Native Fisheries Research and Monitoring in Glacier National Park, Montana: 2008 Summary Report

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ABSTRACT:

The Transboundary Flathead River basin in Montana (USA) and British Columbia (Canada) hosts one of the most diverse and unique aquatic ecosystems throughout North America. Migratory bull trout (*Salvelinus confluentus*) and non-hybridized westslope cutthroat trout (*Oncorhynchus clarkii lewisi;* WCT) migrate from Flathead Lake upstream to the Canadian headwaters to spawn and rear, representing some of the last remaining strongholds in the basin. However, proposed open-pit coal mining and coalbed methane (CBM) drilling in the Canadian headwaters threaten water quality, invertebrate communities, and migratory fish populations downstream to Glacier National Park (GNP) and Flathead Lake. In response to these threats, a multi-agency, long-term research and monitoring program was initiated in 2005 to examine water and sediment chemistry, contaminant levels, aquatic habitat, and the distribution and genetic diversity of native fishes. In 2008, basin-wide fisheries surveys were initiated and data were collected at 119 sites in Canada and GNP. A total of 62 reaches, distributed among 21 streams and 12 habitat patches were sampled from June-September 2008 in GNP. WCT (N = 227) were widely distributed throughout the study area; WCT were detected in 47 reaches, 17 streams and 11 habitat patches. Bull trout (N = 13) were detected in 8 reaches, 6 streams and 4 habitat patches and were generally found in headwater streams in the Bowman and Kintla drainages. Bull trout and WCT occurred in sympatry in just one reach. Continuation of these collaborative investigations will provide necessary baseline data to inform conservation and management decisions impacting this diverse and sensitive transboundary system.

This report meets the reporting requirements for the Interagency Agreement between the USDI National Park Service, Glacier National Park, and the United States Geological Survey, Rocky Mountain Science Center, to provide research, staff, time and other resources towards collection of baseline fisheries and water quality data in the upper Flathead River System in Glacier National Park in advance of potential coal mining, coal-bed methane extraction, gold mining and logging. This report includes summary information to meet the requirements for Task A and C under the Agreement. Results of the bull trout spawning surveys will be reported by the National Park Service, Chris Downs, Fishery Biologist, Glacier National Park, by spring 2009. We thank Carter Fredenberg and Terra Marotz for field data collection, and Jack Potter, Chris Downs, and Mary Riddle for administration and assistance with the project. The document should be cited as:

D'Angelo, V., and C.C. Muhlfeld 2009. Native Fisheries Research and Monitoring in Glacier National Park, Montana: 2008 Summary Report. Progress report to the National Park Service, Glacier National Park by the USGS Northern Rocky Mountain Science Center, Glacier Field Office, Glacier National Park, Montana, USA.

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INTRODUCTION

Research conducted by the USGS Northern Rocky Mountain Science Center (NOROCK), Montana Fish, Wildlife and Parks (FWP), the University of Montana (UM) and several partnering agencies demonstrates that the Transboundary Flathead Basin in Montana, USA and British Columbia (BC), Canada, hosts one of the most diverse and unique native aquatic ecosystems throughout North America. Despite these tremendous ecological values, the Canadian headwaters are targeted for coal-bed methane (CBM) drilling and open-pit coal mining, threatening water and habitat quality, migratory fish populations, and all aquatic life in the headwaters downstream to Glacier National Park (GNP) and Flathead Lake in the USA. Therefore, an international fisheries research project was recently launched to help the United States prepare to meet this challenge to the ecological integrity of one of the Crown Jewels of our National Park System and the irreplaceable and extraordinary international value of the Flathead River-Lake Ecosystem.

A history of coal mining and CBM extraction in the nearby Elk River in Canada and preliminary data from the North Fork strongly suggest that sediment and water pollution from the proposed activities will degrade waters in the USA, thus posing a real and eminent threat to the shared environment of the Transboundary Flathead, GNP, the Flathead Valley and Flathead Lake. The Flathead basin is recognized as a stronghold for native trout in the northern Rocky Mountains, including the threatened bull trout (*Salvelinus confluentus*) and state sensitive westslope cutthroat trout (*Oncorhynchus clarkii lewisi;* WCT). Research shows that a majority of bull trout and WCT migrate from Flathead Lake to spawn in the Canadian headwaters- the same areas proposed for gas and oil development (Muhlfeld et al. In press). These areas likely offer cold, clean water, silt-free streambeds, and diverse and connected habitats, which are critical for persistence of native salmonid species (Boyer and Muhlfeld 2006). However, the status of these transboundary fish populations and their habitats are not known.

This collaborative research project will assess the distribution, abundance, life-history, and genetic characteristics of native fishes in GNP and the Canadian portion of the drainage over the next five years. These baseline data will be used as a reference point for long-term population and habitat monitoring prior to potential mining or CBM development. This is a cooperative project with Montana Fish, Wildlife and Parks, the University of Montana, the State of Montana, BC Ministry of Environment, and the Ktunaxa (too-nah-hah) First Nation of Southeast British Columbia to manage a shared transboundary watershed.

Fieldwork to gather fish and habitat data for the GNP portion of this project began in May 2008 and continued through mid-September. The data collected in GNP in 2008 began the process of identifying crucial WCT and bull trout habitat by establishing a knowledge base that will contribute to more in depth studies and long-term monitoring in the future. Sampling reaches (N = 62) in 2008 were located primarily in tributaries to the North Fork of the Flathead but also included several tributaries to the Middle Fork of the Flathead (Figure 1).

This report provides a description of the methods employed in GNP during the 2008 field season in addition to a descriptive stream-by-stream summary of fish population and habitat sampling results. The fisheries data summarized here focus on the distribution (presence/absence) of WCT, bull trout, and sculpin (*Cottus sp.*), and other native and nonnative fishes. Estimates of relative abundance (catch per unit effort-CPUE; fish >75 mm/hr) and density (fish > 75 mm/100 m^2) are provided for WCT and bull trout, which are negatively

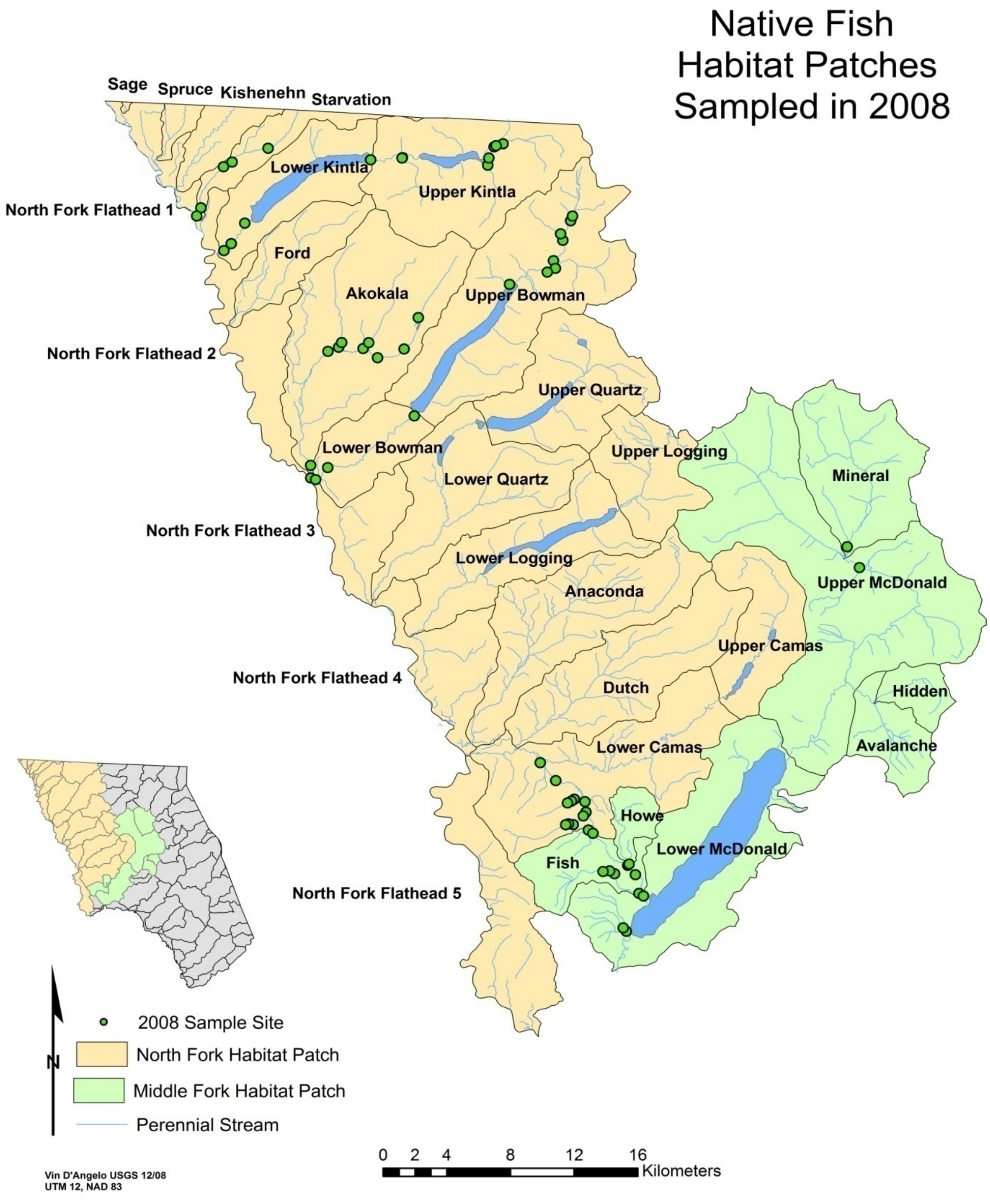

Figure 1: North Fork Flathead and Middle Fork Flathead habitat patches with 2008 fish and habitat sampling reach locations.

biased since reaches were sampled using one-pass electrofishing rather than depletion sampling.

A series of habitat variables were also quantified at each reach. Reach specific fish and habitat data are provided in Appendix A, and Appendix B provides fish density and CPUE estimates for WCT and bull trout in each stream. Appendix C contains length frequency distributions for WCT and bull trout stratified by stream when more than five individuals of a species were captured.

Presently, the bulk of these results are only descriptive. Habitat metrics measured at each reach will potentially correlate with the presence/absence, relative abundance and density of WCT and bull trout. These data will then contribute to the future refinement of critical habitat and detection probability functions according to actual fish distributions.

METHODS

The primary focus of this work is to determine the distribution, abundance and genetic status of WCT and bull trout within the North Fork of the Flathead and GNP. Delineating a watershed into habitat “patches” is a method of determining the geographical boundaries for potentially localized populations of WCT and bull trout (Rieman and McIntyre, 1995; USFWS 2008). Patches are loosely defined as contiguous areas within a watershed or drainage where spawning and early rearing can occur and a local population could be supported (USFWS 2008). Ideally, habitat patches can be used as consistent sampling frames to track changes in the target species demography over time (USFWS 2008). Prior to the delineation of patches based on actual fish distribution and abundance data, potential patches (where species of interest may or may not be present) must be delineated.

Potential bull trout and WCT habitat patches were delineated (Figure 1) using available GIS layers and adaptations of the methods outlined in the Bull Trout Recovery Monitoring and Evaluation Guidance document (RMEG; USFWS 2008). Developing potential habitat patches based on species' distributions was not possible given the minimal current habitat, temperature and species distribution data available for the North Fork of the Flathead watershed in GNP. Therefore, patches were delineated based on current data and hydrologic and geographic boundaries at the sub-watershed level (Figure 1).

Data collected in 2008 are the beginning of an effort to identify the general bounds of WCT and bull trout patches. These data will be used to develop detection probability curves to estimate the level of effort needed to determine presence or absence of the target species in a given habitat patch, stream or sample reach. Estimates of WCT and bull trout relative abundance (catch per unit effort-CPUE) and distribution (presence/absence) will be obtained for each potential habitat patch. Additionally, genetic sampling within each patch will be used to determine hybridization status and genetic structure (Boyer et al. 2008).

Patch Delineation and Sample Reach Selection

Preliminary habitat patches were delineated using a GIS layer outlining the boundaries of 1-4th order perennial streams (Strahler classification system) in the North Fork and Middle Fork of the Flathead watersheds (Figure 1). Most sub-watersheds contain 1st-3rd order streams and resulting patch boundaries are often where two 2nd or 3rd order streams meet. The lowest elevation patches border the mainstem of the North Fork (Figure 1).

The number of reaches sampled per patch should be determined by the probability of detection for previous bull trout or WCT density data for a given area (USFWS 2008). Without sufficient data to start with in the North Fork patches, an uninformed probability of detection of 0.50 was assumed (i.e., if a random reach in a patch is sampled, the probability of detecting WCT or bull trout is 0.5). The 0.5 value was chosen based on previous sampling in BC and the North Fork in the USA (FWP unpublished data, Kalispell). According to RMEG, to maintain 95% statistical power at a 0.50 probability of detection, at least 5 reaches must be sampled per patch (USFWS, 2008). In the GNP patches, a minimum of 5 reaches will be sampled per patch and if bull trout and WCT are not detected, a maximum of 12 reaches will be sampled. Twelve habitat patches were sampled in GNP in 2008; six patches contained at least 5 sample reaches (Table 1, see Appendix A). Additional sampling will be conducted as time and field conditions allow.

Sample reach locations were distributed longitudinally throughout each patch depending upon logistics and ease of access (Figure 1). The upper limits of each patch were delineated as channel gradients equal to or exceeding 10%, as this is generally the upper gradient limit of many salmonid species in the Rocky Mountains (Post and Paul 2001). Previous exploratory work regarding bull trout distributions set a minimum reach length and a minimum number of pools per reach (Rieman et al. 2006). In effort to conduct a similar exploratory search for bull trout and WCT in the GNP patches, each reach sampled contained a minimum of two pools and was a minimum of 50 meters long. Pools were defined as low velocity areas spanning at least half the channel width. A maximum of 150 meters of stream were included in the reach if two pools were not easily found due to the channel morphology of the reach.

Temperature Monitoring

Hobo U22 Water Temp Pro v2 dataloggers were deployed in 30 locations within the North Fork study area and Middle Fork Flathead watershed from June-October 2008 (Figure 2). The dataloggers were programmed to record temperature in degrees Celsius every hour for the duration of deployment (one year).

The location of each datalogger was documented by GPS waypoints, digital photographs, hand drawn maps and detailed descriptions of locations (i.e., number of paces upstream of a bridge crossing) (Figure 2). Unique Site IDs were recorded for each datalogger. Technicians placed loggers in locations where they will likely remain submerged despite seasonal changes in water levels. Dataloggers were tied to root wads, rocks or other sturdy pieces of substrate using thin wire rope and steel clasps. Primary data of interest are maximum summer temperatures and temperature-elevation relationships. To obtain representative temperature data for each potential habitat patch, dataloggers were distributed longitudinally in each patch as logistics allowed (Figure 2).

Fish Sampling

One-pass, backpack electrofishing was conducted at each of the sample reaches with a Smith-Root LR-24 backpack electrofisher. Electrofishing was conducted moving upstream in each section during daylight hours (between 10:00 H and 17:00 H). Start and end times were recorded to determine CPUE (fish/hour). Block nets were not used to establish reach boundaries. The crew consisted of one person carrying the electrofishing unit and one or two people netting fish. Adjustments of electrofisher settings were made at the discretion of the

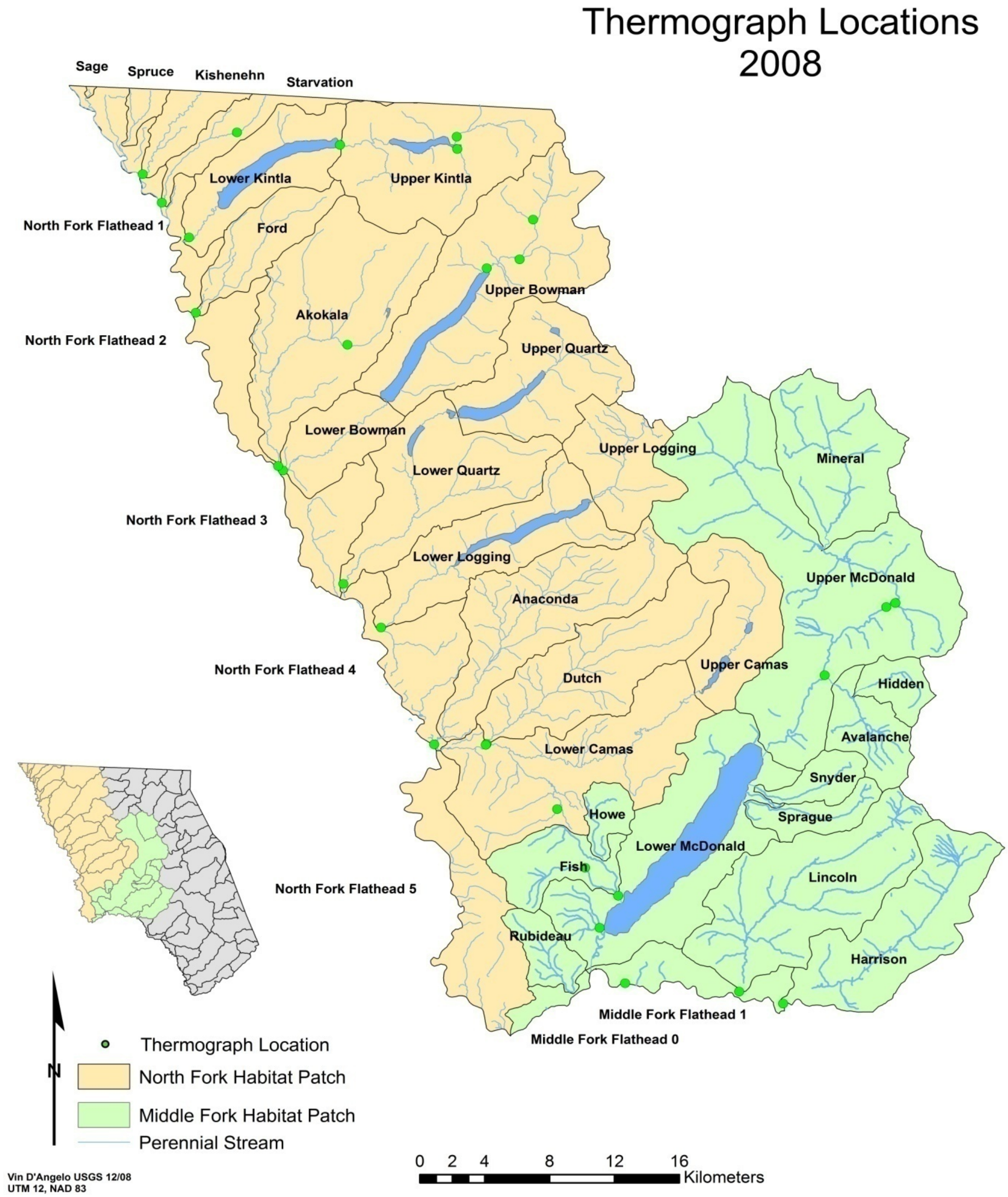

Figure 2: HOBOv22 thermograph sites, 2008.

crew leader and made in response to conditions (i.e., temperature and conductivity) and fish behavior (i.e., tetanus v. taxis). The entire channel was sampled in a zigzag manner. Water temperature was recorded at the beginning of each survey.

All captured fish were netted and placed in buckets. After the entire reach was sampled, captured fish were anesthetized using MS-222. All fish will were numbered, identified to species (WCT, bull trout, mountain whitefish-*Prosopium williamsoni*, and sculpins) and measured (total length (mm)). Genetic (fin clip) and scale samples were taken from fish in each sample reach with the exception of young of the year (YOY) individuals. Scale samples and anal fin clips were collected from ten trout (*O. spp*.) and the first ten char encountered (*Salvelinus sp*.). Fin clips were placed in a vile of 95% ethanol in preparation for laboratory analysis and scales were stored in envelopes. All trout or char captured were included in the analysis if less than ten trout or char were encountered. All viles were labeled appropriately to allow for identification of specific fish attributes (species, length, weight), and capture location (specific reach and habitat patch).

Habitat Sampling

For each sampling reach, the following habitat parameters were collected:

- **Elevation** was determined by handheld GPS units or topographic maps
- **Temperature ^{o}C** was measured by a handheld thermometer before and after fish sampling
- **Large woody debris** (LWD), in total pieces, was counted for the entire length of each reach. LWD = wood > 10 cm in diameter and > 3 m in length. Only pieces of wood directly within the channel or within 1 m of the water surface were counted. Counts included total pieces per reach. For large clusters of LWD (aggregates or root wads) the number of pieces contained was visually estimated and the presence of aggregates and root wads was noted. The total number of LWD aggregates (clusters of at least 5 LWD pieces) was recorded.
- **Wetted width** (m) was obtained using a tape measure at least three times per reach and averaged for each reach.

- **Reach area** in m^2 was calculated from the average wetted width (m) x length (m)
- **Dominant and subdominant substrate** were determined in a representative riffle using a modified Wentworth scale (sand and silt (0.2 cm; rank 1), small gravel (0.2–0.6 cm; rank 2), large gravel (0.6–7.5 cm; rank 3), cobble (7.5–30.0 cm; rank 4), boulders (>30cm; rank5) and bedrock (rank 6).
- **Gradient** was measured with a handheld clinometers looking upstream from the starting point of the reach and downstream from the endpoint with the two measurements averaged for each reach.

FISH AND HABITAT DATA BY STREAM FOR GNP, 2008

A total of 62 reaches (5.4 km of stream), distributed among 21 streams and 12 habitat patches were sampled in GNP from June-September 2008 (Figure 1). Sample reaches ranged from 889-1469 m in elevation (Table 1, see Appendix A). We detected WCT in 42 reaches, 17 streams and 11 habitat patches (N = 227; Figure 3). Bull trout were detected in 8 reaches, 6 streams and 4 habitat patches (N =13; Figure 4).

WCT were detected in far greater numbers than bull trout and were well distributed throughout sampling sites. WCT were detected in both headwater and lower elevation reaches; the Upper Kintla habitat patch was the only patch where WCT were not detected (Figure 3). WCT densities (WCT>75mm/100m^2) and relative abundance estimates based on CPUE (WCT>75mm/hr) were highest in lower elevation reaches in smaller streams such as

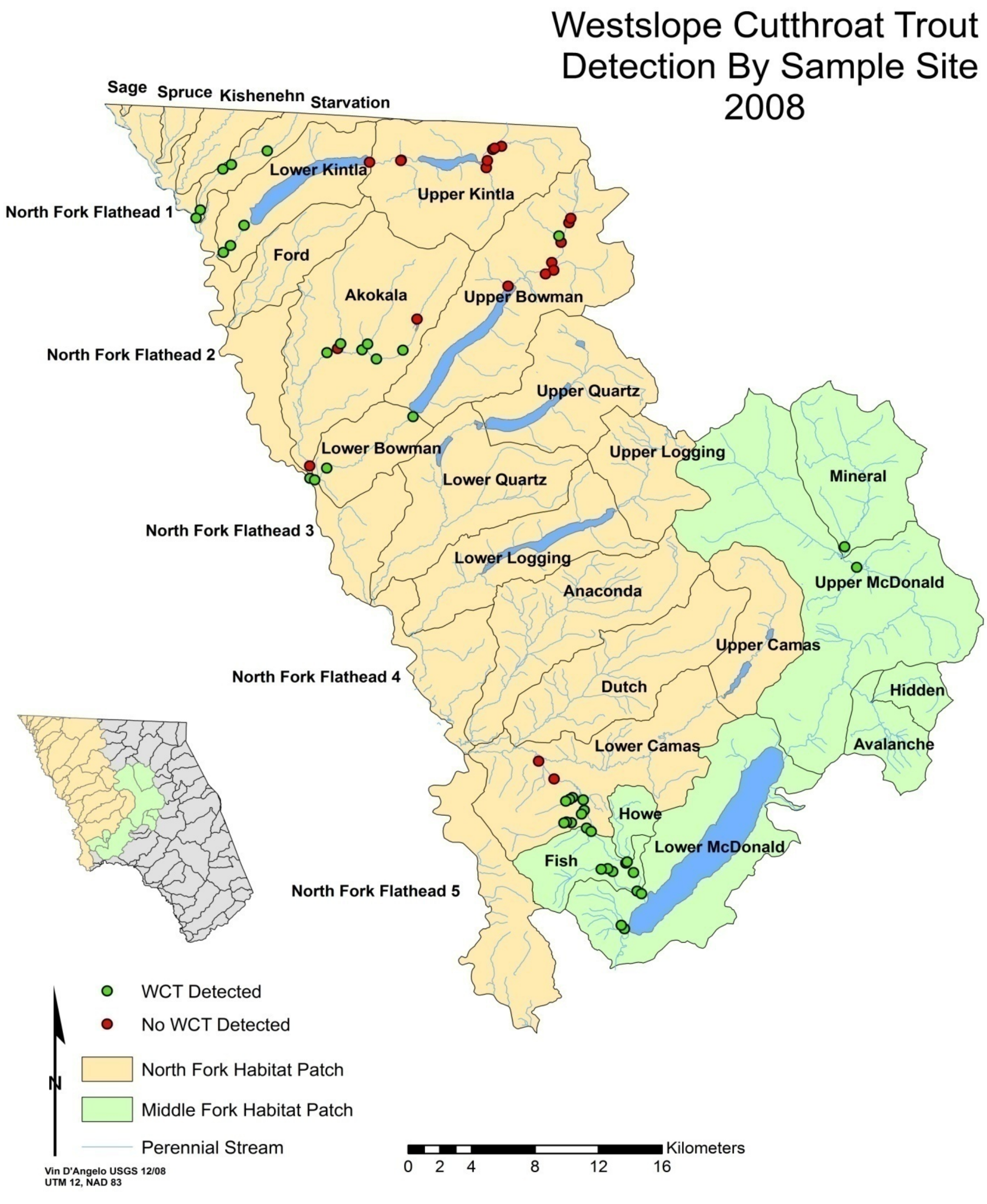

Figure 3: Presence (green) vs. absence (red) of WCT in reaches sampled in 2008.

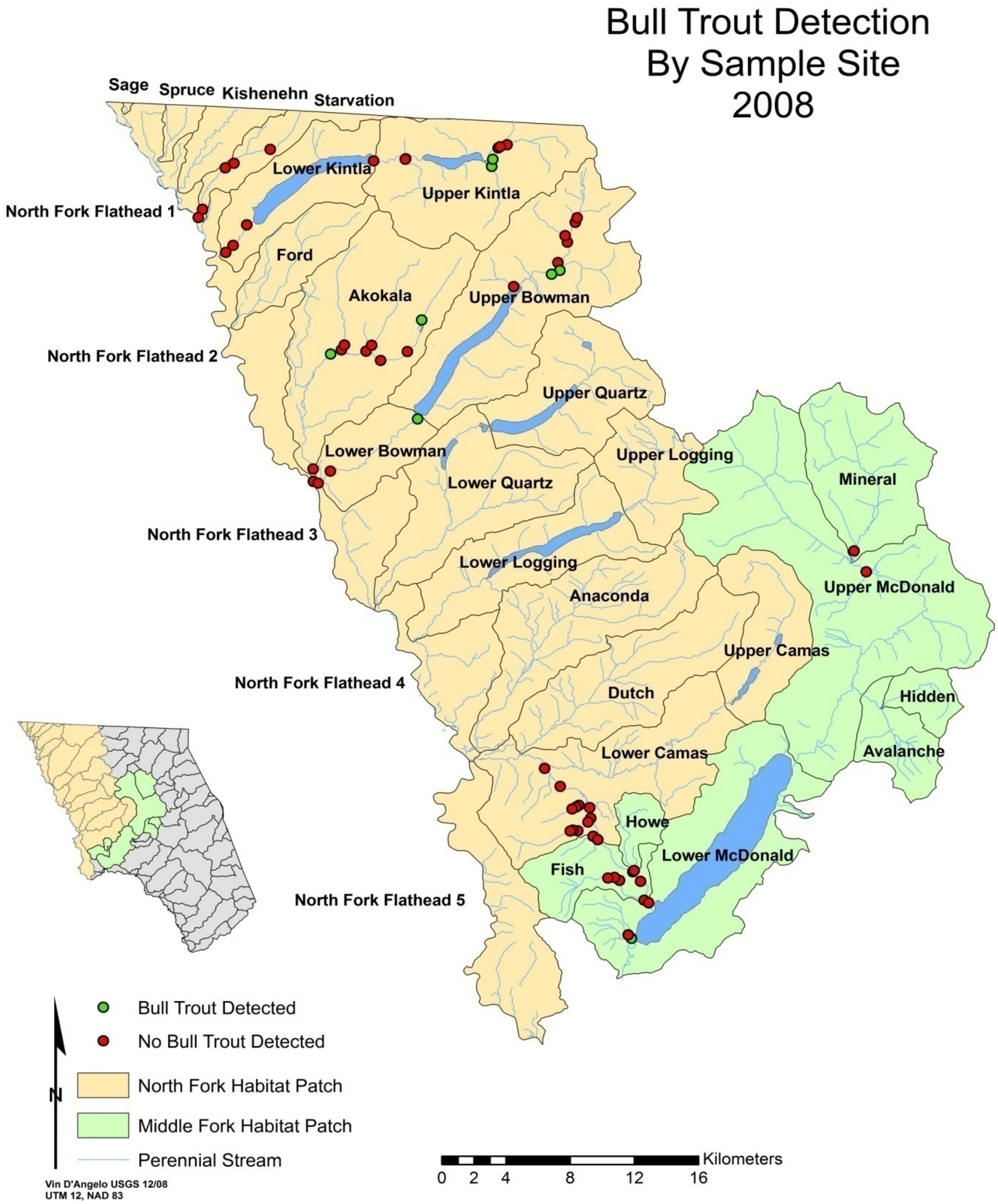

Figure 4: Presence (green) and absence (red) of bull trout in reaches sampled in 2008.

those in Fish, Fern and Howe creeks (Figures 5 and 6, see Appendix B). These results are likely due to a combination of higher WCT abundance in these streams and increased efficacy of our electrofishing methods in smaller streams.

Bull trout were captured primarily in upper reaches such as those sampled on Jefferson Creek, Agassiz Creek and Akokala Creek upstream of Akokala Lake. (N = 13; Figure 4). Bull trout are known to occur in low densities (Peterson et al. 2002), and our findings from 2008 support this (Figures 7 and 8 in Appendix B). However, non-native lake trout (*Salvelinus namaycush*) are present in many of the accessible lakes on the west side of GNP (Kintla, Bowman, Harrison, McDonald and Quartz) and have likely reduced bull trout abundance in these watersheds (GNP, 2004), likely resulting in low densities in spawning and rearing streams.

The susceptibility of WCT and bull trout to the electrofishing methods likely differed due to a combination of different microhabitat preferences and variable sensitivity to the presence of technicians. Bull trout are primarily benthic foragers and often occupy relatively deep pools while WCT feed near the surface and are positioned near the middle of the water column (Jakober et al. 2000). WCT were thus more likely to be captured with a backpack electrofisher in reaches where deep pools offered refuge to bull trout.

Although WCT and bull trout co-evolved in many portions of their range, more data are needed before any conclusions can be made regarding distribution patterns (sympatry or allopatry) among WCT and bull trout on the west side of GNP. Both species were detected together in just three of the 62 reaches sampled in 2008, suggesting that bull trout and WCT are occupying different habitats. However, this disparity may be due to the decline in abundance of bull trout in GNP watersheds due to non-native lake trout.

Since all electrofishing was performed with a backpack unit, the technicians' ability to sample deep pools was restricted. This difficulty is exemplified by several instances of far greater success in capturing WCT (Mineral Creek; near reach 62) and bull trout (the mouth of Agassiz Creek) via angling immediately after electrofishing. Additionally, the high water flows sustained through much of the summer in some North Fork Flathead tributaries hindered sampling on many occasions. High water was also a safety concern and many creeks (Bowman, Kintla, Akokala) were too dangerous to sample until mid-summer.

The reach-level fish and habitat information are summarized below, categorized by streams sampled in 2008. Reaches are identified by unique "reach codes" as seen in Tables 1, 2 and 3 (see Appendix A). The geographic coordinates and elevation for each sample reach are given in Table 1 (see Appendix A). Specific fish and habitat data collected for each sample reach can be found in Tables 2 and 3, respectively (see Appendix A). In the interest of efficiency, tables are not cited for every reference to corresponding data.

The fish population data summarized below focus on WCT and bull trout- the primary species of interest in this study. Presence or absence of other native species of interest such as sculpin, mountain whitefish, redside shiners (*Richardsonius balteatus*), longnose suckers (*Catostomus catostomus*) and any non-native salmonids is also noted. Length frequency histograms were generated for WCT and bull trout by stream when five or more individuals were captured (Figures 9-16, see Appendix C). In streams where less than five individuals were captured, specific fish lengths are given in the text below. Bull trout and WCT that were less than 75 mm in length were considered YOY and were not included in CPUE or fish density calculations. Since all fish density (fish >75 mm/100 m^2) calculations are based on single pass electrofishing results, these estimates are likely lower than actual fish densities.

Starvation Creek

Physical Habitat

Five reaches were sampled in Starvation Creek during the summer of 2008 (Sites 1-5; 7/19-7/21/08; Figure 1). Reaches were distributed from 0.25 km upstream of the Starvation-North Fork Flathead confluence (reach 1) to approximately 50 m upstream of the Starvation Ridge trail-Starvation Creek intersection (reach 5). Reaches ranged in elevation from approximately 1183 to 1413 m. Reach 2 was only 25 m in length due to a loss of battery power in the electrofisher but was included here due to the presence of WCT and sculpin. A HOBOv22 temperature datalogger was placed near each of the two trail intersections (Figure 2).

Reach lengths in Starvation Creek ranged from 25 m (reach 2) to 86 m (reach 1), averaged stream width ranged from 6.6 (reach 2) to 10.7 m (reach 1) and reach areas ranged from 166 (reach 2) to 749.1 m^2 (reach 1). Average gradient ranged from 1.7 (reaches 1, 3) to 2.6 % (reach 5). The density of pools ranged from 0.27 (reach 1) to 0.64/100m^2 (reach 2), the density of LWD pieces ranged from 0.27(reach 1) to 1.92/100m^2 (reach 2) and the density of LWD aggregates ranged from 0 (reaches 1, 3) to 0.60/100m^2 (reach 2). Cobble was the dominant substrate class in all reaches. Mature spruce trees were the dominant riparian vegetation in all but reach 4, where burned spruce trees were dominant.

Fish Populations

In Starvation Creek, WCT were captured in all five sample reaches (N = 14, including YOY; length range: 72-177 mm; Figure 3) with the majority captured in reaches 3-5 (N = 12). A length frequency histogram is given in Figure 9 (Appendix C). All WCT YOY were captured in reach 3 (N = 2; lengths: 72, 73 mm). CPUE for WCT in Starvation Creek ranged from 2.29 (reach 1) to 11.43 fish>75 mm/hour (reach 2). The density of WCT ranged from 0.13 (reach 1) to 1.28 fish >75 mm/100m^2 (reach 4). Sculpin were captured in reaches 1, 3 and 5 (N=7; length range: 44-115 mm) and one mountain whitefish was captured in reach 4 (260mm). No bull trout were captured or observed in Starvation Creek.

Kintla Creek

Physical Habitat

Eight reaches were sampled in Kintla Creek during the summer of 2008 (reaches 6-13; 8/6-8/13/08; Figure 1). Sample reaches were distributed longitudinally from approximately 0.25 km upstream of the Inner North Fork Road to 0.25 km upstream of the North Fork Kintla Creek confluence. Reaches downstream of Kintla Lake were considered lower reaches (reaches 6-8); reaches between Kintla and Upper Kintla lakes were considered middle reaches (reaches 9-10); and reaches upstream of Upper Kintla Lake were considered upper reaches (reaches 11-13). Reaches ranged in elevation from 1177 to 1423 m. Three HOBOv22 temperature dataloggers were distributed longitudinally in Kintla Creek (Figure 4).

Reach lengths in Kintla Creek ranged from 67 m (reach 10) to 153 m (reach 8), average stream width ranged from 5.3 m (reach 11) to 19.4 m (reach 7) and reach areas ranged from 373.3 (reach 11) to 2023.4 m^2 (reach 6). Average gradient ranged from 0.9 (reach 11) to 5.2 % (reach 12). Pool density ranged from 0.10 (reach 6) to 1.05/100 m^2 (reach 12). Pools were exceptionally deep (>2m) in reach 12. The density of LWD pieces ranged from 0.15 (reach 12) to 4.55/100 m^2 (reach 11) and the density of LWD aggregates ranged from 0 to 0.54/100 m^2 (reach

11). Cobble was the dominant substrate in all lower reaches (reaches 6-8). Large gravel and boulders were the dominant substrate types between Kintla and Upper Kintla lakes (reaches 9 and 10). Cobble was the dominant substrate in reaches 12 and 13; sand and silt was the dominant substrate type in reach 11. Mature spruce trees were the dominant riparian vegetation in all reaches sampled in Kintla Creek.

Fish Populations

WCT were detected only in reaches 6-8; the three reaches located downstream of Kintla Lake (N = 21, including 14 YOY; length range: 34-112 mm). A length frequency histogram for WCT is given in Figure 10 (Appendix C). YOY were captured in each of these reaches and were excluded from CPUE and WCT density calculations. All WCT captured in reach 8 were YOY; CPUE and WCT density were not calculated for this reach. CPUE for WCT in reach 6 was 5.76 fish>75mm/hour and the density of WCT was 0.25 fish/100 m^2. CPUE for WCT in reach 7 was 5.26 fish>75mm/hour and the density of WCT was 0.12 fish>75mm/100 m^2.

One bull trout (270mm) was captured in reach 11, the sample reach closest to the mouth of Upper Kintla Lake. CPUE for bull trout in reach 11 was 3.77 fish>75mm/hour and the density of bull trout was 0.27 fish>75mm/100 m^2. Bull trout were not detected by electrofishing in any other reaches in Kintla Creek. However, suspecting that fish were present in the large pools in reach 12 (0.5km upstream of Upper Kintla Lake) and given the difficulty of electrofishing in such deep water, technicians angled in two pools and captured several bull trout (approximate lengths: 200-250 mm).

Sculpin were detected in reaches 6, 7 and 9 (N=8; length range: 64-114 mm). Mountain whitefish were not detected in Kintla Creek. It is worth noting that a series of cascades, including several barrier waterfalls, begins immediately upstream of reach 12. No fish species were captured or observed in reaches upstream of the cascades (reaches 13 and 15).

Agassiz Creek

Physical Habitat

Reach 14 (8/7/08) was the only sample reach in Agassiz Creek, a glacial-fed tributary to Upper Kintla Lake (Figure 1). Reach 14 was located approximately 0.25 km upstream of Upper Kintla Lake at 1354 m in elevation. Reach 14 was 80 m in length, averaged 10.5 m in width, was 836.6 m^2 in area and averaged 3.1% in gradient. The density of pools was 0.24/100 m^2, the density of LWD pieces was 0.60/100 m^2 and the density of LWD aggregates was 0/100 m^2. Cobble was the dominant substrate and mature spruce was the dominant riparian vegetation. One HOBOv22 temperature datalogger was attached to a root wad at the downstream end of the reach immediately prior to sampling (Figure 2).

Fish Populations

WCT were not detected in Agassiz Creek. One bull trout (193 mm) was captured in Agassiz Creek yielding a CPUE of 4.88 fish>75mm/hour and a bull trout density of 0.12 fish>75mm/100 m^2 (Figure 4). Several other bull trout of similar size were observed escaping the netters. It seems likely that bull trout use Agassiz Creek to spawn: nine adult bull trout (approximate length range: 250-450 mm) were captured while angling for tissue samples at the mouth of Agassiz Creek immediately after sampling. Sculpin and mountain whitefish were not detected in Agassiz Creek.

North Fork of Kintla Creek

Physical Habitat and Fish Populations

Reach 15 was the only reach sampled in the North Fork of Kintla Creek during the summer of 2008 (8/6/08; Figure 1). The North Fork of Kintla Creek enters Kintla Creek immediately upstream of the previously mentioned barrier falls and cascades. Reach 15 was located approximately 0.25 km upstream of the confluence with Kintla Creek. Reach 15 was 69 m in length, averaged 5.8 m in width, was 399.4 m^2 in area and averaged 4.4 % in gradient. The density of pools was 1.25/100 m^2, the density of LWD pieces was 0.75/100 m^2 and the density of LWD aggregates was 0/100 m^2. Cobble was the dominant substrate and mature spruce was the dominant riparian vegetation. No fish species were captured or observed in the North Fork of Kintla Creek.

Red Medicine Bow Creek

Physical Habitat and Fish Populations

Reach 16 was the only reach sampled in Red Medicine Bow Creek, a tributary that enters Kintla Creek between Upper Kintla and Kintla Lakes (8/8/08; Figure 1). Reach 16 was located approximately 0.25 km upstream of the confluence with Kintla Creek. Reach 16 was 75m in length, averaged 9.0 m in width, was 677.1 m^2 in area and averaged 5.2 % in gradient. The density of pools was 0.89/100 m^2, the density of LWD pieces was 2.22/100 m^2 and the density of LWD aggregates was 0.30/100 m^2. Cobble was the dominant substrate and mature spruce was the dominant riparian vegetation. No fish species were captured or observed in Red Medicine Bow Creek.

Akokala Creek

Physical Habitat

Six reaches were sampled in Akokala Creek during the summer of 2008 (reaches 17-22; 7/16-8/15/08; Figure 1). Reaches were distributed longitudinally from near the North Fork Flathead confluence to upstream of Akokala Lake and ranged in elevation from 1092 m to 1469 m. Reaches 17-19 were considered lower reaches and were downstream of the confluence with Long Bow Creek while reaches 20-22 were considered upper reaches and were located upstream of the confluence with Long Bow Creek.

Reach lengths in Akokala Creek ranged from 52 (reach 20) to 209 m (reach 19), average stream width ranged from 7.1 (reach 19) to 14.4 m (reach 17) and reach areas ranged from 390 (reach 20) to 1753.1 m^2 (reach 17). Average gradient ranged from 0.9 (reach 17) to 3.1 % (reach 20). Pool density ranged from 0.11(reach 17) to 1.28/100 m^2 (reach 20), the density of LWD ranged from 0.13 (reach 19) to 2.82/100 m^2 (reach 20) and the density of LWD aggregates ranged from 0 (reaches 17, 22) to 0.26/100 m^2(reach 20). A variety of substrate classes were found in Akokala Creek. Cobble was the dominant substrate in reaches 17, 20 and 21, sand and silt was dominant in reaches 18 and 19, and small gravel was dominant in reach 22, upstream of Akokala Lake. Spruce trees were the dominant riparian vegetation in the upper reaches, with willows, burned spruce and lodgepole pine each dominant in one lower reach.

Fish Populations

WCT were detected in reaches 17, 18, 20 and 21 in Akokala Creek (N=17; length range, 70-270 mm; Figure 3). A length frequency histogram for WCT is given in Figure 11 (Appendix C). WCT were detected in similar numbers in the lower reaches (N = 9) and the upper reaches sampled (N = 8) but WCT were not detected above Akokala Lake (reach 22). The most WCT were captured at reach 18 (N = 8), which also had the highest relative abundance of WCT according to CPUE and was the reach closest to the North Fork Flathead. CPUE for WCT ranged from 0 (reaches 19, 22) to 12.10 fish>75mm/hour (reach 18). The density of WCT ranged from 0 (reaches 19, 22) to 0.80 fish>75mm/100 m^2 (reach 21).

Bull trout were detected reaches 17 and 22 in Akokala Creek (N = 3; lengths: 85, 111, 154 mm; Figure 4). The presence of bull trout in one lower reach (17) and the uppermost reach (22) suggests that bull trout are distributed throughout the drainage. Relative abundance of bull trout according to CPUE ranged from 0 to 3.82 fish>75mm/hour (reach 22), and the density of bull trout ranged from 0 to 0.42 fish>75mm/100 m^2 (reach 22).

WCT and bull trout were both detected in reach 17 and bull trout were detected without WCT in reach 22, upstream of Akokala Lake. However, since WCT are present in Akokala Lake, it seems unlikely that the upper reaches of Akokala Creek are occupied solely by bull trout.

Sculpin were detected in reaches 17, 19 and 21 in Akokala Creek (N = 4, lengths: 41, 79, 79, 89 mm). Mountain whitefish were detected in only in reach 18, the reach nearest the North Fork Flathead (N = 4, lengths: 51, 53, 61, 254 mm).

Long Bow Creek

Physical Habitat

Reaches 23 and 24 were sampled in Long Bow Creek during the summer of 2008 (7/17/08; Figure 1). Reach 23 was located approximately 0.25km upstream of the confluence of Long Bow and Akokala creeks and reach 24 was located approximately 0.5 km upstream of reach 23. Both sample reaches were located in areas that have burned since 2000. Reach 23 was 70m in length, averaged 4.0 m in width, was 282m^2 in area and averaged 1.7 % in gradient. The density of pools in reach 23 was 1.06/100 m^2, the density of LWD was 2.48 pieces/100 m^2 and the density of LWD aggregates was 0.71/100 m^2.

In reach 23, large gravel was the dominant substrate and the riparian area was dominated by burned lodgepole pine. Reach 24 was 53 m in length, averaged 5m in width, was 263.9 m^2 in area, and averaged 4.4 % in gradient. The density of pools in reach 24 was 1.14/100 m^2, the density of LWD was 4.55 pieces/100 m^2, and the density of LWD aggregates was 0.38/100 m^2. The large amount of LWD in this reach made fish sampling exceptionally difficult. In reach 24, cobble was the dominant substrate and the riparian zone was dominated by burned spruce.

Fish Populations

Three WCT were captured in Long Bow Creek; one in reach 23 (94 mm) and two in reach 24 (71, 131 mm). In reach 23, the CPUE for WCT was 2.55 fish>75mm/hour, the density of WCT was 0.35 fish>75mm/100 m^2. In reach 24, the CPUE for WCT was 5.96 fish>75mm/hour and the density of WCT was 0.38 fish>75mm/100 m^2. Comparing the findings from these reaches is difficult due to the small overall number of WCT captured in Long Bow Creek. However, it should be noted that a number of WCT (5-10) were observed but escaped capture in reach 24 due to the large amount of LWD that often hindered sampling. Bull trout, sculpin, and mountain whitefish were not detected in Long Bow Creek.

Parke Creek

Physical Habitat

Reaches 25 and 26 were sampled in Parke Creek during the summer of 2008 (7/17-7/18/08; Figure 1). Reach 25 was located approximately 0.25 km upstream of the confluence of Parke and Akokala creeks and reach 26 was located approximately 0.5 km upstream of reach 25. Both sample reaches were located in areas that have burned since 2000. Reach 25 was 54m in length, averaged 5.4m in width, was 293.4 m^2 in area and averaged 0.9 % in gradient. The density of pools in reach 25 was 1.02/100 m^2, the density of LWD was 2.39 pieces/100 m^2, and the density of LWD aggregates was 0.34/100 m^2. In reach 25, boulders were the dominant substrate and the riparian area was dominated by burned spruce. Reach 26 was 67m in length, averaged 6.0m in width, was 399.1 m^2 in area, and averaged 1.7 % in gradient. The density of pools in reach 26 was 0.75/100 m^2, the density of LWD was 2.51 pieces/100 m^2, and the density of LWD aggregates was 0.25/100 m^2. Cobble was the dominant substrate in reach 26 and the riparian zone was dominated by burned spruce trees.

Fish Populations

Two WCT were captured in Parke Creek, both in reach 26 (lengths: 103, 105 mm). In reach 26, the CPUE for WCT was 8.29 fish>75mm/hour and the density of WCT was 0.50 fish>75mm/100 m^2. No fish were captured in reach 25. Bull trout, sculpin and mountain whitefish were not detected in Parke Creek.

Bowman Creek

Physical Habitat

Seven reaches were sampled in Bowman Creek during the summer of 2008 (reaches 27-33; 7/30-8/14/08; Figure 1). Reaches were distributed longitudinally from near the confluence of Bowman Creek and the North Fork Flathead (reach 27) upstream to within 0.5 km of Boulder Falls (reach 33), and ranged in elevation from 1093 to 1395 m. Reaches below Bowman Lake were considered lower reaches (27-29) and reaches above Bowman Lake were considered upper reaches (30-33).

Reach lengths in Bowman Creek ranged from 61 (reach 33) to 203m (reach 29). The average width of Bowman Creek decreased noticeably with upstream distance. Average stream width ranged from 4.9 (reach 31) to 19.2m (reach 29) and reach areas ranged from 396 (reach 31) to 3897.6 m^2 (reach 29). Average gradient ranged from 1.3 (several) to 3.5 % (reach 33). The density of pools was slightly higher in the upper reaches of Bowman Creek. Pool density ranged from 0.08 (reach 29) to 1.01/100 m^2 (reach 31). The density of LWD ranged from 0 (reach 3) to 4.03/100 m^2 (reach 32) and the density of LWD aggregates ranged from 0 (reach 3) to 0.76/100 m^2(reach 31). In general, LWD and LWD aggregates were present in greater densities in the upper reaches of Bowman Creek. In the three lower reaches, cobble was the dominant substrate in two and large gravel was dominant in one reach. Riparian vegetation varied in lower reaches between dogwood, willows and alder. Large gravel was dominant in three upper reaches while boulders were dominant in reach 33. Mature spruce trees were the dominant riparian vegetation in three upper reaches and thimbleberry was dominant in reach 33.

It is necessary to note that as of summer 2008, reaches 31 and 32 were located in an area of Bowman Creek where significant channel rearrangements had taken place due the fall 2006 flood event. These reaches were among the few locations in the area where sampling could take place due to massive depositions of LWD and LWD aggregates in Bowman Creek from the mouth of Pocket Creek upstream to approximately 0.5 km below Boulder Falls. This section is characterized by many side channels of varying velocity often running through thick timber leaving the obvious main channel completely dry. There were also locations in this area where Bowman Creek subsided underground entirely.

Fish Populations

WCT were detected only in the lower reaches (27-29) of Bowman Creek (N = 12, including YOY; length range: 32-131 mm; Figure 3). A length frequency histogram for WCT is given in Figure 12 (Appendix C). Four WCT, including YOY, were captured in each of the three lower reaches. Since WCT captured in reach 28 consisted of fry only, CPUE and WCT density calculations were not performed for this reach. In reach 27, CPUE for WCT was 2.11 fish>75mm/hour, and the density of WCT was 0.10 fish>75mm/100 m^2. In reach 28, CPUE for WCT was 6.13 fish>75mm/hour, and the density of WCT was 0.10 fish>75mm/100 m^2. WCT were not detected in the upper reaches (30-33) of Bowman Creek but are likely present; one individual (183 mm) was captured in Pocket Creek (reach 37), a tributary to upper Bowman Creek and suspected WCT were observed evading capture in several upper reaches.

One bull trout (length: 196 mm) was captured in Bowman Creek, in reach 29, yielding a CPUE of 1.53 fish>75mm/hour and a bull trout density of 0.03 fish>75mm/100 m^2 (Figure 4). Bull trout were not detected in the upper reaches of Bowman Creek but are likely present considering several individuals were captured in 2008 in Jefferson Creek (reaches 34, 35), a tributary to upper Bowman Creek.

Sculpin were captured in all three lower reaches (N = 23; length range: 19-114 mm) and one longnose sucker was found in reach 28 (152 mm) and 29 (175 mm). Mountain whitefish were not detected in Bowman Creek.

Although no fish of any species were captured in the upper reaches of Bowman Creek, fish were observed escaping the netters in three of four upper reaches. In reaches 31 and 32, due to adverse conditions caused by the 2006 flood event/channel rearrangements, pools were often too deep to effectively electrofish and aggregates were often impossible to negotiate resulting in less effective sampling.

Jefferson Creek

Physical Habitat

Reaches 34 and 35 were sampled in Jefferson Creek during the summer of 2008 (7/31/08; Figure 1). Reach 34 was located approximately 0.5km upstream of the confluence of Jefferson and Bowman creeks and reach 35 was located approximately 0.5 km upstream of reach 34. Although in the same drainage, the reaches sampled in Jefferson Creek showed no evidence of the massive LWD deposits and bed scouring evident in the upper reaches of Bowman Creek. A HOBOv22 temperature datalogger was attached to a rootwad at the downstream boundary of reach 34 immediately prior to sampling (Figure 2).

Reach 34 was 97 m in length, averaged 5.7 m in width, was 549.02 m^2 in area and averaged 3.1% in gradient. Pool density in reach 34 was 0.73/100 m^2, the density of LWD was 3.64 pieces/100 m^2 and the density of LWD aggregates was 0.36/100 m^2. Large gravel was the dominant substrate and mature spruce trees dominated the riparian zone. Reach 35 was 122 m in length, averaged 6.0 m in width, was 735.7 m^2 in area and averaged 0.9 % in gradient. Pool density in reach 35 was 0.27/100 m^2, the density of LWD was 1.36 pieces/100 m^2, and the density of LWD aggregates was 0.14/100 m^2. Cobble was the dominant substrate in reach 35 and mature spruce trees were the dominant riparian vegetation.

Fish Populations

No WCT were captured in Jefferson Creek and no suspected WCT were observed escaping netting. Bull trout were captured in both reaches sampled in Jefferson Creek (N = 6; length range: 45-148 mm; Figure 4). One bull trout (148 mm) and one mountain whitefish (244 mm) were captured in reach 34 and five bull trout were captured in reach 35 (45-139 mm), including three YOY. A length frequency histogram for bull trout is given in Figure 13 (Appendix C). In reach 34, CPUE for bull trout was 2.89 fish>75mm/hour and the density of bull trout was 0.18 fish>75mm/100 m^2. In reach 35, CPUE for bull trout was 4.90 fish>75mm/hour and the density of bull trout was 0.27 fish>75mm/100 m^2. Sculpin and mountain whitefish were not detected or observed in Jefferson Creek.

Numa Creek

Physical Habitat and Fish Populations

Reach 36 was the only reach sampled in Numa Creek during the summer of 2008 (7/31/08; Figure 1). Reach 36 was 80 m in length, averaged 5.6m in width, was 451m^2 in area, and averaged 2.6 % in gradient. The density of pools was 1.33/100 m^2, the density of LWD was 5.32/100 m^2 and the density of LWD aggregates was 0.67/100 m^2. The LWD present in Numa Creek was exceptionally large (logs approaching 1 m in diameter, spanning the width of the reach) and often obstructed electrofishing. No fish species were detected or observed in Numa Creek.

Pocket Creek

Physical Habitat

Reach 37 was the only reach sampled in Pocket Creek during the summer of 2008 (7/30/08; Figure 1). Reach 37 was located approximately 0.25 km upstream of the confluence of Pocket and Bowman creeks in an area where large depositions of gravel, sand and silt had recently occurred. Reach 37 was 78 m long, averaged 5.8 m wide, was 450.2 m^2 in area, and averaged 2.6 % in gradient. The density of pools in reach 37 was 0.44/100 m^2, the density of LWD pieces was 1.55/100 m^2 and the density of LWD aggregates was 0.22/100 m^2. Cobble was the dominant substrate and mature spruce trees were the dominant riparian vegetation. A HOBOv22 temperature datalogger was attached to a rootwad at the downstream boundary of reach 37 immediately prior to sampling (Figure 2).

Fish Populations

One WCT was captured in Pocket Creek (183 mm; Figure 3). CPUE for WCT was 2.53 fish>75mm/hour and the density of WCT was 0.22 fish>75mm/100 m^2. Bull trout, sculpin and mountain whitefish were not detected or observed in Pocket Creek.

McGee Creek

Physical Habitat

Eight reaches were sampled in McGee Creek during the summer of 2008 (reaches 38-45; 7/7-7/9/08; Figure 1). Reaches were distributed longitudinally from near the Camas Creek confluence to approximately 1.0 km upstream of the Camas Road. The Camas Road culvert divided the lower (38-41) and upper (42-45) reaches on McGee Creek. A HOBOv22 temperature datalogger was placed in a pool immediately downstream of the Camas Road culvert (Figure 2).

Reach lengths in McGee Creek ranged from 51 (reach 44) to 163 m (reach 43), average stream width ranged from 3.6 (reach 39) to 5.3 m (reach 41) and reach areas ranged from 187.7 (reach 44) to 665.5m^2 (reach 38). Average gradient ranged from 0.9 (reach 40) to 5.2 % (reach 43). The density of pools ranged from 0.47 (reach 43) to 1.60/100 m^2 (reach 44). The density of LWD pieces ranged from 0.63 (reach 40) to 3.73/100m^2 (reach 44) and the density of LWD aggregates ranged from 0 (reaches 39-40, 42) to 0.53/100 m^2 (reach 44). Upper reaches appeared to have significantly more LWD and LWD aggregates than lower reaches. Cobble was the dominant substrate in all lower reaches. Large gravel was the dominant substrate in four reaches (38-40, 42) and cobble was the dominant substrate in four reaches (41, 43-45). Dogwood and willows were the dominant riparian vegetation in reaches 38 and 39, respectively. Mature spruce trees were the dominant riparian vegetation in all other reaches.

Fish Populations

In McGee Creek, WCT were captured in all reaches except reach 40 (N = 47, length range: 49-164 mm, including 18 YOY; Figure 3). A length frequency for WCT is given in Figure 14 (Appendix C). Although more WCT were captured in lower reaches (N = 30) than in upper reaches (N = 17), many individuals captured in reaches 38 and 39 were fry (N = 18) resulting in lower CPUE and WCT density values in the lower reaches of McGee Creek. More WCT were captured in reach 38 (N = 18, including 10 YOY) than in any other reach sampled in 2008. One individual captured in reach 41, the site closest to the Camas Creek confluence, appeared to be a WCTxRBT hybrid (109 mm). CPUE for WCT in McGee Creek ranged from 0 (reach 40) to 18.40 fish>75mm/hour (reach 38). The density of WCT ranged from 0 (reach 40) to 1.26 fish>75mm/100 m^2 (reach 43).

Bull trout and mountain whitefish were not detected in McGee Creek. Sculpin were captured in all lower reaches except reach 38, the uppermost of the lower reaches (N = 21; length range: 41-90 mm). Of the 21 sculpin captured, the majority were found in reach 40 (N = 16). Sculpin were not detected in McGee Creek upstream of the Camas Road culvert. One longnose sucker (78 mm) was also captured in reach 40.

McGee Tributary A

Physical Habitat

McGee Tributary A is a very small (<2.0 m wide) unnamed tributary to McGee Creek that flows beneath the Camas Road <0.25 km north of McGee Creek. Three reaches were sampled in McGee Tributary A during the summer of 2008 (reaches 46-48; 7/9-7/10/08; Figure 1). Reach 46 was located below the Camas Road and considered a lower reach; reaches 47 and 48 were located above the Camas Road and considered upper reaches. McGee Tributary A appears to begin from groundwater directly upstream of reach 48.

Reach lengths in ranged from 53 (reach 48) to 70 m (reach 46), average stream width ranged from 1.5 (reach 48) to 1.7 m in both lower reaches. Reach areas ranged from 77.7 (reach 48) to 118.0 m^2 (reach 47). Average gradient increased with upstream distance and ranged from 2.6 (reach 46) to 6.1 % (reach 47). Pools were more frequent below the Camas Road culvert and the density of pools ranged from 2.57 (reach 48) to 4.31/100 m^2 (reach 46). LWD pieces and aggregates were more frequent downstream of the Camas Road culvert. The density of LWD pieces ranged from 1.29 (reach 48) to 5.39/100 m^2 (reach 46) and the density of LWD aggregates ranged from 0 (reach 48) to 2.16/100 m^2 (reach 46). Sand and silt was the dominant substrate class in reaches 46 and 47 while small gravel was dominant in reach 48. Mature spruce trees were the dominant riparian vegetation in all reaches.

Fish Populations

WCT were captured in all three reaches sampled in McGee Tributary A (N=4, including 2 YOY; lengths: 40, 44, 160, 197 mm; Figure 3). In reach 46, only YOY were captured; WCT abundance and density estimates were not calculated for this reach. One WCT was captured in reach 47 (160 mm); CPUE was 4.97 fish>75mm/hour and the density of WCT was 0.85 fish>75mm/100 m^2. One WCT was captured in reach 48 (197 mm); CPUE was 9.42 fish>75mm/hour and the density of WCT was 1.29 fish>75mm/100 m^2. Relative abundance estimates based on CPUE are likely inflated due to the relatively low amount of effort (shock time) needed to electroshock a reach (at least 50 m) in a stream as small and narrow as McGee Tributary A. Bull trout, sculpin and mountain whitefish were not detected in McGee Tributary A.

Apgar Creek

Physical Habitat

Reach 49 was the only reach sampled in Apgar Creek in 2008 (8/29/08; Figure 1). Reach 49 was located approximately 200 m downstream of where Apgar Creek exits the Camas Road culvert. A HOBOv22 temperature datalogger was installed near the upstream boundary of reach 49 earlier in the summer (6/24/08; Figure 2). Reach 49 was 70 m in length, averaged 4.5 m in width, was 311.5 m^2 in area, and averaged 3.5 % in gradient. The density of pools was 1.28/100 m^2; the density of LWD pieces was 0.64/100 m^2. There were no LWD aggregates present. Large gravel was the dominant substrate class and thimbleberry was the dominant riparian vegetation type.

Fish Populations

Both WCT (N = 2; lengths: 119, 148 mm) and bull trout (N = 1, 198 mm) were detected in reach 49, Apgar Creek (Figures 3 and 4). The bull trout captured was the only bull trout captured or observed in any Middle Fork Flathead tributary sampled in summer 2008; it did not show signs of spawning. The CPUE for WCT was 11.11 fish>75mm/hour and the density of WCT was 0.64 fish>75mm/100 m^2. The CPUE for bull trout was 5.56 fish>75mm/hour and the density of bull trout was 0.32 fish>75mm/100 m^2. Sculpin and mountain whitefish were not captured or observed in Apgar Creek.

Apgar Tributary A

Physical Habitat

Apgar Tributary A is an unnamed tributary that enters Apgar Creek on river-left immediately upstream of the Camas Road culvert in an intermittent burn area. Reach 50 was the only reach sampled in Apgar Tributary A in 2008 (8/29/08; Figure 1). Reach 50 was 60 m in length, averaged 2.5 m in width, was 150 m^2 in area, and averaged 3.0 % in gradient. The density of pools was 4.67/100 m^2, and the density of LWD pieces was 5.33/100 m^2. No LWD aggregates were present in reach 50. Large gravel was the dominant substrate class and alder was the dominant riparian vegetation.

Fish Populations

WCT were detected in reach 50, Apgar Tributary A (N=3; lengths: 134, 135, 137mm; Figure 3). The CPUE for WCT was 15.19 fish>75mm/hour and the density of WCT was 2.00 fish>75mm/100m^2. Bull trout, sculpin, and mountain whitefish were not detected. It is likely that bull trout are present in Apgar Tributary A: reach 50 in Apgar Tributary A was within 0.25km of reach 49, on Apgar Creek, where one bull trout was detected on the same day.

Heaven's Creek

Physical Habitat

Heaven's Creek is a previously unnamed tributary to McDonald Creek, flowing east off of the Heaven's Peak snowfields. Reach 51 was the only site sampled in Heaven's Creek in 2008 (9/14/08; Figure 1). Reach 51 was 50 m in length, averaged 5.5m in width, was 274.0 m^2 in area, and averaged 5.7 % in gradient. The density of pools was 1.46/100 m^2, and the density of LWD pieces was 1.09/100 m^2. There were no LWD aggregates present. Cobble was the dominant substrate type and alder was the dominant riparian vegetation.

Fish Populations

WCT were captured at reach 51 (N = 3; lengths: 82, 105, 111 mm; Figure 3). The CPUE for WCT was 38.43 fish>75mm/hour and the density of WCT was 1.09 fish>75mm/100 m^2. The CPUE value of 38.43 fish>75mm/hour is likely inflated due to a low sampling time. Bull trout, sculpin and mountain whitefish were not detected in Heaven's Creek.

Fern Creek

Physical Habitat

Four reaches were sampled in Fern Creek in summer 2008 (reaches 52-55; 7/10, 7/14/08; Figure 1). Lower reaches (52, 53) were located downstream of the Camas Road and upper reaches (54, 55) were located upstream of the Camas Road. Reach lengths in Fern Creek ranged from 52 (reach 52) to 108 m (reach 53), averaged reach width ranged from 3.2 (reach 55) to 4.2m (reach 52) and reach areas ranged from 219.4 (52) to 446.0 m^2 (53). Average gradient ranged from 2.6 (both upper reaches) to 7.9 % (reach 52). Pools, LWD pieces and LWD aggregates were all more frequent in the upper reaches of Fern Creek. The density of pools ranged from 0.67 (reach 53) to 2.97/100 m^2 (reach 54). The density of LWD pieces ranged from 2.91 (reach 53) to 6.95/100 m^2 (reach 55) and the density of LWD aggregates ranged from 0.67 (reach 53) to 1.11/100 m^2 (reach 54).

Cobble was the dominant substrate class in the lower reaches while boulders were the dominant class in the upper reaches. Burned spruce trees with a light understory characterized the riparian zone in upper reaches while fern (52) and mature spruce (53) were each dominant in one lower reach. A HOBO v22 temperature datalogger was attached to a rootwad directly upstream of the Camas Road culvert (Figure 2).

Fish Populations

We captured WCT in all four reaches in Fern Creek (N = 43, including 14 YOY; length range: 44-170 mm; Figure 3). A length frequency histogram for WCT is given in Figure 15 (Appendix C). As in McGee Creek, more WCT were found in the reaches downstream of the Camas Road including the majority of the fry captured (<75 mm), which were not included in WCT relative abundance and density calculations. With fry omitted, the CPUE and density of WCT were comparable for the upper and lower reaches of Fern Creek. In Fern Creek, the CPUE for WCT ranged from 16.20 (reach 52) to 21.14 fish>75mm/hour (reach 55). The density of WCT ranged from 2.23 (reach 54) to 2.47 fish>75mm/100 m^2 (reach 53).

Bull trout and sculpin were not detected in Fern Creek. One mountain whitefish was captured in reach 53 (245 mm), as was one brook trout (*Salvelinus fontinalis*; 188 mm).

Fish Creek

Physical Habitat

Five reaches were sampled in Fish Creek in mid to late summer 2008 (reaches 56-60; 7/14-9/12/08; Figure 1). Reaches were distributed along the length of Fish Creek from near Fish Creek Campground upstream to approximately 200 m upstream of the Camas Road. Fish Creek is intersected by several roads and as a result reaches were not considered “upper” or “lower” relative to the Camas Road as in Fern Creek, McGee Creek and Apgar Creek. A HOBOv22 temperature datalogger was attached to a rootwad on the left bank approximately 500m upstream of the bridge in Fish Creek Campground (Figure 2).

Fish Creek increases substantially in size along its length resulting in substantial average width and area differences between the lowermost (reach 56) and uppermost reaches (59 and 60). Reach lengths in Fish Creek ranged from 57 (reach 56) to 107 m (reach 55), average reach width ranged from 2.0 (reach 60) to 6.9 m (reach 56) and reach areas ranged from 124 (reach 60) to 737.2 m^2 (reach 56). Average gradient ranged from 0.9 (reaches 58, 59) to 3.5 % (reach 57). The density of pools ranged from 0.41 (reach 56) to 3.23/100 m^2 (reach 60). The density of LWD pieces ranged from 0 (reach 56) to 7.26/100 m^2 (reach 60). There were no LWD aggregates present in the sample reaches. Large gravel was the dominant substrate class in reaches 57, 58 and 60; boulders were the dominant substrate class in reach 56 and cobble was the dominant substrate class in reach 59. Spruce trees were the dominant riparian vegetation in reach 56 while fireweed and alder were dominant in all other reaches.

Fish Populations

WCT were detected in all five reaches sampled in Fish Creek with comparable numbers of WCT captured in all reaches (N = 46, including 1 fry; length range: 72-187 mm; Figure 3). A length frequency histogram for WCT is given in Figure 16 (Appendix C). In Fish Creek, the CPUE for WCT ranged from 19.01 (reach 56) to 71.59 fish>75mm/hour (reach 59). The density of WCT ranged from 1.49 (reach 56) to 7.26 fish>75mm/100 m^2 (reach 60). Bull trout and sculpin were not detected or observed in Fish Creek. In reach 56, the site closest to Lake McDonald, one brook trout (224 mm) was captured in addition to two redside shiners (lengths: 73, 99 mm) and two mountain whitefish (255, 260 mm).

Howe Creek

Physical Habitat

One reach was sampled in Howe Creek in 2008 (reach 61; 9/5/08; Figure 1). Reach 61 was 50 m in length, averaged 2.9 m in width, was 145.0 m^2 in area, and averaged 5.2 % in gradient. The density of pools was 1.38/100 m^2, and the density of LWD pieces was 6.90/100 m^2. The density of LWD was among the highest of any site from 2008. No LWD aggregates were present in site 61. Cobble was the dominant substrate type and fireweed was the dominant riparian vegetation.

Fish Populations

WCT were detected at reach 61 in Howe Creek (N = 9, including 4 fry; length range: 70-115 mm; Figure 3). The CPUE for WCT was 23.32 fish>75mm/hour and the density of WCT was 3.45 fish>75mm/100 m^2. The CPUE value for reach 61 is likely inflated due to a very low shock time. Bull trout, sculpin and mountain whitefish were not detected or observed in Howe Creek.

Mineral Creek

Physical Habitat

One reach was sampled in Mineral Creek in 2008 (reach 62; 9/13/08; Figure 1). Reach 62 was located approximately 0.25 km upstream of the Mineral Creek suspension bridge on the Packer's Roost Trail. Reach 62 was 61.0 m in length, averaged 8.0 m in width, was 489.0 m^2 in area, and averaged 2 % in gradient. The density of pools was 0.41/100 m^2 and there were no LWD pieces or LWD aggregates at reach 62. Bedrock was the dominant substrate type and willows were the dominant riparian vegetation. The pools in this reach were extremely deep (>2.0 m) and difficult to sample with a backpack electrofisher.

Fish Populations

One WCT was captured by electrofishing at reach 62 in Mineral Creek (96 mm; Figure 3). The CPUE for WCT was 6.94 fish>75mm/hour and the density of WCT was 0.20 fish>75mm/100 m^2. After electrofishing, three technicians angled for WCT genetic samples, suspecting that there were more fish in the area than were detected by the electrofisher due to the depth of the pools in reach 62. A large number of WCT were captured by angling (N = 26; length range: 93-269 mm) confirming suspicions that the backpack electrofisher was not effective in the large pools.

OUTLOOK FOR THE 2009 FIELD SEASON

The fish and habitat sampling as performed in 2008 will continue in 2009. In patches where bull trout and WCT were detected in 2008 but less than five reaches were sampled, additional reaches will be sampled to make sure the five reach minimum is met. In patches where WCT and/or bull trout were not detected in 2008 (Upper Kintla for WCT; several for bull trout), sampling must continue until detection occurs or 12 reaches are sampled. These goals will not necessarily be met in 2009 for every habitat patch but it is reasonable to predict that at least 50 more reaches will be sampled.

Given the limitations of electrofishing observed in 2008 in habitats with deep pools and high flows, snorkel surveys will also be employed in 2009. Snorkeling will provide an additional technique for WCT and bull trout detection as well as a basis for comparison with electrofishing methods. In reaches where snorkeling occurs, the habitat sampling will be identical to that employed during electrofishing surveys. When practical, snorkeled reaches will also be electrofished within 24-hours in order to compare total number of fish observed, WCT and bull trout density estimates and size classes of fish observed. Learning which methods work best in a given habitat type will help increase our overall sampling efficiency throughout the duration of this study.

REFERENCES

Boyer, M.C., and C.C. Muhlfeld. 2006. Results of a fish distribution and habitat survey in Foisey Creek, British Columbia. Final report to Montana Fish, Wildlife and Parks, Kalispell, Montana.

Boyer, M.C., C.C. Muhlfeld and F.W. Allendorf. 2008. Rainbow trout (*Oncorhynchus mykiss*) invasion and the spread of hybridization with native westslope cutthroat trout (*Oncorhynchus clarkii lewisi*). Canadian Journal of Fisheries and Aquatic Sciences 65: 658-669.

Department of the Interior, Glacier National Park. 2004. Finding of no significant impact: Quartz Lake fish barrier. http://www.nps.gov/archive/glac/pdf/fishbarrierFONSI04.pdf. URL accessed 04/15/2008.

Jakober, M.J., T.E. McMahon and R.F. Thurow. 2000. Diel habitat partitioning by bull charr and cutthroat trout during fall and winter in Rocky Mountain streams. Environmental Biology of Fishes 59**:** 79–89.

Muhlfeld, C.C., T.E. McMahon, D. Belcer, and J. Kershner. In press. Spatial and temporal spawning dynamics of native westslope cutthroat trout (*Oncorhynchus clarkii lewisi*), nonnative rainbow trout (*O. mykiss*), and their hybrids. Canadian Journal of Fisheries and Aquatic Sciences.

Paul, A.J., and J.R. Post. 2001. Spatial distribution of native and nonnative salmonids in streams of the eastern slopes of the Canadian Rocky Mountains. Transactions of the American Fisheries Society 130:417-430.

Rieman, B.E., J.T. Peterson, D.L. Myers 2006. Have brook trout (*Salvelinus fontinalis*) displaced bull trout (*Salvelinus confluentus*) along longitudinal gradients in central Idaho streams? Canadian Journal of Fisheries and Aquatic Sciences 63: 63-78.

Rieman, B.E. and J.D. McIntyre. 1995. Occurrence of bull trout in naturally fragmented habitat patches of varied size. Transactions of the American Fisheries Society 124: 285-296

U.S. Fish and Wildlife Service (USFWS). 2008. Bull Trout Recovery: Monitoring and Evaluation Guidance. Report prepared for the U.S. Fish and Wildlife Service by the Bull Trout Recovery and Monitoring Technical Group (RMEG). Portland, Oregon. 74 pp.

Appendix A: Reach Specific Fish and Habitat Data

Table 1: Geographic coordinates of fish and habitat sampling reaches, 2008.

Patch Name	Patch Area (ha)	Reach Code	Site Name	UTM 12x (m)	UTM12y (m)	Elevation (m)
Starvation	1871.609	1	Starvation Creek, L1	251839	5426467	1255
		2	Starvation Creek, L2	251574	5425940	1183
		3	Starvation Creek, U1	253261	5429126	1342
		4	Starvation Creek, U2	256062	5430317	1413
		5	Starvation Creek, U3	253800	5429428	1338
Lower Kintla	4730.074	6	Kintla Creek, L1	253287	5423701	1177
		7	Kintla Creek, L2	253744	5424151	1186
		8	Kintla Creek, L3	254603	5425471	1236
		9	Kintla Creek, M1	262512	5429575	1231
Upper Kintla	8438.76	10	Kintla Creek, M2	264505	5429712	1301
		11	Kintla Creek, U1	269938	5429684	1329
		12	Kintla Creek, U2	270277	5430409	1395
		13	Kintla Creek, U3	270827	5430611	1423
		14	Agassiz Creek, 1	269869	5429219	1354
		15	North Fork Kintla Creek,1	270397	5430489	1407
		16	Red Medicine Bow Creek,1	264485	5429688	1291
Akokala	10632.016	17	Akokala Creek, L1	259828	5417175	1238
		18	Akokala Creek, L2	258749	5408986	1091
		19	Akokala Creek, L3	258738	5409798	1092
		20	Akokala Creek, U1	262940	5416763	1352
		21	Akokala Creek, U2	264616	5417332	1396
		22	Akokala Creek, U3	265503	5419360	1469
		23	Long Bow Creek, L1	262039	5417356	1316
		24	Long Bow Creek, U1	262385	5417738	1351
		25	Parke Creek, L1	260496	5417441	1267
		26	Parke Creek, U1	260686	5417751	1259
Lower Bowman	2966.087	27	Bowman Creek, L1	259049	5408879	1093
		28	Bowman Creek, L2	259815	5409652	1110
		29	Bowman Creek, L3	265253	5413001	1233
Upper Bowman	5891.987	30	Bowman Creek, U2	273999	5423046	1272
		31	Bowman Creek, U3	274589	5424362	1299

Table 1 Continued:

Patch Name	Patch Area (ha)	Reach Code	Site Name	UTM 12x (m)	UTM12y (m)	Elevation (m)
		32	Bowman Creek, U4	275082	5425628	1300
Upper Bowman	5891.987	33	Bowman Creek, U5	275193	5425930	1359
		34	Jefferson Creek, 1	274119	5422545	1271
		35	Jefferson Creek, 2	273608	5422304	1199
		36	Numa Creek, 1	271245	5421512	1249
		37	Pocket Creek, 1	274447	5424776	1241
Lower Camas	9643.906	38	McGee Creek, L1	276045	5387359	1181
		39	McGee Creek, L2	275981	5388040	1167
		40	McGee Creek, L3	274147	5389401	1138
		41	McGee Creek, L4	273167	5390561	1115
		42	McGee Creek, U1	275877	5387117	1059
		43	McGee Creek, U2	275238	5386555	1231
		44	McGee Creek, U3	274933	5386597	1230
		45	McGee Creek, U4	274772	5386541	1228
		46	McGee Trib. A, L1	275309	5388195	1181
		47	McGee Trib. A, L2	275130	5388077	1180
		48	McGee Trib. A, U2	274885	5387955	1202
Lower McDonald	11113.631	49	Apgar Creek, 1	278580	5379647	982
		50	Apgar Trib. A, 1	278380	5379869	990
Upper McDonald	7321.222	51	Heavens Creek, 1	293228	5403188	1129
Fish	2644.645	52	Fern Creek, L1	277839	5383373	1142
		53	Fern Creek, L2	279379	5382100	1022
		54	Fern Creek, U1	277529	5383558	1181
		55	Fern Creek, U2	277116	5383520	1202
		56	Fish Creek, L1	279655	5381931	889
		57	Fish Creek, U1	279154	5383311	1059
		58	Fish Creek, U2	278670	5383917	1055
		59	Fish Creek, U3	276198	5386204	1188
		60	Fish Creek, U4	276486	5385987	1184
Howe	1049.059	61	Howe Creek, 1	278754	5384000	1082
Mineral	6215.055	62	Mineral Creek,1	292464	5404532	1167

Table 2: Fish sampling data for all reaches, 2008.

Reach Code	Site Name	Total WCT	CPUE WCT (WCT>75mm/hr)	WCT/100m² (>75mm)	Total BULL	CPUE BULL (BULL>75mm/hr)	BULL/100m² (>75mm)
1	Starvation Creek, L1	1	2.29	0.13	0	0.00	0.00
2	Starvation Creek, L2	1	11.43	0.60	0	0.00	0.00
3	Starvation Creek, U1	4	3.65	0.37	0	0.00	0.00
4	Starvation Creek, U2	6	10.99	1.28	0	0.00	0.00
5	Starvation Creek, U3	2	6.96	0.50	0	0.00	0.00
6	Kintla Creek, L1	12	5.76	0.25	0	0.00	0.00
7	Kintla Creek, L2	5	5.26	0.12	0	0.00	0.00
8	Kintla Creek, L3	4	1.99	0.04	0	0.00	0.00
9	Kintla Creek, M1	0	0.00	0.00	0	0.00	0.00
10	Kintla Creek, M2	0	0.00	0.00	0	0.00	0.00
11	Kintla Creek, U1	0	0.00	0.00	1	3.77	0.27
12	Kintla Creek, U2	0	0.00	0.00	0	0.00	0.00
13	Kintla Creek, U3	0	0.00	0.00	0	0.00	0.00
14	Agassiz Creek, 1	0	0.00	0.00	1	4.88	0.12
15	North Fork Kintla Creek,1	0	0.00	0.00	0	0.00	0.00
16	Red Medicine Bow Creek, 1	0	0.00	0.00	0	0.00	0.00
17	Akokala Creek, L1	1	1.57	0.06	1	1.57	0.06
18	Akokala Creek, L2	8	12.10	0.53	0	0.00	0.00
19	Akokala Creek, L3	0	0.00	0.00	0	0.00	0.00
20	Akokala Creek, U1	4	3.52	0.26	0	0.00	0.00
21	Akokala Creek, U2	4	7.37	0.80	0	0.00	0.00
22	Akokala Creek, U3	0	0.00	0.00	2	3.82	0.42
23	Long Bow Creek,L1	1	2.55	0.35	0	0.00	0.00
24	Long Bow Creek, U1	2	5.96	0.38	0	0.00	0.00
25	Parke Creek, L1	0	0.00	0.00	0	0.00	0.00
26	Parke Creek, U1	2	8.29	0.50	0	0.00	0.00
27	Bowman Creek, L1	4	2.11	0.10	0	0.00	0.00
28	Bowman Creek, L2	4	0.00	0.00	0	0.00	0.00

Table 2 Continued:

Reach Code	Site Name	Total WCT	CPUE WCT (WCT>75mm/hr)	WCT/100m^2 (>75mm)	Total BULL	CPUE BULL (BULL>75mm/hr)	BULL/100m^2 (>75mm)
29	Bowman Creek, L3	4	6.13	0.10	1	1.53	0.03
30	Bowman Creek, U2	0	0.00	0.00	0	0.00	0.00
31	Bowman Creek, U3	0	0.00	0.00	0	0.00	0.00
32	Bowman Creek, U4	0	0.00	0.00	0	0.00	0.00
33	Bowman Creek, U5	0	0.00	0.00	0	0.00	0.00
34	Jefferson Creek, 1	0	0.00	0.00	1	2.89	0.18
35	Jefferson Creek, 2	0	0.00	0.00	5	4.90	0.27
36	Numa Creek, 1	0	0.00	0.00	0	0.00	0.00
37	Pocket Creek, 1	1	2.53	0.22	0	0.00	0.00
38	McGee Creek, L1	18	18.40	1.20	0	0.00	0.00
39	McGee Creek, L2	12	6.32	0.72	0	0.00	0.00
40	McGee Creek, L3	0	0.00	0.00	0	0.00	0.00
41	McGee Creek, L4	0	2.22	0.18	0	0.00	0.00
42	McGee Creek, U1	3	10.04	1.03	0	0.00	0.00
43	McGee Creek, U2	8	14.74	1.26	0	0.00	0.00
44	McGee Creek, U3	2	11.80	1.07	0	0.00	0.00
45	McGee Creek, U4	2	5.26	0.49	0	0.00	0.00
46	McGee Trib. A, L1	2	0.00	0.00	0	0.00	0.00
47	McGee Trib. A, U1	1	4.97	0.85	0	0.00	0.00
48	McGee Trib. A, U2	1	9.42	1.29	0	0.00	0.00
49	Apgar Creek, 1	2	11.11	0.64	1	5.56	0.32
50	Apgar Trib. A, 1	3	15.19	2.00	0	0.00	0.00
51	Heavens Creek, 1	3	38.43	1.09	0	0.00	0.00
52	Fern Creek, L1	13	16.20	2.28	0	0.00	0.00
53	Fern Creek, L2	15	19.58	2.47	0	0.00	0.00
54	Fern Creek, U1	7	17.20	2.23	0	0.00	0.00
55	Fern Creek, U2	8	21.14	2.45	0	0.00	0.00
56	Fish Creek, L1	11	19.01	1.49	0	0.00	0.00

Table 2 Continued:

Reach Code	Site Name	Total WCT	CPUE WCT (WCT>75mm/hr)	WCT/100m^2 (>75mm)	Total BULL	CPUE BULL (BULL>75mm/hr)	BULL/100m^2 (>75mm)
57	Fish Creek, U1	12	53.95	2.93	0	0.00	0.00
58	Fish Creek, U2	8	27.12	3.06	0	0.00	0.00
59	Fish Creek, U3	7	71.59	4.57	0	0.00	0.00
60	Fish Creek, U4	9	59.89	7.26	0	0.00	0.00
61	Howe Creek, 1	9	23.32	3.45	0	0.00	0.00
62	Mineral Creek , 1	1	6.94	0.20	0	0.00	0.00

Table 3: Physical habitat data for all reaches sampled in 2008.

Reach Code	Site Name	Length (m)	Average Width (m)	Area (m^2)	Average Gradient (%)	Pools/ $100m^2$	LWD/ $100m^2$	Aggregates /$100m^2$	Dominant Substrate	Dominant Riparian Vegetation
1	Starvation Creek, L1	86	8.7	749.1	1.7	0.27	0.27	0	Cobble	Spruce
2	Starvation Creek, L2	25	6.6	166.0	1.7	0.60	1.81	0.60	Cobble	Spruce
3	Starvation Creek, U1	50	10.7	536.0	1.7	0.56	1.49	0.19	Cobble	Spruce
4	Starvation Creek, U2	62	7.5	467.7	2.2	0.64	1.92	0.21	Cobble	Burned Spruce
5	Starvation Creek, U3	53	7.6	402.8	2.6	0.50	0.50	0	Cobble	Spruce
6	Kintla Creek, L1	151	13.4	2023.4	2.6	0.10	1.48	0.05	Cobble	Spruce
7	Kintla Creek, L2	89	19.4	1729.1	1.7	0.12	0.17	0	Cobble	Spruce
8	Kintla Creek, L3	153	17.0	2601	2.2	0.12	0.27	0.08	Cobble	Spruce
9	Kintla Creek, M1	82	12.4	1014.8	2.2	0.20	1.87	0.30	Large Gravel	Spruce
10	Kintla Creek, M2	67	9.3	623.1	3.5	0.32	0.32	0	Boulders	Spruce
11	Kintla Creek, U1	71	5.3	373.3	0.9	0.80	4.55	0.54	Sand and Silt	Spruce
12	Kintla Creek, U2	86	7.8	668.7	5.2	1.05	0.15	0	Cobble	Spruce
13	Kintla Creek, U3	135	6.5	870.8	2.2	0.23	0.23	0	Cobble	Spruce
14	Agassiz Creek, 1	80	10.5	836.6	3.1	0.24	0.60	0	Cobble	Spruce
15	North Fork Kintla Creek, 1	69	5.8	399.4	4.4	1.25	0.75	0	Cobble	Spruce
16	Red Medicine Bow Creek, 1	75	9.0	677.1	5.2	0.89	2.22	0.30	Cobble	Spruce
17	Akokala Creek, L1	122	14.4	1753.1	0.9	0.11	0.17	0	Cobble	Burned Spruce
18	Akokala Creek, L2	188	8.0	1505.9	1.3	0.33	0.46	0.07	Sand and Silt	Willows
19	Akokala Creek, L3	209	7.1	1483.9	1.7	0.34	0.13	0	Sand and Silt	Lodgepole
20	Akokala Creek, U1	52	7.5	390	3.1	1.28	2.82	0.26	Cobble	Spruce
21	Akokala Creek, U2	60	8.3	498	1.7	1.00	1.20	0.20	Cobble	Spruce
22	Akokala Creek, U3	64	7.5	481.8	1.7	0.83	0.83	0	Small gravel	Spruce
23	Long Bow Creek, L1	70	4.0	282	1.7	1.06	2.48	0.71	Large Gravel	Burned Lodgepole
24	Long Bow Creek, U1	53	5.0	263.9	4.4	1.14	4.55	0.38	Cobble	Burned Spruce
25	Parke Creek, L1	54	5.4	293.4	0.9	1.02	2.39	0.34	Boulders	Burned Spruce
26	Parke Creek, U1	67	6.0	399.1	1.7	0.75	2.51	0.25	Cobble	Burned Spruce
27	Bowman Creek, L1	82	11.9	973.8	3.1	0.31	2.57	0.21	Cobble	Dogwood
28	Bowman Creek, L2	123	16.6	2041.8	2.6	0.10	0.93	0.10	Cobble	Alder
29	Bowman Creek, L3	203	19.2	3897.6	1.3	0.08	1.05	0.10	Large Gravel	Willows

Table 3 Continued:

Reach Code	Site Name	Length (m)	Average Width (m)	Area (m^2)	Average Gradient (%)	Pools/ 100m^2	LWD/ 100m^2	Aggregates /100m^2	Dominant Substrate	Dominant Riparian Vegetation
30	Bowman Creek, U2	67	13.9	934.2	1.3	0.32	0.64	0.11	Large Gravel	Spruce
31	Bowman Creek, U3	81	4.9	396	2.6	1.01	3.79	0.76	Large Gravel	Spruce
32	Bowman Creek, U4	64	7.4	471.5	1.7	0.42	4.03	0.42	Large Gravel	Spruce
33	Bowman Creek, U5	61	6.6	400.0	3.5	0.50	0	0	Boulders	Thimbleberry
34	Jefferson Creek	97	5.7	549.02	3.1	0.73	3.64	0.36	Large Gravel	Spruce
35	Jefferson Creek	122	6.0	735.7	0.9	0.27	1.36	0.14	Cobble	Spruce
36	Numa Creek, 1	80	5.6	451.0	2.6	1.33	5.32	0.67	Boulders	Spruce
37	Pocket Creek, 1	78	5.8	450.2	2.6	0.44	1.55	0.22	Cobble	Spruce
38	McGee Creek, L1	141	4.7	665.5	1.7	0.60	0.75	0.15	Large Gravel	Dogwood
39	McGee Creek, L2	156	3.6	555.4	1.3	1.26	0.72	0	Large Gravel	Willows
40	McGee Creek, L3	107	4.5	477.2	0.9	1.26	0.63	0	Large Gravel	Spruce
41	McGee Creek, L4	107	5.3	567.1	1.7	0.53	1.23	0.18	Cobble	Spruce
42	McGee Creek, U1	70	4.2	291.7	4.4	1.03	2.06	0	Large Gravel	Spruce
43	McGee Creek, U2	163	3.9	632.4	5.2	0.47	1.74	0.16	Cobble	Spruce
44	McGee Creek, U3	51	3.7	187.7	2.6	1.60	3.73	0.53	Cobble	Spruce
45	McGee Creek, U4	96	4.2	406.1	4.4	0.99	1.48	0.25	Cobble	Spruce
46	McGee Trib. A, L1	56	1.7	92.8	2.6	4.31	5.39	2.16	Sand and Silt	Spruce
47	McGee Trib. A, U1	70	1.7	118.0	6.1	4.24	3.39	0.85	Sand and Silt	Spruce
48	McGee Trib. A, U2	53	1.5	77.7	4.4	2.57	1.29	0	Small gravel	Spruce
49	Apgar Creek, 1	70	4.5	311.5	3.5	1.28	0.64	0	Large Gravel	Thimbleberry
50	Apgar Trib. A, 1	60	2.5	150.0	3	4.67	5.33	0	Large Gravel	Alder
51	Heavens Creek, 1	50	5.5	274.0	5.7	1.46	1.09	0	Cobble	Alder
52	Fern Creek, L1	52	4.2	219.4	7.9	1.82	4.56	0.91	Cobble	Fern
53	Fern Creek, L2	108	4.1	446.0	3.1	0.67	2.91	0.67	Cobble	Spruce
54	Fern Creek, U1	79	3.4	269.5	2.6	2.97	4.45	1.11	Boulders	Burned Spruce
55	Fern Creek, U2	75	3.2	244.7	2.6	2.86	6.95	0.82	Boulders	Burned Spruce
56	Fish Creek, L1	107	6.9	737.2	2.6	0.41	0	0	Boulders	Spruce
57	Fish Creek, U1	57	6.6	375.3	3.5	1.07	1.60	0	Large Gravel	Fireweed
58	Fish Creek, U2	71	3.7	261.7	0.9	1.53	4.20	0	Large Gravel	Alder
59	Fish Creek, U3	73	2.1	153.3	0.9	2.61	3.91	0	Cobble	Fireweed
60	Fish Creek, U2	61.5	2.0	124.0	3.1	3.23	7.26	0	Large Gravel	Alder

Table 3 Continued:

Reach Code	Site Name	Length (m)	Average Width (m)	Area (m^2)	Average Gradient (%)	Pools/ $100m^2$	LWD/ $100m^2$	Aggregates /$100m^2$	Dominant Substrate	Dominant Riparian Vegetation
61	Howe Creek, 1	50	2.9	145.0	5.2	1.38	6.90	0	Cobble	Fireweed
62	Mineral Creek, 1	61	8.0	489.0	2	0.41	0	0	Bedrock	Willows

Appendix B: Mean Catch Per Unit Effort
And Fish Density Figures by Stream for WCT and
Bull Trout

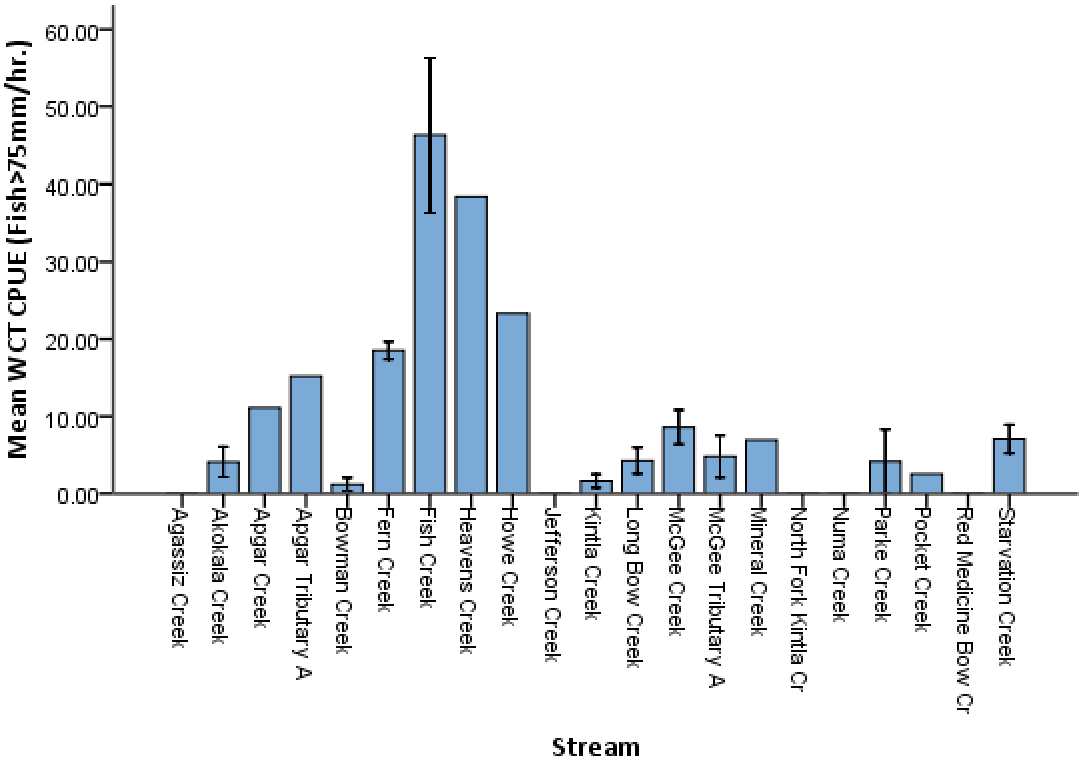

Figure 5: Mean electrofishing catch-per-unit-effort (CPUE; fish>75mm/hour) for westslope cutthroat trout in each stream sampled in GNP during 2008. Standard error bars are given for streams with multiple reaches.

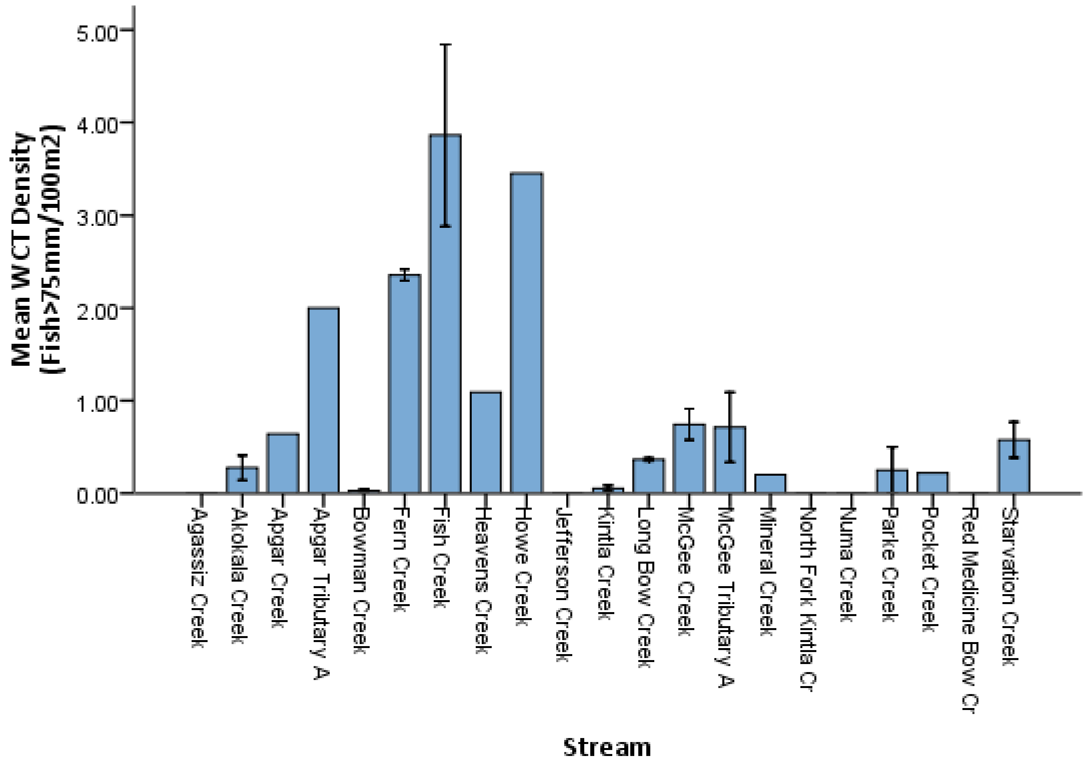

Figure 6: Mean density of westslope cutthroat trout (fish>75mm/100m^2) for each stream sampled in GNP during 2008. Density estimates are likely biased low since they are based on one-pass electrofishing rather than depletion sampling. Standard error bars are given for streams with multiple reaches.

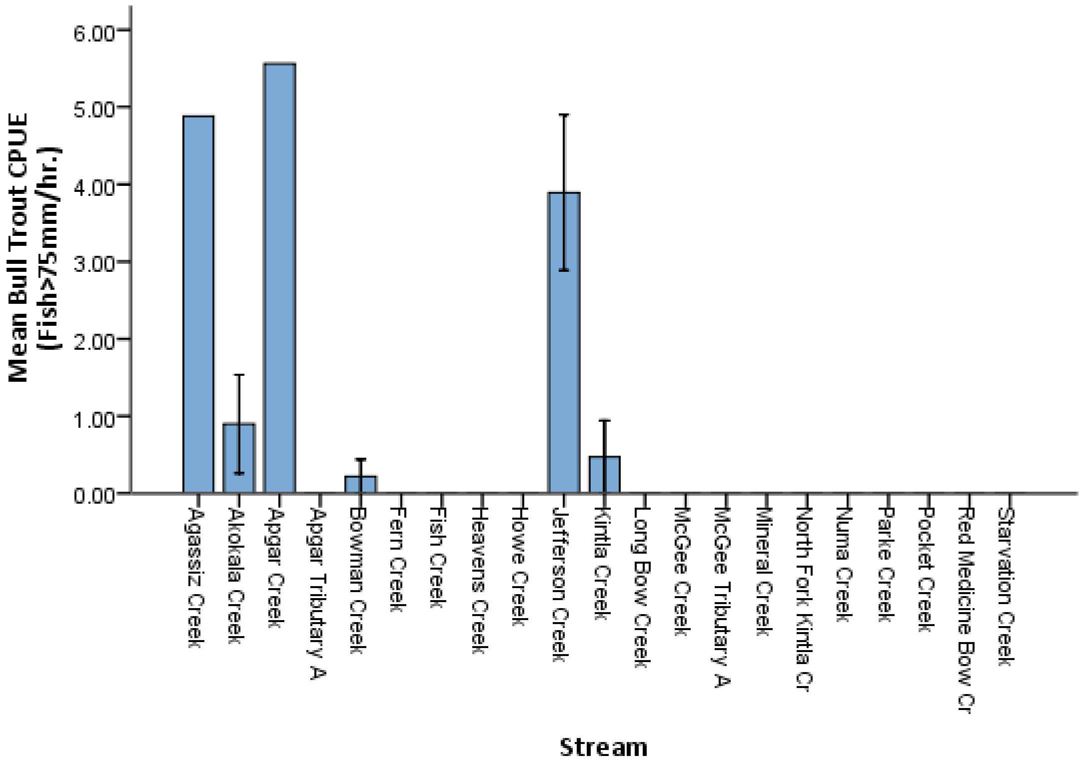

Figure 7: Mean electrofishing catch-per-unit-effort (CPUE; fish>75mm/hour) for bull trout in each stream sampled in GNP during 2008. Standard error bars are given for streams with multiple reaches.

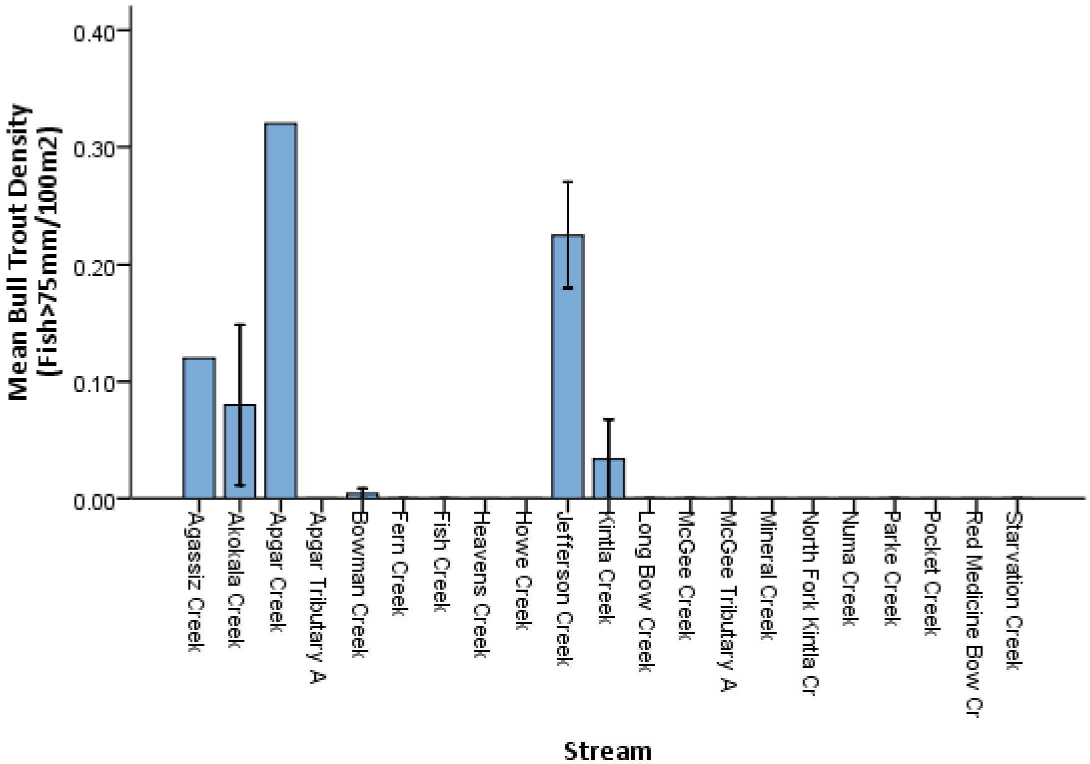

Figure 8: Mean density of bull trout (fish>75mm/100m^2) for each stream sampled in GNP during 2008. Density estimates are likely biased low since they are based on one-pass electrofishing rather than depletion sampling. Standard error bars are given for streams with multiple reaches.

Appendix C: Length Frequency
Histograms by Stream
For WCT and Bull Trout

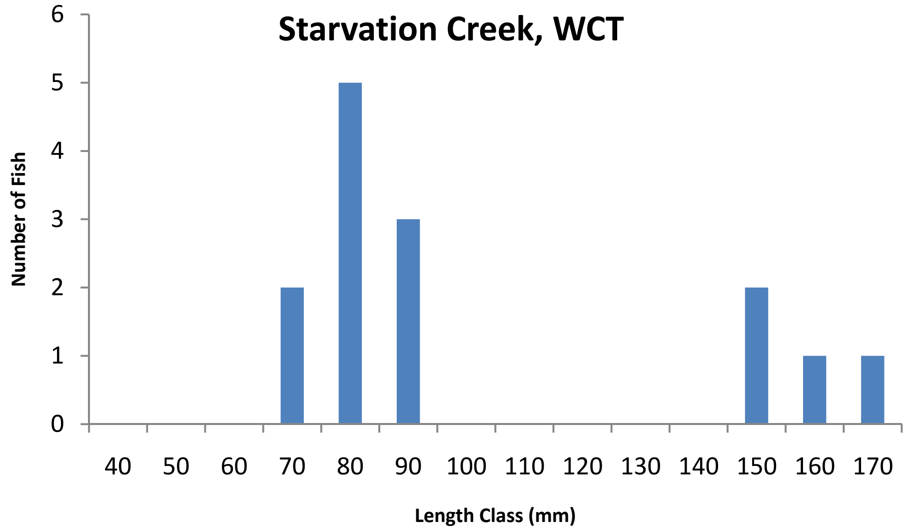

Figure 9: WCT length-frequency histogram for Starvation Creek.

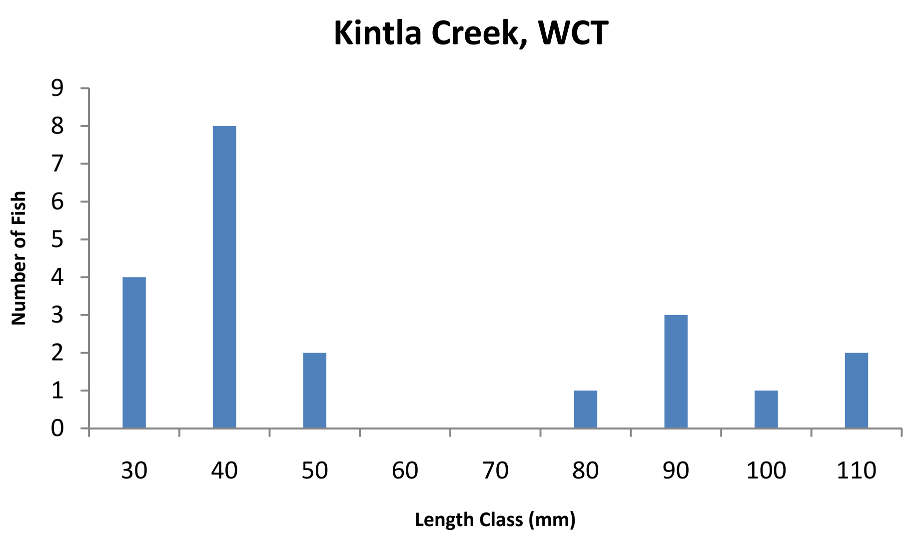

Figure 10: WCT length-frequency histogram for Kintla Creek.

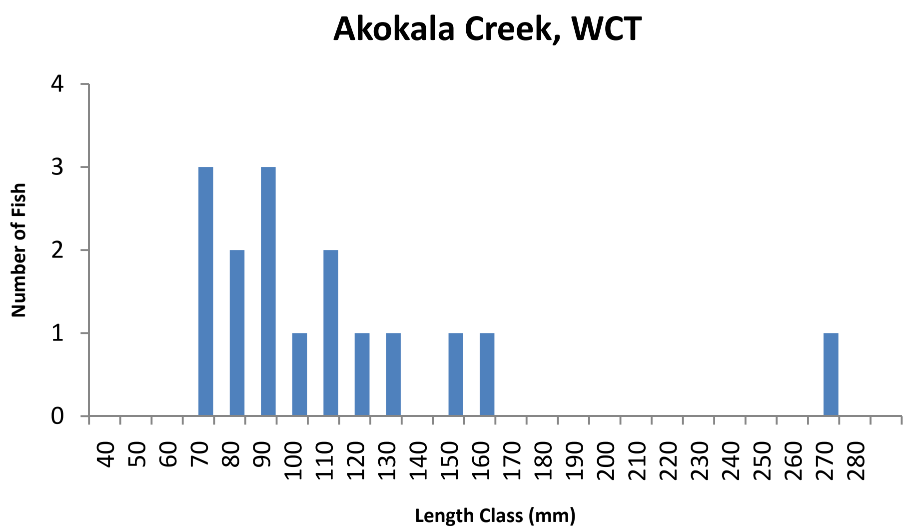

Figure 11: WCT length-frequency histogram for Akokala Creek.

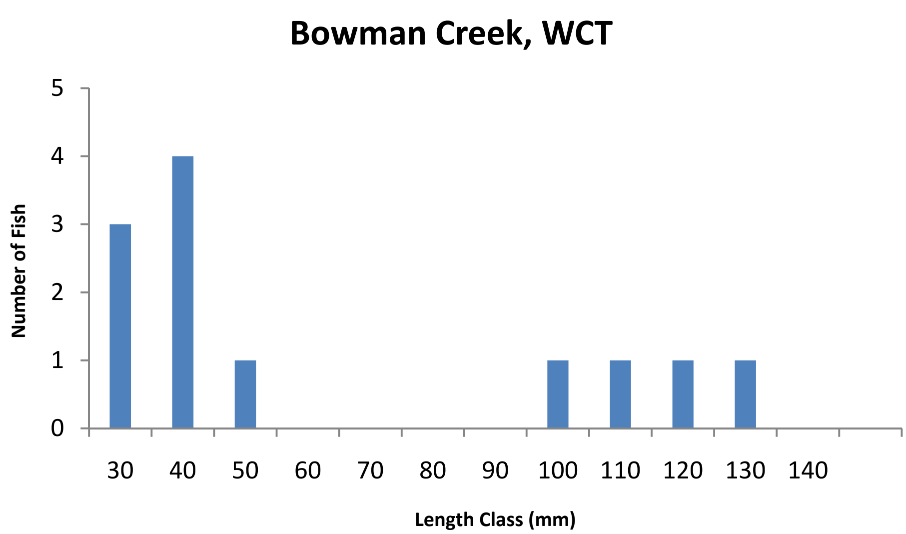

Figure 12: WCT length-frequency histogram for Bowman Creek.

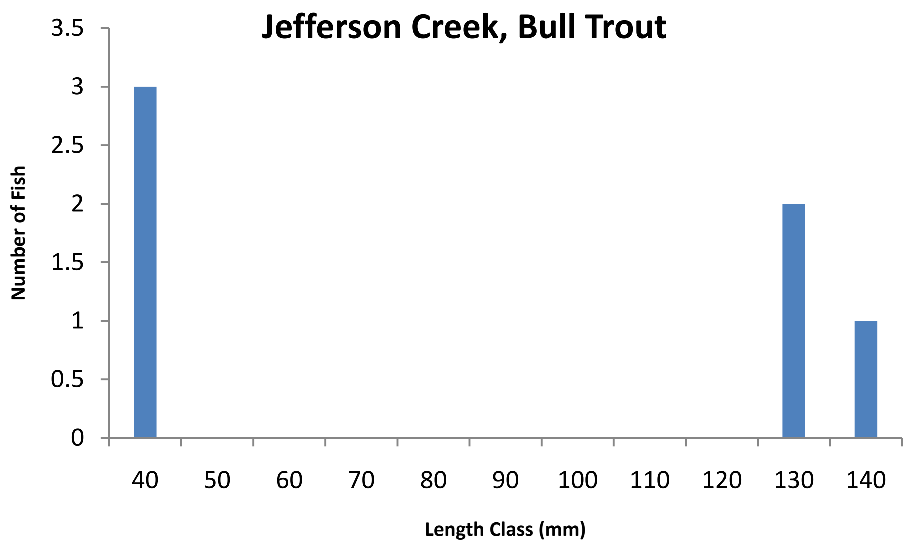

Figure 13: Bull trout length-frequency histogram for Jefferson Creek.

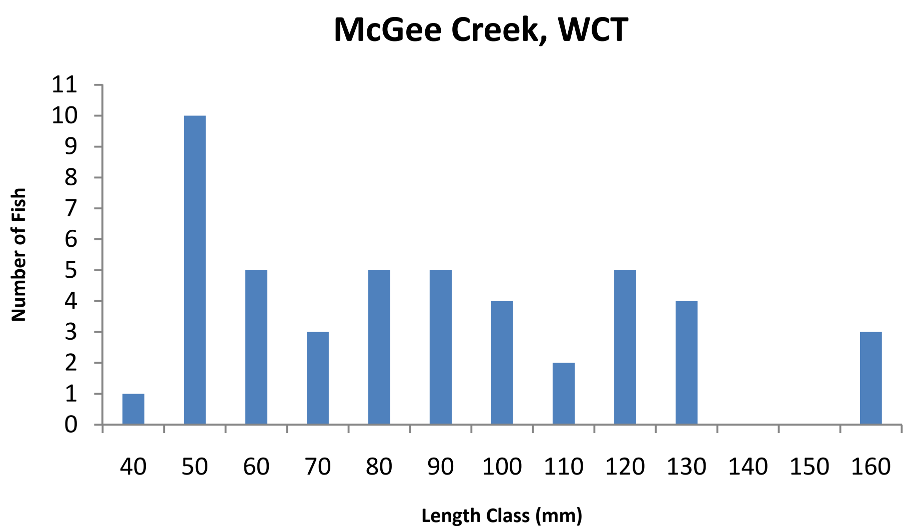

Figure 14: WCT length-frequency histogram for McGee Creek.

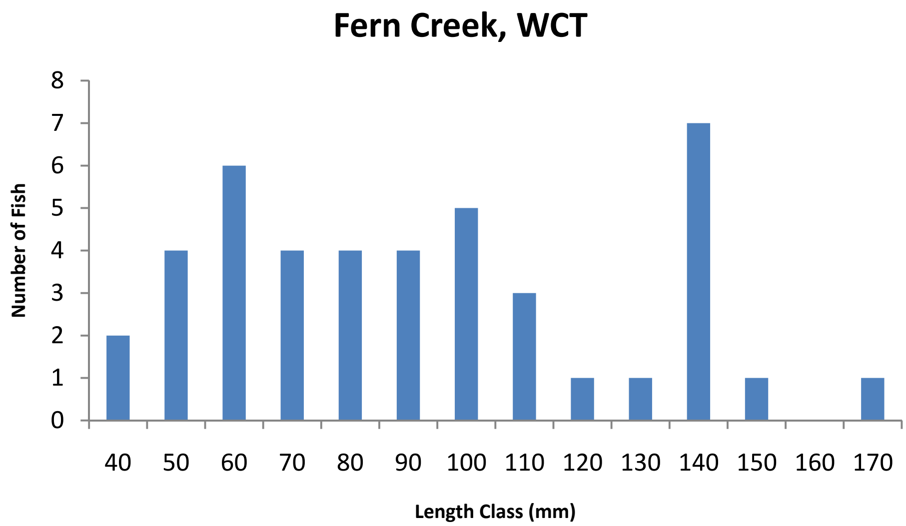

Figure 15: WCT length-frequency histogram for Fern Creek.

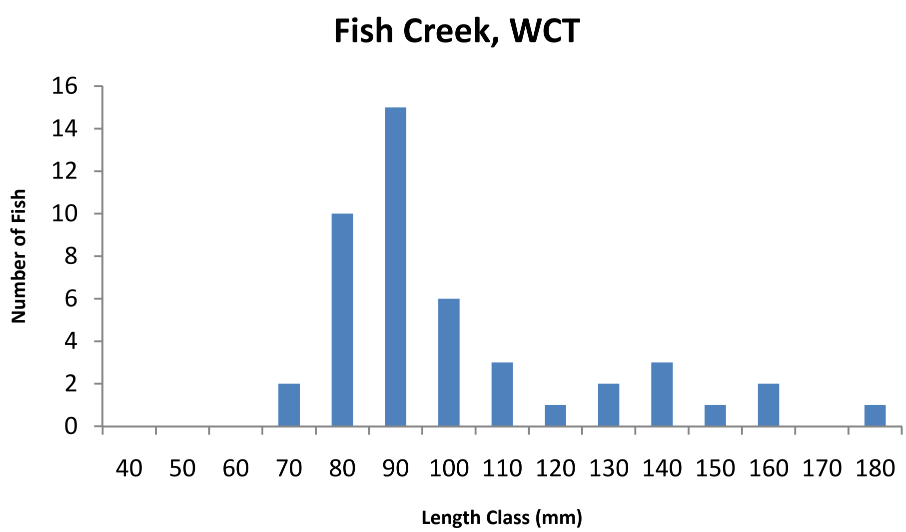

Figure 16: WCT length-frequency histogram for Fish Creek.