36	0.00	0.36	0.52	0.26	0.77	0.00	0.15	0.15
2004	Bostonia Creek	4.2	393	0.00	0.00	0.00	2.80	0.00	2.80	1.78	0.51	2.29
2004	Collins Creek	CC-1	400	0.25	0.00	0.25	3.25	0.25	3.50	0.00	0.00	0.00
2004	Collins Creek	CC-2	238	5.88	0.00	5.88	0.84	0.00	0.84	0.00	0.00	0.00
2004	Collins Creek	CC-3	275	5.09	0.00	5.09	1.82	0.00	1.82	0.00	0.00	0.00

Appendix A, Table 2, Continued

Year	Stream	Transect	Area (m^2)	Rainbow Trout <305 mm	Rainbow Trout >305 mm	Rainbow Trout Total	Cutthroat Trout <305 mm	Cutthroat Trout >305 mm	Cutthroat Trout Total	Bull Trout <350 mm	Bull Trout >350 mm	Bull Trout Total
2004	Floodwood Creek	Random 13.4	1040	1.44	0.00	1.44	3.75	0.00	3.75	0.00	0.00	0.00
2004	Floodwood Creek	Random 9.2	1274	0.63	0.08	0.71	0.47	0.08	0.55	0.00	0.00	0.00
2004	Floodwood Creek		1120	0.63	0.09	0.71	1.07	0.18	1.25	0.00	0.09	0.09
2004	Foehl Creek		976	1.13	0.00	1.13	2.05	0.10	2.15	0.00	0.10	0.10
2004	French Creek	FC-1	242	4.55	0.00	4.55	0.00	0.00	0.00	0.00	0.00	0.00
2004	French Creek	FC-2	142	4.94	0.00	4.94	0.00	0.00	0.00	0.00	0.00	0.00
2004	French Creek	FC-3	108	17.65	0.00	17.65	0.00	0.00	0.00	0.00	0.00	0.00
2004	Isabella Creek	117:16	1100	1.45	0.00	1.45	0.27	0.00	0.27	0.00	0.27	0.27
2004	Isabella Creek	125:16	980	1.73	0.00	1.73	1.73	0.20	1.94	0.00	0.41	0.41
2004	Isabella Creek	134:16	1246	1.61	0.00	1.61	2.25	0.16	2.41	0.00	0.16	0.16
2004	Isabella Creek	IS-1	309	0.00	0.00	0.00	6.79	0.00	6.79	0.00	0.00	0.00
2004	Isabella Creek	IS-1	1064	1.60	0.00	1.60	3.38	0.09	3.48	0.38	0.09	0.47
2004	Isabella Creek	IS-2	126	0.00	0.00	0.00	16.67	0.00	16.67	0.00	0.79	0.79
2004	Isabella Creek	IS-3	227	1.76	0.00	1.76	4.41	0.88	5.29	0.00	0.00	0.00
2004	Isabella Creek	IS-4	174	2.30	0.00	2.30	6.90	0.00	6.90	0.00	0.00	0.00
2004	Isabella Creek		1180	1.44	0.00	1.44	0.76	0.00	0.76	0.00	0.17	0.17
2004	Lake Creek	42:16	1081	0.46	0.09	0.56	1.67	0.19	1.85	0.00	0.09	0.09
2004	Lake Creek	Random 4.0	1158	0.60	0.26	0.86	2.07	0.09	2.16	0.09	0.00	0.09
2004	Lake Creek	112:16	1277	0.31	0.00	0.31	1.17	0.16	1.33	0.00	0.08	0.08
2004	Lake Creek	Random 10.0	691	0.00	0.00	0.00	1.45	0.00	1.45	0.29	0.00	0.29
2004	Little North Fork Clearwater	8:15	1872	0.11	0.00	0.11	0.59	0.32	0.91	0.00	0.05	0.05
2004	Little North Fork Clearwater	13:21	462	0.00	0.00	0.00	5.20	0.00	5.20	0.00	0.00	0.00
2004	Little North Fork Clearwater	16:132	376	0.00	0.00	0.00	9.04	0.00	9.04	0.00	0.27	0.27
2004	Little North Fork Clearwater	32:15	1183	0.51	0.00	0.51	1.27	0.00	1.27	0.17	0.00	0.17
2004	Little North Fork Clearwater	33:15	1700	0.65	0.00	0.65	0.65	0.24	0.88	0.00	0.06	0.06
2004	Little North Fork Clearwater	40:21	1049	0.67	0.00	0.67	1.81	0.19	2.00	0.00	0.19	0.19
2004	Little North Fork Clearwater	46:15	915	0.00	0.00	0.00	2.73	0.00	2.73	0.22	0.44	0.66

Appendix A, Table 2, Continued

Year	Stream	Transect	Area (m^2)	Rainbow Trout <305 mm	Rainbow Trout >305 mm	Rainbow Trout Total	Cutthroat Trout <305 mm	Cutthroat Trout >305 mm	Cutthroat Trout Total	Bull Trout <350 mm	Bull Trout >350 mm	Bull Trout Total
2004	Little North Fork Clearwater	50:15	2544	2.48	0.00	2.48	0.31	0.00	0.31	0.00	0.00	0.00
2004	Little North Fork Clearwater	53:15	617	0.32	0.00	0.32	2.92	0.16	3.08	0.32	0.16	0.49
2004	Little North Fork Clearwater	53:15 (2nd)	1167	0.09	0.00	0.09	1.37	0.00	1.37	0.34	0.17	0.51
2004	Little North Fork Clearwater	54:15	1333	0.15	0.00	0.15	0.68	0.23	0.90	0.15	0.15	0.30
2004	Little North Fork Clearwater	58:15	1470	0.20	0.00	0.20	1.50	0.07	1.56	0.27	0.27	0.54
2004	Little North Fork Clearwater	59:15	1533	1.24	0.00	1.24	0.46	0.46	0.91	0.00	0.13	0.13
2004	Little North Fork Clearwater	59:15 (2nd)	1264	0.08	0.00	0.08	1.34	0.40	1.74	0.08	0.00	0.08
2004	Little North Fork Clearwater	93:16	1972	0.46	0.00	0.46	1.52	0.46	1.98	0.00	0.00	0.00
2004	Little North Fork Clearwater	127:16	2544	0.35	0.00	0.35	0.47	0.12	0.59	0.00	0.04	0.04
2004	Little North Fork Clearwater	133:6	1941	0.57	0.00	0.57	0.72	0.05	0.77	0.00	0.05	0.05
2004	Little North Fork Clearwater	35.9	647	0.00	0.00	0.00	4.79	0.00	4.79	0.15	0.00	0.15
2004	Little North Fork Clearwater	002:15	476	5.04	0.00	5.04	0.84	0.00	0.84	0.21	0.42	0.63
2004	Little North Fork Clearwater	029:15	806	2.48	0.00	2.48	0.62	0.00	0.62	0.37	0.12	0.50
2004	Little North Fork Clearwater	132:16 & 2:15	1248	0.40	0.00	0.40	1.60	0.24	1.84	0.24	0.72	0.96
2004	Little North Fork Clearwater	Random 12.8	1836	0.71	0.00	0.71	0.33	0.00	0.33	0.00	0.00	0.00
2004	Little North Fork Clearwater	Random 3.5	2067	0.05	0.05	0.10	0.68	0.29	0.97	0.00	0.05	0.05
2004	Little North Fork Clearwater	Random 6.4	1768	0.68	0.11	0.79	0.57	0.23	0.79	0.00	0.00	0.00
2004	Lund Creek	56:15	617	0.00	0.00	0.00	1.30	0.00	1.30	0.65	0.16	0.81
2004	Lund Creek	Random 3.4	515	0.00	0.00	0.00	3.69	0.00	3.69	0.00	0.00	0.00
2004	NF above Cedars	44:15	2640	0.08	0.00	0.08	0.27	0.34	0.61	0.15	0.19	0.34
2004	NF above Cedars	113:16	2800	0.25	0.04	0.29	0.89	0.25	1.14	0.21	0.18	0.32
2004	NF above Cedars	19:15 & 141-16	1316	0.00	0.00	0.00	0.53	0.68	1.22	0.00	1.67	1.67
2004	NF above Cedars	22:15 & 47:21	606	0.17	0.00	0.17	1.16	0.00	1.16	1.16	0.00	1.16
2004	NF above Cedars		1895	0.05	0.00	0.05	0.53	1.21	1.74	0.05	2.43	2.48
2004	Niagara Gulch		451	0.00	0.00	0.00	0.44	0.00	0.44	4.21	0.67	4.88
2004	NF above Cedars	101:16 & 009-15	2100	0.05	0.00	0.05	0.10	0.48	0.57	0.05	2.62	2.67
2004	NF above Cedars	129:16 & 41:15 & 139:16	3660	0.03	0.00	0.03	0.22	0.11	0.33	0.11	0.16	0.27

Appendix A, Table 2, Continued

Year	Stream	Transect	Area (m^2)	Rainbow Trout			Cutthroat Trout			Bull Trout		
				<305 mm	>305 mm	Total	<305 mm	>305 mm	Total	<350 mm	>350 mm	Total
2004	NF above Cedars	Random 8.9	2417	0.04	0.00	0.04	0.50	0.29	0.79	0.00	0.00	0.00
2004	Orogrande Creek	VOC-1	170	2.35	0.00	2.35	0.00	0.00	0.00	0.00	0.00	0.00
2004	Orogrande Creek	VOC-3	103	2.92	0.00	2.92	0.00	0.00	0.00	0.00	0.00	0.00
2004	Quartz Creek	28:15	1179	1.27	0.00	1.27	0.42	0.08	0.51	0.00	0.08	0.08
2004	Rocky Run Creek	46:15	895	0.00	0.00	0.00	1.34	0.00	1.34	0.22	0.11	0.34
2004	Rocky Run Creek	60:15 & 145:16	599	0.00	0.00	0.00	2.51	0.00	2.51	0.67	0.33	1.00
2004	Sawtooth Creek		1496	2.21	0.00	2.21	0.94	0.00	0.94	0.00	0.00	0.00
2004	Skull Creek	SC-1	278	0.72	0.00	0.72	1.80	0.00	1.80	0.00	0.00	0.00
2004	Skull Creek	SC-2	560	1.07	0.00	1.07	4.46	0.00	4.46	0.00	0.18	0.18
2004	Skull Creek	SC-3	565	2.12	0.00	2.12	3.71	0.00	3.71	0.00	0.00	0.00
2004	Skull Creek	SC-4	1005	0.20	0.00	0.20	2.59	0.20	2.79	0.00	0.00	0.00
2004	Skull Creek	5:15	1094	1.46	0.00	1.46	0.27	0.27	0.55	0.00	0.09	0.09
2004	Skull Creek	23:15	1164	0.95	0.00	0.95	0.69	0.34	1.03	0.00	0.09	0.09
2004	Skull Creek	25:15	1292	0.23	0.08	0.31	3.79	0.31	4.10	0.00	0.08	0.08
2004	Skull Creek	30:21	1317	0.99	0.00	0.99	2.05	0.84	2.88	0.00	0.08	0.08
2004	Skull Creek	36:15	1104	0.63	0.00	0.63	6.07	0.27	6.34	0.00	0.09	0.09
2004	Skull Creek	40:21	1307	0.69	0.00	0.69	2.60	0.00	2.60	0.00	0.08	0.08
2004	Skull Creek	91:16	943	0.11	0.00	0.11	2.55	0.11	2.65	0.00	0.00	0.00
2004	Skull Creek	95:16	1104	0.27	0.00	0.27	4.62	0.27	4.89	0.00	0.09	0.09
2004	Skull Creek	131:16	1133	1.15	0.00	1.15	1.94	0.00	1.94	0.00	0.09	0.09
2004	Skull Creek	36:15 (2nd)	776	2.71	0.26	2.96	2.71	0.39	3.09	0.13	0.13	0.26
2004	Skull Creek	Random 15.3	900	1.22	0.00	1.22	1.22	0.00	1.22	0.33	0.00	0.33
2004	Skull Creek	Random 7.1	970	1.86	0.10	1.96	6.70	0.31	7.01	0.00	0.00	0.00
2004	Stoney Creek	7:15	1734	0.87	0.00	0.87	0.98	0.00	0.98	0.00	0.06	0.06
2004	Stoney Creek	Random 2.0	1372	0.95	0.00	0.95	1.38	0.07	1.46	0.00	0.00	0.00
2004	Upper NFC	31:21	1505	0.07	0.00	0.07	0.60	0.20	0.80	0.47	0.27	0.73
2004	Upper NFC	Random 1.7	2567	0.04	0.00	0.04	0.39	0.04	0.43	0.00	0.08	0.08

Appendix A, Table 2, Continued

Year	Stream	Transect	Area (m^2)	Rainbow Trout			Cutthroat Trout			Bull Trout		
				<305 mm	>305 mm	Total	<305 mm	>305 mm	Total	<350 mm	>350 mm	Total
2004	Upper NFC	Random 7.0	1312	0.00	0.00	0.00	0.61	0.46	1.07	0.30	0.46	0.76
2004	Vanderbilt Gulch		816	0.00	0.00	0.00	1.10	0.00	1.10	5.15	0.12	5.27
2004	W.F. Floodwood Creek	24:15	621	3.54	0.16	3.71	9.34	0.00	9.34	0.00	0.32	0.32
2005	Isabella Creek	IC-2	112	0.89	0.00	0.89	6.25	0.00	6.25	0.00	0.89	0.89
2005	Isabella Creek	IC-1	195	1.54	0.00	1.54	3.08	0.00	3.08	0.00	0.00	0.00
2005	Beaver Creek	BC-1	97	0.00	0.00	0.00	6.20	0.00	6.20	0.00	0.00	0.00
2005	Beaver Creek	BC-2	29	0.00	0.00	0.00	23.76	0.00	23.76	0.00	0.00	0.00
2005	Isabella Creek	IC-3	98	3.05	0.00	3.05	17.28	2.03	19.32	0.00	0.00	0.00
2005	Isabella Creek	IC-4	112	1.79	0.00	1.79	8.04	0.89	8.93	0.00	0.00	0.00
2005	Collins Creek	CC-2	384	1.04	0.26	1.30	5.22	0.26	5.48	0.00	0.00	0.00
2005	Skull Creek	SC-3	570	0.70	0.35	1.05	3.69	1.40	5.09	0.00	0.18	0.18
2005	Collins Creek	CC-3	258	3.87	0.39	4.26	3.48	0.39	3.87	0.00	0.00	0.00
2005	Collins Creek	CC-1	383	1.83	0.26	2.09	2.35	1.57	3.91	0.00	0.00	0.00
2005	Isabella Creek	Marked	520	0.38	0.19	0.58	5.38	0.19	5.58	0.00	0.19	0.19
2005	Isabella Creek	Marked	425	0.47	0.94	1.41	8.48	2.12	10.60	0.00	0.24	0.24
2005	Isabella Creek	Random 0.5	1000	1.10	0.00	1.10	4.60	0.60	5.20	0.00	0.00	0.00
2005	Skull Creek	SC-1	355	0.56	0.00	0.56	2.82	0.28	3.10	0.00	0.00	0.00
2005	Skull Creek	SC-2	794	0.13	0.00	0.13	5.04	1.26	6.30	0.00	0.25	0.25
2005	Skull Creek	SC-4	938	0.32	0.00	0.32	2.77	0.64	3.41	0.00	0.00	0.00
2005	Skull Creek	Random 1.1	1768	0.11	0.06	0.17	0.96	0.34	1.30	0.00	0.00	0.00
2005	Quartz Creek	Random 0.2	972	0.00	0.00	0.00	2.37	0.62	2.98	0.00	0.21	0.21
2005	Quartz Creek	Marked	1258	0.64	0.00	0.64	2.70	0.87	3.58	0.00	0.00	0.00
2005	Skull Creek	Marked	1435	0.07	0.00	0.07	3.83	0.98	4.81	0.00	0.21	0.21
2005	Collins Creek	Random 0.15	1073	0.19	0.00	0.19	3.35	0.09	3.45	0.00	0.00	0.00
2005	Collins Creek	Marked	1100	1.36	0.09	1.45	3.64	0.18	3.82	0.00	0.00	0.00
2005	Goose Creek	Marked	760	0.13	0.00	0.13	3.29	0.13	3.42	0.26	0.13	0.39
2005	Goose Creek	Marked	860	0.47	0.00	0.47	3.49	0.12	3.60	0.23	0.00	0.23

Appendix A, Table 2, Continued

Year	Stream	Transect	Area (m^2)	Rainbow Trout			Cutthroat Trout			Bull Trout		
				<305 mm	>305 mm	Total	<305 mm	>305 mm	Total	<350 mm	>350 mm	Total
2005	Long Creek	Random 10.1	493	0.00	0.00	0.00	0.41	0.00	0.41	1.01	0.20	1.22
2005	Long Creek	Marked	377	0.27	0.00	0.27	1.06	0.00	1.06	2.39	0.27	2.65
2005	Moose Creek	Random 0.9	2190	0.00	0.05	0.05	0.55	0.23	0.78	0.00	0.05	0.05
2005	Goose Creek	Random 1.7	798	0.25	0.00	0.25	1.88	0.25	2.13	0.38	0.25	0.63
2005	Long Creek	Marked	860	0.23	0.00	0.23	1.40	0.00	1.40	0.12	0.12	0.23
2005	Orogrande Creek	Random 18.6	1733	0.23	0.06	0.29	0.23	0.12	0.35	0.00	0.00	0.00
2005	Orogrande Creek	Marked	1137	0.88	0.09	0.97	1.23	0.18	1.41	0.00	0.18	0.18
2005	NF Black Canyon	Marked	2800	0.00	0.04	0.04	0.54	0.64	1.18	0.00	0.00	0.00
2005	NF Black Canyon	Marked	3300	0.00	0.03	0.03	0.85	0.18	1.03	0.00	0.06	0.06
2005	NF Black Canyon	Marked	2720	0.00	0.04	0.04	0.22	0.26	0.48	0.04	0.33	0.37
2005	NF Black Canyon	Marked	2333	0.00	0.00	0.00	0.21	0.69	0.90	0.00	0.34	0.34
2005	NF Black Canyon	Marked	3067	0.00	0.00	0.00	0.10	0.00	0.10	0.00	0.07	0.07
2005	NF Black Canyon	Marked	3200	0.03	0.00	0.03	0.13	0.38	0.50	0.00	0.22	0.22
2005	NF above Cedars	Marked	1503	0.07	0.00	0.07	0.13	0.40	0.53	0.13	4.66	4.79
2005	NF above Cedars	Marked	1976	0.00	0.00	0.00	0.20	0.00	0.20	0.10	0.10	0.20
2005	NF above Cedars	Marked	2667	0.00	0.00	0.00	0.08	0.04	0.11	0.04	0.11	0.15
2005	NF above Cedars	Marked	2493	0.04	0.04	0.08	0.16	0.16	0.32	0.00	0.04	0.04
2005	NF above Cedars	Marked	1800	0.00	0.00	0.00	0.22	0.56	0.78	0.06	0.11	0.17
2005	Long Creek	Random 2.9	800	0.88	0.00	0.88	2.13	0.50	2.63	0.38	0.13	0.50
2005	Vanderbilt Gulch	Random 1.4	697	0.43	0.00	0.43	0.72	0.14	0.86	1.44	0.14	1.58
2005	Vanderbilt Gulch	Marked	747	0.13	0.00	0.13	0.54	0.00	0.54	0.67	0.13	0.80
2005	Swamp Creek	Random 0.8	637	0.16	0.00	0.16	0.47	0.47	0.94	0.16	0.00	0.16
2005	Swamp Creek	Random 2nd	561	2.32	0.00	2.32	3.03	0.36	3.39	0.36	0.00	0.36
2005	Breakfast Creek	Marked	1181	0.00	0.00	0.00	0.00	0.17	0.17	0.00	0.08	0.08
2005	Floodwood Creek	Random 1.2	757	0.26	0.00	0.26	2.11	0.26	2.38	0.00	0.13	0.13
2005	Floodwood Creek	Marked	887	0.34	0.00	0.34	0.79	0.23	1.01	0.00	0.00	0.00
2005	Floodwood Creek	Marked	1800	0.00	0.11	0.11	1.78	0.11	1.89	0.00	0.00	0.00

Appendix A, Table 2, Continued

Year	Stream	Transect	Area (m^2)	Rainbow Trout <305 mm	Rainbow Trout >305 mm	Rainbow Trout Total	Cutthroat Trout <305 mm	Cutthroat Trout >305 mm	Cutthroat Trout Total	Bull Trout <350 mm	Bull Trout >350 mm	Bull Trout Total
2005	Glover Creek	Random 0.8	717	0.14	0.00	0.14	1.81	0.00	1.81	0.00	0.00	0.00
2005	Floodwood Creek	Marked	927	0.22	0.00	0.22	2.16	0.11	2.27	0.00	0.11	0.11
2005	NF above Cedars	Marked	1333	0.00	0.00	0.00	0.30	0.53	0.83	0.00	0.53	0.53
2005	NF above Cedars	Random 4.1	2112	0.00	0.00	0.00	0.00	0.05	0.05	0.00	0.19	0.19
2005	NF above Cedars	Marked	2261	0.22	0.00	0.22	0.35	0.09	0.44	0.13	0.09	0.22
2005	Long Creek	Marked	825	0.00	0.00	0.00	0.97	0.00	0.97	0.12	0.12	0.24
2005	Ruby Creek	RC-1	81	20.99	0.00	20.99	3.70	0.00	3.70	0.00	0.00	0.00
2005	Moose Creek	Marked	1508	0.60	0.00	0.60	2.32	0.66	2.98	0.27	0.13	0.40
2005	Little Moose Creek	LMSC-3	111	2.70	0.00	2.70	6.31	0.90	7.21	0.00	0.00	0.00
2005	Little Moose Creek	LMSC-2	125	2.41	0.00	2.41	1.60	0.00	1.60	1.60	0.00	1.60
2005	Little Moose Creek	LMSC-1	260	0.77	0.00	0.77	6.93	1.16	8.09	0.77	0.00	0.77
2005	Orogrande Creek	UOC-1	142	3.52	0.00	3.52	1.41	0.00	1.41	0.00	0.00	0.00
2005	Orogrande Creek	UOC-3	82	7.31	0.00	7.31	6.09	0.00	6.09	0.00	0.00	0.00
2005	French Creek	FC-1	192	0.00	0.00	0.00	14.06	0.52	14.58	0.00	0.00	0.00
2005	French Creek	FC-2	175	2.29	0.57	2.86	3.44	0.00	3.44	0.00	0.00	0.00
2005	French Creek	FC-3	241	0.42	0.00	0.42	4.98	0.00	4.98	0.00	0.00	0.00
2005	Little North Fork Clearwater	Marked	1253	0.32	0.00	0.32	0.88	0.00	0.88	0.08	0.08	0.16
2005	Little North Fork Clearwater	Marked	711	0.14	0.00	0.14	0.28	0.00	0.28	0.00	1.27	
2005	Little North Fork Clearwater	Random 39.0	1646	0.30	0.00	0.30	0.97	0.12	1.09	0.06	0.00	
2005	Little North Fork Clearwater	Marked	1394	0.43	0.00	0.43	1.22	0.14	1.36	0.00	0.43	
2005	Little North Fork Clearwater	Marked	1197	0.67	0.00	0.67	1.84	0.17	2.01	0.00	0.42	
2005	Little North Fork Clearwater	Marked	1547	0.45	0.00	0.45	1.68	0.00	1.68	0.13	0.19	
2005	Little North Fork Clearwater	Marked	1867	0.21	0.00	0.21	1.50	0.05	1.55	0.00	0.05	
2005	Little North Fork Clearwater	Random 36.4	1667	0.18	0.00	0.18	2.46	0.18	2.64	0.00	0.06	
2005	Little North Fork Clearwater	Random 24.8	1667	0.36	0.00	0.36	1.32	0.06	1.38	0.00	0.12	
2005	Little North Fork Clearwater	Marked	1933	0.26	0.00	0.26	0.41	0.16	0.57	0.00	0.36	
2005	Little North Fork Clearwater	Marked	896	0.45	0.00	0.45	0.56	0.11	0.67	0.11	0.22	

Appendix A, Table 2, Continued

Year	Stream	Transect	Area (m^2)	Rainbow Trout <305 mm	Rainbow Trout >305 mm	Rainbow Trout Total	Cutthroat Trout <305 mm	Cutthroat Trout >305 mm	Cutthroat Trout Total	Bull Trout <350 mm	Bull Trout >350 mm	Bull Trout Total
2005	Little North Fork Clearwater	Marked	2250	0.18	0.04	0.22	1.02	0.13	1.16	0.00	0.22	0.22
2005	Lund Creek	Marked	653	0.00	0.00	0.00	0.92	0.00	0.92	1.22	0.00	1.22
2005	Little North Fork Clearwater	Marked	1567	0.13	0.00	0.13	1.02	0.06	1.09	0.00	0.13	0.13
2005	Little North Fork Clearwater	Marked	742	0.27	0.00	0.27	1.89	0.00	1.89	0.13	3.23	3.37
2005	Little Lost Lake Creek	Marked	437	0.00	0.00	0.00	2.75	0.00	2.75	0.00	0.23	0.23
2005	Little North Fork Clearwater	Random 12.3	1533	0.20	0.00	0.20	0.52	0.26	0.78	0.00	0.07	0.07
2005	Little North Fork Clearwater	Random 8.7	3777	0.26	0.05	0.32	0.48	0.19	0.66	0.00	0.00	0.00
2005	Little North Fork Clearwater	Marked	1435	0.28	0.00	0.28	0.49	0.28	0.77	0.00	0.07	0.07
2005	Little North Fork Clearwater	Marked	2508	0.32	0.00	0.32	2.23	0.40	2.63	0.16	0.00	0.16
2005	Rocky Run Creek	Marked	587	0.17	0.00	0.17	2.73	0.00	2.73	0.68	0.68	1.36
2005	Little North Fork Clearwater	Marked	1207	0.91	0.17	1.08	0.83	0.17	0.99	0.00	0.33	0.33
2005	Little North Fork Clearwater	Marked	1117	0.45	0.00	0.45	1.52	0.00	1.52	0.09	1.25	1.34
2005	Rocky Run Creek	Marked	675	0.15	0.00	0.15	1.63	0.00	1.63	0.30	0.15	0.44

Appendix A, Table 3. Radio-tagged bull trout migration distances and dates past river fixed sites.

Year	Code	Tagging Group	Watershed HUC 5	Date Past Fixed Site Upstream	Date Located at Max Migration Point	Date Past Fixed Site Downstream	Migration Distance from Tagging Location
2000	930-16	NFC	Long Creek	06/03/00	07/20/00	09/21/00	97.9
2000	930-14	NFC	Long Creek	06/18/00	07/20/00		110.6
2000	930-19	NFC	Long Creek	06/20/00	07/20/00		113
2000	910-16	NFC	Long Creek	06/04/00	08/08/00	09/14/00	117
2000	930-22	NFC	Headwaters NFC	06/08/00	08/08/00		133
2000	910-13	NFC	Headwaters NFC	06/01/00	08/08/00		129.7
2000	930-18	NFC	Long Creek	06/03/00	08/08/00		117
2000	930-12	NFC	Osier Creek	06/17/00	07/20/00		112
2000	910-17	NFC	Kelly Creek	06/18/00	07/20/00		100.5
2000	910-20	NFC	Kelly Creek	06/03/00	07/20/00		102.4
2000	930-26	NFC	Kelly Creek	06/26/00			82.5
2000	930-17	NFC	Upper Weitas Creek	06/16/00	07/20/00		78.8
2000	910-19	NFC	Lost Pete Creek	07/02/00	07/20/00		14.5
2000	930-25	NFC		06/29/00	07/05/00		19.7
2000	930-29	NFC		06/06/00	06/13/00	10/03/00	19.7
2000	910-15	DWR			06/23/00		-76.1
2000	930-20	DWR			07/05/00		-8
2000	910-11	DWR			06/05/00		-7.2
2000	910-12	DWR			06/02/00		2.4
2000	910-14	DWR					-1.8
2000	930-11	DWR			07/05/00		7.6
2001	010-10	NFC	Collins Creek	07/09/01	07/30/01		46.5
2001	930-33	DWR	Larson Creek		08/14/01		78.5
2001	930-22	BFC	Long Creek		08/14/01		117.5
2001	480-10	DWR	Long Creek	07/09/01	08/08/01		101.6
2001	480-04	NFC	Long Creek	07/09/01	07/30/01		116.1
2001	480-07	NFC	Long Creek	07/09/01	08/08/01		89.8
2001	480-22	NFC	Long Creek	07/09/01	08/14/01		69.1
2001	930-16	NFC	Long Creek		07/30/01		98.5
2001	930-32	NFC	Long Creek		08/14/01		91.4
2001	910-29	DWR	Lost Pete Creek		08/08/01		46.6
2001	480-03	NFC	Lost Pete Creek		06/08/01		13
2001	930-27	DWR	Osier Creek		07/10/01		133.7
2001	480-01	NFC	Osier Creek	07/09/01	07/30/01	09/15/01	105.5
2001	480-02	NFC	Quartz Creek	07/09/01	07/30/01	09/15/01	28.6
2001	930-36	NFC	Quartz Creek		08/14/01		9.4
2001	010-07	NFC	Schofield Creek	05/29/01	07/31/01		64.1
2001	930-34	NFC	Schofield Creek		07/10/01		67.3
2001	010-04	NFC	Headwaters NFC	06/14/01	08/14/01		124.1

Appendix A, Table 3, Continued.

Year	Code	Tagging Group	Watershed HUC 5	Date Past Fixed Site Upstream	Date Located at Max Migration Point	Date Past Fixed Site Downstream	Migration Distance from Tagging Location
2001	010-05	NFC	Headwaters NFC	07/09/01	08/14/01		126.9
2001	480-11	NFC	Headwaters NFC	07/09/01	07/23/01		90.8
2001	480-20	NFC	Headwaters NFC	07/09/01	08/14/01		117.3
2001	910-33	NFC	Headwaters NFC	06/21/01	07/30/01		125.7
2001	930-14	NFC	Headwaters NFC		07/10/01		121.3
2001	010-02	NFC	Weitas Creek	07/09/01	08/14/01		81.1
2001	440-49	BFC	Canyon Creek	05/31/01	08/15/01		39.7
2001	480-26	BFC	Canyon Creek	05/30/01	08/05/01		37
2001	480-12	NFC	Canyon Creek	06/17/01	08/15/01		60.4
2001	480-25	BFC	Stony Creek	06/21/01	07/11/01		13.5
2001	480-15	BFC	Stony Creek	06/22/01	07/31/01	10/09/01	7.1
2001	770-03	BFC	Stony Creel	06/10/01	07/11/01	10/04/01	8.8
2001	440-54	BFC	Stony Creek	06/20/01	07/31/01		9.1
2001	440-54[B]		Mid-LNF		09/20/01	10/03/01	13
2001	480-17	BFC	Stony Creek	06/24/01	07/31/01	08/08/01	18.4
2001	480-17[B]		Mid-LNF		10/20/01	6-Oct-01	8.8
2001	770-05	BFC	Stony Creek	06/17/01	06/10/01	08/01/01	15.6
2001	770-05[B]		Mid-LNF		07/11/01		13.7
2001	480-05	BFC	Mid LNF	06/23/01	06/25/01		1.8
2001	770-06	LNF	Mid LNF		06/08/01		10.6
2001	440-50	BFC	Mid LNF		06/08/01		10.8
2001	770-09	LNF	Mid LNF		07/02/01		-2.5
2001	010-03	LNF	Mid LNF	7-Aug-01	08/07/01		24
2001	770-01	BFC	Upper LNF	05/30/01	07/31/01	09/15/01	49.1
2001	770-11	BFC	Upper LNF		08/15/01		64.1
2001	770-12	BFC	Upper LNF		07/31/01		57.5
2001	770-13	BFC	Upper LNF		08/23/01		51.7
2001	930-28	DWR	Upper LNF	06/16/01	07/31/01		62.9
2001	930-38	DWR	Upper LNF	06/10/01	08/15/01		52.9
2001	010-06	LNF	Upper LNF	06/06/01	08/15/01	10/05/01	56.2
2001	010-08	LNF	Upper LNF	06/18/01	08/15/01		33.2
2001	010-09	LNF	Upper LNF	05/29/01	08/23/01		47.5
2001	480-08	LNF	Upper LNF	06/04/01	08/15/01	10/04/01	43
2001	480-09	LNF	Upper LNF	05/31/01	07/11/01	09/29/01	51.2
2001	480-23	LNF	Upper LNF	06/15/01	07/31/01		48.4
2001	770-04	LNF	Upper LNF		07/31/01	10/03/01	57.7
2001	770-07	LNF	Upper LNF	06/07/01	07/11/01		53
2001	770-08	LNF	Upper LNF	06/07/01	08/15/01		43
2001	770-10	LNF	Upper LNF		07/31/01	10/04/01	42.4
2001	770-14	LNF	Upper LNF		07/31/01		47.9

Appendix A, Table 3, Continued.

Year	Code	Tagging Group	Watershed HUC 5	Date Past Fixed Site Upstream	Date Located at Max Migration Point	Date Past Fixed Site Downstream	Migration Distance from Tagging Location
2001	480-06	NFC	Upper LNF		07/31/01		48.1
2001	480-24	NFC	Upper LNF	07/09/01	08/14/01		43
2001	010-01	NFC	NFCR		06/25/01		10.8
2001	440-57	NFC	NFCR		07/10/01		-6.2
2001	480-13	NFC	NFCR		07/10/01		8.1
2001	480-14	NFC	NFCR		07/10/01		6.9
2001	480-18	NFC	NFCR		06/08/01		6.5
2001	480-21	NFC	NFCR	07/09/01	08/02/01		8.2
2001	910-12	NFC	NFCR				11.8
2001	910-25	NFC	NFCR		06/13/01		-1.1
2001	930-30	NFC	NFCR		07/30/01		6.3
2001	770-02	BFC	NFCR		07/09/01		16.5
2001	420-06	NFC	Lower NFC		06/27/01		-14.2
2001	480-16	BFC	Upper Dworshak		06/27/01		-27.2
2001	930-35	BFC	Upper Dworshak		07/02/01		13.3
2001	420-10	DWR	Upper Dworshak		06/13/01		-4.7
2001	930-37	DWR	Upper Dworshak		06/25/01		18.4
2001	480-19	NFC	Upper Dworshak		07/21/01		-31.9
2001	930-19	NFC	Upper Dworshak				-46.6
2001	010-09	BFC					
2001	440-52	BFC					
2001	910-13	BFC					
2001	420-12	DWR					
2001	420-14	DWR					
2001	420-19	DWR		05/30/01			
2001	420-64	DWR					
2001	420-07	DWR					
2001	420-11	DWR					
2001	440-60	LNF		05/31/01	06/08/01		3.4
2001	440-62	LNF					
2001	440-66	LNF					
2001	440-68	LNF					
2001	440-70	LNF					
2001	440-71	LNF					
2001	770-13	LNF					
2001	910-32	LNF					
2001	910-34	LNF					
2001	910-37	LNF					
2001	930-31	LNF					
2001	440-53	NFC					

Appendix A, Table 3, Continued.

Year	Code	Tagging Group	Watershed HUC 5	Date Past Fixed Site Upstream	Date Located at Max Migration Point	Date Past Fixed Site Downstream	Migration Distance from Tagging Location
2001	440-55	NFC					
2001	440-56	NFC					
2001	440-58	NFC					
2001	440-59	NFC					
2001	910-11	NFC					-19.5
2001	910-19	NFC		06/05/01			
2001	910-26	NFC					
2001	910-32	NFC					
2001	930-15	NFC		06/26/01			
2002	149.42.117	NFC	Cold Springs Creek		6-Aug-02		94.43
2002	148.77.138	LNF	Collins Creek		3-Sep-02	2-Oct-02	54.70
2002	149.42.113	NFC	Collins Creek	13-Jul-02	19-Sep-02	27-Oct-02	29.30
2002	149.42.123	NFC	Collins Creek		6-Aug-02		41.55
2002	149.44.064	BFC	Headwaters NFCR	13-Jun-02	19-Sep-02		152.70
2002	148.77.144	NFC	Headwaters NFCR		3-Sep-02		130.60
2002	149.44.061	LNF	Kelly Creek		19-Sep-02	11-Oct-02	124.90
2002	149.42.131	NFC	Kelly Creek	10-Jul-02	6-Aug-02		110.60
2002	149.44.076	NFC	Kelly Creek		31-Oct-02		89.60
2002	148.77.148	LNF	Long Creek		6-Aug-02		139.10
2002	148.77.133	NFC	Long Creek		19-Aug-02		93.80
2002	148.77.136	NFC	Long Creek	11-Jul-02	19-Aug-02		91.70
2002	148.77.155	NFC	Long Creek		6-Aug-02		120.70
2002	149.42.110	NFC	Long Creek		6-Aug-02		107.50
2002	149.42.111	NFC	Long Creek		6-Aug-02		119.50
2002	149.42.114	NFC	Long Creek		6-Aug-02		121.30
2002	149.42.118	NFC	Long Creek		6-Aug-02		114.10
2002	149.42.119	NFC	Long Creek		3-Sep-02		113.50
2002	149.42.125	NFC	Long Creek		6-Aug-02		95.40
2002	149.44.072	NFC	Long Creek		3-Sep-02		121.30
2002	149.44.073	NFC	Long Creek		6-Aug-02		103.80
2002	149.42.115	NFC	Lost Pete Creek	12-Aug-02	3-Sep-02	18-Oct-02	30.81
2002	149.42.120	NFC	Lost Pete Creek		10-Jul-02		20.02
2002	149.42.115	NFC	Lost Pete Creek	12-Aug-02	3-Sep-02	18-Oct-02	30.81
2002	149.42.120	NFC	Lost Pete Creek		10-Jul-02		20.02
2002	148.77.132	NFC	Osier Creek		09/19/02		115
2002	148.77.154	NFC	Osier Creek		08/06/02		110.9
2002	149.42.122	NFC	Quartz Creek		09/03/02	10/13/02	26.38
2002	149.42.085	BFC	Floodwood Creek		08/19/02		7.5
2002	148.91.023	BFC	Middle LNF		07/10/02		-20.29
2002	148.91.031	BFC	Middle LNF	07/19/02	08/06/02		5.39

Appendix A, Table 3, Continued.

Year	Code	Tagging Group	Watershed HUC 5	Date Past Fixed Site Upstream	Date Located at Max Migration Point	Date Past Fixed Site Downstream	Migration Distance from Tagging Location
2002	149.42.065	BFC	Middle LNF	06/18/02	05/30/02		-0.5
2002	148.77.008	DWR	Middle LNF	07/16/02	07/22/02		50.55
2002	148.77.150	LNF	Middle LNF		05/21/02		0
2002	148.91.018	LNF	Middle LNF	07/10/02	07/22/02		3.41
2002	148.91.021	LNF	Middle LNF		07/22/02		5.48
2002	148.91.027	LNF	Middle LNF		09/03/02		-3.25
2002	149.44.069	BFC	Stony Creek	08/09/02	07/22/02	09/30/02	20.6
2002	149.42.128	DWR	Stony Creek		08/06/02		19.73
2002	149.44.067	BFC	Upper LNF	06/22/02	09/03/02		64.86
2002	149.42.088	DWR	Upper LNF	06/11/02	19-Sept.-02		48.78
2002	148.77.137	LNF	Upper LNF	06/18/02	09/03/02		77.3
2002	148.77.139	LNF	Upper LNF		08/06/02		61.1
2002	148.77.140	LNF	Upper LNF	06/21/02	09/19/02	09/30/02	69.5
2002	148.77.141	LNF	Upper LNF	06/11/02	09/03/02	10/12/02	64
2002	148.77.142	LNF	Upper LNF	06/13/02	09/03/02	09/29/02	70.9
2002	148.77.147	LNF	Upper LNF	06/22/02	09/03/02	10/21/02	62.9
2002	148.77.151	LNF	Upper LNF	06/26/02	09/03/02	09/30/02	58.6
2002	148.91.022	LNF	Upper LNF	06/24/02	08/06/02		67.07
2002	148.93.013	LNF	Upper LNF		09/03/02		72.8
2002	149.42.129	LNF	Upper LNF	06/18/02	08/06/02	09/28/02	34.98
2002	149.44.063	LNF	Upper LNF	06/30/02	09/03/02	09/29/02	79.5
2002	149.44.065	LNF	Upper LNF	06/11/02	08/19/02	10/18/02	33.8
2002	149.44.075	LNF	Upper LNF	06/10/02	09/03/02		72.7
2002	148.93.035	BFC	Lower NFCR		08/06/02		-11.38
2002	149.42.062	BFC	Lower NFCR	06/13/02	05/30/02		-6.91
2002	149.42.127	DWR	Lower NFCR		05/21/02		1
2002	149.42.130	NFC	Lower NFCR		08/06/02		-15.5
2002	148.93.027	DWR	Upper Dworshak		08/06/02		-34.04
2002	148.93.015	DWR	NFCR		09/19/02		26.8
2002	149.42.089	DWR	NFCR		11/21/02		32.9
2002	148.77.145	NFC	NFCR		08/19/02		20.2
2002	148.93.010	NFC	NFCR		07/10/02		15.1
2002	149.42.112	NFC	NFCR		07/10/02		10.8
2003	148.48.006	LNF	Floodwood Creek		07/21/03		2.9
2003	148.48.016	LNF	Middle LNF	06/26/03	08/18/03	10/27/03	14.1
2003	148.48.049	NFC	Quartz Creek		08/07/03		40.51
2003	148.48.009	LNF	Upper LNF	06/14/03	08/18/03		50.2
2003	148.48.032	LNF	Long Creek		07/21/03		140.4
2003	148.48.013	LNF					
2003	148.48.010	LNF	Floodwood Creek		07/21/03		3.85

Appendix A, Table 3, Continued.

Year	Code	Tagging Group	Watershed HUC 5	Date Past Fixed Site Upstream	Date Located at Max Migration Point	Date Past Fixed Site Downstream	Migration Distance from Tagging Location
2003	148.48.020	NFC	Skull Creek		07/21/03		25.41
2003	148.48.041	LNF	Middle LNF	07/01/03	08/07/03		22.53
2003	148.48.026	DWR	Lower NFC				
2003	148.48.024	NFC					
2003	148.48.050	LNF	Upper LNF	06/15/03	07/21/03	10/18/03	31.6
2003	148.48.028	DWR	Lower NFC				
2003	148.48.035	LNF	Floodwood Creek		09/01/03		6.51
2003	148.48.039	LNF	Floodwood Creek		08/07/03		6.29
2003	148.48.011	LNF	Middle LNF	06/26/03	09/15/03	10/11/03	16.35
2003	148.48.038	NFC	Cold Springs Creek				82.5
2003	148.48.008	DWR					
2003	148.48.048	LNF	Middle LNF				4.71
2003	148.48.025	LNF	Middle LNF	05/29/03	07/21/03	10/28/03	22.23
2003	148.48.003	DWR	Unknown				
2003	148.48.021	BFC	Upper LNF		09/01/03	10/18/03	35.63
2003	148.48.023	LNF					
2003	148.48.004	NFC					
2003	148.74.019	NFC			06/29/03		
2003	148.48.027	NFC	Skull Creek		09/19/03		24.44
2003	148.48.002	DWR	Unknown				
2003	148.74.038	DWR					
2003	148.48.001	LNF	DWR Reservoir				
2003	148.48.022	LNF	Stony Creek		07/07/03	07/07/03	17.28
2003	148.74.005	NFC	Isabella Creek	07/21/03			9
2003	148.74.002	NFC	Upper Weitas Creek	05/29/03	08/07/03		83.15
2003	148.48.015	NFC					
2003	148.74.006	DWR	Lost Pete Creek		07/07/03		60.11
2003	148.74.012	DWR	Upper LNF	06/26/03	08/18/03	10/14/03	68.30
2003	148.74.045	DWR	Schofield Creek		09/15/03		75.43
2003	148.48.012	LNF	Upper LNF	06/16/03	07/21/03	10/09/03	22.61
2003	148.74.016	LNF	Floodwood Creek		07/07/03		11.26
2003	148.74.022	NFC	Long Creek		08/07/03		112.63
2003	148.74.023	NFC	Quartz Creek	06/11/03	08/18/03		25.88
2003	148.74.004	LNF	Upper LNF	07/02/03	08/07/03		62.50
2003	148.74.001	DWR	Upper LNF	06/26/03	07/21/03	10/14/03	83.71
2003	148.74.036	NFC	Isabella Creek		07/07/03	10/14/03	10.89
2003	148.48.029	LNF	Long Creek		08/18/03		149.54
2003	148.74.010	NFC	Lost Pete Creek		07/07/03		53.81
2003	148.74.033	LNF		06/17/03	07/17/03		
2003	148.48.037	NFC	Beaver Creek	06/26/03	07/21/03		18.31

Appendix A, Table 3, Continued.

Year	Code	Tagging Group	Watershed HUC 5	Date Past Fixed Site Upstream	Date Located at Max Migration Point	Date Past Fixed Site Downstream	Migration Distance from Tagging Location
2003	148.74.035	LNF	Upper LNF	06/17/03	08/18/03	11/05/03	64.14
2003	148.74.009	DWR	Canyon Creek	07/06/03	08/07/03	10/13/03	143.49
2003	148.74.029	LNF	Stayed in Reservoir		09/29/03	10/21/03	22.9
2003	148.74.044	NFC	Kelly Creek		08/18/03		104.02
2003	148.74.032	LNF			07/21/03		
2003	148.74.021	NFC	Middle Fork Kelly Creek		07/21/03		108.40
2003	148.48.044	NFC	NFCR		09/01/03	10/17/03	7.68
2003	148.74.041	NFC	Isabella Creek		07/07/03		9.81
2003	148.74.024	NFC	Cold Springs Creek		08/18/03	10/29/03	82.11
2003	148.76.021	LNF	Middle LNF	05/29/03	08/07/03		20.21
2003	148.74.017	NFC	Beaver Creek	05/29/03	07/21/03		
2003	148.74.008	NFC	Beaver Creek		07/21/03	10/28/03	49.80
2003	148.74.014	NFC	Kelly Creek		07/07/03		94.99
2003	148.74.049	LNF	Upper LNF	06/10/03	10/15/03		62.06
2003	148.48.045	NFC	Long Creek		07/21/03		111.16
2003	148.74.031	LNF	Middle LNF		09/15/03	10/15/03	17.13
2003	148.48.017	NFC	Long Creek		08/18/03		110.1
2003	148.48.007	LNF	Unknown		07/07/03		
2003	148.48.019	LNF	Long Creek	06/29/03	07/21/03		137.34
2003	148.76.015	LNF	Collins Creek		09/01/03		75.29
2003	148.76.001	DWR					
2003	148.76.007	NFC	Upper Kelly Creek		08/07/03		125.11
2003	148.48.046	NFC	Upper Cayuse Creek		08/07/03		121.71
2003	148.74.037	NFC	Upper Weitas Creek		08/07/03		68.77
2003	148.76.030	NFC	Collins Creek	06/12/03	08/07/03		39.02
2003	148.76.009	NFC	Long Creek	06/10/03	08/07/03		98.07
2003	148.48.040	LNF	Upper LNF	06/18/03	09/01/03		31.85
2003	148.76.003	NFC	NFC		07/21/03	10/06/03	10.55
2003	148.76.037	DWR	Headwaters NFC		08/07/03		161.84
2003	148.76.002	DWR					
2003	148.76.027	LNF	Upper LNF	06/16/03	08/18/03	10/19/03	37.04
2003	148.76.031	NFC		06/14/03			26.89
2003	148.48.031	LNF	Upper LNF	06/17/03	08/18/03	10/14/03	40.62
2003	148.48.036	LNF		06/28/03			27.22
2003	148.48.042	NFC	Headwaters NFC		09/01/03		124.89
2003	148.76.014	LNF					
2003	148.76.029	NFC	Long Creek		08/07/03		110.71
2003	148.48.043	NFC	Upper Kelly Creek		07/21/03		112.74
2003	148.74.040	NFC	Unknown	06/26/03		10/10/03	
2003	148.74.007	NFC					

Appendix A, Table 3, Continued.

Year	Code	Tagging Group	Watershed HUC 5	Date Past Fixed Site Upstream	Date Located at Max Migration Point	Date Past Fixed Site Downstream	Migration Distance from Tagging Location
2003	148.74.043	LNF	Upper LNF	06/10/03	07/21/03		42.86
2003	148.76.022	NFC	Long Creek		07/21/03		151.66
2003	148.76.018	LNF	Middle LNF	06/13/03	07/07/03	10/13/03	22.49
2003	148.74.020	NFC	Middle Fork Kelly Creek		08/18/03		179.6
2003	148.48.030	NFC			08/18/03		50.64
2003	148.74.018	NFC	Isabella Creek	06/11/03	07/07/03	10/19/03	9.15
2003	148.74.013	LNF	Upper LNF	05/29/03	08/07/03	10/10/03	55.48
2003	148.76.024	LNF	Upper LNF	06/11/03	07/07/03		31.39
2003	148.76.008	NFC	Headwaters NFC		08/18/03		168.94
2003	148.48.034	NFC	Upper Kelly Creek		08/18/03		123.02
2003	148.74.026	LNF	Upper LNF		07/07/03		
2003	148.76.042	LNF	Upper LNF	06/13/03	07/21/03		63.31
2003	148.76.038	LNF	Upper LNF		07/07/03	10/14/03	28.8
2003	148.74.030	LNF	Upper NFC		07/21/03		146.35
2003	148.76.041	NFC	NFC	06/16/03	06/29/03	08/01/03	9.33
2003	148.74.047	NFC	Headwaters NFC		07/21/03		125.35
2003	148.76.044	NFC	Long Creek		08/07/03		116.63
2003	148.74.046	NFC	Headwaters NFC		07/21/03	10/18/03	122.76
2003	148.74.011	LNF	Upper LNF		08/18/03		58.78
2003	148.74.048	NFC	Long Creek		08/07/03		118.62
2003	148.76.020	LNF	Upper LNF	06/12/03	08/18/03	10/30/03	54.35
2003	148.48.014	LNF	Upper LNF	06/17/03	08/07/03	10/14/03	71.82
2003	148.74.003	NFC	Headwaters NFC		08/07/03		123.34
2003	148.76.034	NFC	Headwaters NFC		08/07/03		129.39
2003	148.76.005	DWR	Upper LNF		08/18/03	10/15/03	93.19
2003	148.74.050	DWR	Upper LNF		07/21/03	10/18/03	56.58
2003	148.76.048	NFC	Collins Creek		08/07/03		27.08
2003	148.48.033	NFC	Upper Kelly Creek		07/21/03		107.23
2003	148.76.025	LNF	Upper LNF	06/24/03	07/21/03	10/13/03	65.12
2003	148.76.040	NFC	Upper LNF		08/18/03	07/27/03	144.63
2003	148.48.018	NFC	Headwaters NFC		07/21/03		107.58
2003	148.76.036	LNF	Upper LNF		07/21/03	10/12/03	56.70
2003	148.76.012	LNF	Middle LNF	06/11/03	07/07/03	10/13/03	30.56
2003	148.76.050	LNF	Upper LNF		07/07/03	10/18/03	34.56
2003	148.74.039	NFC	Headwaters NFC		08/07/03		136.58
2003	148.76.013	LNF	Upper LNF		09/15/03		54.28
2003	148.76.026	NFC	NFCR		07/07/03	10/09/03	14.34
2003	148.76.032	LNF	Upper LNF	06/12/03	07/21/03	10/16/03	49.98
2003	148.76.006	DWR	Upper LNF		07/21/03	10/06/03	40.27
2003	148.76.043	NFC	Lost Pete Creek		07/07/03	07/25/03	24.25

Appendix A, Table 3, Continued.

Year	Code	Tagging Group	Watershed HUC 5	Date Past Fixed Site Upstream	Date Located at Max Migration Point	Date Past Fixed Site Downstream	Migration Distance from Tagging Location
2003	148.76.047	NFC	Headwaters NFC		08/07/03		129.04
2003	148.76.045	NFC	Headwaters NFC		08/07/03		118.63
2003	148.74.015	NFC	Isabella Creek		07/21/03	10/01/03	14.31
2003	148.76.011	NFC	Headwaters NFC		08/07/03	11/01/03	161.43
2003	148.76.035	NFC	Headwaters NFC		09/01/03		121.74
2003	148.76.017	NFC	Headwaters NFC		08/07/03		161.19
2003	148.76.016	LNF	Collins Creek	07/24/03	09/01/03		78.49
2003	148.76.046	NFC	Headwaters NFC	06/11/03	08/07/03		129.49
2003	148.48.047	NFC					
2003	148.76.010	DWR	Long Creek		08/07/03		159.80
2003	148.74.027	LNF	Headwaters NFC		09/01/03		133.07
2003	148.76.049	LNF	Upper LNF		08/07/03	10/12/03	61.1
2003	148.76.039	NFC	Middle Fork Kelly Creek		07/21/03		124.05
2003	148.74.034	NFC	Headwaters NFC		09/01/03	11/05/03	123.63
2003	148.76.004	DWR	Headwaters NFC		08/07/03		167.98
2003	148.76.023	NFC	Headwaters NFC	05/29/03	07/21/03		159.24
2003	148.74.042	NFC	Upper LNF	06/11/03	09/15/03	10/09/03	37.73
2003	148.76.028	LNF	Upper LNF				
2003	148.76.019	LNF	Upper LNF		09/15/03	10/11/03	33.18
2003	148.74.025	LNF	Upper LNF	06/18/03	09/15/03	10/16/03	63.72
2003	148.76.033	LNF	Upper LNF		08/07/03	10/13/03	60.38
2003	148.74.028	LNF	Upper LNF		08/07/03		69.23
2004	149.34.086	NFC	Schofield Creek	05/25/04	06/22/04	11/30/04	59.73
2004	149.34.089	NFC	Osier Creek	06/06/04	08/02/04		87.25
2004	149.34.091	NFC	Collins Creek	06/11/04	08/02/04	09/28/04	32.96
2004	149.34.092	NFC	NFC	06/08/04	06/08/04	06/27/04	7.5
2004	149.34.093	LNF	Middle LNF	05/27/04	08/02/04	11/05/04	28.97
2004	149.34.094	NFC	Headwaters NFC	06/02/04	07/19/04	11/19/04	122.66
2004	149.34.095	NFC	Kelly Creek	06/05/04	09/17/04	11/25/04	87.5
2004	149.34.098	NFC	Lost Pete Creek	06/05/04	06/22/04		14.77
2004	149.34.100	NFC	Long Creek	06/14/04	08/02/04		93.02
2004	149.34.101	NFC	Headwaters NFC	06/07/04	08/30/04	11/05/04	127
2004	149.34.103	NFC	Headwaters NFC	06/22/04	08/30/04		131.03
2004	149.34.106	NFC	Lost Pete Creek	06/15/04	06/22/04		16.46
2004	149.34.108	NFC	Cold Springs Creek	06/26/04	08/16/04	10/18/04	87.16
2004	149.34.111	NFC	Middle LNF	06/22/04	07/19/04		40.8
2004	149.34.112	NFC	Long Creek	06/14/04	07/19/04	10/07/04	114.6
2004	149.34.113	DWR	Headwaters NFC	07/23/04	09/17/04	10/13/04	237.23
2004	149.34.114	NFC	NFC	06/02/04			0.4

Appendix A, Table 3, Continued.

Year	Code	Tagging Group	Watershed HUC 5	Date Past Fixed Site Upstream	Date Located at Max Migration Point	Date Past Fixed Site Downstream	Migration Distance from Tagging Location
2004	149.34.115	NFC	Long Creek		08/16/04		126.07
2004	149.34.117	NFC	Isabella Creek	06/02/04	06/22/04	11/01/04	7.6
2004	149.34.120	NFC	Headwaters NFC	06/19/04	08/02/04		125.37
2004	149.34.121	LNF	Upper LNF	05/22/04	08/02/04	11/30/04	57.8
2004	149.34.122	LNF					1.61
2004	149.34.123	LNF	Upper LNF	05/22/04	08/02/04		59.8
2004	149.34.124	NFC	Beaver Creek	06/01/04	07/16/04	11/05/04	10.8
2004	149.34.125	NFC	Isabella Creek	06/25/04	07/16/04	09/28/04	11.4
2004	149.34.126	NFC	Headwaters NFC	06/15/04	09/17/04	11/05/04	126
2004	149.34.127	LNF	Middle LNF		08/30/04	11/28/04	27.1
2004	149.34.128	NFC	Collins Creek	05/30/04	08/02/04		38.7
2004	149.34.129	NFC	Headwaters NFC	05/23/04	08/30/04		125.15
2004	149.34.130	NFC	Long Creek	05/20/04	08/30/04	11/18/04	101.9
2004	149.34.131	NFC	Collins Creek	05/21/04	07/19/04		35.3
2004	149.34.132	LNF	Upper LNF	05/30/04	08/16/04	10/27/04	70.2
2004	149.34.133	LNF	Upper LNF	06/22/04	08/02/04	11/05/04	38.5
2004	149.34.134	NFC	Beaver Creek	06/06/04	08/16/04		12
2004	149.34.135	NFC	Osier Creek	06/14/04	07/19/04	11/18/04	90.7
2004	149.34.136	LNF	Upper LNF	06/22/04	07/19/04	11/19/04	71.5
2004	149.34.137	NFC	Middle Fork Kelly Creek	06/12/04	08/16/04		131.95
2004	149.34.138	NFC	Middle Fork Kelly Creek	05/10/04	08/16/04	11/25/04	112.3
2004	149.34.139	NFC	Headwaters NFC	06/03/04	08/16/04	11/10/04	117.55
2004	149.34.140	NFC		05/18/04			9.08
2004	149.34.141	NFC	Headwaters NFC	06/14/04	08/16/04		128.82
2004	149.34.142	NFC	Long Creek	06/05/04	08/16/04	11/05/04	119.6
2004	149.34.143	NFC	Collins Creek	06/23/04	07/19/04	11/05/04	23.4
2004	149.34.144	NFC	Long Creek	06/12/04			113.99
2004	149.34.145	LNF	Upper LNF	07/06/04	08/16/04		60.56
2004	149.40.001	NFC	Long Creek	06/14/04	07/19/04	11/02/04	103.3
2004	149.40.002	LNF	Upper LNF	06/22/04	08/30/04	10/21/04	74.5
2004	149.40.003	NFC	Isabella Creek	06/23/04	08/16/04	12/11/04	10.6
2004	149.40.004	NFC	Headwaters NFC	06/18/04	09/17/04	11/08/04	125.4
2004	149.40.005	NFC	Collins Creek	06/24/04	07/06/04	08/27/04	20.9
2004	149.40.006	LNF	Middle LNF	05/22/04	07/19/04	10/24/04	25.9
2004	149.40.007	LNF	Stony	06/22/04	07/19/04	09/17/04	4
2004	149.40.008	LNF	Middle LNF	06/22/04	08/30/04	10/19/04	30.7
2004	149.40.009	NFC	Headwaters NFC	06/02/04	09/17/04		125.5
2004	149.40.010	NFC	Lost Pete Creek	05/25/04			12.8
2004	149.40.011	NFC	Headwaters NFC	06/22/04	07/19/04		127.91
2004	149.40.012	NFC	Headwaters NFC	06/14/04	07/19/04	11/25/04	112.7

Appendix A, Table 3, Continued.

Year	Code	Tagging Group	Watershed HUC 5	Date Past Fixed Site Upstream	Date Located at Max Migration Point	Date Past Fixed Site Downstream	Migration Distance from Tagging Location
2004	149.40.013	LNF					5.51
2004	149.40.014	NFC	Middle LNF	08/09/04	08/30/04	11/25/04	33
2004	149.40.016	DWR	Middle LNF		08/02/04	11/04/04	47.9
2004	149.40.017	NFC	NFC				9.81
2004	149.40.019	NFC	Headwaters NFC	06/04/04	08/16/04	11/25/04	123.7
2004	149.40.021	NFC	Headwaters NFC	05/25/04	08/02/04		115.34
2004	149.40.022	NFC	Headwaters NFC	06/04/04	08/16/04		128.4
2004	149.40.023	NFC	(Beaver Creek)	06/22/04	08/16/04	11/05/04	12.1
2004	149.40.024	DWR	Floodwood Creek	07/06/04	07/19/04	09/17/04	35.3
2004	149.40.025	NFC		06/01/04	07/19/04	08/10/04	10.9
2004	149.40.026	NFC	Headwaters NFC	06/05/04	07/19/04	10/20/04	123.8
2004	149.40.027	NFC	Beaver Creek	06/16/04	07/19/04		10.81
2004	149.40.028	NFC	Quartz Creek	06/25/04	07/19/04		7
2004	149.40.029	DWR	Upper LNF	06/22/04	08/02/04	11/05/04	89.2
2004	149.40.030	LNF	Middle LNF	06/22/04	07/19/04	10/30/04	15.4
2004	149.40.031	DWR	Long Creek	06/08/04	07/19/04		134.3
2004	149.40.032	NFC	Upper LNF	06/22/04	08/02/04	10/26/04	84.34
2004	149.40.033	NFC	Upper LNF	06/22/04	07/19/04	11/05/04	18.1
2004	149.40.036	LNF	Collins Creek	05/26/04	07/19/04		59.21
2004	149.40.037	NFC	Long Creek	06/13/04	09/17/04	10/19/04	104.9
2004	149.40.038	LNF	Upper LNF	06/22/04	08/30/04	11/03/04	67.19
2004	149.40.039	NFC	Headwaters NFC	05/25/04	07/19/04		123.4
2004	149.40.040	NFC	Headwaters NFC	06/04/04	07/19/04	10/29/04	121.9
2004	149.40.041	NFC	Headwaters NFC	06/02/04	08/30/04		128
2004	149.40.042	NFC	Long Creek	06/10/04	08/30/04	10/30/04	124.2
2004	149.40.043	NFC					0.89
2004	149.40.044	NFC	Headwaters NFC	05/22/04	08/30/04	11/25/04	128.3
2004	149.40.045	LNF					1.62
2004	149.40.046	LNF	Upper LNF	05/25/04	08/02/04	M/S	66.69
2004	149.40.047	LNF	Upper LNF	05/25/04	07/19/04	11/05/04	70.5
2004	149.40.048	LNF			08/16/04		
2004	149.40.049	LNF					
2004	149.40.050	LNF	Upper LNF	06/22/04	08/02/04	10/23/04	39.1
2004	149.40.051	NFC	Upper LNF	06/22/04	08/30/04		42.2
2004	149.40.052	LNF	Middle LNF	07/06/04	07/19/04		
2004	149.40.053	LNF	Upper LNF	05/25/04	08/30/04	10/08/04	63.1
2004	149.40.054	LNF	Upper LNF	05/29/04	08/30/04	10/08/04	61.6
2004	149.40.055	LNF	Upper LNF	06/22/04	07/19/04	11/02/04	28.1
2004	149.40.056	LNF	Upper LNF	05/25/04	08/30/04	10/15/04	69.5
2004	149.40.057	LNF	Middle LNF	06/22/04	07/06/04	11/05/04	14.7

Appendix A, Table 3, Continued.

Year	Code	Tagging Group	Watershed HUC 5	Date Past Fixed Site Upstream	Date Located at Max Migration Point	Date Past Fixed Site Downstream	Migration Distance from Tagging Location
2004	149.40.058	LNF	Upper LNF	06/22/04	08/30/04	11/25/04	76.5
2004	149.40.059	LNF	Upper LNF	05/26/04	08/02/04	10/28/04	67.2
2004	149.40.060	LNF	Upper LNF	06/22/04	08/16/04		60.62
2005	148.44.010	NFC	Upper Weitas Cr.	05/28/05	08/03/05	11/11/05	73.8
2005	148.44.011	DWR			10/27/05		
2005	148.44.012	NFC	Long Creek	06/21/05	08/20/05		113.3
2005	148.44.013	NFC	Quartz Cr.	05/26/05	08/03/05	11/17/05	23.1
2005	148.44.014	NFC			09/15/05		
2005	148.44.015	NFC	Upper LNF	06/07/05	08/18/05	10/23/05	58.2
2005	148.44.016	NFC					
2005	148.44.017	NFC	NFC	06/19/05	08/05/05		6.71
2005	148.44.018	LNF	Upper LNF	05/17/05	09/01/05		66
2005	148.44.019	NFC	Cold Springs Creek	06/14/05	07/19/05	11/07/05	88.2
2005	148.44.020	LNF	Upper LNF	05/25/05	08/18/05	10/12/05	62.6
2005	148.44.021	NFC					
2005	148.44.022	BFC	Upper LNF	05/28/05	09/01/05	10/02/05	57.6
2005	148.44.023	NFC	Long Creek	06/20/05	07/19/05		117.4
2005	148.44.024	NFC	Long Creek	06/06/05	07/11/05		110.9
2005	148.44.025	BFC	Upper LNF	06/14/05	08/18/05	10/25/05	42
2005	148.44.026	BFC	Upper LNF	06/11/05	07/24/05	10/28/05	63.2
2005	148.44.027	NFC	Long Creek	06/15/05	08/18/05		111.8
2005	148.44.028	NFC	Long Creek	06/20/05	08/03/05	11/07/05	102.6
2005	148.44.029	NFC	Collins Creek	06/18/05	08/18/05	11/17/05	28.3
2005	148.44.030	BFC	Middle Fork Kelly Cr.	05/28/05	08/03/05	11/24/05	123.62
2005	148.44.031	NFC		06/25/05	08/03/05		
2005	148.44.032	NFC	Long Creek	06/15/05	08/03/05	11/02/05	102.4
2005	148.44.033	NFC	Long Creek	06/18/05	08/21/05		111.6
2005	148.44.034	NFC	Long Creek	05/30/05	07/19/05		107.4
2005	148.44.035	NFC		06/02/05	08/03/05		62.7
2005	148.44.036	LNF	Floodwood Creek		09/15/05		14.5
2005	148.44.037	NFC	Collins Creek	06/04/05	08/08/05		
2005	148.44.038	BFC	Floodwood Creek		09/01/05		10.1
2005	148.44.039	BFC	French Creek	06/15/05	08/03/05	11/13/05	85.3
2005	148.44.040	NFC	Upper LNF	05/29/05	07/24/05	10/24/05	52.7
2005	148.44.041	LNF	Upper LNF	05/14/05	07/26/05	09/29/05	63.6
2005	148.44.042	NFC	Long Creek	05/25/05	09/01/05	11/06/05	123.8
2005	148.44.043	LNF		05/10/05	05/17/05		
2005	148.44.044	BFC	Upper LNF	05/28/05	07/19/05	10/30/05	37.6
2005	148.44.045	BFC	Upper LNF	05/26/05	08/18/05	10/12/05	56.7
2005	148.44.046	LNF	Upper LNF	06/03/05	07/24/05	10/24/05	64.8

Appendix A, Table 3, Continued.

Year	Code	Tagging Group	Watershed HUC 5	Date Past Fixed Site Upstream	Date Located at Max Migration Point	Date Past Fixed Site Downstream	Migration Distance from Tagging Location
2005	148.44.047	NFC	Headwaters NFC		08/18/05		112.2
2005	148.44.049	LNF	Upper LNF	06/10/05	07/26/05	10/28/05	62.1
2005	148.44.050	NFC	Middle Fork Kelly Cr.	05/26/05	08/03/05	12/17/05	88.4
2005	148.44.051	NFC	Headwaters NFC	06/18/05	08/03/05		120.9
2005	148.44.052	NFC	NFC	05/28/05	08/03/05	09/30/05	
2005	148.44.053	NFC		05/29/05			
2005	148.44.054	NFC	Long Creek	06/01/05	08/20/05	11/17/05	119.9
2005	148.44.055	NFC	Long Creek	06/19/05	08/18/05		123.2
2005	148.44.057	NFC	Headwaters NFC	06/12/05	07/19/05	11/12/05	120.3
2005	148.44.058	LNF	Upper LNF	06/06/05	07/24/05	10/24/05	64
2005	148.44.059	NFC	Long Creek	06/19/05	08/23/05	11/20/05	109.9
2005	148.62.110	LNF	Upper LNF	06/12/05	08/18/05	10/27/05	106.4
2005	148.62.111	NFC	Cold Springs Creek	06/11/05	08/03/05		85.3
2005	148.62.112	NFC	Long Creek	06/15/05	08/03/05	09/10/05	143.82
2005	148.62.113	LNF	Upper LNF	05/30/05	07/05/05	10/23/05	22.22
2005	148.62.114	NFC	Long Creek	05/29/05	09/01/05		105.4
2005	148.62.115	NFC	NF Clearwater	06/11/05	08/18/05		64.76
2005	148.62.116	NFC	Long Creek	05/28/05	08/19/05	11/17/05	128.4
2005	148.62.117	BFC	Upper LNF	05/27/05	07/19/05	10/05/05	36.2
2005	148.62.118	BFC					
2005	148.62.119	NFC	Osier Creek	06/07/05	08/18/05		96.8
2005	148.62.120	NFC		05/15/05		06/20/05	6.03
2005	148.62.121	NFC	Cold Springs Creek	05/27/05	09/01/05	11/26/05	82.3
2005	148.62.122	LNF	Upper LNF	05/23/05	08/18/05	11/01/05	63.3
2005	148.62.123	BFC	Stony Creek		07/19/05		11.1
2005	148.62.124	NFC	Headwaters NFC	06/20/05	09/01/05		127.1
2005	148.62.125	BFC	Upper LNF	05/21/05	09/01/05	10/02/05	59.4
2005	148.62.126	DWR	Upper LNF	06/19/05	09/01/05	11/02/05	68.3
2005	148.62.127	NFC	Upper LNF	05/26/06	07/24/05		134.42
2005	148.62.128	NFC					
2005	148.62.129	BFC	Upper LNF	05/29/05	08/18/05	10/29/05	53.1
2005	148.62.130	BFC	Canyon Creek	06/26/05	07/19/05	10/09/05	93.1
2005	148.62.131	LNF	Canyon Creek	05/25/05	09/15/05	10/29/05	89.4
2005	148.62.132	LNF	Upper LNF	05/25/05	07/19/05		64.8
2005	148.62.133	BFC	Upper LNF	06/04/05	08/18/05	10/28/05	117.9
2005	148.62.134	LNF	Upper LNF	05/30/05	07/19/05	10/28/05	29.6
2005	148.62.135	NFC	Upper LNF	06/29/05	09/01/05	11/29/05	98.64
2005	148.62.136	NFC	Osier Creek	05/30/05	08/03/05	02/17/06	108.5
2005	148.62.137	NFC		05/27/05	09/01/05		
2005	148.62.138	BFC	Upper LNF	06/23/05	07/24/05	10/24/05	70.39

Appendix A, Table 3, Continued.

Year	Code	Tagging Group	Watershed HUC 5	Date Past Fixed Site Upstream	Date Located at Max Migration Point	Date Past Fixed Site Downstream	Migration Distance from Tagging Location
2005	148.62.139	BFC	Middle LNF	08/09/05	09/01/05	10/25/05	27.23
2005	148.62.141	BFC	Canyon Creek	06/03/05	09/01/05		75.21
2005	148.62.142	NFC	Long Creek	05/15/05	07/11/05	11/27/05	93.9
2005	148.62.143	NFC		06/01/05	07/19/05		
2005	148.62.144	NFC	Headwaters NFC	05/31/05	08/18/05		120.2
2005	148.62.145	LNF	Upper LNF	06/22/05	08/18/05		103.83
2005	148.62.146	LNF	Upper LNF	06/01/05	07/26/05	10/28/05	63.8
2005	148.62.147	NFC	Lower Weitas Cr	05/29/05	07/19/05		60.8
2005	148.62.148	NFC	Long Creek	06/01/05	08/03/05		110.2
2005	148.62.149	NFC			07/11/05		
2005	148.62.150	BFC	Upper LNF	05/23/05	07/19/05	10/16/05	70.1
2005	148.62.151	NFC	Middle Fork Kelly Cr.	06/04/05	09/15/05		129
2005	148.62.152	NFC	NFCR	05/28/05	07/19/05	11/12/05	9.3
2005	148.62.153	NFC	Upper LNF	06/12/05	07/26/05		100.26
2005	148.62.154	NFC	Kelly Creek	06/19/05			91.5
2005	148.62.155	NFC	Long Creek	06/17/05	08/19/05	11/26/05	108.9
2005	148.62.156	BFC					
2005	148.62.157	BFC	Upper LNF	05/26/05	09/15/05	10/13/05	61.5
2005	148.62.158	NFC	Middle Fork Kelly Cr.	05/29/05	07/19/05	11/13/05	124.8
2005	148.62.159	NFC	Upper LNF	06/03/05	09/15/05	10/02/05	112.52
2005	149.34.070	NFC	Lower Weitas Cr		07/19/05		48.2

Appendix A; Table 4. Movement of bull trout tracked continuously for over 30 minutes.

Month	Code	Time Start	Time End	Distance moved (km)	Hours tracked	km/hr	km/day
12	66200	11:42	18:04	2.62	6.37	0.41	9.88
12	70100	18:34	20:32	1.12	1.97	0.57	13.67
12	72300	20:30	22:00	0.51	1.50	0.34	8.16
12	66200	22:47	23:47	0.32	1.00	0.32	7.68
1	68200	11:31	12:42	1.14	1.18	0.96	23.12
1	66200	12:49	16:07	1.06	3.30	0.32	7.71
1	67800	13:10	15:48	0.37	2.63	0.14	3.37
1	70100	14:00	15:03	0.79	1.05	0.75	18.06
1	72300	14:10	15:13	0.35	1.05	0.33	8.00
1	68200	19:53	22:11	1.74	2.30	0.76	18.16
1	66200	21:47	23:20	0.59	1.55	0.38	9.14
1	67800	0:31	1:51	0.5	1.33	0.38	9.00
1	72300	0:00	2:51	0.72	2.85	0.25	6.06
1	67800	8:21	9:36	4.04	1.25	3.23	77.57
1	68200	10:13	11:43	2.84	1.50	1.89	45.44
1	66200	10:27	11:30	0.66	1.05	0.63	15.09
1	67100	14:04	15:27	0.29	1.38	0.21	5.03
1	66600	16:05	17:21	2.09	1.27	1.65	39.60
1	72300	18:07	20:59	2.36	2.87	0.82	19.76
1	70100	19:11	20:43	0.34	1.53	0.22	5.32
1	66200	21:23	23:02	0.96	1.65	0.58	13.96
2	69600	17:54	19:37	0.46	1.72	0.27	6.43
2	72300	20:01	21:25	0.2	1.40	0.14	3.43
2	65800	21:33	22:58	0.62	1.42	0.44	10.50
2	69000	23:59	1:19	0.4	1.30	0.31	7.38
2	69100	11:34	17:28	7.28	5.90	1.23	29.61
2	68700	11:30	15:28	0.95	3.97	0.24	5.75
2	65200	13:14	14:45	0.52	1.52	0.34	8.23
2	69400	16:21	17:30	0.85	1.15	0.74	17.74
2	67100	12:30	14:00	1.09	1.50	0.73	17.44
2	69100	14:32	15:15	0.57	0.72	0.80	19.09
2	66300	16:20	17:53	1.37	1.55	0.88	21.21
2	68700	16:36	18:04	0.11	1.47	0.08	1.80
2	65800	17:31	18:03	0.48	0.53	0.90	21.60
2	72300	19:23	20:57	0.36	1.57	0.23	5.51
2	68200	21:24	22:54	0.44	1.50	0.29	7.04
2	66200	23:54	1:15	2.94	1.31	2.24	53.86
3	65800	13:48	15:50	2.06	2.03	1.01	24.31
3	68200	9:19	11:36	4.67	2.28	2.05	49.09
3	65800	13:14	15:34	2.24	2.33	0.96	23.04
3	66600	13:36	15:27	1.3	1.85	0.70	16.86
3	72300	19:44	21:44	0.52	2.00	0.26	6.24
4	65300	12:30	14:34	1.66	2.07	0.80	19.28
4	72500	12:35	16:32	1.18	3.95	0.30	7.17

Appendix A; Table 5. Statistics for winter 2004/2005 (interval one) MAP tagged fish depths by month.

November Fish Depth	
Mean	1.72
Standard Error	0.29
Median	1.36
Mode	1.36
Standard Deviation	1.34
Sample Variance	1.79
Range	4.76
Minimum	0.00
Maximum	4.76
Sum	36.04
Count	21.00
Mean max depth at site	80.20

December Fish Depth	
Mean	2.40
Standard Error	0.14
Median	1.36
Mode	0.68
Standard Deviation	2.13
Sample Variance	4.55
Range	9.52
Minimum	0.00
Maximum	9.52
Sum	577.32
Count	241.00
Mean max depth at site	59.20

January Fish Depth	
Mean	3.09
Standard Error	0.21
Median	2.72
Mode	0.68
Standard Deviation	3.18
Sample Variance	10.11
Range	17.00
Minimum	0.00
Maximum	17.00
Sum	728.96
Count	236.00
Mean max depth at site	95.21

February Fish Depth	
Mean	2.60
Standard Error	0.15
Median	2.04
Mode	0.68
Standard Deviation	2.27
Sample Variance	5.14
Range	17.00
Minimum	0.00
Maximum	17.00
Sum	590.24
Count	227.00
Mean max depth at site	87.04

March Fish Depth	
Mean	2.61
Standard Error	0.21
Median	2.04
Mode	0.68
Standard Deviation	2.60
Sample Variance	6.75
Range	24.48
Minimum	0.00
Maximum	24.48
Sum	391.68
Count	150.00
Mean max depth at site	88.35

April Fish Depth	
Mean	0.50
Standard Error	0.14
Median	0.68
Mode	0.00
Standard Deviation	0.69
Sample Variance	0.47
Range	2.72
Minimum	0.00
Maximum	2.72
Sum	11.56
Count	23.00
Mean max depth at site	27.88

Appendix A; Table 6. Temperature statistics for winter 2004/2005 (interval one) MAP tagged fish by month.

November Fish Temperature	
Mean	6.68
Standard Error	0.43
Median	6.80
Mode	4.40
Standard Deviation	2.47
Sample Variance	6.12
Range	7.20
Minimum	2.80
Maximum	10.00
Sum	220.40
Count	33.00
Mean Surface Temp.	9.00

December Fish Temperature	
Mean	5.43
Standard Error	0.07
Median	6.00
Mode	6.00
Standard Deviation	1.91
Sample Variance	3.64
Range	10.40
Minimum	0.40
Maximum	10.80
Sum	4323.00
Count	796.00
Mean Surface Temp.	6.70

January Fish Temperature	
Mean	5.49
Standard Error	0.07
Median	6.00
Mode	6.00
Standard Deviation	1.91
Sample Variance	3.65
Range	10.40
Minimum	0.40
Maximum	10.80
Sum	4714.60
Count	859.00
Mean Surface Temp.	5.20

February Fish Temperature	
Mean	5.45
Standard Error	0.06
Median	6.00
Mode	6.00
Standard Deviation	1.87
Sample Variance	3.48
Range	10.40
Minimum	0.40
Maximum	10.80
Sum	4547.40
Count	835.00
Mean Surface Temp.	4.00

March Fish Temperature	
Mean	5.46
Standard Error	0.07
Median	6.00
Mode	6.00
Standard Deviation	1.94
Sample Variance	3.77
Range	10.40
Minimum	0.40
Maximum	10.80
Sum	4467.00
Count	818.00
Mean Surface Temp.	5.60

April Fish Temperature	
Mean	5.37
Standard Error	0.07
Median	6.00
Mode	6.00
Standard Deviation	1.87
Sample Variance	3.50
Range	10.40
Minimum	0.40
Maximum	10.80
Sum	3732.80
Count	695.00
Mean Surface Temp.	6.70

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