

## **Temporary restoration of bull trout passage at Albeni Falls Dam**

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## **Abstract**

This study was designed to monitor movements of bull trout that were provided passage above Albeni Falls Dam, Pend Oreille River. Electrofishing and angling were used to collect bull trout below the dam. Tissue samples were collected from each bull trout and sent to the U. S. Fish and Wildlife Service Abernathy Fish Technology Center Conservation Genetics Lab, Washington. The DNA extracted from tissue samples were compared to a catalog of bull trout population DNA from the Priest River drainage, Lake Pend Oreille tributaries, and the Clark Fork drainage to determine the most probable tributary of origin. A combined acoustic radio or radio tag was implanted in each fish prior to being transported and released above the dam. Bull trout relocated above the dam were able to voluntarily migrate into their natal tributary, drop back downstream, or migrate upstream to the next dam. A combination of stationary radio receiving stations and tracking via aircraft, boat, and vehicle were used to monitor the movement of tagged fish to determine if the spawning tributary it selected matched the tributary assigned from the genetic analysis. Seven bull trout were captured during electrofishing surveys in 2008. Of these seven, four were tagged and relocated above the dam. Two were tagged and left below the dam as part of a study monitoring movements below the dam. One was immature and too small at the time of capture to implant a tracking tag. All four fish released above the dam passed by stationary receivers stations leading into Lake Pend Oreille and no fish dropped back below the dam. One of the radio tags was recovered in the tributary corresponding with the results of the genetic test. Another fish was located in the vicinity of its assigned tributary, which was impassable due to low water discharge at its mouth. Two fish have not been located since entering the lake. Of these fish, one was immature and not expected to enter its natal tributary in the fall of 2008. The other fish was large enough to be mature, but at the time of capture its sex was unable to be determined, indicating it may not have been mature at the time of capture. These fish are expected to enter their natal tributaries in early summer or fall of 2009.

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Collection of threatened bull trout and other fish species were authorized under scientific collectors permits issued to EWU in 2007 by the USFWS (Recovery Permit No. TE-068143-2) and WDFW (Permit No. 08-029). Fish collections in Idaho were authorized under a scientific collectors permit issued to the Kalispel Tribe (Permit No. F-04-03).

## Introduction

The Pend Oreille and Clark Fork rivers flow 789 km (490 miles) from its source near Butte, Montana, through Pend Oreille Lake, Idaho, to its confluence with the Columbia River in British Columbia, Canada. Prior to the installation of dams, bull trout were able to migrate from tributaries located upstream and downstream of Lake Pend Oreille. The construction of Waneta (rkm 0.8), Seven Mile (rkm 9.7), Boundary (rkm 27.4), Box Canyon (rkm 55.0), Albeni Falls (rkm 145.0), Cabinet Gorge (rkm 241.2), Noxon Rapids (rkm 273.1), Thompson Falls (rkm 334.7) and Milltown (rkm 586.3) dams fragmented the bull trout habitat. None of these dams were constructed with fish passage, causing migratory corridors used by bull trout to be blocked. Blocking of migratory corridors has resulted in the failure of bull trout to return to their natal tributaries (USFWS 2000). Bull trout in the Columbia River Basin were listed as threatened by the U.S. Fish and Wildlife Service (USFWS) in 1998 (USFWS 2000).

Bull trout were historically abundant in the Box Canyon (rkm 55.5-141.5) reach of the Pend Oreille River between Metaline Falls and Albeni Falls (Scholz et al. 2008) prior to dam construction. Populations became isolated when the reach was blocked by Albeni Falls Dam at the upper end in 1952 and Box Canyon Dam at the lower end in 1957. Completion of Box Canyon Dam inundated the Box Canyon Reach, converting it from “an ideal trout stream” into a reservoir that was not conducive to bull trout production. Due to migration corridors being blocked by Albeni Falls Dam, bull trout with migratory life histories were no longer able to migrate upstream to a potential cold-water refuge in Lake Pend Oreille. As a result, the fragmented bull trout populations in Box Canyon went into “decline” and are in imminent danger of extinction unless immediate action is taken to restore the migration corridor. In the Pend Oreille Basin of Washington and Idaho, there is a paucity of bull trout in tributaries located below Albeni Falls Dam (Ashe and Scholz 1992; Scholz et al. 2005a, 2005b). Bull trout are temperature sensitive requiring water temperatures below 16° C. Between Albeni Falls Dam and Box Canyon Dam there are few cold water refuges available to bull trout. The blocking of the bull trout’s historical upstream migratory route to Lake Pend Oreille by Albeni Falls Dam has made the survival of bull trout entrained below Albeni Falls Dam remote.

Above the dam bull trout are more abundant in the Priest River drainage (Fredericks et al. 2002; Dupont and Horner 2004), several inlet tributaries of Lake Pend Oreille, notably Trestle, Granite and Gold creeks (Fredericks et al. 2002; Downs et. al. 2003) and some tributaries of the Clark Fork River (notably Lightning Creek) below Cabinet Gorge Dam (Downs et al. 2003). The Pend Oreille River, between its origin at the outlet of Lake Pend Oreille and Albeni Falls Dam, appears to be used as a migration corridor and possibly an overwintering area by bull trout (Bennett and Dupont 1993; Dupont and Horner 2004; Geist et al. 2004).

The USFWS biological opinion (USFWS 2000) noted that, “*Albeni Falls Dam was constructed without fishways to accommodate safe upstream and downstream passage of fish. . . Bull trout were abundant in the Pend Oreille River through 1957, and then abruptly their numbers decreased to the point that individual fish are now noteworthy.*”

*This abrupt decline correlates with the commencement of operation of Albeni Falls Dam in 1952. No other abrupt or widespread threat can be identified for this portion of the Pend Oreille River Basin during 1950s. In the absence of passage, migratory bull trout remaining in the Pend Oreille River will continue to be harmed.”* As a result, the USFWS (2000a, 2002b) proposed a recovery plan to address this issue. Page 166 of the recovery plan calls on the Corps of Engineers and other agencies to by October 1, 2008, *Investigate and implement upstream passage at Albeni Falls (USFWS Biological Opinion), ...as needed, to reconnect fragmented core habitat of bull trout with Lake Pend Oreille.* The Recovery Plan emphasizes conserving genetic diversity and providing opportunities for genetic exchange, which is at the heart of our proposed capture-and-haul strategy. Captured bull trout in this study that are released 8 km above Albeni Falls Dam can voluntarily move back below the dam, or into the Priest River (or it’s tributary the East River), tributaries of Pend Oreille Lake, or migrate up the Clark Fork River to the tailrace of Cabinet Gorge Dam.

Recovery of Pend Oreille bull trout has been limited by Albeni Falls Dam on the Pend Oreille River, which blocks the migration of bull trout between the river and Lake Pend Oreille (USFWS 2002a, 2002b). Fluvial bull trout that spawn in tributaries of Lake Pend Oreille and migrate downstream to the Pend Oreille River in search of forage can no longer return to their natal streams once passing the dam. This has lead to a consistent annual net loss of genetic material from these natal streams. The adfluvial life history form, which historically spawned in tributaries of the Box Canyon Reach of the Pend Oreille River and migrated upstream to the cold-water refuge of Lake Pend Oreille, can no longer migrate into the lake. Both life history forms of bull trout have been impacted since the construction of Albeni Falls Dam. Because of these impacts, the USFWS Biological Opinion (USFWS 2000) directed the action agencies to evaluate the feasibility of restoring passage at Albeni Falls Dam (see Reasonable and Prudent Measure 10.A.1.3 and Terms and Conditions 11.A.1.3 of the 2000 USFWS BiOp).

In a 2003 study by Geist et al. (2004) seven bull trout capture below the dam were implanted with radio transmitters and released in the spring effluent to determine their interaction with the dam. Through the use of radio receiver stations on the dam and mobile tracking by boat, six of the tagged bull trout below the dam were found to make repeated forays between a cold-water effluent and the base of the dam. The data collected supported the hypothesis that the bull trout originated from tributaries above the dam. If they would have originated from the tributaries below the dam, they would most likely have sought thermal refuge in their home tributary when the water temperature reached the upper end of their thermal tolerance zone.

In a 2004 study by Scholz et al. (2005a, 2005b) two bull trout captured below Albeni Falls Dam were tagged and relocated above the dam to determine if they would migrate upstream or pass back over the dam. Tracking was conducted using stationary receiver stations and mobile surveys by aircraft and vehicle. Both fish migrated from their release point into Lake Pend Oreille. One fish entered Lightning Creek and returned to the lake approximately one month later. It is presumed to have spawned in this tributary. The second fish, which was immature at the time of capture, entered Trestle Creek during the

spawning season the following year. The movements of these two fish supported the hypothesis that these bull trout originated from tributaries above the dam.

Genetic samples were taken from the bull trout captured in the Geist et al. (2004) and Scholz et al. (2005a, 2005b) studies. DNA analysis was used to compare the genetic samples with populations from the Priest River and Lake Pend Oreille drainages as well as populations from Clark Fork River tributaries below Cabinet Gorge Dam (DeHaan and Arden 2008). All nine of the fish from that were collected below Albeni Falls Dam were assigned to tributary populations of Lake Pend Oreille or the Clark Fork River below Cabinet Gorge Dam (DeHaan and Arden 2008).

Varied spawning migration strategies are used by bull trout within the Lake Pend Oreille Basin. Spawning tributaries are entered by some sexually mature bull trout in May or June, 3-4 months prior to peak spawning in September and early October. Early migrations are a critical life history adaptation allowing access to spawning tributaries with intermittent reaches of elevated water temperature during the summer and fall months (Anderson 1971; Pratt 1985; Pratt and Huston 1993; PBTTAT 1998). Due to the geology of this basin many of the streams have influent reaches that are above the water table level. During peak flows water is maintained in the channel but can drop below ground during low flows. Early migrations are a local adaptation allowing bull trout to access natal tributaries before low flow makes them inaccessible.

A late summer/early fall spawning migration also occurs from Lake Pend Oreille into the Clark Fork River and tributaries entering along the Clark Fork (Jeppson 1960; Pratt 1985; Pratt and Huston 1993; PBTTAT 1998; Scholz et al. 2005a, 2005b). A portion of the spawning population in Lightning Creek enters in August and September. Late summer or fall migration is potentially advantageous in terms of reproductive fitness because the fish remains in a more productive environment continuing to feed for a longer period, and converting more energy into gamete production. The downside of a later spawning migration is that intermittent stream reaches may block migration into home tributaries and increase the probability of straying. This is not necessarily a bad strategy, as it could potentially promote some genetic exchange between populations. Both early migrating and late migrating adult bull trout have been reported in Lightning Creek (Anderson 1971; Scholz et al. 2005a, 2005b). These behavioral differences may reflect some of the genetic diversity observed by Spruell et al. (1999) and illustrates why it is important to maintain genetic diversity among these populations. The potential of Albeni Falls Dam preventing bull trout from returning to natal tributaries above the dam to spawn and preventing those of tributaries below the dam from completing their life cycle has been documented in recent studies (Dupont and Horner 2004; Geist et al. 2004; Scholz et al. 2005a, 2005b, Scholz et al. 2008; Dupont et al. 2007).

Recently, the Avista Corporation, in conjunction with the USFWS, has initiated a program to restore upstream fish passage above Cabinet Gorge Dam on the Clark Fork River. Bull trout captured below Cabinet Gorge Dam are held in a temporary fish holding facility at Cabinet Gorge Dam. Biopsy samples are collected from each fish for “rapid response genetic analysis”. The tissue samples are sent to the USFWS genetics lab

in Abernathy Washington, where within 24-48 hours its microsatellite DNA is analyzed and compared to the microsatellite DNA of bull trout populations in tributaries of Pend Oreille Lake (below the dam) and in tributaries of Clark Fork River (above the dam). Tributary assignment based on genetic analysis is used to determine if the fish will be released above or below Cabinet Gorge Dam. The success of the Cabinet Gorge bull trout transportation project has prompted similar efforts at Noxon Rapids and Thompson Falls dams. The recent removal of dams on Big Blackfoot River, a principle tributary of the upper Clark Fork River, and Milltown Dam in the Clark Fork River have restored the Upper Clark Fork and Big Blackfoot rivers to free flowing conditions allowing more natural connectivity of bull trout. The bull trout transportation projects at Cabinet Gorge, Noxon Rapids and Thompson Falls dams provide a temporary solution for bull trout passage at each of these facilities and will likely increase the number of spawning bull trout returning back to their natal tributaries.

This approach appears to be effective in stemming the constant loss of genetic diversity of adfluvial bull trout from their spawning populations. By relocating bull trout captured below Albeni Falls Dam some measure of fish passage is restored over 734.1 km (93%) of the Pend Oreille/Clark Fork rivers, from Box Canyon Dam (rkm 55.0) to the headwaters of the Clark Fork River (rkm 789.1).

The objectives of this project are: (1) relocate bull trout collected below the dam to a release site upstream from the dam, (2) use microsatellite DNA analysis to assign the most probable natal tributary of each fish, and (3) determine if genetically assign natal tributaries match the actual tributary used for spawning. This project is consistent with other bull trout passage restoration efforts underway in the Pend Oreille/Clark Fork subunits. Moving bull trout above the dam will potentially decrease the threat of genetic integrity loss to known small, threatened populations of bull trout in the Pend Oreille basin.

## Methods

### *Study Area*

Eastern Washington University (EWU) and Kalispel Tribe Natural Resources Department (KNRD) crews sampled for bull trout in a 14 km reach of the Pend Oreille River between Indian Creek (RKM 131) and Albeni Falls Dam (RKM 145) (Figure 1).

Albeni Falls Dam was built by the U.S. Army Corps of Engineers between 1951 and 1955. Over 200 million kilowatt hours of electrical energy is produced annually by three generators at Albeni Falls Dam. Albeni Falls Dam had a mean discharge of 24.2 KCFS from 1960-2007 and a peak discharge of 138.2 KCFS during this period of record. In 2008, the mean discharge was 26.9 KCFS and the peak discharge was 97.6 KCFS. The average water temperature in 2008 was 10°C.

EWU and Battelle Northwest Laboratories maintained eleven stationary radio tracking stations on and above Albeni Falls Dam on the Pend Oreille River and Pend Oreille Lake. Four stations were setup on Albeni Falls Dam (N 48° 10.721 W 116° 59.975), one at the Priest River Mudhole Campground (N 48° 10.755 W 116° 53.517), two near the Dover Railroad Bridge north (N 48° 15.379 W 116° 39.948) and south (N 48° 15.136 W 116° 39.964) stations, and four tributaries to Lake Pend Oreille: Trestle (N 48° 17.113 W 116° 20.513), Lightning (N 48° 09.090 W 116° 10.902), Granite (N 48° 05.036 W 116° 25.323) and Gold creeks (N 47° 58.272 W 116° 27.250).

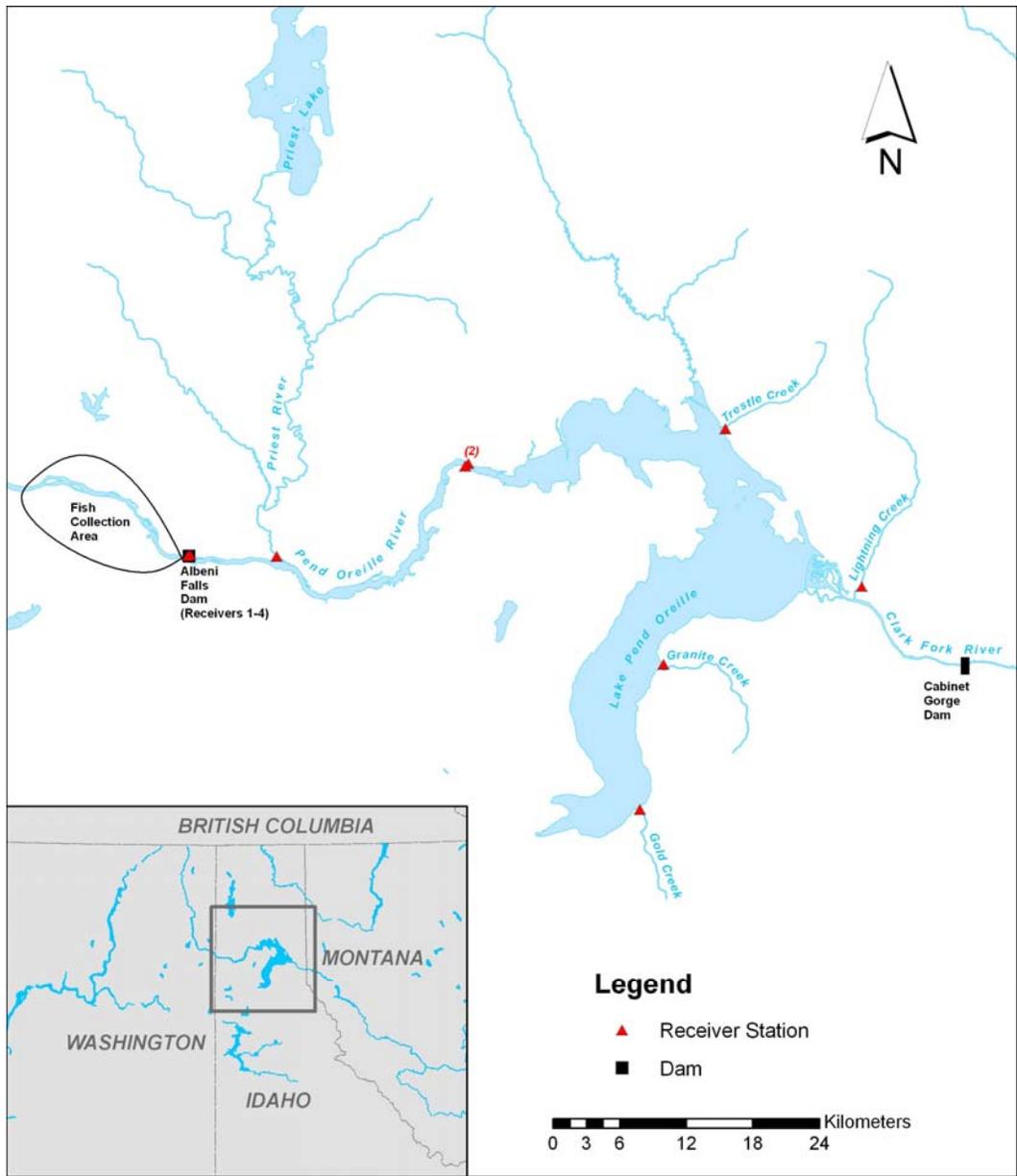


Figure 1. Map describing areas of fisheries surveys (from Indian Creek to below Albeni Falls Dam) and stationary receiver locations.

### ***Field Collections***

Boat electrofishing, hook and line, and snorkeling methods were employed to capture bull trout from the Pend Oreille River between Indian Creek, Washington (N 48° 14.650 W 117° 09.093) and Albeni Falls Dam, Idaho (N 48° 10.721 W 116° 59.975) in 2008.

*Boat electrofishing* - Standardized ten minute boat electrofishing surveys (2-4 amps, 250 volts, 120 pps, DC current) were conducted by EWU and KNRD with one boat sampling the north shoreline and the other boat sampling the south shoreline. Nineteen trips by each agency were conducted between 11-25 March, 2-30 April, 13-27 May, 3-30 June, 15-20 October, and 4 November 2008. Transects were sampled during both day and night hours.

During sampling all fish were collected and identified to species using dichotomous keys (Wydoski and Whitney 1979, 2003). All fish collected were measured to the nearest mm total length (TL) and released.

Genetic tissue samples were collected from bull trout and cutthroat trout by removing a piece of fin with a hole punch. Samples were preserved in 95% ethanol and sent to the Kalispel Tribe to be included in their basin wide microsatellite DNA analysis being funded by Bonneville Power Administration (Olson et al. 2004). A sub-sample of rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), kokanee (*O. nerka*) and mountain whitefish (*Prosopium williamsoni*) were taken and tested for diseases by the USFWS Fish Disease Center.

*Snorkel surveys* - Snorkel surveys were conducted in a culvert (N 48° 10.614 W 117° 01.137), on the south shore of the Pend Oreille River approximately 1.5 km below Albeni Falls Dam, when water elevations permitted at least 15 cm of breathing room. Cold spring water feeds the culvert from the south side of the culvert, as well as through a hole in the middle of the culvert. The direction of water flow (in or out) in the culvert depended on the elevation of the water in the river. A thermograph was placed inside the culvert to gather water temperature data. In previous years, bull trout were captured at this cold-water refuge during the summer months (Geist et al. 2004). Surveys took place on 22 July, 28 July, 6 August, and 22 August 2008 during the day. Each end of the culvert was blocked using a block net. Surveys were conducted with 2-3 individuals moving in one direction together through the culvert using underwater flashlights to spot fish. After one direction was completed, a sweep the other direction was completed. Water temperatures were taken from the center and mouths of the culvert. Water elevation, temperature, and discharge data was gathered from the US Army Corps of Engineers, Northwestern Division ([www.nwd-wc.usace.army.mil](http://www.nwd-wc.usace.army.mil)).

### ***Bull Trout Tagging and Relocation***

*Tagging Procedures* - Methods for tagging bull trout with a radio/acoustic tags are described below. The fish were placed in a large cooler (142.5 liters) with fresh water. The cooler was aerated with oxygen from a small oxygen cylinder and regulator. Ice was

used to maintain ambient river temperatures when needed. The lid was kept closed until the fish stabilizes and recovers from the stress. The fish were anesthetized with 70-100 mg/L MS 222. Once the anesthesia took effect (3- 5 minutes) the fish were checked for fin clips and scanned with a PIT tag detector to confirm it had not previously been captured and tagged.

Experienced surgeons surgically implanted transmitters using procedures described by McLeod and Clayton (1997) and Brown et al. (1999). The fish were placed in a water soaked foam block with a cut out V-notched cradle. The fish were placed dorsal side down, and water was flushed through the gills using a gravity flow bucket filled with a maintenance solution (40-60 mg/L MS 222). The bucket has a valve at the bottom that is connected to a piece of tubing that was placed into the mouth of the fish. Water was periodically poured over the fishes body during surgery to keep it hydrated. A 2-3 cm longitudinal incision was made three cm anterior to the pelvic fins. A PIT tag (DF TX 1400BE, 12 mm long, 134.KHz) was placed in the body cavity according to standard protocols (CBFWA 1999). A 16-gauge hypodermic needle was inserted through the body wall to the side and posterior to the incision. The transmitter antenna wire was inserted through the hollow needle. Once the needle was removed, the antenna was exiting the body wall of the fish. The Lotek digitally encoded radio/ acoustic transmitter (CART 16\_1, 23.8 g, 5 sec burst rate, 663 day tag life or CART 16\_2, 31.5 g, 5 sec burst rate, 904 day tag life) are operating at a frequency of 151.89 MHz (radio frequency) and 76.8 KHz (acoustic frequency). The Lotek digitally encoded radio transmitters (SR 11-18 8.0g, 5 sec burst rate, 449 day tag life or NTC-6-2, 4.5g, 5 sec burst rate, 441 day tag life) are operating at 151.89 MHz (radio frequency). The decision of which size tag to implant was based on the weight of the fish. Tag weight did not exceed 3% of the fish's weight. The incision was closed using the individual simple sutures method at approximately 1-cm intervals. Finally, a veterinary grade liquid Band-Aid (Nexband) was placed over the sutures. The fish were placed in an oxygenated cooler with fresh cold water to recover.

*Relocation* - The fish were then transported by vehicle in an oxygenated cooler to the public boat launch (N 48° 10.617 W 116° 54.245) on the east side of the town of Priest River, Idaho 7.5 km above Albeni Falls Dam. Once the fish had completely recovered, it was released into the water at the boat launch, located on the north bank of the Pend Oreille River about 1 km downstream of its confluence with the Priest River. This location was selected because it was above Albeni Falls Dam, but far enough downstream that it provides an opportunity for the fish to swim up Priest River or continue past towards Lake Pend Oreille.

### ***Tracking***

Fish movements were tracked using a combination of fixed receiver ground stations and mobile tracking using; vehicle, aircraft, and boat. The ground receiver stations operated 24 hours a day. A total mobile tracking effort of 114 hours was conducted between 28 May and 10 November 2008. A total of 65.5 hours of tracking occurred by truck, 41 hours by aircraft, and 7.5 hours by boat. Additional tracking by truck and boat was performed by Battelle, see Bellgraph and Deters (2009) for summary.

*Fixed Ground Stations* - Eleven radio receiving stations were setup for the study in the spring 2008. Receiver locations and setup were the same as during the 2003 and 2004 study (Geist et al. 2004; Scholz et al. 2005). Sites included: Albeni Falls Dam (4 stations), Mudhole Campground on the Priest River (1 station), and the Dover Railroad Bridge (2 stations) approximately 26 km upstream of the Priest River. Four additional stations were set up at the mouths of tributaries to Lake Pend Oreille: Trestle, Lightning, Granite, and Gold creeks. Each station consisted of a Lotek SRX-400 or SRX-600 radio receiver connected to aerial Yagi antennas. The receivers were supplied with either AC or DC (12 volt vehicle batteries) power. Solar panels were used to recharge DC power systems. Beacon tags were used at all stationary receiver locations to monitor receiver status. The beacon tags were programmed to transmit a one-minute signal every hour. See Bellgraph and Deters (2007) for a complete summary of installation and details of each station.

EWU worked with landowners to secure access, and to download and maintain stations via hold harmless agreements and/or permission to entry agreements. Agreements were setup with a private landowner at Gold Creek, Idaho Department of Fish and Wildlife at Granite Creek, Idaho Department of Transportation at Lightning Creek, and Idaho Department of Lands at Trestle Creek (\$100 fee for five year agreement). Procedures for calibrating each receiver station were reported by Bellgraph and Deters (2007).

All fixed receiver stations were inspected and data downloaded April 2008 through May 2009. Data were downloaded using a Lotek *Winhost* program onto a laptop computer, saved and then backed up on a removable thumb drive. After each download, data were examined for active tags, beacon tag signals, and noise. Proper adjustments to the gain were made when necessary. Each station was inspected for damage and repaired if necessary. Beacon and 12 volt batteries were replaced when necessary. Stations were winterized at the end of November, and then reset at the end of March before the April sampling began.

*Vehicle Tracking* - Tracking by vehicle was conducted 18 times between 28 May and 10 November 2008. A Lotek SRX-600 radio receiver connected to a three element Yagi antenna was used when tracking by truck. The receiver's gain was set at 50 and adjusted as needed. The antenna was attached to the hood of the truck using a Magnetic Roto Antenna Mount manufactured by Midway Telemetry.

*Vehicle Route #1* - On 28 May, 4 June, 16 June, 23 June, 2 July, and 7 July 2008 tracking began at Albeni Falls Dam (N 48° 10.721 W 116° 59.975) and followed the Pend Oreille River to Lake Pend Oreille along U.S. Route 2. The north shore of Lake Pend Oreille was tracked along ID S.R. 200 between Sandpoint, ID (N 48° 17.420 W 116° 32.933) and Clark Fork, ID (N 48° 08.752 W 116° 10.616). Colburn Culver Road (N 48° 19.386 W 116° 26.388), off of ID S.R. 200, was used to access Grouse Creek Road (N 48° 24.995 W 116° 26.381), Gold Creek Road (N 48° 22.911 W 116° 26.377), and Rapid Lightning Creek Road (N 48° 21.835 W 116° 26.377). Grouse Creek, Gold Creek, and Rapid Lightning Creek were followed for 10-15 km along these roads. Trestle Creek Road (N 48° 16.994 W 116° 20.972) and Lightning Creek Road (N 48° 08.752 W 116° 10.655)

were directly accessed from ID S.R. 200 and used to track Trestle Creek and Lightning Creek for 10- 15 km.

*Vehicle Route #2-* On 14 July, 4 August, 12 August, 27 August, and 10 September 2008 tracking began at Dover, ID (N 48° 15.153 W 116° 36.644) and followed the Pend Oreille River to Lake Pend Oreille along U.S. Route 2. The north shore of Lake Pend Oreille was tracked along ID S.R. 200 between Sandpoint, ID (N 48° 17.420 W 116° 32.933) and Clark Fork, ID (N 48° 08.752 W 116° 10.616). Colburn Culver Road (N 48° 19.386 W 116° 26.388), off of ID S.R. 200, was used to access Grouse Creek Road (N 48° 24.995 W 116° 26.381), Gold Creek Road (N 48° 22.911 W 116° 26.377), and Rapid Lightning Creek Road (N 48° 21.835 W 116° 26.377). Grouse Creek, Gold Creek, and Rapid Lightning Creek were followed for 10-15 km along these roads. Trestle Creek Road (N 48° 16.994 W 116° 20.972) and Lightning Creek Road (N 48° 08.752 W 116° 10.655) were directly accessed from ID S.R. 200 and used to track Trestle Creek and Lightning Creek for 10- 15 km.

*Vehicle Route #3 -* Tracking on 15 September, 28 September, 15 October, 22 October, 29 October, and 10 November 2008 followed the same path as vehicle route #2 with the addition of following ID S.R. 200 along the north shore of the Clark Fork River between Clark Fork, ID (N 48° 08.752 W 116° 10.616) and the Cabinet Gorge Dam (N 48° 05.196 W 116° 03.859). The south shore of the Clark Fork River was tracked traveling west on Johnson Creek Road (N 48° 08.070 W 116° 10.465) for approximately 3.5 km from the bridge crossing over the Clark Fork River and River Road (N 48° 08.026 W 116° 10.469) was used to track east from the bridge to the Cabinet Gorge Dam (N 48° 05.196 W 116° 03.859).

*Aircraft Tracking -* Tracking by aircraft was conducted using a Cessna C-182 chartered from Felts Field Aviation, Spokane, WA. A Lotek SRX-600 radio receiver connected to single two element Yagi antenna externally mounted under the right wing was utilized for aerial tracking. The receiver's gain was set at 50 and adjusted as needed. Four different flight routes were used during eleven flights between 13 June and 26 October 2008. Two test tags were placed along the flight route over Grouse Creek. One tag was attached to a tree along the shore (N 48° 26.571 W 116° 23.610) and the other was attached to a rock underwater about 1m deep (N 48° 26.266 W 116° 23.770).

*Flight Route #1 -* On 6 June 2008 the flight left Felts Field at 06:00 and proceeded directly to Albeni Falls Dam (N 48° 10.721 W 116° 59.975). Tracking began at Albeni Falls Dam and continued up the Pend Oreille River to the mouth of the Priest River (N 48° 10.600 W 116° 54.745). The flight turned up the Priest River to Priest Lake (N 48° 24.912 W 116° 55.389). The Priest River was followed on the return route to the Pend Oreille River, during which the flight branched off to track along the Upper West Branch of the Priest River (N 48° 24.912 W 116° 55.389), East River (N 48° 21.159 W 116° 51.167), North Fork East River (N 48° 22.280 W 116° 49.196) and the Middle Fork East River (N 48° 22.280 W 116° 49.196). Upon returning to the Pend Oreille River, the flight continued up the Pend Oreille River to Lake Pend Oreille (N 48° 14.391 W 116° 36.096). The flight followed along the North shore of Lake Pend Oreille to the mouth of the Pack

River (N 48° 19.187 W 116° 22.984). The flight followed the Pack River for approximately 45 km. The Pack River was followed on the return to Lake Pend Oreille, with the route branching at Grouse Creek (N 48° 24.159 W 116° 28.705) and Rapid Lighting Creek (N 48° 21.779 W 116° 24.447). Upon returning to Lake Pend Oreille, the north shoreline was followed to Trestle Creek (N 48° 16.949 W 116° 21.165). The flight followed Trestle Creek for approximately 15 km before returning down the same route to Lake Pend Oreille. The flight continued along the north shore of Lake Pend Oreille to Lightning Creek (N 48° 08.453 W 116° 11.470). The flight continued approximately 23 km up Lightning Creek, with passes over its tributaries of Rattle Creek (N 48° 19.580 W 116° 10.381) and Morris Creek (N 48° 13.458 W 116° 06.970) for approximately 5 km. The flight returned back down Lightning Creek to Lake Pend Oreille. The flight passed over Lake Pend Oreille on its return to Felts Field.

*Fight Route #2-* On 17 July 2008 and 29 July 2008 flights left Felts Field at 06:00. The flights proceeded directly to the Pend Oreille River, intercepting it at approximately (N 48° 13.608 W 117° 05.146). Tracking began at the interception point and continued down the Pend Oreille River to Box Canyon Dam (N 48° 46.799 W 117° 24.737). The flight returned up the Pend Oreille River to Albeni Falls Dam (N 48° 10.721 W 116° 59.975). After passing the dam the flight continued up the Pend Oreille River at Lake Pend Oreille (N 48° 14.391 W 116° 36.096). The flight followed along the north shore of Lake Pend Oreille to the mouth of the Pack River (N 48° 19.187 W 116° 22.984). The flight followed the Pack River for approximately 45 km. The Pack River was followed on the return to Lake Pend Oreille, with the route branching at Grouse Creek (N 48° 24.159 W 116° 28.705) and Rapid Lighting Creek (N 48° 21.779 W 116° 24.447). Upon returning to Lake Pend Oreille the north shoreline was followed to Trestle Creek (N 48° 16.949 W 116° 21.165). The flight followed Trestle Creek for approximately 15 km before returning down the same route to Lake Pend Oreille. The flight continued along the north shore of Lake Pend Oreille to Lightning Creek (N 48° 08.453 W 116° 11.470). The flight continued approximately 23 km up Lightning Creek, with passes over its tributaries of Rattle Creek (N 48° 19.580 W 116° 10.381) and Morris Creek (N 48° 13.458 W 116° 06.970) for approximately 5 km. The flight returned back down Lightning Creek to Lake Pend Oreille. The flight passed over Lake Pend Oreille on its return to Felts Field.

*Flight Route #3 -* On 7 August, 18 August, 28 August, 4 September, and 11 September 2008 flights left Felts field at 06:00. These flights flew directly for the mouth of the Pack River (N 48° 19.187 W 116° 22.984). Tracking began when the flight reached Lake Pend Oreille, approximately N 48° 15.225 W 116° 23.387. Several loops were made where the Pack River enters Lake Pend Oreille. The flight followed the Pack River for approximately 45 km. The Pack River was followed on the return to Lake Pend Oreille, with the route branching at Grouse Creek (N 48° 24.159 W 116° 28.705) and Rapid Lighting Creek (N 48° 21.779 W 116° 24.447). Upon returning to Lake Pend Oreille, the north shoreline was followed to Trestle Creek (N 48° 16.949 W 116° 21.165). The flight followed Trestle Creek for approximately 15 km before returning down the same route to Lake Pend Oreille. The flight continued along the north shore of Lake Pend Oreille to Lightning Creek (N 48° 08.453 W 116° 11.470). The flight continued approximately 23 km up Lightning Creek, with passes over its tributaries of Rattle Creek (N 48° 19.580 W

116° 10.381) and Morris Creek (N 48° 13.458 W 116° 06.970) for approximately 5 km. The flight returned back down Lightning Creek to Lake Pend Oreille. The east shore of Lake Pend Oreille was followed down to Granite Creek (N 48° 05.194 W 116° 25.670). Granite Creek was followed for approximately 15 km before returning down the same route to Lake Pend Oreille. The east shore line of Lake Pend Oreille was followed to North Gold Creek (N 48° 58.261 W 116° 27.282) and Gold Creek (N 48° 58.406 W 116° 27.165). The flight traveled up each of these tributaries for approximately 15 km before following them back down to the lake. The flight flew over the lake on its return to Felt Field.

*Fight Route #4* - On 27 September, 11 October, and 28 October 2008 flights left Felts Field at 07:00. These flights flew directly for the mouth of the Pack River (N 48° 19.187 W 116° 22.984). Tracking began when the flight reached Lake Pend Oreille, approximately (N 48° 15.225 W 116° 23.387). Several loops were made where the Pack River enters Lake Pend Oreille. The flight followed the Pack River for approximately 45 km. The Pack River was followed on the return to Lake Pend Oreille, with the route branching at Grouse Creek (N 48° 24.159 W 116° 28.705) and Rapid Lightning Creek (N 48° 21.779 W 116° 24.447). Upon returning to Lake Pend Oreille, the north shoreline was followed to Trestle Creek (N 48° 16.949 W 116° 21.165). The flight followed Trestle Creek for approximately 15 km before returning down the same route to Lake Pend Oreille. The flight followed the shoreline of Lake Pend Oreille to the Clark Fork River (N 48° 08.373 W 116° 11.370). The Clark Fork River was followed up to the Cabinet Gorge Dam (N 48° 05.196 W 116° 03.859). The flight followed the Clark Fork River back to the lake turning up Lightning Creek (N 48° 08.453 W 116° 11.470) along the way. The flight continued approximately 23 km up Lightning Creek, with passes over its tributaries of Rattle Creek (N 48° 19.580 W 116° 10.381) and Morris Creek (N 48° 13.458 W 116° 06.970) for approximately 5 km. The flight returned back down Lightning Creek to Lake Pend Oreille. On the return flight down Lightning Creek, the flight turned up Rattle Creek (N 48° 19.580 W 116° 10.381) and Morris Creek (N 48° 13.458 W 116° 06.970) for approximately 5 km. The east shore of Lake Pend Oreille was followed down to Granite Creek (N 48° 05.194 W 116° 25.670). Granite Creek was followed for approximately 15 km before returning down the same route to Lake Pend Oreille. The east shore line of Lake Pend Oreille was followed to North Gold Creek (N 48° 58.261 W 116° 27.282) and Gold Creek (N 48° 58.406 W 116° 27.165). The flight traveled up each of these tributaries for approximately 15 km before following them back down to the lake. The flight flew over the lake on its return to Felt Field.

*Boat Tracking* - Tracking by boat was conducted on 31 July and 6 August 2008. A Lotek SRX-600 radio receiver was connected to a three element Yagi antenna and a Lotek LHP hydrophone were used when tracking by boat. The receiver's gain was set at 50 and adjusted as needed.

*Boat Route #1* - On 31 July 2008 the boat was launched at the Trestle Creek boat launch (N 48° 16.606 W 116° 20.806). The northeast shoreline of Lake Pend Oreille was followed up to the bay (N 48° 17.127 W 116° 21.301) leading to the Pack River. The east shoreline of the bay was followed to the Pack River (N 48° 19.187 W 116° 22.984). The

west shore of the bay was followed back to the lake (N 48° 19.132 W 116° 22.906). A pass was made up the middle of the bay between the lake and the Pack River and back to the lake. The northeast shoreline was followed back to the boat launch.

*Boat Route #2* - On 6 August 2008 the boat was launched at the boat launch (N 48° 14.139 W 116° 17.179) in Hope, ID. Tracking was conducted in the bay south of Hope, ID and from the bay about 0.5 km into the lake. The area tracked was limited due to a hydrophone malfunction.

### ***Genetic Analysis***

*Rapid Response Genetic Identification* - Genetic samples from each bull trout were shipped to the USFW Service Abernathy Fish Technology Center for rapid genetic analysis. Each genetic sample was compared to a genetic baseline data set of 2,020 bull trout from 37 known populations within the Lake Pend Oreille and Clark Fork River system of northern Idaho and northwestern Montana. The watershed is divided into four regions: Region 1 includes tributaries to the Pend Oreille River, Lake Pend Oreille and the Clark Fork River up to Cabinet Gorge Dam, Region 2 contains Clark Fork River tributaries from Cabinet Gorge Dam to Noxon Rapids Dam, Region 3 contains Clark Fork River tributaries from Noxon Rapids Dam to Thompson Falls Dam and Region 4 contains all Clark Fork River tributaries above Thompson Falls Dam (DeHaan and Arden 2008). Baseline allele frequency data for each population was determined by genotyping all fish in 12 highly polymorphic microsatellite loci (DuPont et al. 2007).

A modified Chelex protocol was used to extract DNA from genetic samples (Miller and Kapuscinski 1996). DNA extracted at 12 microsatellite loci; *Omm1070*, *Omm1128*, *Omm1130* (Rexroad et al. 2001), *Sco104*, *Sco105*, *Sco106*, *Sco107*, *Sco200*, *Sco212*, *Sco216*, *Sco218* (DeHaan and Arden 2005) and *Smm22* (Crane et al. 2004) was amplified using polymerase chain reaction (PCR). PCR reactions were carried out in 15 µl volumes containing 2 µl template DNA, 1X polymerase buffer (10mM Tris-HCl, 50mM KCl, 0.1% Triton X-100), 1.5 or 2.0mM MgCl<sub>2</sub>, 0.2mM of each dNTP, 0.5µM of each primer and 0.2 units of GoTaq DNA polymerase (Promega Co.) (DeHaan and Arden 2008). Initial denaturation of DNA occurred for 3 minutes at 94°C, followed by 38 one second cycles at 94°C, primer specific annealing temperature for 30 seconds and primer extension for 30 seconds at 72°C, and a final extension of 7 minutes at 72°C. Applied Biosystems fluorescent dyes were used to label all forward primers. The loci produced during PCR were pooled into three multiplex sets and run on an AB 3130xl genetic analyzer. *Genemapper v4.0* (Applied Biosystems Inc.) software was used to determine multi-locus genotype of each bull trout. Genotyping error was minimized by running a positive control (a fish with a known genotype), a negative control (a sample containing no DNA), and duplicates of each sample being analyzed (DeHaan and Arden 2008).

*Natal Tributary Assignment* - Population assignment techniques implemented via the program *Whichrun v4.1* (Banks and Eichert, 2000) were used to determine the first and second most likely population of origin from within the genetic baseline dataset for each individual fish (DeHaan and Arden 2008).

## Results

A synoptic list of fish collected during the Pend Oreille River survey in 2008 was summarized (Table 1). In 2008, a total of 3,464 fish were collected via boat electrofishing in the Pend Oreille River, which represented 21 species, during 67.9 total hours of boat electrofishing (Table 2) and 18 fish were collected, representing 7 species, during 32.0 hours of hook-and-line sampling (Table 3). Seven bull trout were collected between 2 April and 22 July (Table 4). Four fish were implanted with a CART tag and a PIT tag, two were implanted with a NANO tag, and one juvenile fish, not large enough to implant a tracking tag, was implanted with a PIT tag (Table 4). Four fish implanted with a tracking tag were released at the Priest River boat launch, 7.0 km above Albeni Falls Dam. Two fish were tagged and released below the dam as part of the KNRD and Battelle Northwest study of bull trout movement below the dam. The untagged juvenile fish was released 2.6 km below the dam at the Newport boat launch.

All of the bull trout released above Albeni Falls Dam passed the Dover receiver stations heading toward Lake Pend Oreille (Table 5). Two bull trout were located during mobile tracking. One was in the vicinity of a tributary matching the results of the genetic assignment and one tag was recovered in the tributary matching the results of the genetic assignment. Two of the bull trout have not been detected at any of the stationary receivers or by mobile tracking since passing the Dover stations. A summary of the movements of each fish released above the dam are summarized below.

Table 1. Synoptic list of fish captured during Pend Oreille River surveys 2008.

<b>Family</b>	<b>Species</b>	<b>Scientific Name</b>
Cyprinidae	Peamouth	<i>Mylocheilus caurinus</i> (Richardson, 1836)
	Northern pikeminnow	<i>Ptychocheilus oregonensis</i> (Richardson, 1836)
	Tench	<i>Tinca tinca</i> (Linnaeus, 1758)
Catostomidae	Longnose sucker	<i>Catostomus Catostomus</i> (Forster, 1773)
	Largescale sucker	<i>Catostomus macrocheilus</i> Girard, 1856
Ictaluridae	Brown bullhead	<i>Ameiurus nebulosus</i> (Lesueur, 1819)
Esocidae	Northern pike	<i>Esox lucius</i> Linnaeus, 1758
Salmonidae	Lake whitefish	<i>Coregonus clupeaformis</i> (Mitchell, 1818)
	Cutthroat trout	<i>Oncorhynchus clarki</i> (Richardson, 1836)
	Rainbow trout	<i>Oncorhynchus mykiss</i> (Walbaum, 1792)
	Brook trout	<i>Oncorhynchus fontinalis</i>
	Kokanee	<i>Oncorhynchus nerka</i> (Walbaum, 1792)
	Mountain whitefish	<i>Prosopium williamsoni</i> (Girard, 1856)
	Brown trout	<i>Salmo trutta</i> Linnaeus, 1758
	Bull trout	<i>Salvelinus confluentus</i> (Suckley, 1858)
	Lake trout	<i>Salvelinus namaycush</i> (Walbaum, 1792)
	Centrarchidae	Pumpkinseed
Smallmouth bass		<i>Micropterus dolomieu</i> Lacepède, 1802
Largemouth bass		<i>Micropterus salmoides</i> (Lacepède, 1802)
Black crappie		<i>Pomoxis nigromaculatus</i> (Lesueur, 1829)
Percidae	Yellow perch	<i>Perca flavescens</i> (Mitchell, 1814)
	Walleye	<i>Sander vitreus</i> (Mitchell, 1818)

Table 2. Electrofishing mean total length (mm), range in total length (mm), and relative abundance (RA) of fish captured in the Pend Oreille River, 2008 (effort = 67.9 hrs).

<b>Species</b>	<b>N</b>	<b>RA (%)</b>	<b>TL (SD)</b>	<b>Range TL (mm)</b>
Peamouth	144	4.16	290 (50)	29-530
Northern pikeminnow	305	8.80	354 (124)	47-728
Tench	111	3.20	333 (72)	96-460
Longnose sucker	299	8.63	400 (107)	47-572
Largescale sucker	1092	31.52	456 (47)	45-570
Brown bullhead	15	0.43	251 (88)	45-318
Cutthroat trout	30	0.87	320 (65)	154-425
Lake whitefish	57	1.65	437 (29)	337-510
Rainbow trout	67	1.93	380 (137)	130-650
Kokanee	55	1.59	144 (41)	90-373
Mountain whitefish	525	15.16	326(37)	130-450
Brown trout	217	6.26	356 (78)	107-699
Bull trout	7	0.20	441(93)	285-535
Lake trout	8	0.23	557 (167)	396-947
Northern pike	7	0.20	942(221)	603-1350
Pumpkinseed	38	1.10	107 (89)	48-610
Smallmouth bass	171	4.94	248 (104)	24-500
Largemouth bass	23	0.66	291 (108)	80-470
Black crappie	9	0.26	210 (41)	132-276
Yellow perch	270	7.79	160 (65)	70-441
Walleye	14	0.40	577(100)	437-710
<b>Grand Total</b>	<b>3,464</b>	<b>100.00</b>		

Table 3. Hook-and-line mean total length (mm), range in total length (mm), and relative abundance (RA) of fish captured in the Pend Oreille River, 2008 (effort = 32.0 hrs).

<b>Species</b>	<b>N</b>	<b>RA %</b>	<b>TL (SD)</b>	<b>Range TL mm</b>
Brown trout	1	5.56	328	328
Largescale sucker	1	5.56	458	458
Mountain whitefish	1	5.56	333	333
Northern pikeminnow	2	11.11	285	285
Pumpkinseed	3	16.67	n/a	n/a
Smallmouth bass	7	38.89	270 (34)	225 - 312
Yellow perch	3	16.67	278 (30)	257 - 300
<b>Grand Total</b>	<b>18</b>	<b>100.00</b>		

Table 4. Capture date, total length, weight, sex, tag type, and tag codes for bull trout captured below Albeni Falls Dam during 2008.

Fish #	Capture date	Total length (mm)	Weight (g)	Sex	Pit tag #	Radio tag type	Tag code #
1	4/2/2008	402	546	Unknown	98512002233446	n/a	n/a
2	5/19/2008	505	1178	F	985121002196227	CART 16_2s	126
3	5/19/2008	501	1133	Unknown	985121002164616	CART 16_2s	128
4	6/11/2008	363	374.5	Unknown	Not tagged	NANO	172
5	6/18/2008	496	1241	F	985121002194596	CART 16_1	108
6	6/24/2008	535	1535	Unknown	985121002157373	CART 16_1	102
7	7/22/2008	285	200	Unknown	985121002193751	NANO	175

Table 5. Tag code, detection location, date, and current status for bull trout captured in the Pend Oreille River below Albeni Falls Dam during 2008.

Fish #	RF code	Location of last detection	Date of last location	Status
1	n/a	n/a	n/a	Fish untagged left below the dam
2	126	Passing North and South Dover stations	6/12/2008	Location unknown believed to be in lake Pend Oreille
3	128	21 km up Grouse Creek	5/28/2008	Tag recovered in Grouse Creek
4	172	Passing North and South Dover stations	6/18/2008	Location unknown believed to be in lake Pend Oreille
5	108	One mile blow the Cabinet Gorge Dam	9/22/2008	Location unknown believed to be in lake Pend Oreille
6	102	n/a	n/a	See Bellgraph (2008) status report for the US Army Corps of Engineers.
7	175	n/a	n/a	See Bellgraph (2008) status report for the US Army Corps of Engineers.

*Fish # 1* - The first bull trout was captured 0.26 km (N 48° 10.785 W 117° 00.113) below the dam on 2 April 2008 by EWU. It had a total length of 402 mm, weight of 546 g, and the sex was undetermined. This fish was not large enough to implant with a radio tag at time of capture (Figure 2). The NANO and SR Series tags were not received until later in the year. A PIT tag (#98512002233446) was inserted into the abdomen of fish#1 and it was release 2.6 km below the below the dam, at the Newport boat launch. Genetic tests determined fish #1 to be a F1 hybrid, between a bull trout and a brook trout.

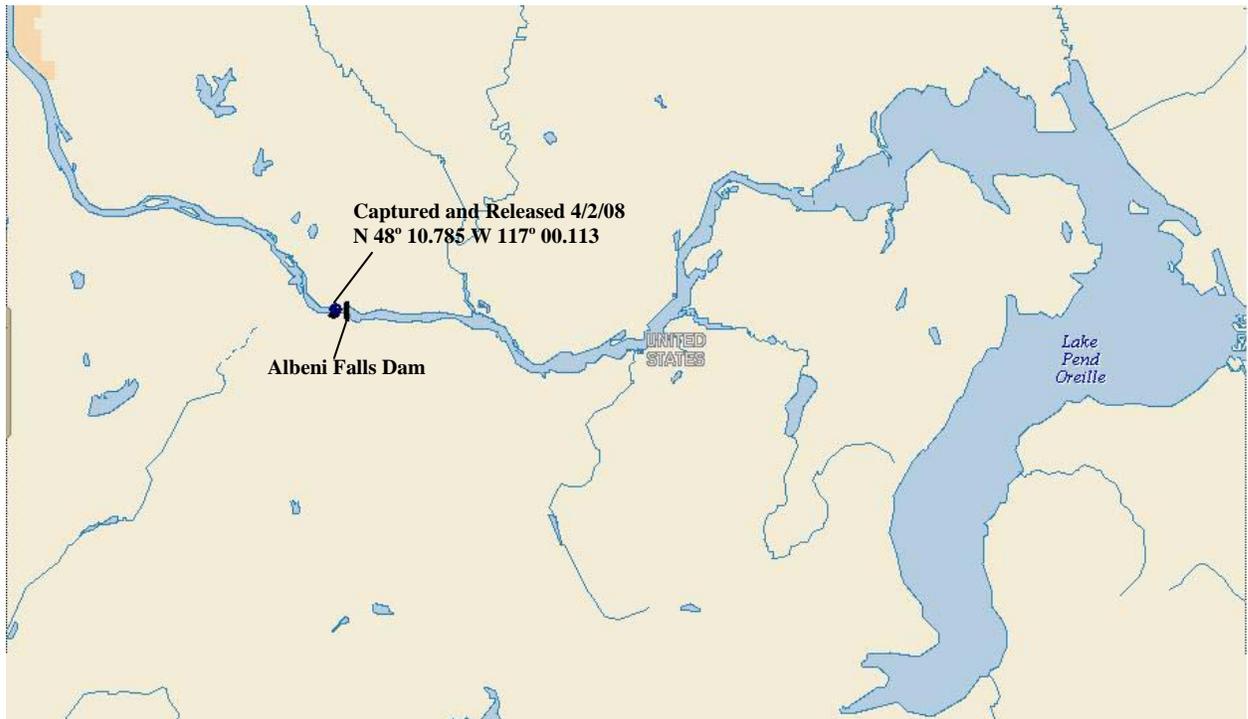


Figure 2. Fish #1 capture and release location.

*Fish #2* - The second bull trout was captured 0.88 km (N 48° 10.639 W 117° 00.637) below the dam on 19 May 2008 by KNRD. It had a total length of 505 mm, weight of 1,178 g, and the sex was undetermined. A CART 16\_2s tag (#126) and PIT tag (#985121002196227) were implanted in this fish. Results of the genetic assignment determined the most likely natal tributary for fish #2 to be Grouse Creek and Trestle Creek was determined to be the secondary possible natal tributary. Fish #2 was released on 19 May 2008 at the Priest River boat launch. During the next twenty three days fish #2 traveled 26.5km between its release site and the Dover receiver stations. Fish #2 was recorded passing the South Dover station between 11 June 2008 21:14:16 and 12 June 2008 04:04:47 and the North Dover station between 11 June 2008 21:28:58 and 12 June 2008 04:30:41. There is an overlap in the coverage areas of the North and South Dover stations, resulting in simultaneous detections at both stations. No detections were recorded on either the stationary receivers or by mobile tracking for fish #2 after passing the Dover stations (Figure 3). Transmissions for tag #128 are expected to last into November 2010. Fish #2 is currently believed to be residing in Lake Pend Oreille.

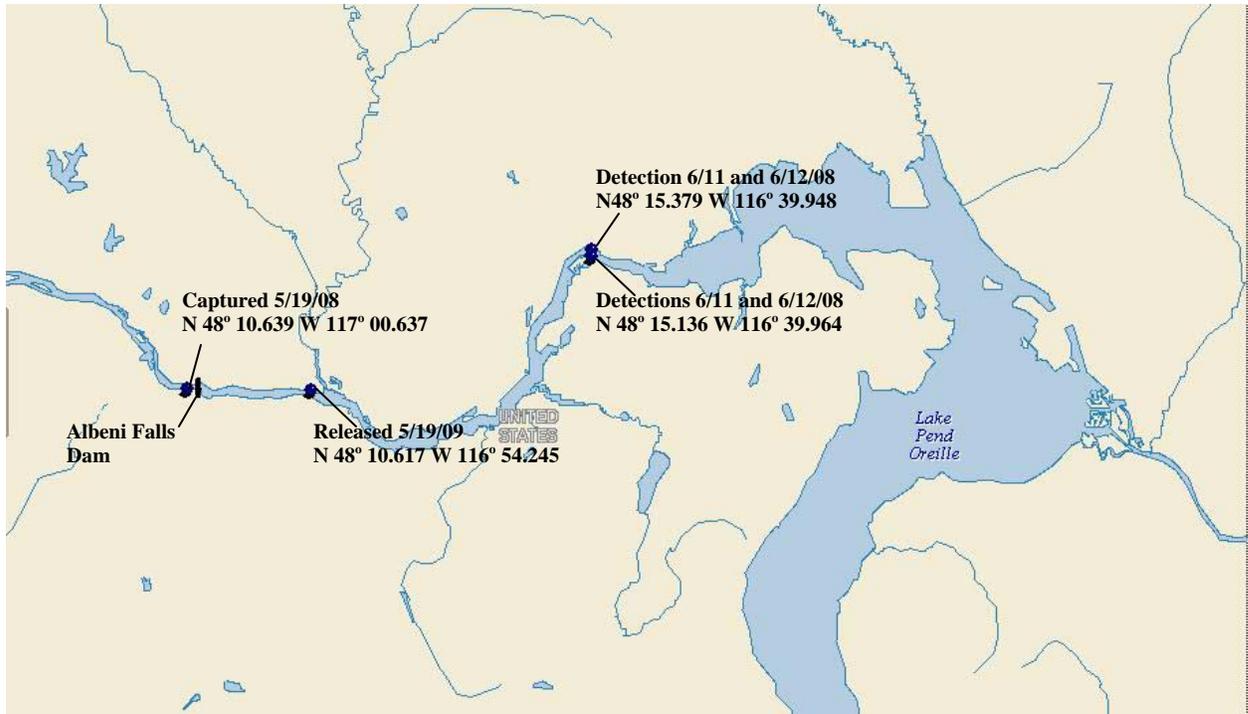


Figure 3. Fish #2 capture, release, and detection locations.

*Fish #3* - The third bull trout was captured 0.89 km (N 48° 10.652 W 117° 00.655) below the dam on 19 May 2008 by KNRD. It had a total length of 501mm, weight of 1,133 g, and the sex was female. A CART 16\_2s tag (#128) and PIT tag (#985121002164616) were implanted in this fish. Results of the genetic assignment determined the most likely natal tributary for fish #3 to be Grouse Creek and Rattle Creek, a tributary of Lightning Creek, was determined to be the secondary possible natal tributary. Fish #3 was released on 19 May 2008 at the Priest River boat launch. During the next nine days fish #3 traveled 26.5 km between its release site and the Dover receiver stations. Fish #3 was recorded passing the South Dover between 28 May 2008 06:11:01 and 28 May 2008 12:31:06. On 11 October 2008 at 08:07 fish #3 was detected during the flight over Grouse Creek (N 48° 27.829 W 116° 16.352). Detections were made on 15 October 2008 16:30 (N 48° 27.925 W 116° 16.184) and 22 October 2008 (N 48° 27.924 W 116° 16.180) during mobile tracking by truck. Tag # 128 was recovered in Grouse Creek (N 48° 27.924 W 116° 16.180) on 22 October 2008 under brush in the creek. Tag #128 was recovered undamaged in 20 cm of 10 °C water (Figure 4). No redds were found in the immediate area surrounding where the tag was recovered.

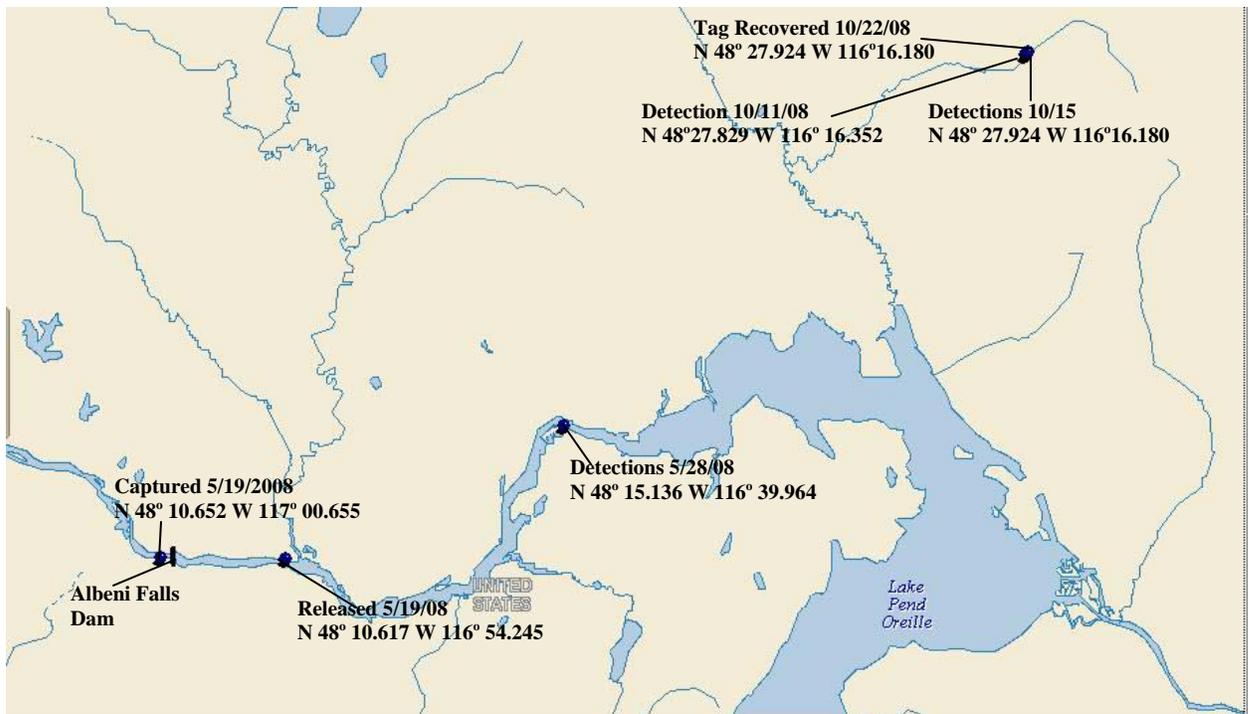


Figure 4. Fish #3 capture, release, detections, and tag recovery locations.

*Fish #4* - The fourth bull trout was captured 0.26 km (N48°10.776 W 117° 00.116) below the dam on 11 June 2008 by EWU. It had a total length of 363 mm, weight of 374 g, and the sex was undetermined. A NANO tag (#172) was implanted in this fish. Scanning with the PIT tag detector indicated a PIT tag present. It was later determined this was a false reading. Fish #4 does not have a PIT tag implanted. Results of the genetic assignment determined the most likely natal tributary for fish #3 to be Lightning Creek and Gold Creek was determined to be the secondary possible natal tributary. Fish #4 was released on 11 June 2008 at the Priest River boat launch. During the next seven days fish #4 traveled 26.5 km between its release site and the Dover receiver stations. Fish #4 was recorded passing North Dover between 18 June 2008 09:26:02 and 18 June 09:26:02. A single detection was recorded at the South Dover station on 18 June 2008 at 09:07:08 (Figure 5). No detects were recorded by either the stationary receivers or mobile tracking for fish #4 after passing the Dover stations. Transmissions for tag #172 are expected to last into August 2009. Fish #4 is currently believed to be residing in Lake Pend Oreille.

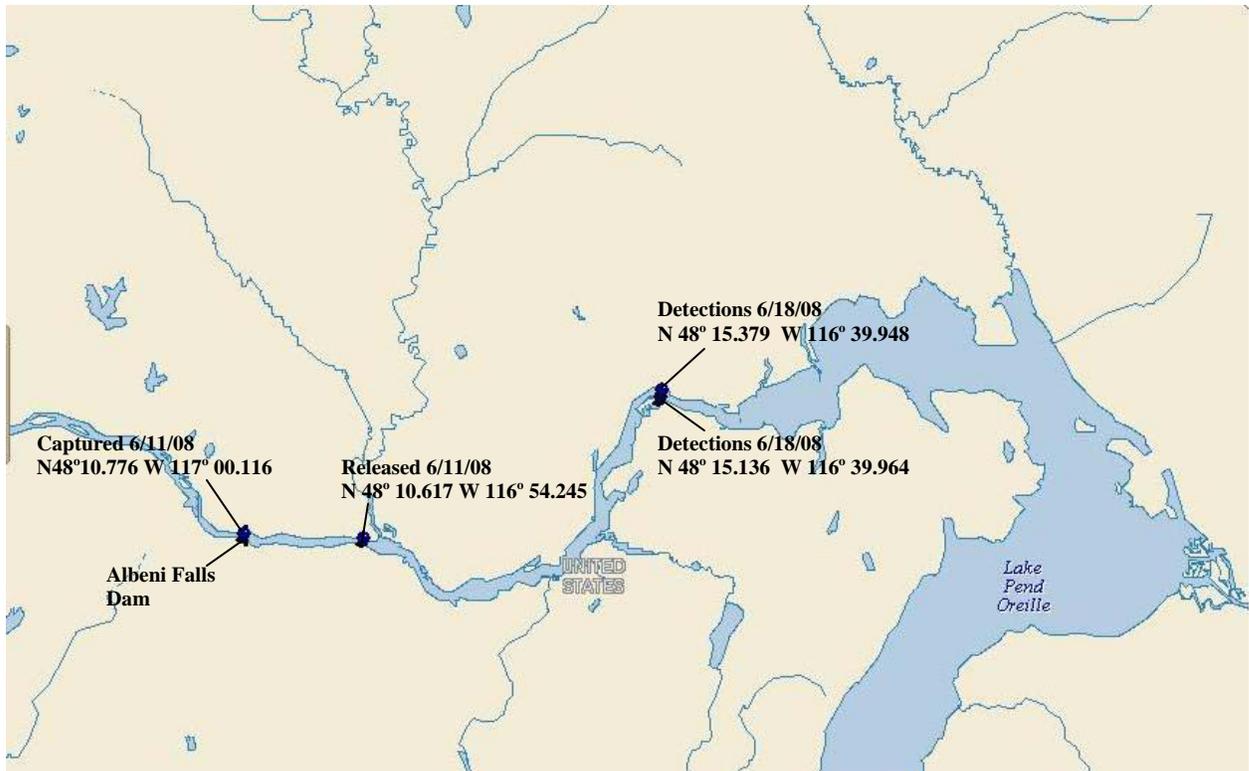


Figure 5. Fish #4 capture, release, and detection locations.

*Fish #5* - The fifth bull trout was captured 4 km (N 48° 11.732 W 117° 02.145) below the dam on 18 June 2008 by EWU. It had a total length of 496 mm, weight of 1,241 g, and the sex was determined to be female. A CART 16\_1 tag (#108) and PIT tag (#985121002194596) was implanted in this fish. Results of the genetic assignment determined the most likely natal tributary for fish #5 to be Rattle Creek and Morris Creek was determined to be the secondary possible natal tributary. Both Morris Creek and Rattle Creek are tributaries of Lightning Creek. Fish #5 was released on 18 June 2008 at the Priest River boat launch. During the five hours following being released fish #5 traveled 1 km between the boat launch and the Priest River. Detections were recorded on the Mudhole receiver on 18 June 2008 between 20:35:46 and 21:11:22. A second set of detections were recorded at the Mudhole receiver between 4 July 2008 23:22:42 and 5 July 2008 00:22:52. Analysis of detection signal strengths do not indicate fish #5 passed upstream into the Priest River. No detections were recorded for fish #5 during the 16 days between detections at the Mudhole receiver. During the twenty hours following the second set of detections at the Mudhole receiver, fish #5 travel 25.5 km to the North Dover station. Detections for fish #5 were recorded as the North Dover station was passed on 5 July 2008 between 20:50:36 and 21:20:03. On 26 September 2008 at 11:40 fish #5 was detected in the Clark Fork River (N 48° 05.647 W 116° 06.349) about 3 km downstream from the Cabinet Gorge Dam and 8 km upstream from Lightning Creek (Figure 6). No detections were recorded by either the stationary receivers or mobile tracking for fish #5 after the detection on 26 September 2008. Transmissions for tag #108 are expected to last into March 2010. Fish #5 is currently believed to be residing in Lake Pend Oreille.

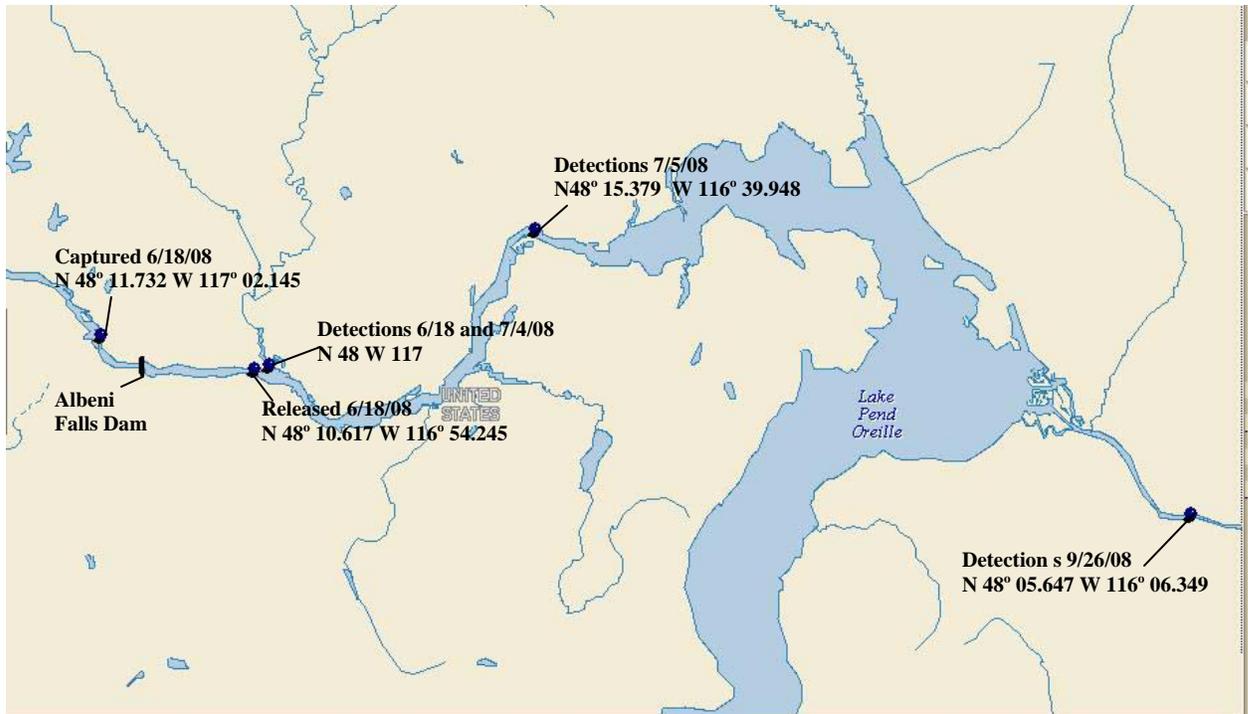


Figure 6. Fish #5 capture, release, and detection locations.

*Tagged Fish Below Dam* – Bull trout and potential surrogate species were tagged and released below Albeni Falls Dam to study movements approaching the dam. Between 24 June and 4 November 2008, 9 fish have been tagged and released below Albeni Falls Dam including; 3 westslope cutthroat trout, 1 lake trout, 2 rainbow trout, and 3 bull trout. Two of the three bull trout were captured below Albeni Falls Dam (fish #6 and fish #7) and one was relocated from Lake Pend Oreille. For fish tag data and detections see Bellgraph (2008) status report for the US Army Corps of Engineers.

## Discussion

In 2007, Eastern Washington University, the Kalispel Tribe of Indians, and Battelle Northwest teamed up to conduct a four year study on bull trout trapped below Albeni Falls Dam. The primary objective was to capture bull trout below Albeni Falls Dam in the spring, transport and release them above the dam and monitor their movements. Radio and acoustic tags would enable us to track them to their home tributaries in the Pend Oreille sub-basin. Genetic analysis from the entrained fish would identify their natal tributary as well as confirm their origin was above Albeni Falls Dam.

Seven bull trout were captured below Albeni Falls Dam during the 2008 sampling. Four of the seven bull trout captured below Albeni Falls Dam were released above the dam and are discussed below. One bull trout was not implanted with a tracking tag and was left below the dam. The remaining two bull trout were left below Albeni Falls Dam as part of the KNRD study of bull trout movements below the dam. Information on these fish can be found in Bellgraph's (2008) status report for the US Army Corps of Engineers.

The first bull trout captured in 2008 was not large enough to implant with the tags available at that time. Tags have since been purchased which can be implanted in smaller size bull trout captured during the remainder of the study. This fish was implanted with PIT tag and released at its capture location.

The second bull trout was implanted with an acoustic/radio tag, which is expected to continue transmitting until November of 2010. This fish was recorded entering Lake Pend Oreille, but not detected entering in any of the tributaries. There are several possible reasons why this fish was not detected in after entering Lake Pend Oreille: 1) This fish may have been lost from the study through predation. This is unlikely because this fish was 505 mm in length and not susceptible to predation by very many fish. 2) This fish may not have been sexually mature. The sex of fish #2 was unable to be determined. Had fish #2 been sexually mature its sex would have been determinable. 3) This fish may have been from a population that enters its spawning tributaries in early summer prior to spawning in the fall (Anderson 1971; Pratt 1985; Pratt and Huston 1993; PBTAT 1998). The genetic analysis of this fish indicated its primary tributary to be Grouse Creek and its secondary tributary is Trestle Creek. There is a stationary receiver station on Trestle Creek and the placement of an additional station at the mouth of the Pack River, of which Grouse Creek is a tributary, is in the process of being set up. It is suspected that this fish may enter one of these tributaries in the late spring/early summer or fall of 2009.

The third bull trout was a female. This fish was implanted with an acoustic/radio tag. Grouse Creek was the assigned natal tributary which did not have a remote receiver station, and was monitored via flight and vehicle tracking. On 11 October 2008, this fish was detected in Grouse Creek approximately 21 km from the mouth. This tag was recovered in Grouse Creek on 22 October 2008. No carcass was found in the area the tag was recovered. The tag was recovered undamaged under a snag of branches crossing Grouse Creek (Figure 7). It is possible that fish #3 expelled its tag during or after

spawning (Mendel et al. 2003). No redds were located in the immediate area the tag was recovered. The status of this fish is unknown. However, since the tag was recovered in the exact tributary the genetic analysis indicated it would migrate back to, it is highly likely that this fish entered the tributary and attempted to spawn. Whether this fish was victim to poaching, predation, natural mortality, or natural expelling of its tag, will likely never be determined.



Figure 7. Snag crossing Grouse Creek (N 48° 27.924 W116° 16.180), oval indicates recovery location of tag #126 from fish #3 on 22 October 2008.

The fourth fish was not sexually mature at the time of capture and only 363 mm in total length. The small radio tag implanted in this fish is expected to continue transmitting until August 2009. It is possible this fish will reach sexual maturity in the fall of 2009. Since most bull trout enter their spawning tributaries in the late spring/early summer or early fall, hopefully it be detected entering its spawning tributary prior to the tag's battery expiring.

The last bull trout released above Albeni Falls Dam was a sexually mature female. This fish was implanted with an acoustic/radio tag. This fish was assigned to Rattle Creek, a tributary of Lightning Creek. Detections of this fish occurred upstream from Lightning Creek, in the Clark Fork River during late September. During flights over Lightning Creek between mid-August through mid-October, we could see that the mouth of Lightning Creek had insufficient water flow to allow of passage to tributaries located upstream (Figure 8). This fish was located near the Cabinet Gorge Fish Hatchery, which has several cold water springs that enter the river. It is likely this fish was attracted to the cold water flow since passage to its natal tributary was blocked. The tag implanted in this fish will continue to transmit until March of 2010. Bull trout are capable of spawning annually. A study of Trestle Creek, a tributary of Lake Pend Oreille located

approximately 19 km northwest of Lightning Creek, by Downs et al. (2006) reported 93 percent of 255 tagged bull trout spawned in both 2001 and 2002. Therefore, if this fish does not enter a refractory period during 2009 it should be detected during the spawning period in 2009.



Figure 8. Lightning Creek approximately 1 km upstream from its confluence with Clark Fork River on 27 September 2008.

The sample size of this study remains low, similar to the first year. A goal of collecting 27-40 bull trout below Albeni Falls Dam was set for this study. This number was based on the capture per unit effort (CPUE) from studies performed in 2003 and 2004 (Geist et al. 2004; Scholz et al. 2005). Ten bull trout were captured during 5.2 hours of electrofishing effort by Geist et al. (2004) and two bull trout were captured during 17.5 hours of electrofishing by Scholz et al. (2005). During this two year interval 12 bull trout were captured during 17.5 hours of electrofishing for an average CPUE of 0.69 fish per hour. Assuming this catch rate was representative, we estimated 40 hours of electrofishing would provide 27 fish ( $40 \times 0.69$ ). Ideally, these fish would be collected in May and June, coinciding with the period of peak river flows and before the temperature of the Pend Oreille River reach critical temperature for bull trout ( $\geq 16^\circ\text{C}$ ). The USFWS required all sampling efforts for bull trout be suspended once river temperatures reach critical levels.

This goal was not achieved during 2008. Seven bull trout were captured during 67.8 hours of electrofishing effort, which calculated to a CPUE of 0.10 fish per hour. Factors leading to this failure may include: incorrect assumption that the 2003-04 studies were

typical representations of CPUE in the area, an alternate sampling method may have worked better for conditions present in 2008, and/or extremely high flow rate during the ideal sampling times limited electrofishing efficacy.

A study by Ashe and Scholz (1992) of the whole Box Canyon Reservoir between 1998 and 1990 only produced four bull trout during 216.6 hours of electrofishing effort for a calculated CPUE of 0.02 fish per hour. During 2003 study by Geist et al. (2004) a surprising number of bull trout were caught in a short period of time producing a CPUE of 0.69 fish per hour. During high discharge periods the water temperature below the dam is relatively low and the bull trout have no need to seek out coldwater refuges. When discharge is decreased water temperature below the dam begins to rise and bull trout begin searching for a coldwater refuge, such as the culvert 1.5 km below the dam. It is possible that these fish may have been collecting below the dam for several years and using the culvert as a coldwater refuge. The CPUE for bull trout in 2004 was 0.16 fish per hour (Scholz et al. 2005), the CPUE in 2007 was 0.05 fish per hour (Scholz et al. 2008), and the current study had a CPUE of 0.10 fish per hour. If the CPUE of the Geist, Scholz, and the current study are averaged the calculated mean CPUE is 0.19 (20/107.5). The CPUE for setting the goal of this study may have been artificially inflated by the unusual number of bull trout captured during a short period of sampling in the Geist et al. study (2004).

Electrofishing is most effective in water less than two meters deep. About 75 percent of the tailrace below Albeni Falls Dam has a depth greater than two meters. Discharge from the spillway and powerhouse between 1 March and 30 June 2008 increased the water level in the tailrace by an average of approximately 2.3 meters with a maximum increase of approximately 4.3 meters during the peak discharge. During 2008 our fish sonar indicated large numbers of fish at depths greater than two meters. The majority of sampling in 2008 occurred during periods where water depths were much greater than two meters. We suspect bull trout may be residing at depths below the effective range of the electrofishing equipment. In 2009 we plan to increase the use hook-and-line sampling during times when water depths would make hook-and-line sampling more effective than electrofishing.

Snotel data (15 April 2008) reported snow accumulation in the Idaho Panhandle region (includes Pend Oreille and Clark Fork rivers) was 111% of normal and that the snow pack contained 121% snow water equivalent (Snotel Internet site: [http://www.wrcc.dri.edu/cgi-bin/sno\\_nar3\\_pl](http://www.wrcc.dri.edu/cgi-bin/sno_nar3_pl)). In western Montana, snow pack averaged 96% of normal with a snow water equivalent averaging 106% of normal in the Flathead, Clark Fork, and Bitterroot basins, which form the headwaters of the Pend Oreille River (Snotel Internet site: [http://www.wrcc.dri.edu/cgi-bin/sno\\_nar3\\_pl](http://www.wrcc.dri.edu/cgi-bin/sno_nar3_pl)). Therefore an above average discharge, similar to the 2003 discharge, was anticipated for 2008. It was then hypothesized that more bull trout would be entrained below the Albeni Falls Dam during the above average spring freshet.

More bull trout were captured below the dam in 2008 than 2007. However, the discharge was much greater than anticipated. The mean discharge (26.9 KCFS) in 2008 was 111%

of the mean discharge (24.2 KCFS) for the period of record (1960-2007) and the peak discharge (97.6 KCFS) was 71% of the peak discharge (138.2 KCFS) for the period of record (1960-2007). The mean discharge during the May 2008 was 18.7 KCFS greater than the May 2003 discharge and the June 2008 was 40.0 KCFS greater than the June 2003 discharge. It was hypothesized the distribution of the bull trout was over a greater area due to increased discharge over an extended time period. This year the discharge rate will be closely monitor and adjustments will be made to fishing effort accordingly to increase our chances of capturing bull trout. There are several tributaries downstream from Albeni Falls Dam which have the potential to attract bull trout. In 2009 we plan to expend more effort fishing the mouths of these tributaries during the time of high discharge at Albeni Falls Dam.

During sampling at the Boundary Dam tailrace, two bull trout with Trestle Creek origins were collected (Seattle City Lights, 2008 *unpublished data*). These fish passed through three dams (Albeni Falls, Box Canyon, and Boundary) before being captured. Recovery of these fish below Boundary Dam supports the hypothesis that the high flow rates increased the range over which the bull trout traveled downstream. Another hypothesis is that these fish continued traveling downstream in search of a cold water refuge.

As of 21 April 2009, the snow accumulation (Snotel Internet Site, 2009) in the Idaho Panhandle Region, based on 7 of 10 stations reporting, was 84% of normal with a 90% snow water equivalent. In Montana, the snow accumulation (Snotel Internet Site, 2009) in the Flathead River Basin, based on 15 of 15 stations reporting, was 87% of normal with an 90% snow water equivalent. The Upper Clark Fork River Basin, based on 14 of 15 stations reporting, was 104% of normal with a 106% snow water equivalent. The Bitterroot River Basin, based on 7 of 7 stations reporting, was 101% of normal with a 102% snow water equivalent. These three Montana river basins form the head of the Pend Oreille River. As of 21 April 2009, the snow accumulation in the Northern Idaho Panhandle is 95% of the accumulation in 2003. In Montana, the Flathead River Basin is at 101%, Upper Clark Fork is at 106%, and the Bitterroot River basin is at 95% of the snow accumulation in 2003. Depending on temperature, the timing of the melt, and amount of drainage within these basins the level of discharge at Albeni Falls Dam could be comparable to what was seen in 2003. We suspect the number of bull trout passing over the dam is related to the amount and timing of the discharge. This year's discharge could potentially match that of 2003 when a large number of bull trout were caught in a short time period.

In addition to this study, bull trout are being collected below Albeni Falls Dam to study their movements related to flows as part of a fish passage assessment study. This study is being conducted for the US Army Corps of Engineers by KNRD and Battelle Northwest. The fisheries agencies in the area have requested a portion of the bull trout we capture in 2009 be released below Albeni Falls Dam to increase their data points. In 2008, two of the seven bull trout captured during sampling were left below Albeni Falls Dam as part of this study. The division of bull trout between the two projects can potentially reduce the number of bull trout released above the dam in 2009.

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