Westslope Cutthroat Trout Transport Evaluation

Project Completion Report

Fish Passage/Native Salmonid Restoration Plan

Appendix C

April 2025

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Abstract

The experimental transport of Westslope Cutthroat Trout (WCT) *Oncorhynchus lewisi* upstream of Cabinet Gorge Dam was initiated in 2015 as part of the *Fish Passage/Native Salmonid Restoration Plan (Appendix C), Upstream Fish Passage Program.* Westslope Cutthroat Trout are captured in the Lower Clark Fork River (LCFR) in Idaho in the vicinity of Cabinet Gorge Dam and are subsequently transported into Cabinet Gorge Reservoir in Montana. The goal for the WCT upstream passage program is to reestablish connectivity for adfluvial WCT utilizing Lake Pend Oreille, Idaho for growth and rearing and attempting to return to Montana tributaries to spawn. To date, there has been no evaluation of transported WCT potential reproduction or contribution to recreational fisheries in Montana.

To determine if any transported WCT have successfully reproduced tissue samples were collected in tributaries identified as being used by transported WCT. Parentage-based tagging was used to determine if any fish collected were offspring of transported WCT. Parentage analysis detected 17 offspring of WCT transported upstream. These offspring were produced by 12 different parents with family groups ranging from 2 to 3 individuals. Parent WCT transported upstream also spanned across 4 different transport years. Offspring were detected in the mainstem Bull River, South Fork Bull River, and the East Fork Bull River. Results from this study highlighted the efficacy of the WCT upstream passage program. Experimental transport of WCT has been ongoing for a decade, however numbers of WCT captured below Cabinet Gorge Dam and transported to Montana to date have remained low. This study provides strong evidence that if capture efficiency of WCT can be improved below Cabinet Gorge Dam it is likely a meaningful component of migratory WCT could be restored in the LCFR.

Individual ancestry was also assessed as a secondary benefit of this project. The extensive sampling undertaken during this study revealed that non-hybridized WCT are widespread in the Bull River drainage and most tributaries are largely if not entirely inhabited by non-hybridized WCT. Genetic sampling also revealed that 80% of putative WCT transported to Montana were non-hybridized WCT. This updated individual ancestry data gives a much more accurate representation of the unintended passage of WCT with non-native ancestry as part of the *Fish Passage/Native Salmonid Restoration Plan (Appendix C), Upstream Fish Passage Program.*

To assess the contribution of transported WCT to recreational fisheries Floy tags were inserted into all transported WCT in 2022 and 2023. No WCT transported upstream of Cabinet Gorge Dam during the study period were reported as captured by anglers. It is unlikely at the current level of passage, WCT transported over Cabinet Gorge Dam are contributing to recreational fisheries in Montana in any meaningful form. One WCT determined to be an offspring of a WCT transported upstream was reported captured by an angler. This is the only contribution to recreational fisheries in Montana from *the Fish Passage/Native Salmonid Restoration Plan (Appendix C), Upstream Fish Passage Program* documented during this study.

Introduction

The Clark Fork River is Montana's largest river by discharge. It has its origins near Butte, Montana at the Continental Divide and flows for approximately 380 km before merging with the Flathead River near Paradise, Montana. The Lower Clark Fork River (LCFR) begins at the confluence with the Flathead River and continues northwestward 165 km before entering Lake Pend Oreille, Idaho (LPO), a large (380 km^2), deep (350 m) natural lake in the Idaho panhandle.

The LCFR was historically an important migratory corridor for Bull Trout *Salvelinus confluentus* and Westslope Cutthroat Trout (WCT) *Oncorhynchus lewisi* which spawned in Montana tributaries but matured in LPO (Huston 1985). Other native non-game species also migrated extensively through the LCFR (e.g., Catastomids, Leuciscids). However, in the 20th century, three dams were constructed that have restricted migrations of native fishes and greatly altered the hydrology and habitat of the river. Thompson Falls Dam, the uppermost of the three dams, completed in 1915 by Montana Power (currently owned by NorthWestern Energy), Cabinet Gorge Dam (completed 1952), and Noxon Rapids Dam (completed 1959) are owned and operated by Avista. Cabinet Gorge Dam is located in Idaho approximately 16 km upstream of LPO and is less than 0.2 km west of the Montana border. This hydroelectric facility blocks upstream fish passage into tributaries within the LCFR in Montana that were historically available to migratory WCT. Historically, migratory WCT were common in many tributaries to the LCFR. Pratt and Huston (1993) interviewed locals that lived in Sanders County concerning fisheries in the area prior to when the hydroelectric dams were built on the mainstem Clark Fork River. Large and presumably migratory, WCT or "redbellies" were common in most Montana tributaries of the LCFR and were directly mentioned as being present in several Cabinet Gorge tributaries including Blue Creek, Elk Creek, Bull River, Pilgrim Creek, and Rock Creek (Pratt and Huston 1993). Currently stream-resident, non-hybridized WCT populations occur in all major drainages to Cabinet Gorge Reservoir as well as some of the minor tributaries (Leary 1993; Ardren et al. 2008; DeHaan et al. 2016; Rehm and Tholl 2023; Rehm et al. 2024). However, post dam construction, migratory (fluvial) WCT are only known to be present in the Bull River drainage (WWP 1996; Chadwick 2000; Katzman and Hintz 2003; Moran 2006; Moran and Storaasli 2015).

As part of the *Fish Passage/Native Salmonid Restoration Plan (Appendix C), Upstream Fish Passage Program* Bull Trout have been captured below Cabinet Gorge Dam and transported to their natal streams in Montana since 2001 (Lockard et al. 2004; Bernall and Duffy 2018). Genetic analyses conducted by the Abernathy Fish Technology Center is used to determine the geographic region and tributary of origin of Bull Trout captured in the LCFR downstream of Cabinet Gorge Dam (Adams et al. 2023). Building on the success observed in the Bull Trout transport program, the experimental transport of WCT upstream of Cabinet Gorge Dam was initiated in 2015 and has occurred in the LCFR over the last decade (2015–2024). Westslope Cutthroat Trout are captured in the LCFR in Idaho in the vicinity of Cabinet Gorge Dam and are

subsequently transported into Cabinet Gorge Reservoir in Montana. The goal for the experimental WCT upstream passage program is to reestablish connectivity for adfluvial WCT utilizing LPO, Idaho for growth and rearing and attempting to return to Montana tributaries to spawn. A suite of microsatellite DNA markers used to identify the most likely population and region of origin for WCT captured downstream of mainstem Clark Fork River dams have not been developed. Montana Fish, Wildlife and Parks recommended that the initial experimental phase of WCT upstream passage should occur only above Cabinet Gorge Dam, due to the inability to assign WCT to region, and in an effort to contain the potential spread of any pathogens upstream. With Noxon Rapids Dam also acting as a fish passage barrier transported WCT only have access to tributaries of Cabinet Gorge Reservoir.

Westslope Cutthroat Trout were selected for transport based on three major criteria: phenotypic characteristics, length, and weight. Fish meeting these requirements display phenotypic characteristics that include a complete and vivid slash marking on the lower jaw and few to no spots in the crescent-shaped area anterior to the dorsal fin and below the lateral line, were a minimum of 340 mm in total length (TL), and weighed a minimum of 400 g (weight requirements were in place from 2015–2018 during radio tagging efforts). Phenotypic criteria were employed to reduce the risk of passing WCT with Rainbow Trout *Oncorhynchus mykiss* or Yellowstone Cutthroat Trout *Oncorhynchus viginalis bouvieri* introgression upstream of Cabinet Gorge Dam (Ardren and Bernall 2016; Bernall et al. 2021). Early radio telemetry work by Bernall et al. (2021) found that no WCT entered tributaries to spawn when lower Clark Fork River water temperatures exceeded 13.6°C. Beginning in 2019, using this optimum water temperature range WCT selected for transport must also be captured prior to or on June 15th in order to provide the best opportunity to complete their spring spawning migration. Methods employed to capture WCT below Cabinet Gorge Dam included night electrofishing, hook-and-line sampling, and since 2022, the Cabinet Gorge Fish Passage Facility (CGFPF). For a more thorough description of the study area and methods, refer to Bernall et al. (2021).

Since the initiation of the experimental transport program, 316 WCT have been transported into Montana. Transported fish were implanted with radio transmitters from 2015–2018 to monitor the movements of these fish following upstream transport (Bernall et al. 2021). A proportion of these radio-tagged WCT were observed migrating into tributaries during the spawning period, which was defined as late March through mid-June. The percentage of WCT passed into Cabinet Gorge Reservoir that entered a spawning tributary over those years ranged from 23–40%, with a mean of 31% (2015= 23%, 2016= 40%, 2017= 37.5%, 2018= 25%; Bernall and Johnson 2016, 2017, 2018; Bernall et al. 2021). Fish were documented entering Blue Creek, Bull River, Pilgrim Creek, and Rock Creek (Figure 1). Each year that WCT were tracked, at least five fish entered the Bull River drainage, 3 of 4 years at least one fish entered Rock Creek and Pilgrim Creek, and 2 of 4 years one fish entered Blue Creek. The percentage of fish passed into Cabinet Gorge Reservoir that have been detected entering the Bull River has ranged from 13–25%, with a mean

of 20% (2015= 13% [n=5], 2016= 25% [n=9], 2017= 22% [n=9], 2018= 21% [n=5]; Bernall et al. 2021).

In August of 2018, a Passive Integrated Transponder (PIT) tag array was installed on the lower Bull River at Rkm 4.5 (Biomark 2018). All transported WCT released in Cabinet Gorge Reservoir from 2019–2024 have been implanted with PIT tags to monitor movement into the Bull River and fallback downstream of Cabinet Gorge Dam. Seventeen percent in 2019 (n=4), 25% in 2020 (n=10), 12% in 2021 (n=2), and 11% (n=3) in 2022 were detected ascending the Bull River during the spawning period following their release (Avista, unpublished data; Rehm and Tholl 2023). From 2015–2022, a total of 47 transported WCT were detected moving into the Bull River during the spawning period.

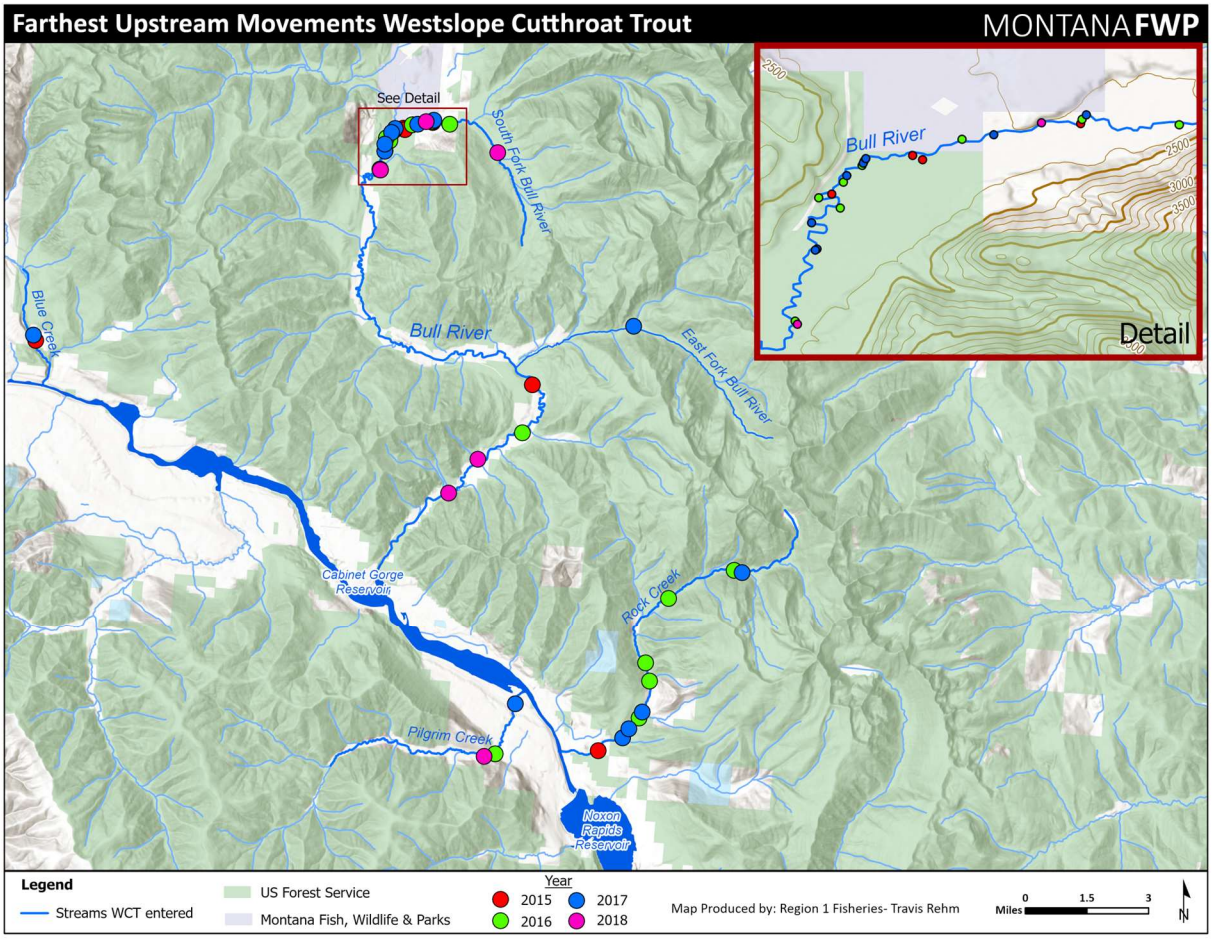

Figure 1. Farthest upstream tributary detections for WCT radio tagged and transported upstream of Cabinet Gorge Dam from 2015–2018 (Bernall et al. 2021).

To date, there has been no evaluation of transported WCT potential reproduction in Montana tributaries or their contribution to recreational fisheries. The goal of this study was to monitor the efficacy of the *Fish Passage/Native Salmonid Restoration Plan (Appendix C), Upstream Fish Passage Program* to reconnect adfluvial WCT populations in the LCFR. This project facilitated the collection of baseline data at current levels of passage of WCT into Montana. Recently a new fish trap (CGFPF) was constructed below Cabinet Gorge Dam with the purpose of capturing upstream migrating Montana origin Bull Trout and WCT. The CGFPF became operational during the summer/fall of 2022 and is set to serve as the primary method of capture for both Bull Trout and WCT below Cabinet Gorge Dam. With operational refinement being adopted to increase capture efficiency of the CGFPF it is likely that numbers of WCT transported upstream of Cabinet Gorge Dam could increase. Results of this study will help inform future passage decisions associated with weighing the benefits to WCT populations and recreational fisheries against risks of disease transmission and passage of WCT with non-native ancestry upstream of Cabinet Gorge Dam.

Methods

Genetic Monitoring

Early work evaluating the farthest upstream movements by WCT transported upstream of Cabinet Gorge Dam from 2015 to 2018 showed fish migrating into numerous tributaries during the spawning period (Figure 1; Bernall et al. 2021). However, the highest percentage of fish observed migrating into a Montana tributary during the spawning period occurred in the Bull River (Figure 1). Using this information, the Bull River and its tributaries were selected as the most likely place to detect offspring of WCT transported upstream of Cabinet Gorge Dam. The Bull River represents the largest tributary drainage entering Cabinet Gorge Reservoir and between the mainstem and its major tributaries it contains over 50 km of connected salmonid habitat. Genetic monitoring occurred at sites in Bull River and its tributaries in the summers of 2022 and 2023 (Figure 2). Specifically, sampling was focused on areas identified as probable spawning locations for WCT transported above Cabinet Gorge Dam (Bernall et al. 2021), the mainstem Bull River downstream of those areas, and Bull River tributary sites being monitored by the *Montana Tributary Habitat Acquisition and Recreational Fishery Enhancement Program (Appendix B), Habitat Restoration Monitoring and Native Salmonid Abundance Monitoring Plan* (Figure 2). A subsample of WCT captured at tributary sites being monitored by the *Habitat Restoration Monitoring and Native Salmonid Abundance Monitoring Plan* were used for genetic analysis (Rehm and Tholl 2023; Rehm et al. 2024).

Methods used to capture fish in the Bull River and its tributaries were drift-boat mounted and backpack electrofishing and hook-and-line sampling in the mainstem of the Bull River. Backpack electrofishing gear was used to perform multi-pass depletion estimates at long-term monitoring sites in the tributaries monitored by the *Montana Tributary Habitat Acquisition and*

Recreational Fishery Enhancement Program (Appendix B), Habitat Restoration Monitoring and Native Salmonid Abundance Monitoring Plan (Rehm and Tholl 2023; Rehm et al. 2024). Sections were sampled in a downstream direction and block nets were employed at the downstream end to prohibit fish from leaving the section, while plunges, shallow riffles, or other features at the upstream end limited fish entering or leaving the section during the sampling effort. Backpack electrofishing with the sole purpose of collecting WCT genetic tissue samples deployed single pass methodology, without the use of a block net, and in an upstream direction. Settings on electrofishing backpacks were kept at a pulsed DC waveform and a frequency of 30 Hz; voltages were then increased to typically 400 to 800 volts to achieve 0.05 to 0.09 amperes when the electrodes were brought to less than 0.5 m apart. In the larger volume mainstem, a small aluminum drift boat with a fixed boom electrode was used to capture fish. These sections were sampled in a downstream direction without the use of block nets. In these instances, electrofisher settings of a higher frequency (50 Hz) but lower voltage of approximately 450 volts provided the amperage (approximately 2 to 2.5) needed for effective fish capture in the larger volume mainstem sections. Associated lengths and weights (weights not collected during hook-and-line sampling) of all fish captured were collected. Fin tissue samples were collected from all WCT captured. Fin tissue samples of WCT collected for genetic testing were approximately 1 cm^2, taken from the anal fin, and placed in 1.5–2 ml screw top vials (with o-ring cap) with 95% non-denatured ethanol. All WCT captured during sampling directly associated with this project were scanned for a PIT tag and a 12 mm long full duplex PIT tag was implanted in the dorsal sinus of all unmarked fish ≥100 mm.

Genetic analysis of all fin tissue samples collected was coordinated with University of Montana Fish Conservation Genetics Lab. Tissue samples of all WCT passed over Cabinet Gorge Dam (2015–2022) were taken at the time of transfer and have been archived at Abernathy Fish Technology Center. The transfer of tissue samples from all WCT passed over Cabinet Gorge Dam from Abernathy Fish Technology Center to the University of Montana Fish Conservation Genetics Lab was coordinated in 2022. Parentage-based tagging, a widely used method to describe reproductive success of known origin salmonid fish throughout the Columbia River basin (e.g., Steele et al. 2019), was used to determine if any fish collected were offspring of those transport fish. All WCT captured in 2022 and 2023 were genotyped using a RAD Capture (Ali et al. 2015) panel specifically designed for WCT; that panel includes more than 500 polymorphic SNPs for parentage in this region, thereby providing high power for accurate parentage inference. Furthermore, the panel also includes more than 1,600 species diagnostic markers (i.e., WCT, Rainbow Trout and Yellowstone Cutthroat Trout) to assess individual ancestry of all migratory adults and juveniles sampled in tributaries, a secondary added benefit of project activities.

Recreational Fisheries Monitoring

Floy tags were inserted into all WCT captured below and transported upstream of Cabinet Gorge Dam in 2022 and 2023. Fish were captured immediately downstream of Cabinet Gorge Dam via boat electrofishing, angling, and the CGFPF. Westslope Cutthroat Trout that were eligible for transport above Cabinet Gorge Dam were ≥340 mm TL and captured prior to or on June 15th. Translocation of WCT involved collection of associated biological data (length and weight), collection and archiving of genetic tissue samples, and individual PIT tagging. A subsample of resident salmonids was also Floy tagged in the mainstem Bull River during genetic sample collection in 2022 and 2023. Fish receiving Floy tags in the Bull River were ≥200 mm TL. All Floy tags were inserted into the dorsal sinus at 45-degree angle towards the posterior end of the fish.

Printed on all Floy tags was an individual identification number and phone number for a Montana Fish, Wildlife and Parks pre-existing tag line for anglers to report their catches. Signage was created and posted at all traditional access points along the Bull River to inform anglers of Floy tagged fish and encourage tag reporting. A news article about the project was also released by Montana Fish, Wildlife and Parks and local outfitters were contacted, made aware of the project, and encouraged to report any tags encountered.

Results

Parentage Analysis

During extensive sampling efforts in 2022 and 2023 a total of 5,011 fish of all species were captured in the Bull River and its tributaries directly associated with this project (Figure 2). Additionally, activities conducted under the *Montana Tributary Habitat Acquisition and Recreational Fishery Enhancement Program (Appendix B), Habitat Restoration Monitoring and Native Salmonid Abundance Monitoring Plan* were used to help facilitate collection of WCT tissue samples at additional sites (Figure 2; Rehm and Tholl 2023; Rehm et al. 2024). Over the sampling period tissue samples from 1,676 putative WCT were collected. A total of 813 tissue samples were collected in 2022 and 863 in 2023. Westslope Cutthroat Trout genetic tissue samples were collected from the entire free-flowing Bull River (Rkm 1.5–39.7; n =939), East Fork Bull River (Rkm 0.0–2.4; n =37), and South Fork Bull River (Rkm 0.0–1.9; n =148; Figure 2). Tissue samples were also collected from Bull River tributaries sampled under the *Habitat Restoration Monitoring and Native Salmonid Abundance Monitoring Plan* at two sites in the North Fork East Fork Bull River (n=100), four sites in the East Fork Bull River (n=140), one site in Napoleon Gulch (n=30), two sites in Hamilton Gulch (n=30), two sites in Dry Creek (n=30), three sites in Berray Creek (n=30), three sites in the North Fork Bull River (n=30), three sites in the Middle Fork Bull River (n=30), three sites in the South Fork Bull River (n=88), and one site in Chippewa Creek (n=44; Figure 2; Rehm and Tholl 2023; Rehm et al. 2024). All samples were sent to the University of Montana Fish Conservation Genetics Lab for analysis. Of the 1,676

samples the lab was able to obtain quality genetic data on 1,597 of the samples (Table 2). The transfer of genetic tissue samples from all putative WCT previously passed over Cabinet Gorge Dam (2015–2022) from Abernathy Fish Technology Center to the University of Montana Fish Conservation Genetics Lab was completed in 2022.

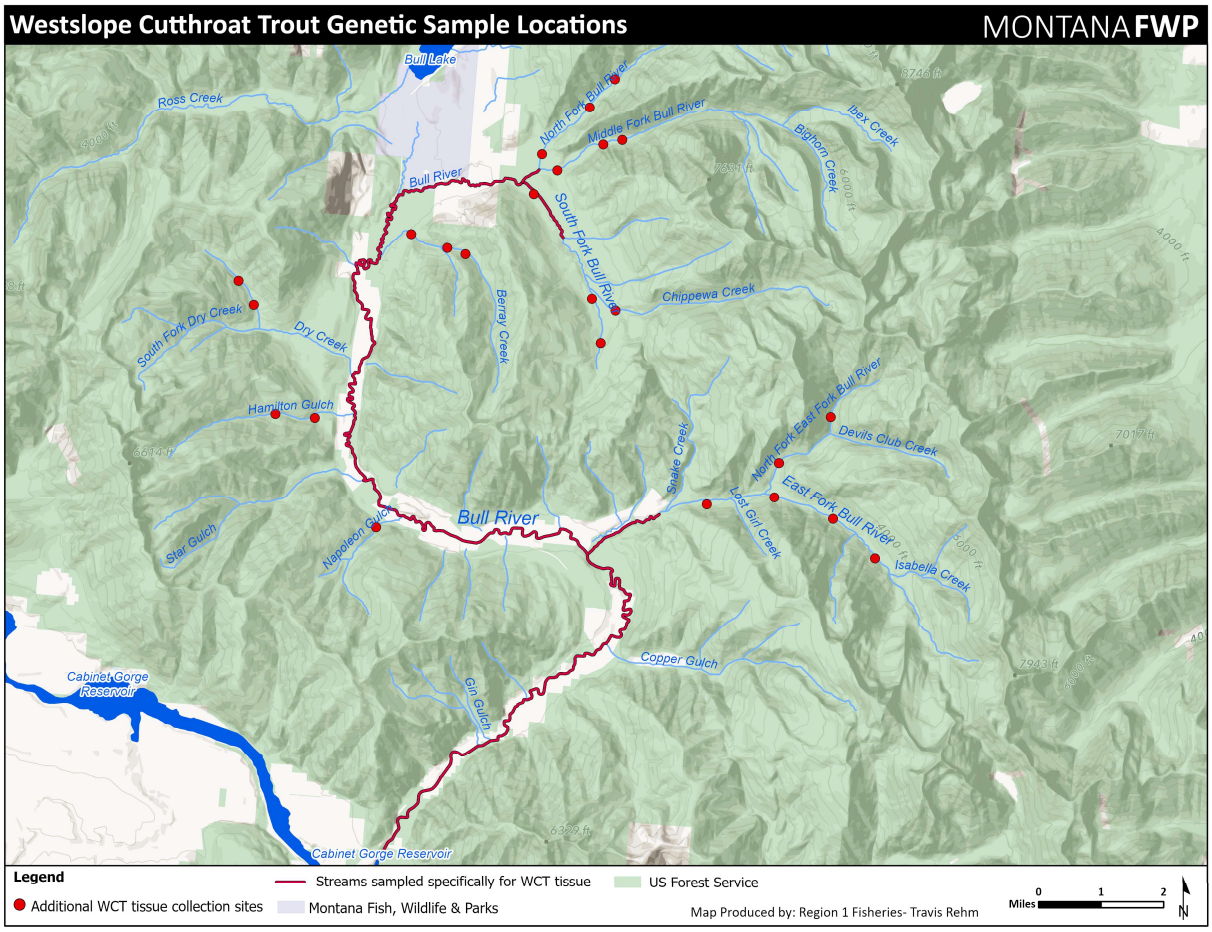

Figure 2. Sampling locations in the Bull River drainage during 2022 and 2023.

Parentage analysis conducted by the University of Montana Conservation Genetics Laboratory detected 17 offspring of WCT transported upstream as part of the *Fish Passage/Native Salmonid Restoration Plan (Appendix C), Upstream Fish Passage Program* (Table 1; Kovach 2024). All offspring of transported WCT had one transport and one non-transport parent. These offspring were produced by 12 different parents with family groups ranging from 2 to 3 individuals (Table 1; Kovach 2024). All family groups were detected within close proximity to one another. One parent WCT transported upstream (CGD_20_3130_082) appeared to have successfully spawned twice in the South Fork Bull River based on capture size of offspring in both 2022 and 2023 (Table 1; Kovach 2024).

Table 1. Parentage results: Each row is a parent offspring pair. Loci is the number of SNP loci that were compared between the parent and offspring, and mismatch is the number of loci where we observed a mismatch (note: unrelated individuals generally have >30 mismatches). Length is the TL of the offspring sample. All parent-offspring pairs passed a basic biological check with respect to expected age/size classes. The parent pWCT is the percent WCT ancestry of the parent.

Offspring	Parent	Loci	Mismatch	Length	Biological Check	Parent pWCT
Bull_22_577	CGD_20_3130_070	1019	0	167	Yes	100
EFBull_22_289	CGD_20_3130_079	1079	0	130	Yes	100
EFBull_22_295	CGD_20_3130_079	1080	0	127	Yes	"
EFBull_22_320	CGD_20_3130_079	1084	0	142	Yes	"
SFBull_22_371	CGD_21_3259_044	1102	0	70	Yes	100
SFBull_22_388	CGD_21_3259_044	1115	0	70	Yes	"
SFBull_22_450	CGD_20_3130_082	1108	0	112	Yes	100
Bull_22_091	CGD_20_3130_081	1083	1	119	Yes	100
Bull_23_125	CGD_16_2912_052	1111	1	420	Yes	100
SFBull_22_438	CGD_20_3130_064	1092	1	124	Yes	100
Bull_23_020	CGD_16_2912_057	1120	2	334	Yes	100
SFBull_22_461	CGD_20_3130_082	1105	2	109	Yes	"
SFBull_23_762	CGD_20_3130_098	817	2	152	Yes	100
SFBull_23_770	CGD_20_3130_098	853	2	166	Yes	"
Bull_22_065	CGD_18_3259_015	1077	1	270	Yes	100
Bull_23_700	CGD_18_3259_015	1114	4	211	Yes	"
Bull_22_075	CGD_16_2912_056	1010	1	402	Yes	100

Parent WCT transported upstream also spanned across 4 different transport years 2021 (n=1), 2020 (n=7), 2018 (n=1), and 2016 (n=3; Table 1; Kovach 2024). Offspring were detected in the mainstem Bull River (n=7), South Fork Bull River (n=7), and the East Fork Bull River (n=3; Figure 3). Many offspring were detected in or directly downstream of areas identified as probable spawning locations for WCT transported above Cabinet Gorge Dam by Bernall et al. (2021). All transported WCT parents that were detected reproducing in Montana tributaries were non-hybridized fish. Definitive Rainbow Trout ancestry was only detected in one (27% Rainbow Trout) of the 17 offspring. This non-native ancestry was introduced by the non-transport parent (Kovach 2024).

Of the 1,597 WCT viable samples collected during 2022 and 2023 only 1.1% were identified as offspring of WCT transported above Cabinet Gorge Dam. However, many samples collected under the *Montana Tributary Habitat Acquisition and Recreational Fishery Enhancement Program (Appendix B), Habitat Restoration Monitoring and Native Salmonid Abundance Monitoring Plan,* were collected in small tributaries and/or headwater areas of the Bull River, with some tributaries experiencing intermittent sections in the lower reaches. These sites were not likely spawning areas for transported WCT, and therefore not likely locations to detect offspring of transported WCT. Excluding those less likely sampling locations (422 samples from

20 different sites in 8 different tributaries), 1.4% of WCT sampled were identified as offspring of WCT transported above Cabinet Gorge Dam.

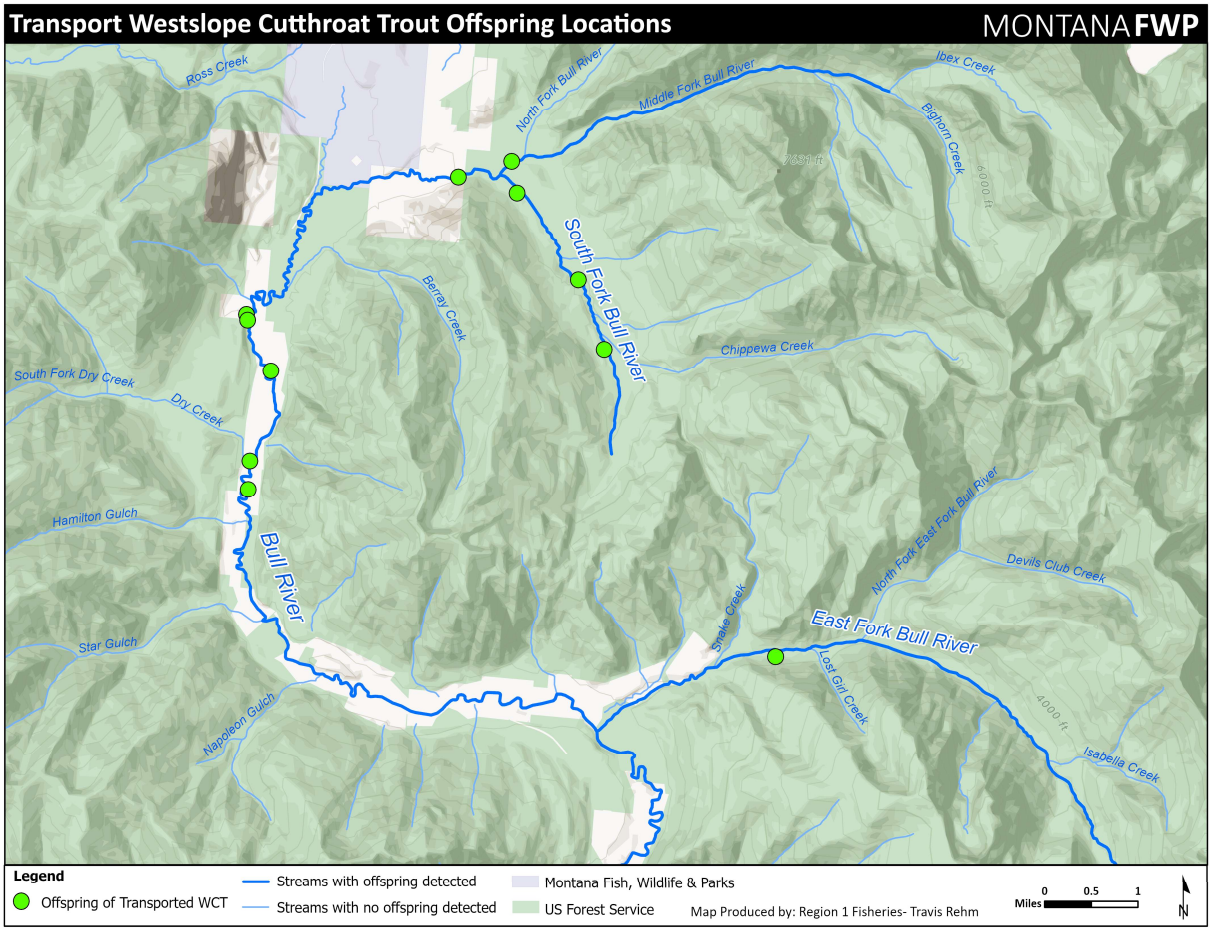

Figure 3. Locations where offspring from WCT transported above Cabinet Gorge Dam were detected in 2022 and 2023.

Population estimates performed at long-term monitoring sites in the tributaries under the *Montana Tributary Habitat Acquisition and Recreational Fishery Enhancement Program (Appendix B), Habitat Restoration Monitoring and Native Salmonid Abundance Monitoring Plan* coupled with the percentage of offspring of transported WCT collected during those surveys allow calculation of linear abundance of offspring (Rehm and Tholl 2023). Offspring of transported WCT were collected in the lower most two sites in the South Fork Bull River (Figure 2). Site 1 is located just upstream from the confluence of the North and Middle Forks at approximately Rkm 0.4. Site 2 is located just above Chippewa Creek at approximately Rkm 3.8. In the South Fork Bull River, 10% of WCT that underwent parentage analysis at Sites 1 and 2 were identified as offspring of WCT transported above Cabinet Gorge Dam. Mean offspring abundance was 1.6 and 4.8 fish/100 meters for Sites 1 and 2, respectively. Offspring of

transported WCT were collected in the lower most site in the East Fork Bull River (Figure 2). This site (#4) is located approximately 550 m upstream of where Forest Service Road 410 meets 407 at Rkm 3.6. In the East Fork Bull River, 12% of WCT that underwent parentage analysis at Site 4 were identified as offspring of WCT transported above Cabinet Gorge Dam. Mean offspring abundance at Site 4 was 3.6 fish/100 meters. Extrapolating linear abundance across stream habitat between and downstream of those sites gives a coarse estimate of the abundance of offspring of transported WCT in the lower reaches of each tributary. Offspring abundance for the lower most 3.8 km of South Fork Bull River was estimated at 122 WCT. Offspring abundance for the lower most 3.6 km of East Fork Bull River was estimated at 131 WCT.

From 2015 to 2022 (years where offspring of transported WCT could be detected during sampling in 2022 and 2023), a total of 246 WCT were captured below Cabinet Gorge Dam and transported into Montana. Sampling in 2022 and 2023 detected offspring of 5% (n=12) of all the WCT transported into Montana, with yearly percentages ranging from 0–19% (Figure 4). From 2015 to 2022, a total of 47 WCT transported upstream of Cabinet Gorge Dam were detected ascending the Bull River during the spawning period following their release (Avista, unpublished data; Rehm and Tholl 2023). Sampling in 2022 and 2023 detected offspring of 26% (n=12) of WCT detected ascending the Bull River during the spawning period, with yearly percentages ranging from 0–70% (Figure 5).

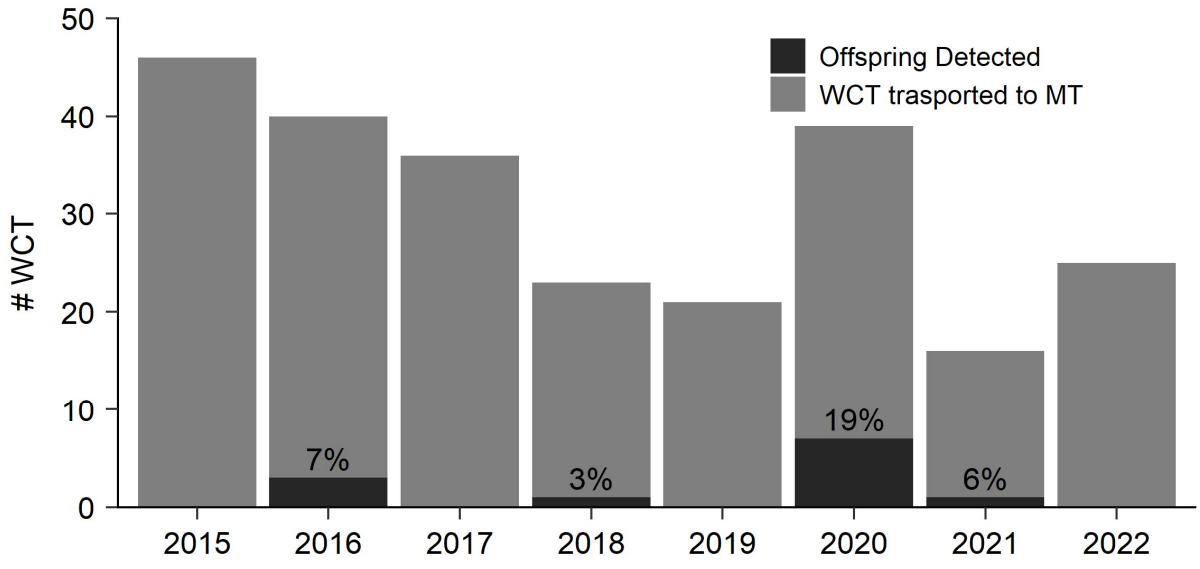

Figure 4. Adult WCT captured below Cabinet Gorge Dam and transported into Montana and the percentage of these fish whose offspring were detected during genetic sampling in 2022 and 2023.

Juvenile WCT of migratory forms have been shown to spend 1–4 years in their natal streams before outmigration (McIntyre and Rieman 1995). Juvenile WCT PIT tagged in the Bull River and South Fork Bull River at locations where offspring of transported WCT were detected have been detected out-migrating at ages estimated between 2–4 years (Rehm et al. 2024). If this migratory life history persists in offspring of transported WCT, then fish from year-classes 2018–2022 would be expected to be available during sampling in 2022 and 2023. This is a more likely pool of parents in which possible offspring could reliably be detected during sampling efforts. During that timeframe, a total of 24 WCT transported upstream of Cabinet Gorge Dam were detected ascending the Bull River during the spawning period following their release (Avista, unpublished data; Rehm and Tholl 2023). Sampling in 2022 and 2023 detected offspring of 38% (n=9) of WCT detected ascending the Bull River during the spawning period during that more likely timeframe (Figure 5).

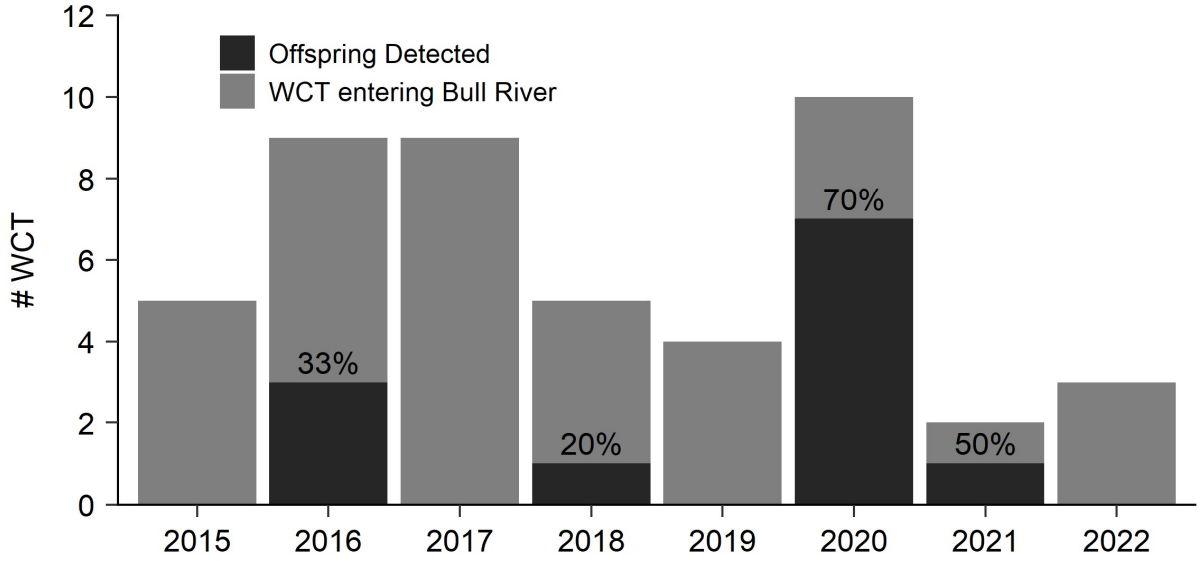

Figure 5. Transported adult WCT detected ascending the Bull River during the spawning period and the percentage of these fish whose offspring were detected during genetic sampling in 2022 and 2023.

Individual Ancestry

Individual ancestry was also assessed as a secondary benefit of this project. The extensive sampling effort that was conducted under this project provided an important and thorough genetic update for WCT in the Bull River drainage. Genetic samples were analyzed for purposes of describing the presence and extent of non-native genetic admixture from Rainbow Trout and/or Yellowstone Cutthroat Trout. Surprisingly, given that the drainage is open to upstream sources of admixture, sampling revealed that non-hybridized WCT are widespread in the system,

and the dominant *Oncorhynchus* taxa in the basin (Table 2; Kovach 2024). Many tributaries still appear to be largely if not entirely inhabited by non-hybridized WCT (e.g., Dry Creek, Hamilton Gulch, Berray Creek, Napolean Gulch, North Fork East Fork Bull River, Chippewa Creek, Middle Fork Bull River; Table 2; Rehm and Tholl 2023; Kovach 2024). Even in portions of the watershed where hybrids were detected (mainstem Bull River, East Fork Bull River, South Fork Bull River, and North Fork Bull River; Table 2), they are numerically rare compared to non-hybridized WCT (Rehm and Tholl 2023; Kovach 2024). The one exception may be the lower portions of East Fork Bull River, where hybrids appear to be the majority of fish, though by a slim margin. The presence of F1, F2, and F3 hybrids in the Bull River watershed emphasizes that Rainbow Trout are actively invading or simply present in the Bull River system and hybridizing with WCT (Kovach 2024).

Table 2. Hybridization results: This table depicts hybridization results for different collections of fish passed over Cabinet Gorge or collected in the Bull River. Hybrids are defined as fish that definitively had non-native ancestry.

Sample	Year	N	#Hybrids	#WCT	Max RBT	Max YCT
Cabinet Gorge	2015	46	11	35	33.1	0.5
Cabinet Gorge	2016	40	8	32	15.1	1.5
Cabinet Gorge	2017	36	5	31	30.6	0
Cabinet Gorge	2018	23	5	18	6.5	0.6
Cabinet Gorge	2019	21	2	19	50.8	0
Cabinet Gorge	2020	39	8	31	32.8	0
Cabinet Gorge	2021	16	4	12	1.92	0
Cabinet Gorge	2022	25	6	19	27.6	0
Bull River	2022	410	20	390	56.1	8.9
EF Bull River	2022	135	5	130	25.7	0
NF EF Bull River	2022	100	0	100	0	0
SF Bull River	2022	100	2	98	9.3	0
Chippewa Creek	2022	44	0	44	0	0
Berray Creek	2023	28	0	28	0	0
Bull River	2023	475	40	435	72.2	0.4
Dry Creek	2023	28	0	28	0	0
EF Bull River	2023	35	11	24	17.8	0
Hamilton Gulch	2023	28	0	28	0	0
Middle Fork Bull River	2023	30	0	30	0	0
Napolean Gulch	2023	27	0	27	0	0
North Fork Bull River	2023	27	4	23	0	0.9
South Fork Bull River	2023	130	8	122	27.6	0

Putative WCT captured below Cabinet Gorge Dam must meet required phenotypic characteristics prior to transport (Bernall et al. 2021). Genetic analysis revealed that using these characteristics to select putative WCT for transport resulted in 80% of WCT transported to Montana that were non-hybridized WCT (Table 2; Kovach 2024). Definitive evidence of

Rainbow Trout and Yellowstone Cutthroat Trout ancestry was detected in 49 fish, with ancestry ranging from 0.1–50.8% and 0.5–1.5%, respectively (Table 2; Kovach 2024).

Recreational Fisheries Monitoring

Floy tags were deployed in all WCT transported upstream of Cabinet Gorge Dam (n=41) in 2022 and 2023. The mean length of transported fish receiving Floy tags was 405 mm with fish ranging from 347–575 mm. Additionally, a subsample of resident salmonids captured in the mainstem Bull River during genetic monitoring efforts were Floy tagged in 2022 and 2023. All resident fish were tagged and released in the mainstem Bull River. Those fish consisted of WCT (n=161), Brown Trout *Salmo trutta* (n=257), Brook Trout *Salvelinus fontinalis* (n=15), Rainbow Trout (n=4), and Rainbow x WCT hybrids (n=5). The mean length of resident fish receiving Floy tags was 338 mm with fish ranging from 200–621 mm.

The Bull River and its tributaries are open to recreational angling during the general fishing season in the western district of Montana (third Saturday in May through November 30th; MFWP 2025). Twelve individual anglers reported catching Floy tagged fish associated with the project during the fishing seasons of 2022, 2023, and 2024 (Appendix A). All fish reported were captured within the Bull River and were part of the subsample of resident salmonids originally tagged there. Of the reported fish, 9 were WCT and 3 Brown Trout. The tag return rate for resident salmonids captured in the Bull River was 6% for WCT and 1% for Brown Trout. Most fish reported by anglers were captured in close vicinity to their tagging locations and no fish made any major movements. Angler harvest rate was 22% for WCT and 67% for Brown Trout.

No WCT transported upstream of Cabinet Gorge Dam during the study period (n=41) were reported as captured by anglers. The Bull River represents the waterbody with the highest angling pressure targeting salmonids in the area WCT transported upstream of Cabinet Gorge Dam can access (Blakney et al. 2017; MFWP 2023). Only eight transported WCT were detected ascending the Bull River during 2022 and 2023 (Rehm and Tholl 2023; Rehm et al. 2024). One WCT (Floy #1103; Appendix A) reported captured by an angler was an offspring of a WCT transported upstream (Bull_23_125; Table 1). This WCT was harvested by the angler (Appendix A).

Discussion

Parentage Analysis

Prior to dam construction migratory WCT were common in many tributaries to the LCFR, including the Bull River drainage (Pratt and Huston 1993). More contemporary studies have suggested that the migratory (fluvial) individuals still exist in the drainage (WWP 1996; Chadwick 2000; Katzman and Hintz 2003; Moran 2006; Moran and Storaasli 2015), however that migratory component appears to be severely reduced (Katzman and Hintz 2003). Results

from this study have highlighted the efficacy of fish passage efforts to reestablish connectivity for WCT utilizing LPO and/or LCRF, Idaho for growth and rearing and attempting to return to Montana tributaries to spawn. Parentage analysis detected 17 offspring of WCT transported upstream as part of the *Fish Passage/Native Salmonid Restoration Plan (Appendix C), Upstream Fish Passage Program,* produced by 12 different parents. Parent WCT transported upstream spanned across 4 separate transport years and offspring were detected in the mainstem Bull River, South Fork Bull River, and the East Fork Bull River. The observation of offspring across multiple transport years provides evidence that WCT transported above Cabinet Gorge Dam have consistently spawned successfully in Montana tributaries. Additionally, based on the results of this study, early radio telemetry work by Bernall et al. (2021) accurately identified spawning locations for WCT transported above Cabinet Gorge Dam. All transported WCT parents that were detected reproducing in Montana tributaries were non-hybridized WCT. There was no detection of non-native ancestry being introduced as part of the *Fish Passage/Native Salmonid Restoration Plan (Appendix C), Upstream Fish Passage Program*.

Of all the 1,597 viable WCT samples that underwent parentage analysis only 1.1% were identified as offspring of WCT transported above Cabinet Gorge Dam. However, of WCT that underwent parentage analysis at the lower most long-term monitoring sites in the South Fork Bull River (Site 1 and 2) and East Fork Bull River (Site 4), 10% and 12% were identified as offspring of WCT transported above Cabinet Gorge Dam, respectively. This higher percentage of offspring observed in the spawning tributaries is likely due to a migratory life history persisting in offspring of transported WCT. Juvenile WCT expressing migratory life histories have been observed spending 1–4 years in their natal streams before outmigration (McIntyre and Rieman 1995). Furthermore, juvenile WCT tagged in the Bull River and South Fork Bull River at locations where offspring of transported WCT were detected have been observed out-migrating at ages estimated between 2–4 years (Rehm et al. 2024). If a migratory life history persists in offspring of transported WCT, juveniles would be expected to be present in their natal streams for several years prior to outmigration. Additionally expected time spent in the mainstem Bull River would likely be more limited. A persistence in a migratory life history in offspring of transported WCT likely attributed to most offspring being detected in or directly downstream of areas identified as probable spawning locations for WCT transported above Cabinet Gorge Dam.

Further evidence of Montana origin WCT attempting to express a migratory life history has been gained from recent use of PIT tag technology below Cabinet Gorge Dam. The CGFPF became operational in the fall of 2022, and monitoring of the facilities efficacy began at that same time. Montana origin WCT have been detected on PIT antennas (at the CGFPF and downstream) below Cabinet Gorge Dam. From 2022 to 2024 PIT antennas have detected five WCT originally tagged in Montana and three of those WCT were tagged as part of this study (Appendix B). Two WCT originally PIT tagged as part of this study have been captured in the CGFPF. Unfortunately, neither were transported upstream of Cabinet Gorge Dam. The first WCT (PIT tag- 989001040870512; Appendix B) was captured after the June 15th transport criteria. The

second WCT (PIT tag- 989001040870882; Appendix B) was 310 mm, which is shorter than the ≥340 mm TL requirement. As a result of this capture starting in 2025 the CGFPF fish handling protocol has been amended to remove the ≥340 mm TL requirement. Westslope Cutthroat Trout with PIT tags in Montana are relatively rare and the ability to detect those tags below Cabinet Gorge Dam is new. While the number of WCT entrained below Cabinet Gorge Dam is unknown, these observations provide further evidence that Montana origin WCT are still attempting to express a migratory life history.

Sampling during this study detected offspring of 25% of WCT detected ascending the Bull River over this period. However, considering that a migratory life history appears to persist in offspring of transported WCT, the more likely timeframe for detection would be 2018–2022. Sampling during this timeframe detected offspring of 38% of WCT detected ascending the Bull River during the spawning period. Both of these percentages represent the minimum number of reproductively successful parents over that time period. Considering the size and availability of spawning habitat in the Bull River drainage, the actual percentage of transported WCT that reproduced is likely higher. While this study has highlighted successful reproduction of WCT as part of the *Fish Passage/Native Salmonid Restoration Plan (Appendix C), Upstream Fish Passage Program* in the Bull River and its tributaries, it is likely successful reproduction of transported WCT is also occurring in other tributaries. While not included in this study due to time, resource, and personnel availability, transported WCT have been documented utilizing Blue Creek, Pilgrim Creek, and Rock Creek during the spawning period (Figure 1; Bernall et al. 2021). These tributaries were also historically documented as having migratory WCT populations prior to dam construction (Pratt and Huston 1993).

Experimental transport of WCT has been ongoing for a decade, however numbers of WCT captured below Cabinet Gorge Dam and transported to Montana to date have remained low (n=315; Avista, unpublished data). This study provides strong evidence that if capture efficiency of WCT can be improved below Cabinet Gorge Dam it is likely a meaningful component of migratory WCT could be restored in the Bull River drainage and likely other drainages in the LCFR. Additionally, development of a suite of microsatellite DNA markers used to identify the most likely population and region of origin for WCT captured downstream of mainstem Clark Fork River dams could further refine the *Upstream Fish Passage Program*.

Individual ancestry

Data available describing the presence and extent of WCT hybridization across the Bull River drainage was between one and three decades old prior to this study (Leary 1993; Ardren et al. 2008; DeHaan et al. 2016). The extensive sampling undertaken during this study revealed that non-hybridized WCT are widespread in the Bull River drainage and most tributaries are largely if not entirely inhabited by non-hybridized WCT (Table 2; Rehm and Tholl 2023; Kovach 2024; Rehm et al. 2024). In tributaries where hybrids were detected they are still numerically rare except for the lower portions of East Fork Bull River. The East Fork Bull River appears to be a hotspot of hybridization between WCT and Rainbow Trout in the Bull River drainage and should

be monitored closely. Further evidence of Rainbow Trout invasion and hybridization in the East Fork Bull River comes from a permanent PIT tag array installed at Rkm 0.2 (Biomark 2018b). Each spring PIT tagged Rainbow Trout and/or Rainbow x WCT hybrids have been detected on the array making apparent spawning movements up East Fork Bull River (Rehm and Tholl 2023; Rehm et al. 2024; Rehm et al. *In Prep*).

During initial discussions on the experimental passage of WCT upstream of Cabinet Gorge Dam, Montana, Fish, Wildlife and Parks expressed concerns with the potential passage of WCT with non-native ancestry. Early genetic investigations by Ardren et al. (2008) identified WCT, Rainbow Trout, and hybrids of the two species downstream of Cabinet Gorge Dam. Genetic assessment of 72 phenotypic classifications of putative WCT captured below Cabinet Gorge and Noxon Rapids Dam illustrated that careful phenotypic assessment could select for a high percentage (96%) of non-hybridized WCT (Ardren et al. 2008). Based on those results it was decided that phenotypic characteristics, that include a complete and vivid slash marking on the lower jaw and few to no spots in the crescent-shaped area anterior to the dorsal fin, would be used to reduce the amount of Rainbow Trout alleles that could potentially be passed upstream.

Genetic monitoring of all WCT passed over Cabinet Gorge Dam has occurred since initiation of the program. This continued monitoring revealed that from 2015–2022, using phenotypic characteristics to select putative WCT for transport, 89% of WCT transported to Montana were non-hybridized WCT (Adams at al. 2020, Adams at al. 2021, Bernall et al. 2021, Adams at al. 2022, Adams at al. 2023). Analysis performed using the RAD Capture (Ali et al. 2015) panel during this study included more than 1,600 species diagnostic markers to assess individual ancestry compared to the 42 diagnostic loci used in previous analyses (Adams at al. 2020, Adams at al. 2021, Bernall et al. 2021, Adams at al. 2022, Adams at al. 2023). This genetic sampling revealed that 80% of putative WCT transported to Montana were non-hybridized WCT (Table 2; Kovach 2024). Unsurprisingly, methodology including >38 times more diagnostic markers identified increased passage of WCT with non-native ancestry. It is also important to note, using the same methodology, sampling revealed that 93% of putative WCT sampled in the Bull River were non-hybridized WCT (Table 2; Kovach 2024). This updated individual ancestry data gives a much more accurate representation of the unintended passage of WCT with non-native ancestry as part of the *Fish Passage/Native Salmonid Restoration Plan (Appendix C), Upstream Fish Passage Program.*

Recreational Fisheries Monitoring

Twelve individual anglers reported catching Floy tagged fish within the Bull River and all were part of the subsample of resident salmonids originally tagged there (Appendix A). Tag return rates between WCT and other non-native salmonids highlighted the vulnerability of WCT to angling. Westslope Cutthroat Trout evolved in low productivity environments and developed aggressive feeding behaviors that translate to high angling vulnerability when compared to other salmonids (MacPhee 1966; Rieman and Apperson 1989; Waters 1992). Westslope Cutthroat Trout are an important ecological, cultural, and economic species, and tag return rates in this

study underscored WCT disproportionate importance to recreational fisheries relative to their abundance. Preliminary results of this study informed recent fishing regulation changes in the Bull River. Anglers fishing the Bull River beginning in 2025 are now required to release all WCT captured (MFWP 2025).

No WCT transported upstream of Cabinet Gorge Dam during the study period were reported as captured by anglers. It is important to note the small sample size (n=41) of transported WCT over the study period and even fewer transported WCT (n=8; Rehm and Tholl 2023; Rehm et al. 2024) ascending the Bull River (Cabinet Gorge Reservoir tributary with the highest salmonid angling pressure; Blakney et al. 2017; MFWP 2023). Indeed, compared to exploitation rates of the larger number of resident WCT Floy tagged in the Bull River, the expected return of WCT transported upstream of Cabinet Gorge Dam would have been two fish. Given that many of these transported fish have been tracked to be present more seasonally than the resident form (Bernall et al. 2021), the ability to document the potential contribution to the recreational fishery of transported fish was limited. It is unlikely at the current level of passage, WCT transported over Cabinet Gorge Dam are contributing to recreational fisheries in Montana in any meaningful form. One WCT determined to be an offspring of a WCT transported upstream was reported captured by an angler. This is the only contribution to recreational fisheries in Montana from the *Fish Passage/Native Salmonid Restoration Plan (Appendix C), Upstream Fish Passage Program* documented during this study. If additional assessment of transported WCT contribution to recreational fisheries is considered important in evaluating the *Upstream Fish Passage Program*, the author recommends continued Floy tagging of upstream transported WCT.

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Appendix A. Angler Floy Tag Returns

Table A-1. Date, Floy tag number, species, location, and fate at recapture event; initial tagging date, location, and capture method; Species abbreviations include Westslope Cutthroat Trout (WCT) and Brown Trout (LL).

Date	Tag Number	Species	Recapture Location	Recapture Latitude	Recapture Longitude	Initial Tag Date	Tag Location	Tagging Latitude	Tagging Longitude	Initial Capture Method	Fate
6/19/2022	555	WCT	Wood Duck	48.1128	-115.84146	5/25/2022	Wood Duck	48.11032	-115.83042	Angling	Released
6/21/2022	554	WCT	Wood Duck	48.11102	-115.83389	5/25/2022	Wood Duck	48.1103	-115.8301	Angling	Released
6/17/2022	561	WCT	Wood Duck	48.1128	-115.84309	5/27/2022	Wood Duck	48.11307	-115.84308	Angling	Released
7/21/2022	476	WCT	Above mile marker 14 on Hwy 56	-	-	7/18/2022	Cross Property	48.16238	-115.86793	Angling	Released
07/27/2022	493/494	WCT	Bighorn Lodge	48.11166	-115.79747	7/20/2022	8-mile bridge to below EFBR	48.11204	-115.80109	Angling	Harvested
8/1/2022	451	WCT	Dry Creek Confluence	48.14522	-115.86884	7/7/2022	Below 12-mile Bridge	48.14426	115.868	Angling	Released
08/28/2022	325	WCT	Below Berray Ck Access	48.18195	-115.86158	4/29/2022	Below Berray Ck Access	48.1732	-115.86258	Boat E-Fish	Released
9/18/2022	448	LL	Bighorn Lodge	-	-	9/12/2022	Wood Duck	-	-	Angling	Harvested
9/26/2022	475	WCT	8-Mile Bridge	48.14994	-115.8643	8/26/2022	Above Highway 12-mile Bridge	48.14994	-115.8643	Angling	Released
5/26/2023	504	LL	Above Avista Boat Launch	-	-	7/13/2022	8-mile bridge to Avista Boat Ramp	-	-	Boat E-Fish	Released
6/16/2023	1103	WCT	Berray Ck access	-	-	7/25/2023	Pullout to 12-mile bridge	48.1679	-115.87131	Angling	Harvested
8/7/2024	535	LL	2.5 miles upstream of 8-mile bridge	-	-	5/31/2023	Wood Duck	-	-	Angling	Harvested

Appendix B. Montana Origin WCT Detected below Cabinet Gorge Dam on PIT Tag Antennas

Table B-1. PIT tag number, species, length and weight at initial tagging; initial tagging location, project associated with initial tagging, river kilometer (Rkm) and date; and range of date detections on PIT tag antennas below Cabinet Gorge Dam.

PIT Tag No.	Species	Length (mm)	Weight (g)	Tagging location	Project	Rkm	Date tagged	Date Detected
989001026315969	WCT	192	65	Prospect Creek	Prospect Creek Fish Salvage	20.3	8/6/2020	6/7/2023-9/26/2024
989001033211852	WCT	440	978	Thompson Falls Dam	Fish Ladder	105.5	4/11/2022	6/24/2022-5/5/2023
989001040870321	WCT	100	9	Bull River	WCT Transport Evaluation	36.5	8/30/2022	5/18/2024
989001040870512	WCT	308	-	Bull River	WCT Transport Evaluation	19.3	9/12/2022	6/16-9/18/2023
989001040870882	WCT	282	-	Bull River	WCT Transport Evaluation	1.9	9/15/2023	4/9-4/30-2024